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Migration and Skills Disparities across the Canadian Provinces

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COULOMBE S. and TREMBLAY J.-F. Migration and skills disparities across the Canadian provinces, Regional Studies. This paper compares the skill intensity and schooling of the international immigrant, interprovincial migrant and Canadian-born population using data constructed from the 2003 International Adult Literacy and Skills Survey (IALSS). On average, international immigrants to Canada have more years of schooling but a lower skill level than the Canadian-born population. The mean skill deficiency of the foreign-born population corresponds to three years of formal education in Canada. Interprovincial migrants typically have a higher skill intensity than the Canadian-born non-migrant population. It is shown that international immigration tends to reduce provincial disparities whereas interprovincial migration tends to increase them. The first effect dominates.

International immigration Brain drain Human capital Interprovincial migration Provincial disparities Skill intensity

COULOMBE S. et TREMBLAY J.-F. Migration et disparités de compétences entre les provinces canadiennes, Regional Studies. Nous comparons l'intensité en compétences et la scolarité des immigrants internationaux, des migrants interprovinciaux et de la population née au Canada en utilisant des données construites à partir de l’Enquête internationale sur l’alphabétisation et les compétences des adultes de 2003. En moyenne, les immigrants internationaux au Canada ont davantage d’années de scolarité mais un niveau plus faible de compétences que la population née au Canada. La déficience moyenne de compétences de la population née à l’étranger correspond à trois années d’éducation formelle au Canada. Les immigrants interprovinciaux ont typiquement une intensité en compétences plus élevée que la population non-migrante née au Canada. Nous démontrons que l’immigration internationale tend à réduire les disparités interprovinciales alors que la migration interprovinciale tend à les augmenter. Le premier effet domine.

Immigration internationale Fuite de cerveaux Capital humain Migration interprovinciale Disparités provinciales Intensité en compétences


Internationale Immigration Abwendung qualifizierter Fachkräfte Humankapital Interprovinzielle Migration Disparitäten zwischen Provinzen Intensität der Qualifikation

COULOMBE S. y TREMBLAY J.-F. Migración y desigualdades de formación en diferentes provincias canadienses, Regional Studies. Comparamos la intensidad de la formación y escolaridad entre inmigrantes internacionales, emigrantes interprovinciales y la población nacida en Canadá con ayuda de datos elaborados a partir del estudio International Adult Literacy and Skills Survey de 2003. De promedio, los inmigrantes internacionales en Canadá tienen más años de escolaridad pero un menor nivel de cualificaciones que la
población nacida en Canadá. La deficiencia media en la formación entre la población nacida en el extranjero corresponde a tres años de educación formal en Canadá. Los emigrantes interprovinciales normalmente tienen un mayor nivel de cualificaciones que la población no emigrante nacida en Canadá. Aquí mostramos que la inmigración internacional tiende a reducir las desigualdades entre las provincias mientras que la migración interprovincial tiende a aumentarlas. Domina el primer efecto.

Inmigración internacional Fuga de cerebros Capital humano Migración interprovincial Desigualdades entre provincias Nivel de cualificaciones

JEL classifications: I20, J24, J61, O15, R23

INTRODUCTION

With the ‘neoclassical revival in growth economics’,¹ the focus of a large body of the growth and development literature has shifted in the last decade to the accumulation of human capital. Following MANKIW et al. (1992), empirical research has used human capital intensity as one of the key determinants of various labour productivity indicators in cross-country studies.² On theoretical grounds, the role of human capital is potentially important. According to MANKIW (1995), the share of human capital in national income, around 50%, is greater than the share of physical capital that is about 33% in most developed economies. This approach to economic growth is particularly attractive in understanding long-run economic developments in small open economies such as the Canadian provinces. Recent empirical evidence (COULOMBE and TREMBLAY, 2001, 2007; COULOMBE, 2003) indicates that the neoclassical framework can account reasonably well for the evolution of per capita provincial income disparities toward their long-run equilibrium distribution across the ten Canadian provinces since the 1950s.

This paper focuses on the relative skill level of international immigrants and of interprovincial migrants in Canada. The relative human capital intensity of the migrant and Canadian-born populations is measured using a direct output measure of human capital based on the results of cognitive tests. The main objectives are to examine the relation between the skills and the schooling of international immigrants and to quantify the contribution of the international immigration and interprovincial migration processes to the skill level of the labour force across the Canadian provinces. To this end, use is made of new data on the skill component of interprovincial migrants and international immigrants in Canada, data extracted and aggregated from the 2003 International Adult Literacy and Skills Survey (IALSS) released by STATISTICS CANADA (2005).

Human capital intensity in cross-country studies is traditionally measured by schooling data, following the Mincerian approach in labour economics. This may be a good first approximation for microeconomic studies dealing with individuals of the same countries if the quality of schooling is relatively homogeneous across schools. However, the quality of the educational system, as with other important social and economic institutions, is likely to differ greatly across countries, especially across developed and developing countries. Indeed, the first important contribution of this paper is to highlight the fact that measuring the contribution of international immigration to human capital intensity by using an output measure of human capital (skills indicator) as opposed to an input measure (years of schooling) matters considerably.

International migration can affect the distribution of human capital intensity across the provinces as international immigrants are concentrated mainly in the provinces with large urban centres.³ The relative human capital intensity across provinces can also be affected by interprovincial migration if the skill intensity of interprovincial migrants differs from the non-migrant population. As documented in COULOMBE (2006), interprovincial migration has always been a powerful mechanism of population redistribution in the Canadian federation. Hence, the second contribution of this paper consists in characterizing the effects of international migration and interprovincial migration on skill disparities across Canadian provinces.

The main results of this analysis are the following.

