



April 2018

Indigenous Access to Skilled Jobs in the Canadian Forest Industry: The Role of Education

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Recommended Citation

Cahill, I. G. (2018). Indigenous Access to Skilled Jobs in the Canadian Forest Industry: The Role of Education. *The International Indigenous Policy Journal*, 9(2).

DOI: 10.18584/iipj.2018.9.2.5

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Abstract

In this article, the effect of education on the skill level of jobs held by Indigenous people working in the Canadian forest industry is examined. A skill index based on detailed occupation is used as the dependent variable in ordered logit models estimated using data from Statistics Canada's 2011 National Household Survey (NHS). Results are obtained by gender. In the case of men, for Métis (a specific mixed European and Indigenous culture) and for First Nations living off reserve estimates of the effect of education are similar to those for non-Indigenous people. The estimated effect is lower for those Indigenous people living on reserve, particularly for those whose employment is also on the reserve. Results for women are similar, though often not statistically significant due to the limited sample size. High school graduation appears insufficient to provide access to better jobs, whereas post-secondary education, including trade certificates and community college, is very effective. The article concludes with a suggestion that, while closing the lag in Indigenous rates of high school education is critical, this must provide a gateway to further education. A discussion provides more policy context.

Keywords

forestry, education, skilled jobs, on reserve, off reserve, National Household Survey (NHS)

Acknowledgments

The author is grateful for support from the Canadian Forest Service and for comments from colleagues Dieter Kuhnke, Asghedom Ghebremichael, Kurt Niquidet, Dave Watson, Jeff Englin, Brian Wiens, and John Doornbos, but accepts responsibility for all errors. Opinions expressed are solely those of the author.

Disclaimer

This article was written while the author was employed by the Canadian Forest Service. The views expressed are solely those of the author, and do not necessarily reflect those of the Canadian Forest Service.

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Indigenous Access to Skilled Jobs in the Canadian Forest Industry: The Role of Education

Indigenous¹ participation in the Canadian forest industry is a natural policy concern. Since about 70 percent of Indigenous Peoples in Canada live in or near forested areas (Natural Resources Canada, 2017b), the forest industry could offer them considerable economic potential. In Canada, about 94 percent of forest land is publicly owned, with provincial and territorial governments managing about 90 percent of the land and setting up licensing or *forest tenure* agreements with harvesters and collecting royalties. Arguing for an increased role in forest management, a National Aboriginal Forestry Association (NAFA) presentation to the Standing Senate Committee on Agriculture and Forestry (Bombay, 2009) cited the proximity of the Indigenous populations to forest lands, relationships to the land, and Indigenous participation as vital components of sustainable forest management, arguing that treaty rights are a form of forest tenure. A current Canadian federal government program, the Indigenous Forestry Initiative (IFI), which has supported Indigenous Peoples' economic development, has included increasing Indigenous participation in forestry among its goals (Natural Resources Canada, 2017a). If the importance of forestry to Indigenous Peoples increases as problems regarding tenure of forest land are resolved,² it will likely highlight other barriers to forest industry employment, particularly education. In this article, the forest industry is defined broadly to include both harvesting and processing of timber (see the Forest Industry in the Method section). The range of jobs and skill levels addressed is similarly broad, ranging from low-skilled jobs in sawmills to jobs requiring a professional forestry designation to engineering jobs in forest-product manufacturing (see Canadian Federation of Professional Foresters Associations, 2017, for an indication of both required skills and links to the provincial associations). In 2016, average annual earnings in the forestry and logging were close to the average for all manufacturing industries in Canada (about \$47,000), and workers in pulp and paper products manufacturing earned close to \$67,000 (Natural Resources Canada, 2017b).

Access to jobs, particularly jobs requiring high levels of skill (which this article refers to as *skilled jobs*) is likely to depend on one's level of education. Unfortunately, however, Indigenous Peoples lag behind the rest of Canadian society in terms of their educational attainment. Extensive literature has measured the deficit in the relative average education level of Indigenous Peoples. With both of these topics in mind, this study asked: Compared to other workers, how much would an improvement in Indigenous Peoples' education levels increase their access to skilled jobs in the forest industry? An econometric approach, which estimated the marginal effect of education on the probabilities of getting jobs of various skill levels, was used to address and answer this research question.³ The skill levels were based on the most detailed occupational categories (Statistics Canada, 2016c). In this way, it was possible to determine if, compared to other workers, Indigenous people are able to effectively apply their education to working in the forest industry.

¹ While the term *Indigenous* is current in international contexts, the term *Aboriginal* has been more commonly used in Canadian government documents and organization names.

² The importance of forest tenure for Indigenous Peoples is discussed in the Tenure in the Results section.

³ The Method section, for example, notes some advantages over the more frequent choice of wages as an outcome measure.

The data used were drawn from the Statistics Canada 2011 National Household Survey (NHS; Statistics Canada, 2015a). With a sample of roughly 30% of the Canadian population, the Survey had a far larger sample size than other Canadian household surveys, and so it is the only data source that would permit restriction of the analysis both to the forest industry and to Indigenous workers therein.

In order to measure the marginal effect of education *ceteris paribus*, this study used a modelling approach that predicted the distribution of job skill levels based on individuals' levels of educational attainment and a group of control variables. The controls included socioeconomic variables that might be correlated with education, as well as the geographic distribution of residence. Separate measures have been estimated for five categories of workers: non-Indigenous, Métis, First Nation off-reserve, First Nation living and working on-reserve, and First Nation living on-reserve but commuting to work off-reserve.

This article is divided into four sections. The first section provides some background information for the study's empirical work, beginning with an historical overview that covers several important issues related to forestry and Indigenous education. The second section describes the data and methodology, including how the study measured skill levels required for different jobs. Then, the third section presents the results of the empirical analysis with some preceding charts that show the key econometric results. Finally, the fourth section concludes the article by discussing the study's findings, their relevance to the Canadian policy context, their international relevance, and some limitations. An appendix provides details of the econometric model and parameter estimates.

Literature Review and Theoretical Framework

The Importance of Forestry

The importance of forestry to Indigenous Peoples underlies this study. The current forest industry is a relatively minor employer of Indigenous people in Canada—in fact, less than 2% in most cases (see Table 1). However, their potential for employment in the forest industry is likely much greater because of the proximity of Indigenous populations to forest lands and their relationship to the land (Bombay, 2009), assuming that barriers like lack of tenure and low educational attainment can indeed be overcome. To some extent, this study was concerned not only with current Indigenous participation, which Frideres (2013) has characterized as reflecting “a history of denial and exclusion” (p. 33), but also with the potential for Indigenous employment in the forest industry. An important factor that could significantly increase opportunities for such employment is a continuation of the trend toward increased Indigenous tenure (see Natural Resources Canada, 2016). Such an increase in tenure has been advocated for by Passelac-Ross and Smith (2013) as essential to accommodating Indigenous rights. To the extent that the tenure issue is resolved, other barriers to Indigenous employment in the forest industry—particularly education—may become more important.

Educational Attainment

The relative lag in Indigenous Peoples' educational attainment compared with that of non-Indigenous peoples has been well documented. As such, it motivates the study of education as a crucial factor to address when considering Indigenous access to skilled jobs in the forest industry.

To this end, historical context helpfully illustrates some of the reasons for this lag in Indigenous Peoples' educational attainment. White and Peters (2009) have identified two major trends in Indigenous education in Canada. From Confederation until World War II, the policy they described as "assimilation, segregation, and separation" (p. 17) propelled the development of the primarily denominational residential school system, which often resulted in the prolonged and severe abuse of Indigenous children. After the gradual winding down of residential schools between the end of World War II and 1970, together with the integration of Indigenous students into provincial schools, came the "Indian control of Indian education" period (White & Peters, 2009, p. 23), so named after the title of the National Indian Brotherhood's 1972 position paper.

Gordon and White (2014) reviewed the evolution of educational attainment using the 1996, 2001, and 2006 Censuses and the 2011 National Household Survey (NHS). They documented significant strides in Indigenous Peoples' education attainment, noting a cumulative increase of 186 percentage points in post-secondary educational attainment between 1996 and 2011, while high school non-completion declined. They saw a positive trend in the similar rates of apprenticeship, trades, and college attainment for Indigenous and non-Indigenous populations. However, there was a large and growing disparity in university attainment. Further, Gordon and White (2014) noted continuing problems with high school non-completion for on-reserve, Status Indian, and Inuit groups.⁴

It should be noted, however, that some past signs of improvement may have been spurious. For example, White and Beavon (2009) noted that although the post-secondary education gap narrowed slightly between 1981 and 1991, it may have been due to an influx of higher educated people who regained Indian status through Bill C-31, together with an additional influx of higher educated people who chose to declare Aboriginal identity. Particularly, looking at the Registered Indian population, White, Peters, and Beavon (2009) showed that between 1991 and 2001 improvements in post-secondary educational attainment did not keep pace with those for the rest of the Canadian population.

Multiple studies have also raised the issue of high school non-completion among Indigenous Peoples. In a study recommending a focus on kindergarten to Grade 12 as the gateway to post-secondary education, Mendelson (2006) noted that, based on the 2001 Census, the proportion of high school graduates from the Indigenous population that go on to complete some form of post-secondary education is similar to that of the total Canadian population. Like Gordon and White (2014), Mendelson noted the disappointingly high rate of high school non-completion among the on-reserve Indigenous population. Similarly, Richards and Scott (2009) illustrated gaps in non-completion rates using data from provincial ministries of education. For British Columbia, they examined secondary school completion rates from Grade 8 onward that culminated in a 32% completion rate for Indigenous students compared to 52% for other Canadians. In Saskatchewan, Indigenous students' completion rates ranged from 25% to 31% between 1995 to 2005, compared to 72% and 75% for all students.

The last historical trend identified by White and Peters (2009) appears to be continuing, since Indigenous control of education remains an important issue in Canada. As such, policy discussions

⁴ Gordon and White (2014) have considered Status Indians (those who are registered under the Indian Act) separately. Some Status Indians live in their reserve communities and some do not. This study distinguishes between those who live on reserve and those who do not, but does not use Indian status as an organizing factor.

concerning Indigenous Peoples' educational attainment are likely to develop and occur in this context. For example, in 2014, the Canadian government introduced Bill C-33 (the First Nations Control of First Nations Education Act; Aboriginal Affairs and Northern Development Canada [AANDC], 2014), which was met by a request from the National Chiefs-in-Assembly (Assembly of First Nations [AFN], 2014) that the government withdraw the Bill and pursue more dialogue with First Nations. As a result, Bill C-33 was withdrawn in 2015 and the National Indian Education Council (NIEC) and the Chiefs Committee on Education (CCOE) have continued to work on a plan for statutory funding of both elementary and secondary education (AFN, 2016).

Progression to Post-Secondary Education

Recent literature has addressed the issue of Indigenous Peoples' progression from high school to post-secondary education. For example, Peters' (2013, Chapter 4) quantitative analysis has demonstrated the importance of academic achievement in high school among Indigenous students. Peters used the 2010 and 2011 University and College Applicant Study (UCAS), which is an annual survey of applicants to Canadian colleges and universities sent to a random sample of applicants to Ontario colleges as well as all applicants to 35 post-secondary education institutions in Canada that participated in the 2010 and/or 2011 UCAS (not a random sample). Notably, both Grade Point Average (GPA) and social support were predictors of expected post-secondary educational attainment. Peters derived her measure of social support based on the number of sources survey respondents used for information about their educational options. In the regression model explaining expectations, the effect of GPA for Indigenous students was very significant and similar in magnitude to that for the non-Indigenous group. The positive effect of social support was also significant and similar for both groups. Using primarily qualitative analysis, Restoule et al. (2013) examined high school to post-secondary education transition for Indigenous students in Ontario. Using a survey of Indigenous post-secondary education students with follow-up interviews, they identified some common difficulties, such as managing community ties and responsibilities. Using focus groups with Indigenous high school students, they documented perceived barriers to post-secondary education, including a lack of role models and scant information about cultural support from post-secondary education institutions. The authors suggested that the earlier establishment of relationships between post-secondary education institutions and potential Indigenous students would be important for successful transitions.

