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Is the lower return to immigrants' foreign schooling a postarrival problem in Canada?

Yigit Aydede* and Atul Dar

* Correspondence:
yigit.aydede@smu.ca
Department of Economics, Saint Mary's University, Halifax, Canada

Abstract

Using the 2006 Canadian Census, this paper investigates the lower return to immigrants' foreign education credentials after adjusting for their occupational matching in hosting labor markets. We develop two continuous indices that quantify the matching quality of the native-born in both horizontal (fields of study) and vertical (educational degrees) dimensions. This allows us to separate the effects of immigrants' occupational attainment and their foreign schooling quality on wage earnings by measuring immigrants' occupational match relative to that of native-born. Our findings indicate that the lack of portability in immigrants' foreign credentials may not be addressed effectively by postarrival policies as the results show that a significant and persistent poor matching quality for internationally educated immigrants cannot substantiate the lower return to their foreign education credentials.

JEL Classification: J6, J15, J61

Keywords: Return to education, Occupational mismatch, Immigration

1 Introduction

Although it is well recognized that education is unambiguously rewarded in labor markets, the literature identifies three different channels through which formal schooling impacts on earnings. When education provides specific skills, it helps individuals find more complex and better-paying occupations, which Lemieux (2014) calls "occupation upgrading." On the other hand, regardless of occupation, more and better education also increases productivity through better cognitive skills in literacy, numeracy, and problem-solving. In other words, while more-educated workers are assigned to more complex jobs, education also increases general productivity in a given job. Green and Riddell (2015) find that about 40 % of the returns to schooling comes from the combined effect of these cognitive skills produced by formal education and can be viewed as the "pure returns" to schooling. The third reason that education affects earnings originates from the assignment of skills obtained by education to jobs that are available in labor markets. Studies in the past have used different measures such as degree of education, ability, and field of study–job relatedness to quantify this matching quality. For instance, Lemieux (2014) estimated the effect of the above three factors on earnings and found that occupation upgrading and occupational matching (provided by the job field of the study match) collectively explain close to half of the conventionally measured return to education for native-born workers.

Despite the overwhelming evidence that education has robust, positive, and casual effects on wage earnings, immigrants' foreign education appears to be greatly discounted in Canada (Li and Sweetman 2014; Ferrer and Riddell 2008).[1] Furthermore, Uppal and LaRochelle-Cote (2014) report that, among internationally educated university-graduate immigrants, 48 % of women and 37 % of men work in occupations that usually require a high school education or less in 2006. The corresponding rates are 15 and 17 %, respectively, for Canadian-educated native-born university graduates. A most recent study by Aydede and Dar (2016) also points to a persistent and significantly poorer horizontal mismatch for foreign-educated immigrants in Canada: 76 % of immigrants work in jobs that are considered least related by native-born workers in their field of study. In light of this evidence, it is obvious that differential returns to formal schooling by nativity would reflect not only the variable quality of education across source countries but also systematic differences in the occupational matching for those groups in Canada. In other words, one may raise the question of immigrants' inability to practice in their trained occupation, when the inferior quality of their education is blamed for the lower return to foreign credentials. Yet, it can also be argued that immigrants' occupational mismatch in the host country could be a result of nonportability of their foreign qualifications due to the nonequivalent quality of their education obtained in the source country.

As noted by Sweetman et al. (2015), there is a common perception that a deficiency in foreign qualification recognition and an excessive cost of reentry in regulated (or self-regulated) occupations following migration hinders the labor market integration of new immigrants and results in the well-documented wage penalty at the entry for newcomers (Picot and Sweetman 2012; Borjas 2013). Unlike the USA, nevertheless, this is a particular concern in Canada, which has a point system for selecting skilled (better-educated) immigrants who would be employed in occupations that arguably face long-term labor shortage. Although the nonrecognition of foreign qualifications is frequently blamed in public policy for declining returns to premigration labor market experience and for the immigrant–native-born gap in the rate of return to education in Canada, the evidence suggests that differences in premigration educational quality, usually proxied by source-country test scores (PISA—Programme for International Student Assessment) or a cross-country human-capital index (Hanushek and Kimko 2000), have substantial impacts on the Canadian labor market earnings of immigrants (Sharaf 2013; Li and Sweetman 2014). But the nonequivalent quality of foreign education may also stimulate systematic and persistent differences in occupational attainment, mobility, and matching for immigrants, which in turn would exacerbate the negative impact of the poor-quality education on payoffs to schooling, especially when these differences are combined with the lack of foreign qualification recognition in hosting labor markets. If this is true, the discount in returns to foreign credentials could be overestimated in wage earnings equations.

The primary objective of this study is to estimate and compare the return to education for internationally educated immigrants after controlling for their occupational matching in hosting labor markets by using the 20 % sample of the 2006 Canadian Census. The size of the data permits us to create two continuous indices that expose the "common" quality of occupational match experienced by native-born Canadian-educated workers in labor markets. These indices quantify the match in two dimensions by

using the clustering of native-born workers in each cell of the field of study–occupation and degree of education–occupation matrices reflecting the relatedness of the 1375 fields of study and 14 major degrees to 520 occupations separately.[2] Unlike studies that define the match between pre- and postmigration (or intended) occupations, or studies that use a measure of "required education," as suggested in the ORU (Over-Required-Undereducation) literature, the present study uses the distribution of native-born workers across occupations by the field of study and degree of education as a benchmark that internationally educated immigrant workers can attain in the long run. This approach helps us eliminate the difficult problem of determining an *ideal* matching ordering of 520 occupations for each of the 1375 fields of study in labor markets, particularly for unregulated occupations. Similarly, it also removes the need for identifying the "required education" in each of 520 occupations, which is usually estimated as the most observed years of schooling or degrees in an occupation and commonly criticized in the literature due to their poor measurement properties. Even if an *ideal* matching in both dimensions could be found, the actual quality of immigrants' occupational match should be gaged relative to a comparison group, and millions of native-born workers in labor markets would appear to be a natural choice. This allows us to estimate the wage earnings of immigrants after removing the dissimilarities in their occupational match relative to that of the native-born. Thus, by adjusting the quality of immigrants' occupational matching, we can isolate the returns to education in estimation such that they reflect the true rewards to foreign credentials.

Although our results show a significant and persistent poor matching quality for internationally educated immigrant workers, their relative wage gain from a better matching is not as sizeable as envisioned in some policy circles.[3] This finding implies that, even if immigrants work in their trained jobs with a required degree, their foreign credentials are subject to a substantial discount in Canadian labor markets. In other words, the lower return to immigrants' foreign credentials is much more a "source-country problem" rather than being a "host-country problem" that can be efficiently dealt with by postarrival policies. The rest of the paper is organized as follows: Section 2 summarizes previous research; Section 3 introduces the data and contains a descriptive analysis. Econometric results and a discussion of our findings are given in Section 4. We provide the concluding remarks in Section 5.

2 Previous research

This study brings together several different but interrelated fields in the literature: the education/skill mismatch in labor markets, immigrants' economic assimilation in hosting countries, and economics of education in general. The widening earnings gap between immigrants and the native-born in Canada over the last three decades has sparked a number of studies investigating the reasons behind this fact. These studies have pointed to the change in the source-country composition during the 1990s with a focus on declining returns to source-country labor market experience, lower payoffs to foreign schooling, and downturn in education quality and language skills (see Picot and Sweetman 2005, 2011 for reviews). Studies that have investigated returns to foreign education in connection with the wage gap in Canada found mixed evidence. Aydemir and Skuterud (2005) have extended the assimilation model applied first by Cheswick (1978) to compare payoffs to schooling by decomposing education years spent in the host and source countries. In fact, by using five censuses between 1981 and 2001, they

found that foreign school years are more valued than Canadian school years for immigrant men. Later, Skuterud and Su (2012) replicated the same study on a rich longitudinal Canadian data source and found that controlling for unobserved individual fixed effects and errors in measuring postarrival schooling does not change the earlier results. Ferrer and Riddell (2008), on the other hand, later pointed out that, relative to degree completion, years of schooling may be a less informative signal of productivity for immigrants than for natives due to the fact that there is a greater dispersion in years of schooling among immigrants in each degree than among natives, reflecting the diversity of education systems across countries. When they simultaneously controlled for years and degrees of education, they found that foreign-acquired education is valued less than education acquired in Canada. Finally, Li and Sweetman (2014) used international test scores as a proxy for the quality of source-country educational outcomes and found that there is a strong and positive association between returns to prearrival schooling in the host country and the quality of education in the source country. Except for Warman et al. (2015), none of these studies have controlled for occupational matching in their models. They defined the match between pre- and postmigration occupations and found that those who do not obtain an occupational match receive no benefit from premigration education.