First, it is found that the skill level is substantially higher in the Canadian-born population than in the foreign-born population, at any level of schooling. The international migration process appears to generate a brain drain that benefits the Canadian economy when using schooling data. But the picture is reversed when skill data are used: international migration tends to dilute the skill intensity in the Canadian economy. Second, evaluated at the mean years of schooling, the measured skill deficiency of international immigrants (the skill–schooling gap) is equivalent to 3 years of formal education in Canada. The skill–schooling gap decreases to 2.1 years of schooling in the case of international immigrants with English or French as first language. Third, the richer provinces are generally more affected by the diluting effect since they tend to attract relatively larger international immigration flows. Consequently, it is shown that international immigration tends to reduce substantially provincial skill disparities. Fourth, interprovincial migration, characterized by the intra-national brain drain from the poor to the rich provinces, has the opposite effect.
on provincial skill disparities. Quantitatively however, the effect of international immigration on provincial skill disparities is much greater than that of interprovincial migration.

The lower skill level of the foreign-born population in Canada has been documented in the study of Ferrer et al. (2006). Their microeconometric analysis is based on immigrant literacy data taken from the 1998 Ontario Immigrant Literacy Survey (OILS) that covers six census metropolitan areas in Southern Ontario. Ferrer et al. (2006) compare these literacy data with a sample of the Canadian-born population from urban areas around Canada taken from the 1994 International Adult Literacy Survey (IALS). Ferrer et al.’s (2006) main finding is that the relatively low literacy of international immigrants is an important factor in explaining the earnings differential between foreign- and Canadian-born. Sweetman (2004) has also related the return to schooling of international immigrants in the Canadian labour market to the cross-country school quality index constructed by Hanushek and Kimko (2000).

This analysis complements Ferrer et al. (2006) and Sweetman (2004) by looking at the effect of migration on the skill intensity at the aggregate provincial level.

The paper follows Borjas (1987) and the related recent studies on development accounting in linking the skill intensity of international immigrants in Canada to the quality of schooling in the country of origin. Borjas found that the return to schooling differs greatly across countries of origin and that immigrants’ earnings in the USA are correlated with political and economic characteristics of the countries of origin. In their growth-accounting study, Klenow and Rodriguez-Clare (1997) adjusted the years of schooling used as a proxy for human capital across countries to account for the positive relationship between wages and per capita income found in Borjas (1987). Hendricks (2002) has also used the earnings of international immigrants in the USA to adjust the years of schooling for human capital measurement in a cross-country study. In a recent theoretical and empirical study, Manuelli and Seshadri (2005) allow the quality of schooling to vary with the level of development across countries. This adjustment helps to increase considerably the capacity of human capital to account for cross-country income differences.

Information on the underlying theoretical and empirical motivations is provided in the next section. The data are then presented before the paper goes on to describe two key stylized facts regarding the skill–schooling relationship for the Canadian international immigrants and the brain drain of the interprovincial migration process. Next, the paper documents the skill intensity of international immigrants, before analysing the effect of international immigration and interprovincial migration processes on aggregate indicators of skills and human capital stock across the Canadian provinces and the overall Canadian economy. Conclusions are then reached in the final section.

THEORETICAL AND EMPIRICAL MOTIVATIONS

The focus on comparing the skill and the schooling measures extracted from the IALSS 2003 data is motivated by theoretical and empirical considerations. Following Mankiw et al. (1992), the augmented neoclassical production function for an economy i at time t can be written in labour intensive form as:

\[ y_{it} = F(k_{it}, h_{it}, A_{it}) \]

where \( y_{it} \) is labour productivity; \( k_{it} \) is the physical capital intensity (the capital/labour ratio); \( A_{it} \) is the level of technology; and \( h_{it} \) is the human capital/labour ratio, or the skill intensity of the labour force. In an open economy with perfect capital mobility such as described in Barro et al. (1995), the ratio of physical capital to output can be assumed to be constant. Consequently, and assuming that the production function takes the Cobb–Douglas form, it can be rewritten in logarithm form as:

\[ \ln y_{it} = \beta \ln h_{it} + \epsilon_i + \ln A_{it} \quad (1) \]

where \( \epsilon_i \) is a time-invariant parameter as long as the world interest rate is constant; and \( A_{it} \) is a normalization of \( A_{it} \). According to this neoclassical approach, the human capital intensity is one of the few important determinants of labour productivity differences across economies. Coulombe and Tremblay (2007) use various time-series and cross-sectional empirical models based on (1) to analyse the relationship between the human capital intensity and per capita income, excluding government transfers to individuals, across the Canadian provinces in the 1951–2001 period.

Note that human capital intensity \( h_{it} \), can also be viewed as a vector that includes a range of different skills contributing to the production process. Considering \( h_{it} \) as such may be particularly important if it is believed that the skills indicators that have been constructed from the IALSS are proxies for only a subset of the different skills that enter the production function.

The standard approach in empirical macroeconomics is to use the mean years of schooling \( s_{it} \) in the labour force as a proxy for skill intensity. This approach is based on the microeconomic Mincerian empirical literature that has related earnings at the individual level to a limited number of key parameters such as years of schooling, experience and sex. From a conceptual point of view, the limits and dangers of measuring skill intensity across economies by comparing years of
schooling can be illustrated using the following ‘human capital production function’:

\[ h_{it} = S_{it}(s_{it}, z_{it}, z_{it-1}, \ldots) \]  

(2)

In country \( i \) at time \( t \), the mean skill intensity of the labour force, or the human capital/labour ratio, is the result (output) of a production process. The inputs entering the skill production function \( S_{it} \) are the mean years of schooling \( s_{it} \) and a set \( z \) of country-specific characteristics. These include such attributes as the quality of the educational system, job-related training and other socioeconomic factors, given that skills are also acquired within the family and social circles outside the educational system and the labour market. The past values of the \( z \) are also likely to affect the present skill intensity. If the present and past \( z_{it} \) are quite comparable across a set of economies, as can be assumed as a first approximation for the ten Canadian provinces, one can approximate the mean skill intensity at the aggregate level adequately by the mean years of schooling of the labour force. This provides an estimation of the skill intensity based on an input measure, but if the purpose of the exercise is to compare the skill intensity across countries with large variations in the present and past values of the \( z \), focusing on an input measure such as schooling might be misleading. For example, after controlling for schooling, BORJAS (1987) finds that the earnings of international immigrants to the USA are positively correlated with the per capita income level of the country of origin. In the human capital function (2), BORJAS’s (1987) findings might be interpreted in the following way: earnings are a good proxy for the skill intensity, and the per capita income level is a proxy of the \( z_{ir} \).

