The Displacement Effect of Immigration on Domestic Wages and Employment in Canada

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Major Paper presented to the
Department of Economics at the University of Ottawa
In partial fulfillment of the requirements of the M.A. Degree
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ECO6999

Ottawa, Ontario
August 2018

ABSTRACT

Throughout the years and particularly in recent discussion, immigration has been a repeated subject in Federal policy and regulation; this has been especially pronounced in the past few years, considering the inflow of immigrants to the country from the Middle East, and now, the U.S. This paper utilises 2001 and 2006 Census data in order to estimate the impact of immigration on native-born Canadian labour market outcomes and the extent to which immigration displaces these outcomes; specifically it looks at: 1) annual native earnings as a result of an increase in the immigrant to total Canadian population ratio; and 2) the unemployment to employment odds ratio of native-borns as a result of an increase in immigration flows. The results follow the general trend of findings that if there is an effect, it is very insignificant. The study does find that an increase in the ratio results in an increase (however small) in annual native earnings, which complements findings from existing literature regarding the complementarity of natives and immigrants. The findings also suggest that an increase in the ratio leads to higher unemployment odds for native-borns, but that this effect is not as strong as it is for other individualistic controls that may affect earnings. Overall, the effects of immigration on native earnings from this study do not suggest displacement of employment or of earnings.

1. Introduction

There is currently a growing literature examining the effect of immigration on labour market outcomes of native-born workers, whether the outcome in question is earnings, employment rates, or participation rates. Researchers who address this relationship typically conduct their research based on one of two assumptions: that native workers and immigrants are substitutes in production, whereby immigration flows displace native-borns from the labour market and have a negative impact on native-born wages, or that native workers and immigrants are complements. In the latter case, immigration may actually cause an increase in labour demand due to the increase in aggregate employment opportunities and the demand for labour of native workers. The general question of this strand of research seeks to answer whether immigration flows displace domestic employment and/or depress the wages of native workers.

This paper estimates the impact of immigration on native-born Canadian annual earnings, while considering other possible factors of wage determination, such as educational attainment levels, age, and the individual's Census Metropolitan Area (CMA). Following Altonji and Card (1991), this study uses data from two consecutive censuses, which enables analysis and comparison between the two years. This study utilises data from the 2001 and 2006 Census public use micro-data files from Statistics Canada. The files contain information on demographic, social and economic characteristics based on a representative 2.7 percent sample of the Canadian population. The study's sample is restricted to native-born Canadians who are between the ages of 15 to 65, and who are employed in the Canadian labour market, earning wages and/or a salary.

In estimating the effect of the ratio of immigrants to the Canadian population on the annual native earnings, the model's identification strategy is to aggregate individuals at a specific time into educational attainment groups (used as a proxy for skill level), as well as groups based on the workers' CMA region. Thus, variation in the ratio of immigrants to the Canadian population is derived by a mapping from an individual's CMA region and education level. Other variables included are age, marital status, census year, as well as interaction variables between educational attainment and the immigrant ratio, and between the census year and the immigrant ratio. Immigrant and native workers are treated in this paper as perfect substitutes and are only regarded as such if they are in the same educational attainment groups, following Aydemir and Borjas (2007).

This study's results are, for the most part, consistent with those of existing empirical research, which tend to suggest that if immigration does have statistically significant effects on labour market

outcomes of native-born workers, the magnitudes are low and not statistically different from zero. Specifically, when estimating the effect on native annual wages, for selected controls, the results suggest that a one percent increase in the immigrant to native worker ratio leads to a maximum of a 0.1 percent change (an increase) in the annual earnings of native-borns in 2001, and a maximum of a 0.05 percent change (an increase) in 2006. Unlike much of the literature, however, no results from either regression equation or specification suggest a negative impact of the immigration to total population ratio on native earnings, implying that immigrant and native workers are weak substitutes. However, in the results from the estimation of the ratio on unemployment probabilities on natives, it is observed that a ten percent increase in the ratio results in a 0.96-to-one odds ratio of the event unemployment to employment among native-born Canadians.