There is a fairly large literature that analyzes the effects of education mismatch on the returns to education. The beginning of the ORU literature can be traced to the study by Duncan and Hoffman (1981) that was the first of its kind defining a worker's attained education as the sum of schooling years in required education and overeducation (or undereducation). Leuven and Oosterbeek (2011) compared the results of a wide range of ORU studies and completed their literature review with a rather pessimistic note: "We conclude that the conceptional measurement of overeducation has not been resolved, omitted variable bias and measurement error are too serious to be ignored, and that substantive economic questions have not been rigorously addressed. Hence new contributions seem only worthwhile if they include a serious attempt to tackle these issues" (p. 39). Despite these setbacks, in a series of papers, Chiswick and Miller (2008, 2009, 2010) used the ORU framework to investigate the lower payoffs to schooling for immigrants in the USA. In these studies, the required level of education is measured by the modal value of schooling years in each occupation and workers' actual education is decomposed to required and overeducation (undereducation) in Mincerian earnings functions. They found that, when the workers' educational match is controlled for in this setting, the gap in returns to schooling measured by years of required education disappears. In other words, immigrant and native-born workers are rewarded the same for their education when they are not over- or undereducated for their jobs. Hence, when the decomposition to actual education is ignored in conventional wage earnings equations, the gap essentially reflects the fact that immigrants disproportionally face a greater incidence of overeducation–undereducation in labor markets. However, some recent evidence (Sharaf 2013) shows that accounting for schooling quality eliminates the native–immigrant gap in the incidence of overeducation in Canada. To address the issue that problems in immigrants' occupational attainment in hosting countries could be one of the major contributors to lower payoffs to their foreign schooling, studies have investigated the intra-occupational earnings progression by comparing returns to education within occupations simply by introducing

occupation dummies into earnings estimations of immigrants and native-born workers (Dell'Aringa et al. 2015; Chiswick and Miller 2007). Finally, two recent studies (Nieto et al. 2014; Aleksynska and Tritah 2013) have applied the ORU method to European countries (EU) by using rich data sets and found that the occupational mismatch among immigrants is mostly due to origin countries' quality of human capital.

Robst (2007) was the first major study to investigate the relationship between workers' field of study and their occupation and how the degree of relatedness between the two affects wages in the USA. The Robst paper, along with a number of recent studies such as Nordin et al. (2010) and Yuen (2010), showed that workers tend to earn higher wages when in an occupation that is closely related to their field of study. In a more recent paper, Lemieux (2014) used the self-reported answers in the 2005 National Graduate Survey with about 10,000 university graduates to identify whether the person works in a related job and then calculated the average of these binary answers in each of 90 cells (10 fields of study and 9 occupations). These average measures reflect each major's relatedness to 9 occupations. By merging these relatedness measures with the publicly available 2006 Canadian Census file, he controlled for the relatedness for each worker through both continuous and binary variables in wage regressions and found that educational degrees and relatedness explain close to half of the conventionally measured return to education. This is important because it is the first decomposition that the match (relatedness) effect accounts for 22.3 % of the university–high school wage gap in Canada. The occupational (horizontal) mismatch has been also investigated in the literature in connection with immigrants' economic integration in hosting labor markets. Two recent reports published in Statistic Canada's research paper series (Plante 2010, 2011) are the first studies in Canada that use a concordance table—which was developed by the Centre for Education Statistics at Statistics Canada using the 2006 Census distribution of Canadian-educated individuals aged 25 to 65—to determine whether internationally educated immigrants are working in their field of study. In her second study, Plante (2011) analyzed the determinants of the immigrants' integration into the Canadian labor markets measured by two proxies: (1) working in an occupation corresponding to their field of study or in an occupation requiring similar or higher skill levels and (2) having earnings at or above the national median earnings calculated for the occupation corresponding best to their field of study. Plante's findings indicated that internationally educated immigrants are less likely than Canadian-educated counterparts to be employed in their field or occupations requiring similar or higher skill levels.[4]

Green's work (1999) was one of the first to suggest that comparing the distribution of intended occupations with actual occupational attainments would make it possible to approximate the level of mismatch for immigrants in Canada. Jantzen (2015) applied this approach by using the National Household Survey and Immigration Landing File Linkage Database to determine whether economic principal applicants work in their intended regulated occupations. How (and to what extent) the cross-border transferability of occupational human capital affects earnings was investigated more explicitly in two analytical works (Imai et al. 2011; Warman et al. 2015). By using the Longitudinal Survey of Immigrants to Canada (LSIC), in addition to detailed information on labor market experience during the first 4 years after immigrating, both studies were able to access information on the last occupation held in the source country prior to

migrating and the intended occupation identified during the selection process. Both studies found that after immigrating to Canada, immigrants have difficulty finding jobs that utilize the occupational human capital that they obtained abroad. Imai et al. (2011) further calculated the potential loss in immigrants' earnings due to inability to work in an occupation that matches their source-country occupational skill requirements. They found that predicted mean earnings might have been 21–23 % higher at 4 years after arrival.

While this study, which builds on a recent work of Aydede and Dar (2016), greatly benefits from the previous research outlined above, it contributes to the current understanding of the gap in returns to education by nativity in Canada through developing a new approach in which the quality of immigrants' education–job match is evaluated relative to the occupational distribution of native-born workers in labor markets both at vertical and horizontal levels. This will help us isolate the effect of occupational attainment in estimation, so that the actual return to foreign education can be assessed for immigrant workers. The rest of the paper provides the details underlying our approach.

3 Data, relatedness, and mismatches

This study uses the 20 % sample of the 2006 Canadian Census available in Canadian Research Data Centers, which is the first census that explicitly asks the location of study (highest degree) of the person. We restricted the data to include only nonaboriginal, civilian, full-time wage earners living in 10 provinces and who were between 19 and 65 years of age and who worked in 2005 and did not attend school at the time. We also dropped nondegree holders (that is, those with no education or an education degree that does not grant a major) and those whose field of study contains fewer than 10 workers. After these restrictions, we obtained about 1.4 million observations. The 2006 Census enables the classification of individuals' major field of study in which the highest postsecondary certificate, diploma, or degree was granted to them. Statistics Canada classifies the major fields of study by using the Classification of Instructional Programs (CIP), which includes 1375 instructional program classes with finer breakdowns provided with up to six-digit codes. The 2006 Census occupation data are classified according to the National Occupational Classification for Statistics 2006 (NOC-S 2006), which is composed of four levels of aggregation. At the first 3 levels, there are 10 broad occupational categories containing 47 major groups that are further subdivided into 140 minor groups. In this study, we use the most detailed level, in which there are 520 occupation unit groups. Statistics Canada defines this classification as occupation unit groups that are formed on the basis of the education, training, or skill level required to enter the job, as well as the kind of work performed, as determined by the tasks, duties, and responsibilities of the occupation.

