DISCIPLINARY DIFFERENCES IN THE IMPACT OF DEGREE LOCATION ON IMMIGRANT EARNINGS IN CANADA

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ABSTRACT

This study uses 2016 Canadian Census data to examine the impact of the location of education on immigrant income in ten academic disciplines. Although past studies have touched on the penalties that foreign-educated immigrants encounter, the value and portability of foreign educational credentials is seldom empirically tested by discipline. Immigrants may be intrinsically more likely to experience the "social closure" or "opportunity hoarding" imposed by the existing social groups in the host country, and with the addition of the context of "credentialism" and "global stratification in higher education", immigrants with educational credentials from the low-income developing countries may face greater barriers in integrating and achieving socioeconomic mobility in the Canadian labour force. Findings indicate that more severe earnings penalties are imposed on foreign degrees in the fields of business and law. Immigrant wage gaps in the arts and humanities and in social sciences are unremarkable, where immigrant earnings are often concentrated in lower figures regardless of where one's degree was obtained. Although there is no consistency regarding which global region's educational degrees are always valued most, overall, North American educational degrees are more economically competitive in the Canadian labour force, and in a select few disciplines immigrants with U.S. degrees can even exceed the earnings of immigrants with Canadian degrees.

INTRODUCTION

Canada is one of the world's most welcoming nations, having opened its borders to more than 286,000 permanent immigrants in 2017 (IRCC, 2018). Faced with a declining birth rate and aging population, in 2018, the Canadian government announced a commitment to welcoming more immigrants annually—300,000 of them by the end of 2020— to populate high-demand positions in the labour force and contribute to Canada's social and economic needs (IRCC, 2018). However, contrary to the government's desires to leverage immigration to boost the economy, and to the desires of immigrants to establish themselves in a wealthy country, studies show that immigrants are at greater risk of poverty than native-born Canadians (Fleury, 2007; Picot, Hou & Coulombe, 2007). Research reveals that the earnings of immigrant workers do not reach parity with those of comparable Canadian-born workers, even after several years of residency (Gilmore, 2009; Morissette & Sultan, 2014).

The economic disadvantages experienced by immigrants are partly explained by the under-recognition of foreign educational credentials in the Canadian labour force (Li, 2001), despite the tendency of immigrants to specialize in the fields of higher earning potential such as Science, Technology, Engineering and Mathematics (Picot and Hou, 2020). Immigrants are twice as likely as Canadian-born citizens to possess foreign educational degrees (Canadian Census, 2016; Fortin, 2016), and nearly three-quarters of masters and doctoral-level students in engineering and computer science in 2016 were immigrants (Picot & Hou, 2019). Although under-recognition and non-recognition of foreign credentials are frequently discussed, research has yet to highlight the wage disparities between foreign-educated and domestically educated immigrants based on their fields of study. The transferability of foreign credentials into a new country may differ by major, especially considering that many STEM fields have stringent

certification requirements, some of which do not recognize all foreign degrees as equivalent. As such, immigrants who were educated outside of Canada may experience greater earning disadvantages compared to immigrants with Canadian credentials. To address the research gap on the potential challenges concerning immigrants with foreign educational degrees in varying disciplines, the current study will investigate the following questions:

1. *Does the location of educational degree attainment have an impact on immigrant earnings?*
2. *If so, how does this impact differ by academic discipline?*

BACKGROUND

Canadian Immigration Policy

Canada is the second-largest country by land mass, home to approximately 37 million people. Its low population numbers and birth rates, however, have long influenced the country's need to find sources of labour from outside the country. A brief literature review of the history of Canadian immigration policy assists us in observing the episodes and evolution of public policy for immigrant screening in Canada. We can see that the waves of immigrants entering the country have coincided with demographic changes throughout history, leading to the significant roles contributed to Canada by immigrants.

The Immigration Act of 1869 was Canada's first immigration legislation, passed two years after the country's founding in 1867. As the Canadian West was considered to be fertile land with rich natural resources, the first Act encouraged immigrants to settle in these western territories. Excluding criminals and imposing barriers on the sick and poor, Canada's first open-door immigration act gave preference to British and American immigrants, followed by northern and central Europeans, with the least favoured being Asians, Blacks, and Jews (Troper, 2013).

In 1885, under pressure from British Columbia, the federal government introduced the first legislation to exclude immigrants on the basis of their ethnic origin — the Chinese Immigration Act of 1885. In the 1880s, a large number of Chinese labourers arrived in Canada to work on the western section of the Canadian Pacific Railway. As Chinese people were regarded as immoral, prone to diseases, and incapable of cultural assimilation, White residents and local politicians in British Columbia protested to impose a $50 CDN tax on each Chinese person wanting to enter Canada. Based on the amendments to the Chinese Immigration Act of 1887, 1892, 1900 and 1903, this "head tax" increased from $50 in 1885 to $500 in 1903 to impede Chinese entrance (Van Dyk, 2021)

At the end of World War I in 1919, the Canadian government amended the Immigration Act to impose restrictive regulations to immigration policy in response to a postwar economic recession and to protect the country from a fear of subversive ideologies and activities. The Russian Bolshevik Revolution of 1917 and the Winnipeg General Strike of 1919 caused widespread fear of communism and growing syndicalism, and thus, the Canadian government added more restrictive regulations to prevent foreign radicals from Eastern Europe (Dirks, 2006). To respond to the anti-foreign and enemy sentiment, immigrants from "enemy aliens" (Roy, 2020), mainly Ukrainians and Germans, were also denied entry, and faced expulsion. By the time the Nazis came to power in Germany in 1933 and until 1945, it was nearly impossible for Jews to seek asylum in Canada. A great number of European Jews tried to escape antisemitism, but Canada refused to accept Jewish refugees at that time. At the end of WWII, Canada finally opened its door to revitalize the economy and absorb immigrants, and so Jewish immigration increased in the post-war era (Ontario Jewish Archives, 2021), though much of this was limited to particular programs to alleviate worker shortages in Canada (Abramson and Lynch, 2019).

Prior to 1946, both individuals born in Canada and immigrants were both classified as British subjects, rather than Canadian citizens. This changed in 1946 with the Canadian Citizenship Act, which created a Canadian citizenship, strengthening Canada's status as a sovereign nation, independent from Great Britain. The Canadian Citizenship Act established the criteria for obtaining citizenship and outlined the circumstances under which citizenship could be lost or revoked. Canadian citizenship was automatically conferred upon natural-born Canadians, as well as those born outside of Canada if their father was born in Canada or was a British subject with a Canadian domicile. Immigrants could apply for citizenship after residing in Canada for five years if they possessed good character and an adequate knowledge of English or French (Van Dyk, 2021a).

After decades of immigration decisions based on national or ethnic origin, a points system was introduced in 1967 and is still in use today. Race and nationality were no longer to be the primary factors considered in immigration selection decisions, but rather potential immigrants would be scored based on their age, level of human capital (education level and work skills), and language ability (English or French). Soon thereafter, in 1971, Prime Minister of Canada, Pierre Trudeau, announced that multiculturalism and the elimination of racial discrimination should be a part of official Canadian immigration policies. A policy of multiculturalism was implemented to promote respect for cultural diversity and grant different ethnic groups' rights to preserve and develop their own cultures within Canadian society (Van Dyk, 2021b). This led to the Immigration Act of 1976, which took effect in 1978, and it was the first time that an immigration act clearly outlined the fundamental objectives of Canadian immigration policy. This act stated explicitly that immigrants were regarded as important in promoting Canada's demographic, economic, social, and cultural goals. Under the act, three

categories of immigrants were recognized: independent immigrants selected on the basis of the points system; a family class which included the immediate family members of Canadian citizens and permanent residents; and refugees as defined by the United Nations (UN) Convention Relating to the Status of Refugees (Van Dyk, 2021c).

By the end of the 1970s, the proportion of visible minority immigrants had increased noticeably, and Asian and African immigrants gradually replaced Europeans as the main immigrants to enter Canada, a pattern that has persisted into the 21st century. As of the latest Canadian Census, approximately 22% of the Canadian population are visible minorities in 2016. South Asian (29.6%), Chinese (19.4%) and Black (16.2%) ranked highest, making up the first three racial/ ethnic minority groups.

Based on the 2021–2023 Immigration Levels Plan published by Immigration, Refugees and Citizenship Canada, we can see that increasing immigration is seen as an essential measure in helping the Canadian economy recover from COVID-19 (IRCC, 2020). In the next three years, Canada plans to continue welcoming immigrants at a rate of about 1% of the population of Canada. This constitutes around 400,000 immigrants each year. In their projections for Statistics Canada, Morency et al. (2017) forecasted that in the year 2036, immigrants will account for between 25 and 30 percent of Canada's population, and approximately 56 and 58 percent of Canada's immigrant population will have been born in Asia.

Immigrants Educational and Economic Achievements in Canada

The purpose of the points system used by Immigration, Refugees and Citizenship Canada (IRCC) (the government department tasked with overseeing Canadian immigration programs) is to select a "higher quality" (Wright and Maxim, 1993) of immigrants, defined as "immigrants having smaller on-entry earnings differentials and having earnings that grow at a faster rate (i.e. converge to the average of native-born individuals more quickly)." (p. 337). The goal of growing the immigrant populations is framed as a solution to mitigate labour shortage and boost the economy in a country with low birth rates and an increasing aging population. Because the government does not want to increase the burden on government welfare programs, immigrant education and work experience are important factors in measuring immigrant eligibility into the country.

