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**HIGHLY EDUCATED IMMIGRANTS**  
Economic Contributions and Implications  
for Public Policy

Steven Globerman



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Fraser Institute

# Highly Educated Immigrants

Economic Contributions and  
Implications for Public Policy

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# Executive Summary

Immigration is a contentious public policy issue. Most contention, however, is about immigration by individuals with relatively limited education and there is much less skepticism about the economic benefits of highly educated immigrants to the native born. Critics of immigration argue that immigrants with little education will compete for jobs with relatively unskilled native-born and drive down their wages; and that they are more likely to draw heavily on public services such as health care while paying little or no taxes. While highly educated immigrants can also compete for jobs with similarly skilled native-born, they are believed to create job opportunities by starting new businesses and promoting trade and investment linkages to their home countries. As high-income earners, they are thought more likely to have a positive net fiscal impact on the host country by paying more in taxes than they receive in government services.

In fact, relatively little is known about the specific effects of highly educated immigrants on the host economy compared to the effects of immigration more generally. The purpose of this study is to set out the main theoretical linkages between immigration by highly educated individuals and the economic welfare of the native born, both more or less well educated. The study also presents and evaluates a wide range of studies providing empirical evidence on the theoretical linkages identified.

There are both direct and indirect linkages between immigration by highly educated individuals and the economic welfare of the native-born. Most of the theoretical linkages point to a positive impact; however, the potential for direct substitution of the skills of highly educated immigrants for the skills of similarly educated native-born raises the prospect that even highly educated immigrants may have mixed effects on the host economy. This concern is magnified to the extent that highly educated immigrants cluster in a few cities, giving rise to diseconomies of scale—disadvantages of very large cities like traffic congestion—that harm the productivity of native-born workers in those cities.

The empirical evidence bearing upon the main linkages of interest is not conclusive as there are a relatively small number of empirical studies, particularly for Canada. However, it points to a conclusion that the main benefits from highly educated immigrants on the native-born are associated with increased innovation and entrepreneurship in the host country. The benefits from increased innovation and entrepreneurship, in turn, arguably reflect in a disproportionate manner, the activities of the upper tier of highly educated immigrants. These tend to be individuals with graduate-school degrees in science, technology, engineering, and math (STEM) disciplines. Unfortunately, while Canada is relatively successful in attracting college-educated immigrants compared to other developed countries, it does not seem to do as well as the United States in attracting the most productive STEM-trained highly educated immigrants.

The pressing issue for Canadian policymakers might therefore be not how to encourage increased numbers of highly educated immigrants but how to improve the

economic benefits that Canadians receive from highly educated immigrants. It may be possible to achieve that goal by giving greater weight in the immigrant-selection process to the quality of the educational institution in which an applicant received his or her graduate training, as well as to graduate training in a STEM-related discipline. However, making immigration to Canada easier for upper-tier STEM degree holders does not ensure that those upper-tier candidates will choose Canada as a host country and the fact that Canada loses so many of its domestically educated systems engineers and computer scientists through emigration to the United States suggests that the higher expected net incomes there make Canada a less attractive destination for STEM stars. For this reason, improved success in attracting the most productive highly educated immigrants might require changes in policies not directly related to immigration, including reductions in the highest marginal income-tax rates and pruning regulatory red tape, which would make it more profitable for highly educated immigrants to establish and grow new enterprises. Such policies would also encourage highly educated native-born to remain in Canada and contribute to innovation and entrepreneurship in their home country.

# 1. Introduction

It is almost a cliché to say that developed economies are “knowledge economies”. Both empirical and anecdotal evidence highlight the growing importance of an educated workforce to the economic well-being of advanced economies. In principle, educated workers are needed both to develop new technologies and to make use of new technologies effectively in production activities, although empirical evidence is mixed on the precise contribution that human capital makes to economic growth (Hulten, 2017).

The stock of skilled workers in an economy can obviously be increased by encouraging more individuals to invest in education, as well as by improving the “quality” of the education provided.<sup>1</sup> It can also be increased by “importing” educated workers through the immigration process. While there is a relatively large literature on the economic effects of total immigration on host economies, substantially less research has been done on the economic consequences for the host country of immigration by highly educated individuals (Peri, 2016). It might seem obvious that highly educated immigrants bring economic benefits to the receiving country.<sup>2</sup> However, economic models of labour markets highlight the potential for educated immigrants to reduce the supply and economic contributions of educated native born, so that the net economic impact of educated immigrants on the native born is at least uncertain in both its magnitude and direction.<sup>3</sup> Furthermore, the economic contribution of highly educated immigrants will be conditioned by factors such as regulations affecting whether and how those immigrants can use their human capital in the host economy, the ease or difficulty immigrants face in starting new businesses, as well as the “absorptive capacity” of the host economy.<sup>4</sup>

In short, the contribution of educated immigrants to the host economy is a potentially complex phenomenon that is influenced by a host of factors related to features of the host economy, as well as by government policies. Furthermore, to the extent that educated immigrants make important net positive contributions to economic growth in receiving countries, competition among developed economies for such individuals can

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1. It is worth pointing out explicitly that throughout this report, we use the terms “educated worker” and “skilled worker” as synonyms. While this is standard in the relevant literature, some researchers argue that skills can differ even among workers with the same level of education. We shall say more about this distinction in sections 2 and 4 of this report.

2. Indeed, Borjas (2016) notes that virtually everyone favours more high-skill immigration, at the same time as there is confusion about why one should be in favour of it.

3. In evaluating the economic impact of immigration, the usual framework is the economic welfare of the native born. For a discussion of the potential substitutability between immigrant and native-born educated workers, as well as some empirical evidence on the nature and degree of substitutability, see Borjas and Doran, 2015.

4. “Absorptive capacity” in this context refers to the capability of the host economy to use innovations developed by educated immigrants.

be expected. This raises the issues of what criteria educated immigrants use in choosing their “target” countries given existing immigration laws, and what government policies can make their countries more attractive to highly skilled immigrants.

This report sets out an economic framework for evaluating the consequences of increased immigration by educated individuals to the host economy and considers the relevant evidence bearing upon both the effects of such increased immigration and the factors that condition those effects. While the issues addressed are relevant to all developed countries, they may be especially relevant for Canada. As will be discussed below, Canada has been an above-average recipient of immigrants relative to its native-born population compared to other English-language countries other than Australia, and it ranks at the top of OECD countries for highly educated immigrants as a share of total immigrants (Nadeau, 2011).<sup>5</sup> Many observers have lauded Canada’s immigration system, particularly its emphasis on economic and educational attributes as criteria for admission.<sup>6</sup> However, Canada’s productivity performance has typically lagged the United States’ performance, particularly in its total factor productivity.<sup>7</sup> The latter largely reflects technological change, which depends, in part, on the output of domestic scientists and engineers, as well as local entrepreneurs who implement new technology through starting new businesses. To the extent that educated immigrants contribute to improved productivity, Canada’s relatively weak total factor productivity might be evidence that it is not using the skills of highly educated immigrants as effectively as it might.<sup>8</sup>

The study proceeds as follows. In the next section, we present data on Canada’s immigration experience and compare it to that of other countries. As noted above, the immigrant population as a share of the total population is higher in Canada than in other English-language countries, save Australia. Canada also ranks higher than other English-language countries for the share of immigrants with undergraduate, technical and professional, and Master degrees, although it lags the United States for those with a Ph.D. as a share of total immigrants.

Section 3 of the paper discusses the theoretical channels through which the inflow of highly educated immigrants can affect the real income levels of the native-born. There are multiple direct and indirect channels of influence through which immigration can

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5. We shall discuss some relevant data in the next section.

6. See, for example, Challinor (2011) and Tepperman (2017).

7. Wu and Willox (2018) document a slower rate of growth in total factor productivity in Canada compared to the United States in the period from 2010 to 2016. However, labour productivity growth in Canada exceeded US growth during this period, although the opposite was true for the period from 1987 to 2010.

8. Challinor (2011) refers to evidence that recent highly skilled immigrants are increasingly unable to find employment that is commensurate with their education and experience, leading some to question the capacity of the Canadian economy to absorb greater numbers of highly skilled immigrants. We shall say more about this in a later section. Clearly, there are numerous factors that could be influencing Canada’s productivity performance.



affect the real income levels of the native-born. The multiple channels inevitably complicate any consideration of the economic effects of highly educated immigrants. They also open more potential avenues through which public policy can affect the number of highly educated immigrants, as well as their economic contributions.

Empirical evidence bearing upon the economic effect of skilled immigrants is summarized and evaluated in Section 4. There are relatively few studies of the impacts of highly educated immigration, particularly for Canada. Of the available empirical studies, the majority focus on the direct labour-market effects of such immigration. That is, the majority focus on whether and to what degree highly educated immigrants substitute for or complement the skills of native-born workers, including highly educated native-born. Studies of this issue tend to conclude that there is some substitution of educated immigrants for highly educated native-born workers, while educated immigrants are complements to less educated native-born.

Some studies provide evidence bearing upon several indirect effects of immigration of highly educated workers. They include the relationship between immigration and entrepreneurship, as well as the contribution of highly educated immigrants to technological change and economic specialization. Since these indirect effects may take a relatively long time to materialize in improvements in productivity, they may not be accurately identified in statistical studies that relate the incomes and employment status of the native-born to immigration by highly educated individuals. Nevertheless, such evidence is relevant and adds to our understanding of the full potential effects of immigration on the economic welfare of the native-born, as do studies of the fiscal impacts of highly educated immigrants.

Section 5 discusses the labour-market performance of highly educated immigrants in Canada. Specifically, it compares the performance of highly educated immigrants in Canada to those in the United States, as well as to native-born Canadians. The main finding is that highly educated immigrants in the United States seem to have better labour-market outcomes than those in Canada. It is not clear what explains the observed differences. It might be the case that the United States is a more desirable location for the most high-achieving immigrant STEM professionals, so that the different labour-market outcomes of the two countries reflects a self-selection bias in terms of where the most productive STEM professionals choose to emigrate. An assessment of public policies that might help increase that economic contribution of highly educated immigrants to the Canadian economy is provided in Section 6. The final section offers concluding comments.

## 2. Overview of Canada's Immigration Experience

In this section of the report, we present summary data on Canada's immigration experience, with particular attention to highly educated immigrants. A question that immediately arises is how to identify highly educated immigrants, since educational experience is a continuous variable. Hence, any sharp demarcation between more educated and less educated immigrants is bound to be somewhat arbitrary. Peri (2016) notes that a number of studies argue that the most relevant partition across workers by educational category is between people with at least some college education and people with a high-school diploma or less. However, other authors maintain that "upper-tail knowledge" rather than "average human capital" is what drives innovation and rapid technological change.<sup>9</sup> That is to say, innovation primarily reflects the skills possessed by top engineers and entrepreneurs, although literacy and numeracy certainly boost productivity by facilitating the broad use of new technologies in an economy.

Some researchers argue that the skill levels of immigrant and native-born workers are not necessarily identical, even when the two types of workers have the same formal educational levels. For example, Peri and Spulber (2008) conclude that immigrants with graduate degrees specialize in occupations demanding more quantitative skills and that similarly educated native-born workers respond to immigration by choosing occupations with less analytical and more communicative content. This conclusion suggests that examining the impact of immigration on the native-born at the occupational rather than at the educational level might provide a more accurate picture of the labour market effects of highly educated immigrants. In fact, the broad findings are similar whether one disaggregates immigrant workers by educational level or by occupation. Since, the preponderance of studies tend to focus on the educational attainment levels of immigrants, and since such data are more readily available, we present data organized by the educational levels of immigrants.