At the individual level, human capital production may also be a function of experience and ability. If immigrants tend to be young relative to natives and if they tend to have a relatively high level of unobserved ability, possibly because of self-selection effects, measures of current observable skills may underestimate the productive human capital and the future skill level of immigrants. This should be kept in mind when assessing the contribution of immigration to the human capital stock of an economy.

The central merit of measuring human capital intensity by using the skills scores of the 2003 International Adult Literacy and Skills Survey (IALSS) is that it provides a direct measure, or an output measure, of the skill intensity. To this end, the skills scores should be designed to be comparable across countries, which is precisely the case with the IALSS and with its predecessor, the 1994 International Adult Literacy Survey (IALS). The results of COULOMBE and TREMBLAY (2006a) empirical analysis based on the IALS 1994 data indicate that skills indicators are preferable to schooling data for comparing the human capital intensity across a subset of 14 OECD countries. The output approach to measuring the skill intensity should be even more useful when comparing the skill intensity of the international immigrant population in Canada because the immigrants come from a variety of countries, developed and developing, with a larger variance in the \( z_{ir} \).

**DATA**

The skills and years of schooling indicators were constructed from the master file of the 2003 IALSS. The IALSS tested the proficiency level of individuals in four skill domains: prose literacy, document literacy, numeracy and problem solving. Proficiency in each of these domains is measured along a continuum and results are reported as a score on a 0–500 scale. The skills indicator for a particular population group is the average score of all individuals in that group over the four domains. Together, the four domains include a wide range of skills that are required to function effectively in everyday life and to participate in the economy (HRSDC–SC, 2005). For each domain, the tests also include tasks of various difficulty levels and therefore are not designed to measure only basic skills. For example, the most difficult tasks require ‘search through complex displays that contain multiple distractors, to make high level text-based inferences, to use specialized knowledge’, to ‘understand complex representations and abstract and formal mathematical and statistical ideas, possibly imbedded in complex texts’ and to ‘judge the completeness, consistency and/or dependency among multiple criteria’ (HRSCS-SC, 2005).

The IALSS is also designed to provide skill measures that are comparable in level across countries and over time. The questionnaire was designed by an international group of experts to provide relevant measures of skills performances for people with various cultural backgrounds. International skill data using the same methodology were collected in various countries in 1994, 1996, 1998 and 2003. Canada participated to the international assessment of adult literacy in 1994 and 2003. According to KIRLICH (2005, p. 91), the IALSS is also designed to provide data that can be used to compare skill levels across major subgroups of the population in a given country.

Consequently, it is important to bear in mind that the IALSS has not been designed to capture ‘Canada-specific’ skills. If it had been the case, the indicator would not have been better than earlier ones, based on immigrant earnings for example, to capture differences in the quality of education across countries. The central merit of the IALSS for the purpose of this study is that it has been precisely designed to capture skill differences across countries and across subgroups of the population with different cultural backgrounds.
The IALSS sample is a stratified multi-stage sample that uses the 1991 Census as a frame. The target population in the Canadian sample includes all non-institutionalized residents (including students) over the age of 16, excluding members of the armed forces and individuals living on First Nations Reserves. The data in this study were constructed from the sample that excludes residents from the Northwest Territory, Yukon and Nunavut. A sample of 20,019 responding units is used with 16,559 Canadian-born and 3,460 foreign-born. In this analysis, a respondent is considered to be an international immigrant if she/he was born outside Canada.

There is an important limitation associated with the skills indicator that should be kept in mind. The IALSS may not capture certain types of skills that may contribute to aggregate production and that should therefore be part of the human capital stock of an economy, including occupation and trade-specific skills, entrepreneurial skills and experience-related skills, among others. Hence, if the relative endowment of such skills differs across the immigrant and Canadian-born populations, the indicator could possibly underestimate the contribution of immigrants to the overall stock of human capital.

SKILLS AND SCHOOLING OF CANADIAN MIGRANTS: TWO STYLIZED FACTS

This section focuses on the main aggregates of human capital intensity of international immigrants, interprovincial migrants and non-migrants, extracted from the IALSS 2003 data bank. For comparison purposes, four subgroups of the Canadian population are used: Canadian-born non-migrants; Canadian-born interprovincial migrants; the total international immigrant population in Canada; and a subset of the previous subgroup, international immigrants from Francophone or Anglophone origins. It is important to note that for most of this analysis (except in the penultimate section), interprovincial migrants are individuals who were interviewed in 2003 in a different province from the province of birth and international immigrants are the foreign-born population in Canada.

The mean years of completed formal education from IALSS 2003 for the four subgroups of the Canadian population are shown in the left side of Fig. 1. A clear pattern emerges from this figure: the typical Canadian migrant (interprovincial migrant and international immigrant) is better educated than the typical Canadian non-migrant. In terms of mean years of schooling, the difference is close to 1 year of schooling between the Canadian-born interprovincial migrants (13.5) and the Canadian-born non-migrant (12.7). The mean years of schooling of the total international immigrant population in Canada falls in the middle (13) of these two numbers; the international immigrant population from Francophone or Anglophone origins has the largest mean years (14) of formal education.

