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STEM Education and STEM Work: Nativity Inequalities in Occupations and Earnings

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ABSTRACT

The recruitment of skilled workers with expertise in science, technology, engineering and mathematics (STEM) is a core component of North American immigration policies. However, few studies examine the labour market integration of immigrant STEM educated workers. Multivariate analysis of the 2011 National Household Survey show that STEM educated immigrants who arrive as adults are less likely than the Canadian born to have STEM jobs and they earn less than their Canadian born counterparts. These patterns partly reflect their socio-demographic characteristics, particularly their lower language proficiencies (measured as a combination of mother tongue and languages spoken at home) and the receipt of their degrees in institutions outside of Canada. These immigrant workers arrived primarily in the skilled worker programme that did not require pre-arranged employment. Policy changes in recruitment and their implications for future STEM immigrant workers are discussed in the conclusion.

INTRODUCTION

Skilled workers with expertise in science, technology, engineering and mathematics (STEM) are deemed essential for the research and development activities that stimulate economic growth. As one commentary notes, "US scientists and engineers have discovered or pioneered the science behind one blockbuster product after another — from flat-panel screens and robotics to the lithium batteries that run next-generation power tools and electric cars" (Lee, 2010). Migrant workers with STEM skills are central in this relationship between skill inputs, product development and markets. Studies note the high percentages of the foreign born as patent holders, or as owners or co-owners of IT start-up firms, emphasize the necessary and synergistic effects of STEM expertise in the workplace and in IT related firms, and the external effects of STEM workers on the wages of other workers (Rothwell, 2013; Walsh, 2015; Winters, 2014).

Not surprisingly, a large and diverse body of North American research on STEM workers exists. Studies primarily focus on national populations undifferentiated by race or nativity, and they generally fall into three domains: those who inventory the characteristics of STEM workers; those who study the retention of STEM degree holders in STEM occupations with particular attention paid to gender differences in such retentions; and those who analyse earning differentials between STEM and non-STEM degree holders/workers or among different STEM occupations (for examples see: Beckstead and Gellatly, 2006; Glass et al., 2013; Hira, 2010; Landivar, 2013a). But less attention is given to nativity differentials within the STEM workforce. A few studies specific to the US context compare wages between the native born and H1B visa holders in STEM occupations, mainly speaking to the policy debate in the US about the proper size and functions of the H1B visa

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(Lofstrom and Hayes, 2011; Luthra, 2009; Martin, 2012). Drawing heavily on US census data and the American Community Surveys, most other quantitative investigations examine differentials for migrant and native-born workers in STEM occupations rather than focusing on workers trained in STEM fields (for two exceptions, see Council of Canadian Academies, 2015a, 2015b; Tong, 2010). Such emphasis reflects data constraints; field of study was not asked in American national population surveys until the 2010 ACS (Gambino and Gryn, 2011; Landivar, 2013b).

From a policy perspective, looking only at those employed in STEM occupations offers only a partial and potentially misleading view; by definition, the analysis of STEM workers omits those who are not employed in the jobs for which they have trained. Our research uniquely contributes to existing STEM research, immigration integration studies and policy discussion by starting with STEM fields of study and asking three questions. First, to what extent do immigrants with STEM fields of study find employment in their areas of expertise and how does this compare to the native born? Similarly for those who hold STEM credentials, do earnings gaps exist between native-born and immigrant workers? Second, do nativity differentials in STEM/non-STEM employment and earnings reflect nativity differences in socio-demographic characteristics known to be associated with occupational and earnings outcomes? Specifically, our analysis of 2011 Canadian data examines the impacts of demographic, language and educational characteristics; we find that place of highest education and language use are important in explaining nativity differentials in having STEM employment and in earnings. Third, what are the implications of the findings for migration policies? In the conclusion we draw on one lesson from the US H-1B programme to assess the possible future impacts of new Canadian policy initiatives.

MATCHING STEM FIELDS OF STUDY TO WORK AND WAGES: THE ROLES OF EDUCATION AND LANGUAGE

A large STEM literature exists; however studies and related estimates that start with STEM fields of study and examine employment outcomes are both few and primarily focus on the total population undifferentiated by nativity (see: Beckstead and Gellatly, 2006: 15; Langdon et al., 2011; Lowell et al., 2009; Mishagina, 2009). Within the North American studies which examine labour market rewards for foreign-born STEM degree holders/workers, two subgroups can be identified. First, specific to the US context are studies comparing the earnings of H1B visa holders with those of native-born or naturalized US workers. Controlling for demographic, educational, and occupational factors, the holders of H1B visas do not suffer from lower wages than US born workers. However, compared with US born workers, temporary workers have earnings disadvantages because of their younger age profile, poorer benefits and lower job security (Lofstrom and Hayes, 2011; Luthra, 2009; Martin, 2012).

Second, a small group of studies adopts a classic integration perspective to study economic returns to STEM degrees/occupations for immigrants. In particular, two studies emphasize the role of the place of education in determining how well foreign born science and engineering professionals (including those with social science degrees) fare in the labour market (Kaushal, 2011; Tong, 2010). These studies find that while foreign-born men and women earn significantly less than their US-born counterparts who have similar demographic and educational (i.e. levels of education and fields of study) background, further adjusting for place of education greatly reduces these wage differentials (Kaushal, 2011: 328–329). Moreover, these two studies also document the importance of completing education in the US. The foreign born who have no host-country schooling and who receive foreign bachelor's degrees in combination with US higher degrees earn significantly less than their US-born counterparts; however, foreign born who complete all their post-secondary education in the US earn similar wages to US-born workers (Tong, 2010).

The negative impact of foreign education is well documented in more general studies of immigrant integration where it is thought to reflect a number of factors including: the imperfect

knowledge by employers of foreign degrees; the lower quality of foreign education; the internal labour markets created by professional associations that demand recertification for the trades and the professionally trained; and the use of foreign education by employers to discriminate statistically in favour of those who are educated in the destination country (Arbeit and Warren, 2013; Boyd and Thomas, 2001; Buzdugan and Halli, 2009; Kanas and van Tubergen, 2009). Additionally, compared with those educated in the destination country, foreign education may indirectly be capturing the effects of less acculturation and/or later ages of arrival for the immigrant population (Tong, 2010). Foreign education also may be associated with limited host country language proficiency (Kanas and van Tubergen, 2009).

Like educational attainments, destination country linguistic skills are considered a form of human and social capital that improve worker productivity and enhance social networking and social integration (Boyd and Cao, 2009; Chiswick and Miller, 2007). To date, studies of nativity differentials in STEM occupations or in wages have not investigated the role played by language skills, perhaps assuming that highly trained workers are highly proficient in the destination country language(s). However, this assumption may not be true when work units, particularly in the information and technology sector, rely on workers solely from countries such as China or India. Further, a recent report emphasizes that complementary skills including communication skills are important for the productivity maximizing effects of STEM skills (Council of Canadian Academies, 2015a).