Since the literature is inconclusive about the definition of highly educated workers, the data presented in this section primarily considers immigrants who have more than a high-school education as being highly educated. Largely, this is a pragmatic choice, as most of the available published data does not identify precise levels of tertiary education possessed by immigrants. At the same time, it is reasonable to expect that individuals with graduate and professional school training and education beyond university will have skills that are not possessed by those whose formal education ended at the two- or four-year college level.

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9. See, for example, Squicciarini and Voigtlander (2015).

The United Nations' website reporting the characteristics of a country's foreign-born population is the best single source of consistently defined data on the educational attainment of immigrants, 15 years of age and older, across countries (UNdata, 2019). Unfortunately, the data series is relatively limited with 2006 being the earliest year. Furthermore, data are reported for different individual years across countries. Hence, it is not possible to report the relevant data for the same years for each sample country. Nevertheless, the available data provide a reasonably informative picture of the educational characteristics of immigrants in Canada and elsewhere over the period from 2006 to 2016.

In reporting the data for Canada, it seems useful to compare Canada's immigration experience to that of other countries. The question then arises as to which countries to use as comparators. As shall be discussed in more detail in a later section, proficiency in the native language of the host country is an important determinant of the economic performance of highly educated immigrants. Since the majority of highly educated immigrants to Canada settle in English-speaking Toronto and Vancouver (Challinor, 2011), the most relevant comparison of Canada's recent immigration experience would seem to be with other primarily English-speaking countries. To the extent that highly educated immigrants attempt to migrate to countries where they are most likely to be economically successful, Canada is most likely to compete with other English-language countries to attract highly educated immigrants.

By way of broad background, **table 1** reports the total stock of immigrants as a percentage of the total population for individual years for Canada, the United States, Australia, the United Kingdom and New Zealand.<sup>10</sup> Of the five countries, Australia is the most "immigrant-intensive" with Canada and New Zealand having comparable percentages. Clearly, Canada is substantially more immigration-intensive than the United States, although the percentage of immigrants in the total population has increased consistently for both countries since 2006.

Table 1: Total stock of immigrants as a percentage of total population

	Canada	United States	Australia	United Kingdom	New Zealand
2006	17.9	9.8	20.2		18.7
2011	19.7	10.4	22.2	11.6	
2013		10.9			20.6
2016	21.6		23.9		

Sources: UN Data, 2019; World Bank, 2019; author's calculations.

**Table 2** reports the ratio of immigrants possessing what the World Bank calls "First Stage Tertiary Degrees" to the total stock of immigrants expressed as a percentage. First Stage Tertiary Degrees include all undergraduate college and university degrees,

10. Data on total population is from World Bank, 2019.

Table 2: Immigrants with First Stage Tertiary Degrees as a percentage of total immigrants

	Canada	United States	Australia	United Kingdom	New Zealand
2006	45.5	41.1	29.7		23.1
2011	50.4	42.6	36.0	46.1	
2013		44.3			25.5
2016	51.2		40.2		

Sources: UN Data, 2019; author's calculations.

professional degrees, and Master degrees. In essence, the category includes all degrees earned after completion of secondary education but not including doctoral degrees. This is obviously a heterogeneous category, including a potentially wide range of educational specialties from engineering through the humanities. With this caveat, the data in table 2 underscore the success that Canada has enjoyed in attracting educated immigrants compared to other countries. In particular, while Australia is more immigrant-intensive than Canada, Canada's stock of immigrants is more "education-intensive" than that of Australia. Indeed, by the measure of First Stage Tertiary Degrees, Canada has the most educated immigrant stock across the five sample countries.

UN Data identifies the total number of immigrants possessing a Second Stage Tertiary Degree, which is essentially a doctorate degree, although it does not report the academic field to which the doctorate pertains. Nevertheless, the data reported in **table 3** shows that Canada's "advantage" in the share of immigrants with First Stage Tertiary Degrees is not replicated when it comes to the share of immigrants with Second Stage Tertiary Degrees. Indeed, the United States enjoys a consistent advantage in this metric, and the ratios for Australia and New Zealand seem comparable to that of Canada.<sup>11</sup> To the extent that the major economic benefits to the host economy come from the most highly educated immigrants, Canada's "educational advantage" from its immigration intake might be smaller than one would infer from the percentages reported in table 2.

There is no evidence of which we are aware that identifies precisely how much of Canada's success in attracting highly educated immigrants is the result of Canada's immigration policies. However, it seems a reasonable conclusion that the emphasis of Canada's recent immigration policies on education and skills provisions that work to the advantage of potential immigrants who have higher education, work experience, and English or French language abilities has had a significant effect on Canada's recent immigration experience. It is beyond the scope of this study to discuss the details of Canadian immigration law. Insofar as highly educated immigrants are concerned,

11. It is not clear why the ratio for New Zealand in 2006 in table 3 is so large. The United Nations' website (UN Data, 2019) reports the number of immigrants in New Zealand with tertiary degrees to be about five times larger in 2006 than in 2013. The reported 2006 number might well be in error.

Table 3: Immigrants with Second Stage Tertiary Degrees as a percentage of total immigrants

	Canada	United States	Australia	United Kingdom	New Zealand
2006	1.4	2.0			7.7
2011	1.5	1.9		0.9	
2013		2.3			1.3
2016	1.7		1.4		

Sources: UN Data, 2019; author’s calculations.

the vast majority enter through the economic immigrant classification. The Express Entry program is the government’s main vehicle for accepting and processing claims for Canadian permanent residence. The system was implemented in January 2015.<sup>12</sup> Around 60% of the number of immigrants expected to enter Canada over the next few years will enter through economic programs.

The Federal Skilled Workers Program (FSWP) selection system (which is administered under the Immigration and Refugee Protection Act) governs the admission of the majority of immigrants entering under the economic immigrant classification, and particularly for highly educated immigrants.<sup>13</sup> In 2018, 52% of invitations to apply for permanent residence under Express Entry were under the FSWP (CIC News, 2018). Under the FSWP, a points system is used to evaluate immigrant applicants. The criteria for which points are allocated, along with point allocations, are summarized in **table 4**. Clearly, language skills and attained education are the two most prominent criteria. Passing a competency test in either official language can earn the applicant up to 24 points with additional points allocated if the applicant scores sufficiently highly in tests of both English and French. For education, there are a large number of degree categories.

Table 4: Six selection factors and points awarded under the Federal Skilled Worker Program (Express Entry)

Criteria	Points (maximum)	Criteria	Points (maximum)
Education	25	Age	12
Official language	28	Arranged employment in Canada	10
Experience	15	Adaptability	10

Note: Applicant needs to score 67 points or higher.

Source: Canada, 2018.

12. For a description of the Express Entry Program, see Canadim, 2017.

13. Some economic-class immigrants also enter Canada through the Provincial Nominee Program.

A three- or four-year Bachelor degree earns 21 points, while a Ph.D. earns 25 points. Applicants with foreign educations must produce evidence from an approved agency showing that the applicant's education is equal to a completed certificate, diploma, or degree from a Canadian secondary high-school or post-secondary school.<sup>14</sup>

In summary, the available data confirm that Canada has been relatively successful in attracting highly educated immigrants. To the extent that educated immigrants make net positive contributions to the per-capita disposable incomes of native-born workers, there is a potential case for policy makers in Canada to expand and intensify initiatives to attract more highly educated immigrants. Conversely, if the economic contribution of immigration to incomes of the native-born has been limited, more attention should be paid by policy makers to the factors that might be limiting that economic contribution. In fact, there are no general equilibrium estimates of how immigration by highly educated individuals affects the disposable income of the native-born. Rather, the available evidence, primarily from the US experience, tends to focus on specific channels through which effects may be experienced. Hence, to identify and evaluate the available evidence, it is useful to set out the theoretical channels through which highly educated immigrants can increase or decrease the disposable incomes of the native-born.

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14. The other point categories are relatively obvious, perhaps with the exception of “adaptability”, where points are rewarded if the applicant and/or spouse had been educated or worked in Canada in the past.

### 3. The Effects of Highly Educated Immigrants on the Host Economy— Conceptual Linkages

In this section, we present a simplified theoretical discussion of how immigration by highly educated people can affect the real incomes of the native-born. This focus clearly adopts the value judgment that immigration should be a benefit to the native-born. Presumably, highly educated immigrants who remain in their adopted country believe themselves to be better off, since they can, in most cases, return to their home countries. However, it is not necessarily true that immigration, even by highly educated people, will make the native-born better off economically. If the native-born are made worse off, the utilitarian case for promoting immigration is compromised.

#### 3.1 Basic assumptions

The basis for our theoretical discussion rests on several plausible economic assumptions. The first is that the income earned by any native-born worker in the labour market will increase or decrease as that worker's marginal productivity increases or decreases.<sup>15</sup> Marginal productivity is defined by economists as the increase in output produced by an additional unit (*e.g.*, an hour) of labour input. The second is that a worker's marginal productivity increases with the worker's skill level, broadly defined. Specifically, a greater skill level, often linked to formal education, will increase a worker's marginal productivity. A third assumption is that a worker's marginal productivity will also depend upon the quantity and quality of complementary inputs. One complementary input is physical capital. The more physical capital available to combine with a given amount of labour, the higher the marginal productivity of that labour. Symmetrically, if the stock of available physical capital grows more slowly than the available supply of labour, the marginal productivity of labour will decline. Another complementary input can be broadly defined as "technology". The latter might be thought of as knowledge about how to combine "conventional" labour and physical capital more efficiently, say through new production processes or new ways to organize production units. If improvements in technology increase faster than the supply of labour, the marginal productivity of workers will increase, all other things constant.

The marginal productivity of native-born workers will also depend upon the number of immigrants in the labour market with similar skills. Specifically, an increase in the number of immigrants in a particular occupation will reduce the marginal productivity of native-born workers in that same occupation owing to what economists identify as

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15. This is equivalent to assuming that labour markets are competitive.

“diminishing marginal product” of a variable factor of production—in this case labour. Simply put, as more workers use a given stock of physical capital and technological knowledge, the additional output gained by increasing the inputs of labour will decline. Put differently, if highly educated immigrants are direct substitutes for highly educated native-born, an increase in the supply of the former will lead to a decrease in wages of the latter, other things constant.

The preceding discussion can be summarized for convenience in this equation:

$$MP_{nt} = f(S_{nt}, K_t, T_t, N_{it}) \quad \text{Equation 1}$$

The term on the left-hand side is the marginal product of a representative native-born worker in period  $t$ . The first term inside the parentheses is the average skill level of the representative native-born worker. Marginal product will increase with increases in average skill level. The second term is the amount of physical capital such as machinery and equipment that is available for use by domestic workers. Marginal product will increase with increases in physical capital. The third term is a measure of technology available to domestic workers in any period. In this case, technology can be thought of as the state of knowledge about how to produce output more efficiently. Increased knowledge improves the marginal productivity of most, if not all, workers.<sup>16</sup> The last term is the supply of immigrant labour in any period. The impact on marginal product will depend upon the degree to which the occupational skills of immigrants are similar to the occupational skills of the native-born. Greater similarity will reduce the marginal product of the native-born for the reason cited earlier. If immigrants have dissimilar skills, an increase in their supply in the labour market might increase the marginal product of native-born workers, as the immigrants’ skills may be complementary to those of the native born.