Indigenous Education and the Economy

The economic impacts of low educational attainment among Indigenous Peoples in Canada have been studied by Sharpe and Arsenault (2010). Specifically, they used disaggregated demographic data from 2006 to 2026 projections, provided by Indian and Northern Affairs Canada (INAC) and the Canadian Housing and Mortgage Corporation (CMHC, 2007), and applied it to 2006 participation rates and employment rates to obtain a base case labour market projection. Then, by adjusting the Indigenous rates to reach non-Indigenous levels, they obtained a simulation of a successful policy. Using the methodology from an earlier study (Sharpe, Arsenault, & Lapointe, 2007), Sharpe and Arsenault (2010) used average employment incomes by educational category to convert the labour market scenarios to estimates of Canadian Gross Domestic Product (GDP). The results are impressive: Closing the education gap would lead to a \$36.5 billion increase in Canada's GDP by 2026.

While this study focusses on the economic benefits of closing the education gap as measured by GDP, it does not suggest that economic benefits are the only or most important ones. When considering the forest industry, issues such as cultural values and the use of traditional knowledge may be important to Indigenous communities. This article presents some evidence for this in the Discussion section under Canadian Policy Context—Aboriginal Forestry Criteria and Indicators, which reviews criteria for and indicators of the success of forestry activities by Indigenous people.

Education and Wages

Some studies addressing education levels among Indigenous Peoples in Canada have considered wages as an indicator of labour market success. For example, Lamb (2013) used the popular Oaxaca (1973) technique with 2006 Census data to decompose wage gaps between Indigenous and non-Indigenous peoples in Canada into an *explained* part due to differences in endowments, such as education, and an *unexplained* part due to differences in returns to endowments. Lamb's results were consistent with a return to education for Indigenous Peoples in Canada that is similar to other Canadians. For example, Lamb found that, for males, there is a 16% gap that can be decomposed into about 10 percentage points explained and 6 percentage points unexplained. Detailed decomposition showed that about 7 percentage points of the explained gap are due to differences in educational endowment. Differences in returns to education contribute about -2 percentage points to the unexplained gap. The negative contribution indicated higher returns for Indigenous males; however, there is considerable statistical error around this result, so it would be consistent with quite similar returns.⁵ Decomposition of the 14.6% gap for females was also consistent with similar returns to education. Lamb considered Indigenous people living on-reserve separately and found that wage gaps are larger: 50% for males and 34% for females. Returns to education contributed little to the unexplained component, however, again indicating similar returns for Indigenous people.

A study by Walters, White, and Maxim (2004) has also considered wages as an outcome measure and is similar to this current study insofar as it focuses on returns to education. Based on the 1995 Statistics Canada National Graduates Survey, Walters et al. controlled for sociodemographic characteristics and found that, for trades and college graduates, Indigenous people earn about the same as non-minority or other visible minorities, while Indigenous people who are university graduates earn more than other groups.

The Current Study in Context

This study fits within a theoretical framework where various levels of educational attainment may impact labour market success in the forest industry, and the impacts may vary according to Indigenous status. Labour market success is evaluated according to a skill requirements index applied to current jobs. The above literature review added elements of policy context to this theoretical framework, including the increasing importance of the forest industry to Indigenous Peoples and increasing Indigenous control of education up to the secondary level. Specifically, this literature review has documented the current gap, some disappointing trends in the relative educational attainment of Indigenous people, and the

⁵ The coefficient estimate, given as a fraction, was actually -0.0217 with a Z statistic of -2.55, which, with the study's large sample, would indicate an error of plus or minus about $1.96 * (\text{coefficient} / Z) = 0.0166$.

economic implications of these problems. Moreover, it has reviewed the issue of high school as a gateway to post-secondary education. Finally, it has noted that some encouraging evidence has been found, which has suggested that (as measured by the effect on wages) returns to education for Indigenous people are similar to those of other Canadians.

Method

Census Data

The data used in this study were drawn from the Statistics Canada (2015a) NHS 2011. A random sample of 4.5 million households (about 30% of all private dwellings in Canada) was invited to respond to the NHS in the spring and summer of 2011 (the reference date of the NHS is May 10, 2011, the date of the 2011 Census of Population). In remote areas or on Indian reservations, all households were invited to participate in the NHS. The final response rate was 68.6%. The sample used in this study was restricted to those greater than 15 years of age and living in private households during the survey week (May 1 to May 7, 2011). The territories were excluded. For model estimation and for some graphs, the sample was further restricted to the forest industry; this required individuals to have been employed in the forest industry either in the survey week or during some period in 2010.

For this study, we chose to include individuals ages 16 and up in our sample, primarily because they may be in the labour force even if they have not completed their education. In some cases, this may permit a valid comparison between the labour market outcomes for similar young people in lower education categories (e.g., working with and without high school completion), even though they may undertake further education later in their lives.

Access to the NHS microdata was provided through a Statistics Canada Research Data Centre (RDC)⁶ hosted by the University of Alberta. Via the RDC, on-site access is provided to a researcher for a limited time. To ensure the confidentiality of information on individuals, results are vetted by the RDC manager before they can be released.

Definition and Grouping of Indigenous Peoples of Canada

This study uses the term *Indigenous*, which is common in international contexts, with the intention that it is approximately synonymous with the term *Aboriginal*, which is common in Canadian government and policy documents. Aboriginal peoples of Canada are defined in the Constitution Act, 1982, Section 35(2) as including those who are Indian,⁷ Inuit, and Métis (Department of Justice Canada, 2015).

This study used the self-reported Aboriginal identity variable in the NHS. This definition is common in the literature and has been defended by Lamb (2013) as preferable to a legal definition such as Registered Indian Status because of its inclusiveness and potential correlation with “intensity of Aboriginal ethnicity” (p. 5), which has been linked to economic disparity by George and Kuhn (1994). The NHS detailed Aboriginal identity has six categories:

⁶ For information on the RDC program, see Statistics Canada (2017).

⁷ Historically, the term Indian was used; however, First Nations is the preferred term.

1. First Nations (North American Indian) single identity,
2. Métis single identity,
3. Inuk (Inuit) single identity,
4. Multiple Aboriginal identities,
5. Aboriginal identities not included elsewhere, and
6. Non-Aboriginal identity.

Category 3, Inuk (Inuit), has effectively been excluded by restricting the sample to the provinces. Categories 2, 4, and 5 were combined. When the sample is limited to the forest industry, more than 92% of respondents in this category are Métis.⁸

Previous studies, such as Lamb (2013) and Mendelson (2006), have identified poor economic and educational outcomes for on-reserve Indigenous people. In the forest industry, a significant proportion of those living on-reserve actually work off reserve (see Table 1).

Motivated by these findings, this study used five categories of Indigenous identity:

- a. Non-Indigenous,
- b. Off-reserve persons who are Métis or in Categories 3 to 5 in the NHS detailed Aboriginal identity (see above),
- c. Off-reserve First Nation,
- d. Indigenous persons living on reserve but commuting off reserve to work,⁹ and
- e. Indigenous persons living and working on reserve.

Although people in the second category do not live on a reserve, they may live on one of eight Métis settlements in northern Alberta, created through the legal transfer of land title by the 1990 Alberta Métis Settlement Act (Bell, 1994), which are somewhat similar to reserves. These settlements comprise only 1.2% of the second category (Statistics Canada, 2016b).

⁸ NHS Categories 4 and 5 in the forest industry were too small for separate analysis. One possible choice would have been to discard them in order to maintain a Métis only category (excluding those who also identify as First Nations). However, if we had done this, then our sample would not have corresponded with many other studies that include all self-identified Indigenous people. Although we cannot determine the demographic composition of Categories 4 and 5 (which are about equal in size) since further disaggregation is prohibited to ensure privacy, respondents in Category 4 declaring both First Nations and Métis identity would share characteristics with the 92% single-identity Métis in our combined category.

⁹ The NHS asked respondents if they commuted to work in another Census Subdivision, which, in the case of a reserve, would mean commuting off reserve.

Table 1. Indigenous Identity Categories by Industry

	Non-Indigenous	Métis & Other	First Nations			All Groups	
			Off Reserve	On Reserve		N ^a	M
				Job Off Reserve	Job On Reserve		
Other industries (in 1,000s)	25,989	383	359	36	180	26,946	
Forestry (in 1,000s)	219.8	5.2	4.8	0.9	2.0	232.7	
% from each group employed in forestry	0.8	1.3	1.3	2.5	1.1		0.9
% of forestry employment from each group	94.5	2.2	2.0	0.4	0.9	100	
% of other industry employment from each group	96.4	1.4	1.3	0.1	0.7	100	

Note. Source: Statistics Canada, National Household Survey, 2011

^aTotals are not exact due to independent rounding of cells.

Although it did not include Métis settlements, the NHS definition of an on-reserve household is quite broad and included some First Nation communities that do not have legal status as an Indian reserve. In Québec in particular, lands reserved for the Cree and for the Naskapis are included (see Statistics Canada, 2016a, for a complete list with definitions).

The Forest Industry

As noted in the introduction, this study defined the forest industry broadly, using the North American Industry Classification System (NAICS) 2007. Besides forestry and logging (NAICS Code 113) and support activities for forestry (Code 1152) such as cruising timber, forest fire fighting services, and reforestation services, we have also included manufacturing of wood products (Code 321) and paper (Code 322; for more detail see Statistics Canada (2015e)). The NAICS industry refers to the job held during the NHS reference week or, if the individual was not employed, to the longest duration job held during 2010.

The Ordered Logit Model

An ordered logit model was used to predict the skill level of an individual's job based on both their level of education and a vector of control variables. The skill levels y are discrete but ordered. The

econometric approach is a generalization of the latent variable interpretation of binomial logit. The model can be defined by an unobserved latent variable y^* with

$$y^* = x\beta + \varepsilon$$

where x is a $1 \times K$ vector of explanatory variables (first component unity) and β is a $K \times 1$ vector of coefficients and ε is an error term that is assumed to have a logistic distribution.¹⁰

We observe:

$$\begin{aligned} y &= 0 && \text{if } y^* \leq 0 \\ y &= 1 && \text{if } 0 < y^* \leq \alpha_1 \\ y &= 2 && \text{if } \alpha_1 < y^* \leq \alpha_2 \\ &\vdots && \\ y &= J && \text{if } \alpha_{J-1} \leq y^* \end{aligned}$$

The cut points α_i are estimated along with the parameters β by maximum likelihood. Estimation is not a problem even with fairly large data sets.¹¹ For a more detailed description of the model, see Greene (2012).

The Dependent Variable

This study used the skill requirements of individuals' current jobs as an outcome measure. A potential advantage of this approach, at least over the more common use of wages as an outcome measure, is that there was a stronger theoretical link to the individual's level of education. In a typical labour supply model, a worker may require a higher wage for working in a job involving danger, harsh working conditions, or a remote location—all of which are not uncommon in the forest industry and may blur the relationship of wage to education. A primary goal of this study was thus to determine the degree to which Indigenous Peoples in Canada are able to apply their education in the labour market. Using skill requirements as an outcome may avoid some misleading situations, such as, for example, an educated person earning a high wage in a dangerous job that does not use their education.

A categorical indicator of the skill requirements of individuals' jobs was used as a dependent variable in the ordered logit model. The 2011 National Occupational Classification (NOC) system provides four categories of skill requirements:

1. Manager or professional,
2. College or apprenticeship training,
3. High school or job-specific training, and
4. On-the-job training.

If individuals were employed during the NHS reference week, then that employment period was considered. Otherwise, the data related to an individual's job of longest duration since January 1, 2010.

¹⁰ A normal distribution would have yielded an ordered probit model. According to Greene (2012), these two distributions generally give similar results in practice.

¹¹ The software package Stata[®] 13 was used for estimation of the model.

When two or more jobs were held, information was taken from the job for which an individual worked the most hours. For more detail on the NOC and the skill levels, see Statistics Canada (2016c).

The Independent Variables

The policy variable of interest for this study was individuals' levels of education. The NHS microdata provided a categorical variable indicating each person's highest certificate, diploma, or degree. This is a derived variable obtained from the educational qualifications questions, which asked people to report all certificates, diplomas, and degrees. The model used the following categories:

1. No certificate, diploma, or degree;
2. High school diploma or equivalency certificate;
3. Registered apprenticeship certificate or other trades certificate or diploma;
4. College, CEGEP,¹² or other non-university certificate or diploma, or university certificate or diploma below bachelor level;
5. University degree.

