Essays on Immigration and Economic Policy

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Abstract

Essays on Immigration and Economic Policy

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In the first essay, I study job-education mismatch and estimate its impact on the earnings of recent immigrants to Canada. Previous related studies have largely ignored cross-country differences in schooling quality. This essay presents a novel idea to account for cross-country differences in the quality of education, using Card and Krueger's (1992) two-step approach. The earning impact of job-education mismatch is estimated using an Over-Required-Under Education technique. Data from the Longitudinal Survey of Immigrants to Canada is used, and both cross sectional and panel data estimation methods are used to estimate the earning equations. Results show that recent immigrants to Canada have a persistent high incidence and intensity of over-education with substantial negative impact on their earnings. Most importantly is that not accounting for differences in educational quality across source countries leads to: 1) Overstating (understating) the incidence of over-education (under-education). 2) Understating (overstating) the return to over-education (under-education) for immigrants from countries with low quality of schooling. 3) Overstating (understating) the return to over-education (under-education) for immigrants from countries with high quality of schooling.

In the second essay, I quality-adjust human capital acquired from different source countries. This is achieved by explicitly deriving quality-adjustment indices, using data on adult males from the 2001 Canadian census. The derived indices are then used to examine the role of schooling quality in explaining the differential returns to schooling and over-education rates by nativity. I also use these indices to identify important inputs in the production technology of schooling quality. The key finding of this study is that accounting for schooling quality virtually eliminates the native-immigrant gaps in the returns to schooling and in the incidence of over-education. Results show wide variations in the return to schooling across countries. These variations are significantly explained by cross-country differences in educational resources, particularly government educational expenditure and the length of the school term.

The third essay studies the effect of graphic cigarette warning labels on smoking prevalence and quit attempts. The Generalized Estimating Equation model is used to estimate the population-averaged (marginal) effects of tobacco graphic warnings on smoking prevalence and quit attempts. It is found that graphic warnings had a statistically significant effect on smoking prevalence and quit attempts. In particular, the warnings decreased the odds of being a smoker and increased the odds of making a quit attempt.

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Azagba contributed to the study design and methodology, both authors performed the data analysis, interpretation of results and wrote the manuscript.

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Mesbah Sharaf

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Introduction

The labor market performance of immigrants compared to native-born Canadians has been the subject of intensive research (e.g. Galarneau and Morissette, 2004; Li et al., 2006; Green et al., 2007; Wald and Fang, 2008). Both earnings and occupational placement have been commonly used to assess the degree of economic integration of immigrants. A key factor directly related to this integration process is the quality of foreign-acquired human capital brought into the host country (Friedberg, 2000; Chiswick and Miller, 2009).

A growing body of research has examined job-education mismatch among immigrants and its impact on earnings (e.g. Galarneau and Morissette, 2004; Li et al., 2006; Green et al., 2007; Wald and Fang, 2008). The general finding is that immigrants have a substantial earnings disadvantage and a higher incidence of over-education relative to the native-born.

The adverse effects of over-education are well established. It has been shown that over-education is associated with high job dissatisfaction, high absenteeism, low productivity, poor health, job instability and lower wages (Tsang, 1987; Tsang et al., 1991). In addition, long term over-education may have negative impact on an individual's technical ability, especially if skills are not updated. Moreover, over-education may be costly for the economy because human capital resources are potentially inefficiently allocated, leading to lower economic growth (Barrett et al. 2006).

Accounting for cross-countries' schooling quality differences has been largely ignored in previous studies. Immigrants come from different source countries whose

educational systems are of different quality. It is well documented in the literature that the national origin of immigrant' education significantly affects its return in the host country's labor market. The first essay of this thesis explicitly accounted for differences in the quality of education by adjusting immigrants' "nominal" years of schooling from different source countries to reflect their "real" value using Card and Krueger's (1992) two-step framework. In particular, the first essay attempted to answer the following questions: First, does schooling quality matter for the incidence of job-education mismatch? Second, how do the incidence and intensity of job-education mismatch evolve over time? Third, what is the impact of job-education mismatch on earnings? Data from the longitudinal survey of immigrants to Canada was used to achieve the objective of this study, and data about schooling quality was obtained from Hanushek and Kimko (2000).

Two empirical regularities have emerged in the economic assimilation literature. First, foreign-obtained schooling is discounted in the destination country's labor market, as reflected by lower return toan immigrant's education compared to the native-born (e.g. Chiswick, 1978; Baker and Benjamin, 1994; Friedberg, 2000; Alboim et al., 2005; Chiswick and Miller, 2008). Second, the prevalence of over-education is on average higher among immigrants than the native-born (e.g. Li et al., 2006; Kler, 2007; Green et al., 2007; Wald and Fang, 2008; Galarneau and Morissette, 2008; Nielsen, 2011). Given that schooling quality is not directly observed, previous studies on the economic integration of immigrants have largely ignored the quality dimension of immigrants' human capital, and focused only on quantity measures, such as years of schooling. However, recent empirical evidence has shown that the quality of human capital is as

important as its quantity (e.g. Hanushek and Kimko, 2000; Sweetman, 2004; Chiswick and Miller, 2010; Schoellman, 2011).

The second essay adds to existing literature on cross-country differences in education quality by incorporating the idea that the labor market performance of foreign educated immigrants in the same labor market can be used to measure the average quality of schooling of their home countries. In particular, the returns to foreign-obtained schooling of immigrants in the Canadian labor market were used to measure the average quality of schooling for a wide set of countries. The estimated returns to schooling were used to identify important inputs in the production technology of schooling quality, adjusting immigrants' years of schooling for cross-county quality differences and revisiting evidence on the differential schooling returns and over-education rates by nativity.

The third essay of this thesis uses longitudinal Canadian data to examine the effect of graphic warnings labels on smoking prevalence and quit attempts. The adverse effects of tobacco use are well documented. Smoking is the leading preventable cause of premature death in the world and is a risk factor for many diseases (e.g. strokes, cardiovascular disease and cancer). According to the World Health Organization (WHO), smoking is responsible for 6 million deaths and by the year 2030; this figure is expected to reach 8 million (WHO, 2011). The average life span of a smoker is reduced by 6 to 10 years. In Canada, smoking is the leading cause of premature and preventable mortality. It is responsible for more than 45,000 deaths and a total economic burden of $15 billion per year.

To address the rising smoking epidemic, the WHO Framework Convention on Tobacco Control (FCTC), requires member countries to implement measures aimed at

reducing the demand for tobacco products (WHO, 2008). Article 11 of the FCTC provides guidelines for warning messages on cigarette packages. It recommends the use of rotating, large, clear, and visible graphic warning messages and it should cover 50% or more of the principal display areas of the package (WHO, 2008). In line with the global effort to curb the rising smoking epidemic, the Government of Canada implemented several measures to discourage smoking. In January 2001, Canada became the first country in the world to enforce graphic health warning labels on cigarette packages. The warnings occupied 50% of the principal display area and appeared in English and French on both sides of the package. Since then, graphic warnings have been the subject of intensive research to determine their effectiveness as an antismoking measure.

Several studies have assessed the effectiveness of graphic warnings in discouraging smoking (For a recent review of the literature see Hammond, 2011), with the general finding that graphic warnings were more effective than text only messages (e.g. Hammond et al.,2006; Givel 2007; Borland et al., 2009; Hammond, 2011). Though there is a substantial literature that examines the effectiveness of graphic warnings as a key tobacco control measure, evidence based on actual smoking behavior has been limited. Previous studies relied on respondents' answers to questions about the graphic warnings to determine their effectiveness. The questions covered the desire to quit, increased health knowledge of tobacco risks, ability to recall the messages, and self-reported effectiveness. The problem with these types of questions is that individuals tend to provide logical responses to questions which involve an appeal to fear. These answers may not reflect actual behavior, and hence may not provide an objective assessment of the effect of graphic warnings (Hastings et al., 2004; Ruiter and Kok, 2005).

Accordingly, this study takes a different approach by using survey data that has smoking related information without any health warning questions. In particular, the effectiveness of graphic cigarette warning labels was assessed based on their effect on smoking prevalence and quit attempts. Longitudinal data from the Canadian National Population Health Survey (1998-2008) is used to conduct the multivariate regression analyses.

Three approaches are used to capture the effect of graphic warnings. In the first approach, the graphic warning is considered to be in effect starting from July, 2001. In the second approach, the warning is considered to be in effect from December, 2001. However, in the third approach, a scaled variable that takes the value of zero for up to the first six months in 2001, then increases gradually to one from December, 2001 is used. Given the longitudinal structure of the Canadian National Population Health Survey and to account for the within individuals dependency, a Generalized estimating equation (GEE) model is used to examine the population-averaged (marginal) effects of tobacco graphic warnings on smoking prevalence and quit attempts. The merit of this model is that it accounts for correlated responses in longitudinal data, and gives consistent estimates of the regression parameters and of their variances under weak assumptions about the joint distribution. Three different working correlation structures; exchangeable, autoregressive and unstructured, are used to check if the main results are sensitive to the structure of covariance matrix.

There are several policy implications from the findings of this thesis, especially, for the Canadian immigration policy, as well as policies designed to help immigrants to assimilate in the labor market. In particular, the findings of the first two essays help to identify which groups of immigrants are genuinely more over-educated, which is of

interest to policies concerned with immigrants' assimilation. In addition, the Canadian immigration point system could take into account the quality of schooling when assigning points for education. The third essay of this thesis provides longitudinal evidence that graphic tobacco warnings have a statistically significant impact on smoking prevalence and quit attempts. This supports the current call for countries that are not yet implementing this policy to start introducing it.

Essay 1

Job-Education Mismatch and its Impact on Earnings among Recent Immigrants to Canada: Does Schooling Quality Matters?

-Abstract-

There is a large literature documenting a high incidence of job-education mismatch among immigrants. When education is measured by the years of schooling alone - as is standard in previous studies - some of this apparent mismatch arises due to differences in schooling quality between the host and source countries. This paper presents a novel idea to account for cross-country differences in the quality of education, using Card and Krueger's (1992) two-step approach. The earning impact of job-education mismatch is estimated using an Over-Required-Under Education technique. Data from the Longitudinal Survey of Immigrants to Canada is used, and both cross sectional and panel data estimation methods are used to estimate the earning equations. Results show that recent immigrants to Canada have a persistent high incidence and intensity of over-education with substantial negative impact on their earnings, though some sort of assimilation has taken place with time spent in Canada. I also find strong evidence that source countries' schooling quality, as measured by international test scores, affect the returns to education for immigrants in the Canadian labor market. Results also show that not accounting for differences in educational quality across source countries leads to: 1) Overstating (understating) the incidence of over-education (under-education). 2) Understating (overstating) the return to over-education (under-education) for immigrants from countries with low quality of schooling. 3) Overstating (understating) the return to over-education (under-education) for immigrants from countries with high quality of schooling.

Keywords*: Job-Education, Mismatch, Earnings, Schooling Quality, Immigrants.*

1. Introduction

The contribution of immigrants to host country's economic welfare largely depends on the degree by which their foreign-obtained educational qualifications translate into useable skills in the labor market. An empirical regularity in the immigrants' assimilation literature is the imperfect transferability of immigrants' human capital across countries (Friedberg, 2000; Green et al., 2007; Chiswick and Miller, 2009). Newly arrived immigrants usually face a set of barriers when searching for jobs that match their qualifications.[1] These barriers either prevent or delay their integration into the host country's labor market. Immigrants who find a job upon arrival to host country usually work in jobs that require a level of education less than what they actually possess. This form of job-education mismatch is known in the literature as over-education.[2] If a worker is employed in a job requiring more years of schooling than what he/she actually has, he/she is considered to be under-educated. Most of the job-education mismatch literature has focused on studying the phenomenon of over-education due to its high incidence and significant adverse effects.

Though there is a large body of literature that studied job-education mismatch among immigrants and its impact on earnings (e.g. Reitz, 2001; Green et al., 2007; Wald and Fang, 2008; Chiswick and Miller, 2009), previous studies have largely ignored the effect of cross-country differences in schooling quality. To measure the incidence of job-education mismatch, actual years of schooling of the workers are compared to required

[1] The common problems that immigrants encounter include non-recognition of foreign credentials and experience, lack of work experience, language barriers, lack of contacts in the job market, costly and long accreditation process for regulated occupations (see Table 1 in the appendix for details).

[2] Other terms include over-qualification and under-employment has been used to refer to the same phenomenon.

years of schooling in each occupation. A common practice in the literature is that studies implicitly or explicitly assume that nominally equal years of schooling of individuals from different source countries are of equal quality. This treatment may not be accurate given the substantial evidence on the existence of wide variation in schooling quality across countries, and that the return and degree of transferability of human capital depends on its national origin (Friedberg, 2000; Hanushek and Kimko, 2000; Bratsberg and Terrell, 2002; Sweetman, 2004; Chiswick and Miller, 2010).

This paper adds to the job-education mismatch literature by presenting a novel idea to control for cross-country differences in schooling quality. In particular, this paper aims to answer the following questions: First, does schooling quality matter for the incidence of job-education mismatch and its earnings impact? Second, how do the incidence and intensity of job-education mismatch evolve over time?[3] Third, what is the impact of job-education mismatch on earnings?

In this paper, I extend Card and Krueger's (1992) two-step approach to account for the difference in schooling quality across source countries.[4] The impact of job-education mismatch on earnings is estimated using an ORU model which is attributable to Duncan and Hoffman (1981).[5]

[3] Studying the pattern of over-education overtime helps to understand the assimilation behavior of immigrants in the labor market.

[4]The methodology used here is an application of the idea developed by Card and Krueger (1992) who related cross-state returns to schooling of migrants to the schooling quality of states.

[5] ORU stands for over-education, required-education and under-education. Under this model, total years of schooling is decomposed into three components; years required by the job, years of surplus schooling above what is required by the job and years of deficit schooling.

The main data source of this study is the Longitudinal Survey of Immigrants to Canada, hereinafter LSIC. Data about source country schooling quality is obtained from Hanushek and Kimko (2000).

The results of this study provide strong evidence that source country's schooling quality matters for the incidence of job-education mismatch and its effect on earnings. In particular, I found that not controlling for source countries' schooling quality differences leads to overstating (understating) the incidence of over-education (under-education). Analogously, not controlling for source countries' schooling quality differences leads to understating (overstating) the return to over-education (under-education) for immigrants from countries with low quality of schooling. The converse is true for immigrants with high quality of education.

The paper proceeds as follow. Section 2 reviews the literature. Section 3 presents the empirical methodology. Section 4 describes the data. Section 5 presents and discusses the results. Section 6 concludes the paper.

2. Background and Literature

Immigrants represent a considerable fraction of the population, and a major source of labor force growth in many host countries such as Canada, US, Australia.[6] As a result, the labor market outcome of immigrants has been subject to intensive research among academics. Along this dimension, several studies, within the assimilation literature, have examined the occupational outcome of immigrants relative to their educational attainment (e.g. Galarneau and Morissette, 2004; Li et al., 2006; Green et al.,

[6] Immigrants in Canada constitute 20% of the population (Canadian census of population, 2006).

2007; Wald and Fang, 2008). The general finding in the literature is that there is substantial earning disadvantage and high incidence of over-education among immigrants (see Figures 1 and 2). For example, Li et al. (2006) found that during the 1993-2001 period 52% of recent immigrants to Canada were over-educated. In another study, Wald and Fang (2008) found that half of the immigrants in Canada who arrived between 1989 and 1997 were over-educated.

The adverse effects of over-education are well established. It has been shown that over-education is associated with high job dissatisfaction, high absenteeism, low productivity, poor health, job instability and lower wages (Tsang, 1987; Tsang et al., 1991). In addition, long term over-education may have negative impact on an individual's technical ability, especially if skills are not updated. Moreover, over-education may be costly for the economy because human capital resources are potentially inefficiently allocated, leading to lower economic growth (Barrett et al. 2006).[7] For example, the Conference Board of Canada (2001) estimated that the Canadian economy loses up to 5 billion Canadian dollars annually because of over-education.

The standard practice in the literature on job-education mismatch is to measure education by the years of schooling alone without controlling for schooling quality. As a result, some of the apparent job-education mismatch arises due to cross-country differences in schooling quality. Equal nominal years of schooling from different origin countries have different real value in the labor market, and so it is important to control for quality differences when studying job-education mismatch.

[7] Job -educational mismatch does not necessarily imply inefficient use of human resources. Education is only one element of the stock of human capital. Other elements include experience, training, ability. Efficiency must be judged on whether the total amount of worker's human capital is fully utilized or not (Sicherman, 1991).

Studies have shown that the observed foreign/native born earnings gap is primarily due to the national origin of the human capital (Friedberg, 2000; Alboim et al., 2005). For example, Friedberg (2000) found that the source of human capital significantly accounts for the residual earnings disadvantage of immigrants to Israel. Immigrants come from countries with educational systems of different qualities. It has been shown that immigrants from countries with a high quality educational system have better labor market outcomes than those from countries with low a quality educational system (Sweetman, 2004; Chiswick and Miller, 2010).[8] In a study of the occupational attainment of immigrants in the US labor market, Mattoo et al. (2008) found that immigrants from Asian and industrial countries are less likely to end up working in unskilled jobs than immigrants from Latin America and Eastern Europe. The authors found a strong relationship between these differences in occupational attainment and the characteristics of the source country that influence the quality of human capital.

In a related study, Bratsberg and Terrell (2002) found that the return to education of immigrants to the United States is affected by measures of source country educational inputs, a commonly used proxy for schooling quality. As well difference in the characteristics of educational systems account for most of the variation in rates of return to education earned by immigrants. In a Canadian study, Sweetman (2004) found that the returns to schooling are greatest for those educated in Canada, and smallest for those educated abroad. He found a strong correlation between source country schooling quality and the return to schooling, and that moving up from the 25th to the 75th percentile of the

[8] Two main methods are used to measure education quality. The first uses education outcomes such as scores on internationally standardized tests like the Programme for International Student Assessment (PISA) as a proxy for schooling quality. The second approach involves estimating an education quality production function and relating educational inputs, such as pupils-teacher ratio, expenditures per pupil to the quality of the educational system.

schooling quality index (which was derived by Hanushek and Kimko (2000)) is associated with a 10 % increase in annual earnings. He also found that the earnings of immigrants who come to Canada at young ages are not a function of their source country school quality because they got most of their education in Canada. In another study, Chiswick and Miller (2010) found a strong positive relationship between the payoffs to schooling for immigrants in the US labor market and their source country schooling quality as measured by the PISA[9] reading, mathematics and science literacy scores. Using Israeli Census data, Friedberg (2000) showed that the most important factor determining the earning gap between immigrants and natives is the source of human capital, and that this factor fully explains the residual earnings disadvantage of immigrants to Israel. She showed that accounting for this factor will eliminate or even reverse the gap in the residual earnings of Israeli immigrants and natives.

In Canada, empirical evidence suggests that an immigrant's foreign education and work experience are significantly discounted in the Canadian labor market, and that the extent of this discounting varies by source country. For example, Alboim et al. (2005) found that the return to a year of foreign education is about 70 percent of the return to a year of Canadian education.

Two main approaches are used in the literature to account for the impact of schooling quality on earnings. The first approach involves adding a school quality measures in a standard earning equation, either as a separate explanatory variable, or interactively with years of schooling or both. This approach was used by Sweetman (2004) to study the impact of school quality differences on earning of immigrants to

[9] PISA refers to the Programme for International Student Assessment. It is an international evaluation of 15-year-old school pupils' scholastic performance conducted every three years by the Organization for Economic Co-operation and Development (OECD).

Canada. The second approach which is attributable to Card and Krueger (1992) entails a two-step estimation process. In the first step, country-specific returns to total schooling is estimated from a standard earnings equation which are then regressed on the school quality measure in a second step. The current study develops a methodology, based on Card and Krueger's (1992) two-step approach, to account for the effect of source country's schooling quality differences.

3. Methodology

The first step of the analysis is to measure the prevalence and intensity of job-education mismatch, and estimate its impact on earnings, using quality-unadjusted years of schooling.[10] The second step is to construct a quality adjustment index for each source country to control for cross-country differences in schooling quality.[11] The quality-adjusted years of schooling will then be used to revisit the evidence found in the first step. These steps are explained in detail in the following subsections.

3.1. Measuring job-education mismatch

As standard in the literature, job-education mismatch is measured by the following equation.

$$O_{ij} = S_{ij}^{a} - S_{j}^{r} \quad (1);$$

where S_{ij}^{a} represents total years of schooling completed by worker i working in job j, and S_{j}^{r} represents years of schooling required by job j. If $S_{ij}^{a} > S_{j}^{r}$, the worker is considered to

[10] Intensity of job-education mismatch refers to years of surplus or deficit schooling beyond what is required by the job.
[11] The adjustment applies only to the foreign obtained education.

be over-educated. Conversely, if $S_{ij}^{a} < S_{j}^{r}$, the worker is under-educated, while if $S_{ij}^{a} = S_{j}^{r}$, the worker is just-educated.

In this study, required schooling for each occupation was determined using the realized match method. Under this method, years of required education in each occupation are determined by the modal (i.e. most frequent) or mean years of schooling of the workers working in that particular occupation.[12] An empirical regularity in the job-education mismatch literature is that the fundamental findings are robust to the method of measuring required education (Hartog, 2000).

3.2. The impact of source counties' schooling quality on returns to education

Before adjusting years of schooling to quality differences across source countries, it is useful to examine whether schooling quality, as measured by international test scores, affects the return to schooling. The methodology used here is an application of the idea developed by Card and Krueger (1992) who related cross-state returns to schooling of migrants to the schooling quality of states. The idea was also applied to international immigrants by Chiswick and Miller (2010). [13]

The first step involves estimating an ORU earning equation, with total years of schooling decomposed into three components; years required by the job, years of surplus schooling above what is required by the job and years of deficit schooling.[14] In the

[12] This study used the modal rather than the mean years of schooling because it is less sensitive to outliers.

[13] Chiswick and Miller (2010) extended Card and Krueger's (1992) two-step approach to study the impact of source countries' schooling quality on the returns to immigrants' education in the US labor market.

[14] This model is attributable to Duncan and Hoffman (1981), and is an extension of the standard Mincerian earning function.

second step of Card and Krueger's approach, the country-specific returns to required education, over-education and under-education obtained from the first step are regressed on the schooling quality index derived by Hanushek and Kimko (2000). This model can be presented as follow:

$$\ln W_{ijt} = \beta_1 X_{ijt} + \sum_{j=1}^{J} \beta_{2j} I_j + \sum_{j=1}^{J} \beta_{3j}(I_j * S_{ijt}^{r}) + \sum_{j=1}^{J} \beta_{4j}(I_j * S_{ijt}^{O}) + \sum_{j=1}^{J} \beta_{5j} (I_j * S_{ijt}^{U}) + u_{ijt} \quad (2)$$

$$\beta_{3j} = \alpha_0 + \alpha_1 \text{ schooling quality}_j + \mu_j \quad (3)$$

$$\beta_{4j} = \delta_0 + \delta_1 \text{ schooling quality}_j + \epsilon_j \quad (4)$$

$$\beta_{5j} = \theta_0 + \theta_1 \text{ schooling quality}_j + \varphi_j \quad (5);$$

where $i, j \; and \; t$ index for individual, source country and time period.

I_j = Set of country indicators

β_{2j} = country specifc intercept

β_{3j} = country specific return to required education

β_{4j} = country specific return to overeducation

β_{5j} = country specific return to undereducation

u_{ijt} = time variant residual

Specifying the earning function as in equation 2 allows each country of origin to have its own intercept and return to Over-Required-Under Education which is central to the current study. Equation 2 shows that the logarithm of the weekly wage of individual i from country j is determined by a country-specific fixed effect β_{2j}, years of Over S_{ijt}^{O} - Required S_{ijt}^{r} -Under S_{ijt}^{u} schooling, a set of common observed covariates X_{ijt} and a stochastic error termu_{ijt}. The control variables included in X_{ijt} are a quadratic in potential

experience, measured by age minus years of schooling minus 6 years, age and its square, two indicators for marital status, ten indicators for field of study, five indicators for immigration category, five indicators for provincial fixed effects, an indicator for gender, two indicators for language proficiency and an indicator for visible minority status.

3.3. Adjusting years of schooling to quality differences

To derive a quality adjustment index for each source country, the country-specific return to required-education(β_{3j}), obtained from the first step of Card and Krueger's model, is expressed as the multiplicative of two components; a return β common to immigrants from all countries and an index that captures the relative quality of schooling q_j (Behrman and Birdsall,1983; Bratsberg and Terrell,2002). Formally, this can be written as follows:

$$\beta_{3j} = \beta_3 \, q_j \qquad (6);$$

where:

β_3 = return to required education, which is country invariant

$q_j = \left(\frac{\text{school quality index of country j}}{\text{school quality index of Canda=54.58}}\right)^{\alpha_3}$ = country-specific quality adjustment index

For simplicity, expressing equations 6 in logarithmic form yields

$$\ln \beta_{3j} = \ln \beta_3 + \alpha_3 \ln\left(\frac{school\ quality\ index\ of\ country\ j}{school\ quality\ index\ of\ Canda=54.58}\right) + \varepsilon_j \qquad (7);$$

where ε_j captures unobserved country-specific factors. The derived country-specific quality adjustment indices q_j are used to convert the "nominal" years of schooling of immigrants from different source countries into Canadian terms. [15]

This is calculated as

$$\widetilde{S_{i,j}^{T}} = q_j * S_{i,j}^{T} \quad (8)$$

The quality-adjusted years of schooling $\widetilde{S_{1,J}^{T}}$ are then used to re-measure the incidence of over-education and it's earning impact as will be shown in the next subsection.[16]

3.4. The impact of job-education mismatch on earnings

In this section I estimate the impact of job-education mismatch on earnings using the ORU model. It has been shown that the ORU model is superior to the conventional Mincerian earnings function that uses total schooling as an explanatory variable.[17]

The ORU model can be presented as follows:[18]

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[15] I assumed that the quality adjustment factor applied to years of required schooling is the same as that applied to surplus and deficit schooling. The rationale behind this is that years of surplus schooling and deficit schooling are determined in the first place before quality adjusting years of schooling.

[16] In another specification, a separate quality adjustment index was derived for required education, under-education and over-education. Then the adjusted total schooling was measured by the following equation $\widetilde{S_{1,J}^{T}} = q_j^{r} * S_{ij}^{r} + q_j^{o} * S_{ij}^{o} - q_j^{u} * S_{ij}^{u}$. Results using this specification were very close to that of using only the adjusting factor derived from the return to required-education.

[17] The standard earning function may give misleading results because the return to surplus schooling - beyond what is required by the job - is likely to be lower than the return to required schooling.

[18] It should be noted that S^{o} and S^{u} are mutually exclusive, where for each individual one of them or both must be zero.

$$S^{T}_{ijt} = S^{r}_{jt} + S^{o}_{ijt} - S^{u}_{ijt} \quad (9)$$

$$\text{Ln } w_{ijt} = \beta_0 + \beta_1 X_{ijt} + \beta_2 S^{r}_{jt} + \beta_3 S^{o}_{ijt} + \beta_4 S^{u}_{ijt} + u_{ijt} \quad (10)$$

Where $i, j \; and \; t$ index for individual, occupation and time period. S^{r} denotes required years of schooling by the job, S^{o} denotes years of over-education and S^{u} denotes years of under-education. **X** is a vector of other control variables including age, gender, field of study, marital status, immigration class, work experience, language proficiency, provincial dummies and visible minority status. u_{ijt} is the standard time variant residual term.

Under the ORU model, over-educated and under-educated workers are compared to co-workers (workers with the same required schooling who are just-educated).[19] Accordingly, the coefficients in the ORU model are interpreted as follows:

$\beta_2 =$ return to an additional year of required schooling

$\beta_3 =$ return to an additional year of surplus schooling relative to coworkers

$\beta_4 =$ wage loss to an additional year of deficit schooling relative to coworkers

$\beta_3 - \beta_2 =$ Return to an additional year of surplus schooling relative to workers with same total schooling that is adequately used.

Several findings concerning the earnings impact of job–education mismatch are documented in the literature.[20] First, the return to over-education is positive ($\beta_3 > 0$) but

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[19] The ORU model is reduced to the standard Mincerian earning equation if $\beta_2 = \beta_3 = |\beta_4|$. However, if this does not hold, the ORU model will give higher R^2 and the return to required education will be greater than the return to total education (Chiswick and Miller, 2010).

smaller than required education ($\beta_3 < \beta_2$), while the return to under-education is negative($\beta_4 < 0$). Second**,** over-educated workers earn less than workers with the same education attainment in jobs which require that level of schooling($\beta_3 - \beta_2) < 0$. However, under-educated workers earn more than workers with the same educational level working in jobs requiring the level of education that they have, and earn less than coworkers possessing the required level of education.

As a baseline model, I estimate equation 10 by a pooled cross-sectional method, ordinary least square (OLS), with the standard errors corrected for clustering at the individual level. This is done by pooling all observations in the three waves of the LSIC.[21] To benefit from the longitudinal structure of the LSIC in accounting for unobserved individual-level heterogeneity, I also estimate equation 10 using panel data estimation methods, both between effect (BE) and random effect (RE) models.[22] Accordingly Equation 10 can be rewritten as:

$$\text{Ln } w_{ijt} = \beta_0 + \beta_1 X_{it} + \beta_2 S^{r}_{jt} + \beta_3 S^{o}_{ijt} + \beta_4 S^{u}_{ijt} + \mu_i + v_{ijt} \qquad (11)$$

Here, the error term u_{ijt}, from Equation 10 became $\mu_i + v_{ijt}$, where μ_i represents time invariant individual-specific effects and v_{ijt} is the standard residual term. In the RE

[20] See for example Sicherman(1991); Kiker et.al (1997); Hartog (2000); Groot and Maassen van den Brink (2000).

[21] Pooled OLS produce consistent estimators if the error term in the ORU model is uncorrelated with all the explanatory variables in the model. However, if unobserved individual charactaristics are cruicial for determing the earnings, then the error term will be correlated with other explanatory variable, and hence it it better to use panel data estimation methods to have consistent estimates.

[22] The between effect is obtained when OLS is performed on the average over time for each individual in Equation 10. The fixed effect model was also estimated but is not reported because the key variables of interest were dropped in the FE estimation.

model, μ_i is assumed to be uncorrelated with other covariates in the model (Wooldridge, 2002). Stata 11 software package is used to conduct the multivariate analyses, and all the estimations are weighted using the LSIC sampling weights.

4. Data and sample characteristics

The main data source for this study is the LSIC. The survey was conducted by Statistics Canada and Citizenship and Immigration Canada using a sample from the 164,200 immigrants who immigrated to Canada between October 2000 and September 2001. The survey consists of three waves of interviews. In the first wave, 12,000 immigrants aged 15 years and above were interviewed between April 2001 and May 2002, six months after becoming permanent residents in Canada. In the second wave, 9,300 of the same immigrants were interviewed in 2003, two years after landing. In 2005, about 7,700 of the same immigrants were re-interviewed, four years after their arrival. The LSIC contains comprehensive information on all standard labor market and socio-demographic variables.[23]

To achieve the objectives of the current study, data from the three waves of the LSIC survey were used. Data about source countries' schooling quality was obtained from Hanushek and Kimko (2000). The Hanushek and Kimko measure of schooling quality is based on six sets of tests in mathematics and science conducted between 1965 and 1991 by the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Educational Progress (IAEP).[24]

[23] For more information about the LSIC see (Statistics Canada, 2005).

[24] For more information on how country-specific scores are constructed see Hanushek and Kimko (2000) pp 1186-1187.

A potential concern with using the school quality measure from Hanushek and Kimko (2000) is that it applies to all students from a certain country. However, immigrants are a selected sample, and hence using this measure may bias my results. To avoid this selection problem, the assumption in this paper is that selection of immigrants based on unobserved characteristics affects only the intercept not the slope of the earnings function. In other words, the effects of selection are captured by the country-of-origin fixed effects, which I discard, while the return to schooling is not affected (Schoellman, 2011).

Data from the confidential 2001 Canadian census of population was used to derive the required years of schooling based on 508 occupations. The required years of schooling in each occupation is determined by the modal (most frequent) years of schooling of Canadian-born workers in that particular occupation.

Due to data limitations, the analysis was confined to 24 source countries with significant percentage of immigrants accounting for about 72% of individuals covered by the LSIC.[25] Some major source countries were excluded because the school quality index derived by Hanushek and Kimko (2000) was not available.[26] In this study, the analysis was restricted to paid workers, aged 19-64 with a resulting sample of 5307 immigrants.

The multivariate analyses included a number of economic and socio-demographic variables commonly used in the literature. Age was represented in continuous form. Gender was captured by two dummy variables. Marital status was represented by two dummy variables; married, separated/single (reference group). An individual's

[25] In this paper source country refers to country where the highest level of education was obtained and not to the country of birth.

[26] These include Pakistan, Bangladesh, Morocco, Senegal, Lebanon, Romania, Czech Republic and Slovakia. The schooling quality indices for the former Soviet Union and Yugoslavia were given to now independent countries that were forming these countries.

educational attainment was captured by the total years of schooling. Work experience in the Canadian labor market was captured by the number of weeks that the immigrant has worked in Canada. Foreign work experience was captured by two specifications. In the first specification, a dummy variable was used to indicate whether the immigrant had a full time foreign work experience before immigration. In the second specification, potential work experience (age-years of schooling-6) was used. Immigration class was captured by four categories; family class, skilled workers, business class (reference group), and refugees. Immigrants' source country of education was represented by twenty four indicator variables, with Canada as the reference group. Provincial or regional fixed effects were represented in five categories; Ontario, Quebec, British Colombia (reference group), Atlantic provinces (comprising New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland and Labrador) and Western provinces (Alberta, Saskatchewan and Manitoba). Immigrants' fields of study were represented by seven categories: educational; fine arts, humanities and social sciences; engineering; health professions; commerce (reference group); agriculture and mathematics; and no specialization. Language proficiency was captured by an indicator variable: English/French is the mother tongue and English/French is not the mother tongue (reference group). Experience recognition was captured by an indicator variable with foreign experience not recognized in the Canadian labor market as the reference group. Working status (full time=1, part time=0) was controlled for in the analysis. The analysis also included a dichotomous variable indicating whether an individual belongs to a visible minority group as defined by Statistics Canada.

<Insert Table 2 here>

Table 2 reports the summary statistics of the variables included in the analysis. Half of the immigrants were males, 80 % were married, 60% had at least a bachelor degree, and 61.3 % were skilled workers. For the field of study, 17.3% had engineering background, 19% were in commerce and management related fields. 9.5% of the immigrants reported English or French as their mother tongue. 48% were residing in Ontario. The average age of individuals in the sample was 35 years. 40% of the immigrants had their highest level of education in three main countries: China (17.95%), India (14.30) and the Philippines (7.34).

Data on schooling quality, as proxied by Hanushek and Kimko (2000) indices shows significant difference across-countries. The Hanushek and Kimko indices for the included countries ranged from 18.26 (Iran) to 65.5 (Japan).

5. Empirical findings

5.1. The impact of source countries' schooling quality on the returns to education

The first step of Card and Krueger's (1992) two-step model was estimated using Ordinary Least Squares with a country-specific intercept.[27] Pooled OLS produces consistent estimators only if the error term in the ORU model is uncorrelated with all the explanatory variables in the model. However, if unobserved individual characteristics are crucial in determining the earnings of immigrants, then the error term will be correlated with other explanatory variable. To this end, I applied panel data estimation methods such as between effect and random effects models. The results were robust to alternative model specifications, and hence only the baseline OLS results are presented here.

[27] As a robustness check, another version of the first step was estimated without including the countries' specific intercepts and the results were very close to the baseline model.

Table 3 presents results for the second step of Card and Krueger's (1992) model, where source countries' returns to years of required education, over-education and under-education are related to schooling quality measure.

< Insert Table 3 here>

To account for the relative sample size of source countries which affects the precision of the estimated return to education, weighted least squares was used to estimate the second-step equations. The total number of workers from each source country in the first-step regression was used as a weight for Equation 3, whereas the numbers of over-educated and under-educated workers were used as a weight for Equations 4 and 5 respectively.[28] This means that source countries with a significant percentage of immigrants like China, India and Philippine were given more weight than source countries with fewer immigrants.[29]

Results showed that the returns to required-education and over-education were significantly affected by source-country schooling quality. An increase in the schooling quality index by 10 points increases the return to required education by 0.74 percentage points and the return to over-education by 0.4 percentage points. The negative sign of schooling quality coefficient for the under-education equation indicates that an under-educated worker earns a lower wage than a coworker working in the same occupation

[28] Another set of weights which were used is the inverse of the variances of the estimated country specific returns to education in the first step. This gives more weight to country specific returns that are precisely estimated and less weight to country returns that are estimated less precisely.

[29] In a different specification for the second step, source countries' per capita real GDP were included as an additional explanatory variable. The obtained results were very similar to the baseline model. For simplicity, only the parsimonious version without including source countries' per capita real GDP and using the number of workers from each country in the first step as a weight is presented here.

with the required level of education. The wage penalty to under-educated workers was not significantly affected by the quality of the source countries' schooling. That is, workers who were under-educated had the same wage penalty relative to coworkers regardless of their source of education.[30]

5.2. Adjusting years of schooling to quality differences across source countries

The weighted least square results from estimating Equation 7 are reported in Table 4.

< Insert Table 4 here>

A quality adjustment index $q_j = \left(\frac{school\ quality\ index\ of\ \ country\ j}{school\ quality\ index\ of\ Canda=54.58}\right)^{0.281}$ was derived for each source country. As shown in Figure 3, the quality adjustment index ranges from 0.74 for Iran to 1.05 for Japan. A quality adjustment index of value 0.74 means that 10 years of schooling from this source country worth 7.4 years when expressed in Canadian terms. Five countries in the sample had a test score higher than that of Canada, and hence their quality adjustment index is greater than unity.[31]

<Insert Figure 3 here>

The derived quality adjustment indices were used to adjust years of schooling for quality differences across source countries. The same exercise of measuring the incidence and intensity of job-education mismatch, and the estimation of its earning impact, was repeated using the quality-adjusted years of schooling.

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[30] Chiswick and Miller (2010) found similar results when they studied the impact of source countries schooling quality on the returns to immigrants' education in the US labor market.

[31] These include Fiji, South Korea, United Kingdom, China and Japan.

5.3. The incidence and intensity of job-education mismatch

The longitudinal feature of the LSIC facilitated the study of how the incidence and intensity of over-education evolved over time. The incidence of job-education mismatch at each wave of the LSIC is reported in Table 5. The results indicated a high incidence of over-education among recent immigrants to Canada even after controlling for cross-country differences in schooling quality. Based on the quality-unadjusted years of schooling, 76.27% of the immigrant males and 71.76% of the females were over-educated at the first wave of the LSIC (6 month after becoming permanent residents). These figures did not improve so much after four years from arrival, where 70.35% of the males and 64.6% of the females were over-educated.[32] However, based on the quality-adjusted years of schooling, 66.27% (62.6%) of the males and 64.21 %(58.76%) of the females were over-educated after 6 month (4 years) from arrival to Canada. The results also indicated that 15.71% of the immigrant males and 16.55% of the females were under-educated after 6 month from arrival to Canada based on the unadjusted years of schooling. While, using the quality adjusted years of schooling, 33.31% of the immigrant males and 35.36% of the females were under-educated after 6 month from arrival to Canada.

< Insert Table 5 here>

These results confirm that when job-education mismatch is measured by the quality-unadjusted years of schooling, as is standard in the literature, some of this apparent mismatch arises due to differences in schooling quality between the host and home countries. In particular, Results showed that not controlling for source countries'

[32] As a benchmark, the incidence of over-education among Canadian-born is estimated at 43.85 percent using data from the 2001 Canadian census.

schooling quality differences leads to overstating the incidence of over-education by 7.7 to 10 percentage points for males and by 5.8 to 7.5 percentage points for females. Analogously, under-education is understated by 16.4 to 17.6 percentage points for males and 18 percentage points for females. These results indicate that the incidence of under-education among immigrants is considerably larger than what the quality-unadjusted data reveals. In other words, a considerable fraction of the apparently overeducated immigrants were in fact not over-educated.

The persistent high incidence of over-education among the recent immigrants is in line with the findings of several previous studies who examined earlier cohorts of immigrants to Canada (e.g. Galarneau and Morissette, 2004; Li et al., 2006; Wald and Fang, 2008). The duration of over-education and the associated low schooling return, at least for some groups of immigrants, could partly explain why it takes long for immigrants to achieve earning parity with natives, and it also implies that the difficulties facing recent immigrants in the labor market are not necessarily transient.

The high incidence of over-education among recent immigrants to Canada could be explained by several reasons that are widely discussed in the literature. Immigrants are forced, at least during early period of entering host country's labor market, to accept jobs with less educational requirement due to lack of host country-specific human capital (e.g. job experience, contacts in labor market, and language skills).[33] After four years from arrival to Canada, lack of Canadian work experience was mentioned to be the main difficulty (49.8%), followed by lack of contacts in the job market (37.1%), non recognition of foreign experience (37%) and foreign qualification (35.4%). About one-

[33] Some of the challenges that confronted immigrants in the Canadian labor market are listed in Table 1.

third of job seekers who experienced difficulties stated language barriers as a problem. Entering the labor market during periods of recession could be a possible reason for the high incidence of over-education (Picot and Hou, 2003). It is evident that the LSIC participants have arrived to Canada during a period of recession. As a result, immigrants are left with no option other than survival jobs. About one-third of the job seekers who experienced difficulties reported lack of employment opportunities as a problem.

Costly accreditation and licensing requirements by professional associations in many regulated occupations also constitute an entry barrier in many occupations. The OECD (2006) reported that non-recognition of immigrants' foreign credentials is the biggest learning recognition problem in Canada, and that a considerable part of the funds spent by Canadian government on educating and retraining immigrants was unnecessary or redundant.

Poor source countries' schooling quality is another reason for the high incidence of over-education among the recent immigrants. Recent data showed that there has been a shift from countries with high quality educational system to countries with low quality educational system. According to the 2006 Canadian census of population, 58.3% of recent immigrants came from Asia (including middle east) compared to 12.1% in 1977, while those who came from Europe were 16.1% compared with 61.6% in 1977. Picot and Hou (2003) found that Canadian employers have no reliable information about the real occupational skills and education quality of graduates from Asian universities. Another challenge is that recent immigrants have less command of official languages. For example, only 9.5% of the immigrants in the LSIC reported English or French as their mother tongue. Another reason is that there could be some sort of discrimination in the

labor market toward visible minorities.[34] About 15% of the immigrants covered by the LSIC reported discrimination to be the main difficulty in finding a suitable job. This is supported by several studies which argued that immigrants are subject to discrimination in the Canadian labor market (see Galarneau and Morissette, 2004; Wald and Fang, 2008; Oreopoulos, 2009). For example, Oreopoulos (2009) conducted a study using thousands of resumes sent in response to online job postings for occupations in Toronto. The author found considerable employer discrimination against applicants with ethnic names on the resume in terms of lower callback rates and interview requests compared to those with English-sounding names.

The wide range of variables in the LSIC enables measuring the incidence of job-education mismatch among different subgroups of immigrants. Accordingly, the sample was stratified by gender, marital status, age, and level of education.

<Insert Table 6 here>

Table 6 shows considerable differences in the incidence of over-education among different subgroups of immigrants. Based on the LSIC data, the incidence of over-education was higher among recent immigrant males than among females, and was also higher among married than singles. The incidence of over-education decreased with age. This is consistent with the job search behavior of young workers and the fact that young workers lack enough job experience or training relative to older workers.

Not surprisingly, the incidence of over-education increased with educational attainment. The results show that immigrants with high educational level face substantial difficulties in transferring their qualifications to the Canadian labor market than the less

[34] Labor market discrimination is a situation in which workers who are equally productive are treated unequally in a way related to observable characteristics like race, ethnicity or gender.

educated immigrants. For example, 90 percent of recent immigrants with a bachelor degree, and 94 percent with a master degree are over-educated. Immigrants with a degree in regulated occupations such as dentistry, medicine, veterinary medicine, optometry and law have the highest incidence of over-education (96 percent). These findings were consistent across the three waves of the LSIC and are in line with the findings of several previous studies (e.g. Li et al., 2006; Wald and Fang, 2008).

A complete understanding of the phenomena of over-education and under-education requires studying not only its incidence but also its intensity, and how both evolve over time. Studying how the job-education mismatch intensity evolves over time helps in understanding the dynamics of the assimilation process, where a reduction in the intensity of job-education mismatch could be an indicator of job match improvement and assimilation. The general finding from this analysis is that the incidence and intensity of over-education decreased with the length of stay in Canada (see Table 7).

< Insert Table 7 here>

< Insert Figure 4 here>

< Insert Figure 5 here>

< Insert Figure 6 here>

The distribution of job-education mismatch intensity for the quality adjusted and unadjusted years of schooling, and its evolution by the length of stay in Canada are shown in Figures 4, 5 and 6. The quality adjusted distribution is more symmetric with a smaller kurtosis and skewness than the quality unadjusted distribution. Unlike the quality adjusted distribution, the quality unadjusted distribution is negatively skewed (skewed to

the left) which means that the left tail is longer, with few negative values (under-educated), while the mass of the distribution is concentrated on the right(over-educated).

5.4. The earning impact of job-education mismatch

Results from estimating the ORU earning equation are reported in Table 8 for the whole population. In addition, the results for males and females are reported in Tables 9 and 10.

< Insert table 8 here >

< Insert table 9 here >

< Insert table 10 here >

Consistent with previous findings, the return to over-education is positive but smaller than the returns to required education for both males and females, while the return to under-education is negative. These findings are robust to changing the model specification, estimation method, and to whether years of schooling are adjusted for cross- countries' schooling quality differences.[35] In the quality unadjusted version of the ORU model in Tables 9 and10, the return to over-education is 36.8% of the returns to required education for females, while for males, the return to over-education is 13.2% of the returns to required education. Over-educated males (females) earned 8.7% (7.6%) less than workers with the same education attainment in jobs which require that level of schooling.[36] This means that for females there was no wage loss to an additional year of deficit schooling relative to coworkers. However under-educated males lost 3.25% for an

[35] Given that the results of the three estimation methods, pooled OLS, Random effects and between effects were very similar, I used result obtained from the pooled OLS model in my interpretations.

[36] Although the return to under-education is not statistically significant for females, the effect of under-education has almost the same magnitude as for over-education.

additional year of deficit schooling relative to coworkers. The effects of the other explanatory variables were consistent with the priori expectations. Earnings increased for immigrants with English or French as a mother tongue, and having full time foreign experience which is recognized in the Canadian labor market. Working in a part time job reduced earnings. Immigrants' earning also increased with age and with having a Canadian work experience.