3.1 Field of study–occupation relatedness

Most studies on the subject use surveys that contain questions explicitly aimed at extracting information on the field of study–occupation matching. Since those surveys are usually limited in size, even producing descriptive analyses in order to understand the incidence of mismatch becomes a real challenge because of the level of aggregation

in classifications. Moreover, the effect of relatedness on labor market outcomes modeled through self-reported binary variables involves some arbitrariness in the classification of workers into two categories—related or not, especially since *relatedness* is perhaps more a matter of degree, than an all-or-none concept. Given the large sample at our disposal, we use frequency distributions of each of the 1375 fields of study and 520 occupations, which give us 715,000 cells to calculate the following clustering index:

$$\mathrm{HRI}_{of} = \frac{L_{of}/L_f}{L_o/L_T},$$

where L is the number of workers, o is the occupation, f is the field of study, and T denotes the whole workforce. This index (Horizontal Relatedness Index—HRI_{of}) measures the relatedness of occupation o in major f by calculating the percentage of workers in major f working in occupation o adjusted by the size of occupation o in the entire workforce. The role of the denominator in the index is twofold: first, it removes the directional differences in simple density calculations; second, it adjusts the simple densities (nominator) by the size of occupation (or field of study). Comparing the shares of each occupation in a field of study with the marginal distribution of each occupation is not new, and Lemieux (2014), for example, identified occupation–field of study cells for which the proportion of workers in the occupation is more than twice its marginal distribution (the share of each occupation in the entire labor force). Lemieux (2014) and Ransom (2014) also used the Duncan index (DI_f) to quantify the occupational distinctiveness of a particular field of study as follows:

$$\mathrm{DI}_f = \frac{\sum_o \left|\theta_{of} - \theta_o\right|}{2},$$

where θ is the fraction of workers. The DI and HRI indices are similar in the sense that both are measures of the distance between the share of workers holding a degree in major f working in occupation o and the share of the same occupation in the entire labor force ($L_{of}/L_f = \theta_{of}$ and $L_o/L_T = \theta_o$). DI, as expressed above, is an aggregation showing the occupational distinctiveness of each field of study and gets bigger as workers cluster in few occupations for a given field of study. HRI, on the other hand, reports the fraction of workers in each occupation–field of study cell relative to the marginal distribution of each occupation or field of study.

3.2 Educational degree–occupation relatedness

The HRI described above can also be adjusted to show the relatedness between educational degrees and occupation. To achieve this, we use frequency distributions of each of 11 educational degrees (Table 10 lists each degree and their sizes) across 520 occupations, which give us 5720 cells for calculating the following alternative clustering index:

$$\mathrm{VRI}_{od} = \frac{L_{od}/L_o}{L_d/L_T},$$

where L is the number of workers, o is the occupation, d is the highest degree of education that grants a major field of study, and T denotes the whole workforce. This index (Vertical Relatedness Index—VRI_{od}) measures the density of degree d in occupation o after removing the differences in size between 11 degrees in the entire workforce. As

explained before, it also provides the same answer to the question of which occupation is most observed in degree d or which degree is most observed in occupation o.

The problem of "size domination" in ORU measures can be seen by examining Table 1, which provides a snapshot from the degree–occupation matrix for the native-born. The table reports the number of workers and normalized VRI (NVRI) in each cell for selected occupations. The horizontal and vertical totals (in thousands) reflect the size of degrees and occupations, respectively. The ORU literature identifies the overeducated–undereducated by comparing workers' actual education in years or degrees with the "usual" education in their occupations, which is calculated by central tendency measures, most commonly the mode. Except for occupation 478, NVRI disagrees in identifying the most common degree in each occupation. One especially noteworthy example is occupation 8. According to the ORU method, the most observed degree (or years) is 9 and thus, all workers in this occupation with degrees in 10, 11, 12, and 13 are identified as overeducated. When RI removes the size effects of all 11 degrees, especially for degree 9, by adjusting simple densities with their marginal distributions, degree 12 becomes the most prevailing one in occupation 8. Workers with degrees 9, 10, and 11 now become undereducated while they were matched and overeducated by the ORU method. Unlike the ORU measures, NVRI also exposes the level of occupation–education mismatch for any given occupation. In occupation 288, for example, NVRI implies that, relative to degree 3, degree 5 is 7 % less common, while degree 4 is 42 %, which shows that the level of overeducation–undereducation may not follow the same hierarchy in educational degrees or years. In other words, calculating the workers' amount of surplus (or deficit in) schooling by the difference between their actual education and the "usual" education in their occupation either by years or degrees leads to a fundamental measurement problem. Most importantly, by using the level of relatedness between educational degrees and occupations calculated for NVRIs for native-born workers as a benchmark, we are able to assess the immigrants' vertical mismatch in relative terms without considering how much the "usual" degrees are affected by temporary labor market conditions, which is another common criticism of the ORU method outlined above.

3.3 Matching

In what follows, we restrict our descriptive tables to report the matching quality for immigrants relative to native-born workers. We consider the occupational distribution of native-born workers as a benchmark reflecting the long-term matching quality in Canadian labor markets. To accomplish this, for each of the 1375 fields of study, we first normalize HRI calculated for native-born workers between 1 and 0 by using the highest HRI as numeraire. Classifying normalized HRIs (NHRI) in five class intervals (1.0–0.8, 0.8–0.6, 0.6–0.4, 0.4–0.2, and 0.2–0) allows us to rank each occupation based on the native-born workers' distribution.[5] We repeat this normalization procedure for our second relatedness index (VRI). This enables us to classify each degree relative to the most prevalent one in an occupation, so that we can additionally determine the overeducated–undereducated. Table 2 shows the current distribution of workers by NHRI and NVRI classes (NHRIC and NVRIC).

Although the five-level classification of the normalized relatedness indices we adopt might appear to be somewhat arbitrary, Table 2 reveals a number of interesting

Table 1 The education degree–occupation matrix for selected occupations—2006 (weighted)

	Degree												"Usual" degree by		
Occupation	3	4	5	6	7	8	9	10	11	12	13	Total	Mean	Mode	VRI
7	995	245	1295	4345	4630	3745	14,815	3645	45	3665	100	38	8.38	9	10
	0.04	0.00	0.24	0.19	0.28	0.51	0.58	1.00	0.10	0.63	0.09				
8	925	355	875	3360	3015	3165	10,765	1370	10	3360	90	27	8.33	9	12
	0.06	0.03	0.26	0.25	0.30	0.74	0.72	0.62	0.00	1.00	0.13				
57	23,970	4245	9505	29,735	15,940	7685	9310	1060	50	930	90	103	5.81	6	5
	0.85	0.26	1.00	0.77	0.52	0.54	0.15	0.10	0.02	0.03	0.00				
288	6530	1970	2075	8395	4460	2240	3190	350	10	315	40	30	5.88	6	3
	1.00	0.58	0.93	0.94	0.64	0.69	0.26	0.18	0.00	0.08	0.06				
478	1310	425	115	380	300	65	105	10	10	10	5	3	4.55	3	3
	1.00	0.63	0.25	0.20	0.21	0.08	0.03	0.02	0.17	0.00	0.02				
Total	883	450	301	1200	917	431	1505	221	21	347	50	6326			

Notes: the numbers are rounded

Table 2 Distribution of workers by NHRIC and NVRIC—2006 (weighted)

	NVRIC						NHRI	UE	OE
NHRIC	1	2	3	4	5	Total	%		
Native-born									
1	776,960	169,795	361,875	184,670	141,115	1,634,415	26	33	19
2	91,065	39,530	84,235	32,855	22,060	269,745	4	49	17
3	130,100	78,600	69,230	54,780	22,830	355,540	6	29	34
4	210,410	115,510	132,590	89,505	45,610	593,625	9	27	38
5	1,048,300	598,625	726,695	615,310	482,995	3,471,925	55	28	41
Total	2,256,835	1,002,060	1,374,625	977,120	714,610	6,325,250		30	34
NVRI %	36	16	22	15	11				
Immigrants, Canadian-educated									
1	114,960	27,145	50,455	32,860	26,165	251,585	22	30	25
2	18,450	8890	12,765	6415	3940	50,460	4	41	23
3	21,730	13,455	12,260	9585	5960	62,990	6	25	40
4	39,100	21,275	22,565	17,990	10,025	110,955	10	23	42
5	184,685	113,930	136,130	123,705	103,920	662,370	58	25	47
Total	378,925	184,695	234,175	190,555	150,010	1,138,360		27	40
NVRI %	33	16	21	17	13				
Immigrants, foreign-educated									
1	36,185	9260	20,170	11,420	11,560	88,595	11	26	33
2	6795	3755	4450	2220	1500	18,720	2	30	33
3	6795	4650	5550	4875	4415	26,285	3	16	58
4	14,715	9410	13,510	12,695	8825	59,155	8	14	61
5	98,540	68,360	101,715	135,355	187,505	591,475	76	0.2	83
Total	163,030	95,435	145,395	166,565	213,805	784,230		10	70
NVRI %	21	12	19	21	27				