Dummy variables for all categories but the first were included as independent variables so that the reference level was high school non-completion. The education variable was more aggregated for females because of the smaller sample. For females, the 4th education attainment level listed above (*college, CEGEP, or other non-university certificate or diploma, or university certificate or diploma below bachelor level*) was combined with the 5th level (*university degree*).

Since education levels were in the definition of the dependent variable, the model might appear tautological. However, the dependent variable refers to skill requirements of individuals' current jobs, whereas the independent variable refers to the education level they have previously attained. Some individuals may fail to find a job that applies their education, thereby adding a stochastic component to the model. Examples of this appear in the results section of this article.

A primary goal of this study was to measure the marginal effect of education by categories of Indigenous identity *ceteris paribus*. The modelling approach permitted controls for potentially confounding factors that might correlate with education and/or Indigenous identity. These controls included socioeconomic and geographic variables.

Estimation of Model Parameters

The model was estimated by maximum likelihood, using the survey weights provided for the NHS microdata. Because this study was descriptive, the parameter of interest was the vector of coefficients that would be obtained by estimating the model using the entire finite population (i.e., all Canadian forest industry workers), which exists regardless of whether the finite population is generated by the

¹² Collège d'enseignement général et professionnel (CEGEP) refers to general and vocational college in the Province of Quebec. It is a publicly funded post-secondary program designed to prepare students for university and other post-secondary education programs.

equations outlined in the Ordered Logit Model section. For a discussion of the advantages of using the weighted estimator, see Carrington, Eltinge, and McCue (2000, pp. 11-18).

Sampling design information available for the NHS was used in the estimation procedures. Specifically, household membership was included as a clustering variable and province was included as a strata variable. Linearization estimators as described in Carrington et al. (2000, pp. 25-26) were used to incorporate these design elements into the estimates of confidence intervals.¹³ If clustering were ignored, then the estimated parameter variances would tend to be understated due to the correlation between error terms within clusters. The NHS did not provide full information on strata and, since the incorporation of strata would generally reduce estimated variances, a conservative approach was used that included only province as a strata variable.

Average Partial Effects (APE)

Although estimation was not a problem, interpreting the ordinal logit model proved difficult. For example, consider the change in the probability that an individual holds a job in a particular skill category due to a change in educational attainment, other independent variables being fixed (apart from interaction with education). Since this “partial effect” of education depends on the values of other independent variables, a parameter of interest is the sample average of the partial effects. This is called the average partial effect (APE).¹⁴ Unfortunately, even the signs of the partial effects cannot be determined from the sign of the coefficients of educational attainment (Greene, 2012, pp. 789-790). Nevertheless, simulation of a change in a binary explanatory variable provides an estimate of the partial effect for each individual. Averaging over the sample then provides an estimate of the APE. These are the estimates reported in the results section.¹⁵

Results

Context

In order to provide context for our model-based results, we have provided the distribution of key characteristics of the NHS population used in the study.¹⁶ Specifically, we have used graphs to present context about the population restricted to the forest industry. For all results, the sample was weighted to be representative of the corresponding Canadian population. Because the forest industry is relatively small, comparisons with other industries are presented in Table 1 above. This table provides an overview of the population that our NHS sample represented. From Table 1, it is apparent that the forest industry has a higher proportion of Indigenous people in every category compared to other industries.

Considering only the Indigenous population, as in Figure 1, it is clear that, for those living on reserve, commuting to work off reserve is more common in the forest industry than in other industries. For

¹³ The Stata® 13 *svyset* command was used to incorporate survey design information.

¹⁴ An alternative would be an estimate of the partial effect at the sample means of the independent variables. According to Greene (2012) current practice favours the APE (see p. 690).

¹⁵ The calculation of the estimated APE was done using the Stata® 13 *margins* command.

¹⁶ The NHS sample used in this study was inflated using sample weights to the corresponding population for the table and figures in this section.

Indigenous people living off reserve, the forest industry is less distinctive, showing a fairly even split between the Métis and First Nation groups that is similar to other industries.

As Figure 2 demonstrates, there was a large gender imbalance in the forest industry, with males dominating both the non-Indigenous group and the Indigenous group across all categories. Because of the risk that gender imbalance is associated with different labour market experiences, however, this study analyzes gender separately, even though the female sample was often too small to provide statistically significant results.

Although the emphasis in this study was on the returns to education in the forest industry, an important element of the context is the relative levels of educational attainment, which are displayed in Figures 3 and 4. For both genders, there was a relatively high rate of high school non-completion for the on-reserve groups of Indigenous Peoples. Considering the off-reserve group, high school non-completion was higher for the First Nations group than for the Métis group, and this was again true for both genders.

Model Results

This section presents the estimated APE of the educational attainment dummies in the econometric model. As discussed previously, the estimated model was simulated to provide the APE estimates, using the lowest level of educational attainment (less than high school graduation) as the base.

Each figure below presents the results of simulating a change from an educational attainment of less than high school to one of the higher levels. This simulated change resulted in a shift of the estimated probabilities of holding a job in each of the four skill categories. We graphed the change in probabilities¹⁷ on the vertical axis for each Indigenous group. Since the probabilities for each Indigenous group must always sum to one, the sum of the changes must sum to zero. The expected pattern from simulating a change to a higher level of educational attainment was a reduction in the probability of holding a job in the lower skill categories and an increase in the probability of holding a job in the higher skill categories. The 95% confidence interval estimates are included on the graphs as vertical line intervals that bracket the top of each bar on the graph. Estimates were referred to as statistically significant if they were significant at the 5% level—i.e., if the 95% confidence level excluded zero.

Because of concerns that the gender imbalance in forestry is associated with differing gender roles, the analyses were done separately by gender in spite of the small female sample. Results for males, which tend to be more conclusive because of the larger sample, have been presented first.

¹⁷ We have expressed probabilities as proportions (always less than one) rather than as percentages. As such, the changes depicted on the vertical axis are simply differences in these probabilities rather than percent differences.

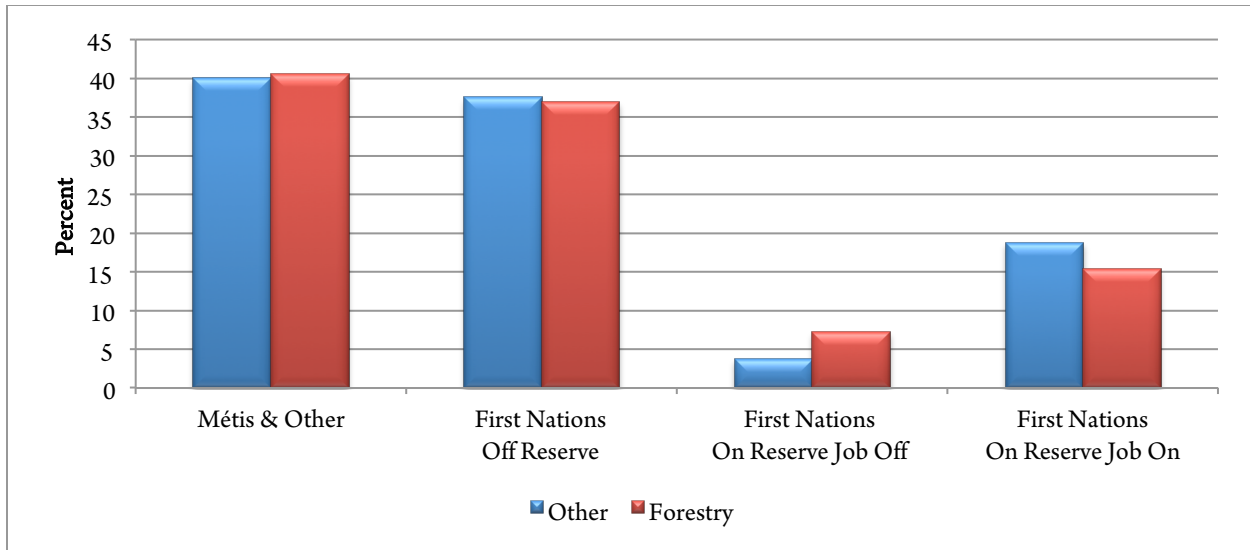


Figure 1. Categories of Indigenous Peoples: Proportions by industry. Source: Statistics Canada, National Household Survey, 2011.

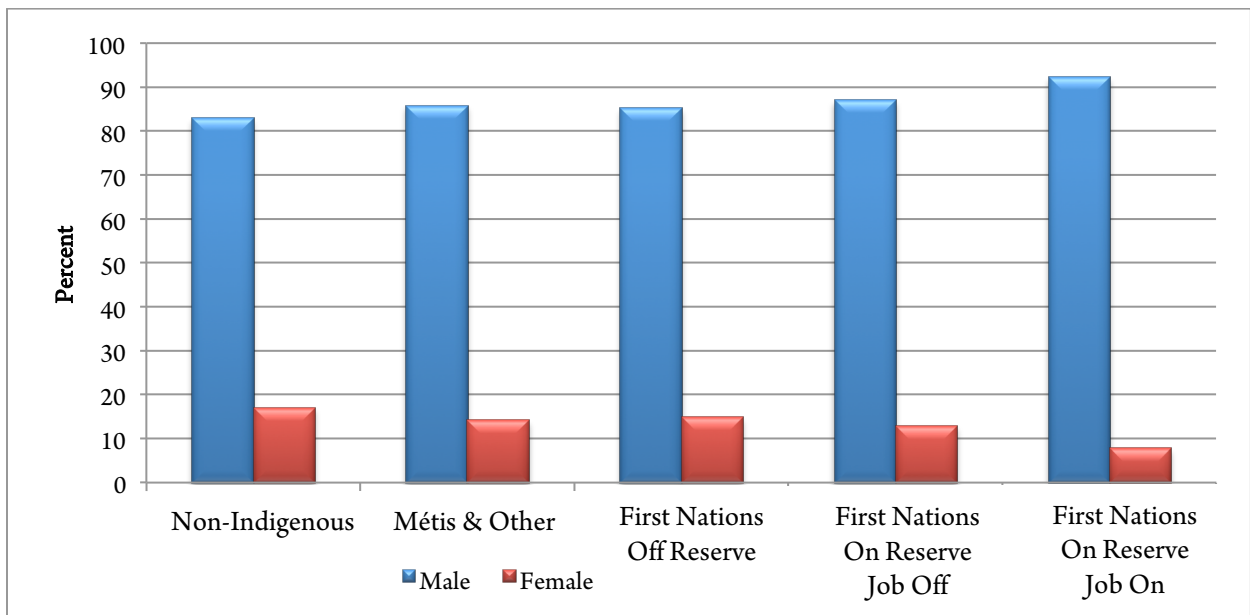


Figure 2. Gender imbalance in the forest industry. Source: Statistics Canada, National Household Survey, 2011.

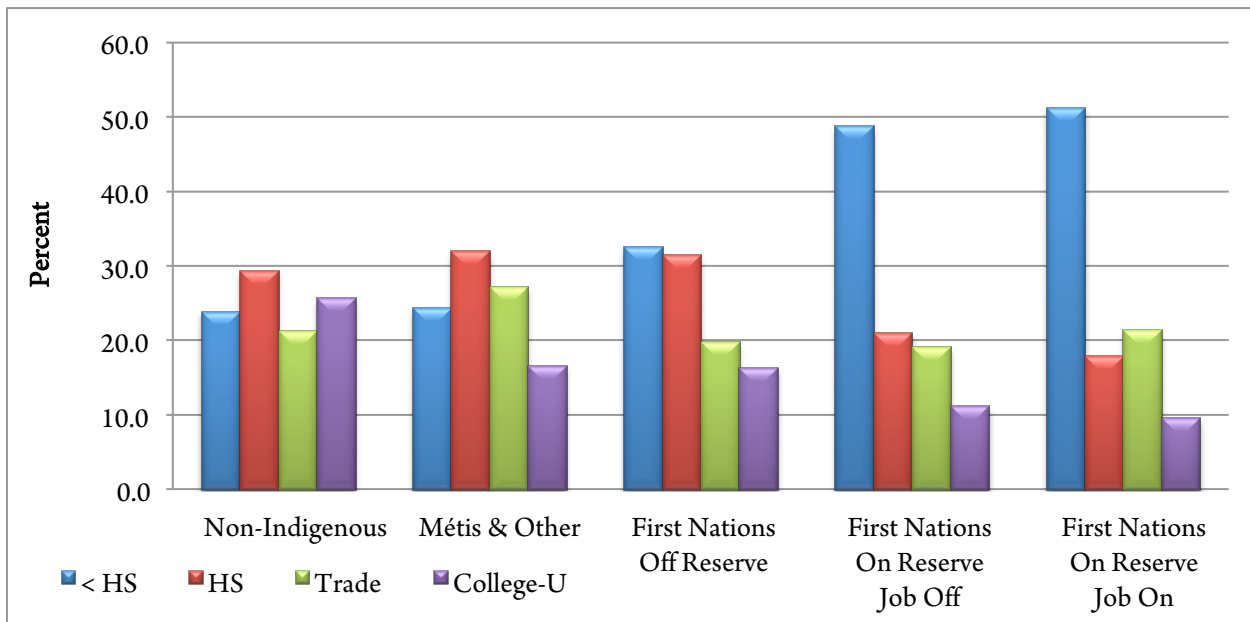


Figure 3. Level of education by Indigenous identity category for males in the forestry industry. Source: Statistics Canada, National Household Survey, 2011. < HS = less than high school; HS = high school diploma; Trade = trades certificate or diploma or equivalent; College-U = college or university diploma or degree.