Results for the quality-adjusted version of the ORU model show that the return to over-education is 24% of the returns to required education for females, while for males the return to over-education is 13.3% of the returns to required education. Over-educated males (females) earned 8.5% (8.12%) less than workers with the same education attainment in jobs which require that level of schooling. Similar to the unadjusted estimation, the return to under-education was not statistically significant for females. However under-educated males lost 1.92% for an additional year of deficit schooling relative to coworkers.

A key observation from Tables 8, 9 and 10 is that the returns to over-education and under-education based on the quality unadjusted years of schooling were less than the returns from the quality adjusted years of schooling. This implies that not controlling for schooling quality differences leads to understating the return to surplus and deficit schooling. This finding was robust to changing the estimation method. A deeper analysis and explanation for this finding is done in the next subsection, where the analysis is stratified by the source country.

5.5. The earning impact of job-education mismatch by source country

The previous section presented the population average impact of job-education mismatch on earnings; however, this impact may differ by source countries. Accordingly, the analysis is stratified by splitting the sample into two subgroups of source countries; countries with quality adjustment index greater than unity, referred to as high schooling quality countries, and the low schooling quality group (adjustment index is less than unity).

< Insert table 11 here >

< Insert table 12 here >

< Insert table 13 here >

< Insert table 14 here >

< Insert table 15 here >

< Insert table 16 here >

Results for the high schooling quality group are presented in Tables 11 to 13 for the whole population as well as for males and females. Similarly, results for the low schooling quality group are presented in Tables 14 to 16.

The main conclusion from stratifying the analyses by source-country schooling quality was that, not controlling for source countries' schooling quality difference leads to overstating (understating) the return to over-education (under-education) for immigrants from countries with high quality of schooling. For example, for male immigrants from source countries with high schooling quality, the return to a year of surplus (deficit) schooling was 1.27% (4.49%) using the quality-unadjusted schooling data. However, using the quality-adjusted years of schooling, the return to a year of

surplus (deficit) schooling was 0.98% (5.58%). Conversely, for male immigrants from countries with low quality of education, not controlling for source countries' schooling quality difference leads to understating (overstating) the return to over-education (under-education). For example, for immigrants from source countries with low schooling quality, the return to a year of surplus (deficit) schooling was 2.71% (1.87%) using the unadjusted schooling data. However, using the quality-adjusted years of schooling, the return to a year of surplus (deficit) schooling was 3.02% (1.46%). These findings were robust to different model specifications and the estimation method. The effects of the other explanatory variables were in general similar to the whole population results.

6. Conclusion

A growing body of research has examined job-education mismatch among immigrants and its impact on earnings. However, accounting for cross-countries' schooling quality differences has been largely ignored in previous studies. Immigrants come from different source countries whose educational systems are of different quality. This paper explicitly account for differences in the quality of education by adjusting immigrants' "nominal" years of schooling from different source countries to reflect their "real" value using Card and Krueger's (1992) two-step framework.

This paper attempt to provide an answer to the following questions: First, does schooling quality matter for the incidence of job-education mismatch? Second, how do the incidence and intensity of job-education mismatch evolve over time? Third, what is the impact of job-education mismatch on earnings?

Results show that the incidence of over-education is significantly high and prevalent among recent immigrants to Canada, though some sign of assimilation has

occurred by the length of time spent in Canada. Results provide strong evidence that source countries' schooling quality affect the returns to education for immigrants in the Canadian labor market. Results from Card and Krueger's (1992) two-step model show a statistically significant positive association between the returns to required education and over-education and schooling quality of the source-countries. Results also show that failure to account for differences in schooling quality across source countries leads to wrong estimates of the incidence of job-education mismatch and its impact on earnings.

For the earnings impact of job-education mismatch, consistent with previous findings in the literature, I find that the return to surplus schooling is positive but smaller than the returns to required schooling even after controlling for differences in the quality of schooling. Results from the ORU model indicated that not controlling for source countries' schooling quality differences understated (overstated) the return to over-education (under-education) for immigrants from countries with low quality of schooling. Conversely, for immigrants from countries with high quality of education, not controlling for source countries' schooling quality differences overstated (understated) the return to over-education (under-education).

One limitation of the current study is that the analyses are restricted to only 24 source countries. This calls for further research using a wider set of source countries to reach generalized findings at the population level. Second, the schooling quality index of Hanushek and Kimko (2000) may not be an accurate measure of the cross-countries schooling quality difference. These measures apply to all students in the source country, however, immigrants are a selected sample, and hence estimates based on these measures may be subject to selectivity bias. Accordingly, in the next chapter of this thesis I will

derive a measure of schooling quality using the immigrants' return to schooling in the Canadian labor market and for a wider range of source countries.

Appendix

Table 1

Difficulties facing immigrants aged 25-44 when searching for a relevant job

	Wave 1	Wave 2	Wave 3
Not enough Canadian job experience	62.6	62.4	49.8
No connections in the job market	33.1	37.1	37.1
Foreign experience not accepted	42.6	37.9	36.6
Foreign qualifications not accepted	39.2	38.0	35.4
Lack of employment opportunities	29.1	42.7	32.4
Not enough Canadian job references	33.2	34.8	32.1
Language problems	38.2	34.6	31.9
Not able to find a job in my field	14.9	34.8	29.8
Not knowing enough people working	15.5	20.1	20.4
Not having family or friends who could help	9.8	13.4	15.4
Discrimination	7.6	13.2	14.6
Not knowing how to find a job	9.7	10.1	10.4
Childcare constraints	n.a.	3.3	4.6
Transportation constraints	8.7	6.4	3.9
Not knowing the city	6.3	5.5	3.5
Other	9.0	9.5	12.9

Numbers are % of respondents answering positively
Source: Longitudinal Survey of Immigrants to Canada, 2005

Table 2

Descriptive statistics

Variables	mean
Age (years)	35.3
Male (1 if yes, zero if no)	49.38
Female (1 if yes, zero if no)	50.62
Married (1 if yes, zero if no)	80.02
Highest level of educational attainment	
Less than high school (1 if yes, zero if no)	12.9
High school (1 if yes, zero if no)	11.9
Some college (1 if yes, zero if no)	5.4
College (1 if yes, zero if no)	10.1
Bachelor degree (1 if yes, zero if no)	41
Graduate degree (1 if yes, zero if no)	17.5
Degree in dentistry, medicine, veterinary medicine, optometry, law or theology (1 if yes, zero if no)	1.2
English or French is the mother tongue (1 if yes, zero if no)	9.49
Visible minority (1 if yes, zero if no)	83.4
Field of study	
Educational, recreational and counseling services	6.3
Fine and applied arts	2.07
Humanities and related fields	5.4
Social sciences and related fields	7.4

Commerce, management and business administration	19.4
Agricultural and biological sciences and technologies	2.3
Engineering and applied sciences	17.3
Health professions, sciences and technologies	3
Mathematics and physical sciences	5.4
Immigration category	
Family class (1 if yes, zero if no)	26.90
Skilled workers (1 if yes, zero if no)	61.29
Business class (1 if yes, zero if no)	5.8
Refugees (1 if yes, zero if no)	4.58
Provincial nominees (1 if yes, zero if no)	0.88
Province of residence	
Quebec	15.24
Ontario	48.07
Western provinces	14.91
Atlantic provinces	1.21
British Columbia	20.57
Host country human capital	
Post immigration education or training in Canada (1 if yes, zero if no)	58.9
Has Canadian work experience (1 if yes, zero if no)	69.4
Working Part Time (1 if yes, zero if no)	17.3
Source country human capital	
Has full time Foreign work experience (1 if yes, zero if no)	74.8

Foreign experience recognized (1 if yes, zero if no)	18.7
has credentials	78
Number of credentials	1.19

Source: Longitudinal Survey of Immigrants to Canada. Statistics are weighted using LSIC sampling weight. These summary statistics are calculated using the balanced sample of immigrants who were interview at the three waves of interviews.

Descriptive statistics continued

country	Hanushek and Kimko schooling quality index	Quality adjusting factor	Percentage of workers from each country
Iran	18.26	0.749	2.44
India	20.8	0.775	14.30
Ghana	25.58	0.819	0.30
Iraq	27.5	0.835	1.10
Algeria	28.06	0.839	1.65
Kenya	29.73	0.852	0.33
Philippines	33.54	0.879	7.34
Brazil	36.6	0.900	0.33
Mexico	37.24	0.904	0.40
Turkey	39.72	0.919	0.35
Srilanka	42.57	0.936	2.05
Indonesia	42.99	0.939	0.39
Trinidad and Tobago	46.43	0.958	0.29
United states	46.77	0.960	2.66
Germany	48.68	0.970	0.65
South Africa	51.3	0.983	1.06
Guyana	51.49	0.984	0.61
Yugoslavia	53.97	0.997	1.87
Canada	54.58	1	0.26
Soviet union	54.65	1	4.24

Fiji	58.1	1.016	0.30
South Korea	58.55	1.018	3.71
United kingdom	62.52	1.036	2.33
China	64.42	1.044	17.95
Japan	65.5	1.049	0.58

Source : column 2 from Hanushek and Kimko (2000) .Column 3 is calculated by the author.

Table 3

The impact of source country's schooling quality on the return to required education, over-education and under-education

	Required education	Under-education	Over-education
Schooling quality	0.0737***	-0.0644	0.0399*
	(0.0182)	(0.0716)	(0.0230)
Constant	6.772***	0.240	0.404
	(0.850)	(3.282)	(1.086)
Observations	24	24	24

Clustered robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4

Estimation results for Equation 7.

Variables	ln β_{3j}
Ln quality ratio	0.281***
	(0.0804)
Constant	2.370***
	(0.0460)
Observations	24

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5

The incidence of over-education among recent immigrants to Canada

		Males			Females		
		Wave 1	Wave 2	Wave 3	Wave 1	Wave 2	Wave 3
Over-educated	Quality unadjusted	76.27	72.51	70.35	71.76	68.89	64.61
	Quality adjusted	65.87	64.40	62.58	64.13	62.16	58.76
Just-educated	Quality unadjusted	8.02	9.18	9.65	11.69	11.79	12.97
	Quality adjusted	0.42	0.51	0.54	0.43	0.43	0.59
Under-educated	Quality unadjusted	15.71	18.31	20	16.55	19.32	22.42
	Quality adjusted	33.71	35.09	36.88	35.44	37.41	40.65

Source: Author's calculation using data from LSIC. All statistics are population weighted using the LSIC sampling weights.

Table 6

The incidence of over-education among different groups of immigrants (% of each relevant group that is over-educated)

	Wave 1		Wave 2		Wave 3	
	Quality unadjusted	**Quality adjusted**	**Quality unadjusted**	**Quality adjusted**	**Quality unadjusted**	**Quality adjusted**
Gender						
Male	76.27	66.27	72.51	64.79	70.35	62.66
Female	71.76	64.21	68.89	62.31	64.61	58.76
Marital status						
married	77.31	68.15	75.89	68.17	72.20	64.84
Not married	59.35	51.31	49.40	44.25	48.04	43.26
Age						
25-34	82.25	73.36	81.39	73.80	75.01	66.75
35-44	81.77	76.06	79.57	75.31	76.34	71.94
45-54	62.05	55.93	60.67	55.55	64.36	61.50
55-64	41.24	31.24	47.05	35.49	48.21	39.96
highest level of education						
Some elementary or elementary	2.51	2.51	1.48	1.48	1.79	1.79
Some high school	7.01	4.3	3.73	3.75	2.81	3.71
High school graduation	20.97	25.43	19.66	26.02	16.80	25.13
Some trade or apprenticeship training	56.08	45.63	52.24	49.52	51.38	53.54
Trade certificate	60.87	42.99	54.73	39.91	58.47	45.64
Some college	66.22	32.38	67.77	37.53	61.68	34.52

College/CEGEP	76.56	65.56	77.09	68.61	75.25	66.57
Some university	85.53	57.11	83.03	58.05	79.95	60
Bachelor's degree	90.92	78.38	89.62	78.06	82.67	71.25
Master's degree	94.35	91.91	92.90	90.87	87.09	84.25
Degree in medicine, or law	95.72	92.91	96.60	94.15	89.52	85.37
Doctorate	87.30	87.18	90.71	90.92	86.86	89.04

Source: Author's compilation using data from LSIC. All statistics are population weighted using the LSIC sampling weights.

Table 7

Distribution of the job-education mismatch intensity for quality adjusted and unadjusted years of schooling

	quality unadjusted			quality adjusted		
intensity	**wave 1**	**wave 2**	**wave 3**	**wave 1**	**wave 2**	**wave 3**
>=9	2.36	1.9	1.69	1.43	1.14	1.01
8	2.03	2.11	1.74	1.364	1.461	1.108
7	2.21	2.208	1.72	3.522	3.159	3.379
6	7.7	6.86	6.282	4.493	4.568	4.105
5	8.952	8.63	7.506	8.519	8.732	10.11
4	16.51	15.77	16.66	9.402	9.054	9.05
3	16.92	15.9	14.43	10.21	9.678	8.305
2	10.86	10.64	10.02	12.71	11.87	11.18
1	6.85	6.85	7.781	13.05	13.14	13.13
0	9.55	10.37	11.11	0.42	0.47	0.56
-1	5.96	6.88	7.803	10.93	10.8	11
-2	5.24	5.6	6.353	7.673	7.7	8.118
-3	2.093	2.674	3	6.474	6.66	7.058
-4	0.975	1.345	1.445	3.642	4.404	4.345
-5	0.607	0.6922	0.82	3.183	3.329	3.771
-6	0.3	0.458	0.67	1.06	1.602	1.54
-7	0.38	0.53	0.35	0.6863	0.7423	0.9466
-8	0.38	0.33	0.25	0.1383	0.174	0.2218
>=-9	0.13	0.25	0.35	0.15	0.27	0.34

Source: Author's compilation

Table 8

The earning impact of job education mismatch- whole population-

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.108***	0.102***	0.105***	0.100***	0.115***	0.111***
	(0.00746)	(0.00759)	(0.00609)	(0.00593)	(0.00752)	(0.00748)
Years of over-education	0.0264***	0.0187***	0.0241***	0.0186***	0.0223***	0.0203***
	(0.00525)	(0.00469)	(0.00536)	(0.00506)	(0.00585)	(0.00558)
Years of under-education	-0.0214***	-0.0145**	-0.0206**	-0.0167**	-0.0192**	-0.0119
	(0.00789)	(0.00694)	(0.00808)	(0.00691)	(0.00859)	(0.00757)
Age	0.0384***	0.0397***	0.0429***	0.0434***	0.0348***	0.0350***
	(0.00872)	(0.00868)	(0.00729)	(0.00731)	(0.00802)	(0.00805)
Age square	-0.000489***	-0.000507***	-0.000521***	-0.000530***	-0.000438***	-0.000445***
	(0.000115)	(0.000114)	(9.04e-05)	(9.07e-05)	(9.94e-05)	(9.98e-05)
Visible minority	-0.0658***	-0.0519**	-0.0561**	-0.0400	-0.0416	-0.0271
	(0.0251)	(0.0260)	(0.0272)	(0.0277)	(0.0280)	(0.0285)
English/ French is mother tongue	0.170***	0.172***	0.176***	0.176***	0.174***	0.173***
	(0.0370)	(0.0372)	(0.0362)	(0.0364)	(0.0382)	(0.0384)
Full time foreign experience	0.0280	0.0175	0.00462	-0.00575	0.0301	0.0222
	(0.0267)	(0.0267)	(0.0310)	(0.0312)	(0.0321)	(0.0323)
Foreign exp is recognized	0.279***	0.283***	0.292***	0.296***	0.283***	0.286***
	(0.0239)	(0.0241)	(0.0263)	(0.0264)	(0.0281)	(0.0282)
Married	0.0252	0.0278	0.0213	0.0250	0.0467	0.0508
	(0.0298)	(0.0300)	(0.0303)	(0.0304)	(0.0317)	(0.0319)
Part time	-0.978***	-0.986***	-0.975***	-0.979***	-0.995***	-1.000***
	(0.0292)	(0.0294)	(0.0210)	(0.0211)	(0.0313)	(0.0314)
Experience in Canada	0.00375***	0.00380***	0.00367***	0.00370***	0.00431***	0.00449***
	(0.000241)	(0.000243)	(0.000201)	(0.000202)	(0.000493)	(0.000495)
Education and recreational	-0.0442	0.000612	-0.0926*	-0.0588	-0.100*	-0.0686
	(0.0489)	(0.0472)	(0.0493)	(0.0484)	(0.0514)	(0.0505)
Fine art	-0.00152	0.0395	-0.0730	-0.0388	-0.0668	-0.0303
	(0.144)	(0.146)	(0.0899)	(0.0902)	(0.0902)	(0.0907)
Humanities	-0.0532	-0.00284	-0.0362	0.00166	-0.00256	0.0335
	(0.0521)	(0.0511)	(0.0528)	(0.0518)	(0.0546)	(0.0537)
Social sciences	-0.0375	0.00594	-0.0527	-0.0190	-0.0493	-0.0180
	(0.0414)	(0.0383)	(0.0470)	(0.0460)	(0.0488)	(0.0477)
Commerce	0.00567	0.0434	-0.00140	0.0259	0.00446	0.0306
	(0.0294)	(0.0283)	(0.0357)	(0.0349)	(0.0371)	(0.0363)
Agriculture	-0.112	-0.0518	-0.0736	-0.0319	-0.0148	0.0212
	(0.0718)	(0.0706)	(0.0775)	(0.0763)	(0.0799)	(0.0785)

Engineering	0.0292	0.0549*	0.00780	0.0253	0.0103	0.0272
	(0.0302)	(0.0300)	(0.0367)	(0.0364)	(0.0382)	(0.0378)
Health	-0.0200	0.0191	-0.0321	-0.00442	-0.0583	-0.0345
	(0.0566)	(0.0566)	(0.0679)	(0.0674)	(0.0704)	(0.0698)
Mathematics	0.190***	0.211***	0.171***	0.185***	0.171***	0.183***
	(0.0536)	(0.0533)	(0.0522)	(0.0521)	(0.0543)	(0.0542)
Family class	-0.000245	0.0174	-0.0236	-0.00550	-0.0571	-0.0410
	(0.0566)	(0.0583)	(0.0521)	(0.0524)	(0.0527)	(0.0530)
Skilled workers	-0.00710	0.00679	-0.0176	-0.00658	-0.0409	-0.0334
	(0.0555)	(0.0559)	(0.0507)	(0.0508)	(0.0510)	(0.0510)
Provincial nominees	-0.0588	-0.0540	-0.137	-0.132	-0.194	-0.188
	(0.0924)	(0.0930)	(0.119)	(0.119)	(0.125)	(0.125)
Refuges	-0.0652	-0.0584	-0.121**	-0.111*	-0.140**	-0.130**
	(0.0659)	(0.0673)	(0.0594)	(0.0598)	(0.0591)	(0.0595)
Quebec	-0.0157	-0.0194	0.00117	-0.000911	-0.00276	-0.00483
	(0.0308)	(0.0309)	(0.0337)	(0.0338)	(0.0357)	(0.0358)
Ontario	-0.0387	-0.0416*	-0.0415	-0.0428	-0.0576**	-0.0589**
	(0.0244)	(0.0245)	(0.0266)	(0.0267)	(0.0284)	(0.0284)
Western	-0.0236	-0.0266	-0.0272	-0.0296	-0.0551	-0.0579
	(0.0327)	(0.0328)	(0.0344)	(0.0345)	(0.0366)	(0.0367)
Atlantic	0.185	0.189	0.101	0.103	0.0574	0.0597
	(0.117)	(0.118)	(0.0967)	(0.0968)	(0.113)	(0.114)
Male	0.146***	0.158***	0.167***	0.178***	0.159***	0.167***
	(0.0205)	(0.0200)	(0.0221)	(0.0220)	(0.0232)	(0.0231)
Constant	3.725***	3.773***	3.695***	3.730***	3.710***	3.723***
	(0.172)	(0.172)	(0.148)	(0.148)	(0.168)	(0.168)
Observations	201123	200471	9338	9311	9338	9311
R-squared	0.393	0.391			0.430	0.429
Number of id			4168	4154	4168	4154

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 9

The earning impact of job education mismatch- males-

	OLS		RE		BE	
	unadjusted	**adjusted**	**unadjusted**	**adjusted**	**unadjusted**	**adjusted**
Years of required education	0.100***	0.0979***	0.0958***	0.0964***	0.118***	0.119***
	(0.00994)	(0.0103)	(0.00789)	(0.00757)	(0.00961)	(0.00949)
Years of over-education	0.0132**	0.0130**	0.0125*	0.0157**	0.00893	0.0169**
	(0.00628)	(0.00540)	(0.00726)	(0.00660)	(0.00794)	(0.00730)
Years of under-education	-0.0324***	-0.0192**	-0.0405***	-0.0245**	-0.0411***	-0.0229**
	(0.0113)	(0.00929)	(0.0122)	(0.00992)	(0.0133)	(0.0113)
Age	0.0255**	0.0253**	0.0367***	0.0361***	0.0136	0.0120
	(0.0104)	(0.0105)	(0.0103)	(0.0103)	(0.0116)	(0.0117)
Age square	-0.000312**	-0.000314**	-0.000417***	-0.000416***	-0.000156	-0.000144
	(0.000130)	(0.000132)	(0.000124)	(0.000125)	(0.000140)	(0.000141)
Visible minority	-0.162***	-0.147***	-0.158***	-0.138***	-0.146***	-0.127***
	(0.0338)	(0.0353)	(0.0367)	(0.0374)	(0.0374)	(0.0382)
English/ French is mother tongue	0.165***	0.161***	0.182***	0.176***	0.164***	0.158***
	(0.0393)	(0.0396)	(0.0482)	(0.0485)	(0.0500)	(0.0505)
Full time foreign experience	0.0121	0.00956	-0.0474	-0.0466	0.0209	0.0256
	(0.0412)	(0.0415)	(0.0526)	(0.0526)	(0.0549)	(0.0550)
Foreign exp is recognized	0.300***	0.301***	0.312***	0.313***	0.298***	0.299***
	(0.0297)	(0.0298)	(0.0339)	(0.0340)	(0.0354)	(0.0356)
Married	0.0432	0.0416	0.0284	0.0274	0.0737	0.0733
	(0.0422)	(0.0424)	(0.0433)	(0.0435)	(0.0449)	(0.0451)
Part time	-1.032***	-1.040***	-1.048***	-1.053***	-1.034***	-1.040***
	(0.0461)	(0.0467)	(0.0311)	(0.0312)	(0.0494)	(0.0496)
Experience in Canada	0.00414***	0.00419***	0.00382***	0.00386***	0.00575***	0.00592***
	(0.000286)	(0.000290)	(0.000249)	(0.000249)	(0.000707)	(0.000711)
Education and recreational	-0.0151	0.00602	-0.0716	-0.0552	-0.0652	-0.0561
	(0.0903)	(0.0881)	(0.0799)	(0.0788)	(0.0824)	(0.0814)
Fine art	0.173	0.197	0.100	0.122	0.181	0.201
	(0.280)	(0.285)	(0.145)	(0.145)	(0.146)	(0.145)

Humanities	-0.0448	-0.0162	-0.0378	-0.0161	-0.00787	0.00815
	(0.0889)	(0.0857)	(0.0993)	(0.0986)	(0.101)	(0.101)
Social sciences	0.00380	0.0256	-0.0120	0.00257	0.000376	0.00790
	(0.0604)	(0.0572)	(0.0668)	(0.0656)	(0.0686)	(0.0675)
Commerce	-0.00254	0.0189	-0.00422	0.0103	0.00741	0.0158
	(0.0368)	(0.0362)	(0.0504)	(0.0491)	(0.0517)	(0.0506)
Agriculture	-0.147	-0.122	-0.107	-0.0971	-0.0569	-0.0609
	(0.0936)	(0.0918)	(0.114)	(0.112)	(0.117)	(0.115)
Engineering	0.0307	0.0424	0.000151	0.00684	0.00856	0.0111
	(0.0356)	(0.0356)	(0.0468)	(0.0464)	(0.0481)	(0.0478)
Health	0.0341	0.0501	0.0779	0.0819	0.0478	0.0428
	(0.110)	(0.111)	(0.114)	(0.113)	(0.116)	(0.115)
Mathematics	0.199***	0.202***	0.184***	0.179***	0.199***	0.186***
	(0.0617)	(0.0619)	(0.0651)	(0.0651)	(0.0667)	(0.0667)
Family class	-0.120	-0.109	-0.145**	-0.128*	-0.180***	-0.163**
	(0.0871)	(0.0906)	(0.0699)	(0.0706)	(0.0698)	(0.0705)
Skilled workers	-0.0555	-0.0512	-0.0817	-0.0811	-0.103	-0.106
	(0.0833)	(0.0845)	(0.0677)	(0.0676)	(0.0671)	(0.0670)
Provincial nominees	-0.240**	-0.234*	-0.291*	-0.282*	-0.330**	-0.320*
	(0.122)	(0.123)	(0.156)	(0.157)	(0.163)	(0.163)
Refuges	-0.140	-0.133	-0.227***	-0.213***	-0.248***	-0.231***
	(0.0957)	(0.0983)	(0.0791)	(0.0797)	(0.0780)	(0.0787)
Quebec	0.0334	0.0301	0.0409	0.0390	0.0438	0.0416
	(0.0385)	(0.0382)	(0.0455)	(0.0457)	(0.0480)	(0.0482)
Ontario	-0.00124	-0.00265	-0.00943	-0.0100	-0.00553	-0.00620
	(0.0300)	(0.0300)	(0.0358)	(0.0360)	(0.0381)	(0.0382)
Western	0.0335	0.0278	0.0399	0.0347	0.00106	-0.00633
	(0.0418)	(0.0419)	(0.0464)	(0.0465)	(0.0495)	(0.0497)
Atlantic	0.337*	0.335*	0.277**	0.273**	0.214	0.208
	(0.174)	(0.177)	(0.124)	(0.124)	(0.154)	(0.154)
Constant	4.316***	4.340***	4.248***	4.239***	4.248***	4.244***
	(0.223)	(0.222)	(0.199)	(0.198)	(0.226)	(0.228)
Observations	112008	111657	5192	5177	5192	5177
R-squared	0.394	0.393			0.419	0.417
Number of id			2224	2216	2224	2216

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 10

The earning impact of job education mismatch- females-

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.120***	0.107***	0.115***	0.103***	0.108***	0.0991***
	(0.0110)	(0.0109)	(0.00973)	(0.00963)	(0.0122)	(0.0122)
Years of over-education	0.0442***	0.0258***	0.0386***	0.0202**	0.0387***	0.0223**
	(0.00893)	(0.00870)	(0.00811)	(0.00802)	(0.00883)	(0.00878)
Years of under-education	-0.0111	-0.00931	-0.00451	-0.00746	-0.00138	-0.00164
	(0.0105)	(0.00970)	(0.0108)	(0.00966)	(0.0113)	(0.0103)
Age	0.0547***	0.0576***	0.0563***	0.0577***	0.0586***	0.0598***
	(0.0150)	(0.0145)	(0.0107)	(0.0108)	(0.0116)	(0.0117)
Age square	-0.000712***	-0.000751***	-0.000718***	-0.000738***	-0.000763***	-0.00078***
	(0.000204)	(0.000196)	(0.000137)	(0.000137)	(0.000148)	(0.000149)
Visible minority	0.0548	0.0649*	0.0722*	0.0784*	0.0845**	0.0895**
	(0.0369)	(0.0379)	(0.0406)	(0.0413)	(0.0422)	(0.0428)
English/ French is mother tongue	0.168**	0.179***	0.153***	0.159***	0.179***	0.182***
	(0.0665)	(0.0670)	(0.0546)	(0.0549)	(0.0587)	(0.0591)
Full time foreign experience	0.0449	0.0309	0.0412	0.0294	0.0549	0.0452
	(0.0359)	(0.0364)	(0.0391)	(0.0400)	(0.0407)	(0.0416)
Foreign exp is recognized	0.224***	0.235***	0.240***	0.251***	0.235***	0.244***
	(0.0382)	(0.0390)	(0.0419)	(0.0421)	(0.0459)	(0.0462)
Married	-0.0103	-0.00539	-0.0137	-0.00545	-0.0147	-0.00601
	(0.0423)	(0.0429)	(0.0432)	(0.0435)	(0.0461)	(0.0464)
Part time	-0.935***	-0.944***	-0.923***	-0.928***	-0.958***	-0.963***
	(0.0381)	(0.0382)	(0.0289)	(0.0290)	(0.0408)	(0.0411)
Experience in Canada	0.00333***	0.00339***	0.00338***	0.00341***	0.00340***	0.00360***
	(0.000403)	(0.000405)	(0.000330)	(0.000331)	(0.000690)	(0.000695)
Education and recreational	-0.0922	-0.0166	-0.123*	-0.0621	-0.132**	-0.0694
	(0.0570)	(0.0530)	(0.0630)	(0.0617)	(0.0668)	(0.0654)
Fine art	-0.134	-0.0681	-0.172	-0.115	-0.220*	-0.157
	(0.143)	(0.144)	(0.114)	(0.115)	(0.116)	(0.117)

Humanities	-0.0880	-0.00276	-0.0631	0.00952	-0.0204	0.0530
	(0.0654)	(0.0630)	(0.0640)	(0.0623)	(0.0677)	(0.0659)
Social sciences	-0.0942	-0.0142	-0.0962	-0.0290	-0.102	-0.0340
	(0.0576)	(0.0516)	(0.0661)	(0.0645)	(0.0695)	(0.0678)
Commerce	0.0114	0.0661	0.00494	0.0480	0.00494	0.0500
	(0.0465)	(0.0441)	(0.0504)	(0.0496)	(0.0532)	(0.0524)
Agriculture	-0.107	-0.0108	-0.0739	0.00901	-0.00632	0.0754
	(0.107)	(0.105)	(0.105)	(0.104)	(0.109)	(0.108)
Engineering	0.00240	0.0568	0.0108	0.0560	0.0209	0.0676
	(0.0605)	(0.0599)	(0.0638)	(0.0637)	(0.0673)	(0.0671)
Health	-0.0559	0.00496	-0.0879	-0.0354	-0.114	-0.0602
	(0.0652)	(0.0637)	(0.0844)	(0.0840)	(0.0896)	(0.0890)
Mathematics	0.178*	0.226**	0.158*	0.200**	0.137	0.184*
	(0.100)	(0.0996)	(0.0917)	(0.0918)	(0.0972)	(0.0971)
Family class	0.134**	0.157***	0.112	0.130*	0.0822	0.0984
	(0.0582)	(0.0584)	(0.0778)	(0.0783)	(0.0801)	(0.0806)
Skilled workers	0.0761	0.0908	0.0714	0.0839	0.0579	0.0663
	(0.0566)	(0.0564)	(0.0762)	(0.0766)	(0.0781)	(0.0785)
Provincial nominees	0.202	0.186	0.0780	0.0631	0.0156	-0.00535
	(0.128)	(0.126)	(0.184)	(0.185)	(0.193)	(0.194)
Refuges	0.0386	0.0392	0.0210	0.0187	0.0187	0.0130
	(0.0800)	(0.0799)	(0.0893)	(0.0900)	(0.0899)	(0.0906)
Quebec	-0.0757	-0.0794	-0.0495	-0.0531	-0.0549	-0.0583
	(0.0499)	(0.0502)	(0.0499)	(0.0503)	(0.0532)	(0.0535)
Ontario	-0.0803**	-0.0866**	-0.0727*	-0.0780**	-0.105**	-0.110***
	(0.0401)	(0.0402)	(0.0394)	(0.0397)	(0.0423)	(0.0426)
Western	-0.0800	-0.0808	-0.0804	-0.0831	-0.0926*	-0.0949*
	(0.0506)	(0.0509)	(0.0510)	(0.0513)	(0.0543)	(0.0547)
Atlantic	-0.00117	0.00288	-0.0723	-0.0721	-0.0772	-0.0739
	(0.0739)	(0.0733)	(0.151)	(0.152)	(0.168)	(0.168)
Constant	3.148***	3.266***	3.166***	3.293***	3.254***	3.344***
	(0.260)	(0.255)	(0.223)	(0.223)	(0.255)	(0.256)
Observations	89115	88814	4146	4134	4146	4134
R-squared	0.349	0.344			0.389	0.384
Number of id			1944	1938	1944	1938

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 11

The earning impact of job education mismatch for source countries with high school quality - whole population -

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.109***	0.107***	0.106***	0.104***	0.116***	0.115***
	(0.0129)	(0.0135)	(0.0105)	(0.0106)	(0.0129)	(0.0131)
Years of over-education	0.0276***	0.0224***	0.0279***	0.0224**	0.0201*	0.0145
	(0.00864)	(0.00811)	(0.00990)	(0.00945)	(0.0111)	(0.0105)
Years of under-education	0.0297**	0.0343**	0.0323**	0.0380**	0.0492***	0.0569***
	(0.0136)	(0.0144)	(0.0154)	(0.0163)	(0.0167)	(0.0176)
Age	0.00948	0.00890	0.0187	0.0182	0.00507	0.00435
	(0.0122)	(0.0124)	(0.0147)	(0.0148)	(0.0163)	(0.0164)
Age square	-9.85e-05	-9.02e-05	-0.000190	-0.000181	-4.09e-05	-3.01e-05
	(0.000156)	(0.000158)	(0.000188)	(0.000189)	(0.000207)	(0.000208)
Visible minority	-0.0529	-0.0713**	-0.0346	-0.0520	-0.0164	-0.0313
	(0.0338)	(0.0349)	(0.0471)	(0.0478)	(0.0494)	(0.0502)
English/ French is mother tongue	0.185***	0.172***	0.212***	0.197***	0.194**	0.174**
	(0.0606)	(0.0617)	(0.0726)	(0.0737)	(0.0778)	(0.0790)
Full time foreign experience	0.0194	0.0329	0.0207	0.0265	0.0928	0.1000
	(0.0643)	(0.0647)	(0.0643)	(0.0650)	(0.0667)	(0.0673)
Foreign exp is recognized	0.281***	0.285***	0.292***	0.297***	0.286***	0.292***
	(0.0369)	(0.0370)	(0.0460)	(0.0462)	(0.0493)	(0.0497)
Married	0.0723	0.0694	0.0554	0.0541	0.0929*	0.0938*
	(0.0460)	(0.0463)	(0.0535)	(0.0540)	(0.0562)	(0.0567)
Part time	-0.969***	-0.970***	-0.978***	-0.978***	-0.874***	-0.865***
	(0.0504)	(0.0510)	(0.0360)	(0.0363)	(0.0544)	(0.0548)
Experience in Canada	0.00485***	0.00486***	0.00452***	0.00453***	0.00639***	0.00648***
	(0.000417)	(0.000420)	(0.000358)	(0.000360)	(0.000828)	(0.000835)
Education and recreational	0.0483	0.0511	0.00987	0.0133	0.00396	0.00767
	(0.0963)	(0.0962)	(0.0918)	(0.0919)	(0.0956)	(0.0957)
Fine art	0.102	0.134	0.0398	0.0737	0.0113	0.0592
	(0.198)	(0.200)	(0.144)	(0.146)	(0.147)	(0.150)
Humanities	-0.00216	0.00182	0.0274	0.0312	0.0859	0.0937
	(0.0912)	(0.0926)	(0.0909)	(0.0914)	(0.0940)	(0.0945)

Social sciences	0.116	0.111	0.0951	0.0961	0.0974	0.102
	(0.0771)	(0.0771)	(0.0853)	(0.0858)	(0.0886)	(0.0891)
Commerce	0.0896*	0.0881*	0.0761	0.0748	0.106	0.106
	(0.0470)	(0.0473)	(0.0643)	(0.0646)	(0.0673)	(0.0675)
Agriculture	-0.0359	-0.0313	-0.00343	0.00265	0.0617	0.0703
	(0.112)	(0.113)	(0.143)	(0.144)	(0.147)	(0.147)
Engineering	0.0638	0.0625	0.0534	0.0532	0.0751	0.0777
	(0.0445)	(0.0449)	(0.0633)	(0.0635)	(0.0663)	(0.0665)
Health	-0.0663	-0.0629	-0.102	-0.0990	-0.111	-0.106
	(0.0665)	(0.0673)	(0.110)	(0.110)	(0.114)	(0.114)
Mathematics	0.201***	0.203***	0.170**	0.173**	0.177**	0.182**
	(0.0671)	(0.0675)	(0.0801)	(0.0804)	(0.0840)	(0.0842)
Family class	0.0244	0.0242	-0.00911	-0.00618	-0.0171	-0.0136
	(0.0625)	(0.0630)	(0.0863)	(0.0868)	(0.0874)	(0.0879)
Skilled workers	0.0365	0.0381	0.00412	0.00765	-0.00316	0.000944
	(0.0588)	(0.0594)	(0.0787)	(0.0792)	(0.0787)	(0.0792)
Provincial nominees	-0.185	-0.193	-0.219	-0.224	-0.238	-0.240
	(0.135)	(0.135)	(0.219)	(0.219)	(0.234)	(0.234)
Refuges	0.0397	0.0429	0.0129	0.0142	0.0164	0.0162
	(0.0899)	(0.0907)	(0.126)	(0.126)	(0.124)	(0.125)
Quebec	-0.00333	-0.00493	-0.0172	-0.0197	-0.0248	-0.0273
	(0.0530)	(0.0533)	(0.0588)	(0.0591)	(0.0623)	(0.0627)
Ontario	-0.0843*	-0.0892**	-0.0895*	-0.0945**	-0.106**	-0.112**
	(0.0433)	(0.0433)	(0.0460)	(0.0462)	(0.0490)	(0.0492)
Western	-0.0615	-0.0656	-0.0917	-0.0977	-0.103	-0.112*
	(0.0525)	(0.0526)	(0.0592)	(0.0595)	(0.0631)	(0.0634)
Atlantic	0.0316	0.0327	0.0179	0.0178	-0.0737	-0.0752
	(0.190)	(0.188)	(0.162)	(0.163)	(0.182)	(0.182)
Male	0.180***	0.185***	0.203***	0.206***	0.214***	0.218***
	(0.0308)	(0.0310)	(0.0387)	(0.0389)	(0.0407)	(0.0409)
Constant	4.034***	4.082***	3.941***	3.986***	3.901***	3.926***
	(0.246)	(0.251)	(0.268)	(0.271)	(0.301)	(0.304)
Observations	79034	78382	3610	3583	3610	3583
R-squared	0.381	0.381			0.400	0.399
Number of id			1691	1677	1691	1677

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12

The earning impact of job education mismatch for source countries with high school quality - males-

	OLS		RE		BE	
	unadjusted	**adjusted**	**unadjusted**	**adjusted**	**unadjusted**	**adjusted**
Years of required education	0.105***	0.103***	0.0967***	0.0947***	0.124***	0.123***
	(0.0190)	(0.0201)	(0.0144)	(0.0144)	(0.0175)	(0.0177)
Years of over-education	0.0127	0.00985	0.0153	0.0113	0.00522	0.00132
	(0.0123)	(0.0116)	(0.0138)	(0.0133)	(0.0153)	(0.0145)
Years of under-education	0.0449**	0.0558***	0.0588**	0.0701***	0.0797***	0.0963***
	(0.0214)	(0.0207)	(0.0242)	(0.0264)	(0.0270)	(0.0289)
Age	-0.00143	-0.00187	0.0128	0.0123	-0.0111	-0.0135
	(0.0173)	(0.0175)	(0.0220)	(0.0223)	(0.0249)	(0.0251)
Age square	7.76e-05	8.63e-05	-3.66e-05	-2.58e-05	0.000242	0.000274
	(0.000219)	(0.000221)	(0.000273)	(0.000276)	(0.000308)	(0.000311)
Visible minority	-0.102**	-0.110**	-0.0717	-0.0793	-0.0640	-0.0666
	(0.0435)	(0.0455)	(0.0660)	(0.0673)	(0.0683)	(0.0697)
English/ French is mother tongue	0.259***	0.252***	0.298***	0.287***	0.280***	0.265**
	(0.0735)	(0.0764)	(0.0965)	(0.0987)	(0.101)	(0.103)
Full time foreign experience	0.0475	0.0458	-0.0757	-0.0768	0.0626	0.0741
	(0.0872)	(0.0870)	(0.126)	(0.127)	(0.132)	(0.134)
Foreign exp is recognized	0.321***	0.322***	0.330***	0.331***	0.321***	0.322***
	(0.0492)	(0.0495)	(0.0622)	(0.0627)	(0.0649)	(0.0654)
Married	0.0958	0.0901	0.0711	0.0667	0.126	0.126
	(0.0689)	(0.0702)	(0.0832)	(0.0841)	(0.0858)	(0.0867)
Part time	-0.965***	-0.963***	-1.042***	-1.044***	-0.785***	-0.770***
	(0.0732)	(0.0751)	(0.0539)	(0.0544)	(0.0932)	(0.0939)
Experience in Canada	0.00550***	0.00552***	0.00478***	0.00479***	0.00785***	0.00804***
	(0.000559)	(0.000563)	(0.000448)	(0.000450)	(0.00123)	(0.00124)
Education and recreational	0.135	0.134	0.0986	0.101	0.0769	0.0752
	(0.143)	(0.144)	(0.157)	(0.157)	(0.162)	(0.162)

Fine art	0.145	0.146	0.120	0.123	0.153	0.158
	(0.152)	(0.151)	(0.249)	(0.250)	(0.255)	(0.256)
Humanities	0.168	0.164	0.189	0.187	0.234	0.226
	(0.252)	(0.251)	(0.199)	(0.199)	(0.203)	(0.204)
Social sciences	0.186	0.186	0.194	0.197	0.182	0.181
	(0.129)	(0.129)	(0.128)	(0.128)	(0.131)	(0.131)
Commerce	0.0703	0.0696	0.0989	0.0988	0.124	0.122
	(0.0606)	(0.0608)	(0.0999)	(0.100)	(0.103)	(0.103)
Agriculture	-0.0630	-0.0630	0.0652	0.0681	0.190	0.194
	(0.192)	(0.192)	(0.213)	(0.214)	(0.221)	(0.221)
Engineering	0.0869	0.0840	0.0912	0.0905	0.117	0.116
	(0.0558)	(0.0564)	(0.0897)	(0.0899)	(0.0923)	(0.0924)
Health	-0.00606	-0.00619	-0.0107	-0.00892	-0.0140	-0.0163
	(0.0940)	(0.0947)	(0.181)	(0.182)	(0.185)	(0.186)
Mathematics	0.214***	0.213***	0.213**	0.216**	0.222**	0.221**
	(0.0818)	(0.0826)	(0.108)	(0.108)	(0.111)	(0.111)
Family class	-0.0683	-0.0602	-0.0563	-0.0488	-0.0557	-0.0446
	(0.101)	(0.103)	(0.134)	(0.136)	(0.134)	(0.135)
Skilled workers	0.00581	0.0155	-0.00206	0.00698	0.0114	0.0227
	(0.0987)	(0.100)	(0.116)	(0.117)	(0.113)	(0.115)
Provincial nominees	-0.367**	-0.362*	-0.377	-0.372	-0.407	-0.397
	(0.184)	(0.184)	(0.303)	(0.304)	(0.314)	(0.315)
Refuges	-0.0155	-0.0107	-0.0584	-0.0556	-0.0161	-0.00889
	(0.144)	(0.145)	(0.182)	(0.183)	(0.182)	(0.183)
Quebec	0.122*	0.123*	0.0958	0.0960	0.118	0.121
	(0.0713)	(0.0716)	(0.0849)	(0.0855)	(0.0887)	(0.0893)
Ontario	-0.0343	-0.0348	-0.0379	-0.0388	-0.0140	-0.0143
	(0.0549)	(0.0549)	(0.0677)	(0.0681)	(0.0713)	(0.0717)
Western	-0.0346	-0.0359	-0.0603	-0.0630	-0.0324	-0.0369
	(0.0680)	(0.0681)	(0.0842)	(0.0846)	(0.0900)	(0.0904)
Atlantic	0.134	0.138	0.171	0.175	0.0574	0.0636
	(0.268)	(0.267)	(0.219)	(0.219)	(0.249)	(0.250)
Constant	4.378***	4.415***	4.311***	4.353***	4.058***	4.092***
	(0.347)	(0.356)	(0.382)	(0.388)	(0.430)	(0.436)
Observations	42158	41807	1907	1892	1907	1892
R-squared	0.372	0.370			0.375	0.374
Number of id			868	860	868	860

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13

The earning impact of job education mismatch for source countries with high school quality - females-

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.114***	0.110***	0.116***	0.112***	0.106***	0.103***
	(0.0161)	(0.0165)	(0.0158)	(0.0160)	(0.0197)	(0.0201)
Years of over-education	0.0476***	0.0394***	0.0439***	0.0356***	0.0389**	0.0308**
	(0.0129)	(0.0122)	(0.0144)	(0.0137)	(0.0163)	(0.0154)
Years of under-education	0.0159	0.0160	0.0158	0.0184	0.0273	0.0300
	(0.0166)	(0.0181)	(0.0197)	(0.0206)	(0.0213)	(0.0222)
Age	0.0227	0.0220	0.0345*	0.0333	0.0305	0.0299
	(0.0192)	(0.0193)	(0.0205)	(0.0206)	(0.0226)	(0.0228)
Age square	-0.000308	-0.000298	-0.000469*	-0.000452*	-0.000439	-0.000430
	(0.000251)	(0.000252)	(0.000265)	(0.000267)	(0.000293)	(0.000295)
Visible minority	0.0153	-0.0180	0.0333	0.00319	0.0448	0.0159
	(0.0525)	(0.0531)	(0.0686)	(0.0693)	(0.0728)	(0.0735)
English/ French is mother tongue	0.0265	0.00773	0.0439	0.0250	0.0341	0.00835
	(0.101)	(0.101)	(0.116)	(0.117)	(0.127)	(0.128)
Full time foreign experience	0.0122	0.0271	0.0337	0.0418	0.0916	0.0966
	(0.0837)	(0.0847)	(0.0740)	(0.0748)	(0.0772)	(0.0779)
Foreign exp is recognized	0.200***	0.209***	0.214***	0.223***	0.196**	0.209***
	(0.0489)	(0.0486)	(0.0699)	(0.0703)	(0.0780)	(0.0786)
Married	0.0295	0.0285	0.00819	0.00911	0.0359	0.0356
	(0.0607)	(0.0608)	(0.0699)	(0.0705)	(0.0756)	(0.0762)
Part time	-0.959***	-0.963***	-0.935***	-0.937***	-0.893***	-0.889***
	(0.0679)	(0.0681)	(0.0486)	(0.0489)	(0.0682)	(0.0687)
Experience in Canada	0.00432***	0.00430***	0.00419***	0.00420***	0.00562***	0.00565***
	(0.000629)	(0.000636)	(0.000568)	(0.000572)	(0.00113)	(0.00114)
Education and recreational	-0.0338	-0.0239	-0.0665	-0.0569	-0.0618	-0.0504
	(0.122)	(0.122)	(0.112)	(0.112)	(0.119)	(0.119)