The results concerning educational attainment are as expected, whereby annual earnings increase significantly for native individuals who hold either a bachelor's or graduate degree relative to a native individual holding only a high school diploma. This increase in annual earnings is as much as 50 percent for individuals holding a graduate degree. In addition, married individuals tend to earn higher annual wages compared to those who are divorced, widowed or separated, relative to an individual who reports as single.

The structure of this paper is as follows: section 2 provides a brief review of the existing literature examining the effect of immigration on the labour market outcomes of native-borns and specifically on their earnings. Section 3 describes the data utilised in this study, as well as the imposed sample restrictions. Section 4 presents the econometric model for both observed relationships, their specifications, and the variables used in these specifications. The main findings from the regression analysis are presented in section 5, with a treatment of any differences in findings caused by changes in the model specification, and section 6 concludes the study.

2. Literature Review

This section will discuss the findings of existing studies that investigate the relationship between immigration and native labour market outcomes. The first three studies examine the relationship while considering it in the Canadian context, followed by five studies conducted using U.S. data. The remaining studies examine the impact of immigration on native wages in European countries.

2.1 Canadian Context

The research focus of a study conducted by Islam (2003) is twofold: native labour market displacement effects as a result of immigration flows (where immigrant flows are exogenous), and unemployment and immigration dynamics (where immigrant flows are endogenous). The author uses a 20 percent sample of the Public Use Micro Data File from the 1996 census data, the Labor Force Historical Review 2001, DRI Basic Economics Quarterly data (now the U.S. Basic Economics Database), and data from the Canadian Socio-Economic Information Management System.

To address the first focus of his study, the effect of immigration on job displacement, Islam begins with the Leontief production function to address substitutability and complementarity between immigrants and native workers, specifically to "determine whether immigrant and Canadian born are substitutes or complements. The Canadian-born workers earnings function is derived from a short-run aggregate Leontif production function, which is then specified at the individual level; the coefficients derived from these wage equations are used to calculate the Hicksian elasticity of complementarity, given that wage rate determination also depends on the relative supplies of labour types to the labour market.

The idea behind this is as follows: in the case where the two inputs, immigrants and native workers, are substitutes, an increase in labour supply by way of immigration will increase competition between the two, which reduces the market wage for the both of them. Employers would then turn to immigrant labour, as it is cheaper than paying native worker wages, which ultimately negatively affects both the earnings and employment of native workers. In the case where the two inputs are complements, there are opposite effects—increased labour supply by way of immigration may increase earnings for native workers. This second case assumes that immigrants fill the skill shortages, and aggregate employment opportunities increase, while immigrants and native workers are employed in two separate labour markets but as complements in production. Thus, Islam notes that the demand for native workers will increase, as will their wage rates.

Islam implements a linear model of wage level determination (the outcome variable), where the inputs considered in his production function are: natives, recent immigrants, earlier immigrants (specifically, the share of recent or earlier immigrants in a labour force) and capital. To examine wage differentials between native workers and immigrant workers, the empirical specification at the micro level includes individual fixed effects, and a vector containing the following controls: marital

status, gender, language ability, labour market experience, years of schooling, region and an industry dummy variable. After estimating the degree of substitutability between immigrant workers and Canadian-born workers using Hicksian elasticities, these wage equations are then estimated using the Full Information Maximum Likelihood method, aggregating by broad industry using aggregated data—either the goods producing industry or the service producing industry.

In addressing his second focus, unemployment and immigration dynamics, Islam begins by conducting the Granger causality test, specifically seeking to answer whether it is immigration that causes unemployment, or whether unemployment causes immigration. The theory behind both hypotheses is that in the first, immigrant flows affect both labour demand and supply, while in the second, immigrant supply may result in unemployment (whether it is the migrant's choice or whether the government has in place restrictions on migrant inflow) (2003).

As the Granger causality test may suffer from omitted variable bias, Islam then (2003) uses a time series model to determine the existence of a long-run and/or short-run relationship between unemployment, immigration, real wage and real GDP using the Engle-Granger methodology as well as the Johansen methodology.