Along with demographic variables, level of education, and fields of study, our study incorporates these two factors – place of education and language skills – into the analysis of nativity differentials in the occupational matching of the STEM educated and in the earnings obtained. Our initial research question asks: do nativity differentials exist with respect to employment in STEM occupations and in earnings for the STEM educated? Multivariate analysis indicates if nativity differentials are associated with socio-demographic compositional differences between the native born and the foreign born. Specifically, to what extent do the occupational profiles and earnings reflect nativity differences in sociodemographic variables such as age, sex, marital status, place of residence, educational attainments, fields of study, and in particular differences in place of education and language use?

DATA

Data and sample

Answering these questions requires a large data set that includes the focal variables of interest along with the detail necessary to determine the STEM educated and STEM occupations.

The long form questionnaire associated with Canada's quinquennial collects extensive demographic, socio-cultural and economic data, and it asks respondents questions that are often not available in other country censuses. For example, beginning in the 1991 census, a question permitted distinguishing between the temporary migrant population and those who were permanent legal residents. Detailed data on major fields of study have been collected since 1986 for all respondents, and starting in 2006, respondents were also asked to name the place where they attained their highest degree. Canada's historically rooted linguistic dualism (English and French) also means that respondents are asked about their mother tongues, their conversational abilities in English and/or French, languages used at home and at work (Boyd, 2015).

The most recent data in the 2B long form prototype are from the 2011 National Household Survey (NHS) in Canada. Following a 2010 federal cabinet decision, the NHS is designed as the replacement to the mandatory census long questionnaire. Excluding three earlier questions on care work, the May 2011 NHS contains all of the questions asked in previous long form censuses and it targets all persons living in private households in Canada. As a voluntary survey administered to 4.5 million households representing approximately one in three households, it has a weighted

response rate of 78 per cent and an unweighted response rate of 68 per cent (Statistics Canada, 2013a). The data are considered to be internally robust, meaning that relationships between variables that were observed in earlier censuses also hold in the 2011 data. The chief consequence of a voluntary questionnaire is the loss of published data for small areas and for sparsely settled areas; additionally, low income measures in 2011 cannot be compared to those from earlier censuses. However, these issues do not affect the core questions of this article.

The most detailed NHS dataset, available from Research Data Centres, permits assessing STEM-educated immigrants and the Canadian born with respect to the levels of working in a STEM occupation, and earnings. The population under investigation consists of non-Aboriginal Canadian-born and immigrant workers who are permanent legal residents and who have majored in STEM fields of study; it excludes the foreign born who are in Canada temporarily. In order to focus on those who are already established in the labour market, we restrict the sample to wage workers aged 30 to 64. Studies find that recent immigrants to Canada frequently take several years to become economically established, and that recently arrived immigrants are having more difficulty with economic integration than those arriving in earlier periods. Immigrant workers who arrived before age 25 are excluded because those arriving at younger ages (e.g. as children or adolescents) are more likely to be educated and socialized in the host country and thus have similar educational and labour-market experiences with the native-born population. Immigrant workers who arrived during or after year 2010 or respondents attending school (September 2010 to May 11, 2011) are also omitted as they have partial or no Canadian 2010 earnings and their labour market behaviours will be different from those who have completed their education.

The 2011 NHS asks about fields of study for post-secondary educated respondents. We exclude persons with trades, apprentice, and those with less than two years of college because the correspondence of their STEM skills to STEM occupations is less certain (Council of Canadian Academies, 2015a). In sum, the population of interest is persons in the labour market who studied STEM fields and have at least two years of college education, are 30 to 64 years old, are non-Aboriginal, are Canadian-born and immigrant permanent residents (arrived at age 25 and older and before year 2010) and were not in school during the preceding year.

Defining STEM fields of study and immigrant status

Recently Statistics Canada defined STEM fields of study from the Classification of Instructional Programs (CIP) Canada 2011 for the highest completed post-secondary degrees (Statistics Canada, 2013b). To facilitate multivariate analysis, we collapse these STEM fields of study into seven broader categories. Health-related fields are excluded, in keeping with definitions of core STEM occupations (Council of Canadian Academies 2015a; Lowell 2010).

As noted previously, immigrants are those who are foreign born (but not Canadian citizens by birth), who are legally admitted into Canada to reside permanently (those admitted temporarily are excluded) and who arrived at age 25 or later. The age of arrival distinction is important because integration concerns frequently target adult migrants. Yet earlier census-based studies, in both Canada and the United States, appear to include the 1.5 generation in the immigrant population (Council of Canadian Academies, 2015a, 2015b; Gambino and Gryn, 2011; Lowell, 2010). Our unpublished investigations suggest that the 1.5 and second generation are younger than the native born, less likely to have STEM employment, and certainly warrant a separate study.

Dependent variables

Education-occupation matches and earnings are two dependent variables frequently used to assess variations in labour market outcomes by nativity status (Chiswick and Miller, 2007, 2011).

Occupations indicate the structural positions of the types of work being done in the labour market. The match between occupations and fields of education in general, and the retention of STEM degree holders in STEM occupations in particular, indicates how well the trainings provided by specific fields of study are utilized in jobs (Boudarbat and Chernoff, 2012; Lowell et al., 2009; Mishagina, 2009). In keeping with previous studies (Cover et al., 2011; Landivar, 2013a, 2013b; Langdon et al. 2011; Lowell 2009, 2010), 500 occupational groups found in the National Occupational Classification 2011 are classified into STEM occupations and non-STEM occupations. The classification also includes three management occupations: architecture and science, engineering, and computers and information sciences. Together the STEM fields of study classification and the STEM occupational classification identify whether the STEM educated population is employed in STEM occupations or in non-STEM occupations.

The second dependent variable is weekly earnings. Earnings are widely used measures of labour market performances in both the literature on inequality and stratification and the literature on immigrant economic integration. Earnings enable the purchase of goods and services related to wellbeing, such as quality food, health care, and housing; earnings also indicate the productive values of worker and are linked to human capital skills, represented by education, on-the-job training and experience. The 2011 NHS collects information on individual annual earnings in the calendar year of 2010 directly from respondents and from 2010 tax returns. Annual earnings are transformed into weekly earnings to account for variations in weeks worked in 2010. The natural logarithm form of weekly earnings is used to adjust for skewness in the distribution of earnings. Because of these transformations, the earnings analysis in this study is restricted to individuals who worked one or more weeks and had positive earnings in 2010. Further transformations into hourly wages are not undertaken because hours worked data are collected for the week prior to the census (May 2011) and not for the preceding year, as done in the United States.

METHODS AND INDEPENDENT VARIABLES

Logistic regression analysis assesses nativity differentials in the occupational match-mismatch of those with STEM degrees while ordinary least square regression is used in the earnings analysis. In both, a step-wise strategy is used in which variables that are also associated with holding STEM occupations and with earnings are successively added to logistic regression equations for STEM occupations and to OLS regressions for logged (ln) earnings. Beginning with the actual percentages in STEM occupations and the average earnings and then adding other variables shows the extent to which the STEM and earnings inequalities between the Canadian and foreign born reflect nativity-specific demographic, language use and education characteristics. Table 1 indicates how these characteristics are defined.