Fine art	0.0754	0.122	-8.75e-05	0.0463	-0.0673	-0.00391
	(0.287)	(0.295)	(0.177)	(0.180)	(0.181)	(0.185)
Humanities	-0.0458	-0.0404	-0.0296	-0.0235	0.0422	0.0530
	(0.102)	(0.104)	(0.104)	(0.105)	(0.110)	(0.111)
Social sciences	0.0432	0.0302	0.0356	0.0336	0.0265	0.0267
	(0.0826)	(0.0814)	(0.115)	(0.116)	(0.122)	(0.123)
Commerce	0.104	0.103	0.0774	0.0766	0.0910	0.0940
	(0.0699)	(0.0708)	(0.0837)	(0.0841)	(0.0898)	(0.0903)
Agriculture	-0.0504	-0.0340	-0.0933	-0.0763	-0.0675	-0.0499
	(0.122)	(0.122)	(0.197)	(0.197)	(0.198)	(0.198)
Engineering	0.0109	0.0147	0.00460	0.00875	0.0290	0.0361
	(0.0718)	(0.0722)	(0.0946)	(0.0949)	(0.101)	(0.101)
Health	-0.0677	-0.0647	-0.118	-0.114	-0.124	-0.117
	(0.0931)	(0.0935)	(0.136)	(0.137)	(0.145)	(0.146)
Mathematics	0.234**	0.239**	0.177	0.182	0.172	0.180
	(0.114)	(0.114)	(0.130)	(0.131)	(0.140)	(0.140)
Family class	0.0750	0.0715	0.0394	0.0382	0.0103	0.00971
	(0.0757)	(0.0760)	(0.112)	(0.112)	(0.117)	(0.117)
Skilled workers	0.0539	0.0523	0.0278	0.0286	-0.00650	-0.00497
	(0.0694)	(0.0701)	(0.105)	(0.106)	(0.110)	(0.110)
Provincial nominees	0.0941	0.0757	0.0868	0.0733	0.0674	0.0570
	(0.120)	(0.120)	(0.319)	(0.320)	(0.353)	(0.354)
Refuges	0.127	0.131	0.111	0.114	0.0826	0.0812
	(0.108)	(0.109)	(0.176)	(0.176)	(0.171)	(0.171)
Quebec	-0.131*	-0.138*	-0.124	-0.129	-0.148*	-0.154*
	(0.0735)	(0.0739)	(0.0821)	(0.0825)	(0.0888)	(0.0893)
Ontario	-0.117*	-0.128**	-0.120*	-0.128**	-0.162**	-0.173**
	(0.0637)	(0.0636)	(0.0632)	(0.0635)	(0.0680)	(0.0684)
Western	-0.0448	-0.0537	-0.0722	-0.0810	-0.112	-0.124
	(0.0776)	(0.0779)	(0.0844)	(0.0847)	(0.0897)	(0.0902)
Atlantic	-0.0684	-0.0729	-0.0841	-0.0880	-0.175	-0.182
	(0.140)	(0.140)	(0.244)	(0.244)	(0.269)	(0.270)
Constant	3.789***	3.876***	3.600***	3.687***	3.740***	3.802***
	(0.352)	(0.355)	(0.385)	(0.388)	(0.442)	(0.447)
Observations	36876	36575	1703	1691	1703	1691
R-squared	0.334	0.334			0.355	0.353
Number of id			823	817	823	817

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 14

The earning impact of job education mismatch for source countries with low school quality - whole population -

	OLS		RE		BE	
	unadjusted	**adjusted**	**unadjusted**	**adjusted**	**unadjusted**	**adjusted**
Years of required education	0.107***	0.104***	0.104***	0.102***	0.112***	0.108***
	(0.00848)	(0.00888)	(0.00752)	(0.00773)	(0.00933)	(0.00950)
Years of over-education	0.0271***	0.0302***	0.0228***	0.0223***	0.0238***	0.0277***
	(0.00654)	(0.00802)	(0.00627)	(0.00760)	(0.00671)	(0.00823)
Years of under-education	0.0187**	0.0146*	0.0152*	0.0154**	0.00596	0.00366
	(0.00933)	(0.00883)	(0.00919)	(0.00784)	(0.00959)	(0.00837)
Age	0.0503***	0.0507***	0.0510***	0.0513***	0.0428***	0.0434***
	(0.0105)	(0.0105)	(0.00816)	(0.00818)	(0.00891)	(0.00891)
Age square	-0.000643***	-0.000654***	-0.000633***	-0.000640***	-0.000552***	-0.000565***
	(0.000138)	(0.000137)	(0.000100)	(0.000100)	(0.000109)	(0.000109)
Visible minority	-0.0655	-0.0285	-0.0622*	-0.0304	-0.0507	-0.0240
	(0.0398)	(0.0432)	(0.0352)	(0.0374)	(0.0356)	(0.0378)
English/ French is mother tongue	0.164***	0.155***	0.161***	0.152***	0.167***	0.159***
	(0.0446)	(0.0443)	(0.0404)	(0.0405)	(0.0421)	(0.0422)
Full time foreign experience	0.0481	0.0444	0.0157	0.0123	0.0377	0.0373
	(0.0297)	(0.0297)	(0.0350)	(0.0350)	(0.0361)	(0.0361)
Foreign exp is recognized	0.270***	0.262***	0.284***	0.278***	0.274***	0.266***
	(0.0306)	(0.0302)	(0.0315)	(0.0317)	(0.0335)	(0.0336)
Married	-0.00377	0.00685	5.38e-05	0.00706	0.0175	0.0251
	(0.0390)	(0.0382)	(0.0360)	(0.0360)	(0.0374)	(0.0374)
Part time	-0.986***	-0.990***	-0.978***	-0.979***	-1.079***	-1.083***
	(0.0334)	(0.0335)	(0.0258)	(0.0258)	(0.0378)	(0.0378)
Experience in Canada	0.00303***	0.00303***	0.00317***	0.00317***	0.00294***	0.00293***
	(0.000300)	(0.000298)	(0.000241)	(0.000241)	(0.000616)	(0.000616)
Education and	-0.0992*	-0.0655	-0.144**	-0.121**	-0.157***	-0.124**

recreational						
	(0.0568)	(0.0562)	(0.0566)	(0.0563)	(0.0587)	(0.0583)
Fine art	-0.0719	-0.0390	-0.162	-0.141	-0.110	-0.0846
	(0.200)	(0.203)	(0.115)	(0.114)	(0.113)	(0.113)
Humanities	-0.0866	-0.0378	-0.0685	-0.0319	-0.0568	-0.00765
	(0.0626)	(0.0612)	(0.0640)	(0.0629)	(0.0662)	(0.0651)
Social sciences	-0.129***	-0.0895*	-0.137**	-0.110**	-0.137**	-0.101*
	(0.0486)	(0.0458)	(0.0548)	(0.0540)	(0.0566)	(0.0557)
Commerce	-0.0425	-0.0130	-0.0401	-0.0202	-0.0431	-0.0125
	(0.0393)	(0.0394)	(0.0420)	(0.0420)	(0.0434)	(0.0432)
Agriculture	-0.157*	-0.127	-0.109	-0.0832	-0.0525	-0.0200
	(0.0933)	(0.0922)	(0.0892)	(0.0884)	(0.0918)	(0.0908)
Engineering	0.00691	0.0298	-0.0190	-0.00389	-0.0272	-0.00220
	(0.0418)	(0.0421)	(0.0451)	(0.0452)	(0.0468)	(0.0468)
Health	0.00551	0.0395	0.0362	0.0592	-0.000611	0.0321
	(0.0856)	(0.0853)	(0.0865)	(0.0863)	(0.0894)	(0.0891)
Mathematics	0.219**	0.243***	0.213***	0.230***	0.215***	0.243***
	(0.0919)	(0.0914)	(0.0735)	(0.0736)	(0.0764)	(0.0764)
Family class	-0.0366	-0.0305	-0.0556	-0.0514	-0.146**	-0.142**
	(0.0960)	(0.0973)	(0.0692)	(0.0692)	(0.0708)	(0.0707)
Skilled workers	-0.0514	-0.0387	-0.0530	-0.0441	-0.123*	-0.114
	(0.0934)	(0.0938)	(0.0683)	(0.0680)	(0.0695)	(0.0692)
Provincial nominees	-0.0373	-0.0449	-0.110	-0.120	-0.218	-0.225
	(0.124)	(0.124)	(0.140)	(0.140)	(0.145)	(0.145)
Refuges	-0.136	-0.135	-0.191**	-0.193**	-0.251***	-0.252***
	(0.105)	(0.106)	(0.0751)	(0.0751)	(0.0757)	(0.0756)
Quebec	-0.0277	-0.0274	0.0123	0.0130	0.0130	0.0137
	(0.0372)	(0.0373)	(0.0401)	(0.0402)	(0.0423)	(0.0423)
Ontario	-0.0103	-0.0118	-0.00644	-0.00709	-0.0199	-0.0207
	(0.0287)	(0.0287)	(0.0318)	(0.0318)	(0.0338)	(0.0338)
Western	0.00278	-0.000104	0.0185	0.0170	-0.00596	-0.00768
	(0.0421)	(0.0421)	(0.0413)	(0.0413)	(0.0439)	(0.0439)
Atlantic	0.299**	0.310**	0.169	0.174	0.190	0.199
	(0.139)	(0.140)	(0.119)	(0.119)	(0.144)	(0.144)
Male	0.117***	0.123***	0.142***	0.146***	0.123***	0.126***
	(0.0277)	(0.0273)	(0.0267)	(0.0267)	(0.0277)	(0.0277)
Constant	3.646***	3.667***	3.660***	3.680***	3.828***	3.854***
	(0.223)	(0.221)	(0.179)	(0.179)	(0.204)	(0.203)
Observations	122089	122089	5728	5728	5728	5728
R-squared	0.411	0.410			0.471	0.471
Number of id			2477	2477	2477	2477

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15

The earning impact of job education mismatch for source countries with low school quality - males-

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.0947***	0.0938***	0.0944***	0.0958***	0.108***	0.107***
	(0.00986)	(0.00990)	(0.00953)	(0.00976)	(0.0116)	(0.0118)
Years of over-education	0.0166**	0.0247***	0.0139*	0.0217**	0.0155*	0.0266**
	(0.00740)	(0.00894)	(0.00831)	(0.00956)	(0.00891)	(0.0104)
Years of under-education	0.0306**	0.0145	0.0337**	0.0185*	0.0276*	0.0109
	(0.0122)	(0.0105)	(0.0133)	(0.0108)	(0.0143)	(0.0119)
Age	0.0341***	0.0336***	0.0386***	0.0378***	0.0149	0.0147
	(0.0126)	(0.0128)	(0.0111)	(0.0112)	(0.0123)	(0.0123)
Age square	-0.000430***	-0.000433***	-0.000468***	-0.000467***	-0.000202	-0.000210
	(0.000156)	(0.000158)	(0.000133)	(0.000133)	(0.000147)	(0.000147)
Visible minority	-0.198***	-0.167***	-0.197***	-0.163***	-0.192***	-0.161***
	(0.0568)	(0.0607)	(0.0463)	(0.0492)	(0.0463)	(0.0492)
English/ French is mother tongue	0.126***	0.114**	0.123**	0.111**	0.107**	0.0954*
	(0.0460)	(0.0461)	(0.0528)	(0.0529)	(0.0542)	(0.0543)
Full time foreign experience	-0.00162	0.00339	-0.0391	-0.0330	0.0108	0.0169
	(0.0465)	(0.0467)	(0.0538)	(0.0536)	(0.0556)	(0.0554)
Foreign exp is recognized	0.289***	0.282***	0.300***	0.294***	0.287***	0.281***
	(0.0362)	(0.0357)	(0.0389)	(0.0390)	(0.0405)	(0.0405)
Married	0.0108	0.0187	0.00865	0.0163	0.0489	0.0568
	(0.0532)	(0.0519)	(0.0482)	(0.0483)	(0.0497)	(0.0498)
Part time	-1.082***	-1.087***	-1.071***	-1.073***	-1.195***	-1.199***
	(0.0539)	(0.0541)	(0.0377)	(0.0377)	(0.0559)	(0.0559)
Experience in Canada	0.00333***	0.00334***	0.00330***	0.00332***	0.00424***	0.00417***
	(0.000324)	(0.000324)	(0.000298)	(0.000298)	(0.000855)	(0.000855)
Education and recreational	-0.100	-0.0799	-0.147*	-0.134	-0.137	-0.117

	(0.113)	(0.110)	(0.0881)	(0.0875)	(0.0903)	(0.0897)
Fine art	0.219	0.266	0.100	0.141	0.279	0.322*
	(0.455)	(0.462)	(0.175)	(0.174)	(0.171)	(0.171)
Humanities	-0.149**	-0.113	-0.132	-0.108	-0.140	-0.105
	(0.0712)	(0.0689)	(0.108)	(0.107)	(0.110)	(0.109)
Social sciences	-0.103*	-0.0767	-0.115	-0.0997	-0.110	-0.0876
	(0.0621)	(0.0609)	(0.0750)	(0.0743)	(0.0767)	(0.0761)
Commerce	-0.0463	-0.0249	-0.0447	-0.0333	-0.0466	-0.0264
	(0.0492)	(0.0487)	(0.0559)	(0.0558)	(0.0569)	(0.0568)
Agriculture	-0.210**	-0.201*	-0.202	-0.202	-0.193	-0.189
	(0.106)	(0.106)	(0.129)	(0.127)	(0.131)	(0.129)
Engineering	-0.00798	0.00878	-0.0451	-0.0363	-0.0543	-0.0376
	(0.0489)	(0.0487)	(0.0533)	(0.0539)	(0.0543)	(0.0549)
Health	0.0832	0.114	0.194	0.205	0.152	0.176
	(0.208)	(0.205)	(0.149)	(0.148)	(0.151)	(0.150)
Mathematics	0.235**	0.250**	0.224***	0.229***	0.239***	0.252***
	(0.0999)	(0.0992)	(0.0865)	(0.0866)	(0.0884)	(0.0885)
Family class	-0.166	-0.161	-0.208**	-0.206**	-0.318***	-0.318***
	(0.124)	(0.126)	(0.0827)	(0.0825)	(0.0835)	(0.0833)
Skilled workers	-0.102	-0.0921	-0.142*	-0.139*	-0.235***	-0.233***
	(0.118)	(0.119)	(0.0819)	(0.0810)	(0.0826)	(0.0815)
Provincial nominees	-0.192	-0.189	-0.238	-0.242	-0.334*	-0.335*
	(0.149)	(0.148)	(0.173)	(0.173)	(0.180)	(0.180)
Refuges	-0.218	-0.211	-0.325***	-0.321***	-0.398***	-0.395***
	(0.137)	(0.139)	(0.0910)	(0.0911)	(0.0905)	(0.0906)
Quebec	-0.0297	-0.0309	-0.00315	-0.00292	-0.00768	-0.00904
	(0.0412)	(0.0411)	(0.0515)	(0.0515)	(0.0541)	(0.0541)
Ontario	0.0217	0.0187	0.0132	0.0118	0.0103	0.00812
	(0.0341)	(0.0339)	(0.0403)	(0.0403)	(0.0426)	(0.0426)
Western	0.0858	0.0792	0.102*	0.0982*	0.0495	0.0447
	(0.0532)	(0.0532)	(0.0535)	(0.0535)	(0.0564)	(0.0565)
Atlantic	0.499**	0.499**	0.356**	0.355**	0.391**	0.395**
	(0.210)	(0.212)	(0.148)	(0.149)	(0.193)	(0.193)
Constant	4.423***	4.425***	4.415***	4.398***	4.703***	4.704***
	(0.278)	(0.276)	(0.230)	(0.230)	(0.263)	(0.262)
Observations	69850	69850	3285	3285	3285	3285
R-squared	0.428	0.428			0.486	0.486
Number of id			1356	1356	1356	1356

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 16

The earning impact of job education mismatch for source countries with low school quality - females-

	OLS		RE		BE	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Years of required education	0.127***	0.122***	0.116***	0.110***	0.114***	0.107***
	(0.0150)	(0.0159)	(0.0124)	(0.0128)	(0.0157)	(0.0160)
Years of over-education	0.0393***	0.0373***	0.0328***	0.0221*	0.0351***	0.0288**
	(0.0113)	(0.0142)	(0.00980)	(0.0125)	(0.0104)	(0.0133)
Years of under-education	0.0111	0.0177	0.000714	0.0117	-0.00911	-0.000709
	(0.0135)	(0.0135)	(0.0128)	(0.0115)	(0.0131)	(0.0120)
Age	0.0719***	0.0732***	0.0680***	0.0690***	0.0734***	0.0741***
	(0.0181)	(0.0178)	(0.0125)	(0.0126)	(0.0135)	(0.0136)
Age square	-0.000921***	-0.000941***	-0.000853***	-0.000865***	-0.000940***	-0.000950***
	(0.000247)	(0.000242)	(0.000159)	(0.000159)	(0.000170)	(0.000171)
Visible minority	0.0822	0.131**	0.0882	0.114**	0.0969*	0.118**
	(0.0526)	(0.0570)	(0.0538)	(0.0575)	(0.0549)	(0.0583)
English/ French is mother tongue	0.184**	0.177**	0.173***	0.166***	0.211***	0.205***
	(0.0786)	(0.0782)	(0.0617)	(0.0620)	(0.0654)	(0.0657)
Full time foreign experience	0.0879**	0.0799**	0.0782	0.0702	0.0791	0.0764
	(0.0390)	(0.0389)	(0.0487)	(0.0493)	(0.0505)	(0.0511)
Foreign exp is recognized	0.209***	0.198***	0.229***	0.227***	0.232***	0.226***
	(0.0526)	(0.0522)	(0.0530)	(0.0535)	(0.0573)	(0.0578)
Married	-0.0295	-0.0210	-0.0281	-0.0227	-0.0483	-0.0406
	(0.0586)	(0.0584)	(0.0555)	(0.0558)	(0.0586)	(0.0588)
Part time	-0.917***	-0.922***	-0.909***	-0.909***	-0.991***	-0.993***
	(0.0426)	(0.0426)	(0.0360)	(0.0361)	(0.0521)	(0.0523)
Experience in Canada	0.00257***	0.00256***	0.00286***	0.00284***	0.00180**	0.00182**
	(0.000535)	(0.000529)	(0.000402)	(0.000402)	(0.000893)	(0.000896)
Education and recreational	-0.137**	-0.0907	-0.162**	-0.125*	-0.177**	-0.126
	(0.0637)	(0.0628)	(0.0754)	(0.0750)	(0.0795)	(0.0788)

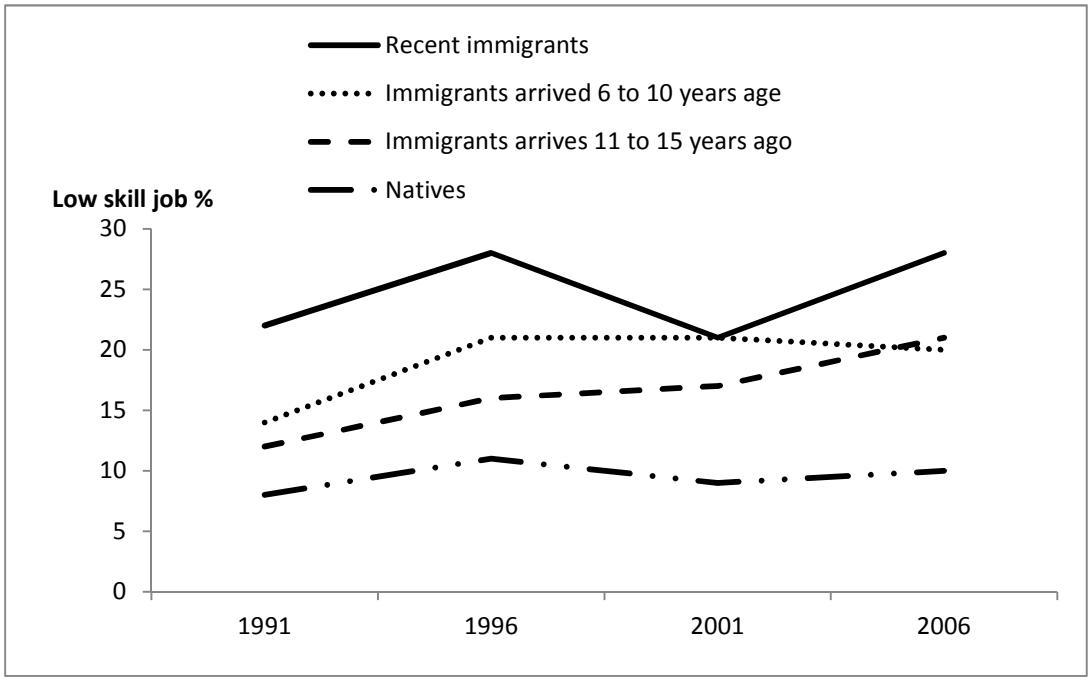
Fine art	-0.302***	-0.269***	-0.330**	-0.307**	-0.352**	-0.319**
	(0.0661)	(0.0644)	(0.152)	(0.153)	(0.153)	(0.153)
Humanities	-0.0948	-0.0281	-0.0633	-0.00205	-0.0376	0.0384
	(0.0854)	(0.0815)	(0.0821)	(0.0799)	(0.0869)	(0.0843)
Social sciences	-0.180**	-0.120*	-0.178**	-0.126	-0.177**	-0.115
	(0.0759)	(0.0676)	(0.0801)	(0.0784)	(0.0835)	(0.0816)
Commerce	-0.0533	-0.0173	-0.0431	-0.0144	-0.0391	0.00134
	(0.0640)	(0.0645)	(0.0635)	(0.0637)	(0.0666)	(0.0666)
Agriculture	-0.144	-0.103	-0.0653	-0.0163	0.0355	0.0942
	(0.145)	(0.144)	(0.123)	(0.122)	(0.129)	(0.128)
Engineering	0.0833	0.127	0.109	0.149	0.117	0.167*
	(0.110)	(0.109)	(0.0967)	(0.0964)	(0.102)	(0.101)
Health	-0.0506	-0.0147	-0.0455	-0.0131	-0.0765	-0.0319
	(0.0890)	(0.0891)	(0.108)	(0.108)	(0.114)	(0.114)
Mathematics	0.174	0.206	0.185	0.213	0.174	0.221
	(0.188)	(0.188)	(0.138)	(0.138)	(0.145)	(0.145)
Family class	0.213**	0.199**	0.188	0.188	0.141	0.143
	(0.0959)	(0.0936)	(0.123)	(0.123)	(0.126)	(0.126)
Skilled workers	0.129	0.116	0.128	0.128	0.116	0.118
	(0.0943)	(0.0912)	(0.121)	(0.121)	(0.123)	(0.123)
Provincial nominees	0.276	0.232	0.117	0.0871	0.0455	0.0134
	(0.170)	(0.165)	(0.233)	(0.233)	(0.237)	(0.237)
Refuges	0.0590	0.0333	0.0371	0.0190	0.0307	0.0146
	(0.115)	(0.112)	(0.130)	(0.130)	(0.132)	(0.132)
Quebec	-0.0393	-0.0352	0.0193	0.0202	0.0214	0.0239
	(0.0673)	(0.0675)	(0.0631)	(0.0635)	(0.0665)	(0.0668)
Ontario	-0.0520	-0.0523	-0.0243	-0.0265	-0.0478	-0.0486
	(0.0505)	(0.0504)	(0.0507)	(0.0509)	(0.0540)	(0.0542)
Western	-0.0936	-0.0956	-0.0699	-0.0744	-0.0560	-0.0591
	(0.0672)	(0.0669)	(0.0641)	(0.0644)	(0.0682)	(0.0684)
Atlantic	0.0572	0.0712	-0.0450	-0.0417	0.0330	0.0391
	(0.0828)	(0.0819)	(0.192)	(0.193)	(0.215)	(0.216)
Constant	2.720***	2.784***	2.870***	2.957***	2.931***	3.023***
	(0.340)	(0.332)	(0.288)	(0.288)	(0.325)	(0.325)
Observations	52239	52239	2443	2443	2443	2443
R-squared	0.371	0.368			0.436	0.433
Number of id			1121	1121	1121	1121

Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figures

Figure 1

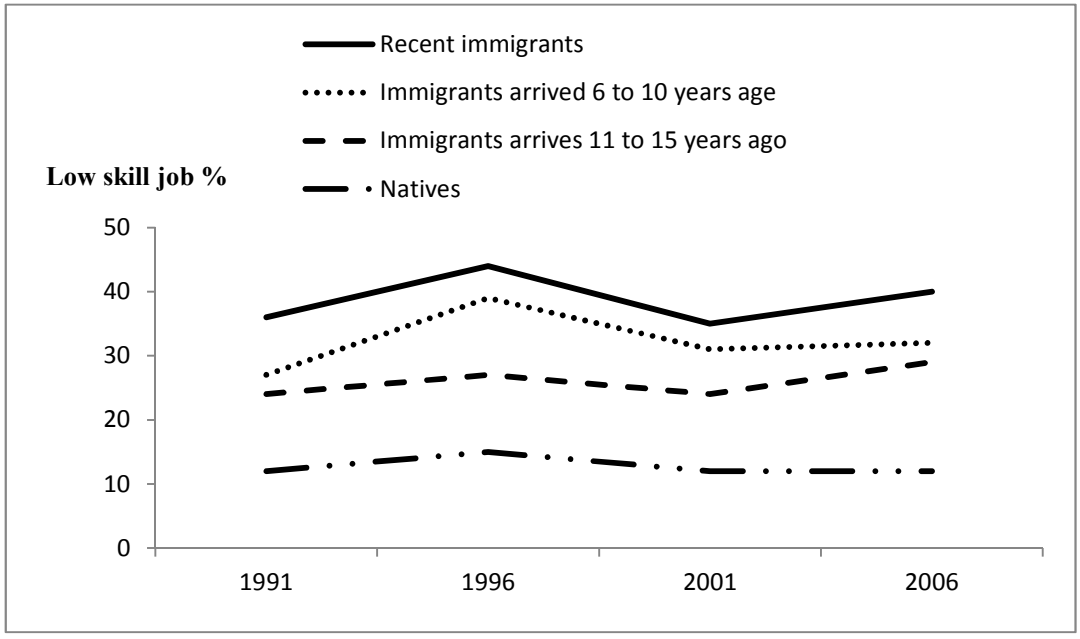
Male immigrants with a university degree in jobs with low educational requirements



Source: Statistics Canada, Census of Population

Figure 2

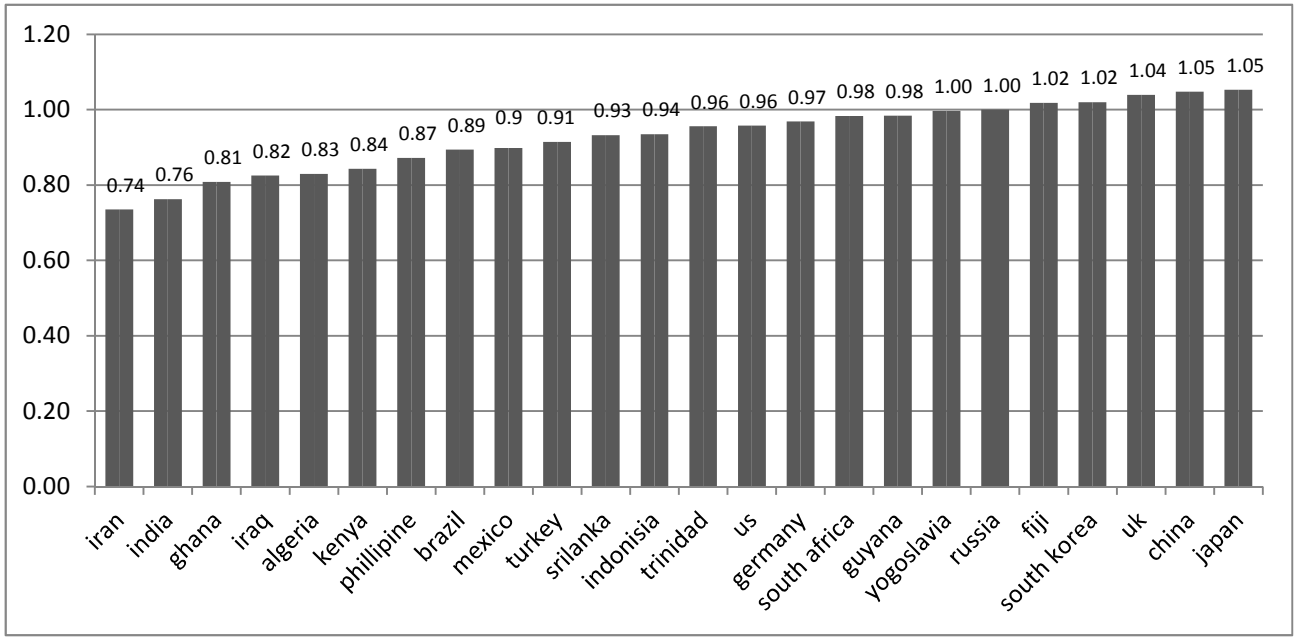
Female immigrants with a university degree in jobs with low educational requirements



Source: Statistics Canada, Census of Population

Figure 3

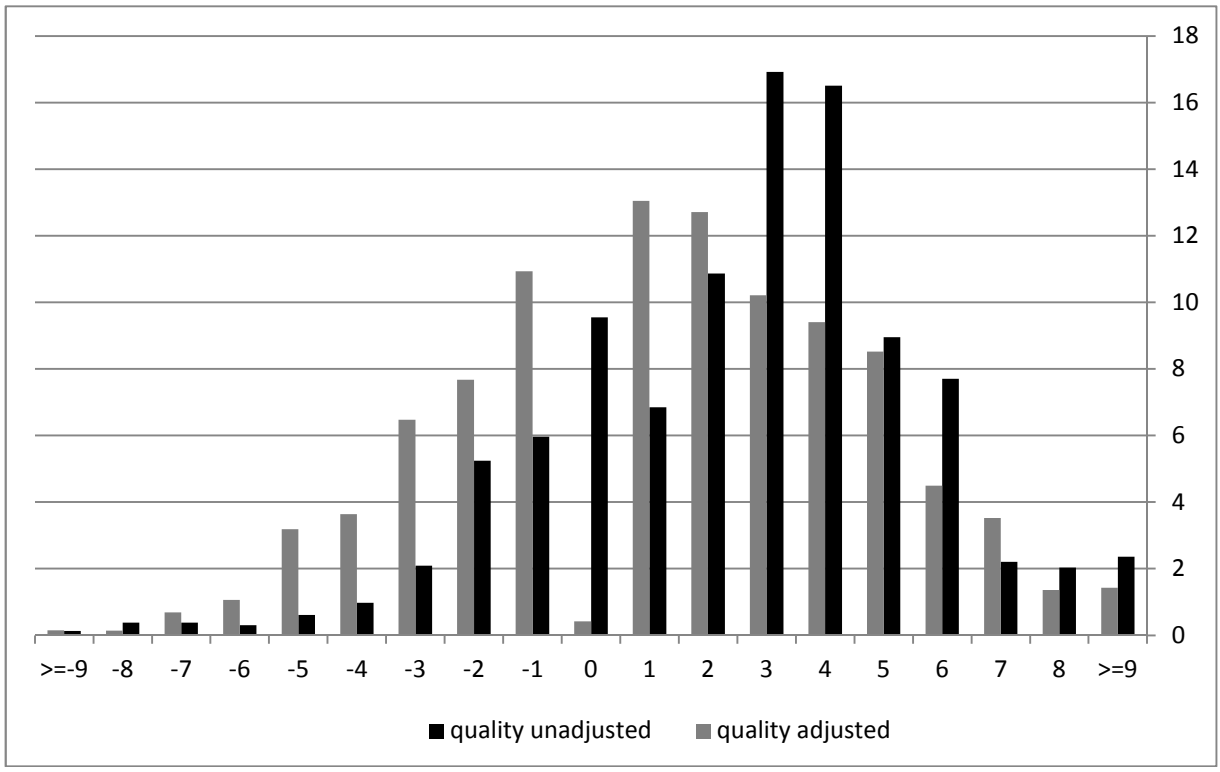
Source country quality adjustment index



Source: Author's compilation

Figure 4

Distribution of job-education mismatch intensity for quality adjusted and raw years of schooling for wave 1

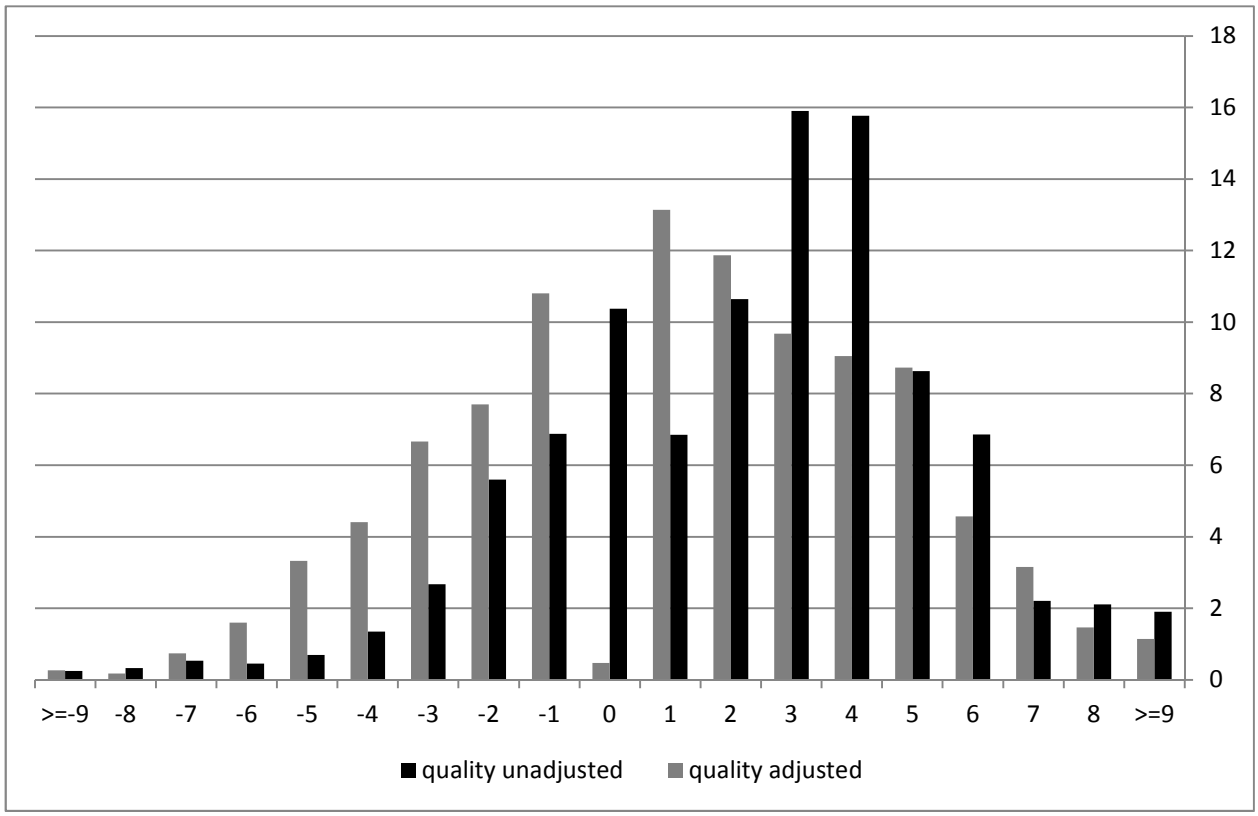


	Mean	Standard deviation	Skewness	Kurtosis
Quality unadjusted	2.54	3.11	-0.169	4.33
Quality adjusted	1.3	3.38	0.099	3.58

Source: The distribution is based on data from table 7

Figure 5

Distribution of job-education mismatch intensity for quality adjusted and raw years of schooling for wave 2

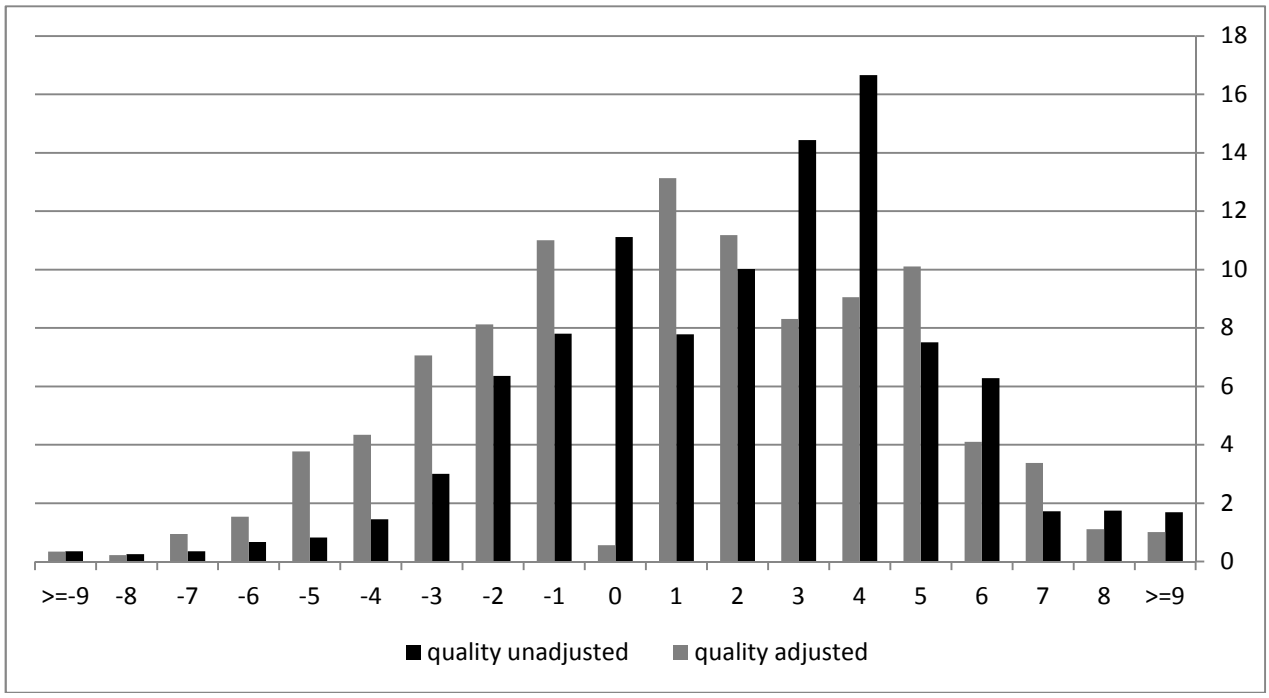


	Mean	Standard deviation	Skewness	Kurtosis
Quality unadjusted	2.29	3.24	-0.158	4.83
Quality adjusted	1.17	3.47	0.077	3.88

Source: The distribution is based on data from table 7

Figure 6

Distribution of job-education mismatch intensity for quality adjusted and raw years of schooling for wave 3



	Mean	Standard deviation	Skewness	Kurtosis
Quality unadjusted	2.05	3.22	-0.195	4.54
Quality adjusted	0.98	3.44	-0.022	3.58

Source: The distribution is based on data from table 7

Essay 2

What Can We Learn From Earnings of Immigrants? Quality Adjustment of Human Capital

Abstract

The economic assimilation literature documents that on average, immigrants receive a lower return to foreign-obtained schooling and have higher over-education rates, compared to the native-born. Given that schooling quality is not directly observed, previous studies mostly ignored the quality dimension of immigrants' human capital, and focused only on quantity measures, such as years of schooling. The main objective of this study is to quality-adjust human capital acquired from different source countries. This is achieved by explicitly deriving quality-adjustment indices, using data on adult males from the 2001 Canadian census. The derived indices are then used to examine the role of schooling quality in explaining the differential returns to schooling and over-education rates by nativity. I also use these indices to identify important inputs in the production technology of schooling quality. The key finding of this study is that accounting for schooling quality virtually eliminates the native-immigrant gaps in the returns to schooling and in the incidence of over-education. Results also show wide variations in the return to schooling across countries. These variations are significantly explained by cross-country differences in educational resources, particularly government educational expenditure and the length of the school term. Results are robust to a variety of robustness checks including different sample selections and model specifications. This study confirms that quality of human capital is important for understanding economic integration of immigrants.

Keywords: *Economic Assimilation, Return to schooling, Over-education, Schooling Quality, Educational inputs.*

1. Introduction

Recent empirical evidence has shown that the quality of human capital plays an important role in accounting for differences in growth rates across countries (e.g. Hanushek and Kimko, 2000; Schoellman, 2011).[37] However, measuring human capital quality remains an empirical challenge given that it is not directly observed.

The original contribution of the current study is its explicit derivation of quality adjustment indices, to adjust human capital for cross-country schooling quality differences, using information on the earnings of immigrants in the Canadian labor market. The derived indices are then used to conduct the following two exercises: a) identifying important inputs in the production technology of schooling quality, b) examining the role of schooling quality in explaining the differential returns to schooling and over-education rates by nativity.

The derivation of the quality-adjustment indices is based on the following two steps; first, I estimate the returns to immigrants' foreign-obtained schooling, using an augmented version of the Mincerian earning function, and provide supportive evidence on the validity of these returns to measure the schooling quality of their country of origin. Second, I derive a quality adjustment index for each country of origin as a ratio between the return to schooling from each foreign country and the Canadian return.

To identify the important quality inputs, I use two criteria, the explanatory power of the schooling quality production model, as measured by the coefficient of determination, and the statistical significance of the estimated coefficients. These two criteria yield a quality production model that accounts the best for the Canadian-foreign differential in

[37] Human capital refers to the stock of skills which an individual acquires through education, training and experience, and which affect his/her earning capacity.

returns to schooling. This model produced the smallest difference between the mean of the returns to quality-adjusted foreign-obtained schooling and the return to Canadian schooling, and also produced the smallest standard deviation of the estimated returns to quality-adjusted foreign-obtained schooling across countries.

Results show wide variations in the quality of schooling by country of origin, that are significantly explained by cross-country differences in educational resources, particularly government educational expenditure and the length of the school term. The fundamental finding of this study is that accounting for schooling quality virtually eliminates the native-immigrant gaps in the returns to schooling and in the incidence of over-education. In particular, the return to an extra year of quality-adjusted schooling of immigrants is 6.87, which is very close to the Canadian return of 7.06. This is in contrast to 5.9 percent, obtained before the adjustment. Results also show that cross-country differences in schooling quality account for over 90 percent of the variation in the returns to foreign-obtained schooling. Estimates show that the incidence of over-education among immigrants, after adjusting for quality differences, is 44.4 percent, which is very close to the Canadian incidence of 43.85 percent. This is in contrast to 58.5 percent, obtained before adjusting for schooling quality. This implies that when job-education mismatch is measured by years of schooling alone, as is standard in the literature, some of this apparent mismatch arises due to differences in the schooling quality between the host and home countries. In sum, the findings of this study confirm that quality of human capital is important for understanding economic integration of immigrants.

This paper is organized as follow: Section 2 presents a review of related studies. Section 3 describes the data source and sample used. In section 4, I estimate the returns to

schooling, conduct some robustness checks, and provide supportive evidence on the validity of the return to schooling to measure schooling quality. Section 5 estimates a schooling quality production function to identify important educational inputs, and derive schooling quality adjustment indices to control for cross-country difference in schooling quality. Section 6 examines the effect of controlling for schooling quality in accounting for the differential over-education rates by nativity. Section 8 concludes the paper.

2. Background and Literature

2.1. Measuring schooling quality

Given that education quality is not directly observed, previous studies mostly used two main methods to infer it. The first approach uses student outcomes such as scores on internationally standardized tests like the Programme for International Student Assessment (PISA) as a direct measure for schooling quality. The second approach involves estimating an education quality production function and relating educational inputs, such as pupils-teacher ratio and expenditures per pupil to an educational outcome. For example**,** Lee and Barro (2001) estimated a schooling quality production function that relates a set of measures for schooling quality such as international test scores, repetition rates and dropout rates to a set of family inputs and school resources. The authors found that the important factors in producing schooling quality include family characteristics such as parent's income and education, and more school resources such as smaller class size, higher teacher salaries and greater school length.

In addition to the use of educational inputs to measure education quality, several studies have used students' scores in international achievement tests to infer the quality

of the educational system (e.g. Hanushek and Kimko, 2000; Sweetman, 2004; Chiswick and Miller, 2010). For example, Hanushek and Kimko (2000) used countries scores from international achievement tests to construct measures of the average quality of the labor force of each country, which were then used to explain cross-country differences in growth rates. The international test scores were found to be highly correlated with the labor market outcomes of immigrants, suggesting that they could be a reasonable measure of the average quality of human capital from a particular country. For example, in a Canadian study, Sweetman (2004) found a strong correlation between Hanushek and Kimko's (2000) schooling quality measure and the return to schooling of immigrants in the Canadian labor market. In a related study, Chiswick and Miller (2010) found a strong positive relationship between the payoffs to schooling for immigrants in the US labor market and their source country schooling quality as measured by the PISA reading, mathematics and science literacy scores. [38]

Though international test scores and educational resources have been commonly used to measure schooling quality, they suffer from several shortcomings that affect their validity and accuracy. For instance, several studies found weak correlation between test scores of students and consequent labor market outcomes. The test scores also suffer from selectivity bias and difficulties in standardizing the tests (Betts, 1995). In addition these test scores are not available for many developing countries. For a more comprehensive review of the shortcomings of these methods see for example Betts (1995), Ladd and Loeb (2012).

[38] PISA refers to the Programme for International Student Assessment. It is an international evaluation of 15-year-old school pupils' scholastic performance conducted every three years by the Organization for Economic Co-operation and Development (OECD).