Next, the analysis examines whether this picture of population subgroups that is based on the input measure of human capital holds for output measures such as the literacy scores. The overall mean literacy scores for the four subgroups of the Canadian population are shown on the right side of Fig. 1. The picture regarding the relative skill level of Canadian-born non-migrants and interprovincial migrants is consistent with the one displayed in Fig. 1: the skill level of the interprovincial migrants is greater than the non-migrant population. The difference between the numbers (13 in the IALSS 2003 scale) is roughly consistent with the difference of 1 year of schooling observed between these two subgroups in Fig. 1. As a first approximation, to convert...
the IALSS (2003) scale into years of schooling. OECD (2000, p. xiv) specifies that an additional year of schooling increases the literacy score of an individual on average by ten points in the 0–500 scale used for literacy tests. However, the literacy numbers for the international immigrants contrast sharply with the schooling numbers. Even if the total international immigrant population has more years of formal education than the Canadian-born non-migrant population, their mean skill level is about 30 points fewer. The same pattern is observed for the international immigrants from Francophone or Anglophone origins. Despite reporting more years of schooling on average (1.5 years) than Canadian-born non-migrants, their mean skill level is seven points lower on the IALSS 2003 scale.

This initial investigation of the skills and schooling levels of Canadian-born and international immigrant populations has highlighted two important stylized facts:

- **The international immigrant skill gap.** Compared with the Canadian-born population, international immigrants in Canada have a lower average skill level but have reported more years of schooling.
- **The interprovincial skill redistribution.** The typical interprovincial migrant in Canada has a skill level higher than the non-migrant. Given that net interprovincial migration flows are typically from the seven traditional ‘have-not’ provinces to Ontario, Alberta, and British Columbia, interprovincial migration results in a skill redistribution process from the poorer to the richer Canadian provinces.

An important point that comes out of these stylized facts is that the choice between schooling and skills for measuring human capital is particularly important for the international migration process.

**DOCUMENTING THE FOREIGN-BORN SKILL GAP**

**The skill—schooling gap**

In order to understand the different relationships between schooling and skills of the international immigrant and Canadian-born populations that emerged from Figs 1 and 2, the mean skill level is computed at all schooling levels from the IALSS 2003 data. The correspondence between skills and schooling for the Canadian-born and international immigrant populations is shown in Fig. 2. Given the small number of respondents who reported years of schooling below 5 and over 22, their mean skill level was not computed accurately and the numbers are not reported.

The striking point that emerges from Fig. 2 is that the skill—schooling curve for international immigrants stands remarkably and relatively steadily below the skill—schooling curve for the Canadian-born population. This indicates that the skill level acquired through schooling is less for the foreign-born than the Canadian-born population at any level of schooling.

The first task is to provide a quantitative assessment of the gap. A simple measure such as the ratio between the mean skill level and years of schooling might be misleading since both skill—schooling curves display similar decreasing-return shapes. Such a non-linear relationship is consistent with the recent cross-country evidence on the macroeconomic return (from earnings) to schooling (Psacharopoulos, 1994). If earnings and skills are closely related, as suggested by Green and Riddell (2001), the marginal and the mean return to schooling in terms of acquired skills should also be decreasing with the number of years at the aggregate level.

One can quantify the differential return to schooling by measuring the vertical distance between the two schooling curves at the mean of the foreign-born curve. Skill differences, however, cannot be interpreted in a straightforward fashion from a quantitative point of view since they are measured on an arbitrary scale from 0 to 500.

All these considerations lead one to interpret the differences in the skill—schooling relationship between the two populations by looking at the horizontal distance between the curves in Fig. 2 at the mean skill level of the foreign-born population. To this end, the relationship has been estimated between the skill level \( h \) and years of schooling \( s \) of the Canadian-born population using the 18 grade-level observations shown in Fig. 2. It was found that the following second-order polynomial best described the skill—schooling relationship:

\[
\begin{align*}
    h &= 75.8 + 22.16s - 0.49s^2 \\
    (9.12) &\quad (16.5) &\quad (-10.0) &\quad R^2 = 0.99 SE of regression = 4.99
\end{align*}
\]

with the \( t \)-statistics shown in parentheses. The actual-fitted-residual graph is shown in Fig. 3. The fit is very
The mean skill level of 243.2 and the corresponding years of formal education of 13 (point A in Fig. 3) obtained for the total international immigrant population corresponds to 9.6 years of formal education in the Canadian-born population. The merit of using the fitted rather than the observed skill curve for the non-migrant population is that the residual depicted in Fig. 3 is treated as white noise generated by, among other things, measurement error.

The skill–schooling gap varies considerably across countries. This suggests that the value of schooling, in terms of acquired skills, also varies considerably across countries. The correlation coefficient between the skill–schooling gap and per capita income in the immigrants’ home country is approximately 0.64. This finding first indicates that there is considerable information contained in the synthetic measure of the quality of schooling. The high correlation is consistent with Borjas’s (1987) results that link the market value of schooling of US immigrants to the per capita income in the immigrants’ home country. In this analysis, the correlation is negative because the skill–schooling gap might be viewed as an attempt at capturing the difference in the return to schooling between Canada and other countries. The higher the skill–schooling gap, the lower is the quality of education.
Results of a simple bivariate OLS regression where the skill–schooling gap is regressed on the per capita income and a constant across the 26 countries are shown with the scatter in Fig. 4. The slope parameter of per capita income is highly significant with a p-value of 0.0004 and the \( R^2 \) of the simple cross-section regression at 0.41. The \(-0.10\) point estimate of the slope coefficient indicates that the skill–schooling gap is one year smaller in countries with a higher per capita income of US$10 000.