Whether current immigrants, who are carefully selected by the point system based on work skills and education levels, are actually aligned with the criteria of "high quality immigrants" is an unanswered question. This system emerged from an ideology of neoliberalism, which believes in a reduced role of government, to be replaced with individuals taking personal responsibility for their own success and failure. Within this ideology, immigrants are expected to learn to survive in and adapt to their new country's job market, and whether they can perform as well as their Canadian counterparts is their own private concern.

Assumed within this model is that returns on human capital are evenly distributed across social groups, although statistics show that immigrants are not guaranteed to reach wage parity with Canadian-born population despite being more likely to obtain a university degree and major in high-paying technical and scientific fields (Crossman, 2013; Hango, 2013; Picot & Hou, 2019, Plante, 2010). Specifically, immigrants in the Canadian labour market who possess a bachelor's degree in STEM earned 28% less than their Canadian-born counterparts after controlling for

demographic, language, and working-time variables (Picot & Hou, 2019). In engineering only 39% of employed immigrants with engineering degrees secured a job that required a university degree, whereas 71% of Canadian-born university graduates did the same (Picot & Hou, 2019). Immigrants also spend more time searching for specialized, high-skilled professional positions, and many end up in occupations for which they are over-educated and is a mismatch with their skills and interests (Boyd & Thomas, 2001; Grenier & Li, 2011; Goldmann, Sweetman & Warman, 2015; Lu & Hou, 2019).

Immigrants' economic integration and performance are often the primary focus of Canadian government institutions and academic scholars. For example, in 2003 Statistics Canada research fellows Picot and Hou published a study showing that from 1980 to 2000, low-income rates among recent immigrants were on an upward trend while the rate among the Canadian-born population was decreasing. Specifically, among three cohorts of "recent immigrants" (residing in Canada for less than 5 years) from the 1980s, 1990's, and 2000's, the low-income rate increased from 1.4 times that of the Canadian-born population to 2.5 times by 2000. Picot, Hou and Coulombe (2007) also found that after the year 2000, the low-income rate of immigrants entering Canada was 3.5 times higher than that of their Canadian-born counterparts. Specifically, they found that about 19 percent of the immigrant cohorts entering between 1992 and 2000 experienced chronically low income within the first five years (i.e. low-income for four of the first five years in Canada), and 16.5 percent of immigrants experienced chronically low income for the first ten years (i.e. low-income for seven of the first ten years in Canada). Further, this pattern held despite the fact that immigrants entering in the 2000s had a much higher level of education and were more likely to belong to the skilled class of immigrants than the 1990s immigrants (Picot, Hou and Coulombe 2007). Picot and Hou (2015) came to the conclusion that

immigrants actually accounted for little in affecting the national decline in low-income rates during the 2000s, because from 1995 to 2010, low-income rates among immigrants did decrease, but at a disproportionate rate relative to the low-income rates among native Canadians, which had also declined.

Similarly, using the longitudinal Survey of Labour and Income Dynamics (SLID) (1999–2004) database, Banerjee (2009) revealed that recent immigrants, regardless of whether they were visible minorities, all faced earning disadvantages compared to Canadian-born populations. However, immigrants with European origins were more likely to reach income parity with their native Canadian counterparts; a "privilege" that was not experienced by visible minorities in the country's labour force.

Li (2001) used the 1996 Canadian Census microdata to compare the earnings of four groups: native-born Canadian degree holders; immigrant Canadian degree holders; immigrant mixed education degree holders; and immigrant foreign degree-holders. His findings show not only that immigrant foreign degree holders had the lowest earnings, but also the impact of having foreign credentials is inextricably linked with gender and racial characteristics of immigrants. He argued that immigrants' credentials adversely affect the earnings of visible minority women and men more than White women and men, and immigrant, foreign-degree holders who are visible minority women often reveal the most obvious earnings disadvantage.

Moreover, Banerjee and Lee (2015) found that the attainment of educational credentials within Canada yields positive effects on all individuals' earnings, but the "catch-up" effect associated with the attainment of an educational credential varies between different groups. Specifically, recent immigrant men are more likely to have a significantly higher growth trajectory after receiving a Canadian credential than the native-born Canadian men. But for

women, visible-minority recent immigrants do not reach parity with native-born Whites after pursuing a Canadian educational credential.

Notably, although the effect of Canadian educational credentials on immigrants' earnings may differ by an individual's gender and race, Banerjee and Lee (2015) and Li (2001; 2008) all pointed out the importance of a Canadian educational credential for immigrants in order to reduce the earnings gap.

"Credentialism" and Global Stratification in Higher Education

Canada is one of the leading industrialized countries that possess high quality education, whether it be elementary school or higher education (OECD, 2021). Not only are many prestigious, research-oriented universities located in this country, but standardized tests show that student capability levels in reading, mathematics and science performance levels are all higher than the international average of countries in the Organisation for Economic Cooperation and Development (OECD) (OECD, 2020). However, some have cautioned that the value of an educational certificate or diploma declines as a rising proportion of the populations has one. Collins introduced the concept of educational inflation and credentialism in his book *The Credential Society A Historical Sociology of Education and Stratification* (1979, 2019), to describe the process of the expansion of higher education attainment in the United States, as well as how educational credentials become tickets into the workforce, subsequently driving out people without diplomas. He revealed an important phenomenon happening in the United States where "high-school diplomas (i.e., twelve-year secondary school) were comparatively rare before 1940; now, high-school degrees are so commonplace that their job value is worthless. University attendance is now more than 60 percent of the youth cohort and is on its way to the same fate as the high-school degree." (p. ix). Collins (2019) argued that educational inflation and

credentialism expand on the false premise that more education can produce more opportunity and more good jobs. However, Collins believes that it is implausible that a country's entire labour force will be scientists or skilled technicians. Collins also argued that different countries have gone through educational inflation at different rates, and that the higher the level of economic development of a country, the higher the proportions of people with elementary, secondary, and higher education. Additionally, even though higher education has become more pervasive and accessible for the majority of young adults, educational inflation has raised the bar for educational credentials, thereby impeding the ability of disadvantaged groups to enter professional or middle-class positions (Holzer and Baum, 2017).

In the context of credentialism, a student's decision to enroll in higher education may be primarily motivated by the desire to obtain certain credentials instead of the desire to improve individual competence, which provides an ethical dilemma among students and academics. (Stodt & Thielens, 1985). The existence of credentialism leads some professional groups and associations to restrict the supply and admission of new professions. For example, in the fields of medicine and law, credentials are rigorously required to perform related jobs (Buon & Compton, 1990). Historically, higher education has only been available for a tiny elite of wealthy professionals, and more specifically, for men. Credentials can not only assist employers to screen people who are not qualified for positions, but can also limit the entry and raise the status of many professions in the job market.

The host country's existing social groups can utilize the methods of "social closure" (Weber, 1978) and "opportunity hoarding" (Tilly, 1998) to limit the entry of new-come outsiders, in order to defend privileges, resources, and chances which they possess and control. The notion of 'social closure' in Weber (1978, p.342) is explained as a closed social relationship

against outside competitors and safeguarding monopolization of intrinsic social power. Weber explains that social closure occurs when "social collectivities seek to maximize rewards by restricting access to rewards and opportunities to a limited circle of eligibles." (Parkin, 1974, p.3). Social groups located at any level in the stratification order can draw boundaries to exclude outsiders, and the criteria and exclusive purpose may depend upon their general location in the distributed system (Parkin, 1974). The ability of groups to engage in social closure is particularly acute among professionals. As professionalism is grounded in expertise making, professionals are better situated to preserve monopoly over their specialized knowledge and to create boundaries to protect their status and roles (Abbott, 1998).

"Opportunity hoarding" is a similar sociological concept introduced by Tilly (1998) in Durable Inequality to examine why long-term structural inequalities exist. An example is the Italian migrant community in Mamaroneck, Long Island (New York, U.S.), where Italian Americans control the economic niches of landscape gardening and seldom employ non-Italian labour. Opportunity hoarding also happens among middle-class parents to use their political, economic, and social capital to ensure the best educational opportunities for their children, thereby causing school segregation in the U.S. (Hanselman and Fiel, 2017). Both theories of "social closure" and "opportunity hoarding" reflect social groups' rejection of outsiders in order to protect, control, and even monopolize valuable resources. Thus, immigrants as newcomers may experience the exclusion in their host country with or without an educational degree recognized in the labour market.

In Canada, for the increasing numbers of immigrants from developing regions, such as Asia and Africa, their "carry-on" educational credentials, skill certificates, and past work experience may be under-recognized or under-valued by employers in host countries with well-

developed educational systems (Guo, 2009). International university ranking systems such as World University Rankings, QS World University Rankings, and U.S. Best Global Universities Rankings, used to measure an institution's abilities in teaching, research, and graduate recruitment, often rank universities in developed high-income countries highest. Pietrucha (2018) found that one of the most critical factors influencing the standing of a university in the world rankings is a country's economy. Williams et al. (2013) also confirms that governmental funding, particularly for expenditure on research and development (R&R), directly influences university rankings. This conclusion is validated by the article's findings that the U.S. comes in with the highest overall ranking, followed by Sweden, Canada, Finland, and Denmark, which all have intensive funding for education. GDP can reflect a country's economic development level, which also indicates whether a country can distribute funding to secure academic excellence in higher education. Research and development expenditures are important for academic and scientific advancement, but in less-developed countries, unsolved issues of food security and human safety may be prioritized over education, thereby leaving universities in low-income countries invisible in global higher education rankings. Educational development is closely linked to government spending on education, which in turn correlates with the country's economic state, therefore less-developed countries are constricted in efforts to improve the quality and global visibility of their educational institutions (Maslak et al., 2005).