Equation 1 is set out to assist in understanding the later discussion of empirical evidence. The main point underscored by equation 1 is that immigration can have direct and indirect effects on the incomes of the native-born. The direct effect is related to how increases in  $N_{it}$  affect  $MP_{nt}$ . The indirect effects are related to how changes in  $N_{it}$  affect other variables inside the parentheses, particularly  $K_t$  and  $T_t$ . Our review of the empirical literature will be organized to address these relevant direct and indirect effects that are the result of an increase in the supply of highly educated immigrants.

### 3.2 Fiscal impacts

Earned income is not equivalent to real disposable income. The latter will also depend upon taxes paid net of fiscal transfers received from the government, where the latter includes items such as disability and unemployment benefits, as well as public services such as health care and education. If immigration results in the native-born paying higher or lower taxes net of fiscal transfers to them from governments, their real disposable

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16. Some new technologies can displace labour, as when robots replace workers in warehouses. It is beyond the scope of this report to address the differential effect that new technology can have on different categories of workers.



incomes will decline or increase. Equivalently, if an increase in government tax revenue allows the native-born to enjoy increased or improved public services without paying more taxes, the native-born enjoy net fiscal benefits from immigration. Conversely, if the native-born must pay more taxes to enjoy the same level of public services prior to immigration, given the taxes paid by immigrants, the native-born will experience a negative fiscal impact from immigration.

Real disposable income will also be affected by changes in the price level of the basket of goods purchased by the native-born.<sup>17</sup> Specifically, faster rates of inflation will reduce real disposable incomes of workers. Since individuals should ultimately care about their real disposable incomes, that is, their inflation-adjusted incomes after taxes and government-provided benefits, a full consideration of how immigration affects the economic welfare of the native-born should also consider how immigration affects the prices of goods consumed by the native-born, as well as the net taxes paid by the latter.

### 3.3 Direct effect—substitution in the labour market

Most studies of immigration acknowledge that the labour-market consequences of immigration for the native-born depend upon whether the skills of immigrants are substitutable for the skills of the native born. If they are substitutable, an increase in immigration is effectively the same thing as an increase in the supply of native-born workers, all other things constant, since employers can use the services of immigrants in place of the services of native-born workers. This increase in supply will, other things constant, result in native-born workers earning lower average incomes given a normal downward sloping demand curve for labour.<sup>18</sup> The demand curve for labour is simply the marginal product of labour. As discussed earlier, an increase in the supply of labour will reduce the marginal product of labour, other things constant. If there is limited or no substitution possible between the skills of immigrants and those of the native-born, an increase in immigration should have little or no direct effect on the earned incomes of the native-born.

Since this study is concerned with immigration of highly educated workers, the primary group of native-born workers potentially affected directly by immigration are highly educated native-born. The issue then becomes whether highly educated immigrants are good substitutes for highly educated native-born in the labour market. This is ultimately an empirical question, and we will discuss the relevant empirical evidence in the next main section of this report. At this point, we note that the issue is an empirical one because education encompasses the acquisition of different skills. As a hypothetical example, it might be the case that most highly educated immigrants are trained to work in science and engineering occupations, whereas highly educated native-born workers are trained for other occupations such as management, finance, and marketing. In this case,

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17. Obviously, individuals will differ in the baskets of goods that they buy. This nuance is incidental to the main point that higher prices for goods and services will reduce the purchasing power of nominal earned incomes, thereby making native-born workers worse off financially. Conversely, lower prices make native-born workers better off.

18. Lower average incomes can result from reduced salaries and wages and/or reduced employment.

there will likely be limited substitutability between immigrant and native-born workers, even though both might have the same amount of formal education. Equivalently, if native-born workers can easily retrain for occupations facing less competition from immigrant workers, there again might be limited direct substitution of immigrant skills for those possessed by the native-born.

### 3.4 Indirect effects upon the labour market—changes in the marginal productivity of native-born workers

Immigration can also have indirect effects on the marginal productivity of native-born workers, even if highly educated immigrants are not direct substitutes for highly educated native-born. The direction and magnitude of the indirect effects will likely vary over time. For example, in the short-run, complementary inputs such as physical capital and technology will be largely fixed in supply. As a result, an increase in the supply of labour associated with an inflow of highly educated immigrants will reduce the marginal productivity of native-born workers in occupations that draw on the same physical capital and knowledge used by the educated immigrants. Simply put, native-born workers need to share a relatively fixed amount of complementary inputs with immigrants, which effectively means that the native-born have fewer complementary inputs to work with. As a result, native-born workers will be less productive and will therefore earn lower incomes.<sup>19</sup>

The analogue to reduced incomes of native-born workers is higher returns to the fixed factors of production. Since educated labour is a complement to physical capital and knowledge, an increase in the supply of educated labour will contribute to increased productivity of physical capital and knowledge and to higher financial returns to investments in those factors of production. The higher financial returns should encourage investments in physical capital, as well as in the creation of new knowledge through, for example, increased expenditures on research and development, licensing of innovations developed outside the country, starting up new ventures, and so forth. With increased investment in complementary inputs, the marginal productivity and incomes of native-born workers should increase. Whether incomes of native-born highly educated workers are higher or lower in the long run depends upon the magnitude of the increase in the available services of complementary inputs, as well as whether there are economies or diseconomies of scale in the activities affected by immigration.<sup>20</sup> If the long-run costs of creating physical and intangible capital (that is, new knowledge) are unchanged by immigration, the increase in capital investment promoted by higher short-run returns

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19. Combining more labour with a fixed amount of complementary inputs leads to what economists call diminishing marginal productivity of labour, as noted earlier. Of course, to the extent that highly educated immigrants bring knowledge (or skills) that are complementary to the skills possessed by less educated native-born, the latter's marginal product (and labour-market income) might increase as discussed shortly.

20. Economies of scale exist when a given percentage increase in all inputs results in a larger percentage increase in output. A smaller percentage increase in output would indicate decreasing returns to scale, while an equal percentage increase in output indicates constant returns to scale.

to capital will restore the capital-to-labour ratio to what it was prior to immigration. The only long-run consequence is that the overall size of the economy is larger. The issue then turns on whether productivity will increase with a growth in the size of the industries that employ new immigrants, that is, are there economies of scale? If there are constant returns to scale, labour incomes of the native-born will, over time, go back to what they were prior to immigration.

This relatively simple model of a labour market experiencing an increase in supply of highly educated immigrants highlights the importance of whether or not immigration will affect the cost of physical and intangible capital. Put slightly differently, it highlights the relevance of how immigration might affect the supply of physical and intangible capital in the post-immigration period. For example, if highly educated immigrants are more disposed than their native-born counterparts to assume the risks of starting new businesses, immigration will effectively lower the financial cost of capital, thereby encouraging investment. Physical capital ( $K$  in equation 1) per native-born worker should therefore be higher after immigration than before immigration, other things constant.

As another example, if immigrants are more capable or more willing than their native-born counterparts to make contributions to the creation of new technologies, the effective cost of creating new knowledge will decrease with immigration. As a consequence, immigration might promote a faster growth in the stock of knowledge ( $T$  in equation 1) that, in turn, contributes to improved labour productivity of the native-born. As an example, Moser, Voena, and Waldinger (2014) describe how Jewish émigrés from Nazi Germany revolutionized US science and helped to increase scientific innovation in the United States, in part by providing unique training to younger, native-born Americans. That is, Jewish émigrés increased both  $T$  and  $S$  in equation 1.

A somewhat less obvious channel through which highly educated immigrants can improve the productivity of native-born workers is by facilitating increased specialization of labour. Immigration can advance specialization to the extent that educated immigrants in particular fields “cluster” in specific locations. For example, Boston is a significant cluster for biotechnology expertise, while Silicon Valley is a well-known cluster for computer-related activities. Occupational specialization is more economically feasible when more activity drawing on the relevant occupational skills is being carried out, as is the case in specific urban clusters. The relevant notion here is that, when educated workers are employed as specialists, rather than as generalists, they are more likely to create and use new knowledge, which, in turn, often becomes available for use by native-born workers both inside and outside the relevant clusters. The knowledge created ( $T$ ) should enhance the productivity of most, if not all, native-born.<sup>21</sup>

Occupational specialization can also be promoted by immigration to the extent that educated immigrants help establish trade and investment linkages between their home country and the country to which they migrate. International trade and foreign direct

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21. As an example, albeit a particularly dramatic one, workers in many occupations both inside and outside the United States use the Google search engine developed by Sergey Brin, an immigrant to the United States from Russia.

investment are two prominent activities that effectively integrate geographic markets, thereby expanding the size of potential markets for specialized and efficient producers. Producers that are more specialized will find it advantageous to hire workers that are more specialized. In addition, increased international trade and foreign direct investment promotes competition in domestic markets, which, in turn, will encourage domestic firms to innovate and adopt more efficient technologies and organizational practices. The practical relevance of the trade and direct-investment channels for promoting technological change will obviously be greater for relatively small, open economies such as Canada.

### 3.5 Changes in the real after-tax disposable income of the native-born

Individuals care about their real incomes after taxes. In this regard, immigration can affect the economic welfare of the native-born through fiscal impacts. In Canada, taxes paid as a share of income increases with higher incomes, while government services tend to benefit different income groups in roughly equal amounts (Grubel and Grady, 2012). Consequently, if immigrants have incomes below those of the native-born, on average, immigration will impose a fiscal burden on the native-born, that is, the latter will be taxed more to pay for government income transfers and services for immigrants. Since we are concerned here with immigration by highly educated individuals, who should enjoy above-average incomes over their working lives, the imposition of a direct fiscal burden on native-born workers is less likely than in the case of immigration by low-skilled individuals. However, there might be indirect fiscal effects on the native-born if increased immigration increases public-sector expenditures on services such as education and health care, which must ultimately be funded by higher taxes on both immigrants and native-born.

### 3.6 Summary

Inflows of highly educated immigrants can affect the real disposable incomes of the native-born in a number of ways. Most directly, to the extent that the skills of highly educated immigrants substitute for the skills of specific groups of native-born, an increased supply of the relevant skills will put downward pressure on the wages of the substitutable native-born sub-groups. However, the influx of highly educated immigrants will also increase the returns to existing physical and intangible capital that are complements to skilled labour. The higher returns will encourage capital investment (both physical and intangible capital investment), which will increase the marginal productivity of native-born workers. The issue then becomes whether the increase in physical capital and knowledge following immigration results in a net increase in the services of physical capital and knowledge available per native-born worker. If so, the average income of native-born workers might well be higher after immigration than before, since native-born workers will be more productive with relatively more physical capital and knowledge available per worker.<sup>22</sup> If not, the average income of native-born workers might

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22. This might be true even for highly educated native-born workers who are presumably most substitutable for highly educated immigrants.

remain unchanged, or even decline, if the long-run stock of physical capital and knowledge per native-born worker remains the same or below the ratio prior to immigration.

Other economic changes resulting from immigration might also affect the productivity of the native-born. A relevant consideration here is whether or not the production activities affected by immigration are characterized by economies of scale. If so, expansion of those activities will improve the productivity of native-born workers. A particularly relevant consideration in this regard is whether immigration will contribute to greater specialization of labour and capital in the host economy. If so, the productivity of the native-born will likely increase because of immigration, since increased specialization of factor inputs is a prominent source of economies of scale.