Notes: "Immigrant, Canadian-educated" also includes immigrants whose location of study is the USA or the UK. The distributions of overeducated (OE) and undereducated (UE) workers for each NHRI class are given in the last two columns of the table. The overeducated–undereducated are identified by the NVRI method as shown and explained in Table 1. Numbers are rounded to the nearest 0 or 5

features. If, for any given field of study, we consider the occupations with NHRI between 1 and 0.2 as relatively better matching occupations, we see that 55 % of native-born wage earners work in unrelated occupations. When we use NHRI calculated for the native-born as a benchmark for immigrants who are educated in Canada, the USA, or the UK (henceforth, Canada), the distribution does not change significantly. However, the overall mismatch ratio increases to 76 %, when we identify the immigrants who are internationally educated. A similar pattern emerges from educational degree–occupation comparisons. While the NVRI distribution for Canadian-educated immigrants is not significantly different than that of native-born workers, foreign-educated immigrants are more populated in occupations that are not considered a good match by the native-born for their educational degree. If we consider educational degrees with NVRIs between 1 and 0.8 as relatively "common" degrees for any given occupation (evaluated by the native-born distribution), 79 % of internationally educated immigrants are either overeducated or undereducated for their jobs. The corresponding number is around 65 % for the native-born and Canadian-educated immigrants. Another interesting, perhaps expected, observation is that the vertical and horizontal

mismatches get worse than the averages as we move to lower NVRIs and NHRIs. For example, 41 % of foreign-educated immigrants who work in their trained occupations (i.e., NHRI is between 1 and 0.8) also work in an occupation that fits their formal educational degree. In contrast, the same number is 17 % for workers who work in occupations that are not related to their field of study (i.e., NHRI is between 0.2 and 0).

Finally, among the native-born workers who do not have a degree that matches their occupation (i.e., NVRIC is 2 or more), 27 % are undereducated and 34 % are overeducated. The same numbers for Canadian-educated immigrants are slightly different: 27 and 40 %. But when it comes to foreign-educated immigrants, the numbers indicate a distinct picture: among those who do not have a matching degree in their jobs, 70 % are overeducated. This becomes even worse, 83 %, for those who also work in jobs that they were not trained for (i.e., NHRIC is 5). This may reflect the fact that immigrants offset the discount to their foreign education with a surplus in schooling in their occupation especially when this discount comes from a higher degree of mismatch between field of study and occupation in labor markets where their foreign credentials are not recognized to their full extent.

Table 3 provides additional information on how relatedness in both dimensions varies across locations of study. In line with what was observed in Table 2, immigrants who obtained their highest degrees from Canada, the USA, or the UK have a better occupational matching in labor markets, regardless of which index of relatedness we examine. Interestingly, among the internationally educated immigrants, those from China have the lowest matching quality followed by others from Asia, the Middle East, and South America. Indeed, among the internationally educated immigrants, those from Asia (including China) are least matched to their occupations with only 20 and 70 % lying in the 1–0.2 range of NHRI and NVRI, respectively. The corresponding numbers for those educated in the USA, the UK, and Europe combined can be shown to be much higher at 31 and 78 %, respectively; as well, those numbers are also higher (25 and 77.5 %, respectively) for those educated in the Middle East, Africa, and South America combined. Thus, Asian immigrants who are educated in their home countries, and who clearly are the major source of new immigrants to Canada, experience the most severe occupational mismatches in Canada. A more relevant question that must be considered, however, is whether or not such mismatches among immigrants persist over time. Ideally,

Table 3 Distribution of all immigrants by NHRI, NVRI, and location of study—2006 (weighted)

	NHRI (1.0–0.2)	NVRI (1.0–0.2)	
	%	%	Total
Canada	42	87	983,545
USA	39	83	72,895
South America	24	78	71,430
Europe	26	74	208,935
UK	38	84	81,965
Africa	27	78	54,405
Middle East	25	76	40,680
China	21	69	76,695
Asia	24	70	329,785

Notes: the numbers are rounded

the issue of persistency can be examined by following the same cohort of immigrants across censuses. However, incompatible classifications of fields of study and occupations across censuses require a substantial amount of time, and this is beyond the scope of this study.[6] Hence, we look at the cross-cohort differences in Table 4 by the distribution of immigrant workers in terms of occupation match and the years since their migration to Canada.

One would expect that, if the underlying reasons are transitory, the resulting mismatch would subsequently improve occupational mobility (Green 1999) so that, similar to Canadian-educated immigrants, the occupational marching quality of internationally educated immigrants would rise in the long run close to that of native-born workers. Yet, it can be seen from Table 4 that the percentage of immigrants working in occupations that are not related to their field of study remains high, in the 75 % range, regardless of how long they have been in Canada. Likewise, the percentage of foreign-educated immigrants who are either highly overeducated or undereducated in their occupation is relatively higher (around 32 %) for recent immigrants than the average (27 %) reported in Table 2. Although this falls to 24 % for established immigrants, it never gets close to around the 11 % range experienced by Canadian-educated native-born or immigrant workers. This is especially noteworthy since, while longer years in Canada translate into significant wage gains in both categories, the poor quality of immigrants' occupational match and the associated wage penalty do not show significant improvement. This persistency in mismatch, as measured by cross-cohort comparisons, suggests that it might be the underlying reasons hampering the immigrants' occupational mobility to translate into a better matching in the long run. This brings us to the question of whether the nonequivalence of immigrants' foreign education is the source of the problem, so that the time spent in Canada rewards their experience but not their occupational matching quality. The next section investigates this question.

4 Statistical framework and estimation results

4.1 Wage earnings and matching

Before analyzing the effect of relatedness on earnings more systematically, we report average weekly wage earnings and the distribution of foreign-educated immigrant

Table 4 Average weekly wages and distribution of internationally educated immigrants by NHRI, NVRI, and years in Canada—2006 (weighted)

	NHRI		NVRI		
Years in Canada	1.0–0.2	0.2–0.0	1.0–0.2	0.2–0.0	Total
Less than 5 years	23 %	77 %	67 %	33 %	298,110
	897	657	749	641	713
More than 5 years	25 %	75 %	76 %	24 %	486,160
	1154	907	994	889	970
Less than 10 years	24 %	76 %	69 %	31 %	424,125
	964	712	812	686	772
More than 10 years	25 %	75 %	77 %	23 %	360,145
	1170	928	1010	917	989

Notes: (i) Weekly average wages are reported below percentages; (ii) Since the numbers are rounded, the totals can be slightly different than those in Table 1

workers by NHRIC and NVRIC in Table 5. The top section shows the distribution of field of study–occupation relatedness (NHRI) by NVRI class. One important observation is that the percentage of immigrants who work in unrelated jobs (NHRIC-5) rises significantly from 60 to 88 % as the educational degree–occupation match gets worse (that is, as NVRI gets larger). Although this may be expected, 60 % of immigrants who are neither undereducated nor overeducated still work in unrelated occupations evaluated in terms of the native-born workers' distribution. In contrast, the corresponding numbers are 47 % for the native-born and 49 % for Canadian-educated immigrants (Table 2). It is obvious from this observation that, although the two types of occupational match are related, the field of study–occupation relatedness could be a fundamental issue even among those whose highest degree is the one of the most common in their occupation. The wage penalty associated with these observations can be seen in the bottom section of Table 5. Monotonic declines in average wages particularly at higher NVRI classes suggest a strong and positive correlation between relatedness and wage earnings.