Although the disparities in economic resources between high and low-income countries may directly affect the education quality and ranking in developing countries, Marginson (2016) saw the university rankings themselves as a result of "inherited Anglo-American neo-imperial advantages, grounded in 250 years of history" (p.24). Marginson (2016) pointed out that English-language nations dominate the global list of higher education institutions, and English materials

are more prominent in universities and academic research. The criteria used for ranking global universities are grounded in the norms of Anglo-American universities. The U.S. maintains hegemony in global university rankings and holds a remarkable concentration of knowledge power. For example, between 2009 and 2012, Harvard produced more than twice as many highly cited papers as the second-place institution, Stanford. American schools often occupy leading numbers in the global top 50 universities. In 2014, among the top 50 higher education institutions, 41 universities belong to the anglosphere (including the U.S., the U.K., Canada, Australia, and New Zealand) and 32 schools are in the U.S. (Marginson, 2016). The disparities in education rankings not only reflect the imbalanced educational system and quality of education, but also indicate the dominant economic position of developed Anglophone countries. When global educational credentialism and licensing criteria are grounded in norms of dominant Anglophone countries, immigrants who were educated in low-income non-English speaking countries seem to experience "doubly disadvantaged" when they come to the Global North with competitive education systems.

For-profit Higher Education and International Students as a Source of Profit

Because top ranking universities are mostly in North America and Western Europe, students have been shown to be highly motivated to relocate abroad. For example, Kim (2011) interviewed 50 Korean graduate students to investigate their motivations to study in U.S. universities, and found that pursuing a degree in the U.S. was seen as a main road to success, or even to obtain fame, in Korean society. As Kim (2011) writes, "Students' choices operate within the global stratification of higher education, and US hegemony exerts enormous influence on the production and consumption of academic capital" (p. 111) in Korean society. Similarly, the U.S. and the U.K. are also the primary destination countries for Chinese students studying abroad.

Bodycott (2009) and Zwart (2013) both identified that the reputation of the educational institutions, and the cost of living and study in the destination country are the most important factors considered by Chinese students before studying abroad.

International students' willingness to pursue a better education in what they saw as more prestigious universities, became an opportunity for economically rich countries to market their "educational services" internationally (Rudner, 1997). The current worldwide international student flow is a movement from the East to the West; from the Global South to the Global North and from non-English-speaking countries to English-speaking areas (Verbik, 2007). Phillips & Stahl (2001) argue that nations with prestigious, higher-education systems such as the United States, the United Kingdom and Australia are the greatest beneficiaries of this growing trade in education services. For example, they point out that the profit of education exports from the U.K. was more than £9 billion by 1997. Australia also experiences large foreign exchange by "touting" the knowledge-based sector. In the U.S., international students contributed nearly $41 billion to the economy, and international education is the fifth-largest service sector export according to data from the National Association of Foreign Student Advisors (NAFSA, 2020).

As educational services become highly profitable in these native-English speaking countries, one unanswered question is whether or not international students can afford access to these well-developed educational systems. Cantwell (2015) revealed that international students, particularly those at undergraduate level, were regarded as a crucial source of revenue; a finding closely connected to the author's argument that international students may simply be "cash cows". Using Canada as the primary example, Usher (2019) revealed that between 2006/2007 to 2018/2019, domestic student tuition increased at approximately inflation plus 2%, while international student tuition fees rose at inflation plus 5%. By the end of the 2018/2019 academic

year, domestic students paid an average of $6,000 per year, but international students were charged over $27,000 per year. Although there is no systematic record of whom are the financial funders of international students in Canada, using New Zealand as an example, I found that 90% of international students in New Zealand were financially supported by their parents in their studies, 7% by themselves, 4% from family members, 3% from scholarships, and less than 1 % by loans (Ward and Masgoret, 2004). A similar situation may also occur in Canada because international students who apply for study permits are required to provide proof of financial support. International students may prepay tuition and deposit a certain amount of money in Canadian banks to ensure the affordability of their living expenses. Additionally, Canadian government limits international students to work a maximum of 20 hours per week while classes are in session, thus it is unrealistic for most full-time students to achieve a self-sufficient balance between high tuition fees and part-time earnings. International students can also utilize personal credit statements from their home countries to borrow loans, but rather than borrow money to pay international tuition and undertake the burden of returning loans, they may choose to study in a more affordable way in their home country.

In general, students in the Global South may wish to study at higher education institutions in developed countries to receive better credentials, but their choice to study abroad may present them with the challenge of paying tuition that is several times higher than that of native residents. Consequently, international students who have had opportunities to study in Canada may arrive with financial advantages over immigrants who have never obtained a Canadian educational degree.

Based on the literature previously noted that immigrants' economic integration and the possible existence of credentialism and opportunity hoarding in Canada, I predict the following hypotheses:

Hypothesis 1: Immigrants with Canadian educational degrees are more economically advantageous than immigrants educated outside of Canada.

Hypothesis 2: Immigrant earnings differ by their major field of study, and the wage gaps are larger in fields with stronger credential requirements.

DATA, MEASURES, AND METHODS

Data

This analysis uses the 2016 Canadian Census Public Use Microdata File (PUMF) (n=930,421), derived from a 2.7% two-phase probability sub-sample of the 25% of Census households who received the long-form questionnaire of the long-form questionnaire of the 2016 Canadian Census (versus the short form questionnaire given to the majority of households). The PUMF file was selected given accessibility constraints to access the Research Data Centre (RDC) at the university library due to the COVID-19 pandemic; notably, the 2016 Census microdata file in the RDC includes 100% of the long-form questionnaire respondents.

Of the 930,421 individuals, 202,320 identified as permanent residents or citizen immigrants, defined as having "been granted the right to live in Canada permanently by immigration authorities" (p.49 of the PUMF user guide). The 'Immigrant' category only includes immigrants who landed in Canada on or prior to May 10, 2016 for the purpose of the 2016 Census. The final sample included 62,030 respondents after dropping any missing values on any of the variables (see Appendix A). Notably, only those aged 15 years and over in private households were asked questions regarding income, which is where a large proportion of cases were dropped.

Measures

To measure immigrants' economic performances, the dependent variable in this analysis is wages (wages, salaries and commissions) during the reference period, which has been log transformed[1] in order to transform a typically highly skewed variable into one that resembles a more normal distribution (Benoit, 2011). Given that the variable is logged, wages should be interpreted in terms of the percentage change in wages given increases in the independent variables. Because I am looking at the impact of location of education on earnings, I want to focus on wages earned from labour and regular work, rather than the overall income which may include money earned from multiple channels, such as investment sources, personal pension sources, government assistance, child benefits, one-time receipts (such as lottery winnings, gambling winnings, and cash inheritances), and so on. In the 2016 Census, wage refers to gross wages and salaries before deductions for such items as income taxes, pension plan contributions and employment insurance premiums during the reference period— indicating the calendar year of 2015 for 2016 Census.

The main independent variable in this research is location of the educational institution granting the respondent's highest educational degree. The 2016 Census includes 17 categories for the location of study, with the first 11 values representing each Canadian province. I grouped those values and created a series of dummy variables indicating whether the location of study was within Canada (omitted category), the United States, "Other America", Europe, Eastern Asia, Southeast and Southern Asia or other regions. The second main independent variable is the field of study, measured through a series of ten dummy variables: arts and humanities (omitted category); science and science technology; engineering and engineering technology;

[1] Because the PUMF replaced wage values that rounded to zero to be coded as $1, I did not first add 1 before doing log transform to ensure no respondent was lost.

mathematics and computer and information science; business and administration; social and behavioral sciences; legal professions and studies; health care; education and teaching; and trades, services, natural resources and conservation.

To assess the level of education, I also included a variable referring to the highest level of education that a person has successfully completed, through a series of dummy variables: a degree below bachelor's level (omitted category); a bachelor's degree, university certificate or diploma higher than a bachelor's; a degree in medicine, dentistry, or veterinary medicine; a master's degree; and a doctorate degree. The category "a degree below bachelor's level" is an aggregate of several separate categories in the original variable, including trades certificate or diploma, Certificate of Apprenticeship, programs from College, CEGEP (a pre-college university program unique to Quebec) or other non-university institutions, and a university certificate or diploma below bachelor level.

A number of demographic controls were included in the models. Visible minority status is measured as a dummy variable, where 0 indicates "White", and 1 indicates "visible minority" if the respondent falls into any of the following categories: South Asian, Chinese, Black, Filipino, Latin American, Arab, Southeast Asian, West Asian, Korean or Japanese. Moreover, demographic variables also include age (recoded according to their midpoints), age at immigration (recoded to their midpoints), gender (measured as a dummy variable with 1 indicating male), marital status (measured as a set of dummy variables: single (omitted category), never married; legally married; common law; separated; divorced; widowed), home language (neither English nor French as the omitted category), labour force status (measured as a set of dummy variables including employed (omitted category), unemployed, and not in the labour force). Finally, interaction terms, computed by multiplying major field of study by

locations of study, were entered into the regression analysis in order to assess whether there are different effects on the location of education by major on immigrant earnings.

Methods

Using the software package STATA, I first calculated descriptive statistics with t-tests to test for differences between those with a Canadian or foreign educational degree. I followed the descriptive statistics by conducting a series of log-linear regression models to predict immigrant wages (logged), first by location of education only, then with demographic controls, followed by a model with the other educational characteristics, and a final model with the interaction terms. To increase the interpretability of the coefficients, I also used the margins command in STATA to predict and visualize immigrant earnings by setting default values for each of the independent variables.