The real disposable income of the native-born might be affected by immigration through changes in the net fiscal burden imposed on the native-born by immigration. The fiscal effect of immigration on the native-born will depend largely upon the average income level of immigrants compared to the average income level of the native-born. In the case of highly educated immigrants, it might be expected that their income levels, on average, will be above the average for the native-born population, although this might not necessarily be the case if highly educated immigrants, for one reason or another, cannot fully exploit their skills in local labour markets.<sup>23</sup>

### 3.7 Empirical issues

The preceding conceptual discussion raises several empirical issues that are critical to any evaluation of the impact of highly skilled immigrants on the economic welfare of the native-born.

1. Are the skills of highly educated immigrants direct substitutes or complements for those of the native-born?
2. How does the immigration of highly educated individuals affect the long-run supply of physical capital and knowledge, where increased knowledge can be equated to technological change?
3. Does immigration contribute to economies or diseconomies of scale?
4. Does immigration of highly educated workers contribute to increases or decreases in the taxes paid by the native-born relative to the government benefits they receive?

### 3.8. Caveats

A focus on these four issues effectively treats immigration as a “once-and-for-all” event. That is, our conceptual discussion addresses the potential effects of immigration by highly educated individuals in a comparative static framework. Specifically, it identifies

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23. Stories abound of immigrants with post-graduate degrees working as Uber or taxicab drivers. For empirical evidence on the relevance of this phenomenon, see Matoo, Neagu, and Ozden, 2008.

the direct and indirect factors that could influence the economic welfare of the native-born given a one-time increase in the number of highly educated immigrants. In reality, immigration is not a one-time event. Indeed, an inflow of highly educated immigrants in one period could well influence emigration decisions of highly educated individuals in later periods. For example, if early waves of immigration from specific countries make a location more attractive for future immigrants from those same countries, its linkage to future immigration patterns might augment or attenuate the long-run effects of earlier immigration. If so, ignoring the linkages between current and future immigration might overstate or understate the economic consequences of any vintage of immigrants.

The comparative static framework also effectively assumes that the economic consequences of future immigration will be similar to past immigration. The applicable caveat to this assumption is relevant to extrapolating any economic relationship into the future. Specifically, if an economic relationship changes over time, past experience might be a misleading predictor of future experience. The practical implication of this caveat is that empirical evidence bearing upon the effects of immigration by highly educated workers might be an unreliable guide to the effects of future immigration to the extent that the relevant underlying economic relationships change over time. For example, if future highly educated immigrants are more or less skilled than earlier vintages, the economic effects of future immigration on the native-born may be different from historical effects.

Finally, our conceptual discussion of the economic effects of highly skilled immigrants implicitly assumes that the effects are transmitted entirely by the first generation of immigrants. If the offspring of immigrants differ in their economic performance from the offspring of the native-born—for example, if the former invest more or less than the latter in formal education—the intergenerational impacts of immigration by highly educated individuals may differ from the “first-generation” effects. To be sure, the intergenerational effects of immigration may be influenced by a variety of factors that are purely matters of speculation, for example, changes in the quality of public education. Moreover, intergenerational models of the effects of immigration ultimately require value judgments about how much importance to place on the economic welfare of future generations compared to the present generation.

In short, while comparative static models of immigration assess the effects of immigration as a “one-time” phenomenon, to do otherwise necessitates speculation and value judgments that are no more defensible than those invoked when analyzing immigration through a comparative static framework. Furthermore, the empirical literature largely identifies the effects of immigration within a comparatively static framework. This literature is reviewed in the next section of this report.

## 4. Empirical Evidence on the Economic Effects of Highly Educated Immigrants

Huang (2010), Peri (2016), and others note that most empirical studies of immigration have focused on the effects of overall immigration on the wages of the native-born at the national level. These studies, largely, find minimal impacts of immigration on wage or employment levels of the native born (Kerr and Kerr, 2011). This latter result might reflect offsetting influences of different groups of immigrants on the labour market conditions for native-born workers. This might be the case, for example, if the labour-market influences of more- and less-educated immigrants differ, so that their separate effects are largely offsetting when they are indirectly aggregated.

In a similar vein, Robson and Mahboubi (2018) find that anticipated immigration levels for Canada through 2040 will have only a very modest impact on the average income per capita for Canada. However, their projection assumes that future labour productivity growth rates will equal the average growth rate from 1971 to 2017. This assumption might be inaccurate to the extent that average educational levels of future immigrants are significantly higher than historical averages.

It might also be true that significant labour-market effects of immigration are observable only for narrowly defined occupational and geographical markets. For example, the immigration of highly educated workers might have identifiable effects only for native-born workers with similar skills and, perhaps, in the same geographical market.<sup>24</sup> Where studies stratify the labour market by the skill level of workers, they mostly focus on blue-collar occupations (Huang, 2010). Since we are concerned here with the labour market effects of highly educated immigrants, studies that focus on those immigrants are of primary interest to us.

### 4.1 Substitution of immigrant for native-born skills

In fact, relatively few studies focus on the degree to which highly educated immigrants directly substitute for highly educated native-born. Rather, most examine the effect of overall immigration on native-born workers possessing different educational and skill levels. For example, Orrenius and Zavodny (2007) analyze the effects of immigration on native-born separately for professionals, service workers, and manual laborers. Using occupation as a proxy for skill, they find negative effects of an increase in foreign-born workers on native-born in blue-collar occupations, although they find no significant effects for professionals and other high-skilled workers. Peri (2016) concludes that focusing on the

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24. A criticism of geographical area studies is that they implicitly assume native-born labour and capital do not adjust across geographical locations in response to immigration. These issues are discussed in Peri (2016) and Sharpe and Bollinger (2016).

wage effects of immigrants through the relative supply channel, and at the national level, one mostly obtains zero or slightly positive effects of immigration on wages of college-educated native-born workers in the United States between 1980 and 2000.

In a study that stratifies both immigrants and native-born into skill categories, Batalova (2006) finds that, for the overwhelming majority of skilled native-born men and women, a larger share of immigrants in the same job is positively associated with higher earnings. However, there is a “tipping point” beyond which working in jobs with more skilled immigrants was associated with a decline in earnings for skilled native-born workers. In a related study, Borjas (2005) finds that an influx of highly educated immigrants directly substitutes for the skills of their highly educated native-born counterparts. In particular, he shows that an influx of foreign students into a particular doctoral field in the United States between 1968 and 2000 had a significant and adverse effect on the earnings of doctorates in that field who graduated at roughly the same time. Specifically, a 10% immigration-induced increase in the supply of doctorates lowers the wage of competing native-born workers by about 3%. Huang (2010) reaches a similar conclusion to Borjas in her examination of the impact of the 1998 increase of US H-1B visas,<sup>25</sup> which increased the supply of highly skilled immigrants into the United States. The latter were defined as foreign-born individuals with at least a bachelor’s degree. She found that a 10% increase in employment as a result of an influx of highly skilled immigrants reduces wages of natives in the same occupation by 2.8% to 4.4%. This is in the range estimated by Borjas (2005). However, Huang finds that an increased supply of immigrants in engineering, computer science, and mathematics has limited impact on the wages of native-born workers in these occupations because the strong growth in labour demand for such skills offsets the impact of increased supply. Of course, this explanation implies that native-born workers might have enjoyed higher wages in the absence of immigration inflows. In a related study for New Zealand, Mare and Stillman (2009) use 1996, 2001, and 2006 census data to examine how the supply of immigrants in particular skill groups affected the employment and wages of the native-born workers of New Zealand. They find some evidence that increases in the number of highly skilled recent migrants have small negative impacts on the wages of highly skilled native-born workers, which are offset by small positive impacts on the wages of medium-skilled New Zealanders.<sup>26</sup>

In summary, the balance of evidence from the few available studies of the direct labour-market effects of highly skilled immigrants suggests that increased immigration of highly educated workers modestly reduces the incomes of comparably educated native-born. There are various reasons for being cautious in interpreting this evidence. Perhaps most relevant is that educational attainment, even within similar occupations, might not be an accurate measure of the similarity in skills across a cohort of individuals.

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25. The US H-1B visa is a non-immigrant visa that allows US companies to employ graduate-level workers in specialty occupations that require expertise in specialized fields such as IT or engineering.

26. Sharpe and Bollinger (2016) also identify a significant substitution effect when examining the impact of an increased number of immigrants on the wage earnings of native-born workers in the same education-experience cohort for the United States.



In this regard, Peri and Sparber (2009) suggest that immigrants have a comparative advantage in manual and physical tasks, while natives have a comparative advantage in communicative tasks. As such, immigrants and natives sort into and specialize in occupations intensive in the task for which they have a comparative advantage. If this occupational sorting exists within education groups, but to greater or lesser degrees across studies, the results of available studies might not be comparable. They may also overstate the degree to which highly educated immigrants substitute for comparably educated native-born in the labour market.

Some indirect evidence on the impact of highly educated immigrants on their native-born counterparts is available for Canada. A recent survey of Canadian STEM graduates documents an alarming rate of out-migration of recent graduates from the University of Waterloo, the University of Toronto, and the University of British Columbia (Spicer, Olmstead and Goodman, 2018). The authors found that one in four STEM graduates from these universities in 2015 and 2016 opted to work outside Canada. The proportion was substantially higher in certain specialties such as software engineering where two thirds of graduates reported leaving Canada. What is relevant in this regard is that competition in the job market from comparably educated immigrants was not cited as a motivation for leaving Canada to seek employment. The United States was the destination for over 80% of those leaving Canada for work opportunities, and prospects for earning higher salaries and working for market-leading companies were the main reasons cited for emigrating.

There is more agreement across studies about the relationship between inflows of highly educated immigrants and the direct labour-market outcomes for less educated native-born. Specifically, available studies indicate that the skills of highly educated immigrants are complements to the skills of the less-educated native-born (Kerr and Kerr, 2011). Hence, inflows of highly educated immigrants should increase the demand for less-educated native-born workers. The overall direct labour-market effect of highly educated immigration will therefore reflect the balance between substitutability of educated immigrants with similarly educated native-born counterparts and complementarity of the skills of highly educated immigrants with those of less-educated native-born. We are unaware of studies that identify empirically the overall balance of the direct labour-market effects of immigration by highly skilled immigrants. However, given the prominent percentage of highly educated immigrants in the overall stock of immigrants in the United States and Canada, and the absence of any large identified direct impact of overall immigration on labour-market conditions for the native-born, one might infer that the overall direct labour-market impact of highly educated immigrants is also modest, at best.

#### 4.2 Direct effects on returns to capital

As discussed in an earlier section of this report, the direct impact of immigration includes short-run changes in returns to factors of production besides labour, while the long-run effects should take into account changes in the productivity of labour because of immigration-related changes in the stock of tangible and intangible capital, as well as economies of scale and fiscal consequences.

An increased supply of skilled immigrant labour, which is a complementary input to capital, should increase the rate-of-return on capital. We are unaware of any studies that identify the income gains to capital in the short run associated strictly with high-skilled immigration.<sup>27</sup> However, given the relatively modest impacts on overall wages that have been identified for total migration, one would not anticipate a substantial increase in returns to capital, nor, therefore, a significant short-run investment response to an influx of skilled immigrants. However, as noted earlier, immigration by highly skilled individuals could have a positive and significant long-run impact on investments in tangible and intangible capital to the extent that it lowers the costs of investing in those assets.