Independent variables are selected using a broader literature that notes their relationship to economic outcomes. Demographic characteristics are: age, sex, marital status, place of residence, and visible minority status. A continuous and a quadratic measure of age is used in the multivariate analyses because the relations between age and earnings tend to be an inverted U-shape, reflecting working experiences gained by individuals as they grow older and possible health deteriorations and reduced working hours when they approach senior age (Luong and Hebert, 2009). We do not control for age-at-immigration. We did investigate whether including age at immigration changed our conclusions about the effects of language or place of education on our dependent variables. It did not.

Gender inequalities in wages and other labour market outcomes exist among both the Canadian born and immigrants and the analysis controls for sex as a dummy variable (with men being the reference group). We are not doing a gender-specific analysis for this article. However, the two

TABLE 1

DEMOGRAPHIC, LINGUISTIC, EDUCATIONAL AND ECONOMIC CHARACTERISTICS FOR THE POPULATION WITH TWO OR MORE YEARS OF COLLEGE AND WITH STEM FIELDS OF STUDY AND IN THE EXPERIENCED LABOR FORCE, FOR CANADIAN BORN AND IMMIGRANTS (ARRIVED 25 AND OLDER, ARRIVED BEFORE YEAR 2010)[a] CANADA, 2011.

	STEM Major		Percent with STEM Occupations
	CB	FB	
	(1)	(2)	(3)
Population Estimates	5,84,840	3,57,310	
Percent of the STEM-educated Population	62.1	37.9	(na)
Core STEM-nonSTEM occupations	100.0	100.0	
STEM	43.9	40.3	(na)
Non-STEM	56.1	59.7	(na)
Actual Weekly Earning (Mean)[b]	$1,861	$1,417	(na)
Log (Ln) Weekly Earning (Mean)[b]	7.2	6.9	(na)
Sex (%)	100.0	100.0	
Women	24.6	26.3	31.3
Men	75.4	73.7	46.4
Age (mean)	44.6	46.2	(na)
Marital Status (%)	100.0	100.0	
Married/CL	76.9	87.9	42.9
Single	15.3	5.3	44.9
Other	7.9	6.8	35.4
CMA (%)	100.0	100.0	
Toronto	13.3	42.3	40.3
Quebec City	4.6	0.6	53.6
Montreal	15.0	12.3	45.7
Ottawa	6.7	4.7	54.5
Hamilton	2.5	1.7	37.6
Kitchener	1.8	1.9	48.7
Winnipeg	1.8	1.7	40.8
Edmonton	3.2	3.7	41.7
Calgary	5.7	6.8	53.6
Vancouver	5.0	13.3	38.7
All other CMAs	28.2	9.5	40.2
All other areas	12.2	1.5	33.5
Visible Minority Groups (%)	100.0	100.0	
South Asian	1.0	17.2	38.3
Chinese	1.8	22.4	48.7
Black	0.7	3.5	38.4
Filipino	0.3	8.0	24.6
Latin American	0.1	3.4	42.7
Arab	0.1	5.5	37.2
Southeast Asian	0.3	1.4	40.1
West Asian	0.0	3.5	39.5
Korean	0.1	2.0	23.9
Japanese	0.3	0.3	41.6
Visible minority,n.i.e	0.1	0.4	31.2
Multiple visible minority	0.1	0.9	38.3
White[c]	95.1	31.5	43.6
Language Use (%)	100.0	100.0	
MT,most,reg=EngFr	93.2	12.7	43.6
MT=EngFr, most and/or reg=Oth	1.3	3.2	39.6
MT=Oth, most=EngFr,reg=EngFr	3.4	14.1	41.5
MT=Oth, most and/or reg=Oth	2.2	70.1	40.7

TABLE 1

(CONTINUED)

	STEM Major		Percent with STEM Occupations
	CB	FB	
	(1)	(2)	(3)
Educational Level (%)	100.0	100.0	
College (> 2 years)	29.8	7.1	38.8
University below Bachelor	8.8	12.6	29.4
Bachelor's degree	44.9	41.2	45.0
University above Bachelor	3.5	9.8	42.6
Master's degree	9.3	21.5	51.7
MD and Ph.D.	3.6	7.8	39.2
Location of Study (%)	100.0	100.0	
Canada	97.7	16.3	44.8
US	1.6	4.5	39.6
Europe	0.5	25.7	42.9
Other country	0.2	53.4	35.6
STEM Field of Study (%)	100.0	100.0	
Life Sciences	18.2	9.6	22.0
Physical Sciences	7.2	8.7	39.5
Engineering	28.7	54.3	48.9
Science Technicians	2.6	1.0	31.6
Engineering Technicians	18.5	4.8	36.2
Math, Computer and IT	21.7	20.1	53.9
Agricultural Sciences	3.1	1.6	25.4

(na) Not Applicable.
[a]Age 30-64, had at least two years of post-secondary education, has an occupation code, not in school, and non-Aboriginal.
[b]For those who worked at least 1 week and had positive earnings in 2010.
[c]The NHS classification includes White only, White & Latin American, White & Arab, and White & West Asian.
Source: 2011 National Household Survey, Master Data File housed in the Research Data Centres.

main conclusions are similarly observed for men and for women. 1) Nativity gaps exist for both dependent variables; and 2) compositional differences in location of study and language use are two major factors that explain the nativity gaps (the role of language use is mainly evident in the earnings analysis).

Controlling for marital status takes into account the association of marriage with higher earnings premiums (Killewald and Gough, 2013). Place of residence affects individuals' labour market outcomes due to differential industrial configurations and labour force compositions associated with various local labour markets; this effect potentially confounds nativity earnings gaps because the vast majority of immigrants concentrate in large census metropolitan areas (CMAs), especially in Toronto, Montreal, and Vancouver (Haan, 2008).

Finally, racial minorities (even those who were born in Canada) continue to face earnings disparities in Canada (Pendakur and Pendakur, 2011) and the statistical analysis adjusts for this impact, using the visible minority classification established by the federal government (Boyd, 2015). Given the miniscule historical migration from Mexico to Canada, Mexicans are not explicitly considered apart from the Latin American group.

Educational characteristics also are associated with labour market rewards, including occupations held and earnings. Measures include level of highest post-secondary educational attainment (six categories) and place of education (for highest degree) as two factors affecting major-occupation

matches and earnings. Although specific countries of education exist, this variable is collapsed into four categories: Canada (reference group), the US, Europe, and other country. A field of study variable (seven categories) also is included in the multivariate analysis.

Destination country language skill is another key predictor that potentially explains the labour market outcomes of immigrant STEM or non-STEM degree holders as compared to native-born STEM degree holders. In the United States and Australia, language proficiency is measured in terms of how well a person speaks English (Chiswick and Miller, 2007). However, the NHS does not have direct measures of language proficiency, emphasizing instead knowledge or use of official languages. We construct a four-category language use typology, based on NHS questions on mother tongue, language most often spoken at home, and language regularly spoken at home. Categories range from English and/or French as mother tongue, language most often and regularly spoken at home, to non-English/French mother tongue and home languages. To reiterate, all these variables are included in a step-wise multivariate analysis of the STEM-educated population in order to determine if the basic observed nativity differences in the likelihood of holding STEM occupations and in earnings in part reflect other nativity differences in socio-demographic characteristics which also are associated with occupations and earnings.