The current study adds to the existing literature on the cross-country differences in education quality by incorporating the idea that the earnings of foreign-educated immigrants in the same labor market can be used to measure the average quality of schooling of their home countries. The idea of using information on the labor market outcomes of foreign-educated immigrants to infer the quality of human capital in their country of origin derives from Hendricks (2002). Hendricks (2002) used the average labor earnings of immigrants, with identical measured skills in the US labor market, to estimate unmeasured human-capital endowments across countries. In a similar fashion, Mattoo et al. (2008) used the probability of placement of highly educated immigrants in skilled jobs in the US labor market as a measure of the "average quality" of human capital of the source country. The authors found that the occupational attainment of immigrants in the US labor market is largely affected by the characteristics of the source country that influence the quality of human capital such as the amount of educational resources devoted to schooling. They found that immigrants from source countries with low schooling quality are more likely to end up working in unskilled jobs than immigrants from source countries with better schooling quality. In a recent study, Schoellman (2011) estimated the return to schooling of immigrants in the US labor market and used these returns as a measure of schooling quality of the source countries. The author showed that cross-country differences in education quality are as important as cross-country differences in quantity of schooling in accounting for differences in output per worker across countries.

The novelty of the current study is its explicit derivation of quality adjustment indices to adjust human capital for cross-country differences in schooling quality. The derived

indices are then used to identify important inputs in the production technology of schooling quality and to examine the role of schooling quality in explaining the differential returns to schooling and over-education rates by nativity.

2.2. Returns to schooling and over-education prevalence by nativity

The labor market performance of immigrants compared to the native-born has been the subject of intensive research (e.g. Galarneau and Morissette, 2004; Li et al., 2006; Green et al., 2007; Wald and Fang, 2008). Earnings and occupational placement have been commonly used to assess the degree of economic integration of immigrants. A key factor directly related to this integration process is the quality of foreign-acquired human capital brought into the host country (Friedberg, 2000; Chiswick and Miller, 2009).

Two empirical regularities have emerged in the economic assimilation literature. First, foreign-obtained schooling is discounted in the destination country's labor market, as reflected by lower return to immigrants' education compared to the native-born (e.g.; Chiswick, 1978; Baker and Benjamin, 1994; Friedberg, 2000; Alboim et al., 2005; Chiswick and Miller, 2008). Second, the prevalence of over-education is on average higher among immigrants than the native-born (e.g. Li et al., 2006; Kler, 2007; Green et al., 2007; Galarneau and Morissette, 2008; Wald and Fang, 2008; Nielsen, 2011).[39] In the current study, I examine how cross-country differences in schooling quality account for these empirical observations.

The relatively lower return to foreign-obtained schooling has been established in the literature since Chiswick's (1978) seminal study on the economic assimilation of foreign-born males in the US labor market. Using 1970 census data, Chiswick (1978) estimated

[39] Over-education occurs when the educational attainment of a worker is greater than the educational requirement of the job.

that an extra year of schooling for the foreign born raises earnings by 5.7 percent, compared with 7.2 percent for the native born. He also found that the return to foreign-obtained schooling varies by country of origin, where the return was larger for immigrants from English-speaking countries (6.6 percent) compared with other immigrants (5.2 percent). Similarly, Beggs and Chapman (1988) found that the return to schooling in the Australian labor market was 8.3 percent for immigrants from English-speaking countries and 4.9 percent for immigrants from non English-speaking countries compared to 9 percent for the native born.

Several studies have estimated the returns to immigrants' education in the Canadian labor market with the general finding that on average, the return to a year of schooling for immigrants is about half that of the native-born (Reitz ,2001; Ferrer et al., 2008;Wald and Fang, 2008). Baker and Benjamin (1994) found that the lower relative return to foreign-obtained schooling was "permanent" among different cohorts of immigrants to Canada. They found that the return to schooling was 4.8 percent for immigrants and 7.3 percent for native-born in 1971, and 4.9 percent and 7.6 percent for the two groups respectively in 1986.[40] Alboim et al. (2005) found that the low return on the foreign-obtained human capital, both education and experience, fully explains the earnings disadvantage of immigrants relative to the native-born. The authors found that foreign human capital was significantly discounted in the Canadian labor market, where the return to a foreign year of schooling was equal to 70 percent of the return to a Canadian year of schooling.

Another empirical observation in the economic assimilation literature is that the prevalence of over-education is higher among immigrants than the native-born. For

[40] For additional evidence from other countries on the lower return to foreign-obtained schooling see Shields and Price (1998) for UK, Friedberg (2000) for Israel and Nordin (2011) for Sweden.

example, using the survey of labor and income dynamics, Li et al. (2006) found that during the 1993-2001 period, 52 percent of recent immigrants to Canada, those in Canada for 10 years or less, were overqualified compared to 28 percent of their Canadian-born counterparts. They also found that recent immigrants were twice as likely to remain overqualified compared to native Canadians. Using census data, Galarneau and Morissette (2008) found that 28 percent of recent immigrant males, and 40 percent of females with university degrees were in jobs with low educational requirements compared to 10 percent and 12 percent for Canadian-born. Using data from the Canadian Workplace and Employee Survey, Wald and Fang (2008) found that 47.8 percent of the recent immigrants to Canada were over-educated compared to 34.6 percent among non-recent immigrants and 31.3 percent among native-born. Evidence from European countries also confirmed this finding. For example, using data from Denmark, Nielsen (2011) found that the incidence of over-education among immigrants with foreign-acquired education was 47 percent compared to 33 percent among native Danes. [41]

Studies also showed that the incidence of over-education among immigrants varied by the region of origin. For example, Green et al. (2007) found that the rate of over-education in the Australian labor market among immigrants from non-English speaking countries was 50 percent to 100 percent higher than immigrants from English speaking countries. Evidence from US also confirms this finding. For example, using the 2000 US Census data on employed males, Chiswick and Miller (2009) noticed wide variations in the extent of over-education across source region. The authors found higher rates of over-education among immigrants from the former USSR, Philippines, South Asia, other

[41] For additional evidence on this empirical finding see Lindley and Lenton (2006) for evidence from U.K, Green et al. (2007) and Kler (2007) for Australia, Galarneau and Morissette (2008) for Canada.

South Asia, Middle East and Sub Saharan Africa, while the rates of over-education were low among immigrants from Southern Europe, Indochina, Mexico, Cuba, Caribbean, Central and South America—Spanish, and Central and South America—non-Spanish.

Several explanations have been suggested for the lower relative return to schooling for the foreign-acquired education and the higher incidence of over-education among immigrants. These include lower quality of foreign schooling (Chiswick and Miller, 2009), "country-specific aspects" of the knowledge acquired in schools (Chiswick, 1978), incompatibility of foreign-obtained schooling with the requirements of the host country labor market (Friedberg, 2000), lack of host country-specific human capital such as language proficiency (Alboim et al., 2005) and racial discrimination. For example, Oreopoulos (2009) conducted a study using thousands of resumes sent in response to online job postings for several occupations in Toronto. The author found considerable employer discrimination against applicants with ethnic names on the resume in terms of lower callback rates and interview requests compared to those with English-sounding names.

3. Data source and sample characteristics

The empirical analysis used data from the confidential master file of the 2001 Canadian census of population. The merit of the census data set is that it includes a large sample of immigrants from a wide range of countries, along with information on a comprehensive set of demographic and labor market variables for a nationally representative sample of individuals.[42] In addition, the census file includes detailed occupational codes for the job held by employed individuals at the time of the

[42] For additional information on the 2001 Canadian census see Statistic Canada (2003).

interview.[43] This was used to determine the years of schooling required in each occupation and hence determine the prevalence of over-education.

The analysis was restricted to males, aged 24 to 65 years who were paid workers and working full time. In addition, the analysis excluded individuals with missing values on the relevant variables. Source countries with observations less than 500 immigrants were also excluded from the sample. These restrictions produced a sample of 5,117,249 Canadians and 680,107 immigrants from 78 source countries. To control for the possibility that an immigrant may have obtained any Canadian education after immigration, I restricted the analyses to immigrants whose age at immigration is at least 24 years old as a baseline specification. I further raised this threshold to 30 years old as a robustness check for the results. The rationale behind this exclusion is that any post immigration investment in education is likely to raise the return to the foreign obtained schooling and hence will bias upward the estimate of the source country schooling quality (Duleep and Regets, 1999).

<Insert Table 1 here>

Table 1 reports the characteristics of the baseline sample that is used in the analysis. Immigrants represent 12.3 percent of the sample. On average, immigrants are older, more educated, have more work experience and more likely to be married than the native-born.[44] About one quarter of the immigrants reported English or French as their mother tongue. Immigrants are concentrated in four main provinces; Ontario (58 percent), British

[43] The occupational coding system is based on the 1980 Standard Occupational Classification.

[44] Work experience is determined based on potential work experience, defined as age-years of schooling-6. The fact that immigrants are on average more educated than their Canadian counterparts may be due to the immigration point system which highly rewards education (up to 25 points).

Columbia (16.3 percent), Quebec (13.2 percent) and Alberta (8.5 percent). 53.88 percent of the immigrants arrived to Canada during the period 1990-2001, 22.8 percent immigrated during 1980-1989, 17.57 percent during 1970-1979 and 5.76 percent during 1960-1969.

<Insert Table 2 here>

Table 2 presents weighted summary statistics on average years of schooling, average annual wages and salaries and the number of observations of the baseline sample for each source country. India was the source of the largest percentage of immigrant males (8.73 percent) followed by United Kingdom (7.8 percent), China (7.75 percent), Philippines (5.49 percent), Hong Kong (4.42 percent), United States of America (3.80 percent) and Poland (3.67 percent). Table 2 illustrates wide cross-country variation in the average years of schooling and average annual wages and salaries of immigrants.

Methodology

The empirical analysis agenda is as follows: first, I estimate the returns to foreign-obtained schooling, conduct several robustness checks, and provide supportive evidence on the validity of these returns to measure schooling quality. Second, the estimated returns to schooling are used to identify important factors in producing schooling quality, derive schooling quality adjustment indices and revisiting the evidence on the differential over-education rates by nativity.

4.1. Estimating the return to schooling

The first step in the analysis is to estimate the returns to foreign-obtained schooling, which are used to measure schooling quality for each country of origin.[45] This is accomplished by estimating the following augmented version of the Mincer earning function:

$$\log(W_i^j) = \alpha^j + \beta^j \ S_i^j + \varphi \, X_i^j + \ \varepsilon_i^j \qquad (1)$$

Specifying the earning function as in equation 1 allows each country of origin to have its own intercept and return to schooling which is central to the current study. Equation 1 is showing that the logarithm of the weekly wage of individual i from country j is determined by a country-specific fixed effect α^j, total years of schooling S_i^j, a set of common observed covariates X_i^j and a stochastic error term ε_i^j. The control variables included in X_i^j are a quartic in potential experience, measured by age minus years of schooling minus 6 years, three indicators for marital status (single, married and separated), four indicators for cohort fixed effects (1960-1969, 1970-1979, 1980-1989, 1990-2000) , ten indicators for provincial fixed effects and two indicators for language proficiency.[46]

[45] The methodology used here is an application of the idea developed by Card and Krueger (1992) who used the cross-state return to schooling of migrants to measure schooling quality of states. The idea was also applied to cross-country comparisons by Betts and Lofstrom (2000), Bratsberg and Terrell (2002), Sweetman(2004), Chiswick and Miller (2010), Schoellman (2011).

[46] Mother tongue was used in the regression analysis rather than ability to speak English or French since the former is exogenous and not affected by an individual's ability to learn new language which may be positively correlated with schooling quality (Sweetman, 2004).

4.2. Baseline estimation results

<Insert Table 3 here>

The estimated country-specific returns to schooling are presented in the first column of Table 3. Consistent with the existing evidence, estimates from the earning function reveals the discounting of foreign-obtained schooling in the Canadian labor market. In particular, an extra year of Canadian schooling raises earnings by 7.06 percent, while the average return to a foreign-obtained year of schooling is estimated at 5.9 percent.[47] Results also show wide variation in the returns to schooling across source countries (STD= 1.8), with a general conclusion that the value of a year of schooling in the Canadian labor market depends on its origin. It is evident from Table 3 that the returns to schooling for most of the source countries were lower than the Canadian return of 7.06 percent.[48] Nicaragua was the source country with the lowest return to schooling, estimated at 1.66 percent, followed by the Dominican Republic (2.4 percent), El Salvador (2.9 percent) and Syria (3.1 percent). For source countries with substantial number of immigrants, the returns to schooling were 6.7 percent for both, China and India, Philippines (4 percent), United Kingdom (6.5 percent) and Poland (4.6 percent). On the upper segment of the returns distribution, the country-specific returns to schooling from 12 countries were higher than the Canadian return. These include Switzerland (11.5 percent), South Africa (9 percent), Hong Kong (8.7 percent), Denmark (8.3 percent), Belgium (8.1 percent), France (7.6 percent), Malaysia (7.5 percent), Australia (7.3

[47] The regression analysis was conducted using Stata 11. All estimations and descriptive statistics are population weighted using the sampling weight provided in the census.

[48] These results are consistent with the findings of earlier studies on the discounting of foreign-obtained schooling in the Canadian labor market (see for e.g. Baker and Benjamin, 1994; Alboim et al., 2005). They are also consistent with evidence for immigrants to US (e.g. Chiswick, 1978; Friedberg, 2000).

percent), Czechoslovakia (7.2 percent), Sri Lanka (7.2 percent), Hungary (7.2 percent) and Israel (7.1 percent). These results are consistent with the empirical evidence on how the national origin of an individual's education matters for its return in the labor market (Friedberg, 2000; Bratsberg and Terrell, 2002; Sweetman, 2004; Chiswick and Miller, 2010).

4.3. Robustness checks

Several robustness checks were conducted to check the sensitivity of the estimated returns to schooling to the sample selection restrictions and to the model specification.

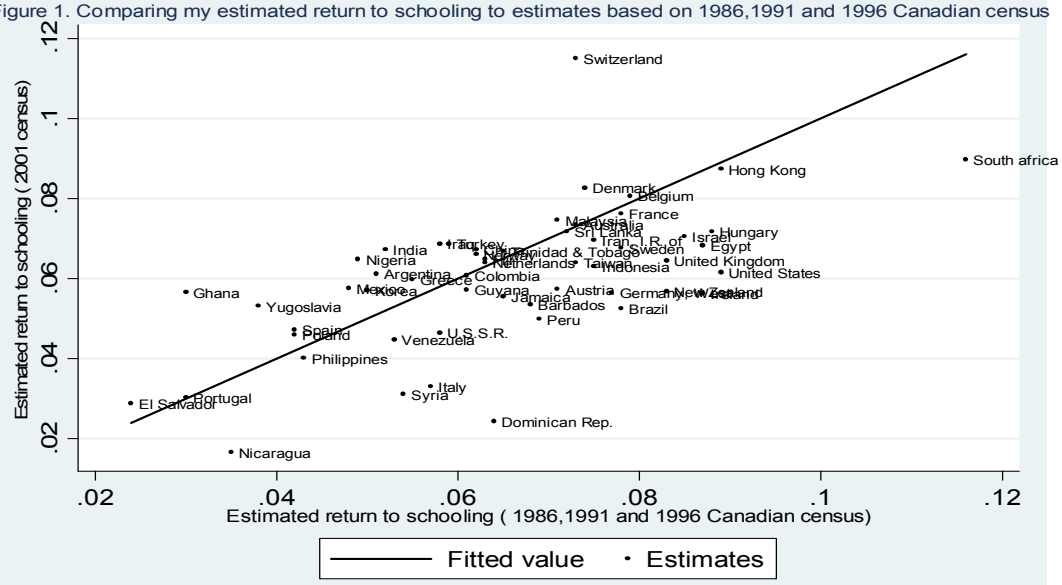
<Insert Table 4 here>

A summary of the results of the baseline specification of the earnings function are reported in table 4. In the second specification, I excluded immigrants whose age at immigration was less than 30 years instead of 24 to further reduce any bias that may result from taking any education in Canada. In the third specification, returns to schooling are allowed to vary by immigration cohort and by occupational skill level (skilled and un-skilled) in the fourth specification. The 508 occupations identified in the census are grouped into skilled and un-skilled categories based on the educational requirement of each occupation; skilled if the occupation requires more than 12 years of schooling, otherwise it is classified as unskilled. Given the finding of several previous studies that foreign-acquired work experience has zero return in the Canadian labor market (e.g. Alboime et al., 2005), I estimated another specification that includes only potential Canadian work experience. The country specific returns to schooling from these different specifications were in general very close to the baseline model. For example, the difference between the Canadian return to schooling and the average returns to foreign

obtained schooling was 1.16 percentage points, and ranges from 0.7 to 1.3 percentage points in the alternative specifications.

In figure 1, I compare my estimated returns to schooling to those obtained by Sweetman (2004). The goal of this comparison is to check whether there is something special about the 2001 Canadian census data set, or that it has particular features that may affect the empirical findings. As shown in Figure 1, my estimated country-specific returns to schooling are in general very close to those obtained using other data sets.[49]

Figure 1. Comparing my estimated return to schooling to estimates based on 1986,1991 and 1996 Canadian census



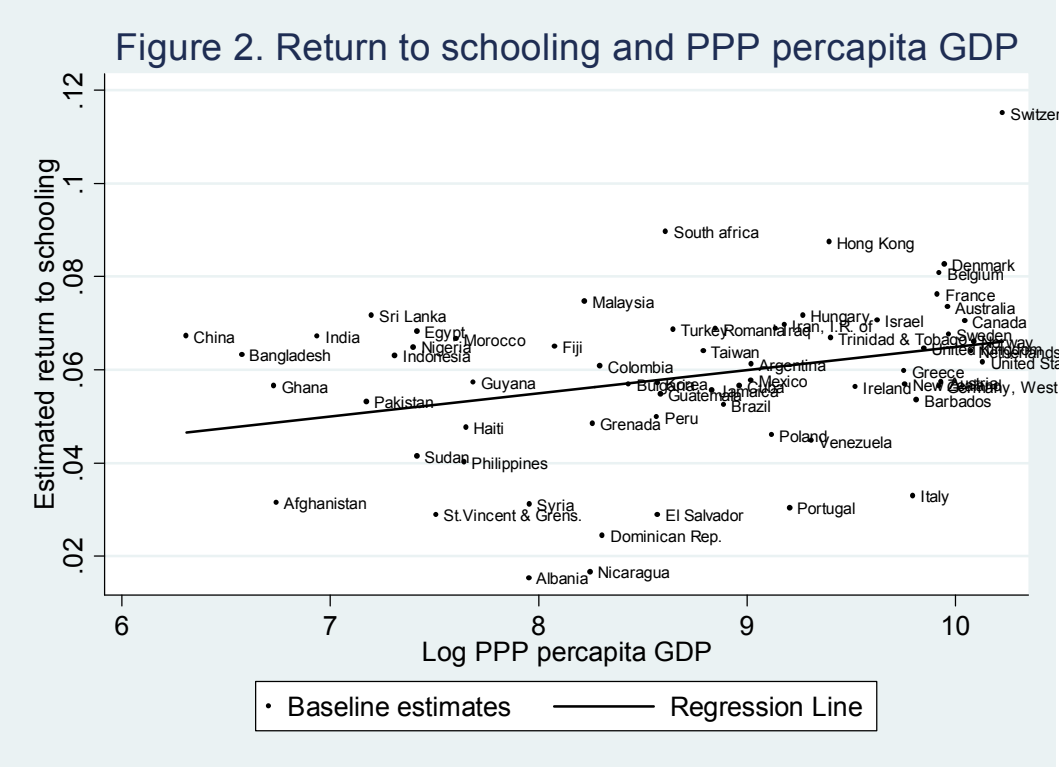
4.4. Supporting evidence for using returns to schooling to measure schooling quality

It has been widely documented that immigrants from countries with high quality educational systems receive higher economic returns to schooling than those from

[49] Sweetman (2004) estimated the return to schooling of immigrants from a wide set of countries using a pooled sample of the 1986, 1991 and 1996 Canadian census. Part of the deviation of my estimated returns from the estimates of Sweetman (2004) may be attributable to differences in the sample selection and model specifications.

countries with low quality educational systems (Sweetman, 2004; Chiswick and Miller, 2010). This implies that the return to schooling could be used as a "productivity-based" or a "market-based" measure for schooling quality (Bratsberg and Terrell, 2002)

To check the soundness of the returns to schooling as being a reasonable measure of schooling quality, I compare these returns to alternative measures that are widely used in the literature as proxies for schooling quality. Figure 2 plots the estimated country-specific returns to schooling against the log of PPP GDP per-capita obtained from the Penn World Tables (Heston et al, 2011). Results show that on average, immigrants from source countries with higher per-capita real GDP earned higher returns on their foreign-obtained schooling than immigrants from countries with lower per-capita real GDP (correlation coefficient = 0.41).



In figure 3, the estimated country-specific returns to schooling were plotted against test scores from international achievement tests constructed by Hanushek and Kimko

(2000).[50] The Hanushek and Kimko (2000) constructed index is an educational outcome, widely used in the literature as a proxy for the average quality of schooling in each country. Figure 3 shows that there is a positive correlation (correlation coefficient= 0.39) between the estimated country-specific returns to schooling and international achievement test scores. [51]

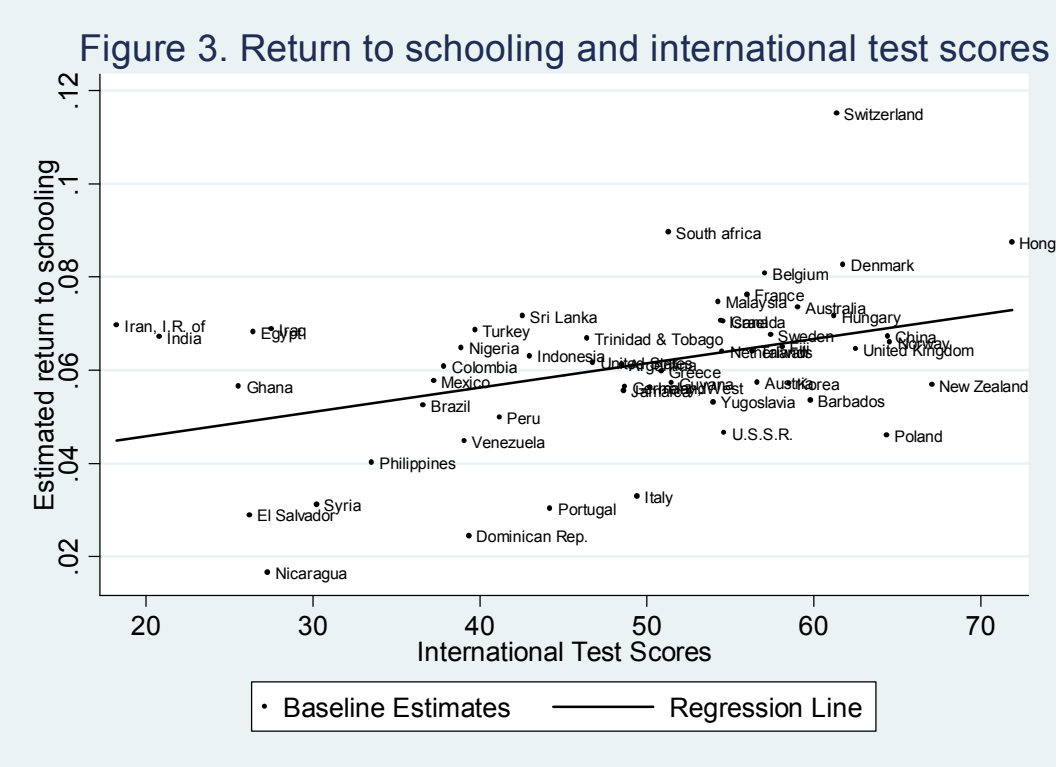


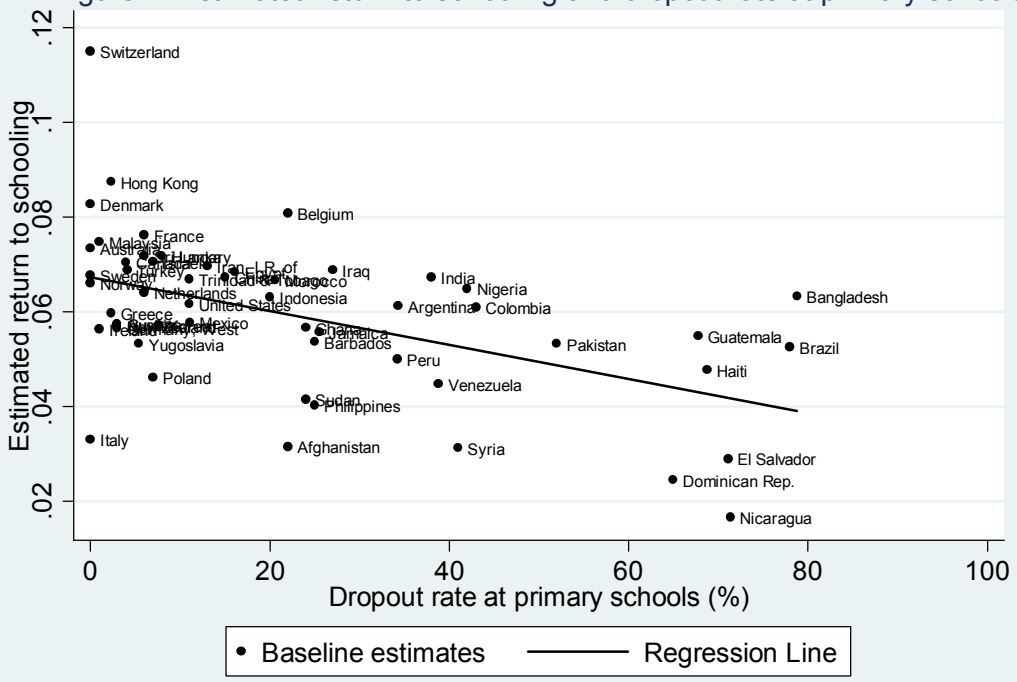
Figure 4 displays the estimated return to schooling against the dropout rate at primary schools, a commonly used proxy for schooling quality. Data on dropout rates are

[50] Hanushek and Kimko (2000) constructed a measure of the average schooling quality for a pool of countries based on students' performance on international tests of academic achievement in mathematics and science conducted between 1965 and 1991 by two different international education testing organizations.

[51] In a recent study, Schoellman (2011) also found a positive correlation between return to schooling of immigrants in the US labor market and another set of international test scores constructed by Hanushek and Woessmann (2009).

obtained from Lee and Barro (1997).[52] As expected, there is a negative correlation (correlation coefficient= -0.54) between estimated return to schooling and dropout rate at primary schools as shown in figure 3.

Figure 4. Estimated return to schooling and dropout rate at primary schools

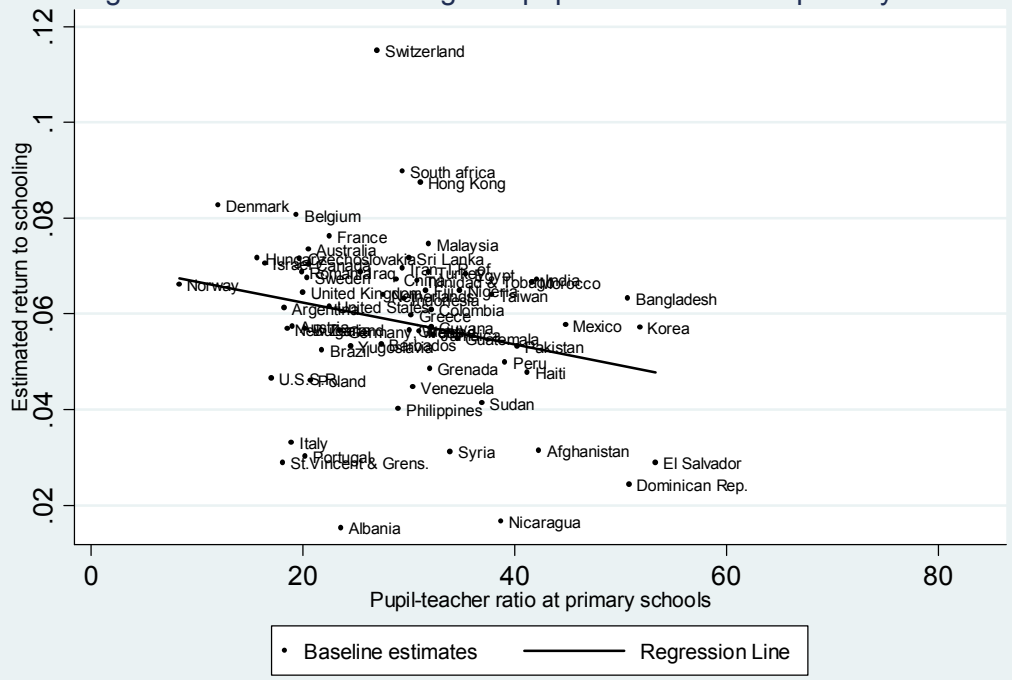


Additional evidence for the validity of schooling returns as a measure for schooling quality can be observed by plotting these estimated returns to schooling against several educational inputs that are directly related to schooling quality.[53] These include student-teacher ratio at primary schools, real government educational expenditure per pupil at primary schools, and real average salary of primary school teachers as a proxy for teachers' quality. Data for these variables were obtained from Lee and Barro (1997).

[52] Dropout rates were defined as the percentage of students who started primary schools but did not attain the final grade of primary schools.

[53] To better capture the attributes of the educational system that were prevailing at the time immigrants undertook their education; I lagged educational inputs data for 20years.

Figure 5. Return to schooling and pupil-teacher ratio at primary schools



As evident from Figure 5, on average, immigrants from countries with low pupil teacher ratios in primary schools earned a higher return on their foreign obtained schooling in the Canadian labor market (correlation coefficient= -0.35). In a similar fashion, estimated schooling returns were positively correlated (correlation coefficient= 0.48) with log of real government educational expenditure per pupil at primary schools as shown in figure 6.[54]

These relationships are in general consistent with findings from other countries and data sets (e.g. Betts and Lofstrom, 2000; Bratsberg and Terrell, 2002; Sweetman, 2004; Chiswick and Miller, 2010). [55]

[54] Similar findings were reached when the estimated return to schooling were plotted against educational inputs data related to secondary schooling.

[55] A potential bias in the estimated returns to schooling may arise if the quality of schooling changed over time within a country (Hanushek and Zhang, 2009). I believe that this bias is mitigated by allowing the return to schooling to vary by immigrants' cohort.

Figure 6. Return to schooling and real government educational expenditure per pupil at primary schools

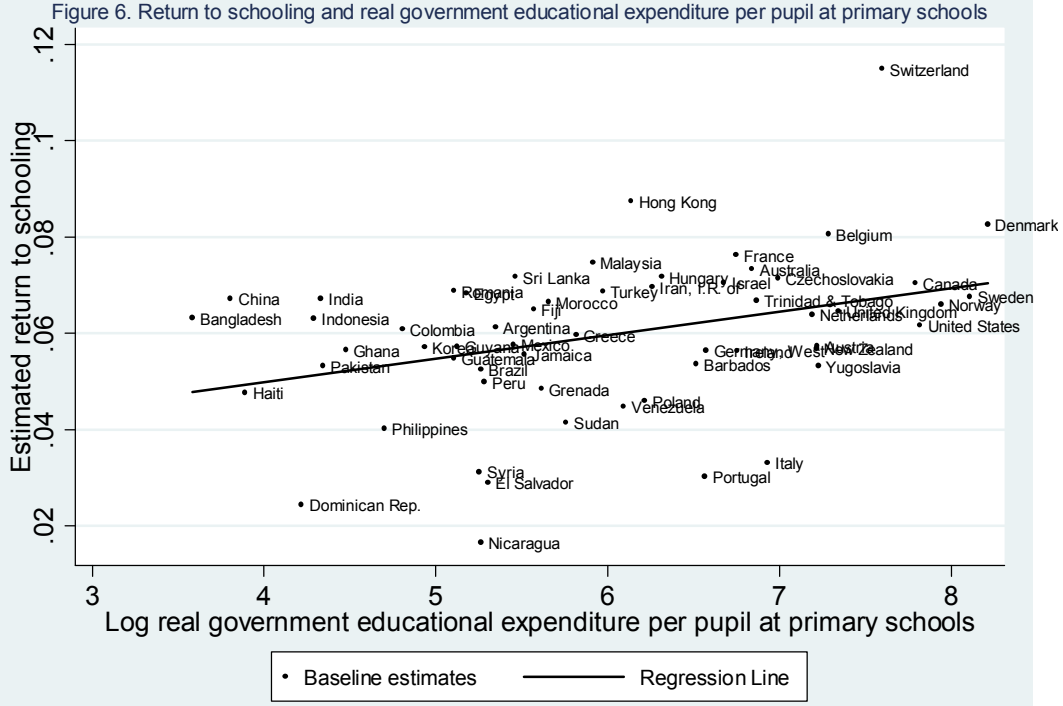
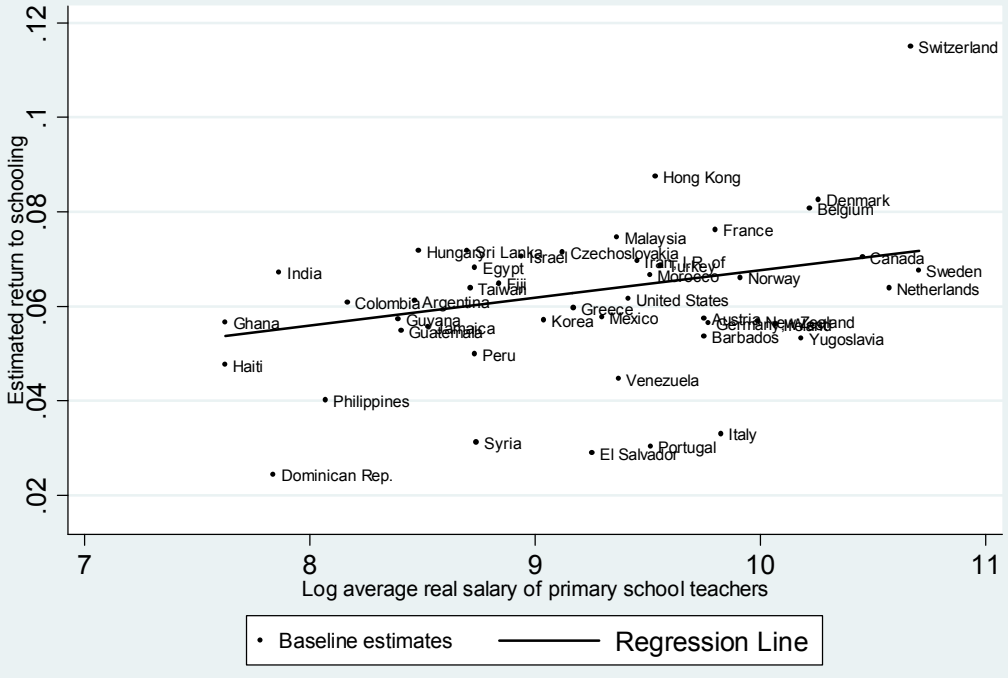
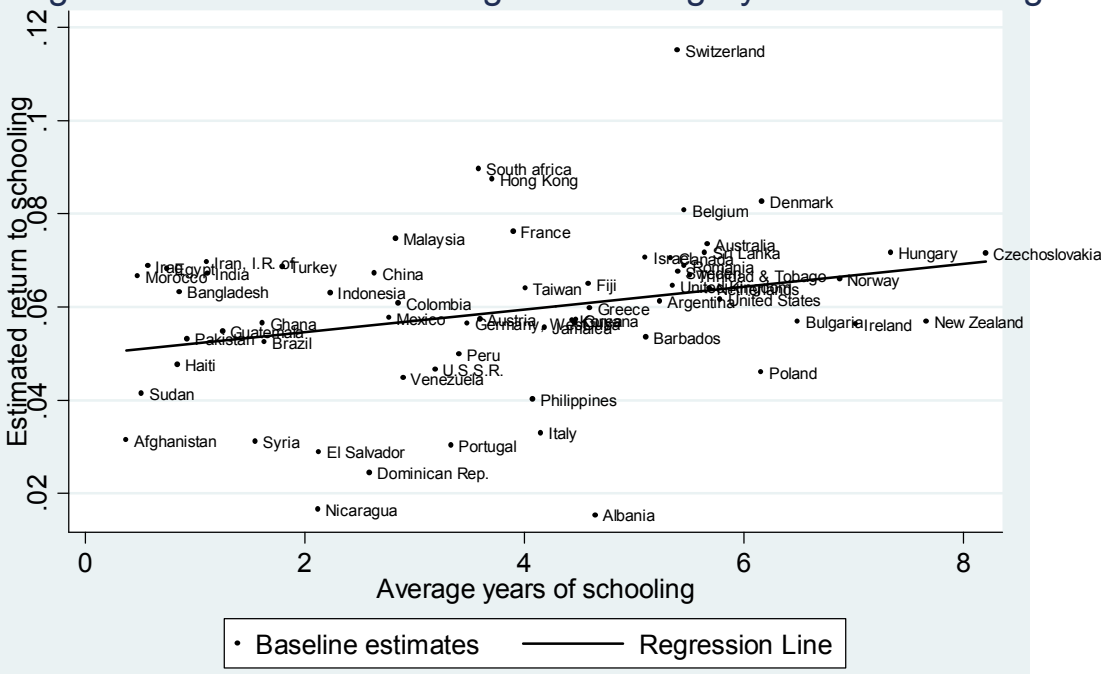


Figure 7. Return to schooling and average real salary of primary school teachers



Figures 7 and 8 display a positive correlation between country of origin returns to schooling and teachers' quality as measured by their average salary (correlation coefficient=0.52) and average schooling (correlation coefficient=0.35).[56]

Figure 8. Return to schooling and Average years of schooling



The evidence provided in this section on the relationship between the estimated returns to schooling and several educational inputs, motivates estimating the contribution of these educational inputs in producing schooling quality as will be shown in the next section.

5. Estimating a schooling quality production function

In this section I identify important educational inputs in producing schooling quality by estimating a schooling quality production function similar to that of Lee and Barro

[56] Average years of schooling are also used in the literature to proxy student's family background.

(2001), and Bratsberg and Terrell (2002).[57] A typical schooling quality production function relates a schooling quality measure to a set of educational inputs as follow:

$$Q = f(P, I) + \varepsilon \quad (2);$$

where Q denotes schooling quality, P represents parental characteristics, I represents educational resources and ε captures unmeasured factors affecting schooling quality. In a more technical term, equation 2 can be specified as follow

$$R_j = \alpha + \beta_1 P_j + \beta_2 I_j + \varepsilon_j \quad (3);$$

where j indexes countries, R_j denotes the country of origin-specific return to schooling, as a measure of schooling quality, P_j denotes a set of parental factors, I_j denotes a vector of educational resources and ε_j captures country-specific unmeasured factors affecting schooling quality.

In the analysis, educational resources are measured by the pupil-teacher ratio in primary schools, log of real government educational expenditure per pupil in primary schools, number of school days per year at primary schools (as a measure of the intensity of education), and the log of real salary of primary school teachers (as a measure of teachers' quality). Data on educational resources are obtained from Lee and Barro (1997).

In addition to school resources, it has been shown that the academic achievement of a student is largely affected by non-school factors such as family background. Several studies have shown that family background such as the parent's education and income level are important determinants of the educational outcomes of their children (Psacharopoulos and Woodhall, 1985; Hanushek, 1995).

[57] Lee and Barro (2001) estimated a schooling quality production function that relates three measures of schooling quality; dropout rates, repetition rates and test scores, to a set of parental factors and educational resources. Bratsberg and Terrell (2002) related country of origin specific return to immigrants' education in the US labor market to several schooling quality measures.

Parental factors are measured by the log of real per capita GDP (as a proxy for family income) obtained from Penn World Tables (Heston et al, 2011), and average years of primary schooling of adults aged 25 and above (as a proxy for the family education) obtained from Barro and Lee (2010).[58]

To better capture the attributes of the educational system and parental factors that were prevailing at the time immigrants undertook their education, I used lagged data from the period 1975 to 1980.[59]

5.1. Results for alternative specifications of the schooling quality production function

<Insert Table 5 here>

The schooling quality production function was estimated under several model specifications to check the sensitivity of the results as shown in Table 5. Model 1 includes only educational resources (pupil-teacher ratio and real government educational expenditure per pupil); model 2 includes the real salary of primary schools teachers in addition to the variables of model 1, while parental factors (real per capita GDP and average years of primary schooling) are added in models 3, 4 and 5.

Given that source countries have different sample sizes, I also estimated the schooling quality production function using weighted least square, with the number of individuals from each source country is used as a weight. The results from the weighted least square are presented in model 5.

[58] In addition the average years of primary schooling could also reflect the education level of the teachers.

[59] In a related study, Bratsberg and Terrell (2002) lagged the educational quality data for 20 years.

The quality production function is used to generate predicted values for the returns to schooling of each country of origin (see last three columns in Table 3), which are used to identify important inputs in the production technology of schooling quality as follows: first, the predicted returns are used to derive adjustment indices to adjust years of schooling for quality differences across countries. Second, I re-estimate the Mincerian earnings function (equation 1) using the quality-adjusted years of schooling, where years of schooling from different source countries are now expressed in the same "quality unit" (Canadian terms).

To identify the important quality inputs, I use two criteria, the explanatory power of the model, as measured by the coefficient of determination, and the statistical significance of the estimated coefficients. In this regard, model 5 is the preferred model because it has the biggest explanatory power $R^2 = 0.39$ and produces statistically significance coefficients. An important prediction of this model is that it produces the smallest difference between the mean of the returns to quality-adjusted foreign-obtained schooling and the return to Canadian schooling. In particular, the mean of the returns to schooling of immigrants becomes 6.9 percent, which is very close to the Canadian return of 7.04 percent. This is in contrast to 5.9 percent obtained before the adjustment. In addition, model 5 also produced the lowest cross-country variation in the returns to schooling, where the standard deviation of the returns to schooling of immigrants becomes 0.15, in contrast to 1.8 obtained before the adjustment. This means that cross-country differences in schooling quality account for over 90 percent of the variation in the returns to foreign-obtained schooling. Given these two predictions, I conclude that model 5 does a good job in identifying the production technology for human capital.

Results show that the pupil-teacher ratio has a negative relationship, though not statistically significant, with schooling quality. This is consistent with the expectation that smaller class sizes enhance quality of education. Results also show that both the length of the school term (as a measure of education intensity), and real government educational expenditure per pupil have a positive and statistically significant effect on schooling quality. A one percent increase in government expenditure per pupil at primary schools raises the return to schooling on average by half a percentage point. Similarly, having twelve more days of schooling raises the return to schooling on average by nearly as much. The regression also included the average years of schooling as a measure of parental education level. This variable has the correct sign but is not statistically significant.

5.2. Deriving schooling quality adjustment indices

The predicted values of the country-specific returns to schooling obtained from the schooling quality production function, in addition to the actual returns to schooling, are used to derive schooling quality adjustment indices to convert years of schooling from different countries into Canadian terms.

The rationale behind the derivation of adjustment indices is as follows: consider two workers, an immigrant from country j and a native-born, who are identical in observed characteristics ($X_i^j = X_i^{can}$) --apart from schooling level-- and earn the same wage net of country fixed effects. Since the country-of-origin fixed effect (α^j) is potentially affected by selection of immigrants based on unobserved characteristics, or may be affected by other factors unrelated to schooling quality, I discard the intercept (α^j) in equation (1)

and focus only on the country-specific return to schooling ($\hat{\beta}^j$). From equation (1), the predicted wages are

$$\widehat{W}^j = \hat{\beta}^j S_i^j + \hat{\varphi} X_i^j = \hat{\beta}^{can} S_i^{can} + \hat{\varphi} X_i^{can} = \widehat{W}^{can} \quad (4);$$

So that

$$\hat{\beta}^j S_i^j = \hat{\beta}^{can} S_i^{can}$$

Then the schooling level of the immigrant is equivalent to the schooling level of the native-born. In other words, years of foreign-obtained schooling can be transformed into Canadian-equivalent years using the relative return to schooling as follows

$$\tilde{s}_i^j = \frac{\hat{\beta}^j}{\hat{\beta}^{can}} S_i^j \quad (5);$$

where $\tilde{s}_i^j$ denotes total years of schooling from country j expressed in its Canadian equivalence, which I will call "quality-adjusted schooling", $\frac{\hat{\beta}^j}{\hat{\beta}^{can}}$ is a country-specific adjustment index that covert foreign-obtained years of schooling into its Canadian equivalence and S_i^j is the quality unadjusted years of schooling.

<Insert Table 6 here>

The derived country-specific quality adjustment indices are presented in Table 6, which shows considerable variation among source countries, ranging from 0.217 for Albania to 1.63 for Switzerland.[60] Two useful reference countries with considerable number of immigrants are Philippines (adjustment index= 0.57) and Hong Kong (adjustment index= 1.24).These adjustment indices can be interpreted as follows: On average, ten years of schooling from Philippines are equivalent to 5.7 years of Canadian

[60] The adjustment indices presented in table 6 are derived using the actual returns to foreign-obtained schooling.

schooling. Similarly, ten years of schooling from Hong Kong are equivalent to 12.4 years when expressed in Canadian terms.

5.3. Returns to schooling using quality-adjusted data

Now I examine the role of the quality-adjusted years of schooling in accounting for the differential returns to schooling of immigrants and native born. In this regard, I re-estimate the Mincerian earnings function using the quality-adjusted years of schooling.[61] Years of schooling from different source countries are now expressed in the same "quality unit" (Canadian terms). Accordingly, if the quality adjustment indices accurately capture differences in schooling quality across countries, then the return to a year of quality-adjusted foreign-obtained schooling should be close to the return to a Canadian year of schooling. In line with this a priori expectation, the return to an extra year of quality-adjusted schooling of immigrants is 6.87, which is very close to the Canadian return of 7.06, obtained earlier. This is in contrast to 5.9 percent, obtained before the adjustment. The main conclusion from this exercise is that cross-country differences in schooling quality substantially explains the lower return to immigrants' education in the labor market and that the gap in returns to schooling nearly disappears once the quality of schooling is taken into account. In a similar fashion, the lower return to immigrants' schooling from many source countries compared to the native-born is mainly due to the low quality of foreign-obtained schooling.

[61] Here, years of schooling are quality-adjusted using adjustment indices based on the predicted returns to schooling obtained from the quality production function.

6. Schooling quality and over-education prevalence by nativity

The schooling quality adjustment derived above shows that immigrants' quality-unadjusted years of schooling, on average, overstate their earning capacity. Hence, an immigrant holding a job that requires less schooling than what he/she has may appear to be over-educated when in fact he/she is not. Accordingly, the quality adjustment indices reported in Table 6 can be used to re-examine the evidence on the prevalence of over-education among immigrants, which is the objective of this section.