#### 4.2.1 Long-run effects on tangible capital formation

Immigration can lower the costs of tangible capital assets to the extent that immigrants are more inclined to assume business risks than the native-born. That is, domestic capital formation is likely to be promoted by immigration if immigrants are more entrepreneurial than their native-born counterparts are. In this regard, there is substantial evidence that immigrants are more entrepreneurial than native-born. For example, in the United States, immigrants represented 24.9% of all new business owners between 2007 and 2011, but only 15.6% of the wage workforce. In 2015, the rate per month of new business formation was almost twice as high among immigrants as among the population born in the United States. For Canada, data from the 2009 *Labour Force Survey* indicates that 17.5% of immigrants aged 18 to 69 were self-employed compared to only 14.4% of the Canadian-born population. Furthermore, in Canada, immigrants are more than 20% more likely to become self-employed than the native population.<sup>28</sup>

There is also evidence that highly educated immigrants are more entrepreneurial than their less educated counterparts. Vandor and Franke (2018) note that, while the relationship between human capital and entrepreneurship is complex, the majority of research suggests an overall positive relationship between human capital and the propensity to start a successful business. More human capital has also been associated with greater economic success of immigrant enterprises. The explanation is that education and work experience allow people to build up a multitude of capabilities that benefit entrepreneurial action, including communication skills and analytical capabilities. In addition, immigrants with more education are more likely to start businesses serving the mainstream market rather than smaller ethnic markets, which contributes to better venture performance (Ndorfer and Priem, 2011).

There is a difference between self-employed entrepreneurs who earn enough to sustain their living and those who create innovative, growth-oriented companies. In this regard, a large-scale longitudinal analysis of entrepreneurs in 11 US states found that immigrants were not only overrepresented among entrepreneurs in general but

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27. Borjas (2005) identifies income gains accruing to native employers associated with an overall increase in foreign-born workers.

28. These data, along with the review of the literature provided in this section, draw from Vandor and Franke (2018).

also among entrepreneurs that had received venture capital funding. Specifically, immigrants constituted 27% of entrepreneurs backed by venture capital, while representing only 19% of the workforce (Vandor and Franke, 2018). This is consistent with studies that find immigrant entrepreneurs to be overrepresented among growth-oriented businesses and, crucially, to be more willing than native-born entrepreneurs to exploit risky business ventures (Kerr and Kerr, 2016). Unfortunately, comparable evidence for Canada is lacking.

An issue that arises is whether immigrant entrepreneurs displace native-born entrepreneurs. If so, the economic benefits of immigrant entrepreneurs might be overstated to the extent that native-born individuals who chose, for one reason or another, not to compete with immigrant entrepreneurs, would have created those benefits. Unfortunately, evidence on this phenomenon is inconclusive. However, it is suggestive that highly educated immigrants are overrepresented in science and engineering disciplines. Vandor and Franke (2018) note that in the 2000 US Census, immigrants accounted for 24% of the science workforce and 47% of the engineering workforce with bachelor and doctorate degrees, while immigrants in total made up only 12% of the workforce. To the extent that highly educated immigrants are more concentrated in science and engineering than the native-born, the former are more likely to start businesses that are less appealing to would-be native-born entrepreneurs. This, in turn, would imply that immigrant entrepreneurship is unlikely to displace native-born entrepreneurship to any significant extent.

In short, highly educated immigrants appear more likely to start new and successful businesses compared to their native-born counterparts, as well as to less well-educated immigrants. This might be a result in part of a greater risk-tolerance on the part of highly educated immigrants, as well as, perhaps, differentiated skills that are relatively well suited for starting high-technology ventures. It might also reflect some displacement of native-born business start-ups by highly educated immigrant entrepreneurs. We are unaware of any studies that empirically estimate the responsiveness of overall investment in business start-ups to inflows of highly educated immigrants. However, the apparent above-average propensity for highly educated immigrants to be entrepreneurs suggests the existence of a positive relationship. If so, highly educated immigrants contribute to higher real incomes of the native-born by encouraging investments in business start-ups, thereby creating more of an important long-run input (complementary to native-born labour), which should increase the demand for native-born labour.

#### 4.2.2 Long-run effects on intangible capital formation

As noted earlier, if highly educated immigrants are more productive at creating knowledge (or new technology) than their native-born counterparts, inflows of highly skilled immigrants should lead to net long-run increases in intangible capital, which is a prominent complementary input to labour. While knowledge is certainly created and introduced to the host economy through immigrant entrepreneurs, another important channel for the creation of knowledge is research and development done by scientists and engineers working for universities, companies, and governments. The issue addressed briefly in this

section is whether highly educated immigrants are more productive than their native-born counterparts in creating new knowledge. A related issue is whether inflows of foreign-born scientists and engineers “crowd-out” native-born scientists and engineers.

Available studies indicate that foreign-born scientists and engineers tend to improve the host country’s technological performance. In one early study, Stephan and Levin (2001) examine whether the foreign-born and foreign-educated are disproportionately represented among individuals making exceptional contributions to science and engineering in the United States. They employ six indicators of scientific achievement to see if the observed frequency by birth (or educational) origin is significantly different from the frequency one would expect given the composition of the scientific labour force in the United States. Their general finding is that individuals making exceptional contributions are disproportionately drawn from the foreign-born. They are also disproportionately foreign educated, both at the undergraduate and graduate level.

Kerr and Lincoln (2010) evaluate the impact of higher H-1B admissions of immigrants in the United States. They focus on employment and patenting by inventors with Indian and Chinese names in cities and firms dependent on the H-1B program relative to their peers, and find that total employment of scientists and engineers, as well as invention, increases with higher H-1B admissions through the contribution of immigrants. They find no significant displacement effect for native-born scientists and engineers. In a similar type of study, Peri, Shih and Sparber (2015) identify the long-run effect of employment growth of STEM workers admitted under the H-1B program on native workers across 219 US cities from 1990 to 2010.<sup>29</sup> They find that increases in H-1B STEM workers are associated with significant wage gains for college-educated natives and smaller, but still significant, wage gains for non-college educated natives. They interpret their findings as evidence that foreign-born STEM workers increase total factor productivity growth in US cities. Hunt and Gauthier-Loiselle (2010) use a panel-data set of immigrant college graduates covering different US states from 1940 to 2000. They show that a one-percentage point increase in immigrant graduates’ population share increases patents per capita by 9% to 18%.

At least one major study identifies adverse labour-market impacts on highly educated native-born from an influx of highly educated immigrants in the same occupation. Borjas and Doran (2012) examine the impact of a large post-1992 influx of Soviet mathematicians on the productivity of their American counterparts. They find a negative productivity effect on those mathematicians whose research overlapped with those of the Soviets. This resulted in some displacement of those American mathematicians to lower-quality institutions and out of active publishing. While the publication output of pre-existing American mathematicians shrank, the Soviet contribution filled the gap so that total publications remained about unchanged. Borjas and Doran’s findings are in contrast to those of Moser, Voena and Waldringer (2014) mentioned in an earlier section of this report. The latter study examines the impact of German Jewish émigrés fleeing Nazi Germany on the patents of US inventors working in fields of the émigré scientists

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29. STEM occupations encompass science, technology, engineering, and mathematics.

relative to overall patenting by US inventors. The authors found a significant increase in innovation in the research fields of the émigrés. Their analysis indicates that the arrival of émigrés encouraged US invention by helping to attract domestic inventors to the research fields of the émigrés. Most of this entry was by new native-born inventors who were trained by the émigrés and then continued to train other scientists.

In summary, highly educated immigrants, particularly scientists and engineers appear to stimulate long-run increases in knowledge, particularly as measured by patenting. Furthermore, they seem not to displace their native-born counterparts to any significant extent. Given the eclectic nature of the relevant studies, it is not possible to offer a numerical estimate of the contribution of highly skilled immigration to the rate of technological change in the host country. Furthermore, virtually all empirical studies of this issue focus on the United States as the receiving country. To the extent that the US experience is unique for any number of reasons, one must be cautious in generalizing the results discussed above to other countries, including Canada. Nevertheless, it seems fair to conclude that highly educated immigrants in STEM occupations make significant positive contributions to the workplace productivity of the native-born by contributing to increases in technological knowledge.

#### 4.3 Economies of scale via increased specialization

In Canada, as well as the United States, highly educated immigrants tend to concentrate in a relatively small number of large, urban centres (Peri, 2016).<sup>30</sup> As noted earlier, if there are efficiencies associated with increased urban density that contribute to improved productivity, or what economists call external economies of scale, the positive indirect effects discussed earlier in this section of the report will understate the positive overall effect of highly skilled immigration on native-born incomes. As discussed earlier, one potential source of increased efficiency is greater specialization of labour given denser labour markets. On the other hand, increased density could lead to diseconomies of scale related to increased congestion that, for example, might lengthen commuting times of workers, as some native-born workers move further from work in downtown cores because of higher housing prices.

Most studies conclude that firms are more productive, on average, in larger cities, although there is some disagreement as to whether the size-productivity relationship is monotonic or whether it exists only over specific city-size thresholds. For example, Fick and Rodriguez-Pose (2018) conclude for an international sample of cities that small cities of up to three million inhabitants are more conducive to economic growth than larger cities. Furthermore, the benefits of external economies of scale are industry-specific, so that larger size, *per se*, does not ensure that a city will be more productive. Conversely, Combes, Duranton, Gobillon, Puga, and Roux (2012) find for a sample of French cities that external economies of scale exist across city-size thresholds, as well as across industrial sectors.

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30. In 2006, 63% of all immigrants, regardless of the period of immigration, lived in the three largest Canadian census metropolitan areas. In contrast, only 27% of the Canadian-born population lived in those metropolitan areas. See Challinor (2011).

To the extent that significant external economies of scale in city size are exhausted at a population of around three million, the main Canadian urban centres receiving the bulk of highly skilled immigrants are unlikely to experience major benefits. Specifically, the Greater Toronto Metro Area has approximately 6.4 million people, the Greater Montreal Area around 4.2 million, and Vancouver Metro Area around 2.6 million. If there were external economies of scale resulting from additional immigration, it would arguably require substantial increases in the stock of highly educated immigrants to make a noticeable difference in Canada's productivity performance. For example, Ahrend, Farchy, Kaplanis, and Lembcke (2017) conclude that the estimated city-size-to-productivity elasticity varies between 0.02 and 0.05. This implies that the average worker will be 0.2% to 0.5% more productive in a city with 10% more inhabitants. Given that annual average labour productivity growth in Canada averaged around 1.23% over the period from 2010 to 2017, a further increase of 0.2% to 0.5% annually would be significant.