NATIVITY DIFFERENCES IN THE STEM-EDUCATED POPULATION

Beyond revealing how independent variables are coded in the multivariate analyses, Table 1 confirms nativity differentials in STEM occupational employment and earnings, demonstrates the existence of additional socio-demographic differences by nativity, and indicates the different percentages holding STEM occupations, across categories of the independent variables. The analysis shows that intending to work in STEM fields or receiving educational training in STEM fields is not synonymous with finding employment in those areas. For the 2011 population of interest, namely the STEM-educated who are between age 30-64 and in the experienced labour force, 44 per cent of the Canadian born hold STEM occupations compared with 40 per cent of the foreign born who immigrated at age 25 or later. Additionally, the average weekly earnings of the STEM-educated immigrants are lower than those received by the Canadian born with STEM fields of study (Table 1).

Initially, the slightly lower percentages of STEM educated immigrants in STEM occupations and their lower earnings seems strange, given that the foreign born are more likely to have degrees beyond the Bachelor level, where the STEM major-STEM employment fit is generally high and where earnings also are high. However, Table 1 also shows other differences in the socio-demographic profiles of the Canadian born and the foreign born. Compared with the Canadian born who have STEM fields of study, immigrants between age 30-64 who are in the experienced labour force are slightly older, more likely to be married, and live in the largest cities of Montreal, Toronto, and Vancouver. Slightly more than one-third is white compared to the 95 per cent of the Canadian born with STEM degrees. The largest visible minority groups for the immigrant STEM-educated population are Chinese and South Asian.

Further, they are much less likely to have English/French mother tongues and to use these languages in the home. And most of their educational degrees are from non-Canadian schools with over half of the degrees issued in countries other than the United States and in Europe.

Table 1, column 3, also indicates variation in the percentages holding STEM occupations for categories of socio-demographic variables. For the 2011 experienced labour force population with STEM education, men are more likely than women to be employed in STEM occupations as are those who are single, living in Quebec City, Ottawa (the so-called Silicon Valley North in the 1990s) and Calgary; persons who declare themselves as Chinese have the highest percentages employed in STEM occupations as do those whose mother tongues and home languages are English and/or French. Employment in STEM occupations is highest for those with Master's degrees,

for those who received their highest degrees in Canada, and for those who studied Mathematics, Computer Sciences, Information Technologies or Engineering.

All these variations along with nativity differences in socio-demographic characteristics are the basis for the multivariate analysis. Analytically, if the foreign-born are more likely to have socio-demographic characteristics in which lower percentages are employed in STEM occupations or work in occupations that pay less, this may help explain Canadian- and foreign-born differences in the percentages found in STEM occupations or differences in earnings. The multivariate analyses presented in the next two sections take nativity differences in socio-demographic composition into account by asking what would be the occupational and earnings outcomes if both the Canadian born and the foreign born has the same distributions for the independent variables.

NATIVITY INEQUALITIES IN THE EMPLOYMENT OF THE STEM-EDUCATED POPULATION

Logistic regression indicates the logged odds that individuals with college and higher degrees in STEM fields of study also work in STEM occupations or not. This statistical technique is particularly suited to outcomes that are binary, such as STEM or non-STEM occupational employment. Successive models introduce demographic variables, language use (as a proxy for destination language skill) and educational variables in order to show the influence of these variables in producing nativity differentials in the (logs) likelihood of employment in a STEM occupation. Appendix A provides the full models including the regression coefficients. For clarity, the logits (the logged regression coefficients) have been transformed into probabilities of having (or not having) a STEM occupation. These are presented in Table 2 as chances out of 100. The third column in Table 2 indicates whether the logit regression coefficient for the foreign born was significantly different from the Canadian born in the logistic regressions (see Appendix A).

The first row in Table 2 repeats the actual percentages of the Canadian born and the foreign born STEM educated who hold STEM occupations (see Table 1). The second row, called "adjusted 1, net of demographic factors," demonstrates the percentages that would exist if the Canadian born and the foreign born had identical distributions with respect to age, sex, marital status, size of place of residence and visible minority membership. The fact that differences are insignificant after controlling for these variables indicates that the lower actual percentage of immigrants in STEM occupations is due to an unfavorable distribution on one or more of the demographic variables. Immigrants who have STEM fields of study are slightly older than are the Canadian born, but the major differences between the two groups concern the concentration of immigrants in Canada's largest cities (which should improve the chances of STEM employment) and the higher percentages of immigrants who are visible minorities, especially Chinese and South Asian. The visible minority effect is partly co-mingled with language use and with the location of education, but also audit studies show that would-be employers are less likely to interview people whose names indicated a certain country of origins and/or phenotypical traits (Oreopoulos, 2011).

The second model takes the very different language usage patterns of STEM-educated immigrants into account; again, if both the Canadian born and the foreign born had the same distribution on the language use scale, there would be no significant differences between the nativity groups in the regression logits and only very small (and unimportant) differences in the percentage holding STEM occupations. This suggests that immigrant language use patterns reduce the chances of working in STEM occupations. As noted earlier (Table 1) a large percentage of immigrants who arrived at age 25 or later have non-English and/or French mother tongues and also use other languages at home. However, the magnitude of this reduction effect is not large, especially when compared to the impact of language in the subsequent earnings model.

TABLE 2

CHANCES OUT OF 100[a] OF WORKING IN A STEM OCCUPATION FOR STEM MAJOR DEGREE HOLDERS, AGE 30-64, WITH AT LEAST TWO YEARS POST-SECONDARY SCHOOLING, NOT IN SCHOOL AND NON-ABORIGINAL, FOR THE CANADIAN BORN AND IMMIGRANTS (ARRIVED 25 AND OLDER, ARRIVED BEFORE YEAR 2010), CANADA, 2011.

	CB-STEM Major (1)	FB-STEM Major (2)	Significance of Difference (FB - CB)[b] (3)
Unadjusted	43.9	40.3	***
Adjusted 1: Net of Demographic Factors[c]	42.1	42.1	(ns)
Adjusted 2: Further Net of Language Use	41.7	42.6	(ns)
Adjusted 3a: Net of Educational Level	42.1	41.7	(ns)
Adjusted 3b: Net of Location of Study	39.5	46.3	***
Adjusted 3c: Net of Detailed STEM Major Field of Study only	42.4	40.3	***
Adjusted 4: Net of Educational Level and Location of Study	39.5	45.9	***
Adjusted 5: Net of All Variables	40.1	43.4	***

[a]Calculated by the margins routine in STATA for logistic regression. If divided by 100, figures are converted into probabilities.
[b]Significance of the differences in the logistic regression coefficients for the foreign born and the Canadian born; see Appendix A1.
[c]Controling for compositional differences in Age, Sex, Marital Status, Place of Residence (CMA), and Visible Minority Groups.
Source: Appendix A1.