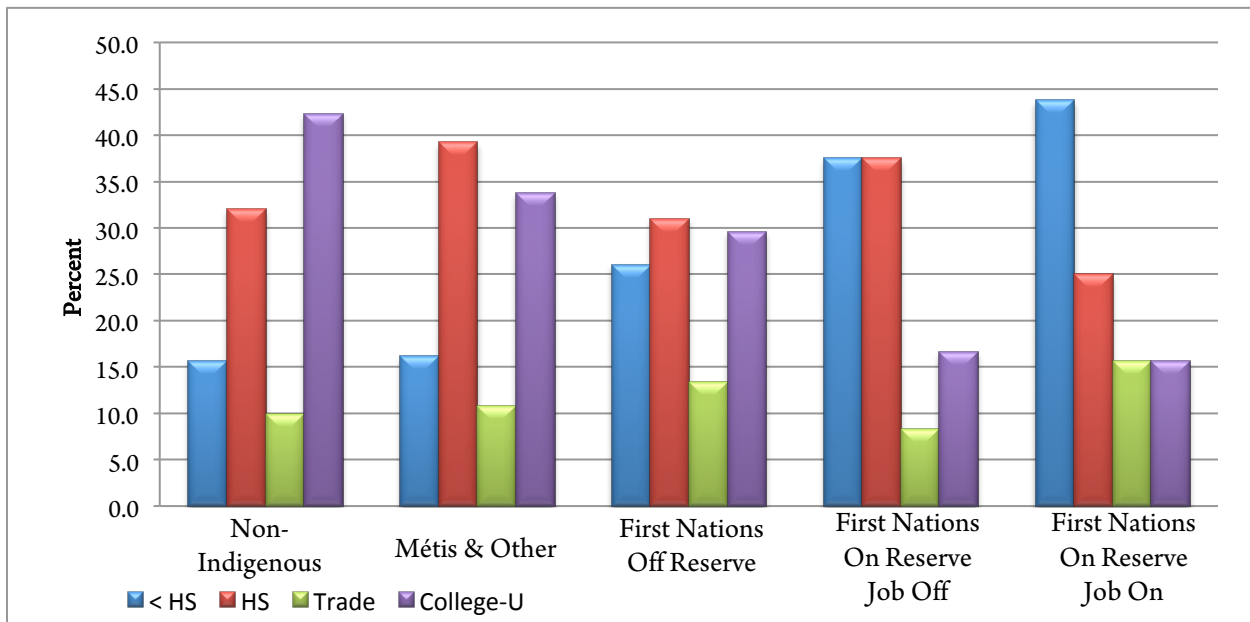


Figure 4. Level of education by Indigenous identity category for females in the forestry industry. Source: Statistics Canada, National Household Survey, 2011. < HS = less than high school; HS = high school diploma; Trade = trades certificate or diploma or equivalent; College-U = college or university diploma or degree.

Figure 5 shows that the non-Indigenous group exhibited the expected pattern for a simulated change in educational attainment from less than high school to high school graduation. The average change in the probability of holding a job in the lowest two skill categories was negative, and for the top two categories it was positive. The changes are very small, however. For example, the probability of holding a job that requires only on the job training dropped by an average of about 0.02 or 2%. Nevertheless, in the case of the non-Indigenous group, these changes are statistically significant.

Unfortunately, the sample size of the Indigenous groups was not large enough to yield statistically significant estimates, and in the case of Métis and First Nations living off reserve, the pattern was not the expected one. Although we cannot reject the hypothesis that graduating from high school has no effect on the skill level of the job acquired, the confidence intervals indicated that, as for non-Indigenous people, the effects are likely to be small (well under 0.1 or 10%).

As Figure 6 illustrates, simulating an increase in educational attainment from less than high school to a registered apprenticeship certificate or other trades certificate or diploma showed a striking positive result compared to an increase to high school graduation only. Here, a clear pattern of improved success in obtaining skilled jobs was seen for both non-Indigenous people and most Indigenous groups. For Métis and First Nations living off reserve, the estimates of the probability changes for employment in the two job categories with the lowest skill requirements were negative and statistically significant, while the probability change for employment in the two categories with the highest skill requirements were positive and statistically significant. For those living on a reserve but commuting to work off reserve, the pattern was different but still consistent with a very beneficial effect of trade certificates. The probability of employment in the lowest skill job category showed the largest decrease for any Indigenous group. This decrease was accompanied by increases in the probability of employment in each of the two job categories with the highest skill requirements, while the probability of employment in the category requiring only job-specific training showed little change.

The exception to this positive story is the group both living and working on reserve. While the pattern was similar to that of the off-reserve groups, the estimated magnitudes of the effects were much smaller and nearer to the margin of statistical significance. Because working off reserve permitted a positive result, it seems likely that a lack of skilled jobs on reserve is a constraint.

According to Figure 7, the effect of a college, CEGEP, or other non-university certificate or diploma, or a university certificate or diploma below bachelor level, is very similar to that of a trade certificate. For the non-Indigenous and Métis groups, the probability of employment in a managerial or professional job shows the greatest estimated increase. In most cases, the estimates were statistically significant. The exception was the Indigenous group living and working on reserve, where, for trade certificates, the availability of suitable jobs may be the primary constraining factor.

Figure 8 shows that the estimated effects of a university degree were strong for the non-Indigenous and off-reserve Indigenous groups. The confidence intervals are broad for the Indigenous groups, however, and for Métis the estimated effects for the two highest skilled job categories were not statistically significant. For the on-reserve Indigenous groups, although the pattern of estimated impacts was as expected, the sample of those obtaining university degrees did not yield statistically significant results.

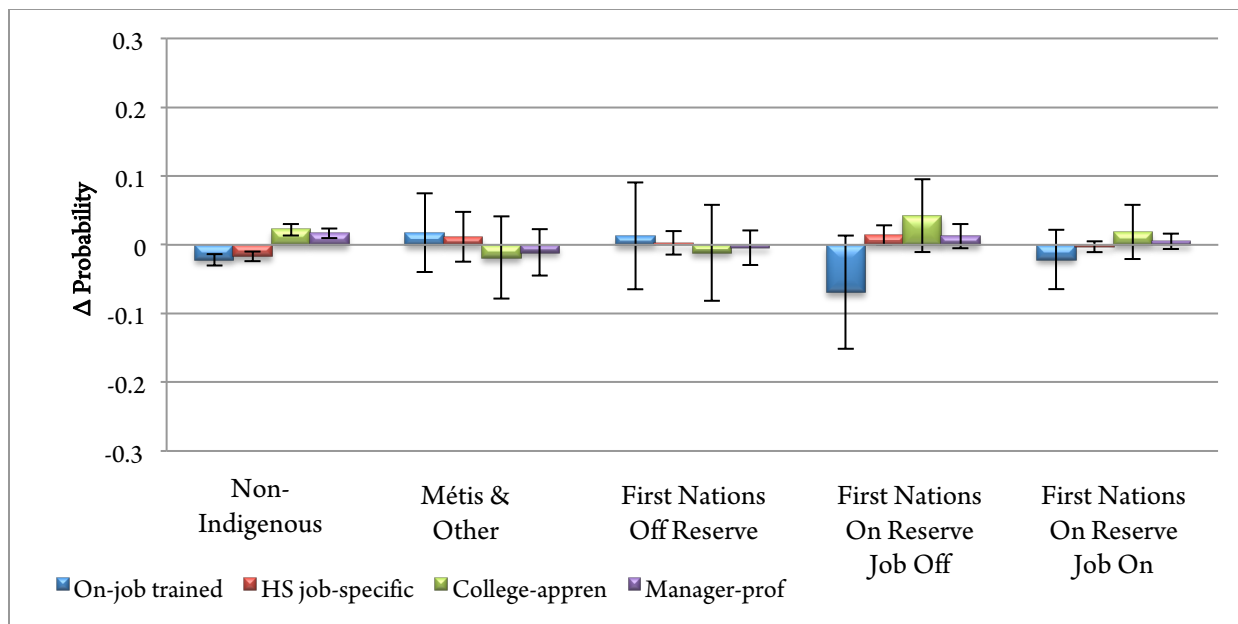


Figure 5. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to high school among males. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

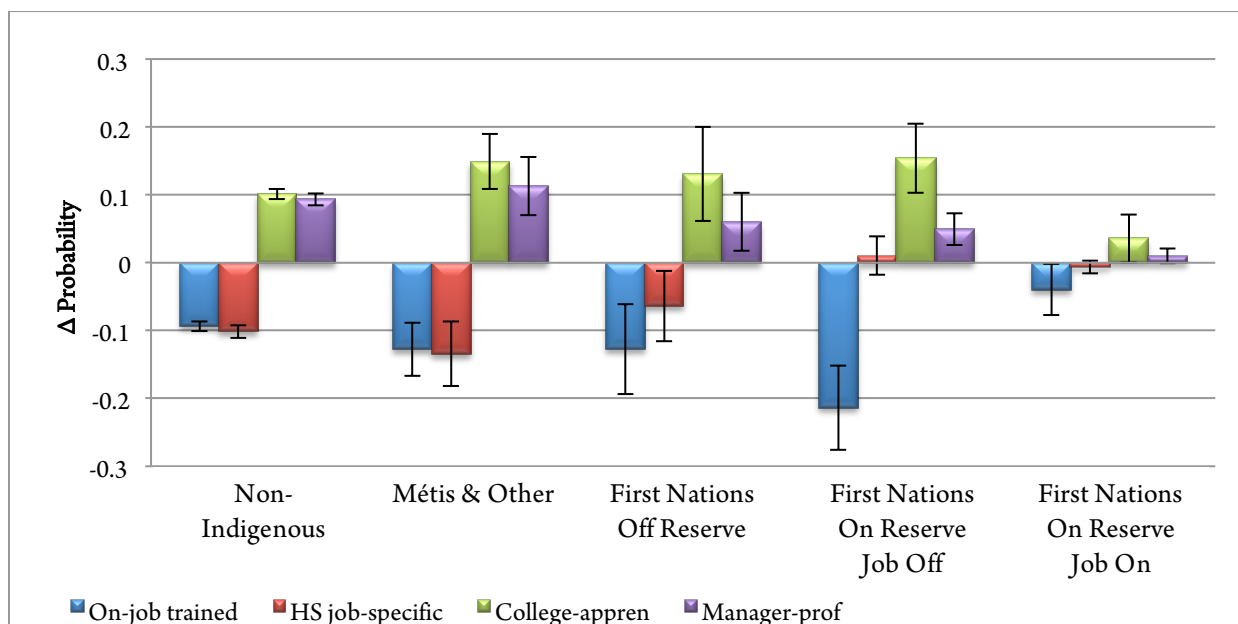


Figure 6. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to a registered apprenticeship certificate or other trades certificate or diploma among males. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