The combined population of the three large Canadian Census Metropolitan Areas (CMAs) was over 13 million in 2017. Hence, a 10% increase in the population of each of the three large CMAs would imply an inflow of over 1.3 million highly educated immigrants in the first year alone. Since the total stock of immigrants to Canada with First-Stage and Second-Stage Tertiary Degrees was slightly over 5.2 million in 2016, anything close to a 10% annual increase in the number of such immigrants to Canada's large cities is unrealistic. In fact, the average annual increase in the total stock of immigrants with First-Stage and Second-Stage Tertiary Degrees was approximately 3% over the period from 2000 to 2016. This implies that the potential annual contribution of highly skilled immigrants to labour productivity growth in Canada through the channel of external economies of scale is likely to be quite small.<sup>31</sup>

#### 4.4 International trade and investment

There are studies that find a statistical linkage between immigration, on the one hand, and increased international trade between the home and host countries of immigrants, on the other hand. It should be noted that the available studies focus on total immigration and not strictly on immigration by the highly educated. For example, Head and Ries (1998) and Partridge and Furtan (2008) find for Canada that small increases in trade are linked to immigration and that they consist mainly of an increase in imports of consumer items from the immigrants' countries of origin. Grubel and Grady (2012) argue that the relatively modest statistical relationship between immigration and trade flows for Canada are unsurprising given the fact that the majority of Canada's trade is with the United States, which accounts for only a very small portion of Canadian immigration. Furthermore, natural resources such as oil and gas, and primary manufacturing such as wood products, are important Canadian exports that are sold in international markets and are unlikely to be influenced by immigration flows.

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31. Using the city-size-to-productivity elasticity estimates of Ahrend, Farchy, Kaplanis, and Lembcke (2017), a 3% increase in the stock of highly educated immigrants would increase labour productivity by between .06% and .15%, a small anticipated increase to the 1.23% average productivity growth rate referenced earlier.

We are unaware of any studies that estimate a statistical relationship between immigration and investment flows for Canada. Certainly, anecdotal evidence suggests that immigration inflows, particularly from China, have contributed to an increase in investments in residential real estate. However, it is possible to argue that the increased demand for residential dwelling assets on the part of immigrants has “crowded out” investment by native-born, especially in Vancouver and Toronto, which have experienced particularly rapid increases in real estate prices over the past few years. Indeed, it is possible that the growth in investment in residential dwellings is partly responsible for a slower rate of growth in business-sector investment through a crowding-out effect.<sup>32</sup> Furthermore, any increase in capital inflows associated with immigration will be partly offset by remittances by immigrants to relatives and investments in their home countries.

#### 4.5 Fiscal impacts

The fiscal impacts of immigration by highly skilled individuals on native-born are likely to vary across countries given differences in tax regimes and government benefit programs. Storesletten (2000) finds for the United States that highly educated immigrants pay more in taxes than they use in public goods and services. Since the average employment incomes of highly educated male and female workers are well above the average for the total Canadian workforce, one might assume that this is also true for highly educated immigrants. However, highly educated immigrants have significantly worse labour market outcomes in Canada than their native-born counterparts, as we shall discuss in more detail in the next section of this report.<sup>33</sup> This is not the case for the United States. Furthermore, there is substantial uncertainty about the elasticity of government expenditures with respect to population growth. Different assumptions about the extent to which government services such as national defence are “public goods” can alter the assumed elasticity.<sup>34</sup> Grubel and Grady (2012) argue that most, if not all, services provided by the government, including national defence, are subject to “exhaustion”. That is, at some point, additional consumption of those services by immigrants will require more expenditure by government if the consumption of the native-born is to be maintained at pre-immigration levels. This implies that some or all of the native-born will need to pay higher taxes to pay for increased government expenditures.

We know of no study that estimates the net fiscal impact of highly educated immigrants on the Canadian native-born. While it seems unlikely that inflows of highly educated immigrants result in the native-born paying increased taxes relative to transfers received from governments, it might also be true that the native-born do not enjoy a significant fiscal benefit from increased numbers of highly educated immigrants. However, this conclusion might be too pessimistic depending upon the characteristics

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32. See Globerman and Press (2018) for a discussion of capital investment in Canada by sector and asset categories.

33. For some evidence on this phenomenon, see Bonikowska, Hou, and Picot (2011).

34. One of the characteristics of a public good is that consumption of the good by an additional individual does not make the good scarcer for existing consumers.

of highly educated immigrants. For example, if immigrants receive most or all of their formal education abroad, the native-born do not pay for the educational skills possessed by immigrants. Furthermore, if some proportion of immigrants move back to their home countries before retirement, the native-born avoid paying for substantial health-care and other costs associated with supporting older citizens. Oxford Economics (2018) finds that, when these factors are taken into account in the case of the United Kingdom, migrants make a substantial net positive fiscal contribution over the course of their lifetimes. Since their finding is for all immigrants, it is likely that they would have found an even larger net fiscal contribution had they focused exclusively on highly educated immigrants.

#### 4.6 Summary of empirical evidence

It is difficult to draw any precise overall conclusions from the empirical evidence bearing upon the impact of highly educated immigrants on the economic welfare of the native-born. This is because most empirical evidence focuses on a small number of specific channels of potential influence, rather than providing evidence from a general-equilibrium model that accounts for the net balance of all of the potential channels of influence. Furthermore, relatively little of the available empirical evidence is specific to Canada, which is somewhat surprising given the attention received by Canada's immigration policies.

In this context, it is difficult to draw even qualitative assessments of the net economic impact of highly educated immigrants on the native-born. Certainly, the impact is likely to differ across categories of native-born. Specifically, it seems likely that less-skilled, native-born Canadians benefit more from highly educated immigrants than do highly educated, native-born Canadians, since highly educated immigrants are poorer substitutes for less-skilled Canadians than they are for Canadians who are more skilled. The evidence also suggests that the most potentially robust channels for generating economic benefits for the native-born are through increased entrepreneurship and innovation associated with immigration of specific types of highly educated immigrants. In particular, highly educated immigrants with training in the sciences and engineering are most likely to create start-ups that increase demand substantially for Canadian workers. They are also most likely to advance scientific and technical knowledge that leads to innovation and technological change with the associated productivity gains for the native-born. However, it is unclear if the evidence on this phenomenon drawn largely from US studies applies to Canada.

Notwithstanding these caveats, the balance of evidence suggests that highly educated immigrants make positive contributions to the economic welfare of the native-born. Taken by itself, this is an argument for increasing the intake of highly educated immigrants. While most of the debate surrounding immigration in Canada has focused on the target number of immigrants, a relevant issue that has received much less attention is whether changes in government policies can increase the economic contributions of highly educated immigrants to the native-born. This includes modifying immigrant-selection criteria, as well as changing tax policies that would make Canada a more



attractive destination both for immigrants with entrepreneurial ambitions and talents and those with advanced training in STEM-related educational programs. As we shall discuss in the next section, the available evidence suggests that Canada has not benefited as much from highly educated immigrants as the United States. Indeed, as noted above, highly educated immigrants have poorer labour-market outcomes than their native-born counterparts. Whether and why highly educated immigrants in Canada are making economic contributions “below expectations” are therefore extremely important questions to be asked about Canadian immigration policy.

## 5. Highly Educated Immigrants in Canada

As noted earlier, it is very difficult to provide an accurate estimate of the overall impact of highly educated immigrants on the economic welfare of the native-born. Perhaps the best one can say is that the main channels through which the contributions of highly educated immigrants are likely to be leveraged are through their contributions to innovation and entrepreneurship. Unfortunately, the bulk of the available evidence on these linkages is for the United States, and this evidence tends to support the potential importance of the linkages. However, the available evidence also suggests that highly educated immigrants in Canada make weaker economic contributions to the host economy than do their counterparts in the United States.

### 5.1 Labour-market outcomes of highly educated immigrants in Canada and the United States

In one relatively recent study, Bonikowska, Hou and Picot (2011) compare cross-cohort patterns in earnings during the first five years after arrival of university-educated immigrants in Canada and the United States over the period from 1980 to 2005. Among other findings, they show that immigrant men experienced a growing earnings disadvantage relative to native-born university graduates in Canada, which was not the case in the United States. The falling relative earnings of university-educated new immigrants in Canada were driven by declines in the absolute wages of successive immigrant cohorts and increases in the earnings of Canadian-born workers. In the United States, earnings rose for both groups of university-educated workers from 1990 to 2000. In a related phenomenon, while the earnings premium (over high-school graduates) for university graduates increased over the period from 1990 to 2005, the earnings premium for university-educated immigrants was lower in 2005 than in 1990. In the United States, the premium to a university education rose from 1980 to 2005 for both immigrants and native-born men and women. By 2005, the university wage premium was 63% higher in the United States than in Canada among native-born men and 255% higher among new immigrants. The differences for women were smaller but in the same direction.

One might expect the earnings premium of highly educated immigrants to the United States to be higher than that of highly educated immigrants to Canada, since the United States enjoys a higher share of immigrants with education levels above a bachelor's degree. However, the findings of Bonikowska, Hou and Picot (2011) are essentially unchanged when the earnings premium comparison is restricted only to those with a bachelor's degree as the highest educational attainment. Challinor (2011) summarizes other studies that identify significant and sustained differences between the income of

newcomers and that of Canadian-born across the education spectrum.<sup>35</sup> Indeed, the increase in low income rates for recent immigrants was most significant for university-educated recent immigrants between the 1996 and 2006 censuses. The contrasting experiences of Canada and the United States appear to hold if one standardizes for occupation and not just level of education. For example, McDonald, Warman and Worswick (2015) compare the occupational outcomes of International Medical Graduates (IMGs) in the United States and Canada. Their main finding is that IMGs in Canada are less likely to be employed as physicians than are IMGs in the United States. Furthermore, a large percentage of the IMGs in Canada are either unemployed or employed in occupations requiring lower skills. The authors posit that the different labour market outcomes reflect the fact that IMGs in the United States are chosen through employer nomination, rather than a point system as is used in Canada.

In summary, the broad findings of recent studies are that highly educated immigrants in the United States seem to have better labour-market outcomes than highly educated immigrants in Canada. Furthermore, while the labour-market outcomes of highly educated immigrants in Canada appear to be deteriorating relative to the outcomes of highly educated native-born, the opposite seems to be the case in the United States.<sup>36</sup> One might infer from these broad findings that the economic contributions of highly educated immigrants to their host economy are likely to be greater in the case of US immigrants than for Canadian immigrants, although we are unaware of any empirical studies that directly support this inference.<sup>37</sup> Nevertheless, the absence of such empirical evidence does not gainsay the importance of understanding the sources of the different labour-market outcomes, since such knowledge could provide insight into how Canada might improve the economic contributions of highly educated immigrants.

Bonikowska, Hou and Picot (2011) try to identify statistically the sources of the differences in the labour-market experiences in Canada and the United States of highly educated immigrants. Unfortunately, they do not identify statistically significant factors. In particular, accounting for differences in the sociodemographic compositions of immigrants such as ability to speak English (or English-French in Canada), age, region of origin, and so forth, did not have much influence on the observed differences between Canada and the United States. They conclude that there may be productivity differences between highly educated immigrants in Canada and the United States that are difficult to identify using conventional measures of immigrants' backgrounds.<sup>38</sup> This conclusion is similar to that of Kaushal and Lu (2015), who note that, while Canada improved its edge over the United States in terms of host-country language proficiency of new immigrants,

35. See also Plante, 2015.

36. For a discussion of some recent evidence of a widening income gap in Canada between immigrant and non-immigrant workers with the same amount of education and work experience, see Li, 2017.

37. In particular, it might be the case that the superior labour-market performance of highly educated immigrants in the United States is internalized entirely in higher earnings of those immigrants.