The classification of a worker into being over-educated is based on the realized match method. According to this method an individual is considered to be over-educated if his educational attainment is greater than a reference measure for the educational requirements of the job (Hartog, 2000; Chiswick and Miller, 2008). The current study uses the modal (i.e. most frequent) years of schooling of Canadian-born workers to determine required years of schooling in each of the 508 occupation identified in the census. As standard, job-education mismatch is measured by the following equation.

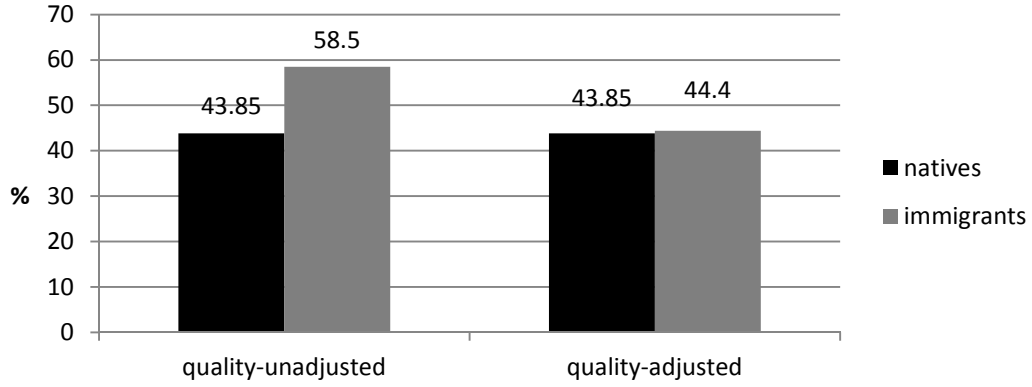
$$O_{ij} = S_{ij}^{a} - S_{j}^{r} \quad (6);$$

where O_{ij} is an indicator variable of whether a worker is over-educated or not, S_{ij}^{a} represents total years of schooling completed by worker i working in job j, and S_j^r represents years of schooling required by job j. A worker is considered to be over-educated if $S_{ij}^{a} > S_{j}^{r}$.

Figure 9 depicts the aggregate incidence of over-education by nativity, using the quality-adjusted and unadjusted years of schooling. The quality-adjustment of schooling in the over-education exercise is done using adjustment indices based on the actual

estimated returns to schooling obtained from the Mincerian earnings function (see the first column in table 3).

Figure 9
Over-education incidence among natives and immigrants



It is evident from figure 9 that the aggregate incidence of over-education, using quality unadjusted years of schooling, is higher among immigrants compared to native-born. Estimates show that 58.5 percent of immigrant males were over-educated in 2001 compared to 43.85 percent of the Canadian born.[62] Another key result is that immigrants not only have a higher incidence of over-education, but also have a higher intensity of over-education, measured in terms of years of surplus schooling above what is required by the job, than their Canadian-born counterparts. Estimates, using quality-unadjusted years of schooling, show that immigrant males have on average 3.6 (STD= 2.28) years of surplus schooling, compared to 2.82 years (STD=1.84) for the natives-born.

[62] The high incidence of over-education among immigrants is in line with several previous studies. For instance, using the survey of labor and income dynamics, Li et al. (2006) found that during the 1993-2001 period, 52 percent of recent immigrants to Canada-those in Canada for 10 years or less-were over-educated. Lindley and Lenton (2006) found that 63 percent of male immigrants to UK are overeducated compared to 37 percent of male natives. In another study, Wald and Fang (2008) found that about 50 percent of the immigrants arriving between 1989 and 1997 were overeducated in 1999.

As previously mentioned, this differential over-education rates by nativity may be due to differences in schooling quality that are not captured by years of schooling alone. Accordingly, the objective now is to see how these aggregate moments (over-education rates) change when schooling quality is taken into account using the quality adjustment indices derived in the previous section.

The fundamental result from this quality adjustment exercise is that accounting for schooling quality virtually eliminates the native-immigrant gap in the incidence of over-education. In particular, the estimates show that the incidence of over-education among immigrants, after adjusting for quality differences, becomes 44.4 percent, which is very close to the Canadian incidence of 43.85 percent. This is in contrast to 58.5 percent, obtained before adjusting for schooling quality. The intensity of over-education among immigrants declined but only a little (from 3.6 to 3.39) after adjusting for quality differences. The general conclusion from these findings is that when job-education mismatch is measured by years of schooling alone, as is standard in the literature, some of this apparent mismatch arises due to differences in the schooling quality between the host and home countries.

Looking at figure 9 gives a population-average measure of over-education rates among immigrants and native-born, and shows the average effect of adjusting for quality differences. However, one may ask what factors are driving these differential over-education rates? Are the effects of quality adjustment uniform across different subgroups of immigrants? Answering these questions helps to identify which groups of immigrants that are genuinely more over-educated, which is of interest to policy makers concerned with immigrants' assimilation. In an attempt to answer these questions, I stratify the

analysis by several socio-demographic characteristics such as age, occupation-skill level, immigration period and country of origin.

Figure 10. over-education incidence by age group

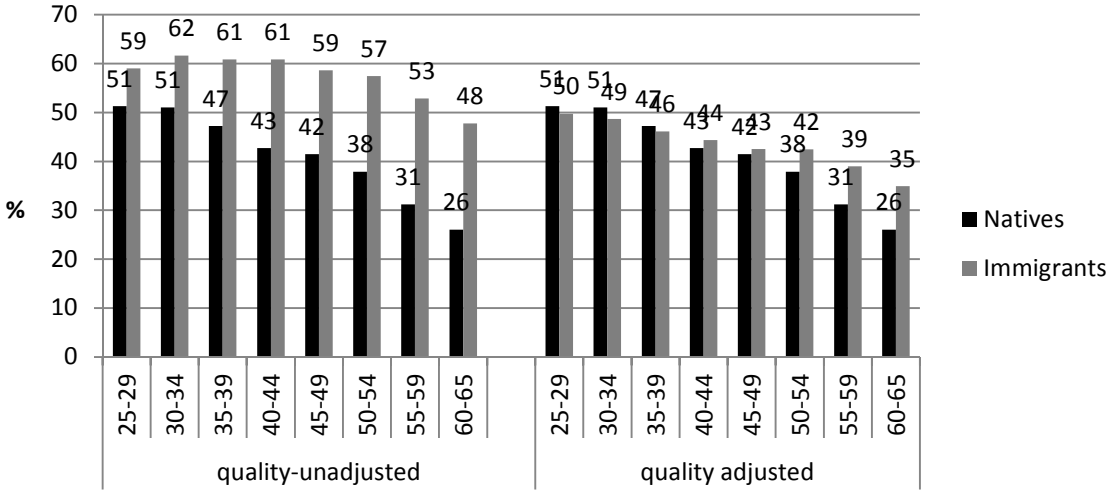


Figure 10 shows that the prevalence of over-education among immigrants and native-born, decreases with age, where the young are more likely to be over-educated than the old. This is consistent with the job-search behavior of young workers and the fact that young workers lack job experience or training relative to older workers. However, with age, workers start to acquire more skills and experience which helps them to find jobs matching their education level.

An important observation is that the immigrant-native gap in over-education rates increases with age. This is consistent with the findings of several studies which documented that over-education is highly persistent among immigrants compared to the native-born, and that immigrants face long term difficulties in finding jobs that match their qualifications (Galarneau and Morissette, 2004; Li et al., 2006; Wald and Fang, 2008). Another key observation concerns the effect of quality adjustment on the immigrant-native over-education gap across different age groups: As shown in figure 10,

though the gap has on average disappeared, the effect was not uniform across all age groups, with a more substantial reduction for the young than the old. This raises the question of what is special about the old immigrants. To this end, I continue stratifying the analysis by other characteristics such as immigration period as shown in figure 11.

Figure 11. over-education incidence by immigration period

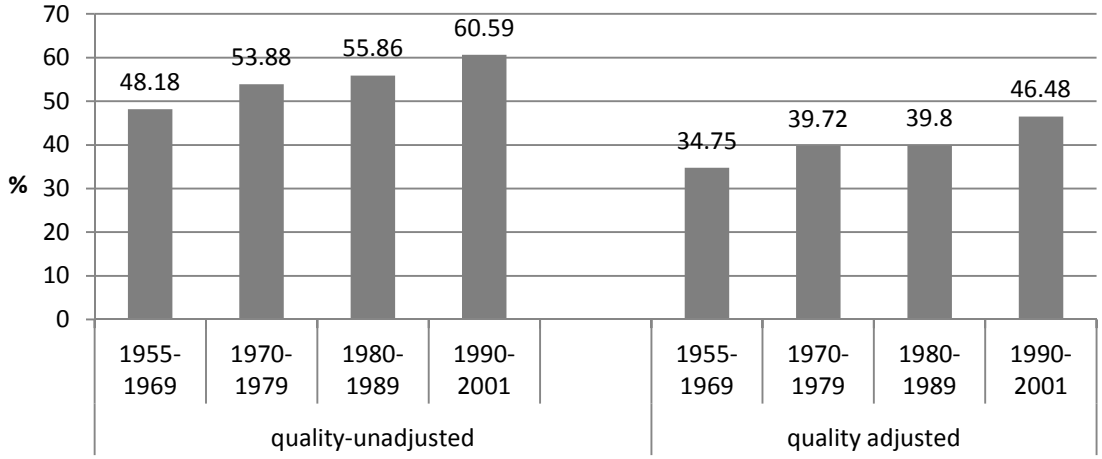


Figure 11 shows that recent cohorts of immigrants have higher incidence of over-education than earlier cohorts. For example, 60.6 percent of immigrants who immigrated during 1991-2000 were over-educated compared to 48.2 percent of immigrants who immigrated during 1955-1969. Results also show that the quality-adjustment reduced the incidence of over-education for all cohorts of immigrants, but with a smaller effect among recent cohort. In particular, as a result of quality-adjustment, over-education rates among the 1990-2001 cohort decreases by 23.3 percent. This is in contrast to a 28 percent and a 29 percent decline among the 1955-1969 and the 1980-1989 cohorts respectively. Statistics from the 2001 census show that these results are not driven by the prevalence of the old in each cohort. For instance, 20.6 percent of immigrants aged 50 to 65 arrived during the 1990-2001 period compared to 20.2 percent in the 1980-1989 period, 43.3 percent during 1970-1979 and 15.9 percent in 1955-1969.

To further understand what is driving the aggregate results, I also stratify the analysis by the occupational skill level. As before, the 508 occupations identified in the census are grouped into un-skilled occupations (require less than 12 years of schooling) and skilled occupations (require more than 12 years of schooling).

Figure 12. over-education incidence by skill level

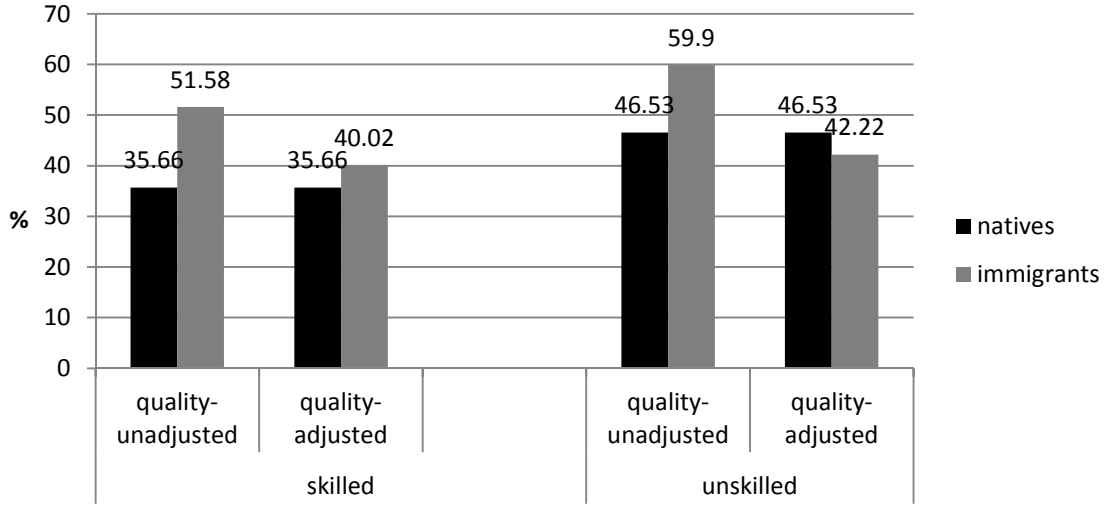


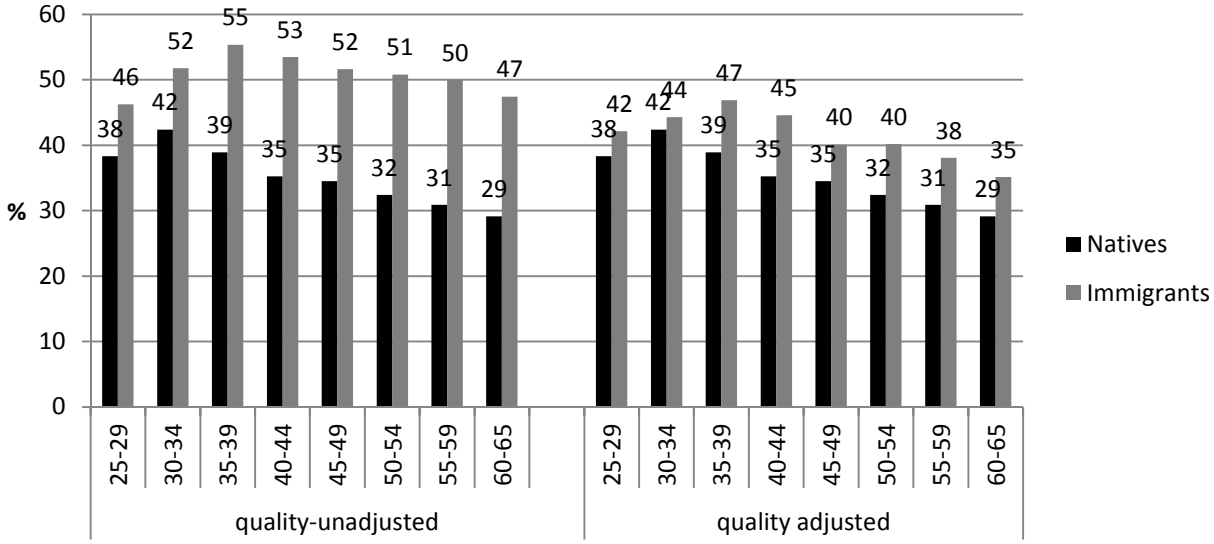
Figure 12 illustrates the incidence of over-education by occupational skill level. A key observation is the differential effect of the quality adjustment across occupational skill levels. The quality-adjustment reduces the immigrant-native gap in over-education rates for the skilled occupations. However, over-education rate among immigrants remains higher than that of natives. On the contrary, the gap is reversed for the unskilled occupations, after adjusting for quality differences. This differential effect of schooling quality-adjustment by the skill level suggests that quality of education matters more for unskilled occupations, i.e. the quality of *lower* level of education is relatively more important.[63] This is in line with my earlier finding that increasing government

[63] This is consistent with the finding that investments at early ages have the largest effect on human capital formation (Heckman and Masterov, 2007).

expenditure on primary education and increasing the length of the school term in primary schools significantly increase the quality of education.

Recall the earlier finding that over-education is more prevalent among older immigrants and more recent cohorts, after adjusting for quality differences. In my sample, recent cohorts of immigrants have more skilled workers than do earlier cohorts. For instance 56 percent of immigrants working in skilled-occupations arrived during 1990-2001 period compared to 20 percent for the 1980-1989 period, 17 percent in 1970-1979 and 6.8 percent in the 1955-1969 period. However, this is not the case with old immigrants where only 29 percent of immigrants aged 50 to 65 were working in high skilled- occupations.

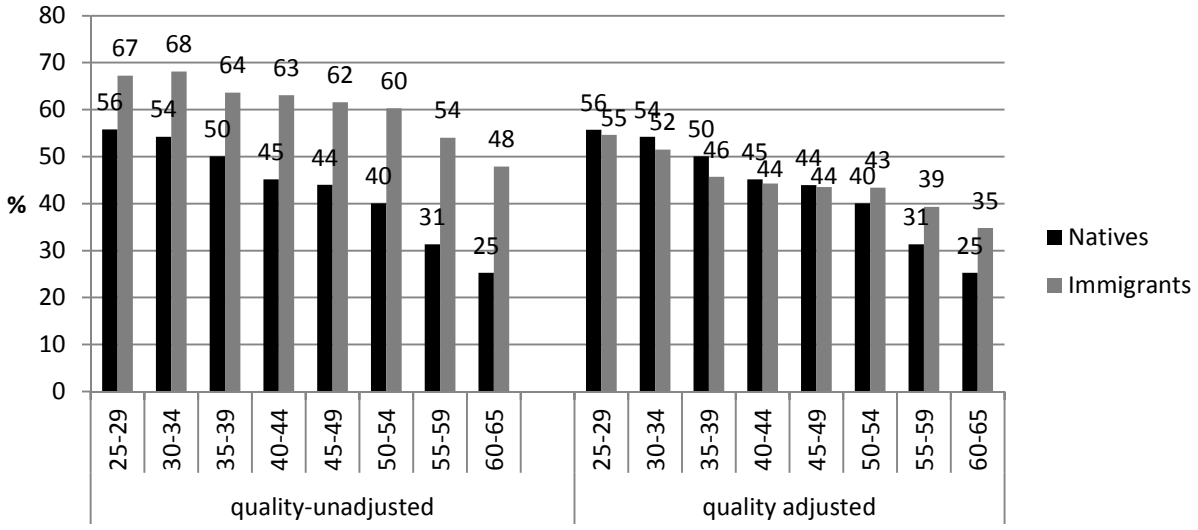
Figure 13. Over-education incidence by age group
- skilled occupations-



Stratifying figure 12 further by age shows a more noticeable reduction in the immigrant/native over-education gap- as a result of the quality adjustment- for individuals working in the un-skilled occupations, especially for the young, as shown in figures 13 and 14.

To sum up, over-education is more prevalent among older immigrants, recent cohorts and skilled workers, after adjusting for quality differences. Additional insights of what explains these observations can be obtained by slicing the sample by country of origin, as shown in figures 15 and 16.

Figure 14. Over-education incidence by age group
- unskilled occupations-



Estimates in figure 15 indicate significant variations in the incidence of over-education by country of origin, as measured by raw years of schooling. The effect of quality-adjustment on the over-education rates is not uniform across all countries: the effect is stronger for source countries with lower schooling quality as measured by their estimated schooling returns.

Notice that the prevalence of over-education did not decrease much, or even increased, after adjusting for quality, among immigrants from such countries as Australia, Hong Kong, Switzerland, Belgium, Czech Republic, France, Denmark, Malaysia, Algeria and South Africa. In my sample, 60 percent of the recent cohort of immigrants, 65 percent of the high-skilled immigrants and 55 percent of the old-age immigrants (aged 50

to 65) are from source countries with high schooling quality (quality-adjustment index≥0.9). This means that the quality-adjustment will either increase their adjusted years of schooling, or will make a minor reduction to it, and hence the quality-adjusted incidence of over-education will either increase or decrease slightly. This suggests that the origin of the human capital could explain the high variation in over-education rates among different sub-groups of immigrants.

To sum up, results show that accounting for schooling quality virtually eliminates the aggregate native-immigrant gap in the incidence of over-education. However, the effect of the quality-adjustment was not uniform across all age groups, immigration cohort, occupational skill levels and countries of origin. Though the current study tried to suggest possible explanations for these heterogeneous effects, further research would be required to better understand this issue.

Figure 15. Over-education by country of origin using quality-unadjusted years of schooling

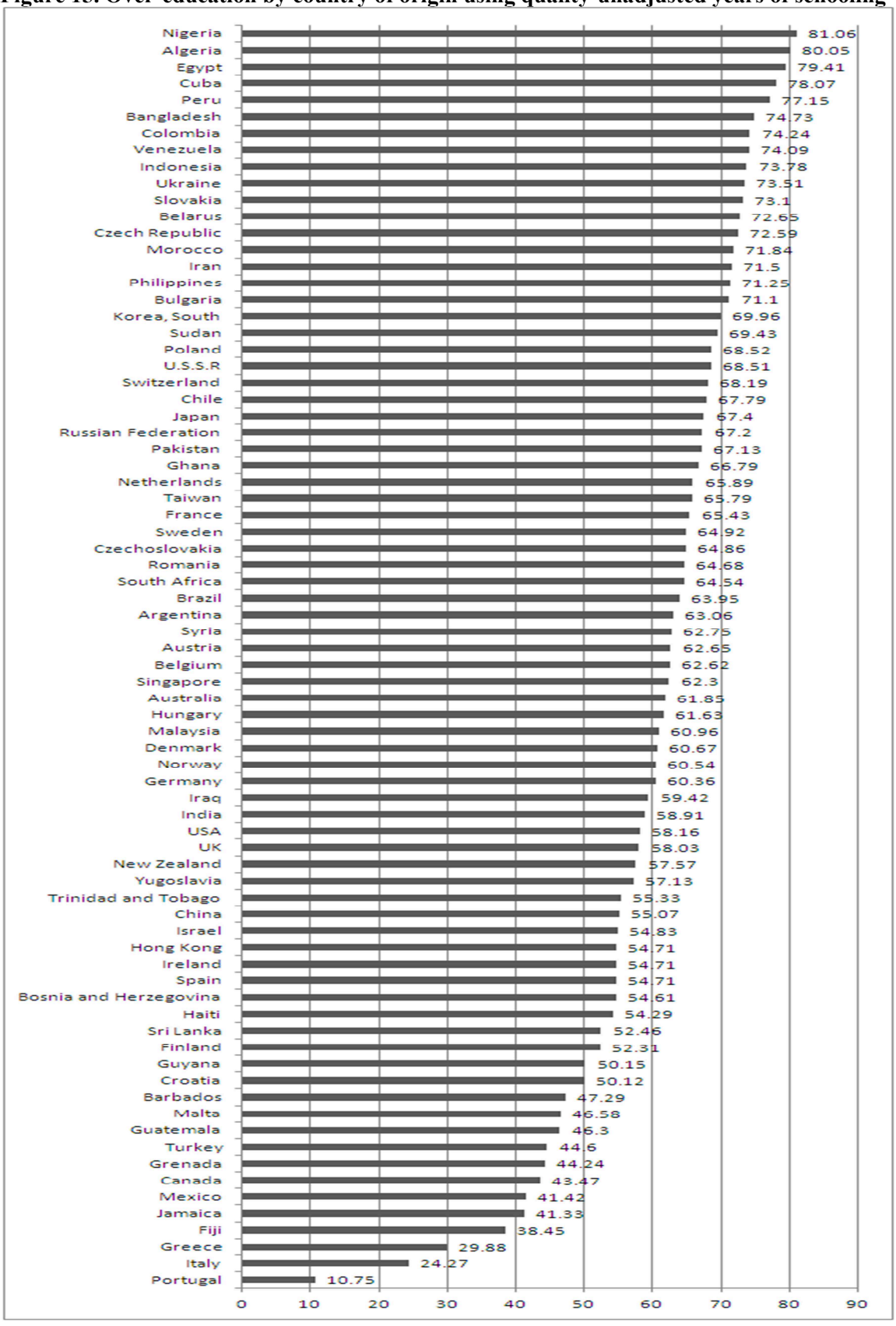
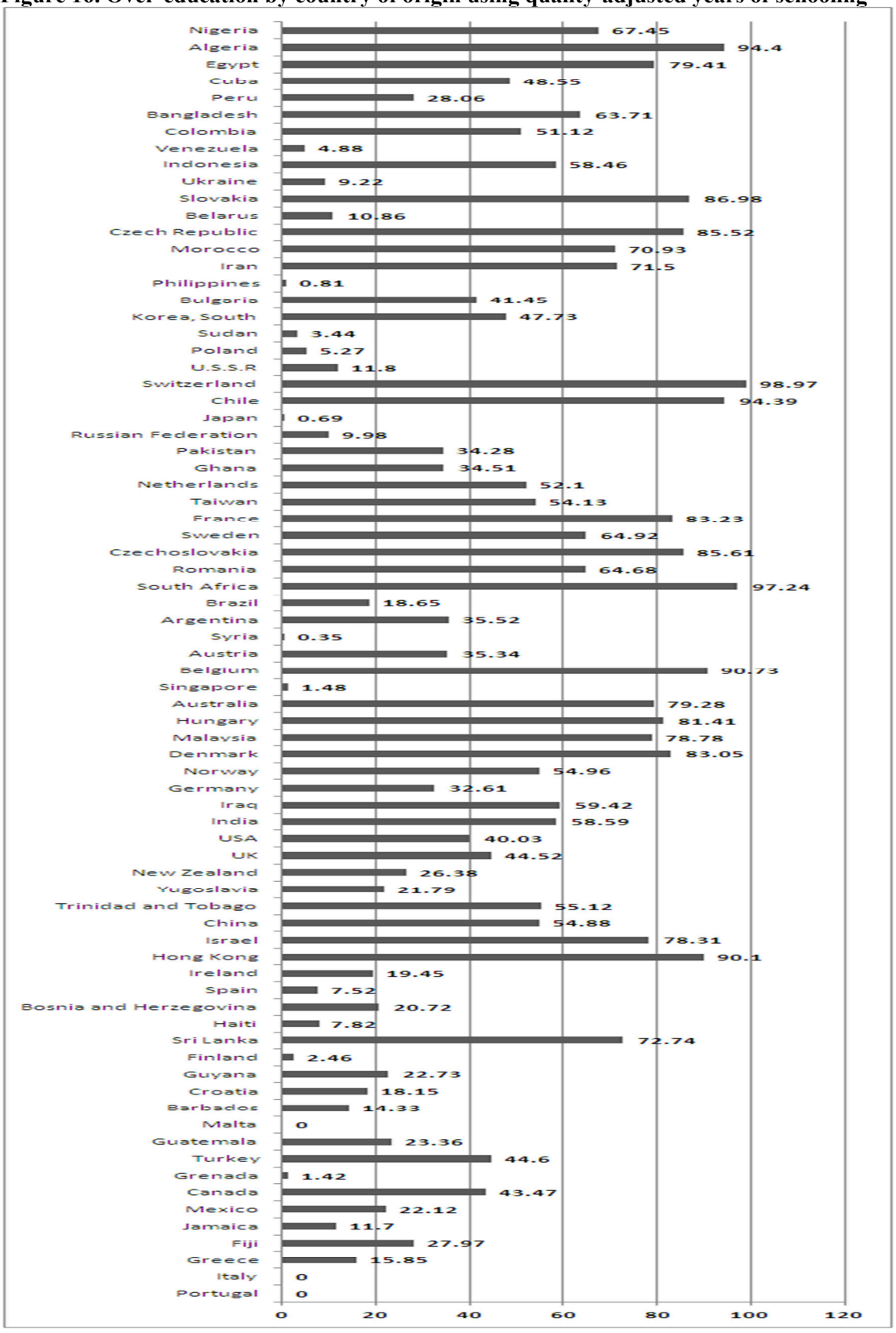


Figure 16. Over-education by country of origin using quality-adjusted years of schooling



7. Conclusion

This study explicitly derives schooling quality adjustment indices to account for cross-country schooling quality differences using information on the labor market earnings of immigrants. The derived indices are used to identify important inputs in the production technology of schooling quality and to explain the differential returns to schooling and over-education rates by nativity.

To derive the quality-adjustment indices, I estimate the returns to immigrants' foreign-obtained schooling, and use the ratio between each of these returns to schooling and the Canadian return as a quality-adjustment index for each country of origin. To identify important inputs in the production technology of schooling quality, I re-estimate the Mincerian earnings function using the quality-adjusted years of schooling.

To identify the important quality inputs, I use two criteria, the explanatory power of the model, as measured by the coefficient of determination, and the statistical significance of the estimated coefficients. These two criteria yield a quality production model that accounts the best for the Canadian-foreign differential in returns to schooling. This model produced the smallest difference between the mean of the returns to quality-adjusted foreign-obtained schooling and the return to Canadian schooling, and also produced the smallest standard deviation of the estimated returns to quality-adjusted foreign-obtained schooling across countries.

The fundamental finding of this study is that accounting for schooling quality virtually eliminates the native-immigrant gaps in the returns to schooling and in the incidence of over-education. In particular, the return to an extra year of quality-adjusted schooling of immigrants is 6.87, which is very close to the Canadian return of 7.06,

obtained earlier. This is in contrast to 5.9 percent, obtained before the adjustment. Estimates also show that the incidence of over-education among immigrants, after adjusting for quality differences, is 44.4 percent, which is very close to the Canadian incidence of 43.85 percent. This is in contrast to 58.5 percent, obtained before adjusting for schooling quality. This implies that when job-education mismatch is measured by years of schooling alone, as is standard in the literature, some of this apparent mismatch arises due to differences in the schooling quality between the host and home countries.

Though accounting for schooling quality virtually eliminates the aggregate native-immigrant gap in the incidence of over-education, the effect of the quality-adjustment is not uniform across different subgroups of immigrants. Over-education is more prevalent among older immigrants, recent cohorts and skilled workers, after adjusting for quality differences.

Estimates from the earnings and the quality production functions show wide variations in the returns to schooling by country of origin (STD= 1.8), which are significantly explained by cross-country differences in educational resources, particularly government expenditure on education and the length of the school term in primary schools. Results also show that cross-country differences in schooling quality account for over 90 percent of the variation in the returns to foreign-obtained schooling.

The findings of this study emphasize the importance of controlling for the source (quality) of human capital when evaluating the economic integration of immigrants. "Quantity of schooling alone is misleading", it is important to account for quality too (Behrman and Birdsall, 1983).

Appendix

Table1. Descriptive statistics (Mean)

Variable	Whole population	Natives	Immigrants
Age	40.37	39.67	45.81
Potential experience	20.7	20.15	25.14
Years of schooling	13.66	13.52	14.66
Wages & salaries	43,322.85	43,694	40,439
Single	32.63	35.68	9.64
Separated	10.78	11.19	7.89
Married	56.07	52.63	81.85
New found land	1.78	2	0.17
Prince Edward	0.48	0.54	0.05
Nova Scotia	3.11	3.46	0.59
New Brunswick	2.69	3.01	0.32
Quebec	25.53	27.20	13.18
Ontario	36.26	33.33	57.72
Saskatchewan	3.06	3.39	0.69
Alberta	11.16	11.52	8.51
British Columbia	11.93	11.33	16.28
Manitoba	3.67	3.86	2.35
English/French is mother tongue	87.54	95.82	27.83
Working in unskilled occupations	74.56	75.44	68.69
Immigration period 1990-2001			53.88
Immigration period 1980-1989			22.80
Immigration period 1970-1979			17.57
Immigration period 1960-1969			5.76
Observations	5,797,356	5,117,249	680,107

Source: Canadian 2001 census. With the exception of age, years of schooling, wages & salaries and potential total experience which are continuous variables, the mean of all other variables represent the percentage of individuals belonging to each sub-category. All statistics are weighted using the sampling weight available in the census.

Table 2. Average annual wages and years of schooling by country of origin

Country	Average annual earnings	Average years of schooling	Obs.
Canada	43656	13.51	5100605
USA	66549	16.62	27210
El Salvador	27184	12.4	6661
Guatemala	27097	12.2	2205
Mexico	28267	11.7	6623
Nicaragua	28866	14.8	1552
Barbados	43856	13.6	2303
Cuba	26637	16.5	1277
Dominican Republic	24978	12.7	674
Grenada	31450	12.6	1268
Haiti	26306	13.2	6723
Jamaica	35346	12.6	14774
Trinidad and Tobago	41427	14	9769
Argentina	40387	14.9	2252
Brazil	50591	16.3	2075
Colombia	39231	16.3	2776
Ecuador	34141	13.1	1589
Guyana	37451	13.5	13090
Paraguay	34291	10.7	478
Peru	32458	15.7	2901
Uruguay	36338	13.5	1010
Venezuela	38602	16.12	1046
Austria	62692	15.1	996
Belgium	55212	16	1597
France	45858	16.1	13231
Germany	53271	15.27	12473

Netherlands	54019	15.5	4896
Switzerland	56877	15.4	2722
Bulgaria	34071	16.7	1976
Czechoslovakia	49361	15.8	1258
Hungary	40703	14.9	3023
Poland	42762	15.15	26263
Romania	43352	16.6	12568
U.S.S.R	40686	17	1051
Russian Federation	37767	16.6	7967
Ukraine	35292	16.6	5455
Ireland	69644	15.5	2561
U.K	66708	15.6	55758
Denmark	61246	14.7	956
Finland	58404	14.4	650
Norway	85377	16.12	484
Sweden	64950	15.4	838
Bosnia and Herzegovina	32354	14.2	5155
Croatia	42111	13.5	4683
Greece	32823	10.8	5722
Italy	40024	9.7	13786
Portugal	36828	7.6	17960
Slovenia	45789	13.2	526
Spain	44549	14.14	1369
Yugoslavia	42932	15	9469
Ghana	34821	14.9	4173
Nigeria	34595	17.2	2587
Algeria	30950	17.4	4913
Egypt	50623	17.7	6597
Morocco	34502	16.3	4375
Sudan	27398	15.8	1279
South Africa	74535	16.8	6628

Iran	34013	16.5	13629
Turkey	35772	13.5	2841
Iraq	34586	14.3	4569
Israel	53050	15.3	1946
Syria	37897	14.8	2290
China	29880	15.1	55370
Hong Kong	41107	14.8	31594
Japan	65145	15.7	3795
Korea, South	30280	16.07	8618
Taiwan	32431	16.2	5806
Indonesia	40277	16.7	1312
Malaysia	47194	15.6	3676
Philippines	33049	15.2	39238
Singapore	48588	16	1488
Bangladesh	25422	16.2	4872
India	37043	14.7	62426
Pakistan	31909	15.7	15730
Sri Lanka	30061	13.6	20314
Australia	64818	15.9	3229
Fiji	32613	12.5	3371
New Zealand	59576	15.7	1789

Source: Author's calculations based on data from Canadian 2001 census. All statistics are weighted using the sampling weight available in the census.

Table 3. Estimates for return to schooling by country of origin-

	Estimated Return	Estimates from schooling quality production function		
		Predicted return without parental factors	Predicted return with parental factors "un-weighted"	Predicted return with parental factors "weighted"
Argentina	6.12	5.92	5.87	5.19
Australia	7.34	6.57	6.53	6.52
Austria	5.74	6.87	6.51	6.76
Bangladesh	6.32	4.46	4.64	5.71
Barbados	5.36	6.10	6.03	6.34
Belgium	8.07	6.48	6.40	6.18
Brazil	5.25	5.67	5.04	4.88
Bulgaria	5.68			
Canada	7.06	6.90	6.88	7.03
China	6.72	6.07	6.52	6.56
Colombia	6.08	5.44	5.33	5.63
Cuba	5.65			
Czechoslovakia	7.15	6.00		5.50
Denmark	8.26	7.47	7.58	7.23
Dominican Rep.	2.44	4.54	4.56	5.93
Egypt	6.83	6.17	6.15	7.18
El Salvador	2.89	4.82	4.82	6.58
Fiji	6.49	5.94	6.32	6.55
France	7.62	6.14	5.76	5.82
Germany, West	5.64	6.92	6.61	7.38
Ghana	5.66	5.47	5.56	5.43
Greece	5.97	5.53	5.32	5.61
Grenada	4.85	5.72		
Guatemala	5.48	5.01	4.52	4.96
Guyana	5.73	5.55	5.94	5.90
Haiti	4.77	5.33	5.17	6.34
Hong Kong	8.74	6.22	6.11	6.92
Hungary	7.17	6.18	6.46	5.43
India	6.72	5.03	5.12	5.85
Indonesia	6.31	5.64	5.68	5.76
Iran, I.R. of	6.96	6.17	5.63	6.48
Iraq	6.87			
Ireland	5.63	5.67	6.04	6.01
Israel	7.05	7.11	7.08	7.09
Italy	3.30	6.86	6.63	6.80
Jamaica	5.56	5.68	5.72	6.11
Korea	5.71	4.95	5.33	6.84

Malaysia	7.47	6.16	6.23	6.85
Mexico	5.77	5.19	5.08	6.41
Morocco	6.66	6.10	6.11	7.63
Netherlands	6.40	6.54	6.61	7.17
New Zealand	5.69	6.89	7.29	6.99
Nicaragua	1.66	5.35	5.26	6.06
Nigeria	6.49			
Norway	6.61	7.30	7.38	6.58
Pakistan	5.32	4.52	4.38	4.67
Peru	4.99	5.34	5.39	6.16
Philippines	4.02	5.30	5.52	5.13
Poland	4.60	6.24	6.46	6.01
Portugal	3.03	6.05	5.72	5.40
Romania	6.88	5.45	5.42	4.51
South Africa	8.97			
Sri Lanka	7.17	5.85	6.63	6.30
Sudan	4.14	5.66	5.56	6.30
Sweden	6.76	7.13	7.18	7.41
Switzerland	11.50	6.86	6.89	7.64
Syria	3.12	6.12	6.05	6.97
Taiwan	6.39			
Trinidad & Tobago	6.69	6.20	6.43	6.88
Turkey	6.87	5.85	5.57	6.20
U.S.S.R.	4.65			
United Kingdom	6.45	6.66	6.62	6.56
United States	6.16	6.49	6.48	6.48
Venezuela	4.47	5.62	5.27	5.66
Yugoslavia	5.32	5.24		

Source: Author's calculations based on data from Canadian 2001 census. All results are weighted using the sampling weight available in the census.

Table 4. Returns to Canadian and foreign-obtained schooling for different specifications of the earnings function

	Canadian return	Average foreign return
Baseline specification	7.06	5.9
Second specification	7.08	5.7
Third specification		
Immigration period 1990-2001	7.05	6.4
Immigration period 1980-1989		5.9
Immigration period 1970-1979		5.1
Immigration period 1960-1969		4.7
Fourth specification		
Unskilled occupations	5.1	4.3
Skilled occupations	6.6	5.7

Standard deviations are in parentheses. In the second specification, I restrict the analysis to immigrants whose age at immigration is more than 30 years. I allowed the returns to schooling to vary by immigration cohort (in the third specification) and by the occupational skill level (in the fourth specification).

Table 5. Estimates for schooling quality production function

	Model 1	Model 2	Model 3	Model 4	Model 5
Educational inputs					
Pupil- Teacher ratio at primary schools	-0.0372	-0.0263	-0.0247	-0.0265	-0.0340
	(0.0279)	(0.0468)	(0.0305)	(0.0470)	(0.0317)
Log real government educational expenditure per pupil at primary schools	0.346	0.389	0.447	0.336	0.550***
	(0.239)	(0.612)	(0.424)	(0.584)	(0.159)
Number of school days per year at primary schools	0.0220*	0.0219*	0.0257	0.0220	0.0412***
	(0.0123)	(0.0123)	(0.0162)	(0.0228)	(0.0120)
Log real salary of primary school teachers		0.194		0.611	
		(0.646)		(0.623)	
Parental factors					
Average years of schooling			0.177	0.142	0.0607
			(0.159)	(0.165)	(0.160)
Log real per capita GDP			-0.296	-0.527	
			(0.435)	(0.367)	
Constant	0.685	-1.638	0.924	-1.041	-6.314*
	(3.217)	(4.592)	(4.586)	(6.779)	(3.310)
Observations	58	45	55	43	56
R-squared	0.192	0.227	0.215	0.261	0.386

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Under Model 5, schooling quality production function was estimated using weighted least square, with the number of individuals from each source country is used as a weight.

Table 6. Quality adjustment indices and over-education rates by country of origin.

	Quality adjustment index	Over-education prevalence	
		Before adjustment	After Adjustment
Algeria	1.185	80.05	94.4
Argentina	0.869	63.06	35.52
Australia	1.042	61.85	79.28
Austria	0.815	62.65	35.34
Bangladesh	0.898	74.73	63.71
Barbados	0.761	47.29	14.33
Belarus	0.668	72.65	10.86
Belgium	1.146	62.62	90.73
Bosnia and Herzegovina	0.756	54.61	20.72
Brazil	0.746	63.95	18.65
Bulgaria	0.807	71.1	41.45
Canada	1.000	43.47	43.47
Chile	1.256	67.79	94.39
China	0.955	55.07	54.88
Colombia	0.864	74.24	51.12
Croatia	0.756	50.12	18.15
Cuba	0.803	78.07	48.55
Czech Republic	1.016	72.59	85.52
Czechoslovakia	1.016	64.86	85.61
Denmark	1.173	60.67	83.05
Egypt	0.970	79.41	79.41
Fiji	0.922	38.45	27.97
Finland	0.626	52.31	2.46
France	1.083	65.43	83.23
Germany	0.801	60.36	32.61
Ghana	0.804	66.79	34.51
Greece	0.848	29.88	15.85
Grenada	0.689	44.24	1.42
Guatemala	0.778	46.3	23.36
Guyana	0.814	50.15	22.73
Haiti	0.678	54.29	7.82
Hong Kong	1.241	54.71	90.1
Hungary	1.019	61.63	81.41

India	0.954	58.91	58.59
Indonesia	0.896	73.78	58.46
Iran	0.988	71.5	71.5
Iraq	0.976	59.42	59.42
Ireland	0.800	54.71	19.45
Israel	1.002	54.83	78.31
Italy	0.469	24.27	0
Jamaica	0.790	41.33	11.7
Japan	0.554	67.4	0.69
Korea, South	0.811	69.96	47.73
Malaysia	1.061	60.96	78.78
Malta	0.270	46.58	0
Mexico	0.820	41.42	22.12
Morocco	0.946	71.84	70.93
Netherlands	0.909	65.89	52.1
New Zealand	0.808	57.57	26.38
Nigeria	0.921	81.06	67.45
Norway	0.938	60.54	54.96
Pakistan	0.756	67.13	34.28
Peru	0.709	77.15	28.06
Philippines	0.571	71.25	0.81
Poland	0.653	68.52	5.27
Portugal	0.430	10.75	0
Romania	0.977	64.68	64.68
Russian Federation	0.668	67.2	9.98
Singapore	0.588	62.3	1.48
Slovakia	1.016	73.1	86.98
South Africa	1.274	64.54	97.24
Spain	0.670	54.71	7.52
Sri Lanka	1.019	52.46	72.74
Sudan	0.588	69.43	3.44
Sweden	0.960	64.92	64.92
Switzerland	1.634	68.19	98.97
Syria	0.443	62.75	0.35
Taiwan	0.908	65.79	54.13
Trinidad and Tobago	0.950	55.33	55.12
Turkey	0.976	44.6	44.6
U.S.S.R	0.661	68.51	11.80
UK	0.917	58.03	44.52
Ukraine	0.661	73.51	9.22
USA	0.875	58.16	40.03

Venezuela	0.635	74.09	4.88
Yugoslavia	0.756	57.13	21.79

Source: Author's calculations based on data from Canadian 2001 census. All results are weighted using the sampling weight available in the census.

Essay 3
The effect of graphic cigarette warning labels on smoking behavior: Evidence from the Canadian experience

Abstract

There is a substantial literature that graphic health warnings on cigarette packs are effective tobacco control measure, however, there is limited evidence based on actual smoking behavior. The objective of this paper is to assess the effect of graphic cigarette warning labels on smoking prevalence and quit attempts. A nationally representative sample of individuals aged 15 years and older from the Canadian National Population Health Survey (1998-2008) is used. The sample consists of 4,853 individuals for the smoking prevalence regression, and 1,549 smokers for quit attempts. The Generalized Estimating Equations (GEE) model is used to examine the population-averaged (marginal) effects of tobacco graphic warnings on smoking prevalence and quit attempts. To assess the effect of graphic tobacco health warnings on smoking behavior, we use a scaled variable that takes the value of zero for the first six months in 2001, then increases gradually to one starting from December, 2001. We find that graphic warnings have a statistically significant association with lower smoking prevalence and increased quit attempts. In particular, the warnings are associated with lower odds of being a smoker (Odds ratio [OR] = 0.875, CI = 0.821-0.932) and increased odds of making a quit attempt (OR = 1.330, CI = 1.187-1.490). Similar results are obtained when we allow for more time for the warnings to appear in retail outlets. This study adds to the growing body of evidence on the effectiveness of graphic warnings. The findings suggest that warnings have a significant effect on smoking prevalence and quit attempts in Canada.

Keywords*: Graphic Cigarette Warning, Quit Attempts, Smoking Prevalence, Panel Data.*

1. Introduction

The adverse health effects of tobacco use are well established (Center for Disease Control and Prevention, 2008). Globally, annual smoking attributable deaths are estimated to be 6 million, with 600,000 nonsmokers exposed to environmental tobacco smoke (World Health Organization [WHO], 2011). In Canada, smoking is the leading cause of premature and preventable mortality. It is responsible for more than 45,000 deaths and a total economic burden of $15 billion per year (Health Canada, 2002). To address the rising smoking epidemic, the WHO Framework Convention on Tobacco Control (FCTC) requires member countries to implement measures aimed at reducing the demand for tobacco products (WHO, 2008). Article 11 of the FCTC provides guidelines for warning messages on cigarette packages. It recommends the use of rotating, large, clear, and visible graphic warning messages and it should cover 50% or more of the principal display areas of the package (WHO, 2008). As of June 2011, more than 40 countries have implemented similar warning messages (Tobacco Free Center, 2011).[64]

In line with the global effort to address the rising smoking epidemic, the Government of Canada implemented several measures to discourage smoking. In January 2001, Canada became the first country in the world to enforce graphic health warning labels on cigarette packages. The warnings occupied 50% of the principal display area and appeared in English and French on both sides of the package. [65]

Externality in the form of nonsmokers' exposure to tobacco smoke, lack of self-control, and imperfect knowledge of the health risks of tobacco use are widely used to

[64] See Table 1 for a list of countries that have implemented graphic warnings as of June 2011.
[65] See Figure 1 for a comprehensive overview of the 16 graphic warnings that were implemented under the Tobacco Products Information Regulations.

justify the need for intervention measures (Chaloupka and Warner, 2000). Some smokers are unaware of the health risks of tobacco use (WHO, 2011), and graphic warnings have been documented as a useful channel for informing individuals about the health hazards of smoking. A one pack-per- day smoker is exposed to graphic warnings up to 20 times a day (Hammond, 2011).