Models 2a through 2c show the impacts of nativity differences with respect to level of study, location, and the STEM fields of study. After taking demographic and language factors into account, the nativity differences in educational attainment do not substantively or statistically create inequalities in the chances of working in STEM occupations. Similarly, adjusting for the Canadian born and foreign born differences in the actual STEM field of study does not dramatically change the chances of immigrants working in STEM occupations relative to the Canadian born. What does matter, however, is the location where the STEM degree was received. Nearly all of the Canadian born received their highest degrees in Canada, in contrast to the 85 per cent of immigrants who received degrees elsewhere. If both groups had the same distributions for where degrees were received (which would mean more Canadian degrees), the immigrant STEM educated would be significantly more likely to work in STEM occupations than the Canadian born (46.3% changes versus 39.5%). The overall impact of nativity differences in the location of the STEM degrees, which privilege those with Canadian degrees, persists in the last and full model, where statistically both the Canadian born and the immigrants are treated as having identical demographic, linguistic and educational characteristics. This last model shows that when differences in all these characteristics are taken into account, the foreign born would have higher chances of employment in STEM occupations than their Canadian born counterparts. The step-wise introduction of the educational variable clearly indicates that it is the non-Canadian location where the STEM degrees are received that is so influential in supressing the employment of immigrants in STEM occupations.

NATIVITY INEQUALITIES IN THE EARNINGS OF THE STEM-EDUCATED POPULATION

Similar questions are asked about earnings: what are the nativity differentials in earnings and what factors help explain these differentials? Ordinarily least squares regresses weekly earnings on clusters of variables known to influence earnings and which also may differ (or be similar) by nativity. Again, the same format of assessing the impact of each cluster or specific variable is followed. The only difference is that because those in STEM occupations are known to earn more, the Canadian born and the foreign born STEM educated populations are distinguished by whether or not they are employed in STEM occupations. As with the previous analysis of STEM occupations, the full OLS regressions are found in Appendix A. Table 3 indicates the magnitudes of the wage differentials, using the Canadian born as the reference group.

Data in Table 3 generate three major conclusions. First, levels of weekly earnings are influenced by nativity and by sites of employment. As found elsewhere (Beckstead and Gellatly, 2006; Cover, Jones and Watson, 2011; Langdon, 2011), persons working in STEM occupations receive higher earnings on average than those employed in non-STEM occupations. But earnings on average are lower for immigrants than for the Canadian born. These two factors in combination mean that the

TABLE 3

PERCENT WEEKLY EARNINGS DIFFERENTIALS FOR THE CANADIAN BORN AND IMMIGRANTS (ARRIVED 25 AND OLDER, ARRIVED BEFORE YEAR 2010) IN STEM AND NON-STEM OCCUPATIONS FOR STEM MAJOR DEGREE HOLDERS, AGE 30-64, WITH AT LEAST TWO YEARS POST-SECONDARY SCHOOLING, NOT IN SCHOOL AND NON-ABORIGINAL, CANADA, 2011[a].

	Canadian Born		Foreign Born	
	STEM Major, STEM Occupation	STEM Major, Non-STEM Occupation	STEM Major, STEM Occupation	STEM Major, Non-STEM Occupation
	(1)	(2)	(3)	(4)
Unadjusted	(rg)	−21.7	−14.2	−49.0
Adjusted 1: Net of Demographic Factors[b]	(rg)	−18.6	−12.7	−46.0
Adjusted 2: Further Net of Language Use	(rg)	−18.5	−2.9	−39.8
Adjusted 3a: Net of Educational Level	(rg)	−17.6	−9.2	−41.9
Adjusted 3b: Net of Location of Study	(rg)	−18.5	3.6	−34.8
Adjusted 3c: Net of Detailed STEM FOS only	(rg)	−17.0	−4.8	−40.6
Adjusted 4: Net of Educational Level and Location of Study	(rg)	−17.6	(ns)	−36.1
Adjusted 5: Net of All Variables	(rg)	−15.9	(ns)	−35.9

(rg) Reference group.
(ns) Differences between the regression coefficents for Immigrants and the Canadian born are not statistically different and deviations are not reported.
[a]Calculated from regression coefficients in Appendix A2 using Halvorsen & Palmquist, 1980.
[b]Adjusting for compositional differences in Age, Sex, Marital Status, Place of Residence (CMA), and Visible Minority Groups.
Source: Appendix A2.

STEM-educated foreign born who work in non-STEM fields are the most disadvantaged compared to the STEM-educated Canadian born. For the Canadian born, employment in non-STEM occupations means a 22 per cent drop in weekly earnings compared to those in STEM occupations (Table 3, column 2, row 1). Immigrants working in STEM occupations earn on average 14 per cent less than their Canadian-born counterparts while STEM-educated immigrants who are working in non-STEM occupations earn almost half (49%) as much.

Second, the step-by-step introduction of variables known to influence earnings also confirms the importance of language characteristics and location of study for the earnings of immigrants. The adjusted model 1 shows that earnings gaps between the Canadian born in STEM occupations and immigrants in STEM and not in STEM occupations would modestly decline if all groups had the same distributions for age, sex, marital status, size of place of residence and visible minority membership. If all groups were also identical in their language use patterns, the comparative deficits would further decline. STEM educated immigrants who work in STEM fields would then earn 2.9 per cent less than their Canadian-born counterparts while those working in non-STEM occupations would earn 40 per cent less (Table 3, columns 3- 4, row 3).

Similarly, the fact that many STEM-educated immigrants received their degrees outside Canada explains much of the Canadian born–foreign born earnings gap, particularly for the foreign born working in STEM occupations. If all groups had the same distributions with respect to demographic composition, language usage and location of study, the earnings of immigrants who are employed in STEM occupations would actually be 3.6 per cent higher than the earnings of the Canadian born in STEM occupations. For the STEM educated immigrants who are employed in non-STEM fields, having the same location of the last degree as the entire population would reduce the income gap to 35 per cent (Table 3, column 4, row 5).

Higher levels of educational attainment characterize the STEM educated foreign born versus the Canadian born (Table 1). The adjusted model 4 (Table 3) takes into account the compositional differences in both education and location of last degree. When this is done, the size of the earning gap between the Canadian born and the foreign born who are employed in STEM occupations is negligible and statistically insignificant. The final model in Table 3 indicates the earnings differentials that would exist, on average, if all nativity-STEM groups had the same distributions in demographic characteristics, language use, and educational characteristics (including the location of study). No significant earnings gap exists between the Canadian born and foreign born employed in STEM occupations; but the Canadian born and foreign born in non-STEM occupations would earn 16 per cent and 36 per cent less on average than the Canadian born in STEM occupations.