38. Green and Worswick (2012) provide evidence that both immigrant and native-born entrants to Canada's workforce experienced earnings declines in the 1990s and early 2000s owing to macro-economic factors.

recent immigrants to Canada have experienced a wage disadvantage compared to recent immigrants to the United States. They speculate that, even though Canada's point system has successfully attracted larger numbers of educated immigrants, it may not be effective in identifying productivity-related traits that are not easily measurable. We shall have more to say about this possibility in the final section of this paper.

## 5.2 Labour-market outcomes of highly educated immigrants within Canada

There is substantially more evidence on the determinants of the labour-market outcomes of highly educated immigrants within Canada. One factor that has been identified in several studies is where immigrants obtained their educations. For example, Plante (2015) reports that internationally educated immigrant workers are less likely than immigrants educated in Canada to report working in their fields or in equivalent occupations. This result might reflect, in part, the fact that immigrants educated in Canada have had more time to adapt culturally and improve their language skills, which would help their labour market prospects upon graduation. Support for this interpretation is provided by Bonikowska, Green, and Riddell (2008) who show that, while not having English or French as a first language does not negatively affect the literacy or numeracy skills of immigrants with Canadian education, it does for those of foreign-educated immigrants. More generally, they find that the literacy, numeracy and problem-solving skills of educated immigrants depend upon where human capital was acquired. Specifically, immigrants who completed their education prior to their arrival in Canada have significantly lower skills than otherwise similar immigrants who obtained some or all of their education in Canada. They also reject the notion that Canadian employers have difficulty in appropriately recognizing immigrants' skills as a systematic issue.

In his extensive review of contributions to the literature on immigration in Canada, Nadeau (2011) references a number of studies that conclude that education and work experience should be discounted if they have not been earned in Canada or in countries whose economies are in comparable states of development as that of Canada. Kerr (2013) summarizes evidence for the United States that the average skilled immigrant appears to be better trained to work in scientific and technical fields conditional on having educational attainments of comparable quality to native-born. Furthermore, the very best trained immigrants have a disproportionate impact on measures such as patenting and business start-ups. In short, the economic performance of highly skilled immigrants appears to depend significantly on where their human capital was acquired, and this might be especially true for the very highest skilled immigrants, particularly those trained in STEM-related occupations, who arguably make the largest economic contributions to the host economy.<sup>39</sup>

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39. Squicciarini and Voigtlander (2015) argue that "upper-tail" knowledge rather than average human capital is what drives industrialization. That is, the skills held by top engineers and entrepreneurs enable a society to innovate and foster rapid technological progress.

While there are other factors that seem to condition the economic performance of highly educated immigrants to Canada, some are directly or indirectly related to their educational background, particularly their degree of fluency in English and/or French. In particular, if an immigrant received some or all of her higher education in Canada, she should be relatively fluent in one or both official languages. Work experience may also be related to educational background to the extent that immigrants enrolled in graduate programs in Canada participate in research and related training activities that will be carried forward into the workplace.<sup>40</sup>

In sum, increasing the number of highly educated immigrants who have acquired tertiary degrees (preferably at the graduate school level) in STEM-related subjects at Canadian universities, or at universities of similar quality, should arguably be a major focus of Canada's immigration policies going forward. Of course, such individuals are also desirable candidates for immigration in the eyes of other governments as well. Whether Canada is a desirable destination for highly prized immigrants depends not only on Canada's immigration policies compared to those of other countries, but also on the benefits the immigrant expects to receive living in Canada relative to other economies. We turn to this latter issue in the next section.

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40. Stuen, Mobarak and Maskus (2012) highlight the contributions that international doctoral students in science and engineering programs make to innovation in the United States.

## 6. The Competition for “Upper-Tail” Scientists and Engineers

In recent years, developed countries have been the recipients of highly educated immigrants from developing countries, including, most notably, China and India. An important channel through which such immigration takes place is through foreign student enrollments in Bachelor degree and post-graduate college and university programs. The concentration of foreign students in doctoral programs in STEM-related subjects is particularly noteworthy.<sup>41</sup> Traditionally, a substantial percentage of foreign students have remained in the host countries for employment after graduation. However, this dynamic might be changing, at least for students from China. In this regard, the number of students returning to China as a proportion of outbound Chinese students increased from 55% in 2011 to nearly 80% in 2016 (ICEF Monitor, 2016). The rapidly growing Chinese technology sector is apparently a major factor drawing Chinese students back to China after finishing their training abroad. As well, Chinese universities are improving in world rankings, which is reducing the demand on the part of Chinese students for enrollment in universities in the United States, United Kingdom, Australia, and Canada (Yiying, 2007).

The growth of China’s economy, and its high-technology sector in particular, implies a significant increase in the competition that Canada will face going forward in attracting highly educated immigrants with training in STEM fields. Conversely, recent changes to the administration of H-1B applications in the United States have apparently decreased applications for H-1B visas, which is a major category through which highly educated immigrants enter the United States.<sup>42</sup> The Trump Administration is also reconsidering existing policies that allow spouses of H-1B visa holders to apply for work permits. There is some evidence that uncertainty on the part of highly educated immigrants in the United States about the security of their visa status has encouraged some increased migration of highly educated immigrants to Canada in the post-Trump era (Weise and Roi, 2018). However, the Trump Administration has also signalled that it wants to reform American immigration law to emphasize preferences for highly educated immigrants possessing skills that are in relatively short supply in the United States.

At the time of writing, it is unclear if the various governments will ratify the successor to the NAFTA (the USMCA). If it is not ratified and the NAFTA is terminated, along with the NAFTA visa arrangement, fewer highly educated Canadians are likely to migrate to the United States to work, since the NAFTA TN visa has been the main way that highly educated Canadians have gained legal work status arrangements there

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41. In the United States, for example, foreign-born students earn almost one-half of all doctorates in science and engineering (see Kaushal and Fix, 2006).

42. For a discussion, see Henry, 2018.

(Iqbal, 2000). This development would indirectly reduce competition that Canadian employers face in hiring highly educated scientists and engineers. Nevertheless, as China, and prospectively India, become attractive locations for educated STEM professionals, competition for the “upper tail” of the highly educated in the STEM fields, which has always been sharp, is likely to become even sharper in future years. Therefore, if Canada is going to compete successfully for such immigrants, it must ensure that it makes itself a more attractive opportunity for upper-tail immigrants than its main competitors for those individuals.

## 6.1 Factors influencing the location decisions of highly educated immigrants

Potential host countries will differ in important attributes including income and employment opportunities by skill, industry, and experience. Political and cultural factors will also have an influence on immigration decisions. Both theory and evidence suggest that differences in per-capita incomes across countries play an important role in determining migration flows (Borjas, 1999). In this regard, in seeking to attract the upper-tail of the distribution of highly educated immigrants, Canada must offer prospects of earning a higher per-capita income than those (English-speaking) countries with which it competes for those immigrants. In this regard, per-capita income comparisons will presumably take into account prospects for future changes in income related to the outlook for host-country companies, opportunities to start one’s own business in the host country, and the host country’s tax structure, other things constant.

Ideally, we would like to have empirical evidence bearing upon the importance of factors that highly educated immigrants consider when choosing among relatively high-income countries as host country destinations. To our knowledge, no such evidence exists. However, there is evidence for a large sample of countries that differences in per-capita income are statistically significant influences on the decisions of the highly educated to migrate (Globerman and Shapiro, 2008). Of more direct interest, perhaps, Globerman and Shapiro show that highly educated immigrants are attracted to countries where the income differences between individuals possessing the same education levels are greater. The interpretation here is that the most skilled want to migrate to labour markets where they will receive the maximum after-tax financial rewards for their superior skills.<sup>43</sup>

Globerman and Shapiro do not find evidence that differences across countries in government revenue as a share of GDP influence the migration decisions of the highly educated. They used this variable as a measure of the immigrant’s expected tax burden. However, they acknowledge that their measure of tax burden is flawed, as it does not capture the degree of progressivity of an individual country’s tax system. In this regard, Moretti and Wilson (2017) look at the influence of differences in tax rates across US states on the migration decisions of “star” scientists. The latter are identified based on

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43. After-tax incomes include the value of government services paid for through taxes, notably including health care and education.

their awarded number of patents. Consistent with their high incomes, the migratory flows of star scientists are sensitive to changes in the 99<sup>th</sup>-percentile marginal tax rate, but they are insensitive to differences in tax rates for median incomes. Corporate income-tax rates are also found to have an effect on star scientists' location decisions, albeit the effect is concentrated among private-sector inventors, as might be expected.

A caveat that might be raised about the findings of Moretti and Wilson is that it is easier for star scientists to migrate across state boundaries than across national boundaries, although the costs of relocation, even across countries, are relatively low for highly educated scientists (Borjas, 1999). Moretti and Wilson also note that other factors besides tax rates influence the location decisions of star scientists, although they do not estimate the effects of other factors in their statistical model. Evidence from surveys focusing on the migration of highly educated Canadians to the United States provide some insight into these other factors. They include better professional growth opportunities and exposure to leading-edge technology. However, higher salaries and lower US taxes are also prominently mentioned in survey responses.<sup>44</sup>

The availability of opportunities to work in leading-edge technology firms will also depend upon a variety of factors. In this regard, the Government of Canada has acknowledged that improvements in the domestic environment for innovation is a priority to attract highly educated scientists and engineers. Among the efforts that the Government of Canada is making in this regard is funding initiatives in artificial intelligence and other cutting-edge technologies (Weise and Roi, 2018). However, relatively high tax rates might blunt or even stymie such efforts. Growth rates of high technology start-ups are especially sensitive to differences in tax structures. In particular, economic research shows that high capital-gains taxes discourage both the willingness of individuals to engage in entrepreneurial activities and the willingness of investors to finance entrepreneurial endeavours.<sup>45</sup> While Canada has a lower top personal marginal capital-gains tax rate than the United States, Canada's rate is higher than those of Australia, the United Kingdom, and New Zealand.<sup>46</sup>

Relatively high marginal income-tax rates can also make it more difficult for entrepreneurial firms to attract upper-tail scientists and engineers as employees. It is difficult to compare effective income-tax rates given differences in tax codes across political jurisdictions. In Canada, the top federal income-tax rate is 33% for taxable incomes above CDN\$205,842. In the United States, a head of household making the equivalent of CDN\$205,842 would face a marginal federal income tax rate of 28%.<sup>47</sup> Provincial

44. For a summary of this survey evidence, see Iqbal, 2000. Spicer, Olmstead, and Goodman (2018) report that systems designers educated in Canada who migrated to the United States earned a base salary of CDN\$143,000. Those who remained in Canada earned a base salary of CDN\$65,000.

45. For a comprehensive summary and assessment of the empirical evidence on this issue, see Mitchell, Garst, Lammam, and Jackson, 2018.

46. New Zealand has no capital gains tax (Mitchell, Garst, Lammam, and Jackson, 2018).

47. This assumes an exchange rate of  $\text{CDN}\$1.0000 = \text{US}\$0.7650$ , although the relatively wide US federal tax bracket of 28% makes the conversion of US to Canadian income relatively insensitive to the precise exchange rate used.



income-tax rates for high-income earners in Canadian provinces tend to be higher than income-tax rates in individual US states. For example, the top income-tax rate in Ontario is 13.2% on taxable incomes over CDN\$220,000. The top income-tax rate in British Columbia is 16.8% on taxable incomes over CDN\$150,000. In contrast, a taxpayer in California having the equivalent taxable income to that of either the Ontario or British Columbia taxpayer would be in the 9.3% tax bracket.