Islam's results concerning immigration affecting job displacement, at the individual level, suggest that recent immigrants and natives are complements in production; specifically, an increase of 10 percent in the number of recent immigrants will increase native workers' earnings by 1.6 percent, which he explains is possibly a result of new immigrants having greater human capital relative to cohorts of earlier immigrants, as well as immigrants' tendency to work in low-paying occupations (2003). He also finds that old immigrants and Canadian-born workers are neither substitutes nor complements to each other, and that the impact of earlier immigrants on native workers' wages is positive, but insignificant. From this, Islam concludes there is no downward pressure on native wages caused by immigration flows.

When aggregating the data by industry, for example, he finds that *new* immigrant workers employed in the service producing industry are complements to native workers employed in the goods producing industry, and vice versa. However, *older* immigrant workers employed in the goods sector are complements to native workers in that sector, but are substitutes for native workers in the service sector (the initial finding for new immigrant workers does not hold for old immigrant workers) (Islam, 2003). This result is supported by Roy (1997), who also finds that natives and immigrants from third-world countries are substitutes in certain occupations, such as in "machining,

product fabricating, assembling and repairing." Islam (2003) does however find that recent and earlier immigrants compete for employment in the goods and service sector. A one percent increase in recent immigrants in any given sector causes the wages of immigrants employed in that sector to fall by 9.17 percent; an increase of one percent in early immigrant labour supply in the service sector causes wages of earlier immigrants in the same sector to fall by 4.68 percent.

Finally, when testing for causality between immigration and employment, Islam finds no significant relationship between the two. In fact, for both the short-term and long-term relationships, the results suggest there may be a net job creation effect as a result of immigration. In conclusion, the results suggest that immigrants and natives are not substitutes unless examined at the industry-specific level, but Islam notes that any job displacement effect is offset by the positive job creation effect due to inflow of immigrants; overall employment, in fact, rises.

While examining the immigrant displacement hypothesis, Laryea (1997) seeks to test the impact immigration has on the wages of Canadian-born workers and on those of early immigrants as well; the study is similar to that of Islam (2005) in that it also tests for substitutability and complementary between the groups, as well as tests of the impacts by skill levels and industry. This is done by examining variations in the fraction of immigrants across age cohorts for Canada's population rather than variations in immigration levels across cities using an immigrant age-cohort approach developed by Suen (1994). Concerning the determination of substitutability between groups, Laryea implements the same approach as the previous study, only that it includes the consideration of skilled versus unskilled labour. Laryea (1997) argues that immigrant flows "lower factor prices with which they are substitutes, and raise factor prices with which they are complements" (p. 32).

Laryea (1997) notes limitations in the typical approach to modelling the effect of immigration on wages; namely, the endogeneity of immigrant distribution across units such as Census metropolitan areas (CMAs) as they may self-select themselves into more attractive cities (those in which employees are paid higher wages). The approach used in this study therefore instead aggregates immigrant groups by age cohorts, then aggregates those cohorts into effective labour supply to determine the substitutability between age cohorts and immigrant groups. The data used for this first section are taken from the 1991 Canadian Census PUMF, while the sample is restricted to family heads born in Canada or abroad between the ages of 25 and 65 at the time of the census, and then further classified into eight age cohorts. The wage equation is then estimated using ordinary least squares. The specification

includes the natural logarithm of hourly wages as the outcome variable, and a set of demographic explanatory variables including: marital status dummy variables, experience, years of schooling, and a dummy variable for whether the individual is an early or recent immigrant. The key variable in this paper is immigration, which is proxied by the share of foreign born workers in various major industries.

The results suggest that the complementarity elasticities are small; if there was a 100 percent increase in the number of new immigrants in the age bracket of 35-39, this increase in supply of workers would increase the wage of immigrant workers in other age brackets by 0.054% as a result of the different age groups being complementary inputs in production. However, for native workers, as well as for early and middle immigrants, in this same age bracket, there is an estimated wage decrease of 0.22 percent—existing recent immigrants suffer most by this immigrant flow, as they are the ones in direct competition with the new immigrants (fall in wages by 0.32 percent). More generally, the simulation's results suggest that a 20 percent increase in immigration levels (increase in the share of foreign born workers) leads to relatively small effects on the wages of native workers (no more than a one percent decline). Thus, the only relatively significant impact found is on the wages of more recent immigrants.