One concern in ordinary least squares (OLS) regression models is multicollinearity, which is a case in which the independent variables are highly correlated with each other. According to Allison (1999), cases of extreme perfect collinearity are easy to spot since software will kick out any independent variables that have a correlation close to 1.0. However, near-extreme collinearity is a harder to identify concern that sometimes can result from three or more variables being so highly correlated with each other that models become less robust. Near-extreme multicollinearity does not violate any assumptions of the linear model but increases the standard errors making it harder to reach significance for variables that would otherwise be statistically significantly related to the dependent variable (Allison 1999). To detect multicollinearity, I used the variance inflation factor (VIF). There is often no formal VIF value for determining the presence of multicollinearity, but a VIF value higher than 10 is a clear indicator of multicollinearity. In Model 1, all VIF values are slightly higher than 1.0. In Model 2,

all VIF values are also less than 2.0. In Model 3, the values collect between 1.0 to 3.20. In Model 4 with interactions, the VIF values increase substantially to nearly 20. This is likely a result of the multiple interaction coefficients since they measure some of the variables twice. The effect of this high degree of multicollinearity means that we cannot put too much weight on any of the significance tests in this model as there may be some relationships that appear non-significant that are a result of collinearity rather than a true null (or vice versa) (Allison 1999).

After estimating the models, heteroskedasticity was tested by using the Breusch-Pagan test in the default form of the hettest command in STATA. After running Model 4, I input the hettest command, which processes the Breusch-Pegan test for heteroskedasticity automatically. The result shows that the chi-square value is 36,603.07, which indicates that heteroskedasticity exists. Although heteroskedasticity has the potential to bias the standard errors and test-statistics, it does not bias the regression coefficients. (Astivia & Zumbo, 2019; Kaufman, 2013). There are usually two ways to cope with heteroskedasticity – using robust standard errors, or by doing a weighted least squares regression. The first, and most common, strategy for dealing with the possibility of heteroskedasticity is heteroskedasticity-consistent standard errors (or robust errors and Huber-White (Robust) Sandwich Estimator). After using the robust standard errors and seeing that they did not change the coefficient estimates, and that the p values also did not demonstrate obvious changes, I was able to determine that heteroskedasticity is not something to be concerned with in my analyses.

Weighted Estimation: Non-Parametric Bootstrapping

Statisticians often utilize mathematical methods and computational techniques to test their models, and reduce biases and inaccuracies involved in their sample data and data manipulation processes. The concept of resampling data—more commonly referred to as

bootstrapping—is a statistical technique used to reduce the assumptions required to validate the analyses and assess the accuracy of statistical estimates (Henderson, 2005).

The non-parametric bootstrapping method cleverly relies on resampling with replacement from a given sample, and calculates the required statistics (e.g. standard errors or confidence intervals) from a large number of repeated samples. The idea of the bootstrap is to imitate the process of randomly sampling from an assumed infinite population. We can suppose that we have a dataset containing N observations. We draw, with replacement, N observations from the N observations dataset. In this random drawing, some of the original observations will appear once, some may appear more than once, and some may not appear at all. This process is repeated 100 times in my study, and each time a new random sample is drawn, and the statistics are recalculated. This can be expressed algebraically, as

$$SE(\widehat{\Theta}) = \sqrt{\frac{1}{B-1}\sum_{1}^{B}\left(\widehat{\Theta}_b - \overline{\Theta}\right)^2}$$

$$\overline{\Theta} = \left(\frac{1}{B}\right)\sum_{1}^{B}\widehat{\Theta}_b$$

$\widehat{\Theta}$ denotes the mean of the estimates across the B bootstrap samples. B refers to the specific number of bootstrap replicates to be performed; in this case 100 replications are performed ($\widehat{\Theta}_b$=1, 2, 3, 4, …, 100). $\widehat{\Theta}_b$ is the statistic calculated using the *b* th bootstrap sample. The STATA user book recommends using 50-200 replications for estimates of standard errors, but for producing confidence intervals, a larger number of replications is recommended. Efron and Tibshirani (1986) also discussed how many bootstrap replications researchers should take, and they found that for assessing standard errors, the B bootstrap samples can be as small as 25 to give reasonable results, and there is little improvement when B passes 100. But confidence

interval assessments require a more ambitious measure of statistical accuracy than standard errors, and it is no surprise to see larger bootstrap samples while estimating confidence intervals.

Besides non-parametric bootstrapping, the 2016 Census PUMF provides an individual weighting factor. The weight variable can represent a number of other individuals in the target population of the Census that are not in the PUMF sample. The PUMF sample includes 16 replicate weights because it is divided into sixteen non-independent random groups (or non-overlapping random groups). However, because STATA does not support the random group estimator, I finally chose non-parametric bootstrapping to estimate the variance.

Weighting is an important technique in survey research to make the sample of survey respondents more representative of the statistical population. Weighting factors give an increase or decrease of the importance of an item, and thus making the samples match the population. For bootstrap weights, the mechanism of bootstrapping is simply to use the resampling of the sample data and then to perform new inferences about a population from a series of resampled data. The common aim of performing weights and bootstrapping is to derive better summary statistics and reduce the bias when performing inferential statistics. Given the strengths and weaknesses of the different weighting methods, I elected to run the models five different ways. Table 2 shows the models that I chose to interpret, which apply probability weights for the coefficients but non-parametric bootstrapping weights for the standard errors. Complete results are shown in in Appendix B using bootstrap weights. Appendix C compares four different weighting methods based on only a full model without interactions, including (1) unweighted; (2) weighted but only adding PWEIGHT (indicating probability or sampling weights); (3) using bootstrap weights (identical to model 3 in Appendix C); and (4) PWEIGHT for coefficients and bootstrapping for standard errors (identical to model 3 in Table 2). The coefficients are not changed by using

different weights, and the only observed differences between weighting methods are found in the standard errors.

RESULTS

Descriptive Statistics

Table 1 provides summary statistics for all variables used in the analyses. Among the sample, the proportion of immigrants who are educated within Canada and outside of Canada are almost half-and-half. The number of domestically educated immigrants is slightly larger than foreign educated immigrants, being 31,168 versus 30,862 respectively. Consistent with past research, the descriptive statistics demonstrated that a statistically significant wage gap exists between domestically educated and foreign-educated immigrants at the $p<0.001$ level. Specifically, Canadian degree-holders earned an average annual wage of $58,298 CAD in 2016, whereas foreign-educated immigrants earned an average of $52,069 CAD.

Table 1. Weighted Descriptive Statistics by Canadian and Foreign credential (2016 Census)

	Canadian degree	95% Confidence Interval	Foreign credential	95% Confidence Interval
Annual Individual Wages	$58,298.20***	57468.30, 59128.10	$52,069.40	51314.00, 52824.90
Visible minority	67.5 %***	67.0, 68.0	71.4 %	70.9, 71.9
Single (never married)	24.7%***	24.2, 25.2	7.7%	7.4, 8.0
Legally married	58.6%***	58.0, 59.1	80.3 %	79.9, 80.8
Common law	8.0%***	7.7, 8.3	4.8%	4.6, 5.0
Separated	2.3%***	2.2, 2.5	1.8%	1.7, 2.0
Divorced	5.5%***	5.2, 5.7	4.0%	3.8, 4.2
Widowed	0.9%***	0.8, 1.0	1.3%	1.2, 1.4
Age at Immigration	17.3***	17.2, 17.4	32.4	32.3, 32.5
Age in completed years	43.4***	43.3, 43.6	47.0	46.9, 47.2
Male	48.9%***	48.3, 49.4	51.1%	50.5, 51.6
Home language (English or French)	62.7%***	62.2, 63.2	37.6%	37.0, 38.1
Employed	84.8%*	84.5, 85.2	85.5%	85.1, 85.9
Unemployed	4.3%	4.0, 4.5	4.2%	4.0, 4.4
Not in the labour force	10.9%*	10.5, 11.2	10.3%	10.0, 10.6
Highest level of education				
Below Bachelor's level	52.7%***	52.1, 53.3	30.6%	30.0, 31.1
Bachelor's degree	30.4 %***	29.9, 31.0	43.0%	42.4, 43.5
University certificate or diploma above bachelor level	2.9%***	2.7, 3.1	4.8%	4.5, 5.0
Degree in medicine, dentistry, veterinary medicine or optometry	0.8%***	0.7, 0.9	1.8 %	1.7, 2.0
Master's degree	11.0%***	10.6, 11.3	17.1 %	16.7, 17.5
Earned doctorate	2.1% ***	2.0, 2.3	2.8%	2.6, 2.9
Major field of study				
Science and technology	5.4 %***	5.2, 5.7	6.9%	6.6, 7.2
Engineering	11.3%***	10.9, 11.6	18.6%	18.2, 19.1
Mathematics and computer and information science	6.8%***	6.5, 7.1	7.3% 23.4%	7.4, 7.9
Business and administration	25.4%***	24.9, 25.9	9.1 %	23.3, 24.4
Arts and humanities	6.5%***	6.2, 6.8	8.0 %	8.8, 9.4
Social and behavioural sciences	10.3 %***	10.0, 10.7	1.2%	7.7, 8.3
Legal professions and studies	1.5 %*	1.3, 1.6	11.0 %	1.1, 1.3
Health care	14.3%***	13.9, 14.6	4.5 %	10.7, 11.4
Education and teaching	3.6 %***	3.4, 3.8	9.2%	4.3, 4.7
Trades, services, natural resources and conservation	15.0 %***	14.6, 15.3		8.9, 9.5
N=	31,168		30,862	

Unweighted point estimates and confidence intervals, unweighted t-tests
* p<.05, ** p<.01, *** p<.001

Overall, 67.5 % of Canadian degree holders belonged to a visible minority group compared to 71.4% of immigrants who possessed a foreign degree. In terms of marital status, there are statistically significant ($p<0.001$) differences between the domestic and foreign educated groups in rates of being single (never married), at 24.7% and 7.7% respectively. Immigrants with foreign credentials are statistically significantly more likely than domestically educated immigrants to be married (80.3% versus 58.6%, respectively). Additionally, the average age that immigrants first obtained "landed immigrant" or "permanent resident" status is also statistically significant at the $p<0.001$ level, with 17 versus 32 years old. Pertaining to the respondent's age in the year of completing the survey, the average age of foreign-educated immigrants was statistically significantly ($p<0.001$) higher than the average age of domestically educated individuals, at 47 versus 43 years old respectively.