CONCLUSION

In North America, immigrants with STEM expertise are admitted with the expectation that such individuals will contribute to research and development activities. However, less is known regarding how well the STEM educated immigrants fare in the labour markets in comparison with their native-born counterparts. On the one hand, studies on immigrant integration do not look at STEM educated immigrants as a distinctive, highly skilled group of people whose economic outcomes possibly differ from the general immigrant population. On the other hand, the STEM literature is largely concerned with those who are currently working in STEM occupations. Our study addresses these research gaps by focusing on the STEM educated workers in Canada, examining nativity differentials in working in STEM occupations and 2010 weekly earnings.

Our analysis of the 2011 NHS in Canada generates two main conclusions. First, compared with STEM educated Canadian born, immigrants with STEM trainings are slightly less likely to work in STEM occupations and have lower weekly earnings; the earnings gap is especially large for

immigrants working in non-STEM occupations. Second, two primary factors that underlie these nativity differences in economic outcomes are that immigrants have lower proficiency in destination languages and that most STEM-educated immigrants received their degrees outside Canada.

These findings have implications for both immigrant integration and immigration policies. First, recent studies on immigrants overall and their economic integration note that poor language skills and having foreign credentials are crucial factors that lower their labour market performances (Boyd and Cao, 2009; Buzdugan and Halli, 2009; Chiswick and Miller, 2003; Kaushal, 2011). Our study indicates that these findings based on the general immigrant population similarly apply to the STEM educated immigrants. Without language proficiency and Canadian education as two forms of *host-country specific* human capital (Chiswick and Miller, 2007), the seemingly high levels of human capital of STEM educated immigrants are not well recognized and utilized in the labour market. Our findings also confirm those in other studies: greater monetary returns exist for those working in occupations that match fields of study. For those who are STEM educated, the Canadian-born working in STEM occupations receive higher earnings than those in non-STEM occupations. Although a migration penalty exists, similarly the earnings of STEM educated immigrants working in STEM occupations also are higher than their compatriots who are STEM-educated but employed in non-STEM occupations.

Second, our study has implications for immigration policies and their implementation. Reflecting the 2011 NHS, the STEM educated immigrant workers in our study are mostly admitted under the foreign skilled worker point system (FSW) before 2010. Three changes since then have the potential to reduce the impact of language and place of education on immigrant occupations and earnings for the STEM educated admitted since then. First, the earlier practice of FSW applicants submitting educational documents as part of their application files has been discarded in favour of assessments by arms-length agencies. A would-be applicant with a foreign degree or diploma now must pay for, and obtain, an Educational Credential Assessment (ECA) certificate, administered by CIC approved academic credential assessment services and regulatory authorities. This ECA form indicates the Canadian equivalents for the educational credentials of the applicant; it forms part of the applicant's file and it is used in the awarding of points on education.

Also, a similar procedure now exists with respect to language skills. All would-be applicants, including those from Anglophone or Francophone countries, must pay for and take one of several designated language tests from agencies approved by Immigration, Refugees and Citizenship Canada (formerly Citizenship and Immigration Canada). The results are submitted with the application form. Both assessments of educational credentials and language skills are designed to standardize skills across countries and to norm them to existing Canadian benchmarks. These procedures minimize the chances of error in the awarding of points based on educational and language skills; and if applicants are assessed below the designated levels for educational and linguistic points, their files are not processed.

Third, significant changes are underway to the application process for permanent admission to Canada as a skilled worker. Prior to significant policy changes in 2015, applicants were admitted on a first-come, first served basis if they accumulate enough points based on their age, language skills, educational qualifications, and work experiences. Our study resonates with existing studies in showing that labour market potentials assessed under the point system often do not transfer into actual labour market successes. However, Canada's current high-skilled immigration policy now favours a two-step process in which admission rests on a "head-of-the-class" selection where *actual* rather than *potential* economic insertion is paramount. In early 2015, Canada began an express entry system previously adopted by New Zealand and Australia (Bedford and Spoonley, 2014) to manage applicants in the Skilled Worker Class, as well as the Canadian Experience Class, the Skilled Trades Class and a portion of the Provincial Nominee programme. Under this new system, applicants file expressions of interest and those with high enough points then are invited to apply for permanent residency. Job offers with valid Labour Market Impact Assessment provide 600

points in addition to those from the points system. Applicants without job offers are required to register in a job-bank data base available to potential employers and they also are ranked by assessment factors following a point system (Citizenship and Immigration Canada, 2015).

The Express Entry system is a new practice that incorporates a core principle of the United States H1-B programme which recruits STEM workers on a temporary basis with employer sponsorship (Boyd, 2014). Although the Canadian Express Entry programme targets workers for permanent residence rather than for temporary employment, it emphasizes employer sponsorship through employer selection of candidates in the Express Entry pool and through legitimate job offers. Further, many of these selected workers have already worked in Canada as a result of its growing temporary worker programme and the creation of the Canadian Experience class that permits changes in status for Canadian-educated post-secondary graduates who have work permits to work in Canada. The resultant tighter links between skills and economic outcomes at the admission stage thus generates at least two questions for future research on STEM immigrants. First, will the majority of immigrants admitted under the new system will be those who previously secured employment in Canada as temporary residents? Current statistics suggest an affirmative answer. According to the CIC 2015 mid-year report of the Express Entry programme, 86 per cent of successful candidates (i.e. those who are invited to apply for permanent residency) currently reside in Canada (Citizenship and Immigration Canada, 2015). Second, compared with our findings, will the recruitment of the STEM educated through employer sponsorship embedded in the Express Entry programme improve the educational-occupation matches and earnings of future cohorts of STEM educated immigrants destined to Canada? Future research is needed to address this last question.

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APPENDIX A1

LOGISTIC MODELS OF WORKING IN STEM OCCUPATIONS FOR STEM DEGREE HOLDERS, FOR THE CANADIAN BORN AND IMMIGRANTS (ARRIVED AGE 25 AND OLDER, ARRIVED BEFORE YEAR 2010)[a], CANADA, 2011.

	Model A		Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted		Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Nativity Groups																
Canadian Born	(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Foreign Born	−0.149	***	0.002	(ns)	0.038	(ns)	−0.013	(ns)	0.278	***	−0.087	***	0.262	***	0.135	***
Age			−0.026	***	−0.026	***	−0.025	***	−0.026	***	−0.025	***	−0.025	***	−0.024	***
Sex																
Female			−0.716	***	−0.716	***	−0.771	***	−0.715	***	−0.547	***	−0.772	***	−0.562	***
Male			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Marital Status																
Married/CL			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Single			−0.026	(ns)	−0.028	(ns)	−0.017	(ns)	−0.042	*	−0.026	(ns)	−0.029	(ns)	−0.026	(ns)
Other			−0.190	***	−0.192	***	−0.168	***	−0.196	***	−0.201	***	−0.172	***	−0.182	***
Region of Residence (CMA)																
Toronto			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Quebec City			0.414	***	0.409	***	0.459	***	0.394	***	0.439	***	0.446	***	0.428	***
Montreal			0.128	***	0.125	***	0.149	***	0.110	***	0.117	***	0.135	***	0.109	***
Ottawa			0.510	***	0.507	***	0.490	***	0.477	***	0.507	***	0.464	***	0.444	***
Hamilton			−0.173	***	−0.175	***	−0.133	**	−0.191	***	−0.107	*	−0.148	***	−0.101	*
Kitchener			0.246	***	0.244	***	0.256	***	0.228	***	0.266	***	0.244	***	0.237	***
Winnipeg			0.043	(ns)	0.040	(ns)	0.031	(ns)	0.025	(ns)	0.117	**	0.016	(ns)	0.105	*
Edmonton			0.011	(ns)	0.007	(ns)	0.019	(ns)	−0.007	(ns)	0.072	*	0.007	(ns)	0.073	*
Calgary			0.498	***	0.495	***	0.477	***	0.494	***	0.497	***	0.476	***	0.487	***
Vancouver			−0.106	***	−0.108	***	−0.108	***	−0.103	***	−0.076	**	−0.101	***	−0.056	*
All other CMAs			−0.104	***	−0.109	***	−0.069	***	−0.121	***	−0.018	(ns)	−0.079	***	−0.008	(ns)