The middle section of Table 5 reports the distribution of educational degree–occupation relatedness by NHRI classes. Again, the correlation between NVRI and NHRI is also obvious here. While 41 % of immigrants who are in the first NVRIC (those who have an educational degree that is the most observed in their occupation) work in jobs that are most related to their field of study, only 17 % of those in NVRIC-1 work in

Table 5 Average weekly wage earnings and distribution of foreign-educated immigrant workers by NHRI and NVRI—2006 (weighted)

	NVRIC					
NHRIC	1	2	3	4	5	Total
	Vertical distribution—NHRIC by NVRIC					
1	22 %	10 %	14 %	7 %	5 %	11 %
2	4 %	4 %	3 %	1 %	1 %	2 %
3	4 %	5 %	4 %	3 %	2 %	3 %
4	9 %	10 %	9 %	8 %	4 %	8 %
5	60 %	72 %	70 %	81 %	88 %	75 %
Total	163,030	95,440	145,340	166,560	213,845	784,270
	Horizontal distribution—NVRIC by NHRIC					
1	41 %	10 %	23 %	13 %	13 %	88,595
2	36 %	20 %	24 %	12 %	8 %	18,720
3	26 %	18 %	21 %	19 %	17 %	26,285
4	25 %	16 %	23 %	21 %	15 %	59,155
5	17 %	12 %	17 %	23 %	32 %	591,475
Total	21 %	12 %	19 %	21 %	27 %	784,270
	Average weekly wages—CAD					
1	1240	1105	1126	1073	1145	1166
2	1484	1354	1177	1027	900	1284
3	1054	886	916	960	869	946
4	1083	968	834	774	713	886
5	1002	827	830	730	751	810
Total	1084	892	885	768	774	872

jobs that are least related to their field of study. This pattern changes for those in the NVRIC-5 category: only 13 % of workers with surplus or deficit in schooling in their occupation work in jobs that are related to their jobs. One critical observation emerges here when we compare these NVRI and NHRI distributions. While 75 % of internationally educated immigrants work in jobs that are considered by the native-born least related to their field of study, 27 % of those have a degree that is least related to their occupation. From this observation, it seems that the occupational mismatch of foreign-educated immigrants is mainly dominated by field of study–occupation relatedness relative to educational degree–occupation relatedness. Nevertheless, although immigrants are much more smoothly distributed across NVRI classes, there is a clear wage penalty for immigrants in occupations that are regarded as relatively less related to their degrees by native-born workers as shown at the bottom of the table.

The objective of this paper is to evaluate the payoffs to education for immigrants after isolating the effect of their matching quality on wage earnings. Up to this point, we have developed a method that quantifies this quality in a way that their occupational matching can be compared to that of native-born workers. Table 6 shows, for example, average weekly wages and the distribution of workers who work in the most matching jobs in terms of their field of study and educational degree. When we compare the workers with NHRIC-1 in the upper section of the table, the wage differences between native-born and foreign-educated workers for all NVRI classes become insignificant. A similar observation emerges for workers whose NVRIC is 1 in the bottom section of the table. The underlying reason for this could be that those whose foreign education quality is not significantly different than that of their Canadian-educated counterparts may also be more likely to be better matched. Besides, occupational matching in labor markets may also reflect an ability sorting (specially in language) among immigrants. One way to address this problem is to control for occupational matching by using

Table 6 Average weekly wage earnings and distribution of workers by NHRIC-1 and NVRIC-1—2006 (weighted)

	NVRIC					
NHRIC-1	1	2	3	4	5	Total
NB	48 %	10 %	22 %	11 %	9 %	1,634,415
	1152	1055	1109	1128	1104	1125
IMM-CE	46 %	11 %	20 %	13 %	10 %	251,585
	1259	1088	1187	1169	1218	1210
IMM-FE	41 %	10 %	23 %	13 %	13 %	88,595
	1240	1015	1126	1073	1145	1166
	NHRIC					
NVRIC-1	1	2	3	4	5	Total
NB	34 %	4 %	6 %	9 %	46 %	2,256,835
	1152	1644	1193	1077	976	1085
IMM-CE	30 %	5 %	6 %	10 %	49 %	378,925
	1259	1913	1278	1214	1128	1224
IMM-FE	22 %	4 %	4 %	9 %	60 %	163,030
	1240	1484	1054	1083	1002	1084

Notes: "NB", "IMM-CE", and "IMM-FE" denote native-born, Canadian-educated immigrant, and foreign-educated immigrant workers, respectively. Average weekly wages are shown under the percentage distributions

NHRIC–NVRIC matrices in wage earnings functions, so that we can compare the returns to education in each cell separately. The following section elaborates on the details.

4.2 Wage earnings function

As noted before, there are mainly three different reasons identified in the literature for why education may have positive effects on earnings. Lemieux (2014) calls first two channels as "pure education" and "occupation upgrading" channels based on the idea that formal education not only increases workers' overall productivity but also helps them find better paying occupations. The third reason is that the workers become more productive if they work in jobs that are a good match for their education. Although modeling these three channels through matching is a fairly complex process, in practice, occupation upgrading and specialization are controlled in wage earnings functions by binary variables that identify occupation and field of study fixed effects. The channel that reveals the payoffs to more (better) schooling seems a residual effect that is measured by either a continuous variable of schooling years or a binary variable that controls for the degree of education. The approach in this study employs a Mincerian wage function used by Lemieux (2014), augmented to include controls for each of the three earnings impacts of education noted above, including the ones that capture the effect of matching quality. This specification is as follows:

$$\ln w_{ifod} = \mathbf{X}\beta_i + a_d + b_f + c_o + \alpha.m(f,o) + \lambda.m(d,o) + \varepsilon_{ifod}, \quad (1)$$

where person i working in occupation o with degree d in field of study f earns wage w. Vector $\mathbf{X}$ includes a set of usual variables such as age, gender, and location of work. Indicator variables a_d, b_f, and c_o control for differences in degrees of education, fields of study, and occupations, respectively. The terms $m(f, o)$ and $m(d, o)$ control for the matching quality between occupation o and field of study f and degree d, respectively, and yield wage premiums, α and λ, to the extent to which field of study f and degree d are valuable in occupation o.

A concern in the literature, one that we fully recognize, has been the problem of unmeasured ability. Studies that have used instrumental variables confirm the ability bias in the estimated causal effect of education on earnings using the ordinary least squares (OLS) method but find that this bias is quite small in size—see, for instance, Card (1999) and Ashenfelter et al. (1999). The ability bias in the effect of field of study on wages has not been tested yet by IV methods due to difficulties in finding credible instrumental variables. As with the choice of field of study, the match quality could also be correlated with a person's ability. However, studies investigating wage differentials across fields of study (Altonji et al. 2012) and the effect of relatedness on earnings (Nordin et al. 2010) include proxies in their equations to control for unobserved ability and observe no significant changes in results. Lemieux (2014) explains in great detail why the OLS results of Eq. (1) should be valid especially when they are used in estimating average effects. In light of this, we also estimate the model using OLS but facilitate statistical inference by estimating two-way clustered standard errors (Cameron et al. 2011) at each cell of the NVRIC–NHRIC matrix. We also use VRI and HRI as proxies for $m(f, o)$ and $m(d, o)$.