Undoubtedly, there are non-labour market and income-related considerations that are relevant to the emigration decisions of top-tier STEM professionals, including access to good educational opportunities for their children, the quality of health care, the attitudes of native-born to immigrants, and so forth. However, the available evidence suggests that any serious policy initiative to compete internationally for the best available, highly educated STEM professionals must consider whether after-tax income opportunities in Canada for those individuals are at least equivalent to those in the United States and other English-speaking countries, since the latter are arguably Canada's most direct competitors for highly educated STEM immigrants. Indeed, competition for upper-tail STEM immigrants might increase given increasing calls in the United States to redirect the million green cards a year it currently issues to all immigrants exclusively to the world's most talented workers (Conrad, 2019).<sup>48</sup>

## 6.2 Changing Canada's immigration laws

Against the background of increasing competition for upper-tail STEM professionals, it is relevant to address whether altering Canada's immigration laws might attract more upper-tail STEM professionals. To the extent that such individuals primarily self-select into locations that are relatively favourable for starting new businesses and participating in innovative activities, immigration rules, *per se*, might have a very modest influence, at best, on their decisions to immigrate to Canada rather than other countries. If so, immigration policy might best be viewed in the context of a broader set of public policies.

To the extent that the quality of human capital obtained through formal education is linked to future performance as a STEM professional, one possible change to the current point system used in Canada is to calibrate the allocation of points by the quality of the post-secondary institutions in which the applicant's formal education was obtained. Under the current system, applicants will receive maximum points if they obtained their education from a Canadian university or a foreign university of equivalent quality. However, there is substantial variation in the quality of Canadian universities themselves.<sup>49</sup> A possible modification to the existing rule is to allocate additional points if an applicant has graduated from a top-tier Canadian university or a foreign university of an approximate ranking by one or more of the organizations that produce systematic

48. The Trump Administration recently unveiled changes to how visas are allocated for highly skilled foreign workers in an effort to increase the number awarded to people with advanced degrees from US universities (Radnofsky, 2019).

49. For one set of rankings of Canadian universities relative to universities worldwide, see Top Universities, 2018.

rankings.<sup>50</sup> While extra points as given to applicants with Second-Stage Tertiary Degrees, the incremental points above those with First-Stage Tertiary Degrees might be increased to acknowledge the reality that significant breakthroughs in science and engineering are more likely to be made by individuals with post-graduate degrees rather than a bachelor degree. Finally, given the evidence that individuals with STEM backgrounds are more likely than others to start successful new companies and contribute in a significant manner to scientific and technical advances, the possession of a formal degree in a STEM-related field might be a separate category for points in addition to the level of the candidate's formal education.<sup>51</sup>

Li (2017) also argues that the value of education for foreign-trained immigrants in Canada is linked to the quality of education in source countries. Specifically, the economic performance of immigrants who completed their education before moving to Canada is strongly influenced by the quality of their source countries' educational systems. Li advocates the use of standardized test scores rather than university rankings as a means of evaluating the quality of an immigrant's educational background for those who did not graduate from Canadian universities.<sup>52</sup>

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50. Recall that extra points are given to candidates who are proficient in both official languages as opposed to solely one of the languages.

51. In 2017, the Canadian government created a program called the Global Skills Strategy to issue temporary work permits to people with job offers in certain categories, including senior software engineers, in as little as two weeks (Weise and Roi, 2018).

52. The Canadian government recently released changes to the Post-Graduate Work Permit effectively making it easier for international students studying at Canadian "designated learning institutions" to apply for permanent residence after their student permits expire. However, the changes do not take into account quality of the institution, nor the student's field of study (Canadim, 2019).

## 7. Concluding Comments

It is almost a conventional wisdom that highly educated immigrants make a positive contribution to the economic welfare of the native-born. Surprisingly, there is relatively little available evidence that quantifies the overall economic impact of highly educated immigrants, although there is some evidence that bears upon specific channels through which the native-born might be affected. Much of the evidence is related to the issue of whether, and to what extent, highly educated immigrants affect labour-market conditions facing the highly educated native-born. The evidence, on balance, suggests that highly educated immigrants are net substitutes for their native-born counterparts. Hence, the direct result of increased immigration by highly educated individuals is likely lower incomes for the highly educated native-born individuals, other things constant. At the same time, such immigration is a complement to the skills of less-educated native-born workers, thereby promoting improved labour-market conditions for the latter group.

In the longer run, the incomes of the highly educated native-born might indirectly increase because of immigration by highly educated individuals to the extent that the stock of tangible and intangible capital per native-born worker increases. This might be the case to the extent that highly educated immigrants are more likely than their native-born counterparts to invest in start-up businesses and to make significant contributions to science and technology. There is some evidence to support this case, although the relevant evidence is mostly drawn from US experience. The problem with extrapolating this evidence to Canada is that highly educated immigrants in the United States seem to have better labour-market performances than highly educated immigrants to Canada. This may be partly because a greater percentage of immigrants in the United States have second-stage tertiary degrees, that is, degrees beyond a Master's degree. It may also reflect a self-selection process whereby educated immigrants from the upper tail of the distribution of skills favour the United States as a destination because the pecuniary rewards to their skills are maximized there.

Much of the controversy surrounding the effects of immigration on the native-born focuses on whether immigration increases or decreases the net fiscal burden of the native-born. That is, does immigration result in the native-born paying more or less tax relative to the government benefits that they receive. Since highly educated immigrants have above-average incomes, and since tax rates in Canada are progressive, while government services tend to be proportionally distributed, one would expect that immigration by highly educated immigrants would reduce the fiscal burden of the native-born. However, this inference assumes that tax rates are unaffected by immigration. To the extent that governments must spend more money to provide public services to a larger population, the native-born might find themselves paying higher taxes while consuming the same amount of public services. Available evidence from the United Kingdom suggests that the net fiscal impact of highly educated immigrants is likely to be strongly positive for the native-born.

Highly educated immigrants in Canada tend to cluster in Canada's major cities. To the extent that productivity is higher in larger cities than in smaller cities because of external economies of scale, immigration might benefit the native-born in Canada's major cities by indirectly increasing their productivity. While available evidence tends to support the relevance of economies to urban size, there is some debate about when those economies are exhausted. That is, there is some question about whether Canada's major cities are already at a size where external economies of scale from additional population growth are no longer significant. Indeed, the real possibility exists that increased population densities in Canada's major metropolitan areas might also be imposing some external costs on the native-born in the form of increased commuting times to and from work and other manifestations of congestion.

In the absence of quantitative evidence from general equilibrium models that take into account all of the possible effects that immigration by the highly educated can have on the native-born, one is left making qualitative evaluations of the limited evidence on specific channels of influence. Since the available evidence points to a small, but positive, income effect of total immigration on the native-born, again primarily based on the US experience, it seems reasonable to infer that immigration by the highly educated confers a positive, and, likely larger economic benefit on the native-born.

While the focus of the immigration debate in Canada has been primarily upon whether Canada would benefit from more or less immigration, it can be argued that an equally, if not more important, issue in the Canadian context is how to enhance the economic benefits to the native-born from current rates of immigration of highly educated immigrants. In particular, how can the contributions of highly educated immigrants to entrepreneurship and innovation be increased?

One approach is to incorporate more selective educational criteria into the Express Entry points system. This might include distinguishing among foreign (and, perhaps, Canadian) universities in terms of their quality, particularly in STEM-related disciplines. Immigrant applicants with degrees from highly ranked graduate programs would receive substantial bonus points. While graduate school rankings can be controversial, they are used routinely by universities as criteria for hiring faculty, as well as by businesses, as evidenced by the strong demand that US companies have for graduates of the University of Waterloo.

As the rules currently exist, an applicant with a degree from a Canadian university, or from a foreign university of equivalent quality, qualifies for the maximum number of points allocated to the relevant degree category. In fact, there are substantial differences in the rankings of individual Canadian universities and, therefore, in the rankings of foreign universities of equivalent quality to Canadian universities.<sup>53</sup> While concerns exist about the reliability of league tables that rank universities, Canada's current immigration rules rely on external verification of the quality of an immigration candidate's college or university. While the ranking of universities becomes more contentious the finer

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53. For one league table ranking Canadian universities that illustrates the dispersion across Canadian universities in their global rankings, see Top Universities, 2018.

the degree of separation one seeks to attain, the failure to distinguish between world-leading universities and the rest of the population of higher-education institutions wastes valuable information.<sup>54</sup>

Another possible modification to the current criteria is to give additional weight to the possession of what was identified earlier as a Second-Stage Tertiary Degree, essentially professional degrees and the Ph.D. Currently, applicants with post-Baccalaureate degrees do receive more points than those with First-Stage Tertiary Degrees. However, the additional points allocated are quite modest. For example, applicants with earned bachelor degrees receive 21 points, while those with earned Ph.D.s receive 25 points. Significant scientific and technical achievements are more likely to be made by professionals with post-graduate training, and this potential should arguably be given a more prominent weight in the immigration selection process.

Finally, the current point system might be altered to create a separate category for individuals with formal university or post-university education in a STEM-related field. The current criteria indirectly recognize specialized training in different professional categories as that training is linked to specific degree holdings. In particular, specific distinctions exist between professional degrees such as Doctor of Laws and Doctor of Medicine, although the point allocation is typically the same. However, no explicit additional point allocation is made for advanced degrees in STEM-related subjects. For reasons discussed earlier, if the policy objective is to improve the economic benefits that highly educated immigrants confer on the native-born, immigrants trained in the sciences and engineering are more likely than others to be contributors to technological change, as well as to the creation of start-ups that can compete with technology start-ups in other countries.

Given a selection bias of upper-tier STEM professionals for work in the United States, changes to Canada's immigration criteria might need to be augmented by other public policies. An obvious focus is to improve the domestic environment for entrepreneurship and innovation. This would not only make it more likely that highly educated immigrants will make fuller contributions to business start-up and innovation activities in Canada, it also increases the attractiveness of Canada to highly educated immigrants with upper-tail skills.

It is less obvious how to improve the environment in Canada for entrepreneurship and innovation. While there are a number of potential policy options, the country's tax structure should be recognized as a potentially important feature conditioning the environment for entrepreneurship and innovation. Specifically, lower taxes on capital gains will spur more entrepreneurial activity among both highly educated immigrants, as well as their native-born counterparts. At the same time, lower marginal tax rates at the high end of the income scale will make Canada a more attractive location for star scientists born abroad, as well as star scientists born in Canada.

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54. Stuen, Mobarak and Maskus (2012) found that US visa restrictions limiting the entry of high-quality students were particularly harmful to academic innovation.



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## About the Author

### Steven Globerman

Steven Globerman is Resident Scholar and Addington Chair in Measurement at the Fraser Institute as well as Professor Emeritus at Western Washington University. Previously, he held tenured appointments at Simon Fraser University and York University and has been a visiting professor at the University of California, University of British Columbia, Stockholm School of Economics, Copenhagen School of Business, and the Helsinki School of Economics. He has published more than 200 articles and monographs and is the author of the book, *The Impacts of 9/11 on Canada-U.S. Trade*, as well as a textbook on international business management. In the early 1990s, he was responsible for coordinating Fraser Institute research on the North American Free Trade Agreement. He earned his BA in economics from Brooklyn College, his MA from the University of California, Los Angeles, and his PhD from New York University.



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