APPENDIX A1

(CONTINUED)

	Model A		Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted		Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
All other areas			−0.388	***	−0.394	***	−0.327	***	−0.403	***	−0.256	***	−0.337	***	−0.219	***
Visible Minority Groups																
South Asian			−0.310	***	−0.304	***	−0.298	***	−0.147	***	−0.254	***	−0.165	***	−0.115	***
Chinese			0.206	***	0.223	***	0.215	***	0.336	***	0.171	***	0.303	***	0.235	***
Black			−0.367	***	−0.376	***	−0.340	***	−0.368	***	−0.355	***	−0.346	***	−0.328	***
Filipino			−0.882	***	−0.879	***	−0.778	***	−0.636	***	−0.944	***	−0.574	***	−0.625	***
Latin American			−0.102	*	−0.087	(ns)	−0.053	(ns)	0.093	(ns)	−0.105	*	0.097	(ns)	0.078	(ns)
Arab			−0.434	***	−0.430	***	−0.419	***	−0.320	***	−0.443	***	−0.332	***	−0.344	***
Southeast Asian			−0.186	**	−0.180	**	−0.158	*	−0.147	*	−0.215	**	−0.145	*	−0.183	*
West Asian			−0.149	**	−0.135	*	−0.138	*	−0.016	(ns)	−0.148	**	−0.044	(ns)	−0.069	(ns)
Korean			−0.896	***	−0.877	***	−0.871	***	−0.683	***	−0.932	***	−0.707	***	−0.771	***
Japanese			−0.026	(ns)	−0.024	(ns)	−0.025	(ns)	0.023	(ns)	−0.002	(ns)	0.009	(ns)	0.039	(ns)
Visible minority,n.i.e			−0.572	***	−0.585	***	−0.512	***	−0.553	***	−0.553	***	−0.495	***	−0.454	**
Multiple visible minority			−0.221	**	−0.222	**	−0.190	*	−0.125	(ns)	−0.234	**	−0.117	(ns)	−0.133	(ns)
White[b]			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Language Use																
MT,most,reg=EngFr					(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
MT=EngFr, most and/or reg=Oth					−0.097	*	−0.108	*	−0.094	*	−0.139	**	−0.104	*	−0.139	**

APPENDIX A1

(CONTINUED)

	Model A		Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted		Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
MT=Oth, most=EngFr,reg=EngFr					0.019	(ns)	−0.007	(ns)	0.008	(ns)	−0.026	(ns)	−0.019	(ns)	−0.061	*
MT=Oth, most and/or reg=Oth					−0.066	**	−0.103	***	−0.051	*	−0.135	***	−0.090	***	−0.158	***
Educational Level																
College (> 2 years)							(rg)						(rg)		(rg)	
University below Bachelor							−0.273	***					−0.262	***	−0.460	***
Bachelor's degree							0.353	***					0.373	***	0.321	***
University above Bachelor							0.337	***					0.352	***	0.281	***
Master's degree							0.652	***					0.637	***	0.643	***
MD and Ph.D.							0.104	***					0.071	*	0.307	***
Location of Study																
Canada									(rg)				(rg)		(rg)	
US									−0.307	***			−0.393	***	−0.404	***
Europe									−0.196	***			−0.243	***	−0.266	***
Other country									−0.541	***			−0.541	***	−0.510	***
Detailed STEM Fields of Study																
Engineering											(rg)				(rg)	
Life Sciences											−1.166	***			−1.262	***
Physical Sciences											−0.368	***			−0.431	***
Science Technicians											−0.703	***			−0.592	***

APPENDIX A1

(CONTINUED)

	Model A		Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted		Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Engineering Technicians											−0.668	***			−0.461	***
Mathametics & Computer Sciences											0.152	***			0.191	***
Agricultural Sciences											−1.000	***			−1.045	***
Constant	−0.244	***	1.090	***	1.098	***	0.832	***	1.116	***	1.297	***	0.839	***	1.046	***
Log Pseudolikelihood	−641970		−617078		−617016		−610018		−615320		−596989		−608376		−587721	
Pseudo R-square	0.001		0.040		0.040		0.051		0.042		0.071		0.053		0.085	

(ns) Not Significant, *p<=0.05, **p<=0.01, ***p<=0.001.

[a]Age 30-64, had at least two years of post-secondary education, has an occupational code, not in school, and non-Aboriginal.

[b]The NHS classification includes White only, White & Latin American, White & Arab, and White & West Asian.

Source: 2011 National Household Survey, Master Data File housed in the Research Data Centres.

APPENDIX A2

OLS MODELS OF LOG WEEKLY EARNING FOR STEM DEGREE HOLDERS, BY CANADIAN BORN AND IMMIGRANTS (ARRIVED AGE 25 AND OLDER, ARRIVED BEFORE YEAR 2010)[a] AND BY WORKING IN STEM OCCUPATIONS OR NOT, CANADA, 2011.

	Model A		Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted		Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
Nativity and STEM																
OCC Groups																
Canadian Born, STEM FOS, STEM Occupation	(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Canadian Born, STEM FOS, Non-STEM Occupation	−0.245	***	−0.206	***	−0.205	***	−0.194	***	−0.205	***	−0.186	***	−0.193	***	−0.173	***
Foreign Born, STEM FOS, STEM Occupation	−0.153	***	−0.136	***	−0.030	**	−0.096	***	0.035	*	−0.050	***	−0.013	(ns)	−0.020	(ns)
Foreign Born, STEM FOS, Non-STEM Occupation	−0.673	***	−0.616	***	−0.508	***	−0.542	***	−0.428	***	−0.520	***	−0.448	***	−0.444	***
Age			0.079	***	0.081	***	0.084	***	0.084	***	0.081	***	0.086	***	0.084	***
Age Squared/100			−0.082	***	−0.084	***	−0.088	***	−0.087	***	−0.085	***	−0.090	***	−0.088	***
Sex																
Female			−0.247	***	−0.246	***	−0.269	***	−0.245	***	−0.231	***	−0.268	***	−0.224	***
Male			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Marital Status																
Married/CL			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Single			−0.162	***	−0.165	***	−0.161	***	−0.170	***	−0.158	***	−0.165	***	−0.159	***
Other			−0.083	***	−0.086	***	−0.073	***	−0.088	***	−0.081	***	−0.076	***	−0.074	***
Region of Residence (CMA)																
Toronto			(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Quebec City			−0.185	***	−0.201	***	−0.181	***	−0.203	***	−0.177	***	−0.184	***	−0.175	***
Montreal			−0.089	***	−0.097	***	−0.093	***	−0.101	***	−0.094	***	−0.097	***	−0.098	***
Ottawa			0.094	***	0.084	***	0.060	***	0.073	***	0.085	***	0.052	***	0.052	***
Hamilton			0.004	(ns)	−0.001	(ns)	0.011	(ns)	−0.007	(ns)	0.008	(ns)	0.006	(ns)	0.004	(ns)
Kitchener			0.036	*	0.033	*	0.026	(ns)	0.025	(ns)	0.041	**	0.020	(ns)	0.015	(ns)