First, we assess the occupational matching of foreign-educated immigrants by using the distribution of Canadian-educated native-born workers as a benchmark reflecting the long-term matching quality in Canadian labor markets. This approach allows us to identify immigrants clustering in occupations that are not *preferred* by Canadian-educated native-born workers in a given field of study. To accomplish this, we use normalized HRIs classified into five groups as noted earlier, which we treat as categorical variables that rank each occupation based on the native-born workers' distribution. Thus, using this categorical variable as a proxy for $m(f, o)$ in Eq. (1) for immigrants allows us not only to estimate the wage penalty that immigrant workers face but also to treat $m(f, o)$ as exogenous, which has otherwise been a major challenge for many studies in the literature.[7] Second, we also use the distribution of native-born workers across educational degrees in each occupation, as a part of the occupation–education degree matrix shown in Table 1. Using horizontally normalized VRIs classified into five groups, we can rank each degree for a given occupation based on the native-born workers' distribution. Likewise, using this categorical variable as a proxy for $m(d, o)$ in Eq. (1) for immigrants, we can control for the effect of vertical mismatch on wage earnings.

There are two potential sources for a possible selectivity problem in our work: first, we only look at wage earners; hence, selectivity to employment could be a potential problem. Second, we distinguish foreign-educated immigrant workers from Canadian-educated immigrants. There might be an ability sorting, for example, between these two groups that may lead to a case that the lower returns to education for foreign-educated immigrants reflect unobserved ability deficiencies, instead of a discount to their source-country education. Since our analysis focuses on the comparison of returns to formal schooling by nativity, it is quite reasonable to expect that the likelihood of a bias is already low because all three groups possibly face selectivity into employment. Nonetheless, to address the issue further, we have also applied a conventional Heckman selection process and included self-employed individuals in these three groups to reduce the selectivity problem even more and found that our results are not sensitive to these applications. The second issue, a possible ability sorting between Canadian-and foreign-educated immigrants, can be understood better when viewed in the Canadian context. Every year, more than 60 % of new immigrants are accepted in Canada as skilled workers based on a point system designed to select better-educated individuals with relatively high level of language skills. Unlike other immigrant-receiving countries, such as the USA, Canada has a negligible number of illegal immigrants and a modest refugee population. The shift in the immigration policy in the 1990s to the point system that explicitly targets adult workers (between 35 and 45 years old) with a postsecondary education and work experience has generally provided higher levels of human capital to meet the needs of Canadian labor markets (Ferrer et al. 2014). Therefore, a negative ability sorting could actually be an issue for immigrants who are defined as "Canadian educated" if their highest degree is obtained in Canada. Another potential problem is the endogeneity identified specially in the ORU literature that the unobserved inabilities might lead to both wage penalties and educational mismatches in labor markets. Although this is discussed later in the paper, since we compare payoffs to schooling only for those who work in the most matching occupations by nativity, this type of endogeneity seems an unlikely problem in our estimations.

Finally, that different cohorts of immigrants might have different levels of human capital reflecting the shift in the source-country composition of the inflow especially in Canada after the 1990s has been an issue that has been well investigated. The cohort effect has been examined in relation with the rate of economic assimilation, and it has been found that accounting for these cohort effects on wage levels substantially reduces the speed of wage convergence between immigrant and native-born workers (Green and Worswick 2012; Borjas 2013). Since we use single cross-sectional data, differences across cohorts can only be reflected in age differences. Hence, as a common application, instead of age, we include two variables, years since migration and before migration, to immigrants' wage equations. Additionally, we have checked the age distributions of Canadian- and foreign-educated immigrants in the two-level HRI–VRI matrix. Since the distributions are almost identical, the comparison of payoffs to their schooling should not be affected by the differences in human capital across cohorts.

4.3 Estimation results

Table 7 summarizes the estimation results for three specifications of the earnings function given by Eq. (1) without including the matching quality variables, $m(f, o)$ and $m(d, o)$. The first specification shows the results for native-born workers. The last two specifications report the results for Canadian-and internationally educated immigrant full-time wage earners, respectively. All specifications include controls for age, age square, marital status, disability, visible minority status, primary earner status, spoken language, regional fixed effects for 10 provinces, location of study fixed effects, and industry fixed effects for 21 categories. Moreover, the sample size allows us to control for field of study fixed effects

Table 7 OLS estimates of weekly wage earnings—2006

	(1) Native-born		(2) Immigrants—CE		(3) Immigrants–FE	
	Coef.	$P > \|z\|$	Coef.	$P > \|z\|$	Coef.	$P > \|z\|$
Degrees						
Trades	Base		Base		Base	
Registered apprenticeship	0.0437	0.000	0.0109	0.480	−0.0511	0.022
College—less than 1 year	−0.0053	0.551	−0.024	0.179	−0.1999	0.543
College—1 to 2 years	0.0357	0.000	0.0166	0.280	−0.0265	0.174
College—more than 2 years	0.0787	0.000	0.0549	0.001	−0.0156	0.399
University—below bachelor's	0.1039	0.000	0.0628	0.004	0.0283	0.191
Bachelor's	0.1819	0.000	0.1471	0.000	0.0433	0.052
Above bachelor's less than Master's	0.2234	0.000	0.1861	0.000	0.0802	0.002
Medicine, dentistry, veterinary, optometry	0.1080	0.071	0.1833	0.007	0.0698	0.244
Master's	0.3061	0.000	0.2347	0.000	0.0640	0.032
PhD	0.4808	0.000	0.4356	0.000	0.2547	0.001
Observations	1,228,448		219,417		150,183	

Notes: (1) The dependent variable is log weekly wage. (2) Standard errors are adjusted at occupation and field of study cells by using the two-way clustering method (Cameron et al. 2011). (3) All equations also control for age, age square, marital status, disability, visible minority status, primary earner status, spoken language (only English, only French, bilingual, others), regional fixed effects for 10 provinces, location of study fixed effects at 10 categories, field of study fixed effects at 1375 categories, and occupation fixed effects at 520 categories. (4) The equations also include industry fixed effects at 21 categories. However, results do not change significantly when industry fixed effects are excluded. (5) "CE" and "FE" denote Canadian-educated and foreign-educated. (5) Immigrants' age is decomposed to years since migration and before migration. (6) Information on years in education is not available in the 2006 Census. Therefore, we have to use age as a proxy to control work experience

for 1375 categories and occupation fixed effects for 520 categories, which helps us isolate the payoffs to degrees from the wage differences resulting from differences in fields of study and occupations. The results in Table 7 are in line with the evidence in the North American immigration literature in the sense that immigrants' education obtained abroad is less rewarding in Canadian labor markets (Li and Sweetman 2014; Warman et al. 2015). Specifically, our results verify this finding in that, in contrast with the first two specifications, either there is no education effect on wage earnings of immigrants who obtained their degrees outside of Canada or the rates of return are substantially discounted.

Table 8 reports the same specifications, but now, they include the relatedness (matching) variables, NHRIC and NVRIC. Regardless of birthplace or location of study, the results indicate a positive impact on wages of greater relatedness. Note that this relationship as structured in Eq. (1) appears to be correlational rather than causational, particularly when self-reported answers to survey questions or the distributional aspects of workers are used as a proxy for $m(f, o)$: workers might feel better matched in better-paying jobs, or they might cluster more around occupations with higher wages. Hence, the results for native-born workers should be interpreted in light of this fact. When it comes to