Proficiency scores by skill domains and age groups

Another point of interest is to verify if the relative performance of the foreign-born varies across literacy domains that are related to communication skills and quantitative skills. To this end, the mean score has been computed for the four literacy domains tested in IALLS 2003: prose, document, numeracy and problem solving. The ratio between the mean score of the total international immigrant and Canadian-born populations are 0.87 (prose), 0.89 (document), 0.90 (numeracy) and 0.87 (problem solving). Thus, the relative performance of the international immigrants does not differ much across the four domains: it is a little better in numeracy than in prose but not significantly better in problem solving than in prose and document. The key point that emerges is that the skill gap of international immigrants is not significantly smaller in quantitative domains such as problem solving and numeracy than in domains that capture reading capacities such as prose and document. It is important to point out, however, that the numeracy and problem-solving scores of international immigrants with poor reading skills in French or English might have been driven down because they have problems understanding the questions in those languages.

The relationship between the mean literacy score and age is shown in Fig. 5 for the Canadian-born and foreign-born populations. In both cases, the score

---

**Table 1. The skill–schooling gap of international immigrants by country of origin and per capita income (Y)**

<table>
<thead>
<tr>
<th>Country</th>
<th>Skill–schooling gap</th>
<th>Per capita income</th>
<th>Skill–schooling gap</th>
<th>Per capita income</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.9</td>
<td>28 381</td>
<td>Vietnam</td>
<td>3.2</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.9</td>
<td>13 134</td>
<td>Mexico</td>
<td>3.2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>1.3</td>
<td>20 965</td>
<td>Other countries</td>
<td>3.2</td>
</tr>
<tr>
<td>Italy</td>
<td>1.4</td>
<td>20 147</td>
<td>China</td>
<td>3.3</td>
</tr>
<tr>
<td>Russia</td>
<td>1.4</td>
<td>7192</td>
<td>Philippines</td>
<td>3.7</td>
</tr>
<tr>
<td>UK</td>
<td>1.5</td>
<td>19 543</td>
<td>Jamaica</td>
<td>4.2</td>
</tr>
<tr>
<td>France</td>
<td>2.2</td>
<td>20 142</td>
<td>El Salvador</td>
<td>4.2</td>
</tr>
<tr>
<td>Germany</td>
<td>2.4</td>
<td>21 048</td>
<td>Sri Lanka</td>
<td>4.3</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>2.4</td>
<td>25 168</td>
<td>Poland</td>
<td>4.4</td>
</tr>
<tr>
<td>Romania</td>
<td>2.5</td>
<td>4780</td>
<td>India</td>
<td>4.4</td>
</tr>
<tr>
<td>Taiwan</td>
<td>2.8</td>
<td>14 583</td>
<td>South Korea</td>
<td>4.9</td>
</tr>
<tr>
<td>Guyana</td>
<td>3.0</td>
<td>2651</td>
<td>Pakistan</td>
<td>5.0</td>
</tr>
<tr>
<td>Iran</td>
<td>3.0</td>
<td>5302</td>
<td>Ukraine</td>
<td>6.5</td>
</tr>
<tr>
<td>Lebanon</td>
<td>3.2</td>
<td>4495</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: The skill–schooling gap for an international immigrant subgroup is the horizontal distance between the point corresponding to its mean skill level and schooling in the skill–schooling plan and the Canadian-born skill schooling curve in Fig. 3. It corresponds to the difference between the mean years of schooling of the immigrant subgroup and the typical Canadian born with the same skill level. The larger the skill–schooling gap, the smaller is the value of education in terms of acquired skills. Per capita income is the real gross domestic income adjusted for terms of trade changes in 1995 measured in US dollars at 1996 constant prices. The income data were extracted from Penn World Table.

\(^*\)For all skill–schooling gaps, the standard error (computed from the results from regression equation (R1) using the delta method) is 0.514 years. Consequently, the 95% confident interval is around 1 year and skill–schooling gaps estimated for the USA and Portugal are not significantly different from zero.
starts to increase with age, up to 30–34 years of age for the Canadian-born population and to 25–29 years for the international immigrants. After the peak, the skill level decreases with age. More importantly, the skill–age curve of international immigrants stands steadily and considerably below the skill–age curve of the Canadian-born population. Therefore, differences in the age structure of Canadian-born and foreign-born populations cannot account for the skill–schooling gap.

A provincial perspective

The international migration flow is not spread evenly across the ten Canadian provinces. As shown in the first column of Table 2, the proportion of international immigrants in the population in the IALSS 2003 sample varies considerably across provinces. Only two provinces, Ontario (0.33) and BC (0.32), have migration rates greater than the Canadian average (0.23). Three other provinces, Alberta (0.19), Manitoba (0.16), and Quebec (0.12) also attract relatively substantial numbers of international immigrants. International migration rates are considerably smaller in the Atlantic provinces (ranging from 0.02 to 0.06) and in Saskatchewan (0.05).

Analysis of the IALSS 2003 data reveals a surprising fact regarding the skill intensity of the international immigrant flows across provinces. As shown in the second column of Table 2, the mean skill level of international immigrants varies considerably across provinces. More specifically, the skill intensity is relatively very low in Ontario and Manitoba. Furthermore, the skill intensity of international immigrants is high in Newfoundland and Nova Scotia. In the other provinces, the skill intensity of international immigrants is relatively constant and falls between these two extremes.

The portrait of international immigration per province is completed with the last two columns of Table 2 that report the skill—schooling gap of total international immigrants and international immigrants with English or French as first language. Interestingly, the five provinces with the larger skill—schooling gap are also the five provinces with the largest international migration rates (as reported in the first column of Table 2). Ontario has the highest skill—schooling gap among the ten provinces for both total immigrants and immigrants with English or French as first language. The skill—schooling gap is smaller in all provinces for the immigrant population with English or French as first language. Interestingly, in two traditional immigration provinces, Alberta and British Columbia, the skill—schooling gap of the immigrants with English or French as first language is around 0.4 years. This is remarkably smaller than the 2.8 years observed for the same subgroup in Ontario.