Notably, 62.7% of immigrants educated within Canada spoke English or French at home compared to only 37.6% of foreign-educated immigrants. The vast majority of respondents are employed, and there are minimal differences between groups in terms of being unemployed or not in the labour force.

In terms of level of education, for most domestically educated immigrants, their "highest educational degree" is lower than bachelor's level (52.7%), but for foreign-educated immigrants, the largest group (43.0%) possesses a bachelor's degree. Foreign-educated immigrants are statistically significantly ($p<0.001$) more likely than domestically educated immigrants to have a higher level of education, including a master's level (17.1% vs. 11.0%) or doctorate level (2.8% vs. 2.1%).

Notably, there are statistically significant differences (at the $p<.001$ level) between domestic and foreign degree holders' academic discipline. Foreign-educated immigrants are

significantly more likely than domestically educated immigrants to have majored in science, engineering, mathematics and computer information science. The largest gap is in engineering where 18.6% of foreign-educated immigrants major in engineering, compared with 11.3% of Canadian-educated immigrants. Domestically educated immigrants are more likely to study business and administration, social science, healthcare and trades, services and natural resources and conservation fields. Legal studies have the smallest difference in rates of study between Canadian and foreign-trained immigrants, significant at the $p<.05$ level.

Overall, we see that Canadian degree holders have higher earnings but lower levels of education, and are more likely to have degrees in business, social and behavioral science, law, healthcare, and trades, compared with foreign trained immigrants who tend to have majored in STEM fields, the arts and humanities, and education.

OLS Regression Models

Examining Model 1 in Table 2, we can see that education attained outside of Canada predicts lower logged wages, unless the degree was earned in the United States or other locations in the Americas. Immigrants who pursued a degree in the U.S. earned 13.3 % more than domestically educated immigrants, though there were no statistically significant differences between Canadian degree holders and those with degrees from other locations in the Americas. European degree holders experienced 16.5% lower annual wages than those who studied in Canada. The most disadvantaged immigrants in Canada were educated in the countries labelled as "others", who earned 17.1% less income than immigrants with a Canadian degree. [2]

[2] Appendix D includes a crosstab between place of birth and location of education to see which region accounted for the most in the category of "others", and the findings show that countries labelled as "others" mainly include Eastern Africa, Northern Africa, Other Africa, Iran and Other West Central Asia.

Model 2 includes the addition of demographic controls, which increased the R-squared from 0.001 to 0.237. After controlling for demographics, the U.S. is still the only location of education with a positive coefficient among the six regions, earning 14.7% more than immigrants who were educated in Canada. Other Americas, however, shift from non-significance to have statistically significantly lower predicted earnings, whereas the opposite holds true for Eastern Asia, shifting from significance to non-significance.

Moreover, almost all demographics were statistically important predictors of immigrant income, except for visible minority status. Men were predicted to earn 28.1% more than women. An individual's earnings also have a slightly negative relationship with age, where each year older reduces predicted earnings by 0.9%. All marital statuses are significant positive predictors of immigrants' earnings relative to being single. Speaking English or French at home predicts 18.3% higher annual wages than those whose home language is something other than one of the two official languages ($p<0.001$). Labour market status is also a critical predictor of earnings. Findings show that those who are not in the labour force actually earned far less than employed and unemployed immigrants.

Model 3 includes the variables of level of education and major field of study in order to test the hypothesis that immigrant earnings may differ by major, and some disciplines may impose varying credential requirements for entering related fields. We can see that controlling for these variables shifts the coefficient for U.S. education to non-significance, but the coefficient remains positive. All other regions earn statistically significantly less than Canadians, controlling for all of the demographic variables and area of academic study.

We also find that among the ten academic majors, all of the other nine majors demonstrated economic advantages compared to majors in arts and humanities (the omitted

category). The arts and humanities field, which represents the most disadvantaged disciplines within the ten majors, generally earned less than other majors. Engineering, mathematics, and computer information science were the most lucrative majors, with health care in second place. Immigrants majoring in engineering and mathematics are predicted to earn 51.6% and 61.6% more than immigrants studying arts and humanities. Health care is also an economically advantageous field, with 44.5% higher income than arts and humanities studies. Social science, education, and trades, services and natural resource conservation yield relatively lower incomes compared to other academic disciplines.

Finally, in Model 4, I added two-way interactions between academic majors and location of study to examine whether the impact of location of education on immigrant earning is moderated by major field of study. Aiken and West (1991) and Jaccard, Turrisi and Wan (2003) identified that there are a number of difficulties in interpreting interactions, thus three-way interactions are often the limit when considering interaction effects, and higher order interactions are rarely meaningful and hard to interpret. Interactions between continuous variables often involve the centering of variables and the selection of specific values for the moderator variable to make them more interpretable. In this case, majors and location of education are both dummy variables, thus the interpretation of interactions is easier than that of continuous variables. The margins command is a useful tool in understanding and interpreting categorical or continuous interactions, and predictive margins can be generated based on the different values set on the independent variables.

Table 2: OLS Regression Models Predicting Individual's Ln Income (2016 Census)

	(1) LNwage	(2) LNwage	(3) LNwage	(4) LNwage
Location of education				
United States	0.133**	0.147***	0.017	0.154
	(0.052)	(0.047)	(0.047)	(0.123)
Europe	-0.165***	-0.089***	-0.152***	-0.056
	(0.028)	(0.029)	(0.029)	(0.095)
Other America	-0.029	-0.094**	-0.092**	-0.027
	(0.042)	(0.042)	(0.041)	(0.167)
Eastern Asia	-0.060**	-0.010	-0.056*	0.113
	(0.026)	(0.030)	(0.029)	(0.098)
Southeast and Southern Asia	-0.029*	-0.095***	-0.146***	-0.110
	(0.018)	(0.021)	(0.021)	(0.066)
Others	-0.171***	-0.178***	-0.223***	-0.056
	(0.029)	(0.030)	(0.031)	(0.087)
Demographic controls				
Visible minority		0.006	-0.022	-0.026
		(0.017)	(0.017)	(0.018)
Male		0.281***	0.211***	0.208***
		(0.014)	(0.015)	(0.015)
Age		-0.009***	-0.006***	-0.006***
		(0.001)	(0.001)	(0.001)
Age at Immigration		-0.000	-0.002***	-0.002***
		(0.001)	(0.001)	(0.001)
Legally married		0.378***	0.354***	0.355**
		(0.020)	(0.020)	(0.020)
Living common law		0.330***	0.344***	0.346***
		(0.027)	(0.028)	(0.027)
Separated		0.153***	0.182***	0.183***
		(0.049)	(0.049)	(0.049)
Divorced		0.195***	0.208***	0.207***
		(0.034)	(0.033)	(0.033)
Widowed		-0.736***	-0.703***	-0.696***
		(0.122)	(0.124)	(0.124)
Home language (English or French)		0.183***	0.200***	0.200***
		(0.013)	(0.013)	(0.013)
Unemployed		-1.010***	-0.993***	-0.992***
		(0.043)	(0.042)	(0.042)
Not in the labour force		-2.729***	-2.705***	-2.696***
Level of education		(0.041)	(0.041)	(0.041)
Bachelor's degree			0.309***	0.309***
			(0.015)	(0.015)
Degree above bachelor's			0.337***	0.334***
			(0.062)	(0.035)
Medicine			0.380***	0.376***
			(0.266)	(0.064)
Master's			0.410***	0.415***
			(0.021)	(0.022)
Doctorate			0.590***	0.589***
Major field of study [c]			(0.053)	(0.052)
Science and science technology			0.291***	0.294***
			(0.038)	(0.056)
Engineering			0.516***	0.557***
			(0.030)	(0.055)
Mathematics			0.616***	0.725***
			(0.035)	(0.053)

Business and administration	0.371*** (0.029)	0.448*** (0.047)
Social and behavioural sciences	0.167*** (0.035)	0.225*** (0.057)
Legal professions	0.370*** (0.059)	0.682*** (0.086)
Health care	0.445*** (0.035)	0.489*** (0.053)
Education and teaching	0.178*** (0.043)	0.226*** (0.067)
Trades and services	0.286*** (0.035)	0.318*** (0.052)
Interactions		
Science * U.S.		-0.157 (0.251)
Science * Europe		0.072 (0.131)
Science * Other America		0.213 (0.212)
Science * Eastern Asia		0.109 (0.155)
Science * Southeast and Southern Asia		0.024 (0.083)
Science * Others		-0.203 (0.132)
Engineering * U.S.		-0.315 (0.189)
Engineering * Europe		-0.102 (0.114)
Engineering * Other America		0.002 (0.177)
Engineering * Eastern Asia		-0.163 (0.113)
Engineering * Southeast and Southern Asia		0.065 (0.081)
Engineering * Others		-0.189 (0.114)
Mathematics * U.S.		-0.299 (0.175)
Mathematics * Europe		-0.006 (0.112)
Mathematics * Other America		0.042 (0.204)
Mathematics * Eastern Asia		-0.200 (0.124)
Mathematics * Southeast and Southern Asia		-0.338*** (0.082)
Mathematics * Others		-0.107 (0.119)
Business * U.S.		0.072 (0.147)
Business * Europe		-0.096 (0.108)
Business * Other America		-0.154 (0.166)
Business * Eastern Asia		-0.311*** (0.104)
Business * Southeast and		-0.094