Table 8 OLS estimates of weekly wage earnings with NHRIC and NVRIC—2006

	(1) Native-born		(2) Immigrants—CE		(3) Immigrants—FE	
	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$
Degrees						
Trades	Base		Base		Base	
Registered apprenticeship	0.0358	0.000	0.0090	0.587	−0.0437	0.021
College—less than 1 year	−0.0055	0.213	−0.0306	0.022	−0.0113	0.593
College—1 to 2 years	0.0429	0.000	0.0249	0.280	−0.0082	0.434
College—more than 2 years	0.0841	0.000	0.0663	0.000	0.0135	0.384
University—below bachelor's	0.1138	0.000	0.0777	0.000	0.0581	0.001
Bachelor's	0.1856	0.000	0.1568	0.000	0.0869	0.000
Above bachelor's less than Master's	0.2252	0.000	0.2028	0.000	0.1431	0.000
Medicine, dentistry, veterinary, optometry	0.1394	0.001	0.2281	0.001	0.1433	0.004
Master's	0.2987	0.000	0.2417	0.000	0.1229	0.000
PhD	0.4490	0.000	0.4149	0.000	0.2946	0.000
NHRIC						
1	Base		Base		Base	
2	−0.0045	0.581	−0.0036	0.832	−0.0061	0.776
3	−0.0174	0.090	−0.0259	0.087	−0.0278	0.307
4	−0.0342	0.000	−0.0280	0.030	−0.0415	0.020
5	−0.1127	0.000	−0.1070	0.000	−0.0932	0.000
NVRIC						
1	Base		Base		Base	
2	−0.0149	0.001	−0.0327	0.000	−0.0269	0.000
3	−0.0179	0.002	−0.0316	0.000	−0.0266	0.002
4	−0.0379	0.000	−0.0644	0.000	−0.0621	0.000
5	−0.0784	0.000	−0.1142	0.000	−0.1063	0.000
Observations	1,228,448		219,417		150,183	

Notes: (1) See the notes to Table 7. (2) Standard errors are adjusted at NHRIC and NVRIC cells by using the two-way clustering method (Cameron et al. 2011)

immigrants, however, using NHRIC dummies in specifications (2) and (3) calculated for the native-born field of study–occupation distribution, and not that of immigrants, provides us with the desired exogeneity in relatedness. In particular, as we saw in Table 2, internationally educated immigrants are less likely to be assigned to occupations where native-born workers choose to work. In other words, more immigrants work in lower-paid occupations relative to native-born workers, and this breaks the simultaneity between higher wage earnings and crowded occupations. As for the vertical mismatch, a possible ability bias in estimating the wage penalty associated with overeducation–undereducation has always been an issue in the ORU literature. Since we do not distinguish the overeducated from undereducated in VRI calculations,[8] the aggregation of both groups in NVRIC may cancel out the ability bias, which works opposite directions for those who have a deficit or a surplus in schooling required by their jobs.[9]

The results show that, while the effect of relatedness on wage earnings are similar for native-born and Canadian-educated immigrant workers, it is slightly lower for internationally educated immigrants, especially for those who are working in the least matching occupations (NHRIC-5). Considering that more than 75 % of foreign-educated immigrants work in those least matching occupations, occupational mismatch would appear to be less punishing for immigrants. Another interesting point is that, unlike NHRIC, all categories in NVRIC are associated with a substantial and increasing wage penalty. Besides, while the vertical mismatch (education degree–occupation match) is less punishing than the horizontal mismatch for native-born workers, the opposite can be observed for both Canadian- and foreign-educated immigrant workers. Finally, when both dimensions of occupational matching are controlled by the inclusion of NHRIC and NVRIC, payoffs to educational degrees improve for foreign-educated immigrants. Although they are still deeply discounted, returns to degrees above "college—more than 2 years" now become positive and significant. As discussed earlier, this implies that the lower return to foreign schooling observed in the literature may also reflect the wage penalty to education–occupation mismatch as we report in Table 8.

This brings us to the question of how much of the discount in payoffs to foreign education is attributable to source-country education quality. For example, in their recent study, Aydede and Dar (2016) found that the cost of immigrants' occupational mismatch is negligible and, even if their matching quality improves to what native-born workers experience in Canada, it would not significantly reduce the wage gap between them. This evidence implies that the underlying reason for lower returns to foreign schooling and a persistent and significant occupational mismatch may not be the post-arrival difficulties involving the recognition of immigrants' foreign credentials but rather the lower quality of those credentials. One way to address this issue more explicitly is to separate these two effects by looking at returns to education for those whose education, in terms of field of study and educational degree, is in line with what is considered "required" for native-born workers in their jobs. In order to achieve this, we first reduce the classification of NHRI and NVRI from five categories to two. The first category is the same as before (NHRI and NVRI between 1 and 0.8), and the second category covers the 0–0.8 range. With this new classification, we introduce NHRIC2 and NVRIC2 into our regressions interacted with 11 degrees as shown in Table 9. Since our interest is in the payoffs to education only for those who have a matching degree and field of study, except for the first part of the results that shows

Table 9 OLS estimates of weekly wage earnings with interactions between degrees, NHRIC2, and NVRIC2—2006

	(1) Native-born		(2) Immigrants—CE		(3) Immigrants—FE	
	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$	Coef.	$P>\|z\|$
Degrees × NHRIC2 × NVRIC2						
Trades–1–1	Base		Base		Base	
Trades–1–2	−0.0158	0.254	−0.0483	0.035	−0.0619	0.349
Trades–2–1	−0.0893	0.000	−0.0668	0.016	−0.0665	0.001
Trades–2–2	−0.1357	0.000	−0.1516	0.000	−0.1243	0.000
Registered apprenticeship–1–1	0.0496	0.000	−0.0115	0.539	−0.0843	0.000
College—less than 1 year–1–1	−0.0139	0.067	−0.0551	0.000	0.0084	0.651
College - 1 to 2 years - 1 - 1	0.0717	0.001	0.0292	0.214	0.0409	0.353
College—more than 2 years–1–1	0.0747	0.000	0.0718	0.000	0.0021	0.970
University—below bachelor's–1–1	0.0981	0.000	0.0808	0.005	0.1279	0.135
Bachelor's–1–1	0.1557	0.000	0.1493	0.000	−0.0125	0.642
Above bachelor's less than Master's–1–1	0.2133	0.000	0.2259	0.000	0.1498	0.000
Medicine, dentistry, veterinary, optometry–1–1	0.3187	0.000	0.2830	0.000	0.1679	0.000
Master's–1–1	0.2510	0.001	0.0381	0.487	0.2519	0.019
PhD–1–1	0.4230	0.000	0.4103	0.000	0.2722	0.000
Observations	1,228,448		219,417		150,183	

Notes: (1) See the notes to Table 7. (2) Standard errors are adjusted at NHRIC and NVRIC cells by using the two-way clustering method (Cameron et al. 2011)

the full details of the interactions for "Trades," we report only the interactions between degrees and the first categories of NHRIC2 and NVRIC2.

The results show that almost all degrees are associated with increasing payoffs for native-born workers who work in matching jobs. The differential rates of return for each degree are not fundamentally different from those observed in Tables 7 and 8. This observation is almost the same with a minor discount for Canadian-educated immigrants. On the other hand, internationally educated immigrants who are also working in jobs that are considered good matches by native-born workers for their education face a large discount in returns to their foreign schooling. Except for graduate degrees, payoffs to all degrees are discounted zero, including the most crowded bachelor's degree. Given that the comparison is made for those who work in matching jobs in terms of field of study without any deficit or surplus in their schooling, the results reflect the isolated returns to education after removing the impact of occupational mismatch, field of study specialization, and occupational upgrading.

Some insight into each degree's contribution to the overall picture can be seen by noting that, among the best matched workers (those with NVRI and NHRI indices in the 1–0.8 range), while the bachelor's degree is the most crowded degree especially among foreign-educated immigrants, together with graduate degrees, workers who hold a postsecondary degree account for 55 % of all such immigrants. The corresponding numbers are 33 % for native-born wage earners and 43 % for Canadian-educated workers. Yet, despite the greater share of immigrant workers with higher education, the occupational match is one of the lowest, particularly for university degree holders. Our

results in Table 9 show that even among these well-matched foreign-educated immigrant workers, returns to education are discounted to zero for 80 % of them, including those who hold bachelor's degrees.

Finally, to check the robustness of the results in Table 8, we compare the returns to education for those who have the lowest relatedness index in both levels in Table 10. To achieve this, we define the lowest normalized relatedness between 0.2 and 0 for NHRIC2 and NVRIC2 and change the base to Trades–2–2 in estimations. The results show that, while the rates of return for each degree generally sustain their incremental values for native-born and Canadian-educated immigrant workers, payoffs to each degree of internationally educated workers are discounted to zero. Although those who hold a bachelor's degree are rewarded an additional 4 % for their education, this is not comparable to the 14–15 % earned by native-born and Canadian-educated counterparts.