APPENDIX A2

(CONTINUED)

	Model A	Model B		Model C		Model D		Model E		Model F		Model G		Model H	
	(1)	(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Unadjusted	Adjusted 1: Demographic information		Adjusted 2: Language Use		Adjusted 3a: Educational Level		Adjusted 3b: Location of Study		Adjusted 3c: Detailed STEM Major		Adjusted 4: Educational Level & Location of Study		Adjusted 5: Net of everything	
Winnipeg		−0.089	***	−0.094	***	−0.123	***	−0.100	***	−0.096	***	−0.128	***	−0.121	***
Edmonton		0.137	***	0.129	***	0.109	***	0.123	***	0.121	***	0.105	***	0.103	***
Calgary		0.249	***	0.240	***	0.223	***	0.238	***	0.225	***	0.222	***	0.215	***
Vancouver		−0.040	***	−0.046	***	−0.059	***	−0.047	***	−0.051	***	−0.059	***	−0.057	***
All other CMAs		−0.074	***	−0.087	***	−0.079	***	−0.091	***	−0.076	***	−0.083	***	−0.081	***
All other areas		−0.231	***	−0.247	***	−0.216	***	−0.250	***	−0.224	***	−0.219	***	−0.212	***
Visible Minority Groups															
South Asian		−0.155	***	−0.140	***	−0.133	***	−0.075	***	−0.137	***	−0.090	***	−0.080	***
Chinese		−0.176	***	−0.132	***	−0.139	***	−0.084	***	−0.132	***	−0.112	***	−0.115	***
Black		−0.117	***	−0.152	***	−0.142	***	−0.146	***	−0.142	***	−0.146	***	−0.140	***
Filipino		−0.109	***	−0.099	***	−0.048	**	0.005	(ns)	−0.111	***	0.021	(ns)	0.011	(ns)
Latin American		−0.101	***	−0.060	**	−0.037	(ns)	0.015	(ns)	−0.062	**	0.010	(ns)	0.006	(ns)
Arab		−0.195	***	−0.180	***	−0.187	***	−0.131	***	−0.186	***	−0.158	***	−0.159	***
Southeast Asian		−0.087	*	−0.069	*	−0.053	(ns)	−0.048	(ns)	−0.066	(ns)	−0.048	(ns)	−0.048	(ns)
West Asian		−0.131	***	−0.092	***	−0.102	***	−0.043	(ns)	−0.102	***	−0.073	**	−0.079	**
Korean		−0.405	***	−0.359	***	−0.356	***	−0.277	***	−0.362	***	−0.302	***	−0.302	***
Japanese		−0.022	(ns)	−0.014	(ns)	−0.028	(ns)	0.005	(ns)	−0.017	(ns)	−0.019	(ns)	−0.016	(ns)
Visible minority,n.i.e		−0.067	(ns)	−0.109	(ns)	−0.077	(ns)	−0.092	(ns)	−0.097	(ns)	−0.072	(ns)	−0.067	(ns)
Multiple visible minority		−0.062	*	−0.062	(ns)	−0.048	(ns)	−0.020	(ns)	−0.061	(ns)	−0.025	(ns)	−0.025	(ns)
White[b]		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
Language Use															
MT,most,reg=EngFr				(rg)		(rg)		(rg)		(rg)		(rg)		(rg)	
MT=EngFr, most and/or reg=Oth				−0.073	***	−0.078	***	−0.071	***	−0.081	***	−0.075	***	−0.078	***
MT=Oth, most=EngFr, reg=EngFr				−0.053	***	−0.061	***	−0.053	***	−0.063	***	−0.061	***	−0.067	***
MT=Oth, most and/or reg=Oth				−0.177	***	−0.183	***	−0.165	***	−0.192	***	−0.173	***	−0.184	***

APPENDIX A2

(CONTINUED)

	Model A	Model B	Model C	Model D	Model E	Model F	Model G	Model H
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Unadjusted	Adjusted 1: Demographic information	Adjusted 2: Language Use	Adjusted 3a: Educational Level	Adjusted 3b: Location of Study	Adjusted 3c: Detailed STEM Major	Adjusted 4: Educational Level & Location of Study	Adjusted 5: Net of everything
Educational Level								
College (> 2 years)				(rg)			(rg)	(rg)
University below Bachelor				0.031 **			0.035 **	0.063 ***
Bachelor's degree				0.202 ***			0.208 ***	0.251 ***
University above Bachelor				0.198 ***			0.202 ***	0.242 ***
Master's degree				0.282 ***			0.272 ***	0.322 ***
MD and Ph.D.				0.482 ***			0.461 ***	0.541 ***
Location of Study								
Canada					(rg)		(rg)	(rg)
US					0.067 ***		−0.007 (ns)	−0.005 (ns)
Europe					−0.061 ***		−0.086 ***	−0.099 ***
Other country					−0.205 ***		−0.184 ***	−0.188 ***
Detailed STEM Fields of Study								
Engineering						(rg)		(rg)
Life Sciences						−0.108 ***		−0.159 ***
Physical Sciences						−0.057 ***		−0.100 ***
Science Technicians						−0.264 ***		−0.145 ***
Engineering Technicians						−0.198 ***		0.023 (ns)
Mathametics and Computer Sciences						−0.118 ***		−0.072 ***
Agricultural Sciences						−0.216 ***		−0.225 ***
Constant	7.326 ***	5.638 ***	5.616 ***	5.398 ***	5.557 ***	5.692 ***	5.356 ***	5.402 ***
R-square	0.067	0.107	0.109	0.125	0.112	0.115	0.127	0.131

(ns) Not Significant, *p<=0.05, **p<=0.01, ***p<=0.001.

[a]Age 30-64, had at least two years of post-secondary education, worked at least one week in 2010, has positive earning, not in school, and non-Aboriginal.

[b]The NHS classification includes White only, White & Latin American, White & Arab, and White & West Asian.

Source: 2011 National Household Survey, Master Data File housed in the Research Data Centres.