Southern Asia	(0.069)
Business * Others	-0.259
	(0.111)
Social Sciences * U.S.	-0.313
	(0.181)
Social Sciences * Europe	-0.107
	(0.111)
Social Sciences * Other America	-0.068
	(0.190)
Social Sciences * Eastern Asia	-0.107
	(0.143)
Social Sciences * Southeast and Southern Asia	-0.030
	(0.096)
Social Sciences * Others	-0.125
	(0.144)
Legal studies * U.S.	-0.156
	(0.277)
Legal studies * Europe	-0.996*
	(0.236)
Legal studies * Other America	-0.520
	(0.371)
Legal studies * Eastern Asia	-0.809
	(0.390)
Legal studies * Southeast and Southern Asia	-0.359
	(0.171)
Legal studies * Others	-0.678***
	(0.213)
Health care * U.S.	-0.126
	(0.186)
Health care * Europe	-0.090
	(0.132)
Health care * Other America	0.010
	(0.188)
Health care * Eastern Asia	-0.299**
	(0.150)
Health care * Southeast and Southern Asia	0.021
	(0.075)
Health care * Others	-0.136
	(0.114)
Education * U.S.	-0.468
	(0.243)
Education * Europe	0.073
	(0.136)
Education * Other America	-0.011
	(0.233)
Education * Eastern Asia	-0.077
	(0.171)
Education * Southeast and Southern Asia	-0.050
	(0.102)
Education *Others	-0.119
	(0.123)
Trades * U.S.	-0.026
	(0.186)
Trades * Europe	-0.174
	(0.115)
Trades * Other America	-0.093
	(0.191)

Trades * Eastern Asia				-0.019
				(0.124)
Trades * Southeast and Southern Asia				0.214***
				(0.079)
Trades * Others				0.067
				(0.134)
Constant	10.242***	10.453***	9.917***	9.867***
	(0.011)	(0.035)	(0.045)	(0.056)
Obs.	62030	62030	62030	62030
R-squared	0.001	0.237	0.251	0.253

Standard errors are in parenthesis

**** p<0.01, ** p<0.05, * p<0.1*

a. Probability weights (pweight) for coefficients and non-parametric bootstrapping for standard errors

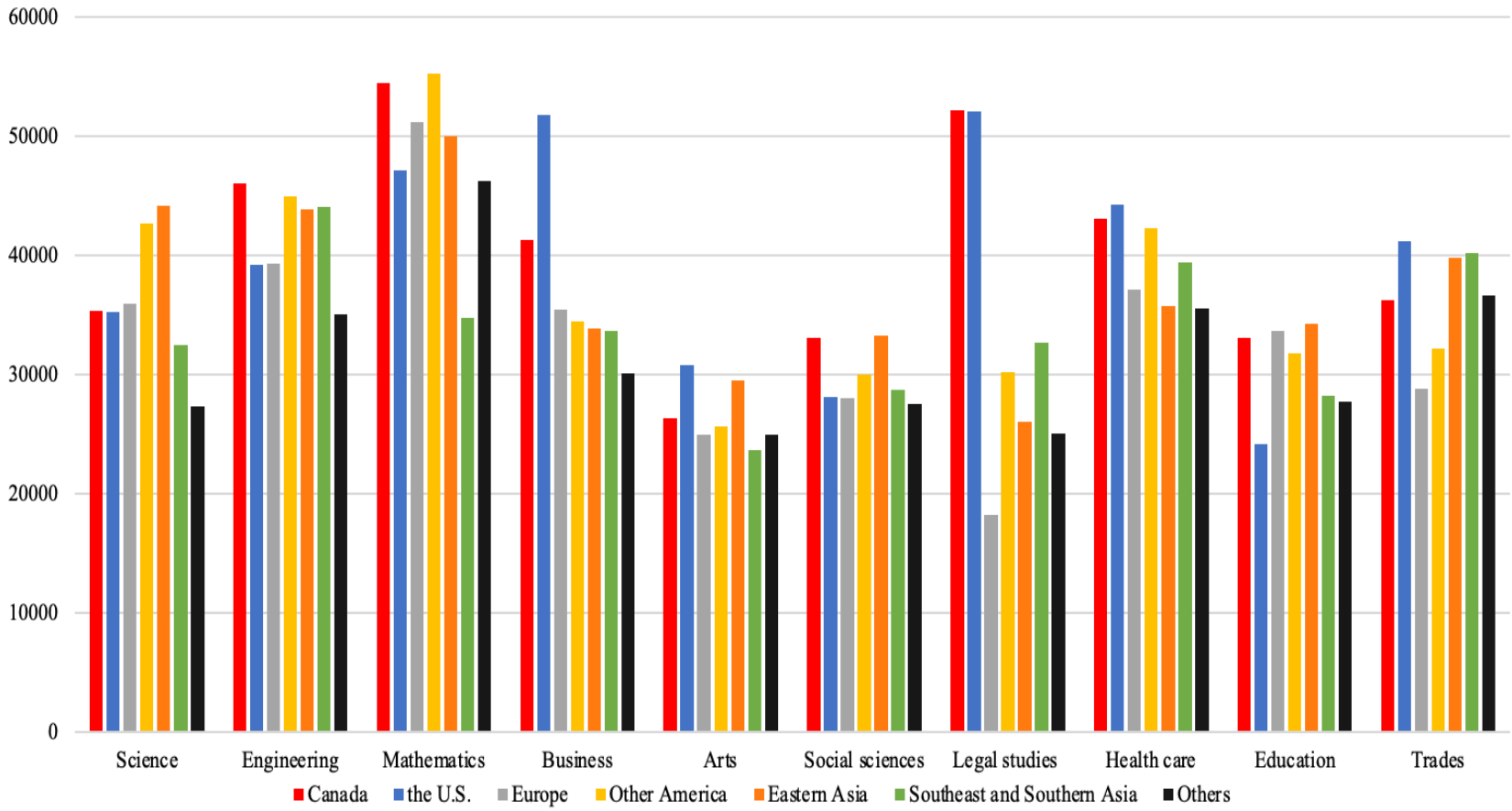
b. Table 2 is the same as Appendix B because coefficients are not changed after rounding decimals.

c. Omitted category is arts and humanities

In model 4, we can see that the R-squared increases by 0.2% compared to model 3, and the variables indicating location of education change to non-significant. Several interaction terms demonstrate statistical significance. The coefficient associated with the first product term, where majoring in science is multiplied by a U.S. educational degree, is used as an example to interpret interaction effects. If science=1 and U.S.=1, the coefficient is -0.157, and then it is necessary to include the coefficients associated with the main effects to calculate the predicted value. In this case, the coefficient for the main effect of studying in the U.S. is 0.154, and majoring in science is 0.294, therefore the overall value is 0.154+0.294-0.157=0.291. Because the reference group is immigrants who major in arts and humanities with a Canadian degree, we can infer that immigrants majoring in science with a US degree earn 0.291(logged wage) more than the reference group. We can calculate all product terms using the same methods, but the margins function in the statistical software can help us calculate in a faster and more accurate way.

Based on Model 4, I used the margins command in STATA to predict various interactions of field of study and location of education. I set the control variables to predict wages for a hypothetical respondent who is a racial minority, female, 43 years of age, legally married, whose home language is a non-official language, with an immigration age of legible 25 years, who holds a bachelor's degree and is currently employed. Because the marginsplot function in STATA can only generate line plots, I used Excel to create side-by-side bar graphs to make the figure more legible. I used margins to predict the values of logged income and converted the natural logarithmic form values to normal values to visualize the data in a meaningful metric: Canadian Dollars.

Figure 1: Predicted Immigrant Wage based on Model 4 in Table 2



In Figure 1, we can see where the location of education has influenced immigrant income by academic discipline. Across the ten academic disciplines, we find that immigrants majoring in arts and social sciences generally earn less than other majors, and the earning differences between the location of education are also not remarkable in the two fields. Education and trades majors also have the similar characteristics of lower earning and less obvious earning disparities, but the overall wage levels of the two fields are slightly higher than arts and social sciences.

In this figure, the red bar represents a Canadian degree, and it is observable that in the fields of engineering, mathematics, social sciences, law, and health care, immigrants with domestic degrees generally earn more than immigrants with foreign educational degrees. Notably, immigrants with American degrees sometimes demonstrate the same, and even more competitive earning advantages in the fields of business administration, arts, legal professions, heath care, and trades and services. In the business fields, the predicted earnings of US degree holders exceed domestically educated immigrants, and a similar situation also occurs in the arts, health care and trades disciplines. The legal field is the most apparent category where foreign educational degrees are devalued, but Canadian and US degrees maintain almost the same economic advantages. The bar chart is generated based on the default that the immigrant's native language is neither English nor French. If we account for the positive measure of native-English speakers for immigrants from the U.S., the earning advantages will be higher than the current level.

Occasionally, educational credentials outside of North America also display economic advantages, for example, in science fields, immigrants with educational degrees from other America and Eastern Asia can earn even more than domestically educated immigrants; and in the

math fields, Other America degree holders also display competitive economic advantages. However, for the most part, foreign credentials may cause economically disadvantaged immigrant earnings; for instance, immigrants who were educated in Southeast and Southern Asia and countries labelled "Others" are almost always represented by lower wages in science and mathematics fields. Generally, possessing a North American educational credential can yield more economic advantage, particularly in the fields with higher credential requirements such as legal studies and business.