Several studies have assessed the effectiveness of graphic warnings in discouraging smoking (For a recent review of the literature, see Hammond, 2011). Evidence from population-based surveys, together with empirical research, shows that graphic warnings- particularly large, prominent and comprehensive warnings- are effective in discouraging smoking initiation (European Commission, 2009; Vardavas et al., 2009) and encouraging smoking cessation (Hammond et al., 2003; Miller et al., 2009). A number of Canadian studies find that pictorial cigarette health warnings are effective (e.g., Health Canada, 2001; Hammond et al., 2003; Hammond et al., 2004). Empirical evidence from other countries (e.g., Health Promotion Board, 2004; Nascimento et al., 2008; Webster and Wakefield, 2008; Vardavas et al., 2009; Miller et al., 2009; Li and Grigg, 2009) and cross-country studies (e.g., Hammond et al., 2006; Givel, 2007; Hammond et al., 2007; Borland et al., 2009) have shown that graphic health warnings are effective. For example, in Australia, Miller et al. (2009) noted that the call volume to the help quit line increased following the introduction of warning messages on cigarette packs. In Singapore, 47% of smokers reported decreased cigarette consumption after pictorial warning labels were introduced (Health Promotion Board, 2004)

Research has shown that graphic warnings were more effective than text-only messages. Graphic warnings induced a greater emotional response, were more likely to

retain their salience over time, and increased awareness of health risks, compared with text warnings (Hammond et al., 2006; Hammond, 2011). Similarly, cross-country studies found that large and graphic health warning images were more effective in stimulating cognitive reactions (i.e., quit intentions as a result of increased knowledge of the health risks of smoking) compared with text-only warnings (Hammond et al., 2006; Hammond et al., 2007; Borland et al., 2009). Givel (2007) compared Canadian cigarette pictorial warning labels to the United States' text-only messages and found Canadian pictorial labels to be more effective in promoting smoking cessation.

There is also evidence that graphic warnings supplement other tobacco-control measures to discourage smoking. For example, Chang et al. (2011) found that the implementation of Taiwan's graphic cigarette warning labels, in combination with smoke-free laws, were effective in increasing awareness of the harmful effects of smoking and thoughts of cessation. Similarly, Brennan et al. (2011) found evidence of complementary effects between graphic warnings and television advertisement in increasing the knowledge of the health risks of smoking and motivating smoking cessation in Australia.

There is a substantial literature that graphic health warnings on cigarette packs are effective tobacco control measure; however, there is limited evidence based on actual smoking behavior. Previous studies have relied on respondents answers to questions about the graphic health warnings to determine their effectiveness. Some of the measures of effectiveness include desire to quit, increased health knowledge of tobacco risks, ability to recall the messages, and self reported effectiveness. Although these measures may predict future behavior, subjects tend to provide logical responses to questions that

involve an appeal to fear. These answers may not reflect actual behavior, and hence may not provide an objective assessment of the effect of graphic warnings (Hastings et al., 2004; Ruiter and Kok, 2005).

Accordingly, this study takes a different approach by using survey data that have smoking-related information without any health warning questions. The objective of this paper is to assess the effect of graphic cigarette warning labels on actual smoking behavior. We used longitudinal data from the Canadian National Population Health Survey (NPHS, 1998-2008), which covers both pre- and post policy periods.

The structure of this paper is as follows: in Section 1.2, we present a brief background on the economic rationale models for intervention and the tobacco control policy environment in Canada. Section 1.3 describes the data and methodology. Section 1.4 presents the results and conclusions are provided in Section 1.5.

2.1. Economic Rationale Models for Intervention

Economists have formulated models to explain the rationale for addictive consumption. The general point of reference is the rational addiction (RA) model of Becker and Murphy (BM) (1988). In this model, consumers optimally make smoking decisions with knowledge of the health consequences of tobacco use, the addictive nature of cigarette smoking and all the monetary costs. Therefore, government legislation that mandates health warnings will be of no use in the BM model. A central assumption of the RA framework is time consistency, that is to say, future preferences coincide with the current decision to smoke.

In contrast to the time consistent preferences in the RA model, the behavioral economics literature uses hyperbolic discounting to characterize consumers' preferences

for addictive goods as time inconsistent[66]. Smokers in this framework place a higher value to immediate gratification, hence, significantly discount the long-term negative impact. O'Donoghue and Rabin (1999; 2002), and Gruber and Koszegi (2001) showed how time-inconsistent behavior depends on perceived future beliefs of self-control. Naive agents tend to overestimate their ability to control future behavior while sophisticated agents fully understand future self-control problems. Due to the incentive effect, sophisticated smokers are more likely to refrain from smoking than naive smokers.[67] Gruber and Koszegi suggested that government intervention in the tobacco market should not be limited to externalities (costs that smokers impose on others) but should also include smoking internalities. Self control and failure to attain a desired future level of smoking are the two key features that separate time-consistent from time-inconsistent agents. Hersh (2005) argued that smokers' support for government regulations on restricting smoking in public areas is an indication of the lack of self control among smokers. Bernheim and Rangel (2004; 2005) argued that addictive goods can sometimes interfere with the decision part of the brain, and lead to wrong "cue-conditioned" craving. The implication is that provocative counter-cue policies, like graphic cigarette health warnings, may moderate neurotic behavior but their impact is limited on smokers that are "neurologically sensitized" to nicotine.

Until recently, the impact of health warnings (text only messages) on tobacco consumption was embedded in the advertising bans literature. The effect of tobacco advertising on tobacco consumption has remained a contentious public health concern.

[66] O'Donoghue and Rabin (1999) described time inconsistent preferences as 'present-biased preferences'

[67] Incentive effect here refers to a situation where sophisticated smokers refrain from current consumption in order to prevent future indulgence, see O'Donoghue and Rabin (2002) for details.

There is mixed empirical evidence from studies that examined the effects of the tobacco advertising ban on consumption. For example, Saffer and Chaloupka (2000) and Blecher (2008) used cross-country data and found that the tobacco advertising ban is effective in reducing cigarette consumption while Nelson (2003) found advertising bans to be ineffective. The mixed results in the tobacco advertising literature is largely due to the varying level of advertising ban in different countries and the difficulty in defining a ban variable that truly reflects these levels.

2.2. Canadian Tobacco Control Policy Environment

The Canadian health warning labels started with four rotating text messages, covering 20% of the front and back of the package, in English and French, under the federal law of 1989. Subsequently, there has been an increase in the number of messages. In 1994, a new set of eight rotating black-and-white text-warning messages, occupying 35% of the front and back of the package were implemented (Cismaru and Lavack, 2007; Non Smokers' Rights Association). In 1995, the Supreme Court of Canada removed the legal basis for imposing these warnings. It was not until 1997 when the parliament passed the Tobacco Act that the government got the right to regulate the packaging of cigarettes. The Tobacco Act of 1997 enforced a set of regulations concerning advertising and packaging of tobacco products. In June 2000, the Tobacco Products Information Regulations (TPIR) under the Tobacco Act became a law, and tobacco companies were given a grace period until the end of December 2000 to add the new warning labels. The new regulation mandated the display of one of 16 different-colored graphic warnings on at least 50% of the principal display area. It appears in English and French on both sides of the package. The regulation also mandated the inclusion of messages inside the

package about the health risks of smoking and messages to help smokers quit (Health Canada, 2000). Since then, the warning message labelling on tobacco products became an integral component of a comprehensive tobacco-control strategy to discourage smoking. Parallel to the introduction of the Canadian graphic warnings, there has been a substantial increase in cigarette taxes both at the federal and provincial levels, which resulted in higher cigarette prices. In April 2001, the Federal Tobacco Control Strategy proposed raising tobacco taxes, in addition to other measures, to reduce smoking and exposure to secondhand smoke (Health Canada, 2002). This triggered a sequence of tax hikes. At the federal level, the excise tax was first raised to $10.99 per carton in May 2001, and then to $12.62 by the end of 2001. In mid-2002, the federal tax was further raised to $13.86 per carton and then to $15.85 in July 2002 (Gabler and Katz, 2010).

Canadian provinces followed the federal government and increased their taxes on cigarettes, but by different magnitudes. For example, between 2000 and 2003, real cigarette taxes almost doubled in Ontario, Alberta, New Brunswick, and Nova Scotia. Taxes increased by 83% in Quebec, 70% in Manitoba and Saskatchewan, 45% in British Columbia, and 37% in Newfoundland. After 2003, nominal taxes were subject to small increases to offset the impact of inflation.

In line with the Federal Tobacco Act, Canadian provinces implemented legislation to ban smoking in public places and workplaces (Health Canada, 2007). In January 1, 2005, the Saskatchewan Tobacco Control Act banned smoking in all enclosed public places, including restaurants, bars, and casinos. This was followed by the Newfoundland and Labrador Smoke-free Environmental Act in July 1, 2005. In January 1, 2006, Alberta enforced its Smoke-free Places Act. The Smoke-free Ontario Act and Quebec's Tobacco

Act became effective on May 31, 2006. Nova Scotia enforced its Smoke-free Places Act on December 1, 2006. In January 2008, British Columbia enforced legislation for banning smoking throughout the province (Shields, 2007).

Though the Tobacco Act of 1997 called for banning tobacco advertising, it continued to allow point-of-sale display of tobacco products, as well as sponsorship promotion by tobacco companies. As of October 1, 2003, tobacco companies were prohibited from using the sponsorship of cultural and sports events as an avenue to advertise their tobacco products. Tobacco companies tried to get around these restrictions by using retail stores as a channel to promote tobacco products (Cohen et al., 2008). To address this challenge, the point-of-sale displays of tobacco products were the target of provincial policies. Saskatchewan was the first province to adopt a display restriction in 2002, but the policy was struck down after a challenge from tobacco companies. Since then, all Canadian provinces have implemented a display ban, beginning with Manitoba (2004), followed by Saskatchewan (2005), Prince Edward Island (2006), Nova Scotia (2007), British Columbia, Ontario, Quebec and Alberta (2008), New Brunswick (2009), and Newfoundland and Labrador (2010) (The Ontario Tobacco Research Unit, 2010).

3. Methodology

3.1. Data

This study used nationally representative data from the Canadian NPHS. A detailed description of the NPHS has been documented elsewhere (Statistics Canada, 2009). Briefly, the NPHS is a longitudinal dataset that contains information on each respondent's health-related characteristics, as well as corresponding economic and socio-demographic variables. The first cycle of the NPHS was conducted in 1994/1995 and, since then, respondents have been re-interviewed every two years. We used balanced

panel data from Cycle three (1998/1999) to Cycle eight (2008/2009) and the sample is restricted to the adult population aged 15 years and older. The sample consisted of 4,853 individuals, resulting in 29,118 person-year observations for smoking prevalence, whereas for quit attempts, there were 1,549 smokers and 6,269 person-year observations.

3.2. Measures

Outcome Variables: Smoking Behavior. We used two self-reported measures of smoking behavior: smoking prevalence and quit attempts. Smoking prevalence is derived from participants' responses to the survey question, "At the present time do you smoke cigarettes daily, occasionally or not at all?" We created a dichotomous indicator for smoking status, which takes the value of 1 if an individual reported smoking cigarettes daily or occasionally; and zero otherwise. If daily and occasional smokers reported trying to quit smoking in the past six months, they were assigned the value one, indicating a quit attempt; otherwise a zero was recorded.

We did not examine the intensity of smoking. This is normally measured by the number of cigarettes consumed. Recent evidence suggested that the quantity smoked does not necessarily reflect the actual intensity of smoking (Farrelly et al., 2004; Adda and Cornaglia, 2006). Smokers may reduce the quantity of cigarettes smoked but increase the intensity with which they smoke each cigarette. Moreover, in response to higher cigarette prices, Farrelly et al. (2004) found that some smokers increased tar and nicotine intake in order to compensate for a reduction in the quantity of cigarettes smoked. Unfortunately, the level of nicotine intake is not available in the NPHS.

Graphic Warnings Variable. To assess the effect of graphic tobacco health warnings on smoking behavior, we created a policy variable to capture pre-and post policy periods

using three approaches. First, we used a dichotomous indicator that takes the value of one starting from July, 2001 onward and zero otherwise. July 2001 is used as the starting point to capture the period when graphic warnings were prevalent in retail shops. In the second approach, we allowed more time for the policy to take effect by creating a dummy variable that takes the value of one starting from December 2001 onward and zero otherwise. Third, we used a scaled variable that takes the value of zero for the first six months in 2001, then increases gradually to one starting from December, 2001 (the following scale was used: 0.1 for July 2001; 0.3 for August; 0.5 for September; 0.7 for October, and 0.9 for November).

Control Variables. We included the following standard covariates in the analyses: gender; age groups: 15-24 (reference group= ref), 25-34, 45-64, and 65 or older; educational attainment: less than secondary (ref), secondary, some post-secondary and post secondary; household income in quartiles adjusted for the household size: low income (ref), low-middle income, high-middle income, and high income; marital status: single (ref), separated or widowed, and married; household size; employment status; employed (ref) and unemployed; immigration status: non-immigrant (ref) and immigrant; workplace smoking bans: no ban (ref), partial ban, and full ban; and province of residence. The analysis also controlled for cigarette prices. We constructed a yearly average of cigarette prices from 1998 to 2009 using the monthly cigarette price index for each province from the Canadian Socioeconomic Information Management System (CANSIM) and the provincial nominal cigarette prices, as of March 31, 2006, from the Non-Smokers' Right Association (Non-Smokers' Rights Association, 2006). To obtain

the inflation-adjusted cigarette price, the province-specific consumer price index obtained from CANSIM was used to deflate the nominal cigarette prices.

Following Herrick (2000), Fagan et al. (2007) and Kahende et al. (2011), we used a standard set of variables including a proxy for nicotine dependence in the quit attempt analysis. For our measure of nicotine dependence among smokers, we used the time to the first cigarette after waking and the average number of cigarettes smoked per day. Previous studies using structural equation modeling have shown both these as good measures for nicotine dependence (Richardson and Ratner, 2005; Nonnemaker and Homsi, 2007). We used three categories for quantity smoked: less than 11 (ref); 11 to 19; and 20 or more cigarettes per day. The time to first cigarette after waking was categorized: within 30 minutes (ref); 31 to 60 minutes; and more than 60 minutes.

3.3. Statistical Analysis

A generalized estimating equation (GEE) model was used to examine the population-averaged (marginal) effects of tobacco graphic warnings on smoking prevalence and quit attempts. In an extension to generalized linear models, Liang and Zeger (1986) proposed the GEE approach to account for correlated responses in longitudinal data.[68] The estimating equations are derived from a working generalized linear model for the marginal distribution of $y_{i,j}$ without specifying a form for the joint distribution of individual repeated observations. Liang and Zeger showed that the GEE approach gives

[68] According to Zeger et al. (1988) pg.1051 "an advantage of population-averaged models is that the population-averaged response for a given covariate, $x_{i,j,}$ is directly estimable from observations without assumptions about the heterogeneity across individuals in the parameters. Population-averaged parameters are in the sense one step closer to the data than individual parameters".

consistent estimates of the regression parameters and of their variances under weak assumptions about the joint distribution.[69]

Following Liang and Zeger (1986), the marginal density for of $y_{i,j}$ is represented as

$$f(y_{i,j}) = \exp[\{y_{i,j}\theta_{i,j} - a(\theta_{i,j}) + b(y_{i,j})\}\phi] \quad (1)$$

where

i denotes individuals, for $i = 1, \ldots\ldots, N$

j denotes time, for $j = 1, \ldots\ldots, t$

$\mathbf{y}_i$ are the outcome values

ϕ is the dispersion parameter

$\theta_{i,j}$ equals $h(\eta_{i,j})$

$\eta_{i,j}$ equals $x_{i,j}\beta$

$x_{i,j}$ are the explanatory variables

Under this specification, the first two moments of $y_{i,j}$ are given by

$$E(y_{i,j}) = a'(\theta_{i,j}) \quad (2)$$

$$Var(y_{i,j}) = a''(\theta_{i,j})/\phi \quad (3)$$

The GEE model for a binary outcome using logit as the link function can be expressed in the following form;

$$\text{logit } P\left(\frac{E(y_{i,j})}{1-E(y_{i,j})}\right) = \mathbf{x}_{i,j}\beta \quad (4)$$

$$E(y_{i,j}) = \mu_{i,j} \quad (5)$$

$$Var(y_{i,j}) = \mu_{i,j}(1 - \mu_{i,j}) \quad (6)$$

[69] See Liang & Zeger (1986) for detailed discussion on the regularity conditions.

where $y_{i,j}$ denotes a binary measure for the two dependent variables of interest in the study;

(a) Smoking prevalence (i.e. smoking, 0 = no and 1 = yes)

(b) Quit attempt (i.e. tried to quit smoking, 0 = no and 1 = yes)

The solution to the GEE score equation can be written as

$$\mathbf{U}(\beta) = \sum_i^m \frac{\delta\mu_i}{\delta\beta} V_i^{-1}(\alpha)\left(y_i - \mu_i\right) = 0 \quad (7)$$

$$V_i(\alpha) = A_i^{1/2} R(\alpha) A_i^{1/2} \quad (8)$$

where A_i is a diagonal matrix of variance functions $v(\mu_{i,j})$, the dependency between repeated observations can be accounted for by using different within-panel correlation structure, $R(\alpha)$. This correlation structure may depend on a vector of unknown parameters, is assumed to be the same for all individuals. The GEE treats the covariance structure as a nuisance and an average dependence is assumed by specifying a "working" correlation matrix. In this study, we briefly describe the three most often used working correlation structures: exchangeable (also known as equal correlation or compound symmetry); autoregressive (AR1) and unstructured (unrestricted) correlation.[70] The GEE estimates are robust to misspecification of the within-panel correlation structure.[71]

3.3.1. Exchangeable Correlation

An exchangeable correlation assumes equal correlations across repeated measures. The working correlation matrix takes the following form;

[70] Other forms of working correlation structure are independent, stationary and non-stationary.
[71] See Liang & Zeger (1986); Hardin & Hilbe (2003) for detailed discussion.

$$R(\alpha) = \begin{bmatrix} 1 & \alpha & \alpha & \cdots & \alpha \\ \alpha & 1 & \alpha & \cdots & \alpha \\ \alpha & \alpha & 1 & \cdots & \alpha \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \alpha & \alpha & \alpha & \cdots & 1 \end{bmatrix} \tag{9}$$

which can be written as:

$$R_{s,t} = \begin{cases} 1 & \text{if } s = t \\ \alpha & \text{otherwise} \end{cases} \tag{10}$$

The ancillary correlation parameter, α, is estimated using model fit Pearson residuals, $\hat{r}_{i,j}$.

$$\hat{r}_{i,j} = \frac{(y_{ij} - \hat{\mu}_{i,j})}{\sqrt{V(\hat{\mu}_{i,j})}} \tag{11}$$

$$\hat{\alpha} = \frac{\left\{ \sum_{i=1}^{m} \left(\frac{\sum_{j=1}^{n_i} \sum_{k=1}^{ni} \hat{r}_{i,j} \hat{r}_{i,k} - \sum_{j=1}^{ni} \hat{r}_{i,j}^2}{n_i (n_i - 1)} \right) \right\}}{G} \tag{12}$$

$$G = \frac{\sum_{i=1}^{m} \sum_{j=1}^{ni} \hat{r}_{ij}^2}{\sum_{i=1}^{m} n_i} \tag{13}$$

3.3.2. Autoregressive Correlation

Autoregressive working correlation assumes that repeated observations depend on their past values in systematic order. A first-order autoregressive process is commonly used. The correlation structure requires k parameters to be estimated such that α has a vector of length $k + 1$.[72]

$$\hat{\alpha} = \frac{\left[\sum_{i=1}^{m} \left(\frac{\sum_{j=1}^{n_i} \hat{r}_{i,j}^2}{n_i}, \frac{\sum_{j=1}^{n_i - 1} \hat{r}_{i,j} \hat{r}_{i,j+1}}{n_i}, \ldots, \frac{\sum_{j=1}^{n_i - k} \hat{r}_{i,j} \hat{r}_{i,j+k}}{n_i} \right) \right]}{W} \tag{14}$$

$$W = \sum_{i=1}^{m} \frac{\sum_{j=1}^{n_i} \hat{r}_{i,j}^2}{n_i} \tag{15}$$

where the Pearson residuals is defined in equation (11).

The working correlation structure is given by

[72] Where the first element of α is 1.

$$R_{s,t} = \begin{cases} \alpha_1 |s-t| & \text{if } |s-t| \leq k \\ 0 & \text{otherwise} \end{cases} \quad (16)$$

3.3.3. Unstructured Correlation

Unstructured correlation uses the unconstrained correlation matrix. The working correlation model can be written as

$$R_{s,t} = \begin{cases} 1 & \text{if } s = t \\ \alpha_{s,t} & \text{otherwise} \end{cases} \quad (17)$$

$$\alpha = \frac{\begin{bmatrix} N_{1,1}^{-1}\hat{r}_{i,1}^2 & N_{1,2}^{-1}\hat{r}_{i,1}\hat{r}_{i,2} & \cdots & N_{1,n}^{-1}\hat{r}_{i,1}\hat{r}_{i,n} \\ N_{2,1}^{-1}\hat{r}_{i,2}\hat{r}_{i,1} & N_{2,2}^{-1}\hat{r}_{i,2}^2 & \cdots & N_{2,n}^{-1}\hat{r}_{i,2}\hat{r}_{i,n} \\ \vdots & \vdots & \ddots & \vdots \\ N_{n,1}^{-1}\hat{r}_{i,n_i}\hat{r}_{i,1} & N_{n,2}^{-1}\hat{r}_{i,n_i}\hat{r}_{i,2} & \cdots & N_{n,n}^{-1}\hat{r}_{i,n}^2 \end{bmatrix}}{W} \quad (18)$$

where

$$N_{p,q} = \sum_{i=1}^{m} I(i,p,q) \quad (19)$$

$$I(i,p,q) = \begin{cases} 1 & \text{if panel i has observations at indexes p and u} \\ 0 & \text{otherwise} \end{cases} \quad (20)$$

Pearson residuals and W are represented by equations (11) and (15) respectively.

$N_{i,j} = \min(N_i, N_j)$, $N_i =$ number of panels observed at time i, and $n = \max(n_1, n_2, \ldots . n_m)$

Separate analyses are performed using the three measures of graphic warnings. To determine if graphic health warnings, as a dichotomous variable, and cigarette prices in levels can be identified separately in the regression, we used a rule of thumb by estimating a variance inflation factor (VIF). A VIF of 7.64 is obtained when a graphic dummy is regressed on cigarette prices. The VIF thus confirms that there is sufficient independent price variation in the sample to identify the price effect in the analysis.

To check whether the analyses are sensitive to the inclusion of additional control variables, three model specifications are used. Model 1, the baseline specification, controlled for gender, age, educational attainment, income level, marital status, household size, employment status and immigration status. In addition to the baseline covariates in Model 1, Model 2 included workplace smoking bans and provincial fixed effects. In Model 3, we re-estimated Model 2 but restricted the sample to daily smokers.

Insert Table 2 here

Insert Figure 1 here

4. Results

Table 2 presents the characteristics of the respondents included in the study. Among the study sample, about half are male, a large percentage is 35 years and older, more than 80% are non immigrants. A significant proportion of the sample is well educated, with most (more than 70%) having completed more than secondary education. The trend of both smoking prevalence and smokers quit attempts from 1998 to 2008 are shown in Figure 1. For smoking prevalence, there has been a gradual decrease in the smoking participation rate. The percentage of smokers reporting past quit attempts increased between 1998 and 2002, with a significant drop in 2004 and 2008. Although there has been a decline in smoking prevalence in Canada, the largest decrease in smoking prevalence, and the largest increase in quit attempts for our study period occurred between 2000 and 2002 (see Figure 1). We cannot determine from the unconditional analysis whether the graphic warnings had any significant impact on smoking behavior during this period because there was also a major increase in cigarette taxes and hence prices. Tables 3 to 22 report the odds ratios (OR) and the corresponding 95% confidence intervals (CI) from the GEE regression for the smoking prevalence and quit attempts

respectively. The estimates from the GEE model are interpreted as population-average (marginal) effects rather than subject-specific effects.

4.1. Unstructured Working Correlation

4.1.1. Smoking Prevalence Results

The tobacco graphic cigarette warnings, represented by the scaled variable, had a statistically significant effect on smoking prevalence (see Table 3). The policy variable decreased the odds of being a smoker (OR = 0.875, CI = 0.821-0.932; Model 2). The graphic warnings also decreased the odds of being a daily smoker (OR = 0.868, CI = 0.809-0.931; Model 3). The results were similar when the policy dummy is defined to be one starting from July 2001, and zero otherwise (OR = 0.874, CI = 0.820-0.931; Model 2) and (OR = 0.864, CI = 0.805-0.927) (Model 3) (see Table 4). The results from the warnings variable, defined to be one starting from December 2001, indicated that warnings decreased the odds of being a smoker (OR = 0.875, CI = 0.821-0.932; Model 2) and the odds of being a daily smoker (OR = 0.869, CI = 0.810-0.931; Model 3) (see Table 5).

Insert Table 3 here

Insert Table 4 here

Insert Table 5 here

In terms of the other control variables (Table 3), those older (age 25-34: OR = 0.990, CI = 0.876 - 1.117; age 35-44: OR = 0.904, CI = 0.786 - 1.041; age 45-64: OR = 0.766, CI = 0.657 - 0.892; age 65+: OR = 0.587, CI = 0.493 - 0.698) and with a higher education status (except secondary)(some post secondary: OR = 0.863, CI = 0.737 - 1.010; post secondary: OR = 0.840, CI = 0.719 - 0.983) were less likely to be smokers compared to

their respective reference categories. Males were more likely to be smokers than females (OR = 1.156, CI = 1.025-1.304). The income variable showed the standard socioeconomic gradient in smoking, where those with higher income status were less likely to be smokers (low-middle income: OR = 0.936, CI = 0.865 - 1.014; high-middle income: OR = 0.888, CI = 0.812 - 0.971; high income: OR = 0.868, CI = 0.787 - 0.957). The odds of being a smoker were found to be lower for those who were married (OR = 0.842, CI = 0.759-0.934), immigrants (OR = 0.579, CI = 0.458-0.732), and had higher household size (OR = 0.984, CI = 0.962-1.001). Those separated or widowed (OR = 1.066, CI = 0.934-1.217) were more likely to be smokers than those who were single, and those employed (OR = 1.173, CI = 1.084-1.269) had higher odds of being smokers than those unemployed. Lower odds of smoking were associated with cigarette price (OR = 0.790, CI = 0.663-0.942) and full ban on workplace smoking (OR = 0.916, CI = 0.857-0.979).

4.1.2. Quit Attempts Results

The reported results in Table 6 indicated that graphic warnings, using a scale variable representation, had a positive and statistically significant effect on quit attempts among smokers. Graphic warnings increased the odds of making a quit attempt (OR = 1.330, CI = 1.187-1.490; Model 2). Among daily smokers, graphic warnings also increased the odds of making a quit attempt (OR = 1.331, CI = 1.175-1.508; Model 3). A similar result was obtained when the policy dummy is defined to be one starting from July, 2001 and zero otherwise (OR = 1.329, CI = 1.188-1.490; Model 2) (see Table 7). Using the warnings variable defined to be one starting from December 2001 indicated

that warnings increased the odds of making a quit attempt among daily smokers (OR = 1.332, CI = 1.176-1.508) (Model 3) (see Table 8).

Results for the other covariates revealed no statistically significant difference in the odds of attempting to quit by gender (male: OR = 0.961, CI = 0.808 - 1.143), income status; (low-middle income: OR = 1.047, CI = 0.843 - 1.300; high-middle income: OR = 0.985, CI = 0.787 - 1.234; high income: OR = 0.824, CI = 0.635 - 1.068), marital status (married: OR = 0.883, CI = 0.710 - 1.096; separated: OR = 0.922, CI = 0.720 - 1.181), household size (OR = 1.031, CI = 0.969 - 1.098), immigration status (immigrant: OR = 1.030, CI = 0.748 - 1.418), and workplace smoking bans (full ban: OR = 0.943, CI = 0.762 - 1.167; partial ban: OR = 0.898, CI = 0.725 - 1.113). Older adults and those employed were less likely to make a quit attempt (age 25-34: OR = 0.572, CI = 0.431 - 0.760; age 35-44: OR = 0.541, CI = 0.400 - 0.730; age 45-64: OR = 0.491, CI = 0.357 - 0.676; age 65+: OR = 0.398, CI = 0.257 - 0.617; employed: OR = 0.824, CI = 0.660 - 1.029). Immigrants (OR = 1.030, CI = 0.748 - 1.418) and the well educated (secondary: OR = 1.120, CI = 0.846 - 1.483; some post secondary: OR = 1.164, CI = 0.912 - 1.485; post secondary: OR = 1.194, CI = 0.935 - 1.524) were more likely to have attempted quitting smoking. The measure for nicotine dependence showed a statistically significant effect on quit attempt. Decreased odds of making a quit attempt were associated with consuming 20 or more cigarettes per day (OR = 0.561, CI = 0.478-0.658; Model 2) and between 11 and 19 cigarettes per day (OR = 0.690, CI = 0.597-0.798) compared with those consuming less than 11 cigarettes per day. Among daily smokers (reported in Table 6, Model 3), increased odds of making a quit attempt were associated with having the

first cigarette after waking between 31 and 60 minutes (OR = 1.166, CI = 0.991-1.371) and more than 60 minutes (OR = 1.050, CI = 0.876-1.259).

Insert Table 6 here

Insert Table 7 here

Insert Table 8 here

4.2. Exchangeable Working Correlation

4.2.1. Smoking Prevalence Results

When we changed the structure of the correlation matrix to be exchangeable, results were qualitatively similar to the unstructured specification in the previous subsection. In particular, the tobacco graphic cigarette warnings, represented by the scaled variable, had a statistically significant effect on smoking prevalence (see Table 9). The policy variable decreased the odds of being a smoker (OR = 0.867, CI = 0.812 - 0.926) (Model 2). The graphic warnings also decreased the odds of being a daily smoker (OR = 0.852, CI = 0.792 - 0.916) (Model 3). The results were similar when the policy dummy is defined to be one starting from July, 2001 and zero otherwise (OR = 0.866, CI = 0.812 - 0.925) (Model 2) and (OR = 0.850, CI = 0.791 - 0.914) (Model 3) (see Table 10). The results from the warnings variable defined to be one starting from December, 2001, indicated that warnings decreased the odds of being a smoker (OR = 0.867, CI = 0.813 - 0.926) (Model 2) and the odds of being a daily smoker (OR = 0.852, CI = 0.793 - 0.916) (Model 3) (see Table 11).

Insert Table 9 here

Insert Table 10 here

Insert Table 11 here

In terms of the other control variables (Table 9), those older (age 35-44: OR = 0.952, CI = 0.817 - 1.109; age 45-64: OR = 0.811, CI = 0.688 - 0.957; age 65+: OR = 0.653, CI = 0.541 - 0.788) and with a higher education classes (some post secondary: OR = 0.875, CI = 0.740 - 1.034; post secondary: OR = 0.856, CI = 0.724 - 1.012) were less likely to be smokers compared to their respective reference categories. Males were more likely to be a smoker than females (OR = 1.146, CI = 1.015 - 1.294). The income variable also confirmed the standard socioeconomic gradient in smoking, where those with higher income status were less likely to be smokers (low-middle income: OR = 0.936, CI = 0.859 - 1.020; high-middle income: OR = 0.884, CI = 0.801 - 0.974; high income: OR = 0.864, CI = 0.778 - 0.960). The odds of being a smoker were found to be lower for those who were married (OR = 0.827, CI = 0.738 - 0.926), immigrants (OR = 0.566, CI = 0.446 - 0.717), and had higher household size (OR = 0.979, CI = 0.955 - 1.005). Those separated or widowed (OR = 1.031, CI = 0.896 - 1.188) were more likely to be smokers than singles and those employed (OR = 1.189, CI = 1.091 - 1.296) had higher odds of being a smoker than those unemployed. A lower odds of smoking was associated with cigarette price (OR = 0.784, CI = 0.656 - 0.938) and workplace smoking bans: full ban (OR = 0.913, CI = 0.848 - 0.983).

4.2.2. Quit Attempts Results

The reported results in Table 12 showed that graphic warnings, using a scale variable representation, had a positive and statistically significant effect on quit attempts among smokers. Graphic warnings increased the odds of making a quit attempt (OR = 1.313, CI = 1.172 - 1.472; Model 2). Among daily smokers, graphic warnings also increased the odds of making a quit attempt (OR = 1.314, CI = 1.161 - 1.488; Model 3). A similar

result was obtained when the policy dummy is defined to be one starting from July 2001 and zero otherwise (OR = 1.313, CI = 1.172 - 1.472; Model 2) (see Table 13). Using the warnings variable defined to be one starting from December 2001 indicated that warnings increased the odds of making a quit attempt among daily smokers (OR = 1.315, CI = 1.161 - 1.489; Model 3) (see Table 14).

Results for the other covariates revealed no statistically significant relationship between gender, income status, marital status, household size, immigration, workplace smoking ban and the odds of attempting to quit. Older adults and those employed were less likely to make a quit attempt. Immigrants and the well educated were more likely to have attempted quitting smoking. The measure for nicotine dependence, showed a statistically significant effect on quit attempt. Decreased odds of making a quit attempt were associated with consuming 20 or more cigarettes per day (OR = 0.614, CI = 0.509 - 0.741; Model 3) and between 11 and 19 cigarettes per day (OR = 0.726, CI = 0.618 - 0.854) compared to those with less than 11 cigarette per day. Among daily smokers (reported in Table 12, Model 3), increased odds of making a quit attempt were associated with having the first cigarette after waking between 31 to 60 minutes (OR = 1.163, CI = 0.986 - 1.372) and more than 60 minutes (OR = 1.038, CI = 0.865 - 1.246).

Insert Table 12 here

Insert Table 13 here

Insert Table 14 here

4.3. Autoregressive Correlation (AR1)

4.3.1. Smoking Prevalence Results

Results based on the AR (1) working correlation structure revealed similar pattern to the previous two specifications, and hence confirm the robustness of the results to changing the structure of the working correlation matrix. The tobacco graphic cigarette warnings, represented by the scaled variable, had a statistically significant effect on smoking prevalence (see Table 15). In particular, warnings decreased the odds of being a smoker (OR = 0.885, CI = 0.827 - 0.948; Model 2). The graphic warnings also decreased the odds of being a daily smoker (OR = 0.860, CI = 0.797 - 0.927; Model 3). The results were similar when the policy dummy is defined to be one starting from July 2001 and zero otherwise (OR = 0.884, CI = 0.827 - 0.946; Model 2) and (OR = 0.857, CI = 0.794 - 0.924; Model 3) (see Table 16). The results from the warnings variable defined to be one starting from December, 2001, indicated that warnings decreased the odds of being a smoker (OR = 0.886, CI = 0.827 - 0.948; Model 2) and the odds of being a daily smoker (OR = 0.860, CI = 0.798 - 0.928; Model 3) (see Table 17).

Insert Table 15 here

Insert Table 16 here

Insert Table 17 here

In terms of the other control variables (Table 15), the results were qualitatively similar to the previous two specifications. For example, those older (age 25-34: OR = 0.964, CI = 0.847 - 1.098; age 35-44: OR = 0.858, CI = 0.737 - 0.998; age 45-64: OR = 0.703, CI = 0.598 - 0.828; Age 65+: OR = 0.477, CI = 0.394 - 0.576) and with a higher education classes (secondary: OR = 0.959, CI = 0.793 - 1.159; some post secondary: OR

= 0.820, CI = 0.698 - 0.963; post secondary: OR = 0.778, CI = 0.663 - 0.912) were less likely to be smokers compared with their respective reference categories. Males were more likely to be a smoker than females (OR = 1.168, CI = 1.035 - 1.319). The income variable revealed the standard socioeconomic gradient in smoking, where those with higher income status were less likely to be smokers (low-middle income: OR = 0.934, CI = 0.857 - 1.018; high-middle income: OR = 0.877, CI = 0.798 - 0.964; high income: OR = 0.850, CI = 0.766 - 0.942). The odds of being a smoker were found to be lower for those who were married (OR = 0.847, CI = 0.760 - 0.944), immigrants (OR = 0.600, CI = 0.473 - 0.761), and had higher household size (OR = 0.988, CI = 0.964 - 1.013). Those separated or widowed (OR = 1.118, CI = 0.973 - 1.286) were more likely to be smokers than singles and also, those employed (OR = 1.177, CI = 1.082 - 1.280) had higher odds of being a smoker than those unemployed. A lower odds of smoking was associated with cigarette price (OR = 0.820, CI = 0.677 - 0.994) and workplace smoking bans: full ban (OR = 0.909, CI = 0.848 - 0.975).

4.3.2. Quit Attempts Results

The reported results in Table 18 indicated that graphic warnings, using a scale variable representation, had a positive and statistically significant effect on quit attempts among smokers. Graphic warnings increased the odds of making a quit attempt (OR = 1.333, CI = 1.163 - 1.528; Model 2). Among daily smokers, graphic warnings also increased the odds of making a quit attempt (OR = 1.398, CI = 1.200 - 1.629; Model 3). A similar result was obtained when the policy dummy is defined to be one starting from July 2001 and zero otherwise (OR = 1.332, CI = 1.162 - 1.527; Model 2) (see Table 19). Using the warnings variable defined to be one starting from December 2001, indicated

that warnings increased the odds of making a quit attempt among daily smokers (OR = 1.398, CI = 1.201-1.629; Model 3) (see Table 20).

Results for the other covariates revealed no statistically significant relationship between gender, income status, marital status, household size, immigration, workplace smoking ban and the odds of attempting to quit. Older adults and those employed were less likely to make a quit attempt. Immigrants and the well educated were more likely to have attempted quitting smoking. The measure for nicotine dependence, showed a statistically significant effect on quit attempt. Decreased odds of making a quit attempt were associated with consuming 20 or more cigarettes per day (OR = 0.512, CI = 0.423 - 0.621; Model 2) and between 11 and 19 cigarettes per day (OR = 0.679, CI = 0.571 - 0.806) compared with those with less than 11 cigarette per day. Among daily smokers (reported in Table 18, Model 3), increased odds of making a quit attempt were associated with having the first cigarette after waking between 31 and 60 minutes (OR = 1.179, CI = 0.969 - 1.433) and more than 60 minutes (OR = 1.144, CI = 0.901 - 1.453).

Insert Table 18 here

Insert Table 19 here

Insert Table 20 here

5. Discussion

In January 2001, Canada became the first county in the world to introduce pictorial warning messages on cigarette packs. As of June 2011, more than 40 countries have implemented similar warning messages (Tobacco Free Center, 2011). Since then, a growing body of research has been conducted to assess the effectiveness of this policy in

discouraging smoking. Previous studies mostly agree that graphic cigarette warnings appear effective, however, there is limited evidence based on actual smoking behavior.

This study adds to the existing literature by using longitudinal data from the Canadian NPHS (1998-2008), which covers pre- and post-policy periods to assess the effect of graphic warning labels on actual smoking behavior. The multivariate analysis shows that graphic warnings have a statistically significant association with lower smoking prevalence and increased quit attempts (for a summary of the results, see Tables 21 and 22).

The positive effect of the graphic warning on quit attempts is in line with the findings of several previous studies (e.g., Hammond et al, 2003; Borland et al., 2009). For example, in a Canadian study, Hammond et al (2003) found that smokers who noticed, thought about and discussed the new graphic labels at baseline were more likely to quit or to make a quit attempt. Borland et al (2009) found that forgoing cigarettes and cognitive reactions as a result of warnings, consistently predicts quit attempts. Though not directly comparable, our results are consistent with projection-based studies that have assessed the potential effect of warning labels on smoking prevalence within the context of a tobacco-control-simulation framework, "SimSmoke" (e.g., Levy et al., 2008; Nagelhout et al., 2011). The findings of an early study by Gospodinov and Irvine (2004), runs contrary to our results. The authors used cross-sectional data collected six months before the graphic warnings policy was introduced and five months after introduction to evaluate the immediate effect of the policy on smoking behavior. They found that pictorial warnings had no significant impact on smoking prevalence. However, in this current study, we use a longer time period and longitudinal data. Also, the warnings

variable is captured in ways that allow the messages to diffuse throughout the retail shops.

Some potential limitations of this study warrant discussion. First, the outcome measures, smoking participation and quit attempts are self-reported. However, this is standard in the literature. Second, due to data limitations, there may be other relevant confounding factors that we did not control for. For example, there is no information in the survey about participation in the black market or about the type of cigarettes (discount or premium) smokers consumed. Also, there is no information about compensatory behaviors. As a result, our estimates of the effect of graphic warnings on smoking prevalence and quit attempts may be biased. The smuggling of cigarettes and the existence of a considerable black market (estimated to satisfy about 30% of demand in Canada), may partially offset the effects of the graphic warnings on smoking behavior (Gabler and Katz, 2010). For example, cigarette packs smuggled from the United States into Canada do not currently contain graphic warnings. Nonetheless, the inclusion of provincial dummies may help capture some of the smuggling effect in Canadian border provinces. The scope of the contraband cigarette market in Canada has been steadily expanding. According to estimates by Physicians for a Smoke-Free Canada (2010), contraband cigarette sales as a percentage of the total cigarette sales has increased from 7% (2002) to 10% (2003), 20% (2006), 27% (2007), and 31% (2008).

Graphic warnings may also be prone to wear out (Hammond et al., 2007). In response to the wear-out effect, in September, 2011, Canada introduced new tobacco graphic warning regulations, which increased the size of the graphic warnings to 75% along with other modifications. The new regulations allow for a transition period of up to

six months for industry to introduce the new labels on packages, and an additional three months for retailers to clear up their inventory with the old warning labels (Health Canada, 2011). Despite these limitations, we believe that this study is timely and relevant for policy makers to understand the Canadian experience, especially for countries that are in the process of implementing graphic cigarette warnings. For example, from September 2012, the United States will implement graphic warning labels on cigarette packs.

In summary, existing evidence on the effectiveness of graphic warnings are mainly based on emotional responses and projections from simulation models. The current study is among the first to provide longitudinal evidence at the population level that graphic tobacco warnings have a statistically significant impact on smoking prevalence. Given the differences in the anti-smoking policy environment across countries, further empirical evidence from other countries will be needed before reaching a generalized conclusion.

Appendix

Table 1
Countries and jurisdictions that require pictures or images on cigarette packs

1- Canada	23- Mauritius
2- Brazil	24- India
3- Singapore	25- Latvia
4- Thailand	26- Pakistan
5- Venezuela	27- Switzerland
6- Jordan	28- Mongolia
7- Australia	29- Colombia
8- Uruguay	30- Turkey
9- Panama	31- Mexico
10- Belgium	32- Philippines
11- Chile	33- Norway
12- Hong Kong	34- Malta
13- New Zealand	35- France
14- Romania	36- Guernsey
15- United Kingdom	37- Spain
16- Egypt	38- Honduras
17- Brunei	39- Ukraine
18- Iran	40- Nepal
19- Malaysia	41- Argentina
20- Taiwan	42- Bolivia
21- Peru	43- Israel
22- Djibouti	44- United States

Source**:** http://www.tobaccofreekids.org/research/factsheets/pdf/0325.pdf and http://www.smoke-free.ca/warnings

Table 2
Selected characteristics of the respondents included in the study analyses

	Percentage(standard deviation)			
	Smoking prevalence		Quit attempts	
Male	50.5	(0.500)	50.9	(0.500)
Female	49.5	(0.500)	49.1	(0.500)
Age 15-24	7.1	(0.257)	10.2	(0.302)
Age 25-34	17.7	(0.381)	23.1	(0.422)
Age 35-44	24.8	(0.432)	28	(0.449)
Age 45-64	38.7	(0.487)	33.4	(0.472)
Age above 64	11.7	(0.321)	5.3	(0.224)
Less secondary	12.6	(0.332)	13.6	(0.342)
Secondary	14.3	(0.350)	17.8	(0.383)
Some post secondary	27.4	(0.446)	29.3	(0.455)
Post secondary	45.7	(0.498)	39.2	(0.488)
Low income	6.1	(0.240)	10.4	(0.305)
Low middle income	15.7	(0.364)	16.8	(0.374)
High middle income	35.9	(0.480)	37.6	(0.484)
High income	42.3	(0.494)	35.3	(0.478)
Married	67.4	(0.469)	56.7	(0.495)
Separated	13.8	(0.345)	18.2	(0.386)
Single	18.9	(0.391)	25.1	(0.433)
Employed	74.3	(0.437)	79.4	(0.404)
Unemployed	25.7	(0.437)	20.6	(0.404)
Immigrant	16.6	(0.372)	11.1	(0.314)
Non immigrant	83.4	(0.372)	88.9	(0.314)
Full ban	47.0	(0.500)	36.2	(0.481)
Partial ban	20.0	(0.400)	27.1	(0.445)
No ban	32.6	(0.468)	36.6	(0.482)
Newfoundland	1.8	(0.134)	1.8	(0.134)
Prince Edward	0.6	(0.074)	0.9	(0.095)
Nova Scotia	3.4	(0.182)	3.7	(0.189)
New Brunswick	2.6	(0.158)	2.5	(0.155)
Quebec	24.8	(0.432)	25.6	(0.437)
Ontario	40.2	(0.490)	39	(0.488)
Manitoba	3.3	(0.178)	3.5	(0.184)
Saskatchewan	2.8	(0.164)	3.5	(0.184)
Alberta	9.8	(0.298)	11	(0.312)
British Columbia	10.8	(0.310)	8.5	(0.279)
Observations	29118		6269	

The statistics are weighted using the NPHS sampling weights.