Table 2. Literacy score and the skill—schooling gap of international immigrants, per province

<table>
<thead>
<tr>
<th>Proportion of international immigrants in the population</th>
<th>Mean literacy overall score of international immigrants</th>
<th>Skill—schooling gap of international immigrants</th>
<th>Skill—schooling gap of international immigrants with English or French as first language</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>0.32</td>
<td>200.9</td>
<td>2.5</td>
</tr>
<tr>
<td>Alberta</td>
<td>0.19</td>
<td>248.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>0.05</td>
<td>264.0</td>
<td>1.3</td>
</tr>
<tr>
<td>Manitoba</td>
<td>0.16</td>
<td>234.5</td>
<td>2.9</td>
</tr>
<tr>
<td>Ontario</td>
<td>0.33</td>
<td>238.2</td>
<td>3.4</td>
</tr>
<tr>
<td>Québec</td>
<td>0.12</td>
<td>249.8</td>
<td>2.5</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>0.04</td>
<td>250.7</td>
<td>2.1</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>0.06</td>
<td>272.0</td>
<td>1.9</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>(IO)</td>
<td>(IO)</td>
<td>(IO)</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>0.02</td>
<td>281.1</td>
<td>1.8</td>
</tr>
<tr>
<td>Canada</td>
<td>0.23</td>
<td></td>
<td>2.06</td>
</tr>
</tbody>
</table>

Notes: The proportion of international immigrants in the population and the mean literacy overall score of international immigrants were computed by the authors from IALSS 2003. The skill—schooling gap for an international immigrant subgroup is the horizontal distance between the point corresponding to its mean skill level and schooling in Fig. 3 and the adjusted Canadian-born skill—schooling curve. In the last column, the numbers for Saskatchewan, Prince Edward Island and Newfoundland are not reported because of an insufficient number of observations. (IO): Indicates that there is an insufficient number of observations (below 30) to be sufficiently confident about the estimate. All reported estimates are based on at least 30 observations.
THE EFFECT OF MIGRATION ON PROVINCIAL MEAN SKILL LEVELS

This section provides a quantitative assessment of the accounting effect of migration flows on the skill intensity of the ten Canadian provinces. This accounting exercise is designed to estimate, from a quantitative point of view, whether the ‘dilution’ effect of international migration and the redistribution effect of interprovincial migration on the skill intensity are substantial.

The effect of international migration

Given the variability in migration rates and the differences in skill intensities observed earlier, the effect of international migration on skill intensity is likely to vary considerably across provinces. This net effect of international immigration on the mean skill intensity is measured by taking the difference in the mean skill levels of the total population and the Canadian-born portion of the population. The results are presented in the first column of Table 3 for the ten provinces and for Canada as a whole.

For Canada, the addition of international immigrants to the Canadian-born population translates into a decrease of the mean skill intensity by 7.5 points in the IALSS 2003 scale. This number corresponds to a decrease of 0.72 years of schooling in the Canadian-born skill–schooling curve around its mean.

As expected, the differences across provinces are indeed striking. Only two provinces stand below the national average: Ontario, with a decrease of 14 points and British Columbia with a decrease of 12.1 points. In years of schooling around the mean in the Canadian-born skill–schooling curve, these two numbers correspond to a decrease of 1.31 and 1.15 years of schooling respectively. The negative effect is also substantial and just below the national average for Alberta, with a drop of 7.4 points, and for Manitoba with 6.3 points. For the other provinces, the net effect of international immigration on skill intensity is not that substantial. The effect is negative but very small for Saskatchewan, Quebec and New Brunswick. Interestingly, the net effect is positive (although very small) in Nova Scotia and Newfoundland. Hence, in these two provinces, the mean skill level is greater for international immigrants than for the Canadian-born.

The contribution of international immigration to the provincial skill levels implies that the dispersion of skill intensity of the total population across the ten provinces (including international immigrants) is much smaller than for the Canadian-born population. In the IALSS 2003 scale, the standard deviation of the skill intensity across the provinces measured with the Canadian-born population is 11.11; it falls to 7.66 when the international immigrant population is included in the population. The dispersion of skill intensity, evaluated around the dispersion measured using the total population, is reduced by 45% when international immigration is accounted for. By comparison, international immigration reduces the dispersion in years of schooling by only 9%; the standard deviation of years of schooling across provinces decreases from 0.51 for the Canadian-born population to 0.47 when international immigrants are included.

An important caveat should be noted here. There is some evidence that the literacy skills of immigrants increase with the length of time spent in Canada (Ferrer et al., 2006). Therefore, the effect of a group of international immigrants arriving in Canada at a particular point in time on provincial skill disparities may tend to decrease in the long run. The accounting exercise does not take this into account in assessing the effect of international immigration on the mean provincial skill levels.