DISCUSSION

In this study, I explore wage disparities between domestically and foreign-educated immigrants, and also examine the impact of academic discipline on immigrant earnings across ten academic disciplines. Past studies reveal that foreign credentials can damage immigrant earning potential in the Canadian labour force, however, in this study, I find that immigrants educated in the United States are at least as competitive in the Canadian job market as those educated domestically. In some disciplines, a U.S. degree can even exceed the earnings of Canadian degree holders. Educational credentials outside of North America are more likely to pose economic disadvantages on immigrant earnings, but the magnitude of this disparity may depend on their major field of study.

My second hypothesis is that the impact of the location of educational degree on immigrant earnings may differ by major. This study finds that arts and social sciences are generally the fields with the lowest wages. We can see that if immigrants major in arts and social science, where the general wages are lower than other academic disciplines, the wage gap resulting from the location of educational attainment is not remarkable. Similar patterns also exit in the fields of education and trades, where a Canadian or American degree does not yield an

absolute earning advantage. However, the most remarkable earning advantage exists in the fields of law and business. In the legal discipline, the predicted wages of North American degree holders are more than $50,000 per year, but foreign degree holders in law may earn less than $30,000. In the business fields, U.S. education attainment also displays a remarkable wage advantage over degrees in other countries, including Canada. In the highest-paying disciplines such as engineering and mathematics, immigrants with Canadian degrees occupy competitive economic positions, but degrees from Europe, "Other America" and Asia seem to not lag too far behind. Although there is no consistency regarding which region's education is valued the least and thereby yields the lowest wages across the ten majors, we can see that across most disciplines, immigrants with North American degrees can earn more than those with degrees from other regions.

To explain the phenomena observed in my study, I can refer back to Weber's 'social closure' and Tilly's 'opportunity hoarding' theories from previous sections. These ideologies can be used to explain the devolution of foreign credentials, along with higher credential requirements for certain academic disciplines. Social closure often happens in cases of educational segregation, occupational licensing, high-paying professional jobs opportunities, and social discrimination based on race, gender, and sexual orientation. When immigrants carry on their foreign educational credentials, the original groups in the host country's labour force may draw boundaries and exclude outsiders to ensure the intrinsic benefits of their groups, and to maintain the bar and quality of their professions. Collins' credentialism and Marginson's theory of global stratification in higher education discuss educational inflation and the "monopolization" of top-ranking universities in developed worlds. As Canada is a high-income developed country with a thorough education system and pervasive higher education attainment,

most native Canadians can access public education and high-ranking schools within their country. However, because the majority of immigrants in Canada are from developing regions such as Asia and Africa, their educational attainment within their home country may not be recognized and be devalued when they carry them and enter the Canadian labour market. As economy is often inextricably linked with education investment in a country, an educational credential is an indicator of a country's economy, and also indicates the reputations of teaching and research quality of these educational institutions. For immigrants who have a North American educational degree, they are more likely to have the applicable credentials and capabilities set by the social groups in the host country. However, for those who never had a chance to receive education in North America, they may be excluded and encounter more obstacles to enter certain professional fields in the Canadian job market.

Limitations

The study uses the PUMF of the 2016 Census, but the RDC contains 100% of the long-form respondents for the 2016 Census. The microdata at RDC provides a more detailed database for researchers, but because the Covid-19 pandemic prolongs the application time of accessing the data, the use of public files is more approachable for me to satisfy the graduation requirements of my master's degree. Given that the data were a random sample of the census, despite the smaller size, with the weighted analyses we can be confident that the results are representative of the Canadian population.

Moreover, because wage is often regarded as right skewed, I use the logarithm of wage as the dependent variable to make the distribution much more like a normal distribution, rather than a right skewed distribution. However, I found that the un-logged form makes the predicted immigrant income higher than the logged form, and the wage level of the un-logged form seems

also to be closer to the earning realities in the Canadian labour force. In this study, I follow the common method to log transform the dependent variable, but in a future study, more detailed and advanced model tests may be needed.

Finally, the 2016 PUMF provides limited information regarding if the respondents work in the compatible industries with their major fields of study. Immigrants with a law degree may work in unrelated industries, which results in the lower wage. This can further reveal the high credential requirements among certain academic disciplines. The education-job match rates between domestically educated immigrants and foreign-educated immigrants could be another research topic to investigate in the future research.

CONCLUSION

This study examines the hypotheses: (1) whether the location of education has an impact on immigrant earnings; and (2) whether the impact of location of educational degree attainment on immigrant earnings in Canada differ by academic discipline. My findings show that immigrants with North American degrees find competitive advantage in the job market for most cases. Particularly in the fields of business and law, the economic advantages of Canadian or American degrees are more significant. Arts and social sciences are two fields generally with lowest earnings, and the wage gap brought by the location of educational attainment is minimal. Immigrants with foreign educational credentials are not bound to be economically disadvantaged in all disciplines, however, under the context of credentialism and opportunity hoarding, immigrants with highly recognized educational degrees may be more capable of adaptively integrating into the Canadian labour force, and flourishing in the industries compatible with their educational background.

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Appendix A. Missing Data among respondents who were permanent immigrants

	Dropped	N
Starting N		202,320
Age at Immigration	3,253	199,067
Wages	89,160	109,907
Visible Minority	7,803	102,104
Highest certificate, diploma or degree	1,356	100,748
Age	849	99,899
Location of education	33,083	66,816
Knowledge of official language	104	66,712
Major	2,448	64,264
Labour force status	2234	62,030
Final Total N		62,030

Appendix B. Non-parametric Bootstrapping Models for both Coefficients and Standard Errors (Replications:100)

	(1) LNwage	(2) LNwage	(3) LNwage	(4) LNwage
Location of education				
United States	0.133**	0.147***	0.017	0.154
	(0.052)	(0.047)	(0.047)	(0.123)
Europe	-0.165***	-0.089***	-0.152***	-0.056
	(0.028)	(0.029)	(0.029)	(0.095)
Other America	-0.029	-0.094**	-0.092**	-0.027
	(0.042)	(0.042)	(0.041)	(0.167)
Eastern Asia	-0.060**	-0.010	-0.056*	0.113
	(0.026)	(0.030)	(0.029)	(0.098)
Southeast and Southern Asia	-0.029*	-0.095***	-0.146***	-0.110
	(0.018)	(0.021)	(0.021)	(0.066)
Others	-0.171***	-0.178***	-0.223***	-0.056
	(0.029)	(0.030)	(0.031)	(0.087)
Demographic controls				
Visible minority		0.006	-0.022	-0.026
		(0.017)	(0.017)	(0.018)
Male		0.281***	0.211***	0.208***
		(0.014)	(0.015)	(0.015)
Age		-0.009***	-0.006***	-0.006***
		(0.001)	(0.001)	(0.001)
Age at Immigration		-0.000	-0.002***	-0.002***
		(0.001)	(0.001)	(0.001)
Legally married		0.378***	0.354***	0.355**
		(0.020)	(0.020)	(0.020)
Living common law		0.330***	0.344***	0.346***
		(0.027)	(0.028)	(0.027)
Separated		0.153***	0.182***	0.183***
		(0.049)	(0.049)	(0.049)
Divorced		0.195***	0.208***	0.207***
		(0.034)	(0.033)	(0.033)
Widowed		-0.736***	-0.703***	-0.696***
		(0.122)	(0.124)	(0.124)
Home language (English or		0.183***	0.200***	0.200***
French)		(0.013)	(0.013)	(0.013)
Unemployed		-1.010***	-0.993***	-0.992***
		(0.043)	(0.042)	(0.042)
Not in the labour force		-2.729***	-2.705***	-2.696***
Level of education		(0.041)	(0.041)	(0.041)
Bachelor's degree			0.309***	0.309***
			(0.015)	(0.015)
Degree above bachelor's			0.337***	0.334***
			(0.062)	(0.035)
Medicine			0.380***	0.376***
			(0.266)	(0.064)
Master's			0.410***	0.415***
			(0.021)	(0.022)
Doctorate			0.590***	0.589***
Major field of study [a]			(0.053)	(0.052)
Science and science			0.291***	0.294***
technology			(0.038)	(0.056)
Engineering			0.516***	0.557***

	(0.030)	(0.055)
Mathematics	0.616***	0.725***
	(0.035)	(0.053)
Business and administration	0.371***	0.448***
	(0.029)	(0.047)
Social and behavioural sciences	0.167***	0.225***
	(0.035)	(0.057)
Legal professions	0.370***	0.682***
	(0.059)	(0.086)
Health care	0.445***	0.489***
	(0.035)	(0.053)
Education and teaching	0.178***	0.226***
	(0.043)	(0.067)
Trades and services	0.286***	0.318***
Interactions	(0.035)	(0.052)
Science * U.S.		-0.157
		(0.251)
Science * Europe		0.072
		(0.131)
Science * Other America		0.213
		(0.212)
Science * Eastern Asia		0.109
		(0.155)
Science * Southeast and Southern Asia		0.024
		(0.083)
Science * Others		-0.203
		(0.132)
Engineering * U.S.		-0.315
		(0.189)
Engineering * Europe		-0.102
		(0.114)
Engineering * Other America		0.002
		(0.177)
Engineering * Eastern Asia		-0.163
		(0.113)
Engineering * Southeast and Southern Asia		0.065
		(0.081)
Engineering * Others		-0.189
		(0.114)
Mathematics * U.S.		-0.299
		(0.175)
Mathematics * Europe		-0.006
		(0.112)
Mathematics * Other America		0.042
		(0.204)
Mathematics * Eastern Asia		-0.200
		(0.124)
Mathematics * Southeast and Southern Asia		-0.338***
		(0.082)
Mathematics * Others		-0.107
		(0.119)
Business * U.S.		0.072
		(0.147)
Business * Europe		-0.096
		(0.108)
Business * Other America		-0.154
		(0.166)