Table 3
Odd ratios (95% confidence intervals) for the smoking prevalence regression using warning scale (unstructured working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.874***	0.875***	0.868***
	(0.821 - 0.930)	(0.821 - 0.932)	(0.809 - 0.931)
Male	1.167**	1.156**	1.153**
	(1.035 - 1.315)	(1.025 - 1.304)	(1.014 - 1.311)
Age 25-34	0.989	0.990	1.102
	(0.876 - 1.116)	(0.876 - 1.117)	(0.958 - 1.268)
Age 35-44	0.901	0.904	1.011
	(0.783 - 1.038)	(0.786 - 1.041)	(0.860 - 1.188)
Age 45-64	0.763***	0.766***	0.896
	(0.655 - 0.888)	(0.657 - 0.892)	(0.753 - 1.066)
Age 65+	0.588***	0.587***	0.629***
	(0.494 - 0.698)	(0.493 - 0.698)	(0.516 - 0.767)
Secondary	1.003	1.009	0.949
	(0.827 - 1.217)	(0.832 - 1.222)	(0.781 - 1.155)
Some post secondary	0.861*	0.863*	0.837**
	(0.736 - 1.009)	(0.737 - 1.010)	(0.717 - 0.976)
Post secondary	0.837**	0.840**	0.730***
	(0.715 - 0.979)	(0.719 - 0.983)	(0.622 - 0.856)
Low middle income	0.938	0.936	0.926*
	(0.866 - 1.015)	(0.865 - 1.014)	(0.846 - 1.014)
High middle income	0.888***	0.888***	0.865***
	(0.812 - 0.971)	(0.812 - 0.971)	(0.783 - 0.955)
High income	0.868***	0.868***	0.834***
	(0.787 - 0.957)	(0.787 - 0.957)	(0.751 - 0.926)
Married	0.842***	0.842***	0.842***
	(0.759 - 0.933)	(0.759 - 0.934)	(0.749 - 0.947)
Separated	1.061	1.066	1.030
	(0.929 - 1.211)	(0.934 - 1.217)	(0.890 - 1.192)
Household size	0.984	0.984	0.981
	(0.962 - 1.007)	(0.962 - 1.008)	(0.955 - 1.007)
Employed	1.121***	1.173***	1.116**
	(1.055 - 1.191)	(1.084 - 1.269)	(1.023 - 1.218)
Immigrant	0.567***	0.579***	0.546***
	(0.451 - 0.714)	(0.458 - 0.732)	(0.421 - 0.707)
Cigarette price	0.787***	0.790***	0.714***
	(0.662 - 0.936)	(0.663 - 0.942)	(0.587 - 0.868)
Full ban		0.916***	0.933*
		(0.857 - 0.979)	(0.868 - 1.002)
Partial ban		0.988	1.030

		(0.918 - 1.062)	(0.952 - 1.114)
Newfoundland		0.963	0.892
		(0.720 - 1.288)	(0.656 - 1.211)
Prince Edward		1.201	1.237
		(0.891 - 1.619)	(0.903 - 1.694)
Nova Scotia		1.127	1.171
		(0.852 - 1.491)	(0.887 - 1.546)
New Brunswick		1.044	1.199
		(0.788 - 1.382)	(0.910 - 1.580)
Quebec		1.083	1.133
		(0.857 - 1.368)	(0.894 - 1.435)
Ontario		1.050	1.055
		(0.842 - 1.309)	(0.861 - 1.292)
Manitoba		0.985	1.048
		(0.755 - 1.285)	(0.803 - 1.367)
Saskatchewan		1.209	1.265*
		(0.939 - 1.556)	(0.986 - 1.623)
Alberta		1.249*	1.308**
		(0.974 - 1.601)	(1.053 - 1.625)
Observations	29118	29118	29118

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

Table 4
Odd ratios (95% confidence intervals) for the smoking prevalence regression (Warnings are defined to be in effect from July, using unstructured working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.873***	0.874***	0.864***
	(0.820 - 0.929)	(0.820 - 0.931)	(0.805 - 0.927)
Male	1.167**	1.156**	1.153**
	(1.035 - 1.315)	(1.025 - 1.304)	(1.014 - 1.311)
Age 25-34	0.989	0.990	1.103
	(0.876 - 1.117)	(0.877 - 1.118)	(0.958 - 1.269)
Age 35-44	0.902	0.905	1.011
	(0.783 - 1.038)	(0.786 - 1.042)	(0.860 - 1.188)
Age 45-64	0.763***	0.766***	0.896
	(0.656 - 0.888)	(0.658 - 0.892)	(0.753 - 1.066)
Age 65+	0.588***	0.587***	0.629***
	(0.494 - 0.698)	(0.493 - 0.698)	(0.516 - 0.766)
Secondary	1.003	1.008	0.949
	(0.827 - 1.217)	(0.832 - 1.222)	(0.781 - 1.155)
Some post secondary	0.861*	0.863*	0.837**
	(0.736 - 1.008)	(0.737 - 1.009)	(0.717 - 0.976)
Post secondary	0.837**	0.840**	0.730***
	(0.715 - 0.979)	(0.719 - 0.983)	(0.622 - 0.856)
Low middle income	0.938	0.937	0.926*
	(0.866 - 1.016)	(0.865 - 1.014)	(0.846 - 1.014)
High middle income	0.888***	0.888***	0.865***
	(0.812 - 0.971)	(0.812 - 0.971)	(0.784 - 0.955)
High income	0.868***	0.868***	0.834***
	(0.788 - 0.958)	(0.787 - 0.957)	(0.751 - 0.925)
Married	0.842***	0.842***	0.843***
	(0.759 - 0.933)	(0.759 - 0.934)	(0.749 - 0.948)
Separated	1.061	1.067	1.031
	(0.929 - 1.211)	(0.934 - 1.218)	(0.890 - 1.193)
Household size	0.984	0.985	0.981
	(0.962 - 1.008)	(0.962 - 1.008)	(0.955 - 1.007)
Employed	1.121***	1.173***	1.116**
	(1.055 - 1.191)	(1.084 - 1.269)	(1.023 - 1.218)
Immigrant	0.567***	0.579***	0.546***
	(0.451 - 0.714)	(0.458 - 0.732)	(0.421 - 0.707)
Cigarette price	0.788***	0.792***	0.721***
	(0.663 - 0.937)	(0.665 - 0.943)	(0.592 - 0.878)
Full ban		0.916***	0.933*
		(0.857 - 0.979)	(0.868 - 1.002)

Partial ban		0.987	1.029
		(0.918 - 1.062)	(0.951 - 1.114)
Newfoundland		0.962	0.891
		(0.719 - 1.287)	(0.656 - 1.211)
Prince Edward		1.200	1.236
		(0.891 - 1.618)	(0.903 - 1.694)
Nova Scotia		1.126	1.170
		(0.851 - 1.490)	(0.886 - 1.545)
New Brunswick		1.043	1.200
		(0.788 - 1.382)	(0.910 - 1.581)
Quebec		1.082	1.134
		(0.857 - 1.367)	(0.895 - 1.436)
Ontario		1.050	1.056
		(0.842 - 1.309)	(0.862 - 1.294)
Manitoba		0.984	1.047
		(0.754 - 1.283)	(0.802 - 1.365)
Saskatchewan		1.208	1.263*
		(0.939 - 1.555)	(0.985 - 1.621)
Alberta		1.248*	1.308**
		(0.974 - 1.600)	(1.053 - 1.625)
Observations	29118	29118	29118

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

Table 5
Odd ratios (95% confidence intervals) for the smoking prevalence regression (warnings are defined to be in effect from December, using unstructured working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.874***	0.875***	0.869***
	(0.821 - 0.930)	(0.822 - 0.933)	(0.810 - 0.931)
Male	1.167**	1.156**	1.153**
	(1.035 - 1.315)	(1.025 - 1.304)	(1.014 - 1.311)
Age 25-34	0.989	0.989	1.102
	(0.876 - 1.116)	(0.876 - 1.117)	(0.958 - 1.268)
Age 35-44	0.901	0.904	1.011
	(0.783 - 1.038)	(0.786 - 1.041)	(0.860 - 1.188)
Age 45-64	0.763***	0.766***	0.896
	(0.655 - 0.888)	(0.657 - 0.892)	(0.753 - 1.066)
Age 65+	0.588***	0.587***	0.629***
	(0.494 - 0.698)	(0.493 - 0.698)	(0.516 - 0.767)
Secondary	1.003	1.009	0.949
	(0.827 - 1.217)	(0.832 - 1.222)	(0.781 - 1.155)
Some post secondary	0.861*	0.863*	0.837**
	(0.736 - 1.009)	(0.738 - 1.010)	(0.717 - 0.976)
Post secondary	0.837**	0.840**	0.730***
	(0.715 - 0.979)	(0.719 - 0.983)	(0.622 - 0.856)
Low middle income	0.938	0.936	0.926*
	(0.866 - 1.015)	(0.865 - 1.014)	(0.846 - 1.014)
High middle income	0.888***	0.888***	0.865***
	(0.812 - 0.971)	(0.812 - 0.971)	(0.783 - 0.955)
High income	0.868***	0.868***	0.834***
	(0.787 - 0.957)	(0.787 - 0.957)	(0.751 - 0.926)
Married	0.842***	0.842***	0.842***
	(0.759 - 0.933)	(0.759 - 0.934)	(0.749 - 0.947)
Separated	1.061	1.066	1.030
	(0.929 - 1.211)	(0.934 - 1.217)	(0.890 - 1.192)
Household size	0.984	0.984	0.981
	(0.962 - 1.007)	(0.962 - 1.008)	(0.955 - 1.007)
Employed	1.121***	1.173***	1.116**
	(1.055 - 1.191)	(1.084 - 1.269)	(1.023 - 1.218)
Immigrant	0.567***	0.579***	0.546***
	(0.451 - 0.714)	(0.458 - 0.732)	(0.421 - 0.707)
Cigarette price	0.786***	0.789***	0.712***
	(0.661 - 0.936)	(0.662 - 0.941)	(0.586 - 0.866)
Full ban		0.916***	0.933*

		(0.857 - 0.979)	(0.868 - 1.002)
Partial ban		0.988	1.030
		(0.918 - 1.062)	(0.952 - 1.114)
Newfoundland		0.963	0.892
		(0.720 - 1.289)	(0.656 - 1.211)
Prince Edward		1.201	1.237
		(0.891 - 1.619)	(0.903 - 1.694)
Nova Scotia		1.127	1.171
		(0.852 - 1.492)	(0.887 - 1.546)
New Brunswick		1.044	1.199
		(0.788 - 1.382)	(0.910 - 1.580)
Quebec		1.083	1.132
		(0.857 - 1.368)	(0.894 - 1.434)
Ontario		1.050	1.055
		(0.842 - 1.309)	(0.861 - 1.292)
Manitoba		0.985	1.048
		(0.755 - 1.285)	(0.803 - 1.367)
Saskatchewan		1.209	1.265*
		(0.939 - 1.556)	(0.986 - 1.623)
Alberta		1.249*	1.308**
		(0.974 - 1.601)	(1.053 - 1.624)
Observations	29118	29118	29118

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

Table 6
Odd ratios (95% confidence intervals) for the quit attempts regression using warning scale (Unstructured Working Correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.326***	1.330***	1.331***
	(1.184 - 1.485)	(1.187 - 1.490)	(1.175 - 1.508)
Male	1.009	1.008	0.961
	(0.865 - 1.176)	(0.863 - 1.176)	(0.808 - 1.143)
Age 25-34	0.624***	0.626***	0.572***
	(0.482 - 0.809)	(0.482 - 0.813)	(0.431 - 0.760)
Age 35-44	0.554***	0.559***	0.541***
	(0.421 - 0.730)	(0.423 - 0.738)	(0.400 - 0.730)
Age 45-64	0.489***	0.491***	0.491***
	(0.366 - 0.654)	(0.366 - 0.660)	(0.357 - 0.676)
Age 65+	0.427***	0.418***	0.398***
	(0.287 - 0.634)	(0.282 - 0.621)	(0.257 - 0.617)
Secondary	1.136	1.138	1.120
	(0.877 - 1.472)	(0.876 - 1.478)	(0.846 - 1.483)
Some post secondary	1.161	1.157	1.164
	(0.925 - 1.459)	(0.920 - 1.455)	(0.912 - 1.485)
Post secondary	1.104	1.098	1.194
	(0.880 - 1.387)	(0.873 - 1.383)	(0.935 - 1.524)
Low middle income	1.042	1.048	1.047
	(0.848 - 1.279)	(0.853 - 1.288)	(0.843 - 1.300)
High middle income	1.003	1.021	0.985
	(0.812 - 1.239)	(0.825 - 1.263)	(0.787 - 1.234)
High income	0.876	0.890	0.824
	(0.692 - 1.108)	(0.701 - 1.132)	(0.635 - 1.068)
Married	0.987	0.963	0.883
	(0.810 - 1.203)	(0.789 - 1.174)	(0.710 - 1.096)
Separated	1.042	1.022	0.922
	(0.828 - 1.312)	(0.811 - 1.288)	(0.720 - 1.181)
Household size	1.010	1.012	1.031
	(0.955 - 1.068)	(0.957 - 1.070)	(0.969 - 1.098)
Employed	0.756***	0.801**	0.824*
	(0.653 - 0.876)	(0.653 - 0.984)	(0.660 - 1.029)
Immigrant	1.044	1.064	1.030
	(0.792 - 1.377)	(0.805 - 1.407)	(0.748 - 1.418)
cigarettes smoked per day 11-19	0.693***	0.690***	0.726***
	(0.600 - 0.801)	(0.597 - 0.798)	(0.617 - 0.855)
cigarettes smoked per day >20	0.561***	0.561***	0.615***

	(0.479 - 0.658)	(0.478 - 0.658)	(0.510 - 0.741)
Smoke within 31-60 mins after waking			1.166*
			(0.992 - 1.372)
Smoke after 60 mins from waking			1.050
			(0.876 - 1.259)
Full ban		0.931	0.943
		(0.767 - 1.129)	(0.762 - 1.167)
Partial ban		0.916	0.898
		(0.753 - 1.114)	(0.725 - 1.113)
Newfoundland		1.134	0.955
		(0.765 - 1.682)	(0.612 - 1.490)
Prince Edward		1.044	0.964
		(0.704 - 1.546)	(0.616 - 1.509)
Nova Scotia		1.187	1.067
		(0.817 - 1.722)	(0.705 - 1.613)
New Brunswick		0.894	0.916
		(0.590 - 1.355)	(0.584 - 1.437)
Quebec		1.003	1.024
		(0.730 - 1.377)	(0.716 - 1.464)
Ontario		1.024	1.015
		(0.755 - 1.390)	(0.714 - 1.444)
Manitoba		1.089	0.947
		(0.736 - 1.612)	(0.614 - 1.461)
Saskatchewan		1.602**	1.440
		(1.074 - 2.388)	(0.916 - 2.265)
Alberta		1.119	1.016
		(0.802 - 1.561)	(0.690 - 1.496)
Observations	6269	6269	5204

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

Table 7
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from July, using unstructured working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.326***	1.329***	1.325***
	(1.183 - 1.485)	(1.186 - 1.490)	(1.170 - 1.500)
Male	1.009	1.008	0.961
	(0.865 - 1.176)	(0.863 - 1.176)	(0.808 - 1.143)
Age 25-34	0.624***	0.626***	0.573***
	(0.482 - 0.808)	(0.482 - 0.812)	(0.431 - 0.761)
Age 35-44	0.554***	0.559***	0.541***
	(0.421 - 0.730)	(0.423 - 0.738)	(0.401 - 0.731)
Age 45-64	0.489***	0.491***	0.493***
	(0.366 - 0.654)	(0.366 - 0.659)	(0.358 - 0.677)
Age 65+	0.427***	0.419***	0.400***
	(0.287 - 0.634)	(0.282 - 0.621)	(0.258 - 0.619)
Secondary	1.136	1.138	1.120
	(0.877 - 1.472)	(0.875 - 1.478)	(0.846 - 1.483)
Some post secondary	1.161	1.156	1.164
	(0.925 - 1.458)	(0.919 - 1.455)	(0.912 - 1.485)
Post secondary	1.103	1.097	1.193
	(0.879 - 1.386)	(0.872 - 1.382)	(0.934 - 1.524)
Low middle income	1.042	1.048	1.048
	(0.848 - 1.280)	(0.853 - 1.288)	(0.844 - 1.301)
High middle income	1.004	1.021	0.987
	(0.813 - 1.240)	(0.826 - 1.263)	(0.788 - 1.236)
High income	0.877	0.892	0.826
	(0.693 - 1.109)	(0.702 - 1.133)	(0.637 - 1.070)
Married	0.987	0.962	0.882
	(0.810 - 1.202)	(0.789 - 1.174)	(0.710 - 1.096)
Separated	1.042	1.021	0.922
	(0.827 - 1.311)	(0.811 - 1.287)	(0.720 - 1.180)
Household size	1.010	1.012	1.031
	(0.955 - 1.068)	(0.957 - 1.070)	(0.969 - 1.098)
Employed	0.757***	0.801**	0.824*
	(0.653 - 0.876)	(0.652 - 0.984)	(0.660 - 1.029)
Immigrant	1.044	1.064	1.029
	(0.791 - 1.376)	(0.804 - 1.407)	(0.747 - 1.417)
cigarettes smoked per day 11-19	0.694***	0.690***	0.726***
	(0.600 - 0.801)	(0.597 - 0.798)	(0.617 - 0.854)
cigarettes smoked	0.561***	0.561***	0.614***

per day >20			
	(0.479 - 0.658)	(0.478 - 0.658)	(0.509 - 0.740)
Smoke within 31-60 mins after waking			1.166*
			(0.991 - 1.371)
Smoke after 60 mins from waking			1.050
			(0.876 - 1.259)
Full ban		0.932	0.944
		(0.768 - 1.131)	(0.763 - 1.169)
Partial ban		0.917	0.899
		(0.754 - 1.115)	(0.726 - 1.114)
Newfoundland		1.134	0.955
		(0.765 - 1.682)	(0.612 - 1.490)
Prince Edward		1.044	0.964
		(0.704 - 1.547)	(0.616 - 1.509)
Nova Scotia		1.186	1.066
		(0.817 - 1.721)	(0.705 - 1.612)
New Brunswick		0.895	0.917
		(0.591 - 1.356)	(0.585 - 1.438)
Quebec		1.003	1.024
		(0.730 - 1.377)	(0.716 - 1.464)
Ontario		1.024	1.015
		(0.754 - 1.390)	(0.713 - 1.443)
Manitoba		1.088	0.946
		(0.736 - 1.610)	(0.613 - 1.459)
Saskatchewan		1.602**	1.440
		(1.074 - 2.388)	(0.916 - 2.264)
Alberta		1.118	1.015
		(0.801 - 1.560)	(0.689 - 1.495)
Observations	6269	6269	5204

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

Table 8
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from December, using unstructured working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.325***	1.329***	1.332***
	(1.183 - 1.484)	(1.187 - 1.489)	(1.176 - 1.508)
Male	1.009	1.008	0.961
	(0.865 - 1.176)	(0.863 - 1.176)	(0.808 - 1.143)
Age 25-34	0.624***	0.626***	0.572***
	(0.482 - 0.809)	(0.482 - 0.813)	(0.431 - 0.760)
Age 35-44	0.554***	0.559***	0.540***
	(0.421 - 0.730)	(0.423 - 0.738)	(0.400 - 0.730)
Age 45-64	0.489***	0.491***	0.491***
	(0.366 - 0.654)	(0.366 - 0.660)	(0.357 - 0.676)
Age 65+	0.427***	0.418***	0.398***
	(0.287 - 0.634)	(0.282 - 0.621)	(0.257 - 0.617)
Secondary	1.136	1.138	1.120
	(0.877 - 1.472)	(0.876 - 1.478)	(0.846 - 1.483)
Some post secondary	1.162	1.157	1.164
	(0.925 - 1.459)	(0.920 - 1.455)	(0.912 - 1.485)
Post secondary	1.104	1.099	1.194
	(0.880 - 1.387)	(0.873 - 1.383)	(0.935 - 1.524)
Low middle income	1.042	1.048	1.047
	(0.848 - 1.279)	(0.853 - 1.287)	(0.843 - 1.300)
High middle income	1.003	1.021	0.985
	(0.812 - 1.239)	(0.825 - 1.263)	(0.787 - 1.234)
High income	0.876	0.890	0.823
	(0.692 - 1.108)	(0.701 - 1.132)	(0.635 - 1.067)
Married	0.987	0.963	0.883
	(0.810 - 1.203)	(0.789 - 1.174)	(0.710 - 1.096)
Separated	1.042	1.022	0.922
	(0.828 - 1.312)	(0.811 - 1.288)	(0.720 - 1.181)
Household size	1.010	1.012	1.031
	(0.955 - 1.068)	(0.957 - 1.070)	(0.969 - 1.098)
Employed	0.756***	0.801**	0.824*
	(0.653 - 0.876)	(0.653 - 0.984)	(0.660 - 1.029)
Immigrant	1.044	1.064	1.030
	(0.792 - 1.377)	(0.805 - 1.408)	(0.748 - 1.418)
cigarettes smoked per day 11-19	0.693***	0.690***	0.727***
	(0.600 - 0.801)	(0.597 - 0.798)	(0.617 - 0.855)
cigarettes smoked	0.561***	0.561***	0.615***

per day >20			
	(0.479 - 0.658)	(0.478 - 0.658)	(0.510 - 0.741)
Smoke within 31-60 mins after waking			1.167*
			(0.992 - 1.372)
Smoke after 60 mins from waking			1.050
			(0.876 - 1.259)
Full ban		0.931	0.943
		(0.767 - 1.129)	(0.762 - 1.167)
Partial ban		0.916	0.898
		(0.753 - 1.114)	(0.725 - 1.113)
Newfoundland		1.134	0.955
		(0.765 - 1.682)	(0.612 - 1.490)
Prince Edward		1.043	0.964
		(0.704 - 1.546)	(0.616 - 1.509)
Nova Scotia		1.187	1.067
		(0.818 - 1.722)	(0.705 - 1.613)
New Brunswick		0.894	0.916
		(0.590 - 1.355)	(0.584 - 1.437)
Quebec		1.003	1.024
		(0.730 - 1.377)	(0.716 - 1.464)
Ontario		1.024	1.015
		(0.755 - 1.391)	(0.714 - 1.445)
Manitoba		1.089	0.947
		(0.736 - 1.612)	(0.614 - 1.461)
Saskatchewan		1.602**	1.440
		(1.074 - 2.388)	(0.916 - 2.265)
Alberta		1.119	1.016
		(0.802 - 1.561)	(0.690 - 1.496)
Observations	6269	6269	5204

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

Table 9
Odd ratios (95% confidence intervals) for the smoking prevalence regression using warning scale (exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.869***	0.867***	0.852***
	(0.815 - 0.927)	(0.812 - 0.926)	(0.792 - 0.916)
Male	1.162**	1.146**	1.145**
	(1.029 - 1.311)	(1.015 - 1.294)	(1.006 - 1.304)
Age 25-34	1.040	1.038	1.162**
	(0.909 - 1.190)	(0.908 - 1.187)	(1.002 - 1.347)
Age 35-44	0.952	0.952	1.081
	(0.817 - 1.109)	(0.817 - 1.109)	(0.914 - 1.279)
Age 45-64	0.811**	0.811**	0.977
	(0.688 - 0.956)	(0.688 - 0.957)	(0.814 - 1.172)
Age 65+	0.657***	0.653***	0.729***
	(0.545 - 0.792)	(0.541 - 0.788)	(0.592 - 0.899)
Secondary	1.065	1.066	1.043
	(0.861 - 1.317)	(0.863 - 1.317)	(0.834 - 1.305)
Some post secondary	0.877	0.875	0.888
	(0.741 - 1.037)	(0.740 - 1.034)	(0.745 - 1.058)
Post secondary	0.856*	0.856*	0.783***
	(0.724 - 1.013)	(0.724 - 1.012)	(0.655 - 0.936)
Low middle income	0.939	0.936	0.922
	(0.861 - 1.023)	(0.859 - 1.020)	(0.835 - 1.018)
High middle income	0.885**	0.884**	0.854***
	(0.803 - 0.976)	(0.801 - 0.974)	(0.766 - 0.953)
High income	0.868***	0.864***	0.820***
	(0.781 - 0.963)	(0.778 - 0.960)	(0.732 - 0.918)
Married	0.827***	0.827***	0.826***
	(0.737 - 0.927)	(0.738 - 0.926)	(0.732 - 0.932)
Separated	1.028	1.031	0.993
	(0.892 - 1.185)	(0.896 - 1.188)	(0.853 - 1.156)
Household size	0.979	0.979	0.978
	(0.954 - 1.004)	(0.955 - 1.005)	(0.950 - 1.007)
Employed	1.136***	1.189***	1.160***
	(1.066 - 1.210)	(1.091 - 1.296)	(1.054 - 1.277)
Immigrant	0.558***	0.566***	0.528***
	(0.443 - 0.704)	(0.446 - 0.717)	(0.405 - 0.690)
Cigarette price	0.771***	0.784***	0.722***
	(0.646 - 0.921)	(0.656 - 0.938)	(0.592 - 0.882)
Full ban		0.913**	0.916**
		(0.848 - 0.983)	(0.845 - 0.992)
Partial ban		0.994	1.029

		(0.919 - 1.076)	(0.944 - 1.122)
Newfoundland		0.903	0.816
		(0.662 - 1.232)	(0.582 - 1.144)
Prince Edward		1.213	1.165
		(0.888 - 1.656)	(0.835 - 1.626)
Nova Scotia		1.170	1.179
		(0.880 - 1.555)	(0.902 - 1.541)
New Brunswick		1.027	1.112
		(0.766 - 1.376)	(0.836 - 1.480)
Quebec		1.108	1.109
		(0.872 - 1.407)	(0.874 - 1.407)
Ontario		1.069	1.002
		(0.852 - 1.341)	(0.813 - 1.235)
Manitoba		0.899	0.967
		(0.669 - 1.209)	(0.736 - 1.272)
Saskatchewan		1.205	1.201
		(0.930 - 1.563)	(0.936 - 1.541)
Alberta		1.266*	1.268**
		(0.979 - 1.638)	(1.008 - 1.594)
Observations	29118	29118	29118

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

Table 10
Odd ratios (95% confidence intervals) for the smoking prevalence regression (Warnings are defined to be in effect from July, using exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.868***	0.866***	0.850***
	(0.814 - 0.926)	(0.812 - 0.925)	(0.791 - 0.914)
Male	1.162**	1.146**	1.146**
	(1.029 - 1.312)	(1.015 - 1.294)	(1.006 - 1.304)
Age 25-34	1.040	1.039	1.162**
	(0.909 - 1.190)	(0.908 - 1.188)	(1.002 - 1.347)
Age 35-44	0.953	0.953	1.081
	(0.818 - 1.110)	(0.818 - 1.110)	(0.914 - 1.279)
Age 45-64	0.811**	0.811**	0.977
	(0.688 - 0.957)	(0.688 - 0.957)	(0.814 - 1.173)
Age 65+	0.657***	0.653***	0.730***
	(0.545 - 0.793)	(0.541 - 0.788)	(0.592 - 0.899)
Secondary	1.065	1.066	1.043
	(0.861 - 1.317)	(0.863 - 1.318)	(0.834 - 1.305)
Some post secondary	0.877	0.874	0.888
	(0.741 - 1.037)	(0.740 - 1.034)	(0.745 - 1.058)
Post secondary	0.856*	0.856*	0.783***
	(0.724 - 1.013)	(0.724 - 1.012)	(0.655 - 0.936)
Low middle income	0.939	0.936	0.922
	(0.861 - 1.023)	(0.858 - 1.020)	(0.835 - 1.018)
High middle income	0.885**	0.884**	0.855***
	(0.803 - 0.976)	(0.801 - 0.974)	(0.766 - 0.953)
High income	0.867***	0.864***	0.820***
	(0.781 - 0.963)	(0.778 - 0.960)	(0.732 - 0.918)
Married	0.827***	0.827***	0.826***
	(0.737 - 0.927)	(0.738 - 0.926)	(0.732 - 0.932)
Separated	1.028	1.032	0.994
	(0.892 - 1.185)	(0.896 - 1.188)	(0.854 - 1.157)
Household size	0.979	0.979	0.978
	(0.954 - 1.004)	(0.955 - 1.005)	(0.950 - 1.007)
Employed	1.136***	1.189***	1.160***
	(1.066 - 1.210)	(1.091 - 1.296)	(1.053 - 1.277)
Immigrant	0.558***	0.566***	0.528***
	(0.443 - 0.704)	(0.446 - 0.717)	(0.405 - 0.689)
Cigarette price	0.772***	0.785***	0.725***
	(0.647 - 0.921)	(0.656 - 0.939)	(0.593 - 0.885)
Full ban		0.913**	0.916**
		(0.848 - 0.983)	(0.845 - 0.992)

Partial ban		0.994	1.029
		(0.918 - 1.075)	(0.944 - 1.122)
Newfoundland		0.902	0.817
		(0.661 - 1.231)	(0.583 - 1.145)
Prince Edward		1.212	1.165
		(0.888 - 1.656)	(0.835 - 1.626)
Nova Scotia		1.170	1.179
		(0.880 - 1.555)	(0.902 - 1.541)
New Brunswick		1.027	1.113
		(0.766 - 1.376)	(0.836 - 1.480)
Quebec		1.107	1.109
		(0.872 - 1.406)	(0.874 - 1.407)
Ontario		1.069	1.002
		(0.852 - 1.342)	(0.813 - 1.235)
Manitoba		0.899	0.967
		(0.669 - 1.208)	(0.736 - 1.272)
Saskatchewan		1.205	1.201
		(0.929 - 1.563)	(0.936 - 1.540)
Alberta		1.266*	1.268**
		(0.979 - 1.637)	(1.008 - 1.594)
Observations	29118	29118	29118

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

Table 11
Odd ratios (95% confidence intervals) for the smoking prevalence regression (Warnings are defined to be in effect from December, using exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	0.869***	0.867***	0.852***
	(0.815 - 0.927)	(0.813 - 0.926)	(0.793 - 0.916)
Male	1.162**	1.146**	1.145**
	(1.029 - 1.311)	(1.015 - 1.294)	(1.006 - 1.304)
Age 25-34	1.040	1.038	1.161**
	(0.909 - 1.190)	(0.908 - 1.187)	(1.002 - 1.347)
Age 35-44	0.952	0.952	1.081
	(0.817 - 1.109)	(0.817 - 1.109)	(0.914 - 1.279)
Age 45-64	0.811**	0.811**	0.977
	(0.688 - 0.956)	(0.688 - 0.957)	(0.814 - 1.172)
Age 65+	0.657***	0.653***	0.729***
	(0.545 - 0.792)	(0.541 - 0.788)	(0.592 - 0.899)
Secondary	1.065	1.066	1.043
	(0.861 - 1.317)	(0.863 - 1.317)	(0.834 - 1.305)
Some post secondary	0.877	0.875	0.888
	(0.741 - 1.037)	(0.740 - 1.034)	(0.745 - 1.058)
Post secondary	0.856*	0.856*	0.783***
	(0.724 - 1.013)	(0.724 - 1.012)	(0.655 - 0.936)
Low middle income	0.939	0.936	0.922
	(0.861 - 1.023)	(0.859 - 1.020)	(0.835 - 1.018)
High middle income	0.886**	0.884**	0.854***
	(0.803 - 0.976)	(0.801 - 0.974)	(0.766 - 0.953)
High income	0.868***	0.864***	0.820***
	(0.781 - 0.963)	(0.778 - 0.960)	(0.732 - 0.918)
Married	0.827***	0.827***	0.826***
	(0.737 - 0.927)	(0.738 - 0.926)	(0.732 - 0.932)
Separated	1.028	1.031	0.993
	(0.892 - 1.185)	(0.896 - 1.188)	(0.853 - 1.156)
Household size	0.979	0.979	0.978
	(0.954 - 1.004)	(0.955 - 1.005)	(0.950 - 1.007)
Employed	1.136***	1.189***	1.160***
	(1.066 - 1.210)	(1.091 - 1.296)	(1.054 - 1.277)
Immigrant	0.558***	0.566***	0.529***
	(0.442 - 0.704)	(0.446 - 0.717)	(0.405 - 0.690)
Cigarette price	0.771***	0.784***	0.722***
	(0.646 - 0.920)	(0.655 - 0.938)	(0.591 - 0.881)
Full ban		0.913**	0.916**
		(0.848 - 0.983)	(0.845 - 0.992)

Partial ban		0.994	1.029
		(0.919 - 1.076)	(0.944 - 1.123)
Newfoundland		0.903	0.816
		(0.662 - 1.232)	(0.582 - 1.144)
Prince Edward		1.213	1.165
		(0.888 - 1.656)	(0.835 - 1.626)
Nova Scotia		1.170	1.179
		(0.880 - 1.555)	(0.902 - 1.541)
New Brunswick		1.027	1.112
		(0.766 - 1.376)	(0.836 - 1.480)
Quebec		1.108	1.108
		(0.872 - 1.407)	(0.873 - 1.407)
Ontario		1.069	1.002
		(0.852 - 1.341)	(0.813 - 1.234)
Manitoba		0.899	0.967
		(0.669 - 1.209)	(0.736 - 1.272)
Saskatchewan		1.205	1.201
		(0.930 - 1.563)	(0.936 - 1.541)
Alberta		1.266*	1.268**
		(0.979 - 1.638)	(1.008 - 1.594)
Observations	29118	29118	29118

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

Table 12
Odd ratios (95% confidence intervals) for the quit attempt regression using warning scale (exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.308***	1.313***	1.314***
	(1.167 - 1.465)	(1.172 - 1.472)	(1.161 - 1.488)
Male	1.002	1.004	0.958
	(0.859 - 1.169)	(0.860 - 1.172)	(0.805 - 1.139)
Age 25-34	0.619***	0.620***	0.562***
	(0.479 - 0.799)	(0.480 - 0.802)	(0.426 - 0.743)
Age 35-44	0.554***	0.557***	0.530***
	(0.421 - 0.728)	(0.423 - 0.734)	(0.394 - 0.714)
Age 45-64	0.494***	0.494***	0.487***
	(0.369 - 0.660)	(0.368 - 0.663)	(0.355 - 0.668)
Age 65+	0.437***	0.428***	0.402***
	(0.295 - 0.648)	(0.289 - 0.634)	(0.260 - 0.621)
Secondary	1.163	1.166	1.140
	(0.896 - 1.509)	(0.896 - 1.516)	(0.859 - 1.512)
Some post secondary	1.156	1.152	1.158
	(0.919 - 1.453)	(0.915 - 1.449)	(0.906 - 1.480)
Post secondary	1.118	1.113	1.210
	(0.890 - 1.405)	(0.884 - 1.401)	(0.947 - 1.547)
Low middle income	1.022	1.028	1.020
	(0.830 - 1.257)	(0.835 - 1.266)	(0.819 - 1.271)
High middle income	0.997	1.013	0.976
	(0.806 - 1.235)	(0.817 - 1.256)	(0.777 - 1.225)
High income	0.872	0.885	0.812
	(0.688 - 1.105)	(0.695 - 1.127)	(0.625 - 1.055)
Married	0.960	0.938	0.869
	(0.786 - 1.171)	(0.768 - 1.146)	(0.700 - 1.080)
Separated	1.003	0.985	0.901
	(0.796 - 1.264)	(0.781 - 1.243)	(0.703 - 1.156)
Household size	1.012	1.014	1.032
	(0.957 - 1.071)	(0.958 - 1.073)	(0.969 - 1.099)
Employed	0.753***	0.788**	0.819*
	(0.650 - 0.874)	(0.639 - 0.973)	(0.653 - 1.027)
Immigrant	1.025	1.041	1.009
	(0.778 - 1.351)	(0.787 - 1.376)	(0.732 - 1.390)
Full ban		0.952	0.953
		(0.780 - 1.160)	(0.766 - 1.185)
Partial ban		0.926	0.903
		(0.757 - 1.132)	(0.725 - 1.125)
cigarettes smoked per day	0.694***	0.691***	0.726***

11-19			
	(0.601 - 0.801)	(0.598 - 0.799)	(0.618 - 0.854)
cigarettes smoked per day >20	0.565***	0.565***	0.614***
	(0.482 - 0.662)	(0.481 - 0.663)	(0.509 - 0.741)
Smoke within 31-60 mins after waking			1.163*
			(0.986 - 1.372)
Smoke after 60 mins from waking			1.038
			(0.865 - 1.246)
Newfoundland		1.166	0.972
		(0.787 - 1.728)	(0.623 - 1.517)
Prince Edward		1.037	0.952
		(0.701 - 1.534)	(0.608 - 1.489)
Nova Scotia		1.186	1.069
		(0.819 - 1.718)	(0.708 - 1.612)
New Brunswick		0.881	0.899
		(0.580 - 1.339)	(0.572 - 1.414)
Quebec		1.009	1.027
		(0.735 - 1.385)	(0.719 - 1.468)
Ontario		1.030	1.025
		(0.759 - 1.398)	(0.721 - 1.457)
Manitoba		1.096	0.944
		(0.742 - 1.619)	(0.613 - 1.454)
Saskatchewan		1.601**	1.430
		(1.075 - 2.384)	(0.910 - 2.248)
Alberta		1.117	1.009
		(0.802 - 1.556)	(0.686 - 1.485)
Observations	6269	6269	5204

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

Table 13
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from July, using exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.308***	1.313***	1.308***
	(1.167 - 1.466)	(1.172 - 1.472)	(1.155 - 1.481)
Male	1.002	1.004	0.958
	(0.859 - 1.169)	(0.859 - 1.172)	(0.805 - 1.139)
Age 25-34	0.618***	0.620***	0.563***
	(0.479 - 0.798)	(0.479 - 0.802)	(0.426 - 0.744)
Age 35-44	0.554***	0.557***	0.531***
	(0.421 - 0.728)	(0.423 - 0.734)	(0.395 - 0.716)
Age 45-64	0.493***	0.494***	0.488***
	(0.369 - 0.659)	(0.368 - 0.663)	(0.356 - 0.670)
Age 65+	0.437***	0.429***	0.404***
	(0.295 - 0.648)	(0.289 - 0.635)	(0.261 - 0.624)
Secondary	1.163	1.165	1.140
	(0.896 - 1.509)	(0.896 - 1.516)	(0.859 - 1.512)
Some post secondary	1.156	1.151	1.158
	(0.919 - 1.453)	(0.915 - 1.449)	(0.906 - 1.479)
Post secondary	1.117	1.112	1.210
	(0.889 - 1.404)	(0.883 - 1.400)	(0.947 - 1.546)
Low middle income	1.022	1.028	1.021
	(0.831 - 1.258)	(0.835 - 1.267)	(0.819 - 1.272)
High middle income	0.998	1.014	0.977
	(0.806 - 1.235)	(0.818 - 1.257)	(0.778 - 1.227)
High income	0.873	0.886	0.815
	(0.689 - 1.106)	(0.697 - 1.128)	(0.627 - 1.058)
Married	0.960	0.938	0.869
	(0.786 - 1.171)	(0.768 - 1.146)	(0.700 - 1.080)
Separated	1.002	0.984	0.901
	(0.795 - 1.263)	(0.780 - 1.242)	(0.703 - 1.155)
Household size	1.012	1.014	1.032
	(0.957 - 1.071)	(0.958 - 1.073)	(0.969 - 1.099)
Employed	0.754***	0.788**	0.819*
	(0.650 - 0.874)	(0.639 - 0.972)	(0.653 - 1.027)
Immigrant	1.025	1.040	1.008
	(0.777 - 1.351)	(0.786 - 1.376)	(0.731 - 1.390)
Full ban		0.953	0.954
		(0.781 - 1.161)	(0.767 - 1.186)
Partial ban		0.926	0.904
		(0.758 - 1.133)	(0.725 - 1.126)

cigarettes smoked per day 11-19	0.694***	0.691***	0.726***
	(0.601 - 0.802)	(0.598 - 0.799)	(0.617 - 0.854)
cigarettes smoked per day >20	0.565***	0.565***	0.614***
	(0.482 - 0.662)	(0.482 - 0.663)	(0.509 - 0.740)
Smoke within 31-60 mins after waking			1.162*
			(0.986 - 1.371)
Smoke after 60 mins from waking			1.038
			(0.865 - 1.246)
Newfoundland		1.166	0.972
		(0.787 - 1.728)	(0.623 - 1.517)
Prince Edward		1.037	0.952
		(0.701 - 1.534)	(0.608 - 1.489)
Nova Scotia		1.185	1.068
		(0.818 - 1.717)	(0.708 - 1.611)
New Brunswick		0.882	0.900
		(0.581 - 1.339)	(0.572 - 1.415)
Quebec		1.009	1.027
		(0.735 - 1.385)	(0.719 - 1.468)
Ontario		1.030	1.024
		(0.759 - 1.397)	(0.721 - 1.456)
Manitoba		1.095	0.943
		(0.741 - 1.618)	(0.613 - 1.452)
Saskatchewan		1.601**	1.430
		(1.075 - 2.384)	(0.910 - 2.247)
Alberta		1.116	1.009
		(0.802 - 1.555)	(0.685 - 1.484)
Observations	6269	6269	5204

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

Table 14
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from December, using exchangeable working correlation)

	Model 1	Model 2	Model 3
Graphic warnings	1.308***	1.313***	1.315***
	(1.167 - 1.465)	(1.172 - 1.471)	(1.161 - 1.489)
Male	1.002	1.004	0.958
	(0.859 - 1.169)	(0.860 - 1.172)	(0.805 - 1.140)
Age 25-34	0.619***	0.620***	0.562***
	(0.479 - 0.799)	(0.480 - 0.803)	(0.426 - 0.743)
Age 35-44	0.554***	0.557***	0.530***
	(0.421 - 0.728)	(0.423 - 0.734)	(0.394 - 0.714)
Age 45-64	0.494***	0.494***	0.487***
	(0.369 - 0.660)	(0.368 - 0.663)	(0.354 - 0.668)
Age 65+	0.437***	0.428***	0.402***
	(0.295 - 0.648)	(0.289 - 0.634)	(0.260 - 0.621)
Secondary	1.163	1.166	1.140
	(0.896 - 1.509)	(0.896 - 1.516)	(0.859 - 1.512)
Some post secondary	1.156	1.152	1.158
	(0.920 - 1.453)	(0.915 - 1.450)	(0.906 - 1.480)
Post secondary	1.118	1.113	1.211
	(0.890 - 1.405)	(0.884 - 1.402)	(0.947 - 1.547)
Low middle income	1.022	1.028	1.020
	(0.830 - 1.257)	(0.835 - 1.266)	(0.819 - 1.271)
High middle income	0.997	1.013	0.976
	(0.806 - 1.235)	(0.817 - 1.256)	(0.777 - 1.225)
High income	0.872	0.885	0.812
	(0.688 - 1.105)	(0.695 - 1.127)	(0.625 - 1.055)
Married	0.960	0.938	0.869
	(0.786 - 1.171)	(0.768 - 1.146)	(0.700 - 1.080)
Separated	1.003	0.985	0.902
	(0.796 - 1.264)	(0.781 - 1.243)	(0.703 - 1.156)
Household size	1.012	1.014	1.032
	(0.957 - 1.071)	(0.958 - 1.073)	(0.969 - 1.099)
Employed	0.753***	0.788**	0.819*
	(0.650 - 0.874)	(0.639 - 0.973)	(0.653 - 1.027)
Immigrant	1.025	1.041	1.009
	(0.778 - 1.351)	(0.787 - 1.376)	(0.732 - 1.390)
Full ban		0.951	0.953
		(0.780 - 1.160)	(0.766 - 1.184)
Partial ban		0.925	0.903
		(0.757 - 1.132)	(0.725 - 1.125)

cigarettes smoked per day 11-19	0.694***	0.691***	0.726***
	(0.601 - 0.801)	(0.598 - 0.799)	(0.618 - 0.854)
cigarettes smoked per day >20	0.565***	0.565***	0.614***
	(0.482 - 0.662)	(0.481 - 0.663)	(0.509 - 0.741)
Smoke within 31-60 mins after waking			1.163*
			(0.987 - 1.372)
Smoke after 60 mins from waking			1.038
			(0.865 - 1.246)
Newfoundland		1.166	0.972
		(0.787 - 1.728)	(0.623 - 1.517)
Prince Edward		1.037	0.952
		(0.701 - 1.534)	(0.608 - 1.489)
Nova Scotia		1.187	1.069
		(0.819 - 1.718)	(0.709 - 1.612)
New Brunswick		0.881	0.899
		(0.580 - 1.339)	(0.572 - 1.414)
Quebec		1.009	1.027
		(0.735 - 1.385)	(0.719 - 1.468)
Ontario		1.030	1.025
		(0.759 - 1.398)	(0.721 - 1.457)
Manitoba		1.096	0.944
		(0.742 - 1.619)	(0.613 - 1.454)
Saskatchewan		1.601**	1.430
		(1.075 - 2.384)	(0.910 - 2.248)
Alberta		1.117	1.009
		(0.802 - 1.556)	(0.686 - 1.485)
Observations	6269	6269	5204

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

Table 15
Odd ratios (95% confidence intervals) for the smoking prevalence regression using warning scale (Autoregressive Correlation (AR1)

	Model 1	Model 2	Model 3
Graphic warnings	0.881***	0.885***	0.860***
	(0.825 - 0.942)	(0.827 - 0.948)	(0.797 - 0.927)
Male	1.181***	1.168**	1.162**
	(1.046 - 1.333)	(1.035 - 1.319)	(1.021 - 1.323)
Age 25-34	0.961	0.964	1.059
	(0.844 - 1.095)	(0.847 - 1.098)	(0.912 - 1.230)
Age 35-44	0.851**	0.858**	0.945
	(0.732 - 0.990)	(0.737 - 0.998)	(0.796 - 1.122)
Age 45-64	0.697***	0.703***	0.801**
	(0.593 - 0.819)	(0.598 - 0.828)	(0.666 - 0.962)
Age 65+	0.475***	0.477***	0.488***
	(0.394 - 0.573)	(0.394 - 0.576)	(0.393 - 0.605)
Secondary	0.952	0.959	0.858
	(0.787 - 1.151)	(0.793 - 1.159)	(0.704 - 1.045)
Some post secondary	0.814**	0.820**	0.759***
	(0.693 - 0.956)	(0.698 - 0.963)	(0.647 - 0.890)
Post secondary	0.769***	0.778***	0.646***
	(0.656 - 0.902)	(0.663 - 0.912)	(0.549 - 0.760)
Low middle income	0.934	0.934	0.917*
	(0.856 - 1.018)	(0.857 - 1.018)	(0.832 - 1.010)
High middle income	0.875***	0.877***	0.857***
	(0.797 - 0.961)	(0.798 - 0.964)	(0.772 - 0.952)
High income	0.847***	0.850***	0.827***
	(0.764 - 0.938)	(0.766 - 0.942)	(0.740 - 0.923)
Married	0.846***	0.847***	0.869**
	(0.760 - 0.943)	(0.760 - 0.944)	(0.766 - 0.986)
Separated	1.111	1.118	1.116
	(0.966 - 1.277)	(0.973 - 1.286)	(0.954 - 1.305)
Household size	0.988	0.988	0.981
	(0.964 - 1.013)	(0.964 - 1.013)	(0.953 - 1.009)
Employed	1.122***	1.177***	1.107**
	(1.051 - 1.198)	(1.082 - 1.280)	(1.010 - 1.213)
Immigrant	0.582***	0.600***	0.565***
	(0.461 - 0.734)	(0.473 - 0.761)	(0.435 - 0.735)
Cigarette price	0.833*	0.821**	0.772**
	(0.690 - 1.005)	(0.678 - 0.994)	(0.622 - 0.958)
Full ban		0.909***	0.935*
		(0.848 - 0.975)	(0.868 - 1.007)
Partial ban		0.992	1.029