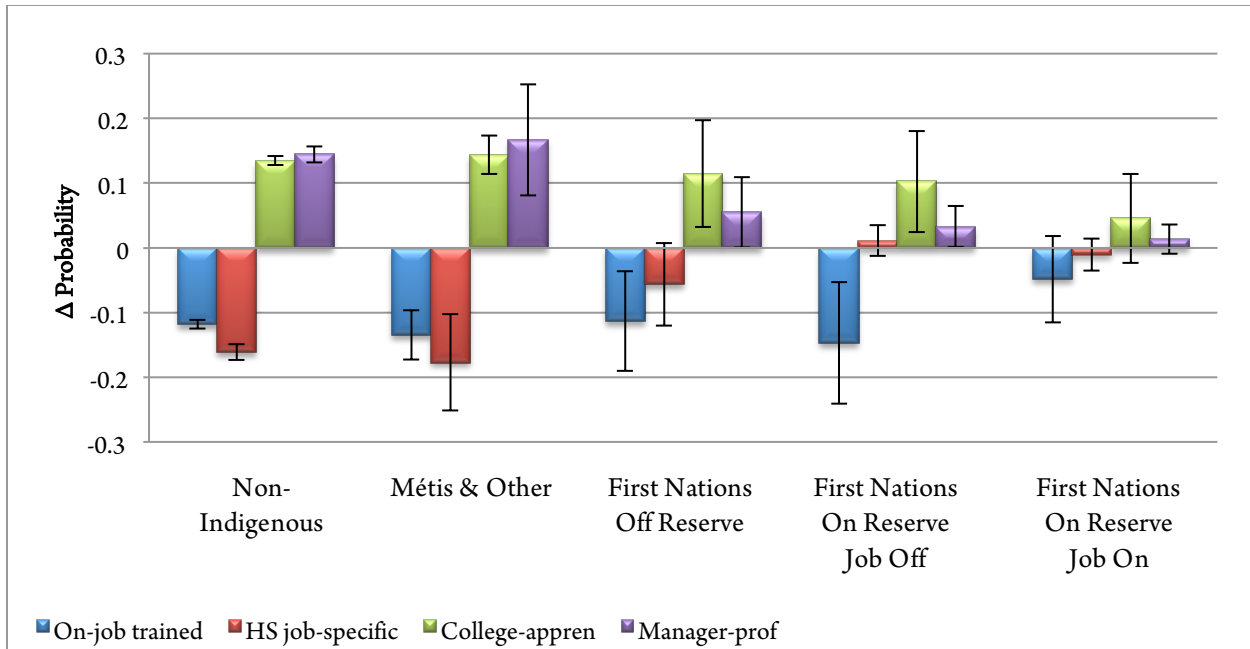


Figure 7. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to college certificate or diploma among males. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

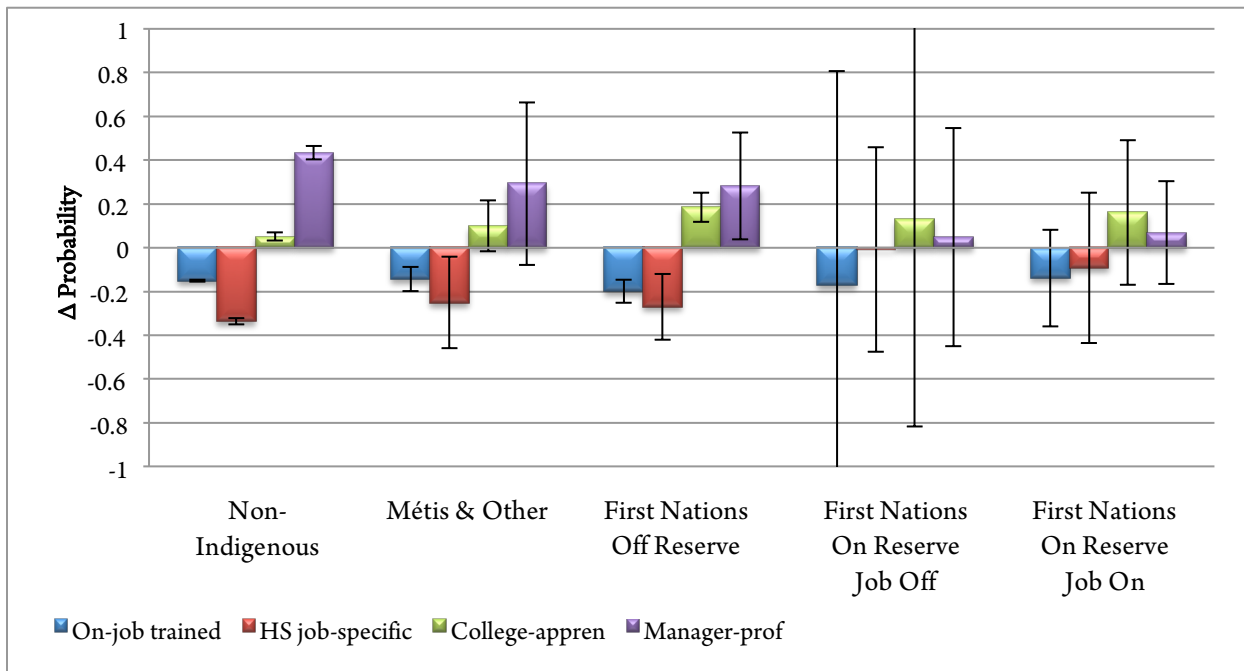


Figure 8. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to university degree among males. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

Figure 9 demonstrates that, for non-Indigenous females, the effect of high school graduation was both positive and significant. However, the effect was not statistically significant and thus we could not draw firm conclusions. The pattern appeared as expected for all groups except those living on reserve but commuting to work off reserve, where the pattern was reversed. Further research would be necessary to determine both if this is a real effect and what its causes might be.

For non-Indigenous females, Figure 10 shows a fairly strong and significantly positive effect of trade certificates similar to that found for males. Although wide confidence intervals prevent us from drawing firm conclusions for the Indigenous groups, the difference between Métis and off-reserve First Nations women was striking. While estimates for Métis women are very small and far from significance, among First Nations women estimates were large enough to be statistically significant in a couple of cases and close to significance in the others. For the group living on reserve but commuting to work off reserve, the curious “reversed” pattern of probability changes observed in the simulation of high school graduation was repeated, but, again, the estimates were not statistically significant.

Recall from Section 3.6 that the *college certificate or diploma educational attainment* category was combined with the *university degree* category for females because of the small sample size. Figure 11 shows very similar, very positive results for both the non-Indigenous and the First Nations off-reserve groups. The results for the First Nations off-reserve group are all statistically significant, as was the case for trade certificates. The much smaller and statistically insignificant estimates for the Métis group, however, provided little evidence of ability to apply post-secondary education in the labour market—even though the pattern was as expected. It is important to note that this divergence between Métis and First Nations results was not observed for males.

The results for the on-reserve groups were also mixed. While those working on reserve showed the expected positive pattern with statistical significance near the margin, those commuting to work off reserve again showed the peculiar “reversed” distribution of estimated probability changes observed for this group in the simulation of high school graduation and trade certificate attainment.

Discussion

Overview of Findings

A key empirical finding of this study was that post-secondary education is very effective at facilitating Indigenous males’ access to skilled jobs in the forest industry. This finding applied particularly to males living off reserve, both Métis and First Nations, insofar as the estimated impacts of an increase in educational attainment on the chances of obtaining a job at a higher skill level were similar to those of non-Indigenous males. For males living on reserve, however, the situation was more complicated. Those who commute to work off reserve showed a similar benefit to increases in educational attainment. Yet, those who work on reserve do not appear to benefit as much, except in the case of university graduation.

While post-secondary education provides significant benefits, graduation from high school alone appeared to provide little benefit to males employed in the forest industry. This applied to both Indigenous and non-Indigenous workers.

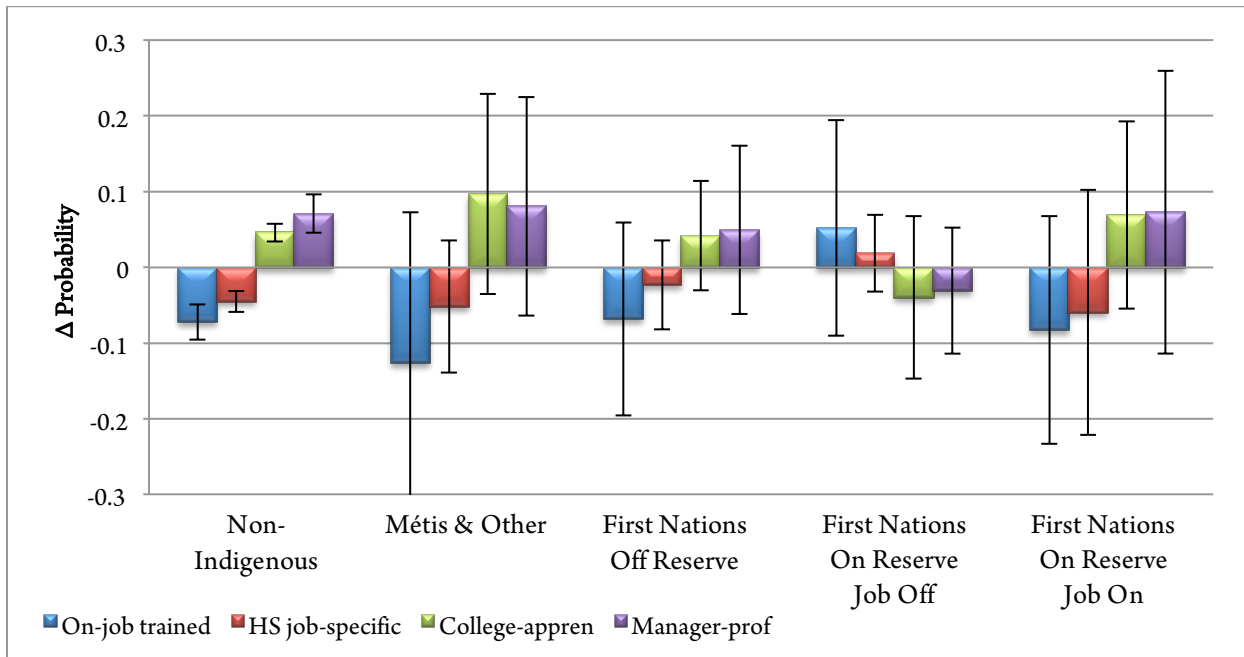


Figure 9. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to high school among females. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

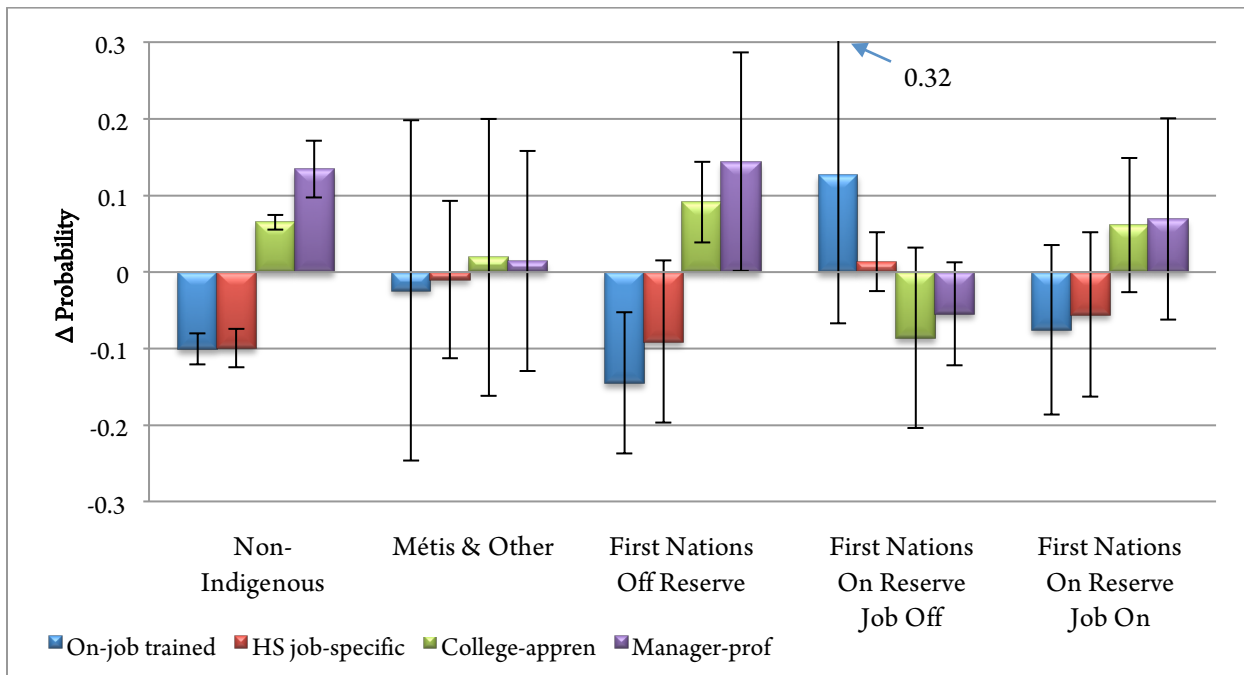


Figure 10. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to a registered apprenticeship certificate or other trades certificate or diploma among females. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