Business * Eastern Asia	-0.311***
	(0.104)
Business * Southeast and Southern Asia	-0.094
	(0.069)
Business * Others	-0.259
	(0.111)
Social Sciences * U.S.	-0.313
	(0.181)
Social Sciences * Europe	-0.107
	(0.111)
Social Sciences * Other America	-0.068
	(0.190)
Social Sciences * Eastern Asia	-0.107
	(0.143)
Social Sciences * Southeast and Southern Asia	-0.030
	(0.096)
Social Sciences * Others	-0.125
	(0.144)
Legal studies * U.S.	-0.156
	(0.277)
Legal studies * Europe	-0.996*
	(0.236)
Legal studies * Other America	-0.520
	(0.371)
Legal studies * Eastern Asia	-0.809
	(0.390)
Legal studies * Southeast and Southern Asia	-0.359
	(0.171)
Legal studies * Others	-0.678***
	(0.213)
Health care * U.S.	-0.126
	(0.186)
Health care * Europe	-0.090
	(0.132)
Health care * Other America	0.010
	(0.188)
Health care * Eastern Asia	-0.299**
	(0.150)
Health care * Southeast and Southern Asia	0.021
	(0.075)
Health care * Others	-0.136
	(0.114)
Education * U.S.	-0.468
	(0.243)
Education * Europe	0.073
	(0.136)
Education * Other America	-0.011
	(0.233)
Education * Eastern Asia	-0.077
	(0.171)
Education * Southeast and Southern Asia	-0.050
	(0.102)
Education *Others	-0.119
	(0.123)
Trades * U.S.	-0.026
	(0.186)

Trades * Europe				-0.174
				(0.115)
Trades * Other America				-0.093
				(0.191)
Trades * Eastern Asia				-0.019
				(0.124)
Trades * Southeast and Southern Asia				0.214***
				(0.079)
Trades * Others				0.067
				(0.134)
Constant	10.242***	10.453***	9.917***	9.867***
	(0.011)	(0.035)	(0.045)	(0.056)
Obs.	62030	62030	62030	62030
R-squared	0.001	0.237	0.251	0.253

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

a. omitted category is arts and humanities

Appendix C. Comparison of Weighting Methods Based on Model 3

	(1) Unweighted	(2) PWEIGHT	(4) Bootstrapping	(5) Table 2
Location of education				
United States	0.017	0.017	0.017	0.017
	(0.040)	(0.045)	(0.047)	(0.047)
Europe	-0.152***	-0.152***	-0.152***	-0.152***
	(0.026)	(0.030)	(0.029)	(0.029)
Other America	-0.092**	-0.092**	-0.092**	-0.092**
	(0.039)	(0.039)	(0.041)	(0.041)
Eastern Asia	-0.056*	-0.056*	-0.056*	-0.056*
	(0.032)	(0.029)	(0.029)	(0.029)
Southeast and Southern	-0.146***	-0.146***	-0.146***	-0.146***
Asia	(0.022)	(0.020)	(0.021)	(0.021)
Others	-0.223***	-0.223***	-0.223***	-0.223***
	(0.030)	(0.031)	(0.031)	(0.031)
Demographic controls				
Visible minority	-0.022	-0.022	-0.022	-0.022
	(0.018)	(0.019)	(0.017)	(0.017)
Female	0.211***	0.211***	0.211***	0.211***
	(0.015)	(0.015)	(0.015)	(0.015)
Age	-0.006***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)
Age at Immigration	-0.002***	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Legally married	0.354***	0.354***	0.354***	0.354***
	(0.020)	(0.019)	(0.020)	(0.020)
Living common law	0.344***	0.344***	0.344***	0.344***
	(0.032)	(0.029)	(0.028)	(0.028)
Separated	0.182***	0.182***	0.182***	0.182***
	(0.049)	(0.052)	(0.049)	(0.049)
Divorced	0.208***	0.208***	0.208***	0.208***
	(0.036)	(0.040)	(0.033)	(0.033)
Widowed	-0.703***	-0.703***	-0.703***	-0.703***
	(0.068)	(0.114)	(0.124)	(0.124)
Home language (English	0.200***	0.200***	0.200***	0.200***
or French)	(0.015)	(0.015)	(0.013)	(0.013)
Unemployed	-0.993***	-0.993***	-0.993***	-0.993***
	(0.033)	(0.041)	(0.042)	(0.042)
Not in the labour force	-2.705***	-2.705***	-2.705***	-2.705***
	(0.022)	(0.041)	(0.041)	(0.041)
Level of education				
Bachelor's degree	0.309***	0.309***	0.309***	0.309***
	(0.017)	(0.016)	(0.015)	(0.015)
Degree above bachelor's	0.337***	0.337***	0.337***	0.337***
	(0.036)	(0.036)	(0.034)	(0.034)
Medicine	0.380***	0.380***	0.380***	0.380***
	(0.061)	(0.061)	(0.062)	(0.062)
Master's	0.410***	0.410***	0.410***	0.410***
	(0.022)	(0.022)	(0.021)	(0.021)
Doctorate	0.590***	0.590***	0.590***	0.590***
Major field of study [a]	(0.046)	(0.051)	(0.053)	(0.053)
Science and science	0.291***	0.291***	0.291***	0.291***
technology	(0.036)	(0.038)	(0.038)	(0.038)
Engineering	0.516***	0.516***	0.516***	0.516***
	(0.030)	(0.032)	(0.030)	(0.030)

Mathematics	0.616***	0.616***	0.616***	0.616***
	(0.035)	(0.033)	(0.035)	(0.035)
Business and	0.371***	0.371***	0.371***	0.371***
administration	(0.027)	(0.029)	(0.029)	(0.029)
Social and behavioural	0.167***	0.167***	0.167***	0.167***
sciences	(0.032)	(0.034)	(0.035)	(0.035)
Legal professions	0.370***	0.370***	0.370***	0.370***
	(0.062)	(0.065)	(0.059)	(0.059)
Health care	0.445***	0.445***	0.445***	0.445***
	(0.031)	(0.032)	(0.035)	(0.035)
Education and teaching	0.178***	0.178***	0.178***	0.178***
	(0.041)	(0.041)	(0.043)	(0.043)
Trades and services	0.286***	0.286***	0.286***	0.286***
	(0.032)	(0.035)	(0.035)	(0.035)
Constant	9.917***	9.917***	9.917***	9.917***
	(0.042)	(0.047)	(0.045)	(0.045)
Obs.	62030	62030	62030	62030
Adj. R-squared	0.250	0.250	0.250	0.250

a. Omitted category is arts and humanities

Appendix D: Tabulation of Place of Birth and the Location of Education (dummy variable)

Place of birth of person	RECODE of LOCSTUD (Education: Location of study)		
	Canada	foreign	Total
Canada	2	0	2
	0.01	**0.00**	**0.00**
United States	1101	849	1950
	3.53	**2.75**	3.14
Central America	626	420	1046
	2.01	**1.36**	**1.69**
Jamaica	1072	225	1297
	3.44	**0.73**	**2.09**
Other Caribbean and Bermuda	1710	491	2201
	5.49	**1.59**	**3.55**
South America	1589	1153	2742
	5.10	**3.74**	**4.42**
United Kingdom	2393	1649	4042
	7.68	**5.34**	**6.52**
Germany	448	319	767
	1.44	**1.03**	**1.24**
France	505	737	1242
	1.62	**2.39**	**2.00**
Other Northern and Western Europe	695	452	1147
	2.23	**1.46**	**1.85**
Poland	676	612	1288
	2.17	**1.98**	**2.08**
Other Eastern Europe	1311	2058	3369
	4.21	**6.67**	**5.43**
Italy	720	105	825
	2.31	**0.34**	**1.33**
Portugal	409	43	452
	1.31	**0.14**	**0.73**
Other Southern Europe	596	346	942
	1.91	**1.12**	**1.52**
Eastern Africa	937	499	1436
	3.01	**1.62**	**2.32**
Northern Africa	1139	1243	2382
	3.65	**4.03**	**3.84**
Other Africa	1102	976	2078
	3.54	**3.16**	**3.35**
Iran	640	686	1326
	2.05	**2.22**	**2.14**
Other West Central Asia and the Middle East	1513	1209	2722
	4.85	**3.92**	**4.39**
China	2564	2976	5540
	8.23	**9.64**	**8.93**
Hong Kong	1754	476	2230
	5.63	**1.54**	**3.60**
South Korea	479	514	993
	1.54	**1.67**	**1.60**
Other Eastern Asia	476	383	859
	1.53	**1.24**	**1.38**
Philippines	1974	5470	7444
	6.33	**17.72**	**12.00**
Viet Nam	738	118	856
	2.37	**0.38**	**1.38**

Other Southeast Asia	492	261	753
	1.58	**0.85**	**1.21**
India	1894	4461	6355
	6.08	**14.45**	**10.25**
Pakistan	646	1089	1735
	2.07	**3.53**	**2.80**
Sri Lanka	566	383	949
	1.82	**1.24**	**1.53**
Other Southern Asia	200	461	661
	0.64	**1.49**	**1.07**
Oceania and others	201	198	399
	0.64	**0.64**	**0.64**
Total	31168	30862	62030
	100.00	100.00	100.00

First row has *frequencies* and second row has *column percentages*