Table 3. The incidence of migration on skill levels across provinces

<table>
<thead>
<tr>
<th>Net contribution of international immigration on the mean skill level</th>
<th>Net contribution of interprovincial migration on the mean skill level</th>
<th>Stock of net skills gains from interprovincial migration</th>
<th>Stock of gross skills loss from interprovincial migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>British Columbia</td>
<td>−12.1</td>
<td>−0.1</td>
<td>0.21</td>
</tr>
<tr>
<td>Alberta</td>
<td>−7.4</td>
<td>1.5</td>
<td>0.26</td>
</tr>
<tr>
<td>Saskatchewan</td>
<td>−1.7</td>
<td>2.2</td>
<td>−0.54</td>
</tr>
<tr>
<td>Manitoba</td>
<td>−6.3</td>
<td>−3.6</td>
<td>−0.27</td>
</tr>
<tr>
<td>Ontario</td>
<td>−14.0</td>
<td>0.5</td>
<td>0.03</td>
</tr>
<tr>
<td>Québec</td>
<td>−1.8</td>
<td>−1.6</td>
<td>−0.05</td>
</tr>
<tr>
<td>New Brunswick</td>
<td>−0.4</td>
<td>−3.0</td>
<td>−0.13</td>
</tr>
<tr>
<td>Nova Scotia</td>
<td>0.1</td>
<td>1.9</td>
<td>−0.04</td>
</tr>
<tr>
<td>Prince Edward Island</td>
<td>(IO)</td>
<td>1.0</td>
<td>−0.46</td>
</tr>
<tr>
<td>Newfoundland</td>
<td>0.5</td>
<td>−5.2</td>
<td>−0.31</td>
</tr>
<tr>
<td>Canada</td>
<td>−7.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Computed by the authors from IALSS 2003. (IO): Indicates that there is an insufficient number of observations (below 30) to be sufficiently confident about the estimate. All reported estimates are based on at least 30 observations.
The effect of interprovincial migration

In order to measure the effect of interprovincial migration on the overall skill intensity of provinces, use is again made of the skill intensity of the total population (including international immigrants) as the benchmark and it is compared with the skill intensity that provinces would have in the absence of any interprovincial migration. An alternative approach would be to use as benchmark the provincial skill intensities that would result from excluding all international immigrants and assigning all Canadian-born individuals to their province if birth. However, one of the objectives is to compare how international immigration and interprovincial migration affect the dispersion in skills across provinces, relative to the actual dispersion of skills. Therefore, it is preferred to use the actual interprovincial skills distribution as the benchmark.

The net accounting effect of interprovincial migration on the mean skill level of province $i$, $(NetP)_i$, is computed from the following equation:

$$NetP_i = A(TP)_i - \left( \frac{A(TP)_i \cdot N(TP)_i - A(MI)_i \cdot N(MI)_i}{N(TP)_i} + A(MO)_i \cdot N(MO)_i \right)$$

where $A$ and $N$ are respectively, the mean skill level and the number of people of the population subset specified in parenthesis, namely the total population $(TP)$, the interprovincial in-migrant population $(MI)$, and the interprovincial out-migrant population $(MO)$. The in-migrants for province $i$ are the individuals who currently reside in province $i$ but were born in a different province, whereas the out-migrants for province $i$ are the individuals who were born in province $i$ but now reside in another province. Of course, for Canada as a whole, the effect of interprovincial migration on the mean skill level is null.

The results of the exercise are presented in the second column of Table 3. The first important point that emerges is that, overall across the ten provinces, the quantitative impact of interprovincial migration on the distribution of the skill intensity is much smaller than for international immigration. The standard deviation of the net effect of interprovincial migration, which is 2.6 on the IALSS 2003 scale, is around half what it is for international migration (5.4). Not surprisingly, Newfoundland, the province that had the largest rate of negative net migration since the mid-1970s (COULOMBE, 2006) is the one that is characterized by the largest brain drain.9 The brain drain is also relatively substantial in New Brunswick and Manitoba but is much smaller in Quebec. The brain gain is minimal in the two rich provinces of Ontario and Alberta and the net effect is virtually null in British Columbia. The most interesting finding, however, is that interprovincial migration translates into a small but positive brain gain for Saskatchewan, Nova Scotia and Prince Edward Island.

From a purely accounting point of view, interprovincial migration helps to increase the dispersion in the skill intensity across the provinces. The standard deviation of the hypothetical skill intensity distribution where all interprovincial migrants are assigned to their province of birth is 1.6 point smaller on the IALSS (2003) scale than for the distribution based on the total population. Again, evaluated at the standard deviation of the total population, interprovincial migration accounts for an increase of 21% of the dispersion of the skill intensity across the Canadian provinces.

Overall, the two migration channels have opposite effects on the skill disparities across the ten Canadian provinces. International immigration tends to reduce provincial disparities whereas interprovincial migration tends to increase them. The net effect of the two channels on provincial disparities, however, is clearly negative since in absolute value, the negative effect of international migration is more than twice as great as the positive effect of interprovincial migration.

It should be noted that the accounting exercise does not take account of the fact that part of the skills of interprovincial migrants may be acquired after migration. That could lead to over-estimation of the skills redistribution that occurred through migration, especially if migration responds to labour market opportunities that also result in skill acquisition. Moreover, individuals may migrate before completing their formal education, to attend university in a different province for instance, which would also lead to the over-estimation of the amount of interprovincial skills redistribution. This issue is partly addressed in the next section.

INTERPROVINCIAL MIGRATION AFTER HIGH SCHOOL EDUCATION

This section provides a quantitative assessment of the direct effect of interprovincial migration, after high school education, on the total human capital stock among the provinces. To that end, the definition of both migrants and non-migrants has been changed. An in-migrant in province $i$ is now an individual who resides in province $i$ but completed his last year of high school education in another province, whereas an out-migrant from province $i$ completed his last year of education in province $i$ but currently resides in another province. The in-migrant and out-migrant populations include foreign-born individuals who completed their last year of high school education in Canada and subsequently moved to another province. Of course, a non-migrant is an individual who was interviewed in the same province as the one of schooling (including the foreign-born individuals who completed...
their last year of high school in Canada). The aggregate measure of the human capital stock gained or lost through interprovincial migration in province \( i \) is the stock of net skill gains \( \text{NetHI} \). It is defined as a percentage of the human capital stock of the non-migrant population:

\[
\text{NetHI}_i = \left( \frac{A(MI)_i \cdot N(MI)_i - A(MO)_i \cdot N(MO)_i}{A(NM)_i \cdot N(NM)_i} \right)
\]