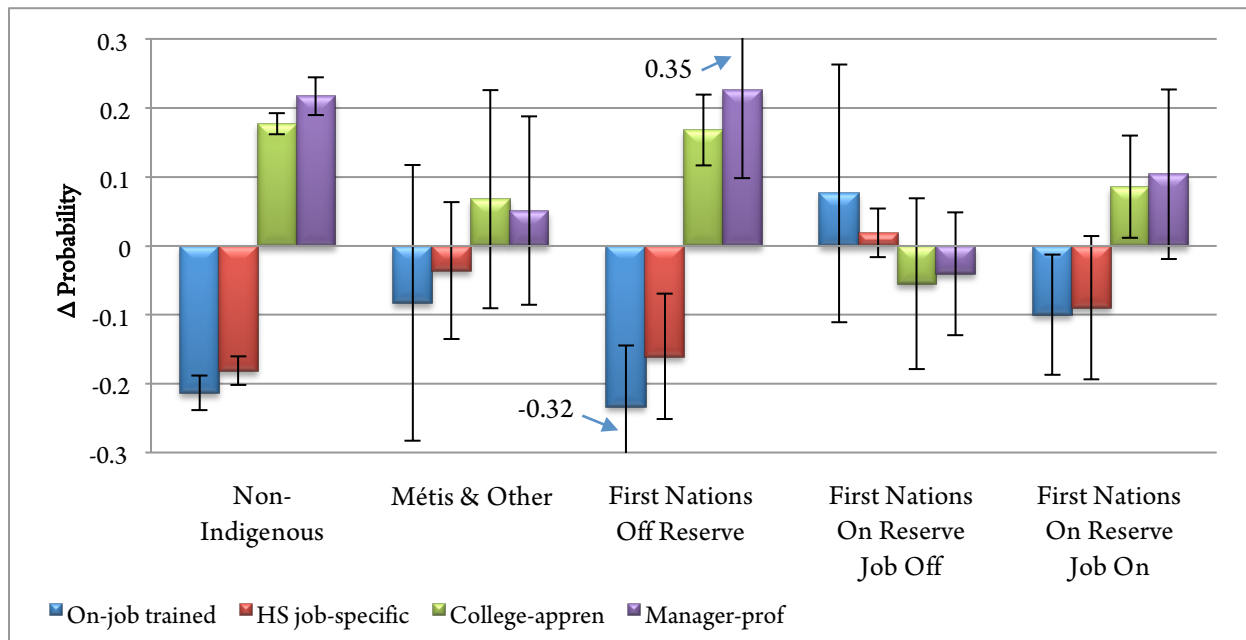


Figure 11. Average change in the probability of holding a job by skill level as a result of increasing education from less than high school to a college certificate or diploma or university degree among females. Source: Statistics Canada, National Household Survey, 2011. On-job trained = On-the-job training; HS job-specific = High school or job-specific training; College-appren = College or apprenticeship training; Manager-prof = Manager or professional.

As noted above, because there is a pronounced gender imbalance in the Canadian forest industry, the sample of females was not generally sufficient to draw firm conclusions. Nevertheless, a strong positive effect of post-secondary education was observed for First Nation women living off reserve. A similar effect was not observed among Métis women, however. Although the sample size was not adequate to draw any firm conclusions, the estimated effect of post-secondary education for women living on reserve and commuting to work off reserve is reversed. As such, more research is necessary in order to verify and determine the cause of these negative findings.

Canadian Policy Context

Indigenous Peoples face many barriers to participation in the forest industry. This study has focused on the issue of education, particularly the formal education system of Canada—which often does not include the traditional knowledge of Indigenous Peoples. Nevertheless, to discuss policies that will improve the accessibility of good jobs in the forest industry to Indigenous Peoples, it is necessary to consider a range of issues associated with barriers. As such, this section raises multiple important issues in order to place the study’s findings in a policy context that acknowledges their complex, overlapping connections.

Other Industries

Evidence has suggested that education may be a key factor for assuring that Indigenous people obtain better jobs in other industries. For example, as with the forest industry, mining and fishing can potentially provide employment in remote locations. Notably, education has been raised as an important issue for both of these industries.

In their study addressing the impact of mining on Indigenous communities in northern Canada, Gibson and Klinck (2005) noted, although mining provides employment opportunities, the best jobs are disproportionately taken by outsiders, leaving only entry-level positions for untrained Indigenous people. Despite policies and quotas for hiring Indigenous workers, educational requirements prevent their movement up job hierarchies. Within Indigenous communities, exclusion based on one's level of education is divisive and produces economic stratification. Participation in the English-language workplace may lead to loss of Indigenous languages, for example, particularly when there is a lack of educational materials and programs available in these languages.

In the case of the fishing industry, considerable potential for Indigenous Peoples' increased participation exists through enterprises developed by Indigenous people themselves. The major federal government programs that aim to increase Indigenous participation in commercial fisheries—the Pacific Integrated Commercial Fisheries Initiative (PICFI) and its Atlantic counterpart the AICFI—have focused on supporting Indigenous fishing enterprises. There is thus a link between supporting increased Indigenous participation and educational attainment, since both the PICFI and the AICFI have capacity-development components that include training in fishing and navigation. Moreover, both programs assist with the development of the training plans required as part of an enterprise business plan (Fisheries and Oceans Canada, 2014; 2015). Examining both Indigenous and non-Indigenous enterprises, Pinkerton et al. (2014) have emphasised the importance of capacity building in rebuilding fisheries management institutions in coastal British Columbia. In their case study of an Indigenous fishery for intertidal clams in the Broughton Archipelago, they noted the potential for involvement with the Coastal Guardian Watchmen for both training and the development of monitoring capacity. Guardian Watchmen programs are coordinated through the Coastal Stewardship Network (CSN), which supports the Stewardship Technicians Training Program offered by Coastal First Nations in partnership with Vancouver Island University (CSN, 2016). Milko (2011) has analysed the Stewardship Technicians Training Program in more depth by reviewing the curriculum and analysing responses to a CSN survey. Milko noted the lack of courses covering Indigenous ecological knowledge and some notable gaps in the program's technical and scientific curriculum. She concluded, “again, courses in Western ecological knowledge should be intertwined with teachings in Indigenous Ecological Knowledge” (p. 95). This resonates with a similar theme raised in the forest industry context in the Aboriginal Forestry and Aboriginal Forestry Criteria and Indicators (C&I) sections below.

Gender

As is evident from Figure 2, gender was a significant issue in the forest industry for both Indigenous and non-Indigenous people, with less than 20% of workers in the forest industry being female across all categories. This suggests that women's experiences are likely quite different from men's, which is why it was necessary to separate women for analysis even though the sample size made drawing conclusions

very difficult. Mills (2006) has specifically addressed segregation of women and Indigenous Peoples in the forest industry using data from the 2001 Census. Mills found that, overall, the degree of segregation by gender of Indigenous people did not differ from other Canadians in the forest industry; Mills' finding accords with those of this study. However, the type of segregation showed some difference, with Indigenous women not only excluded from male-dominated occupation and industry combinations, but also from female-dominated clerical and secretarial occupations as well. A very tentative hypothesis might align this result with the odd (and not statistically significant) result in the current study that, for Indigenous women living on reserve but commuting to work off reserve, increased levels of education do not necessarily lead to more skilled jobs. If, in off-reserve firms, education is used to screen women even for low-skilled clerical work, highly educated Indigenous women on reserve may obtain and frequently "settle" for this type of work. Certainly, more research—probably of a qualitative type—would be needed to verify such a hypothesis.

Tenure

A critical issue that is in principle related to educational attainment is Indigenous Peoples' forest tenure. An increase in tenure could be complementary to improved educational attainment, since an educated workforce would be required to take full advantage of increased tenure; this could, in turn, potentially make more highly skilled jobs—including those in forest management—available to Indigenous people. In fact, the number of tenures held by Indigenous Peoples in Canada has increased, although there is considerable variation across provinces and territories both in current status and rates of improvement. Also, the details of forest tenure agreements providing access to provincial and territorial Crown forestlands vary considerably across Canada. The National Aboriginal Forestry Association (NAFA, 2015) has provided a summary for each province and territory and has also provided a uniform measurement of First Nations' access to Crown forestlands in the *Third Report on First Nation-Held Forest Tenure in Canada 2015*. The measure is intended to capture "access to wood fibre in the form of secure tenure opportunities to support commercial enterprise" (NAFA, 2015, p. 6). Nationally, First Nations allocation of tenure was 10.4% between 2013 and 2014, up 4 percentage points since 2006. The provinces with the largest share of First Nations tenure during this period were British Columbia, Ontario, and Saskatchewan, comprising 47.8%, 22.3%, and 18.8% of the national total, respectively. The corresponding shares of First Nations allocation are 10.8%, 42.2%, and 14.1%, with respective increases of 3.5, 8.4, and 17.9 percentage points since 2006.

The complementarity of tenure and education has been recognized by Beaudoin (2012) in the context of a proposed community capacity-building framework. Specifically, Beaudoin proposed a framework through which First Nations communities address the following questions:

- a. Where are we?
- b. Where do we want to be?
- c. How do we get there?
- d. How well are we doing?

Among the considerations for answering the first question, "Where are we?" are issues surrounding access to territory and human resources. Beaudoin specifically noted that "important considerations include: Does the community have enough experience and skilled workers or appropriate governing

institutions?” (p. 574). Among considerations for the third question, “How do we get there?” Beaudoin included human resources development. Finally, in the discussion of the fourth question, Beaudoin noted that local Aboriginal perspectives have recently been integrated into criteria and indicators (C & I), which, as will be discussed later in this section, both address the issue of education.

Aboriginal Forestry

Another thread in the literature has consisted of attempts to define and analyse the notion of Aboriginal forestry.¹⁸ Again, we have found evidence of links to education, but there are several complex themes underlying these links.

One such theme is the potential for synergy between a model rooted in Aboriginal culture and one based on Western science and business management skills, and a role for education has been identified here. For example, Parsons and Prest (2003), seeking a definition of Aboriginal forestry, stated:

Aboriginal forestry can be subdivided into three categories; the Western model of sustainable forest management, traditional knowledge systems, and the combination of both systems. Bringing together the systems would create a model that is potentially more ecological and less economic. (p. 780)

The authors take the view that education is one of the keys to a successful combination. Referring to Aboriginal youth, the authors stated, “they need to educate themselves and immerse themselves in both worldviews in forestry, so they can communicate clearly, thereby creating a greater understanding between all involved” (p. 784). In a review of progress in Aboriginal forestry, Wyatt (2008) has taken a similar view by presenting a model for Aboriginal forestry that has the interests of First Nations and their abilities to define the institutions and practices pertaining to their land as its key principles. Wyatt affirmed, “both TK [traditional knowledge] and Western science would be required, acknowledging the distinct basis of each. Professional foresters would need to learn about Aboriginal management systems, while training for Indigenous people in science for forest lands should be expanded” (p. 178).

Another theme is the profitability of Aboriginal forestry enterprises. Here, the link to education may be complex and involve both institutional factors and human capital. Trosper, Nelson, Hoberg, Smith, and Nikolakis (2008), for example, conducted a telephone survey of 40 forestry firms that had First Nations participation. Analysing the results using ordinary least squares regression models, they found that a separation from the political process and participation in forest management led to better profitability. They did not explicitly include levels of education in their model, but they do consider the possibility that the communities’ human and social capital may influence institutional factors. To this end, education could play an indirect role in determining the profitability of Aboriginal forestry enterprises.