5 Conclusions

Using the 2006 Canadian Census, this paper investigates the lower return to immigrants' foreign education credentials after adjusting for their occupational matching in hosting labor markets. There is a common perception that a deficiency in foreign qualification recognition and an excessive cost of reentry into regulated (or self-regulated) occupations hinders the labor market integration of new immigrants and results in the well-documented wage penalty at entry for newcomers. At the same time, the evidence in the literature also suggests that the differences in foreign schooling quality have substantial impacts on the earnings of immigrants. But the quality of foreign education can have an impact on the payoffs to schooling through different channels: the "pure" returns to education (reflecting the increased productivity of workers in a given occupation), occupation upgrading (resulting from education allowing workers to find more complex and better-paying jobs), and matching effects (the quality of the match

Table 10 OLS estimates of weekly wage earnings with interactions between degrees, NHRIC2, and NVRIC2—2006

	(1) Native-born		(2) Immigrants—CE		(3) Immigrants—FE	
	Coef.	$P > \|z\|$	Coef.	$P > \|z\|$	Coef.	$P > \|z\|$
Degrees × NHRIC2 × NVRIC2						
Trades–2–2	Base		Base		Base	
Registered apprenticeship–2–2	0.03378	0.000	0.6442	0.000	−0.0635	0.000
College—less than 1 year–2–2	−0.0302	0.000	−0.0276	0.000	0.0112	0.181
College—1 to 2 years–2–2	0.0455	0.001	0.0902	0.000	−0.0658	0.000
College—more than 2 years–2–2	0.0764	0.000	0.1219	0.000	−0.0381	0.000
University—below bachelor's–2–2	0.1146	0.000	0.1263	0.000	0.0215	0.014
Bachelor's–2–2	0.1447	0.000	0.1501	0.000	0.0447	0.000
Above bachelor's less than Master's–2–2	0.1940	0.000	0.2381	0.000	0.0769	0.000
Medicine, dentistry, veterinary, optometry–2–2	0.1679	0.000	0.2884	0.000	0.0541	0.191
Master's–2–2	0.1369	0.000	0.2073	0.000	0.0086	0.445
PhD–2–2	0.2432	0.000	0.3944	0.000	0.0259	0.001
Observations	1,228,448		219,417		150,183	

Notes: (1) See the notes to Table 7. (2) Standard errors are adjusted at NHRIC and NVRIC cells by using the two-way clustering method (Cameron et al. 2011)

between workers' skills and the occupations in which they are employed). Hence, unless the matching quality is controlled for in wage earnings equations, the existing evidence falls short of revealing the underlying reasons behind the gap in returns to education by nativity. The objective of this paper is to shed light on this very issue, one that has important policy implications. If it is the nonportability of foreign credentials rather than the lack of immigrants' transitory occupational mobility, solutions to the poor economic integration of immigrants into Canadian labor markets should lie more in policies targeting new immigrants' source-country human-capital characteristics rather than policies designed for postmigration improvements.

The approach we adopt in this study is to estimate a Mincerian wage function, augmented with controls for matching quality and occupational upgrading, among other things, to assess the returns to education of immigrants (both Canadian- and foreign-educated) relative to those of native-born Canadians. Our study breaks fresh ground in that we define and quantify matching quality using two measures of relatedness—one based on the match between educational degrees and occupation and the second based on the matching between field of study and occupation. The size of the sample we use allows us to develop these indices at a considerably low level of aggregation. Specifically, we are able to create two continuous indices that expose the "common" quality of occupational match experienced by native-born wage earners in labor markets. These indices quantify the match in two dimensions by using the clustering of native-born workers in each cell of the field of study–occupation and degree of education–occupation matrices reflecting the relatedness of each of the 1375 fields of study and 14 major degrees to 520 occupations separately. Unlike studies that define the match between pre- and postmigration (or intended) occupations, or studies that use a measure of "required education," as suggested in the ORU literature, the present study uses the distribution of native-born workers across occupations by field of study and degree of education as a benchmark that internationally educated immigrant workers can attain in the long run. This approach helps us eliminate the difficult problem of determining an *ideal* matching ordering of 520 occupations for each of the 1375 fields of study and 11 degrees in 520 occupations in labor markets, particularly for unregulated occupations. Thus, by adjusting the quality of immigrants' occupational matching, we can isolate the returns to education in estimation such that they reflect the true rewards to foreign credentials.

Our findings show that, in general, well-matched native-born and Canadian-educated immigrants earn more the higher their educational attainment in terms of degrees. However, for well-matched (by native-born standards) foreign-educated workers, the payoffs to schooling are severely discounted. Specifically, except for graduate degrees, the payoffs to all other degrees, including the most populous bachelor's degree, are effectively discounted to zero. This is especially noteworthy given that, among internationally educated immigrants, 35 % hold a bachelor's degree, relative to 24 % for the native-born. While foreign-educated immigrants generally have higher educational attainments, their matching quality is low, especially for postsecondary degree holders. It seems that the depressed earnings of internationally educated immigrants have more to do with their nonequivalent quality of source-country human capital and cannot be overcome through a better matching of skills to occupations.

Endnotes

[1]Earlier studies found that foreign education provides a significant wage return with a slight discount in Canada (Aydemir and Skuterud 2005), as we noted earlier. Since information on the location of study was not available before the 2006 Census, these studies used information on the year of immigration to identify years of schooling that immigrants have obtained abroad and in Canada, separately. Another common approach in the literature has been to assume that immigrants who came to Canada at the age of 25 or older could be considered as foreign-educated and information on the place of birth has been used to identify their location of study. However, the data from the 2006 Census show that more than 24 % of those immigrants actually obtained their highest degree in Canada, with this ratio jumping to 66 % for those coming from the Middle East in the same age group. In both these earlier approaches to identifying locations of study, measurement errors might contaminate the true discount to foreign education. A short list of studies on the issue for other immigrant-receiving countries can be found in Chiswick and Miller (2010).

[2]In the literature, the terms "horizontal match" and "vertical match" are often used for field of study–occupation and education–occupation matching, respectively.

[3]For instance, Reitz (2001) estimated the annual underutilization cost due to the immigrant's occupational mismatch to be as high as 15 billion dollars. On the other hand, the Conference Board of Canada (2001) has estimated this cost to be much lower, somewhere between 4.1 billion and 5.9 billion dollars.

[4]By using the same concordance table, Xue and Xu (2010) and Zeitsma (2010) also reported very detailed information about educational characteristics, occupational outcomes, and skill and field of study distributions of postsecondary educated immigrants based on the 2006 Canadian Census.

[5]Empty cells are assigned zero.

[6]Besides, although a concordance table is provided, Statistics Canada recommends that users not make historical comparisons between 2001 and 2006 censuses in terms of field of study.

[7]Cells with less than 10 native-born or 5 immigrant workers are dropped. However, we have reestimated all regressions with cells restricted to 15–20–25–30 native-born and immigrant workers in the field of study–occupation matrix. Since the results did not change fundamentally, we do not report them here.

[8]We also applied the ORU setting and found that the wage penalty for the overeducated disappears for internationally educated immigrants. This may imply that immigrants may offset lower returns to their foreign education with surplus in their formal schooling. We do not show the results here, as we believe that the issues in occupational matching cannot be addressed effectively within the ORU setting.

[9]Although estimating the direct wage effects of these indices is not the main objective of the paper, we have experimented with several different options when introducing HRI and VRI into our estimations. First, we have changed the five-level classification to a two-level classification and reestimated all three specifications in Table 8. The results are consistent with those reported in Table 8. We have also used the HRI and VRI as continuous variables (in logs and levels). Again, the results indicate a significant wage gain for those who work in matching occupations in both dimensions.

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