		(0.918 - 1.073)	(0.948 - 1.118)
Newfoundland		1.034	0.954
		(0.782 - 1.368)	(0.710 - 1.282)
Prince Edward		1.157	1.295
		(0.857 - 1.562)	(0.941 - 1.781)
Nova Scotia		1.121	1.225
		(0.842 - 1.491)	(0.911 - 1.648)
New Brunswick		1.041	1.244
		(0.787 - 1.378)	(0.933 - 1.660)
Quebec		1.070	1.187
		(0.846 - 1.353)	(0.929 - 1.517)
Ontario		1.018	1.110
		(0.818 - 1.267)	(0.896 - 1.375)
Manitoba		1.032	1.113
		(0.784 - 1.358)	(0.836 - 1.481)
Saskatchewan		1.193	1.274*
		(0.920 - 1.547)	(0.969 - 1.674)
Alberta		1.201	1.335**
		(0.939 - 1.536)	(1.058 - 1.683)
Observations	29118	29118	29118

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

Table 16
Odd ratios (95% confidence intervals) for the smoking prevalence regression (Warnings are defined to be in effect from July, using Autoregressive Correlation (AR1))

	Model 1	Model 2	Model 3
Graphic warnings	0.881***	0.884***	0.857***
	(0.824 - 0.941)	(0.827 - 0.946)	(0.794 - 0.924)
Male	1.181***	1.168**	1.162**
	(1.046 - 1.333)	(1.035 - 1.319)	(1.021 - 1.323)
Age 25-34	0.962	0.965	1.060
	(0.845 - 1.095)	(0.847 - 1.099)	(0.912 - 1.231)
Age 35-44	0.852**	0.858**	0.946
	(0.732 - 0.991)	(0.738 - 0.998)	(0.796 - 1.123)
Age 45-64	0.697***	0.704***	0.801**
	(0.593 - 0.819)	(0.598 - 0.828)	(0.666 - 0.962)
Age 65+	0.475***	0.477***	0.488***
	(0.394 - 0.574)	(0.394 - 0.576)	(0.393 - 0.605)
Secondary	0.952	0.958	0.857
	(0.787 - 1.151)	(0.793 - 1.159)	(0.704 - 1.045)
Some post secondary	0.814**	0.820**	0.759***
	(0.692 - 0.956)	(0.698 - 0.963)	(0.647 - 0.890)
Post secondary	0.769***	0.778***	0.646***
	(0.656 - 0.902)	(0.663 - 0.912)	(0.549 - 0.760)
Low middle income	0.934	0.934	0.917*
	(0.857 - 1.018)	(0.857 - 1.018)	(0.833 - 1.010)
High middle income	0.875***	0.878***	0.858***
	(0.797 - 0.962)	(0.799 - 0.964)	(0.773 - 0.953)
High income	0.847***	0.850***	0.827***
	(0.764 - 0.939)	(0.766 - 0.943)	(0.740 - 0.924)
Married	0.846***	0.847***	0.869**
	(0.759 - 0.943)	(0.760 - 0.944)	(0.767 - 0.986)
Separated	1.111	1.119	1.117
	(0.966 - 1.277)	(0.973 - 1.286)	(0.955 - 1.306)
Household size	0.989	0.988	0.981
	(0.964 - 1.013)	(0.964 - 1.013)	(0.953 - 1.009)
Employed	1.122***	1.177***	1.107**
	(1.051 - 1.198)	(1.082 - 1.280)	(1.010 - 1.213)
Immigrant	0.582***	0.599***	0.565***
	(0.461 - 0.734)	(0.473 - 0.760)	(0.435 - 0.734)
Cigarette price	0.834*	0.823**	0.779**
	(0.691 - 1.005)	(0.680 - 0.995)	(0.627 - 0.967)
Full ban		0.909***	0.935*
		(0.848 - 0.975)	(0.868 - 1.007)

Partial ban		0.992	1.029
		(0.918 - 1.073)	(0.948 - 1.117)
Newfoundland		1.033	0.953
		(0.781 - 1.366)	(0.709 - 1.282)
Prince Edward		1.157	1.294
		(0.857 - 1.561)	(0.941 - 1.780)
Nova Scotia		1.119	1.223
		(0.841 - 1.489)	(0.910 - 1.645)
New Brunswick		1.040	1.244
		(0.786 - 1.377)	(0.933 - 1.660)
Quebec		1.069	1.188
		(0.845 - 1.352)	(0.930 - 1.518)
Ontario		1.018	1.110
		(0.818 - 1.268)	(0.896 - 1.376)
Manitoba		1.031	1.111
		(0.783 - 1.357)	(0.835 - 1.479)
Saskatchewan		1.193	1.272*
		(0.920 - 1.546)	(0.968 - 1.672)
Alberta		1.201	1.335**
		(0.939 - 1.536)	(1.058 - 1.683)
Observations	29118	29118	29118

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

Table 17
Odd ratios (95% confidence intervals) for the smoking prevalence regression (Warnings are defined to be in effect from December, using Autoregressive Correlation (AR1))

	Model 1	Model 2	Model 3
Graphic warnings	0.882***	0.886***	0.860***
	(0.825 - 0.943)	(0.827 - 0.948)	(0.798 - 0.928)
Male	1.181***	1.168**	1.162**
	(1.046 - 1.333)	(1.035 - 1.319)	(1.021 - 1.323)
Age 25-34	0.961	0.964	1.059
	(0.844 - 1.094)	(0.847 - 1.098)	(0.912 - 1.230)
Age 35-44	0.851**	0.858**	0.945
	(0.732 - 0.990)	(0.737 - 0.998)	(0.796 - 1.122)
Age 45-64	0.697***	0.703***	0.801**
	(0.593 - 0.819)	(0.598 - 0.828)	(0.666 - 0.962)
Age 65+	0.475***	0.477***	0.488***
	(0.394 - 0.573)	(0.394 - 0.576)	(0.393 - 0.605)
Secondary	0.952	0.959	0.858
	(0.787 - 1.151)	(0.793 - 1.159)	(0.704 - 1.045)
Some post secondary	0.814**	0.820**	0.759***
	(0.693 - 0.956)	(0.698 - 0.963)	(0.647 - 0.890)
Post secondary	0.769***	0.778***	0.646***
	(0.656 - 0.902)	(0.663 - 0.912)	(0.549 - 0.760)
Low middle income	0.934	0.934	0.917*
	(0.856 - 1.018)	(0.856 - 1.018)	(0.832 - 1.010)
High middle income	0.875***	0.877***	0.857***
	(0.797 - 0.961)	(0.798 - 0.964)	(0.772 - 0.952)
High income	0.847***	0.850***	0.827***
	(0.764 - 0.938)	(0.766 - 0.942)	(0.740 - 0.923)
Married	0.846***	0.847***	0.869**
	(0.760 - 0.943)	(0.760 - 0.944)	(0.766 - 0.986)
Separated	1.111	1.118	1.116
	(0.966 - 1.277)	(0.973 - 1.286)	(0.954 - 1.305)
Household size	0.988	0.988	0.981
	(0.964 - 1.013)	(0.964 - 1.013)	(0.953 - 1.009)
Employed	1.122***	1.177***	1.107**
	(1.051 - 1.198)	(1.082 - 1.280)	(1.010 - 1.213)
Immigrant	0.582***	0.600***	0.565***
	(0.461 - 0.734)	(0.473 - 0.761)	(0.435 - 0.735)
Cigarette price	0.832*	0.820**	0.771**
	(0.689 - 1.005)	(0.677 - 0.994)	(0.621 - 0.957)
Full ban		0.909***	0.935*
		(0.848 - 0.975)	(0.868 - 1.007)

Partial ban		0.992	1.029
		(0.918 - 1.073)	(0.948 - 1.118)
Newfoundland		1.034	0.954
		(0.782 - 1.368)	(0.710 - 1.282)
Prince Edward		1.157	1.295
		(0.857 - 1.562)	(0.941 - 1.781)
Nova Scotia		1.121	1.225
		(0.842 - 1.492)	(0.911 - 1.648)
New Brunswick		1.041	1.244
		(0.787 - 1.378)	(0.932 - 1.660)
Quebec		1.070	1.187
		(0.846 - 1.353)	(0.929 - 1.517)
Ontario		1.018	1.110
		(0.818 - 1.267)	(0.896 - 1.375)
Manitoba		1.032	1.113
		(0.784 - 1.358)	(0.836 - 1.481)
Saskatchewan		1.193	1.274*
		(0.920 - 1.547)	(0.969 - 1.674)
Alberta		1.201	1.335**
		(0.939 - 1.536)	(1.058 - 1.683)
Observations	29118	29118	29118

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

Table 18
Odd ratios (95% confidence intervals) for the quit attempt regression using warning scale, and Autoregressive Correlation (AR1)

	Model 1	Model 2	Model 3
Graphic warnings	1.323***	1.333***	1.398***
	(1.155 - 1.515)	(1.163 - 1.528)	(1.200 - 1.629)
Male	1.044	1.034	1.057
	(0.865 - 1.260)	(0.855 - 1.249)	(0.852 - 1.311)
Age 25-34	0.497***	0.499***	0.505***
	(0.363 - 0.680)	(0.364 - 0.684)	(0.355 - 0.720)
Age 35-44	0.475***	0.482***	0.500***
	(0.338 - 0.669)	(0.341 - 0.681)	(0.344 - 0.729)
Age 45-64	0.433***	0.437***	0.444***
	(0.302 - 0.620)	(0.304 - 0.627)	(0.300 - 0.656)
Age 65+	0.333***	0.329***	0.356***
	(0.200 - 0.554)	(0.198 - 0.547)	(0.204 - 0.621)
Secondary	1.287	1.306	1.351*
	(0.935 - 1.772)	(0.944 - 1.807)	(0.944 - 1.932)
Some post secondary	1.242	1.241	1.319*
	(0.943 - 1.636)	(0.941 - 1.636)	(0.979 - 1.777)
Post secondary	1.223	1.222	1.327*
	(0.928 - 1.611)	(0.924 - 1.617)	(0.976 - 1.806)
Low middle income	0.990	1.009	1.079
	(0.784 - 1.250)	(0.799 - 1.275)	(0.836 - 1.393)
High middle income	0.912	0.938	0.926
	(0.714 - 1.165)	(0.732 - 1.201)	(0.707 - 1.214)
High income	0.767*	0.788	0.720**
	(0.580 - 1.014)	(0.594 - 1.047)	(0.525 - 0.987)
Married	1.074	1.035	1.003
	(0.839 - 1.373)	(0.809 - 1.324)	(0.762 - 1.319)
Separated	1.184	1.158	0.979
	(0.893 - 1.571)	(0.874 - 1.535)	(0.721 - 1.328)
Household size	1.014	1.020	1.016
	(0.949 - 1.083)	(0.954 - 1.090)	(0.941 - 1.097)
Employed	0.795***	0.912	0.859
	(0.669 – 0.946)	(0.721 - 1.155)	(0.661 - 1.117)
Immigrant	1.101	1.110	1.121
	(0.795 - 1.525)	(0.799 - 1.541)	(0.778 - 1.615)
Full ban		0.850	0.964
		(0.680 - 1.062)	(0.752 - 1.235)
Partial ban		0.826*	0.912
		(0.659 - 1.034)	(0.710 - 1.170)
cigarettes smoked	0.676***	0.679***	0.720***

per day 11-19			
	(0.569 - 0.803)	(0.571 - 0.806)	(0.587 - 0.882)
cigarettes smoked per day >20	0.514***	0.512***	0.590***
	(0.425 - 0.622)	(0.423 - 0.621)	(0.469 - 0.742)
Smoke within 31-60 mins after waking			1.179*
			(0.969 - 1.433)
Smoke after 60 mins from waking			1.144
			(0.901 - 1.453)
Newfoundland		1.060	0.859
		(0.639 - 1.757)	(0.482 - 1.530)
Prince Edward		0.817	0.782
		(0.492 - 1.356)	(0.443 - 1.383)
Nova Scotia		1.200	1.084
		(0.747 - 1.929)	(0.636 - 1.848)
New Brunswick		0.784	0.794
		(0.460 - 1.334)	(0.443 - 1.423)
Quebec		0.919	0.999
		(0.607 - 1.392)	(0.632 - 1.578)
Ontario		0.945	0.976
		(0.631 - 1.414)	(0.626 - 1.521)
Manitoba		0.961	0.877
		(0.581 - 1.590)	(0.525 - 1.466)
Saskatchewan		1.328	1.258
		(0.779 - 2.266)	(0.699 - 2.266)
Alberta		0.957	1.045
		(0.621 - 1.475)	(0.640 - 1.708)
Observations	4720	4720	3799

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

Table 19
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from July, using Autoregressive Correlation (AR1))

	Model 1	Model 2	Model 3
Graphic warnings	1.323***	1.332***	1.392***
	(1.154 - 1.515)	(1.162 - 1.527)	(1.194 - 1.621)
Male	1.044	1.033	1.056
	(0.864 - 1.260)	(0.855 - 1.249)	(0.851 - 1.311)
Age 25-34	0.496***	0.499***	0.505***
	(0.363 - 0.680)	(0.364 - 0.684)	(0.355 - 0.720)
Age 35-44	0.475***	0.482***	0.501***
	(0.338 - 0.669)	(0.341 - 0.681)	(0.344 - 0.729)
Age 45-64	0.433***	0.437***	0.444***
	(0.303 - 0.620)	(0.304 - 0.627)	(0.300 - 0.657)
Age 65+	0.333***	0.330***	0.357***
	(0.200 - 0.555)	(0.199 - 0.548)	(0.205 - 0.623)
Secondary	1.287	1.306	1.351*
	(0.935 - 1.773)	(0.944 - 1.807)	(0.944 - 1.932)
Some post secondary	1.242	1.241	1.318*
	(0.943 - 1.636)	(0.941 - 1.636)	(0.978 - 1.776)
Post secondary	1.222	1.222	1.327*
	(0.928 - 1.610)	(0.923 - 1.616)	(0.975 - 1.806)
Low middle income	0.989	1.008	1.077
	(0.783 - 1.250)	(0.798 - 1.274)	(0.834 - 1.392)
High middle income	0.911	0.937	0.926
	(0.713 - 1.164)	(0.732 - 1.200)	(0.706 - 1.213)
High income	0.767*	0.789	0.720**
	(0.580 - 1.014)	(0.594 - 1.048)	(0.525 - 0.988)
Married	1.072	1.034	1.002
	(0.838 - 1.372)	(0.808 - 1.323)	(0.762 - 1.318)
Separated	1.183	1.157	0.977
	(0.892 - 1.569)	(0.873 - 1.534)	(0.720 - 1.326)
Household size	1.014	1.020	1.016
	(0.949 - 1.083)	(0.954 - 1.090)	(0.942 - 1.097)
Employed	0.796**	0.913	0.860
	(0.669 - 0.947)	(0.721 - 1.155)	(0.662 - 1.118)
Immigrant	1.101	1.110	1.121
	(0.795 - 1.525)	(0.800 - 1.541)	(0.778 - 1.615)
Full ban		0.850	0.964
		(0.680 - 1.063)	(0.753 - 1.235)
Partial ban		0.826*	0.912
		(0.660 - 1.034)	(0.711 - 1.170)

cigarettes smoked per day 11-19	0.676***	0.679***	0.720***
	(0.569 - 0.803)	(0.571 - 0.807)	(0.587 - 0.882)
cigarettes smoked per day >20	0.515***	0.513***	0.589***
	(0.425 - 0.623)	(0.423 - 0.621)	(0.468 - 0.741)
Smoke within 31-60 mins after waking			1.177
			(0.968 - 1.432)
Smoke after 60 mins from waking			1.144
			(0.901 - 1.453)
Newfoundland		1.059	0.860
		(0.639 - 1.756)	(0.483 - 1.532)
Prince Edward		0.817	0.783
		(0.492 - 1.356)	(0.443 - 1.384)
Nova Scotia		1.200	1.084
		(0.746 - 1.928)	(0.636 - 1.847)
New Brunswick		0.784	0.795
		(0.461 - 1.335)	(0.444 - 1.424)
Quebec		0.920	0.999
		(0.607 - 1.392)	(0.632 - 1.579)
Ontario		0.944	0.975
		(0.631 - 1.413)	(0.626 - 1.520)
Manitoba		0.960	0.876
		(0.580 - 1.588)	(0.524 - 1.463)
Saskatchewan		1.328	1.258
		(0.779 - 2.266)	(0.699 - 2.265)
Alberta		0.956	1.044
		(0.620 - 1.474)	(0.639 - 1.705)
Observations	4720	4720	3799

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

Table 20
Odd ratios (95% confidence intervals) for the quit attempts regression (Warnings are defined to be in effect from December, using Autoregressive Correlation (AR1))

	Model 1	Model 2	Model 3
Graphic warnings	1.323***	1.333***	1.398***
	(1.155 - 1.515)	(1.163 - 1.528)	(1.201 - 1.629)
Male	1.044	1.034	1.057
	(0.865 - 1.260)	(0.855 - 1.249)	(0.852 - 1.311)
Age 25-34	0.497***	0.499***	0.505***
	(0.363 - 0.680)	(0.364 - 0.684)	(0.355 - 0.720)
Age 35-44	0.475***	0.482***	0.500***
	(0.338 - 0.669)	(0.341 - 0.681)	(0.344 - 0.729)
Age 45-64	0.433***	0.437***	0.444***
	(0.302 - 0.620)	(0.304 - 0.627)	(0.300 - 0.656)
Age 65+	0.333***	0.329***	0.356***
	(0.200 - 0.554)	(0.198 - 0.547)	(0.204 - 0.621)
Secondary	1.287	1.306	1.351*
	(0.935 - 1.772)	(0.944 - 1.807)	(0.944 - 1.932)
Some post secondary	1.242	1.241	1.319*
	(0.943 - 1.636)	(0.941 - 1.636)	(0.979 - 1.777)
Post secondary	1.223	1.222	1.327*
	(0.928 - 1.611)	(0.924 - 1.617)	(0.976 - 1.806)
Low middle income	0.990	1.009	1.079
	(0.784 - 1.250)	(0.799 - 1.275)	(0.836 - 1.393)
High middle income	0.912	0.938	0.926
	(0.714 - 1.165)	(0.732 - 1.201)	(0.707 - 1.214)
High income	0.767*	0.788	0.720**
	(0.580 - 1.014)	(0.594 - 1.047)	(0.525 - 0.987)
Married	1.074	1.035	1.003
	(0.839 - 1.373)	(0.809 - 1.324)	(0.762 - 1.319)
Separated	1.184	1.158	0.979
	(0.893 - 1.571)	(0.874 - 1.536)	(0.721 - 1.328)
Household size	1.014	1.020	1.016
	(0.949 - 1.083)	(0.954 - 1.090)	(0.941 - 1.097)
Employed	0.795**	0.912	0.859
	(0.669 - 0.946)	(0.721 - 1.155)	(0.661 - 1.117)
Immigrant	1.101	1.110	1.121
	(0.795 - 1.525)	(0.799 - 1.541)	(0.778 - 1.615)
Full ban		0.850	0.964
		(0.680 - 1.062)	(0.752 - 1.235)
Partial ban		0.826*	0.911
		(0.659 - 1.034)	(0.710 - 1.170)

cigarettes smoked per day 11-19	0.676***	0.679***	0.720***
	(0.569 - 0.803)	(0.571 - 0.806)	(0.587 - 0.882)
cigarettes smoked per day >20	0.514***	0.512***	0.590***
	(0.425 - 0.622)	(0.423 - 0.621)	(0.469 - 0.742)
Smoke within 31-60 mins after waking			1.179
			(0.970 - 1.433)
Smoke after 60 mins from waking			1.144
			(0.901 - 1.453)
Newfoundland		1.060	0.859
		(0.639 - 1.757)	(0.482 - 1.530)
Prince Edward		0.817	0.782
		(0.492 - 1.356)	(0.442 - 1.383)
Nova Scotia		1.200	1.084
		(0.747 - 1.929)	(0.636 - 1.848)
New Brunswick		0.783	0.794
		(0.460 - 1.333)	(0.443 - 1.422)
Quebec		0.919	0.999
		(0.607 - 1.392)	(0.632 - 1.578)
Ontario		0.945	0.976
		(0.631 - 1.414)	(0.626 - 1.521)
Manitoba		0.961	0.877
		(0.581 - 1.591)	(0.525 - 1.467)
Saskatchewan		1.328	1.258
		(0.779 - 2.266)	(0.699 - 2.266)
Alberta		0.957	1.046
		(0.621 - 1.475)	(0.640 - 1.708)
Observations	4720	4720	3799

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

Table 21

A summary for the odd ratios (95% confidence intervals) for the prevalence regression

	Model 1	**Model 2**	**Model 3**
Unstructured working correlation			
Warning scale	0.874***	0.875***	0.868***
	(0.821 - 0.930)	(0.821 - 0.932)	(0.809 - 0.931)
July	0.873***	0.874***	0.864***
	(0.820 - 0.929)	(0.820 - 0.931)	(0.805 - 0.927)
December	0.874***	0.875***	0.869***
	(0.821 - 0.930)	(0.822 - 0.933)	(0.810 - 0.931)
Exchangeable working correlation			
Warning scale	0.869***	0.867***	0.852***
	(0.815 - 0.927)	(0.812 - 0.926)	(0.792 - 0.916)
July	0.868***	0.866***	0.850***
	(0.814 - 0.926)	(0.812 - 0.925)	(0.791 - 0.914)
December	0.869***	0.867***	0.852***
	(0.815 - 0.927)	(0.813 - 0.926)	(0.793 - 0.916)
Autoregressive Correlation (AR1)			
Warning scale	0.881***	0.885***	0.860***
	(0.825 - 0.942)	(0.827 - 0.948)	(0.797 - 0.927)
July	0.881***	0.884***	0.857***
	(0.824 - 0.941)	(0.827 - 0.946)	(0.794 - 0.924)
December	0.882***	0.886***	0.860***
	(0.825 - 0.943)	(0.827 - 0.948)	(0.798 - 0.928)

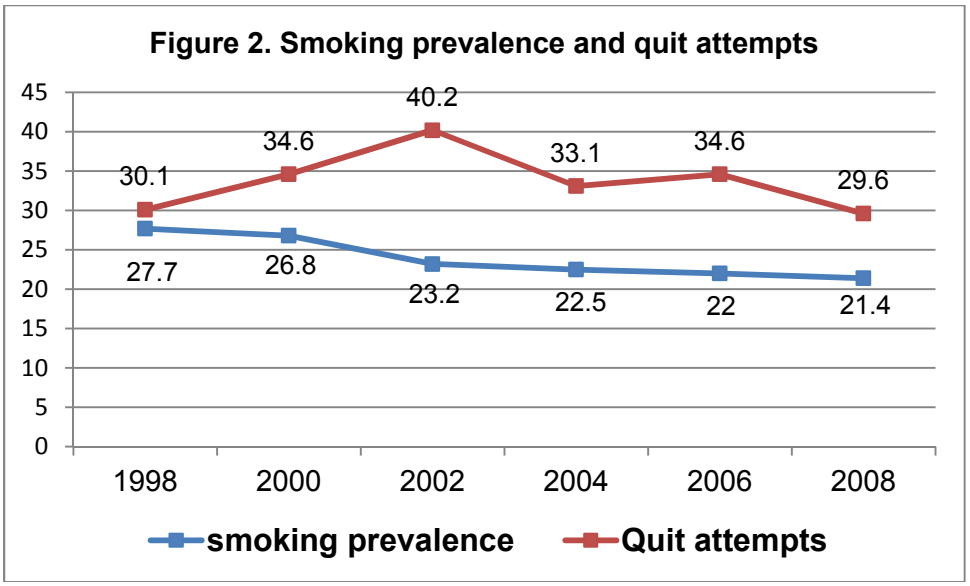
Table 22
A summary for the odd ratios (95% confidence intervals) for the quit attempts regression

	Model 1	Model 2	Model 3
Unstructured working correlation			
Warning scale	1.326***	1.330***	1.331***
	(1.184 - 1.485)	(1.187 - 1.490)	(1.175 - 1.508)
July	1.326***	1.329***	1.325***
	(1.183 - 1.485)	(1.186 - 1.490)	(1.170 - 1.500)
December	1.325***	1.329***	1.332***
	(1.183 - 1.484)	(1.187 - 1.489)	(1.176 - 1.508)
Exchangeable working correlation			
Warning scale	1.308***	1.313***	1.314***
	(1.167 - 1.465)	(1.172 - 1.472)	(1.161 - 1.488)
July	1.308***	1.313***	1.308***
	(1.167 - 1.466)	(1.172 - 1.472)	(1.155 - 1.481)
December	1.308***	1.313***	1.315***
	(1.167 - 1.465)	(1.172 - 1.471)	(1.161 - 1.489)
Autoregressive Correlation (AR1)			
Warning scale	1.323***	1.333***	1.398***
	(1.155 - 1.515)	(1.163 - 1.528)	(1.200 - 1.629)
July	1.323***	1.332***	1.392***
	(1.154 - 1.515)	(1.162 - 1.527)	(1.194 - 1.621)
December	1.323***	1.333***	1.398***
	(1.155 - 1.515)	(1.163 - 1.528)	(1.201 - 1.629)

Figures

Figure 1
Canadian graphic cigarette warning labels under the Tobacco Products Information Regulations

Source: Health Canada. Available at : http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/legislation/label-etiquette/other-autre-eng.php



Source: Authors' compilation using data from NPHS

References

Adda, J., Cornaglia, F. (2006). Taxes, Cigarette Consumption and Smoking Intensity. *American . Economic. Review*, 96, 1013-1028.

Alboim, N., Finnie, R., and Meng, R. (2005). The Discounting of Immigrants' Skills in Canada, *IRPP choices*, 11(2).

Altonji, J.G., and Blank, R.M. (1999). Race and gender in the labor market. *Handbook of Labor Economics*, 3: 3143-3259 .

Baker, M., Benjamin, D. (1994).The performance of immigrants in the Canadian labor market. *Journal of Labor Economics*, 12 (3):369-405.

Barro, R.J., Lee, J.W. (2010). Education Attainment for Population Aged 15 and Over 1950-2010. Available at [http://www.barrolee.com/data/yrsch.htm].

Becker G., Murphy K. (1988). A Theory of Rational Addiction. *Journal of Political Economy*, 96(4).

Beggs, J.J., Chapman, B.J. (1988). Immigrant wage adjustment in Australia cross-section and time-series estimation. *Economic Record*, 64 (186):161-167.

Behrman, J.R., Birdsall, N. (1983). The Quality of Schooling: Quantity Alone is Misleading. *American Economic Review*, 73(5), 928-946.

Bernheim, B.D., Rangel, A. (2004). Addiction and Cue-Triggered Decision Processes. *American Economic Review*, 94(5).

Betts, J.R., Lofstrom, M. (2000). The educational attainment of immigrants: trends and implications. G.J. Borjas (Ed.), Issues in the Economics of Immigration, University of Chicago Press: 51-117.

Betts, J.R. (1995). Does School Quality Matter? Evidence from the National Longitudinal Survey of Youth. *The Review of Economics and Statistics*, 77(2), 231-250.

Borland, R., Wilson, N., Fong, G.T., Hammond, D., McNeill, A., Cummings, K.M., et al. (2009). Impact of Graphic and Text Warnings on Cigarette Packs: Findings from Four Countries over Five Years. *Tobacco Control*, 18, 358-364. doi:10.1136/tc.2008.028043.

Bratsberg, B, and Terrell, D. (2002). School Quality and Returns to Education of U.S. Immigrants. *Economic Inquiry*, 40(2):177-198.

Brennan, E., Durkin, S.J, Cotter, T., Harper, T., Wakefield, M.A. (2011). Mass media campaigns designed to support new pictorial health warnings on cigarette packets:

evidence of a complementary relationship. *Tobacco Control*. 20, 412-418. doi:10.1136/tc.2010.039321.

Card, D., and Krueger, A. B. (1992). Does School Quality Matter? Returns to Education and the Characteristics of Public Schools in the United States. *Journal of Political Economy*, 100(1): 1-40.

Centers for Disease Control and Prevention (2008). Smoking-attributable mortality, years of potential life lost, and productivity losses-United States, 2000-2004. *Morbidity and MortalityWeekly Report*, 57, 1226-8.

Chaloupka, F., Warner, K.E. (2000). The Economics of Smoking. In A.J. Cuyler and J.P. Newhouse (eds.), *Handbook of Health Economics* (North Holland): 1539-1627.

Chang, F., Chung, C., Yu, P., Chao, K. (2011). The impact of graphic cigarette warning labels and smoke-free law on health awareness and thoughts of quitting in Taiwan. *Health Education. Research*, 26 (2), 179-191. doi: 10.1093/her/cyq073.

Chiswick, B. R. and Miller, P.W. (2010). Chapter 4 The Effects of School Quality in the Origin on the Payoff to Schooling for Immigrants, in Gil S. Epstein, Ira N. Gang (ed.) *Migration and Culture (Frontiers of Economics and Globalization), Volume 8*, Emerald Group Publishing Limited, 67-103.

Chiswick, B.R., and Miller, P.W. (2008).Why is the payoff to schooling smaller for immigrants? *Labor Economics*, 15(6):1317-1340.

Chiswick, B.R. (1978). The effect of Americanization on the earnings of foreign-born men. *Journal of Political Economy*, 86 (5):897-921.

Chiswick, B.R., and Miller, P.W. (2009). The international transferability of immigrants' human capital. *Economics of Education Review*, 28(2):162-169.

Cismaru, M., Lavack, A.M. (2007).Tobacco Warning Labels and the Protection Motivation Model: Implications for Canadian Tobacco Control Policy. *Canadian Public Policy*, 33(4), 477-486.

Cohen, J.E, Planinac, L.C., Griffin, K., Robinson, D.J., O'Connor, S.C., Lavack, A.et al.,(2008). Tobacco promotions at point-of-sale. The last hurrah. *Canadian Journal of Public Health*, 99(3), 166-171.

Duleep, H. O, and Sanders, S. (1993). The Decision to Work by Married Immigrant Women. *Industrial and Labor Relations Review*, 46(4): 677-90.

Duleep, H.O., Regets, M.C. (1999). Immigrants and Human-Capital Investment. *The American Economic Review*, 89(2): 186-191.

Duncan,G.J, and Hoffman, S. D. (1981). The incidence and wage effects of overeducation. *Economics of Education Review*, 1(1):75–86.

European Commission (2009). Eurobarometer: Survey on Tobacco (Analytical Report Flash EB No 253 – Survey on Tobacco). Available at http://ec.europa.eu/public_opinion/flash/fl_253_en.pdf (accessed 23 November 2011).

Farrelly, M.C., Nimsch, C.T., Hyland,A., Cummings,M. (2004). The Effects of Higher Cigarette Prices on Tar and Nicotine Consumption in a Cohort of Adult Smokers. *Health Economics*, 13(1), 49-58.

Fagan, P., Augustson, E., Backinger, C.L., O'Connell, M.E., Vollinger, R.E., Kaufman A, Gibson, J.T.(2007)..Quit attempts and intention to quit cigarette smoking among young adults in the United States. *American Journal of Public Health*, 97(8):1412-20.

Ferrer, A.M., Riddell, W. C. (2008). Education, Credentials, and Immigrant Earnings. *Canadian Journal of Economics*, 41(1): 186-216.

Friedberg,R.M. (2000). You Can't Take It With You? Immigrant Assimilation and the Portability of Human Capital. *Journal of labor economics*, 18(2): 221-251.

Gabler, N., Katz, D. (2010). Contraband Tobacco in Canada: Tax Policies and Black Market Incentives; Fraser Institute: Vancouver, BC, Canada.

Galarneau, D., Morissette, R. (2004). Immigrants: Settling for less? *Perspectives on Labour and Income*, 5(6) Statistics Canada Catalogue no. 75-001-XIE, 5-16.

Galarneau, D., Morissette, R. (2008) Immigrants Education and Required Job Skills. Perspectives on Labour and Income, Statistics Canada Catalogue no75-001-X .

Givel, M. (2007). A Comparison of the Impact of U.S. and Canadian Cigarette Pack Warning Label Requirements on Tobacco Industry Profitability and the Public Health. *Health Policy*, 83(2-3),343-352.

Gospodinov, N., Irvine, I.J(2004). Global Health Warnings on Tobacco Packaging: Evidence from the Canadian Experiment. *Topics in Economic Analysis & Policy*, 4(1), 30.

Green, D.A, and Worswick, C. (2004). *Immigrant Earnings Profiles in the Presence of Human Capital Investment: Measuring Cohort and Macro Effects, The institute for fiscal studies ,WP04/13* .

Green, C., Kler, P., and Leeves, G. (2007). Immigrant overeducation: Evidence from recent arrivals to Australia. *Economics of Education Review*, 26: 420-432.

Groot, W., and Van den Brink, H. M. (2000). Overeducation in the labor market: a meta analysis. *Economics of Education Review*, 19: 149-158.

Gruber, J., Koszegi, B. (2001). Is Addiction "Rational"? Theory and Evidence. *Quarterly Journal of Economics*, 116(4).

Hammond, D., Fong, G.T., McDonald, P.W., Cameron, R., Brown, K.S. (2003). Impact of the graphic Canadian warning labels on adult smoking behaviour. *Tobacco Control*, 12, 391-395.

Hammond, D., Fong, G.T, McDonald, P., Brown, S.K., Cameron, R. (2004). Graphic Canadian Cigarette Warning Labels and Adverse Outcomes: Evidence from Canadian Smokers. *American Journal of Public Health*, 94(8), 1442-5.

Hammond, D. (2011). Health warning messages on tobacco products: a review. *Tobacco Control*. doi:10.1136/tc.2010.037630.

Hammond, D., Fong, G.T., McNeill, A., Borland, R., Cummings, K.M. (2006). Effectiveness of Cigarette Warning Labels in Informing Smokers about the Risks of Smoking: Findings from the International Tobacco Control (ITC) Four Country Survey. *Tobacco Control*, 15(3). doi: 10.1136/tc.2005.012294.

Hammond, D., Fong, G.T., Borland, R., Cummings, K.M., McNeill, A., Driezen, P. (2007). Text and Graphic Warnings on Cigarette Packages: Findings from the International Tobacco Control Four Country Study. *American Journal of Preventive Medicine*, 32 (3), 202-9.

Hanushek, E. A., Kimko, D.D., (2000). Schooling, Labor-Force Quality, and the Growth of Nations. *American Economic Review*, 90(5): 1184- 1208.

Hanushek E.A., Woessmann L. (2009). Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation. NBER Working Paper 14633.

Hanushek, E. A., Zhang, L. (2009). Quality Consistent Estimates of International Schooling and Skill Gradients. *Journal of Human Capital*, 3(2): 107-143.

Hanushek, E. A., Interpreting recent research on schooling in developing countries. *The World Bank Research Observer,* 10, 227-46.

Hardin J.W., Hilbe J.M. (2003). Generalized Estimating Equations, New York: Chapman and Hall.

Hartog, J. (2000). Over-education and Earnings: Where Are We, Where Should We Go? *Economics of Education Review*, 19(2): 131-147.

Hastings, G., Stead, M., Webb, J. (2004). Fears Appeals in Social Marketing: Strategic and Ethical Reasons for Concern. *Psychology and Marketing*, 21(11), 961-986.

Health Canada (2001). The Health Effects of Tobacco and Health Warning Messages on Cigarette, Survey of Adults and Adult Smokers and Youth. Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/por-rop/impact_2005-eng.php

Health Canada (2000). Tobacco Products Information Regulations. Available at: http://www.hc-sc.gc.ca/hc-ps/pubs/tobac-tabac/rc/index-eng.php

Health Canada (2002). The Federal Tobacco Control Strategy: A Framework for Action. Health Canada. Available at: http://www.hc-sc.gc.ca/hc-ps/alt_formats/hecs-sesc/pdf/pubs/tobac-tabac/ffa-ca/ffa-ca-eng.pdf.

Health Promotion Board. (2004). Singapore. Graphic Health Warnings on Tobacco Packaging Inspire Smokers to Quit the Habit. Available at: http://www.hpb.gov.sg/hpb/default.asp?pg_id=2982

Health Canada. (2007). Public smoking bans by province and territory. Available at: http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/res/news-nouvelles/ban-interdiction-public-eng.php

Health Canada. (2011). Tobacco Products Labeling Regulations (Cigarettes and Little Cigars) (TPLR-CLC). Available at [http://www.hc-sc.gc.ca/hc-ps/tobac-tabac/legislation/label-etiquette/index-eng.php].

Heckman, J.J., Masterov, D.V. (2007). The Productivity Argument for Investing in Young Children. *Review of Agricultural Economics*, 29(3): 446-493.

Herrick, H (2000).Quit-Smoking Attempts Among Adult Daily Smokers in North Carolina: Results from the 1993-1998 NC Behavioral Risk Factor Surveillance System (BRFSS). State Center for Health Statistics, study No. 119.

Hersch, J., (2005). Smoking Restriction as a Self-Control Mechanism. *Journal of Risk and Uncertainty*, 31(1).

Hendricks, L. (2002). How Important Is Human Capital for Development? Evidence from Immigrant Earnings. *American Economic Review*, 92 (1).

Heston, A., summers, R., Aten, B. (2011). Penn World Table Version 7.0, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

Kahende, J.W., Malarcher, A.M., Teplinskaya, A., Asman, K.J. (2011). Quit Attempt Correlates among Smokers by Race/Ethnicity. *International Journal of Environmental Research and Public Health*, *8*, 3871-3888.

Kiker, B.F., Santos, M.C., and De Oliveira, M .M. (1997). Overeducation and undereducation: evidence for Portugal, *Economics of Education Review*, 16(2): 111-125 .

Kler, P. (2007). A panel data investigation into over-education among tertiary educated Australian immigrants. *Journal of Economic Studies*, 34(3): 179 – 193.

Ladd, H., Loeb, S. (Forthcoming). The challenges of measuring school quality: Implications for educational equity. In D. Allen, & R. Reich (Eds), *Education, Justice, and Democracy* (pp.22-55). Chicago, IL: University of Chicago Press.

Lee, J.W., Barro, R.J. (1997). Schooling Quality in a cross section of countries. NBER working paper No. 6198.

Lee, J.W., Barro, R.J. (2001). Schooling quality in a Cross-Section of Countries. *Economica*, 68: 465-488.

Levy, D.T, Benjakul, S., Ross, H., Ritthiphakdee, B (2008). The role of tobacco control policies in reducing smoking and deaths in a middle income nation: results from the Thailand SimSmoke simulation model. *Tobacco Control*, 17:53-59 doi:10.1136/tc.2007.022319

Liang, K. Y., & Zeger, S. L. (1986). Longitudinal data analysis using generalized linear models. *Biometrika*, 73, 13–22.

Li, C., Gervais, G., and Duval, A. (2006). The Dynamics of over qualification: Canada's Underemployed University Graduates. Statistics Canada analytical paper, Catalogue no. 11-621-MIE -No. 039.

Li, J., Grigg, M. (2009). New Zealand: New Graphic Warnings Encourage Registrations with the Quitline. *Tobacco Control*, 18, 72. doi:10.1136/tc.2008.027649.

Lindley, J.K., Lenton, P. (2006).The Over-Education of UK Immigrants: Evidence from the Labour Force Survey. Sheffield Economic Research Paper Series SERP Number: 2006001.

Mattoo, A., Neagu, I.C. and Özden, C. (2008). Brain waste? Educated immigrants in the US labor market. *Journal of Development Economics,* 87: 255-269.

Miller, C.L., Hill, D.J., Quester, P.G., Hiller, J.E. (2009). Impact on the Australian Quitline of New Graphic Cigarette Pack Warnings Including the Quitline Number. *Tobacco Control*, 18, 235-237. doi:10.1136/tc.2008.028290.

Nagelhout, G.E., Levy, D.T., Blackman, K., Currie, L., Clancy, L., Willemsen, M.C (2011). The effect of tobacco control policies on smoking prevalence and smoking-

attributable deaths. Findings from the Netherlands SimSmoke Tobacco Control Policy Simulation Model. *Addiction*, 107(2):407-16. doi: 10.1111/j.1360-0443.2011.03642.x.

Nascimento, B.E., Oliveira, L., Vieira, A.S., Joffily, M., Gleiser, S., Pereira, M.G., Cavalcante,T., Volchan, E. (2008). Avoidance of Smoking: The Impact of Warning Labels in Brazil. *Tobbaco Control*, 17(6), 405-9.

Nielsen, C.P. (2011). Immigrant over-education: evidence from Denmark. *Journal of Population Economics*, 24:499-520.

Nonnemaker, J.M., Homsi, G (2007). Measurement properties of the Fagerstrom Test for Nicotine Dependence adapted for use in an adolescent sample. *Addictive Behaviors*, 32:181-186.

Non Smokers' Right Association. Health warnings on tobacco products in Canada available at [http://www.nsra-adnf.ca/cms/index.cfm?group_id=1281]

Non Smokers' Right Association (2006). A map comparing cigarette prices in Canada. available at [http://www.nsra-adnf.ca/cms/index.cfm?group_id=1420].

Nordin, M. (2011). Immigrants' Returns to Schooling in Sweden. *International Migration*, 49 (4). doi:10.1111/j.1468-2435.2009.00570.x.

O'Donoghue, Rabin M. (1999). Doing it Now or Later. *American Economic Review*, 89(1).

O'Donoghue, Rabin M. (2002). Addiction and Present-Biased Preferences. Economics Working Paper E02-312, University of California at Berkley.

Oreopoulos, P. (2009). Why Do Skilled Immigrants Struggle in the Labor Market? A Field Experiment with Six Thousand Résumés. NBER Working Paper No. 15036.

Physicians for a Smoke-Free Canada (2010). Estimating the volume of Contraband Sales of Tobacco in Canada. Available at [http://www.smoke free.ca/pdf_1/2010/Estimating%20the%20volume%20of%20Contraband%20Sales%20of %20Tobacco%20in%20Canada-2009.pdf].

Picot, G., and Hou, F.(2003). The Rise in Low-Income Rates among Immigrants in Canada. Analytical Studies Branch Research Paper Series. Catalogue no.11F0019MIE2003198, Statistics Canada.

Psacharopoulos, G., Woodhall, M. (1985). Education for Development: An Analysis of Investment Choices. Oxford University Press for the World Bank.

Reitz, J.G. (2001). Immigrant skill utilization in the Canadian labour market: Implications of human capital research. *Journal of International Migration and Integration.*2(3): 347-378, DOI: 10.1007/s12134-001-1004-1.

Richardson, C.G., Ratner, P.A (2005). A confirmatory factor analysis of the Fagerstrom Test for Nicotine Dependence. *Addictive Behaviors*, 30:697-709.

Ruiter, A.C., Kok, G. (2005). Saying is not (always) Doing: Cigarette Warning Labels are Useless. *European Journal of Public Health*, 15 (3): 329. doi: 10.1093/eurpub/cki095.

Schoellman, T. (2011). Education Quality and Development Accounting. *Review of Economic Studies*. xx, 1–30. doi: 10.1093/restud/rdr025.

Shields, M. A., Price, S. W. (1998). The earnings of male immigrants in England: evidence from the quarterly LFS. *Applied Economics*, 30, 1157-1168.

Shields, M. (2007). Smoking bans: Influence on smoking prevalence. *Health Reports*, 18(3).

Sicherman, N. (1991). Overeducation in the Labor Market. *Journal of Labor Economics*. 9(2): 101-22.

Statistics Canada (2009). National Population Health Survey Household Component. Available at: http://www.statcan.gc.ca/imdb-bmdi/document/3225_D10_T9_V3-eng.pdf.

Statistic Canada (2003). 2001 census Handbook, Catalogue No.92-379-XIE. Available at [http://www12.statcan.ca/english/census01/Products/Reference/2001handbook/pdf/92-379-XIE02001.pdf].

Sweetman, A. (2004). Immigrant Source Country Educational Quality and Canadian Labor Market Outcomes. Statistics Canada, Analytical Studies Branch Research Paper No. 234.

The Conference Board of Canada, (2004). Performance and Potential 2004- 2005: Key Findings. How Can Canada Prosper in Tomorrow's World? Available at [www.conferenceboard.ca].

The Ontario Tobacco Research Unit. (2010). RETAIL DISPLAY OF TOBACCO PRODUCTS: MONITORING UPDATE. Available at: http://www.otru.org/pdf/15mr/15mr_no1_4.pdf.

Tobacco free center. (2011). pictorial warning labels by countries and jurisdictions. Available at: http://tobaccofreecenter.org/files/pdfs/en/WL_examples_en.pdf

Tsang, M. (1987). The impact of underutilization of education on productivity: a case study of the U.S. Bell companies. *Economics of Education Review*, 6, 239–54.

Tsang, M. and Levin, H. (1985). The economics of overeducation. *Economics of Education Review*, 4, 93–104.

Tsang, M., Rumberger, R. and Levin, H. (1991). The impact of surplus schooling on worker productivity. *Industrial Relations*, 30, 209–28.

Vardavas, C.I., Connolly, G., Karamanolis, K., Kafatos A. (2009). Adolescents Perceived Effectiveness of the Proposed European Graphic Tobacco Warning labels. *European Journal of Public Health*, 19(2), 212-7.

Verdugo, R.R., and Verdugo, N.T. (1989). The Impact of Surplus Schooling on Earnings: Some additional findings. *Journal of Human Resources*, 24(4): 629-643.

Wald, S. and Fang, T. (2008). Overeducated Immigrants in the Canadian labour market: Evidence from the Workplace and Employee Survey. *Canadian Public Policy*, 34(4).

Webster, B., Wakefield, M. (2008). Do Graphic Health Warning Labels have an Impact on Adolescents' Smoking Related Beliefs and Behaviours? *Addiction*, 103(9), 1562-71.

Wooldridge JM. Econometric Analysis of Cross Section and Panel Data. The MIT Press, Cambridge, MA, 2002.

World Health Organization. (2011). WHO report on the global tobacco epidemic, 2011, warning about the dangers of tobacco. WHO Press Geneva, Switzerland. Available at : http://whqlibdoc.who.int/publications/2011/9789240687813_eng.pdf

World Health Organization. (2008). MPOWER: a policy package to reverse the tobacco epidemic. WHO Press Geneva, Switzerland. Available at : http://www.who.int/tobacco/mpower/mpower_english.pdf.

Zeger, S.L., Liang, K.Y., Albert, P.S. (1988). Models for longitudinal data: a generalized estimating equation approach. *Biometrics*, 44(4):1049-60.