The links between education and Aboriginal forestry in the preceding discussion suggest a situation in which education, adding to the human capital of communities, might enable and reinforce the positive aspects of Aboriginal forestry, including sustainability. However, Nikolakis and Nelson (2015) have

¹⁸ In this article, we generally refer to Indigenous Peoples, following international and current Canadian practise, rather than Aboriginal peoples, as was recently common in Canada, although we view the terms as synonymous. This and the following section refer to a concept of *Aboriginal forestry* occurring frequently in the literature.

identified some serious difficulties. They used qualitative research techniques to analyse the experience of British Columbia First Nations engaged in forestry. A major theme that emerged was the tension that First Nations experience between the desire for conservation-based stewardship of forests and the need for revenue to meet urgent social requirements, particularly in cases in which communities live in poverty. Nikolakis and Nelson concluded that, in a forestry model based on conservation and an enhanced stewardship ethic, the short-term revenue that could be gained from logging should be seen as an opportunity cost. Nevertheless, their research does suggest some potential policy solutions. A number of interviewees in their study saw increases in the First Nations Woodland Licences, which create small area-based longer-term tenures, as desirable. In addition to Woodland Licences, Nikolakis and Nelson referred to political agreements that provide access to timber and other economic opportunities, together with financial support for consultation and resource coordination. They noted that a potential criticism of such an effort would be that it proposes short-term fixes to much bigger structural problems, however.

Aboriginal Forestry Criteria and Indicators (C & I)

Another strand of literature related to Aboriginal forestry has addressed how suitable criteria and indicator (C & I)¹⁹ frameworks can be used to monitor sustainable forest management and include local community concerns in the forest management decisions. The criteria usually include education, but the emphasis has been on ensuring that traditional knowledge is included as a complement to Western scientific knowledge. For example, Karjala and Dewhurst (2003) and Karjala, Sherry, and Dewhurst (2004) reviewed C & I frameworks that were developed through ongoing research projects as forest-planning tools for the John Prince Research Forest (JPRF) in central interior British Columbia. The JPRF is co-managed by an Indigenous group, the Tl'azt'en Nation, and the University of Northern British Columbia. Based on a review of documents in the Tl'azt'zen archives, interviews, and a variety of secondary sources, both papers summarised the criteria, including a theme of *human factors* that included education, community, and employment. When reporting their results under human factors, Karjala and Dewhurst (2003) provided quotations from interview transcripts representing themes they encountered, particularly a desire for both traditional and technical education (see p. 5). One community member explained, "the Elders said we have to teach our young generation our way of life, our language, our culture. And also they have to have formal education. That's the only way that we can be whole again. You can't have one without the other" (Karjala et al., 2004, p. 101). Karjala et al. provided a description of the education criteria, based on Elders' transcripts, which stated, "younger generations need to understand proper relationship with the environment. Must teach language to youth" (p. 101). In their conclusion, Karjala et al. referred to the Aboriginal Forest Planning Process (AFPP) that emerged from several research projects as a method for organizing archival information into C & I. They stated, "the AFPP is a method for eliciting and managing community information in developing a set of C & I used to link local Aboriginal knowledge and values with Western analytical approaches" (p. 108).

¹⁹ A criterion is "a category of conditions or processes by which sustainable forest management may be assessed," and an indicator is "a measure (measurement) of an aspect of a criterion" (Canadian Council of Forest Ministers [CCFM], 1995, p. 5).

The emphasis on integrating traditional knowledge into education has also been evident in research by Saint-Arnaud, Asselin, Dubé, Croteau, and Papatie (2009), which focused on a portion of the ancestral lands of the Anicinapek of Kitcisakik in Abitibi-Témiscamingue, Québec. Saint-Arnaud et al. used individual and family interviews, combined with notes from their participation in meetings between families and industry representatives, general assemblies, and workshops, as data to develop a C & I framework that grouped criteria into forest management principles, including the “educational principle” (p. 92), summarized as “promotion of adaptive mutual learning between stakeholders on Kitciakik Akî [the ancestral territory]” (p. 92). Enhancement of Anicinapek knowledge and capacity building in forest management was targeted, but reinterpreted within a specific, local cultural context. The authors suggested a parallel with Kitcisakik youth who work to promote their culture through film, music, and television. The importance of traditional knowledge and support for the intergenerational transmission of knowledge was highlighted and suggested as a potential indicator to evaluate the implementation of educational principles.

A similar conclusion, but with more emphasis on cultural values, has been drawn by Adam and Kneeshaw (2008) in their study comparing Aboriginal forest ecological perspectives that have been defined by local level C & I frameworks with non-Aboriginal frameworks. Adam and Kneeshaw found that issues pertaining to broad criteria of forest conditions (p. 2030) were covered to a similar degree in both Aboriginal and non-Aboriginal C & I. However, cultural values, particularly those related to traditional trapping and hunting, were predominant in Aboriginal C & I. In their conclusions, they highlighted the potential benefits of integrating the two approaches, stating that “C & I frameworks prove to be a valuable medium within which social values merge with scientific knowledge of environmental conditions to monitor and influence trends in forest practices” (p. 2025).

This strong desire for the harmonization of traditional knowledge and cultural relevance may have a strong link to this study’s policy implications. Our finding that post-secondary education has a very positive effect on the Indigenous Peoples’ probabilities of successfully finding skilled jobs in the forest industry, together with our finding that high school alone has little benefit, suggests that a key challenge is to encourage Indigenous youth to complete high school (as a gateway) and then continue on to post-secondary education. As noted in this article’s literature review, Restoule et al. (2013) have indicated that the lack of cultural support and role models were significant barriers to post-secondary education entry for Indigenous students. Reaching a point where Aboriginal forestry integrates traditional knowledge and cultural values with Western scientific knowledge may require increased effort both in the forest industry and in the post-secondary education system.

Policy Objectives

In this section, we suggest general policy objectives based on both our findings and the policy context discussed in the previous section. While it is beyond the scope of this study to provide specific policy recommendations, evidence of the positive effects of education can, particularly alongside other policy issues, provide some helpful direction.

An encouraging aspect of this study’s findings is the evidence that post-secondary education effectively facilitates Indigenous males’ access to skilled jobs in the forest sector—particularly for those living or working off reserve, and also for First Nations women living off reserve. Nevertheless, we have identified

two challenges. First, high school graduation alone was not sufficient to obtain a skilled job in the forest industry. Understanding the role of high school graduation as a gateway to post-secondary education will thus be key to successful policies, as emphasised by Mendelson (2006). Second, since post-secondary education showed less benefit for those living and working on reserve, it appears that policies must also address job shortages. The evidence, therefore, tends to support economic development programs focused on Indigenous people living on reserve, such as the Indigenous Forestry Initiative (Natural Resources Canada, 2017a), as complements to education policies. Overall, however, since a large gap in education remains (Gordon & White, 2014), this study provides another argument in favour of policies that address this gap.

Earlier in this article, we noted that Indigenous control of education appears to be the new reality following histories of “assimilative segregation for integration” (White & Peters, p. 15) and “assimilation, segregation, and separation” (p. 17). A significant challenge, then, is the effective provision of post-secondary education to Indigenous people in this context. While it is beyond the scope of this article to suggest particular solutions, increased understanding of the difficulties that Indigenous people face when pursuing post-secondary education is important. For example, Peters (2013) has documented the role of high school academic performance and social support for Indigenous students’ post-secondary education success, and Restoule et al. (2013), using qualitative methods, provided some insight into the barriers Indigenous students face in the transition from high school to post-secondary education. In fact, their findings regarding Indigenous students’ desire for cultural support related to Indigenous Peoples’ desire for the integration of traditional knowledge and cultural values in Aboriginal forestry. A reasonable objective might be for post-secondary education institutions to participate more fully in the process of harmonizing traditional knowledge, cultural values, and Western scientific and technical knowledge by being mindful of how Indigenous students expect to apply their studies after graduation. Finding more specific ways to increase the attractiveness of post-secondary education to Indigenous students might be a fruitful direction for future research. For example, Pidgeon, Archibald, and Hawkey (2014) have indicated that a culturally relevant peer and faculty mentoring initiative, SAGE (Supporting Aboriginal Graduate Enhancement), assisted Indigenous students by fostering supportive intergenerational relationships and a general sense of belonging in academe. Institutional barriers still existed, but were less debilitating in a peer-mentored entity that worked to support and help students. More recently, Pidgeon (2016) has explored how post-secondary education institutions could achieve meaningful Indigenous inclusion. Based on interviews with community members of Elsipogtog First Nation in the Canadian province of New Brunswick, Simon, Burton, Lockhart, and O’Donnell (2014) explored the role that distance education could play in making post-secondary education accessible to Indigenous people, specifically within the context of Indigenous control over education.

In the context of Indigenous control of education, an important issue is the desire to increase Indigenous cultural content, particularly Indigenous languages, in the early grades, while at the same time preparing students to achieve their full potential in any setting. The Assembly of First Nations considers achieving these dual goals to be essential (AFN, 2010), and recent research on school language programs has been encouraging. Lindholm-Leary and Genesee (2014), Fontaine (2012), and Osborne (2011), for example, have indicated that students in Aboriginal language programs generally perform as well as or better than their peers in regular programs. The findings of our study emphasised the importance of secondary school as a gateway to post-secondary education, which appears compatible with the goal of preserving Indigenous languages.

Our findings have suggested that Indigenous women's experiences working in the forest industry are different from men's. Although in our case the small sample size prevents definite conclusions, as noted above, findings from a study by Mills (2006) that Indigenous women may face barriers even in female-dominated occupations could explain why the expected pattern of improved access to skilled jobs is not found in the case of Indigenous women commuting off reserve to work. Considering this, together with Mills' (2006) suggestion that Indigenous women may face barriers even in female-dominated occupations, policies directed at removing such barriers would complement policies aiming to increase access to post-secondary education.

As discussed above, policies concerning education are naturally integrated with the development of Aboriginal forestry. Tenure and education will thus be complementary inputs to the development of Aboriginal forestry. The issue of historical claims to lands and resources, as discussed by Passelac-Ross and Smith (2013), will continue to be important. Nevertheless, the results of this study have indicated that, where jobs are available, Indigenous Peoples can benefit from education. In turn, Aboriginal forestry, through its definition and through the C & I that have been developed to implement and evaluate it, involves a synergy between traditional knowledge and formal education. Because of this integration, policies that support education and Indigenous Peoples' access to post-secondary education will be a component of a suit of policies required to support Aboriginal forestry.

International Relevance

Indeed, the issues addressed in this study concerning the education of Indigenous Peoples and their relationships with forests and associated industries are likely of international policy interest. For example, Article 14 of the United Nations Declaration on the Rights of Indigenous Peoples has directly addressed the issue of Indigenous control of education (United Nations, 2008). Around the world, the issue of Indigenous Peoples' access to higher levels of education is therefore likely to be set in the context of Indigenous control of the lower levels of education as well.

Much scholarship has noted that the importance of the forest industry for Indigenous Peoples in many countries relates to their special bonds with the land. Some specific examples of this are given in United Nations Environment Programme (UNEP), United Nations Food and Agriculture Organisation (FAO) and United Nations Forum on Forests (UNFF; UNEP, FAO, & UNFF, 2009). The potential for synergy between the traditional knowledge associated with these bonds and the knowledge obtained through formal education has been supported by literature from various national contexts. For example, Indigenous Peoples' bond with their lands—especially the moral and ethical contexts of traditional knowledge systems—has been explored in detail by Berkes (2012). Drawing on examples from Indigenous cultures around the world, Berkes explored *sacred ecology* as a way to approach the unity of humans and the environment. Also using examples from around the world, but focusing on forest knowledge, Asselin (2015) has examined many facets of traditional Indigenous knowledge, including ecological insights, environmental ethics principles, and the value of non-timber products (e.g., mushrooms). Asselin strongly advocated for the integration of this knowledge with scientific knowledge for purposes of sustainable forest management.