The stock of net skill gains is measured from the skill level \( A \) and number \( N \) of the in-migrants \( MI \), out-migrants \( MO \) and non-migrants \( NM \). The results of the computation are presented in the third column of Table 3. The net human capital loss is very substantial in four provinces: Saskatchewan \((-0.54)\), Prince Edward Island \((-0.46)\), Newfoundland \((-0.31)\) and Manitoba \((-0.27)\). The number for Saskatchewan implies that the net skills loss, measured on the IALSS 2003 scale, corresponds to 54% of the skill stock of the non-migrant population in this province. The loss is also substantial in New Brunswick \((-0.13)\) but much less significant in Quebec and Nova Scotia. The net skill gain is not substantial for Ontario, and only the two western provinces of Alberta \(0.26\) and British Columbia \(0.21\) show substantial gains.

If the skills indicator is a good proxy for the human capital produced through formal primary and secondary education, it may also be interesting to examine the importance of emigration from particular provinces, adjusted for the skill intensity of emigrants, as a share of total skills produced. Among other things, this may have implications for the incentives of provincial governments to invest in education. With interprovincial migration, part of the skills produced by the investment of provincial governments in education benefits other provinces, both from the external benefits of human capital and from the taxation of the labour market returns on skills. This will generally lead provincial governments to underestimate the full return of education funding and to underinvest in schooling.

To get an idea of the quantitative importance of provincial out-flows of skills, the gross skills loss \( \text{OutHI}_i \) of each province were computed as follows:

\[
\text{OutHI}_i = \left( \frac{A(MO)_i \cdot N(MO)_i}{A(NM)_i \cdot N(NM)_i + A(MO)_i \cdot N(MO)_i} \right)
\]

It corresponds to the gross skills loss of each province as a ratio of the total skills produced in that province, abstracting from the skills of international emigrants. Results are presented in the last column of Table 3. Saskatchewan is again leading with respect to gross skill loss with 39% of the total skills produced in this province having left for other provinces. Prince Edward Island follows closely with a 0.38 ratio. The ratio of skills loss is also very substantial in New Brunswick, Nova Scotia and Manitoba. The size of these ratios suggests that the incentives for provincial governments to invest in education may be substantially weakened by migration.

**CONCLUSION**

Direct measures of human capital based on cognitive tests indicate that international immigrants in Canada have, on average, a lower skill level than the Canadian-born population, whereas interprovincial migrants are more skilled than the non-migrants. These facts, combined with the distribution of migrants across provinces, imply that international immigration and interprovincial migration have opposite effects on regional disparities. In particular, it was found that international immigration has a relatively large negative effect on the mean skill level in the provinces of Ontario, British Columbia, Alberta and Manitoba, the first three being the richest provinces. Moreover, the standard deviation of the skill intensity across provinces, measured on the 2003 IALSS scale, is 45% higher for the Canadian-born population than for the total population that includes international immigrants. In contrast, interprovincial migration has the opposite effect on the level of skill disparity, although quantitatively the effect is only about half of the effect of international migration. Overall, migration therefore tends to reduce provincial skill disparities.

It is important to emphasize that the alleviating effect of international immigration on Canadian skill disparity unveiled in this paper comes from the fact that an output approach to the measurement of human capital was used. This effect does not show up when human capital is measured by a traditional input approach based on schooling data because international immigrants typically have more years of formal education than the Canadian-born population. This is one of the main contributions of the paper: measuring human capital using an output measure matters considerably when assessing the contribution of immigrants coming from a wide range of countries.

The analysis also highlights an important measurement issue by showing that schooling indicators may be relatively poor measures of the skills of potential migrants. Among other things, this possibly questions the relevance of using schooling attainment as a criterion in the selection of international immigrants. More importantly, it shows that measuring the relative skill intensity of international immigrants and inter-regional migrants, using direct measures of skills, may be critical in understanding the pattern of regional disparities in developed countries.

The gap between schooling indicators and direct measures of skills for international immigrants, as well as the general distributional pattern of international and internal migration across the relatively rich and
relatively poor regions of Canada, are likely to apply to other developed countries that experience important migration flows, such as the USA and the UK. The results lead one to believe that using direct measures of skills to investigate the impact of migration on the distribution and redistribution of human capital across regions of developed countries is an important area for future research.

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NOTES

1. From the title of Klenow and Rodríguez-Clare (1997).
3. Ontario, Quebec, British Columbia, and Alberta. Manitoba is also an important province for international immigration.
4. Prose literacy is defined as ‘the knowledge and skills needed to understand and use information from texts including editorials, news stories, brochures and instructions manuals’, document literacy as ‘the knowledge and skills required to locate and use information contained in various formats including job applications, payroll forms, transportation schedules, maps, tables and charts’, numeracy as ‘the knowledge and skills required to effectively manage the mathematical demands of diverse situations’ and problem solving ‘involves goal-directed thinking and action in situations for which no routine solutions exist’ (HRSDC-SC, 2005).
5. For more information on IALSS, refer to Murray et al. (2005).
6. Also Coulombe and Tremblay (2006b) for results regarding second generation immigrants, immigrants having some schooling in Canada and for those who have completed all their formal education abroad.
7. In their study of the effect of literacy on immigrant earnings, Ferrer et al. (2006) have analysed extensively the distribution of literacy test scores for international immigrants and for the Canadian-born populations using kernel density methods and have found that the distribution for immigrants is inferior to that of the Canadian-born population.
8. The data required for these calculations, as well as for the calculations reported in the following subsection and main section below, is presented in the Appendix of the working paper version (Coulombe and Tremblay, 2006b).
9. This result concurs with López-Rodríguez et al. (2007) findings that human capital accumulation is smaller in remote European regions.

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