The importance of education to Indigenous Peoples has been explored using examples from many countries. A variety of approaches and perspectives have been used. For example, Loxton, Schirmer, and

Kanowski (2012) conducted a case study in northern Queensland in Australia that focused on participation in an emergency response to damage by Cyclone Larry in 2006. Although the response, managed by the Queensland government, had the primary goal of cleaning properties of debris and damaged timber while salvaging usable timber, the authors focus on activities that would normally be associated with the management of production forests. The study also reported results from a literature review and a consultation process by the Australian Department of Agriculture, Fisheries and Forestry, in developing the National Indigenous Forestry Strategy. They find that lack of skills was a key barrier to employment. Interviews with participants involved in the emergency response confirmed that insufficient skill levels, both forestry-based skills and general literacy and business management skills, created a barrier to employment for Indigenous people. This also prevented them from developing their own businesses or taking on management roles. Also using a case study, Nkem et al. (2012) studied forest-related assets of Indigenous Peoples that would be affected by climate change. Their case study focuses on the Bantus and Pygmies of southern Cameroon. Using literature and document review combined with expert opinions, they note education, both formal and informal, as a component of the human capital assets that would be affected by climate change, with highest effects in primary lowland tropical forests as a result of disruption of forest livelihoods due to degradation of ecosystems, flooding, and erosion. Porro, Lopez-Feldman, and Vela-Alvarado (2015) took an econometric approach in their study of forest use and agriculture in Ucayali, Peru, which is an area on the Amazon forest frontier. Over 50% of the households studied were classified to belong to Indigenous groups. Other factors constant, including sources of income and ethnic origin, education implies a higher income and a lower probability of poverty. The interaction of education with other factors was not studied, however.

This study's findings add to this knowledge, and could thus be of interest in other countries. Our econometric approach, our comparison of Indigenous and non-Indigenous people, and our focus on job quality may complement other studies using different approaches.

Limitations

Possible Bias

While the NHS provided a very large sample, there is potential bias in this study from incompletely enumerated reserves, individual non-response, and the lack of detailed questions pertaining to the Indigenous Peoples' particular situations. A serious problem, for example, concerns the 36 cases of incomplete enumerations of reserves, including 18 cases in which enumeration was not permitted or was interrupted before completion. Results were also suppressed when the gross nonresponse rate for a Census Subdivision was less than 50%. However, even with incomplete enumerations and suppressed results, overall response from reserves compared well with that from the rest of Canada. According to Statistics Canada (2015d), of the 4,567 Census Subdivisions with a population of more than 40, NHS estimates are available for 3,439 (75.3%). Of the 648 reserves with a population of more than 40, NHS estimates are available for 572 (93.5%). According to Statistics Canada (2017), bias is much less when studying large geographic areas. Nevertheless, the potential for bias could be severe because bands that opt-out of the NHS may be distinctive in ways that are difficult to control for in statistical studies. Another problem is that, even on participating reserves, individuals may not respond. This problem is more severe for reserves than for the rest of the population (2.8% for reserves compared to 2.2% for other Census Subdivisions). Finally, there may be response bias due to incomplete responses from

individuals. It is particularly difficult for Statistics Canada to estimate some issues, such as some Indigenous people not self-identifying as Indigenous. Based on comparison with administrative data pertaining to Registered Indians, Statistics Canada (2015d) described the biases as, “in general well mitigated, with exceptions” (p. 27). One notable exception was an increase in Métis and off-reserve First Nations populations, which cannot be compared to administrative data and may be due to changes in the propensity to self-identify (Statistics Canada, 2015c, 2015d, 2017).

Sampling Error

This study has focused on the forest industry, which we have noted has very low female participation, and even lower participation from Indigenous females (see Table 2).

Although the release of disaggregated unweighted counts from the confidential NHS microdata is restricted by Statistics Canada, for the key results of the study both the strength of the effects and the uncertainty due to sample size have been captured in the graphs in the Model Results section. The estimates of Average Partial Effects of educational attainment included 95% confidence intervals that identified statistically significant results when the interval excluded zero.

Limitations of Quantitative Analysis

Finally, as a purely quantitative analysis, this study was less able to provide explanations for some observed relationships than a qualitative analysis. For example, the evidence presented in this study suggesting²⁰ that First Nations women, but not Métis women, are able to apply post-secondary education in the forest industry may be important, but further research into this issue is necessary to determine the cause. In this sense, qualitative research using in-depth interviews and focus groups is necessary to reveal a complex story.

Table 2. Unweighted Forest Industry Samples: Indigenous Status by Gender

	Non-Indigenous	Indigenous
Male	35,405	3,830
Female	7,305	510

Note. Source: Statistics Canada, National Household Survey, 2011. These numbers have been rounded for release as required by Statistics Canada Research Data Centre guidelines. Rules to protect privacy restrict the release of more disaggregated unweighted totals.

²⁰ Even for First Nations women, the results are barely significant and pertain to two skill level groups.

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Appendix

Definition of On-Reserve Household

On-reserve status includes households residing in the following census subdivision (CSD) type:

- Indian reserve (IRI),
- Indian settlement (S-É) (Exclusions: Champagne Landing 10, Klukshu, Two and One-Half Mile Village, Two Mile Village, and Kloo Lake),
- Indian government district (IGD),
- Nisga'a village (NL),
- Terres réservées aux Cris (TC),
- Terres réservées aux Naskapis (TK),
- Designation also includes households in Sandy Bay.

Table A1. Ordinal Logit Full Regression Results

Variable	Males			Females		
	Coef.	SE	$P > t $	Coef.	SE	$P > t $
Forestry, logging, and support activities	0.469	0.036	0	0.296	0.078	0
Indigenous Identity						
Métis	0.033	0.175	0.852	0.269	0.694	0.698
First Nations off reserve	-0.359	0.241	0.136	-0.121	0.343	0.724
First Nations on reserve job off	-1.069	0.163	0	0.855	0.450	0.057
First Nations on reserve job on	-0.276	0.189	0.144	0.640	0.532	0.229
Non-Indigenous				<i>Ref.</i>		
Indigenous x Forestry						
Métis	0.144	0.181	0.426	0.064	0.478	0.894
First Nations off reserve	0.568	0.202	0.005	0.265	0.400	0.509
First Nations on reserve job off	0.640	0.174	0	1.006	0.430	0.019
First Nations on reserve job on	0.243	0.184	0.187	0.329	0.489	0.501
Non-Indigenous				<i>Ref.</i>		
Education						
No certificate, diploma, or degree				<i>Ref.</i>		
High school	0.192	0.039	0	0.594	0.101	0
Trade	0.954	0.040	0	0.984	0.118	0
College	1.354	0.046	0	College or University for Females		
University	2.770	0.082	0	1.848	0.103	0

Table A1. Ordinal Logit Full Regression Results (continued)

Variable	Males			Females		
	Coef.	SE	$P > t $	Coef.	SE	$P > t $
Indigenous x High School						
Métis	-0.337	0.237	0.154	0.286	0.732	0.696
First Nations off reserve	-0.277	0.258	0.285	-0.106	0.511	0.835
First Nations on reserve job off	0.175	0.235	0.456	-0.947	0.497	0.057
First Nations on reserve job on	-0.066	0.141	0.641	0.073	0.738	0.922
Non-Indigenous	<i>Ref.</i>					
Indigenous x Trade						
Métis	0.285	0.202	0.158	-0.818	0.814	0.315
First Nations off reserve	-0.012	0.277	0.964	0.224	0.494	0.651
First Nations on reserve job off	0.258	0.206	0.209	-1.744	0.559	0.002
First Nations on reserve job on	-0.715	0.127	0	-0.364	0.531	0.492
Non-Indigenous	<i>Ref.</i>					
Indigenous x College						
Métis	0.164	0.292	0.575			
First Nations off reserve	-0.513	0.337	0.128			
First Nations on reserve job off	-0.527	0.307	0.086			
First Nations on reserve job on	-1.053	0.232	0			
Non-Indigenous	<i>Ref.</i>					

Table A1. Ordinal Logit Full Regression Results (continued)

Variable	Males			Females		
	Coef.	SE	$P > t $	Coef.	SE	$P > t $
Indigenous x University				Indigenous x College or University for Females		
Métis	-0.677	0.962	0.482	-1.270	0.742	0.087
First Nations off reserve	-0.400	0.653	0.541	0.091	0.408	0.824
First Nations on reserve job off	-1.747	3.724	0.639	-2.340	0.595	0
First Nations on reserve job on	-1.699	1.264	0.179	-0.970	0.448	0.03
Non-Indigenous				<i>Ref.</i>		
Indigenous x Self-Employed						
Métis	-0.873	0.313	0.005	0.933	0.954	0.328
First Nations off reserve	-0.711	0.432	0.099	-0.698	0.527	0.186
First Nations on reserve job off	1.178	1.382	0.394	-0.768	0.437	0.079
First Nations on reserve job on,	-0.006	0.290	0.982	-0.022	0.588	0.97
Non-Indigenous				<i>Ref.</i>		
Rate of Employment in Forestry, Logging, & Support Activities in Census Division	1.993	0.963	0.038	9.151	2.943	0.002
Rate of Employment in Wood Products Manufacturing in Census Division	-3.621	0.653	0	-7.526	1.832	0
Rate of Employment in Pulp and Paper Manufacturing in Census Division	2.197	1.083	0.042	-3.853	3.120	0.217
Age	0.056	0.007	0	0.060	0.017	0
Age² / 1,000	-0.446	0.084	0	-0.497	0.192	0.01

Table A1. Ordinal Logit Full Regression Results (continued)

Variable	Males			Females		
	Coef.	SE	$P > t $	Coef.	SE	$P > t $
Marital Status						
Married	0.329	0.038	0	0.262	0.072	0
Not married				<i>Ref.</i>		
Age of Children in Household						
0-5 years	0.001	0.049	0.992	0.150	0.112	0.18
> 5 years	0.031	0.034	0.37	-0.026	0.070	0.71
No children				<i>Ref.</i>		
Unemployment Rate in Census Division	1.447	0.681	0.034	-0.842	1.832	0.646
Self-Employment						
Self-employed	0.795	0.076	0	0.962	0.174	0
Not self-employed				<i>Ref.</i>		
Hours of Employment						
Full-time				<i>Ref.</i>		
Part-time	-0.394	0.071	0	-0.192	0.091	0.035
Number of Weeks Worked in 2010	0.015	0.001	0	0.016	0.002	0
Commuting Status						
Commute to job	0.049	0.029	0.09	0.063	0.062	0.303
Do not commute to job				<i>Ref.</i>		
Mean Income in Census Subdivision/10⁵	0.913	0.247	0	-0.008	0.491	0.987

Table A1. Ordinal Logit Full Regression Results (continued)

Variable	Males			Females		
	Coef.	SE	$P > t $	Coef.	SE	$P > t $
Metro Influence^a						
Urban	-0.006	0.099	0.952	0.678	0.378	0.073
High metropolitan influence zone (MIZ)	-0.018	0.109	0.872	0.644	0.388	0.097
Mid MIZ	-0.151	0.100	0.13	0.493	0.380	0.194
Low MIZ	-0.123	0.097	0.203	0.563	0.376	0.135
No MIZ			<i>Ref.</i>			
Province						
Newfoundland	0.025	0.140	0.856	0.473	0.376	0.208
Prince Edward Island	-0.935	0.246	0	-0.585	0.613	0.34
Nova Scotia	0.052	0.088	0.553	0.124	0.236	0.599
New Brunswick	0.005	0.075	0.951	0.392	0.168	0.019
Quebec	0.030	0.055	0.584	0.294	0.117	0.012
Manitoba	0.101	0.110	0.356	-0.246	0.182	0.178
Saskatchewan	0.370	0.156	0.018	0.363	0.355	0.307
Alberta	0.351	0.069	0	0.613	0.132	0
British Columbia	0.145	0.049	0.003	0.289	0.103	0.005
Ontario			<i>Ref.</i>			
/cut1	1.955	0.278	0	2.505	0.662	0
/cut2	4.236	0.280	0	4.716	0.664	0
/cut3	6.500	0.282	0	6.442	0.666	0
Number of observations ^b	47,050			47,050		
Subpopulation observations for gender ^b	39,240			7,815		
F : H0 all coef = 0	68.69	$F(60, 43,875)^c$		39.00	$F(55, 43,880)^c$	
Prob > F	0.0000			0.0000		

Note. The aggregate variables are intended to control for economic environment. In the case of rates, they were constructed using individual counts by Census Division (CD).

^aThe urban influence variable is based on the census metropolitan influenced zone (MIZ) defined by Statistics Canada. This depends on the percentage of employed residents that commute to work to a Census Metropolitan Area (CMA) or Census Agglomeration (CA). The five categories used in this study range from actually living in a CMA or CA to “no metropolitan influence.” For more details, see Statistics Canada (2015h).

^bObservations are rounded to the nearest five.

^cDegrees of freedom (to nearest five) reflect design (strata = province, cluster = household).