In terms of substitutability and complementarity regarding the total sample, the author finds that immigrants and native workers are complements; specifically, a one percent increase in the immigrant flow would increase native workers' wages by about 0.5 percent.

The study also looks at the variability of wage effects by industry or skill level using a longitudinal approach by estimating a two-stage generalized least squares (GLS) model. The model treats immigrant workers and native workers as separate production inputs with potential differences in productivity, and differentiates between the quantity of labour (L) and quality of labour (H), whereby the later may be proxied by the level of education or total years of schooling. Here, the author suggests that in the case where L and H are complements, immigration flows (an increase in L) would increase the productivity, and thus the wages of well-educated native workers, but decrease the wages of less qualified native workers. This model also uses the natural logarithm of hourly wages, while human capital is measured by variables such as experience and years of schooling; industry classifications were included as other explanatory dummy variables to analyze industry differences.

The first technique consists of simple ordinary least squares regression applied to a pooled time-series cross-sectional model. The second technique considered is a fixed effects model that considers the possibility of omitted variables leading to changing cross-section and time series intercepts, which

would change the magnitude of the constant term in the equation; this is corrected by including dummy variables to account for the changing intercepts. The third technique is the random effects model, which is the appropriate model to use when individual specific constant terms are viewed as randomly distributed across cross-sectional units, which is the technique used in the second stage GLS model. The data used for the first and third technique are from a ten percent random sample of the Labour Market Activity Survey for the years 1988 to 1990, inclusive.

When controlling for industry type, Laryea (1997) finds that wage depression appears in the primary, transport, storage, wholesale and retail trade industries, which was hypothesized as these industries generally employ workers in low-skilled occupations that provide entry level jobs for new immigrants specifically, and that potentially increases the labour supply, resulting in a fall in wages. When looking specifically at substitutability and complementarity between natives and recent or earlier immigrants, the author finds that new immigrants and natives are substitutes, and that a 10 percent increase in the share of foreign workers will cause native wages to fall by 0.9 percent. On the other hand, earlier immigrants and natives are complements. Laryea also notes that substitutability is also seen when the data are broken down by occupation type, whereby professional immigrants and Canadian professionals are substitutes, and unskilled immigrants and skilled Canadians are complements.

Aydemir and Borjas (2007) conduct a comparative analysis of effects of immigration on labour market outcomes in Canada, the U.S., and Mexico. The authors use skill groups defined by educational attainment, labour market experience and a calendar year to represent a skill group at a point in time for each country's labour market. They then employ variation in time in the share of immigrants within each skill group to identify the impact of immigration on each country's wage structure for the corresponding groups of native workers. This scheme implies that workers with the same level of schooling but with different levels of experience are imperfect substitutes. This method also controls for the bias that is created by immigrant or native workers having an incentive to respond to supply or demand shocks, whether they are moving to a city as a result of higher wages, or moving out of a city as a result of lower wages. This is because regional flows caused by labour moving to other cities may diffuse the impact of immigration across all regions, thus making the impact measurable only at the national level. A method that addresses this systematic settlement due to shocks is Card's (2001) supply-push component of recent immigration flows that uses historical

patterns of immigrant settlement to allow for a prediction of immigrant flows.

The data employed in the log-linear model in this study are thus aggregated by years, as well as by education groups and by experience groups. The dependent variables used for these regressions are either (i) log annual, monthly or weekly earnings, or (ii) fraction of weeks worked over a year, or (iii) the labour force participation rate. Log monthly earnings and the labour force participation rate are only calculated for the case of Mexico. For the purpose of this literature review, this section will only review the labour market outcomes of Canada and the U.S. The exogenous variables in this model include educational attainment/skill level, experience, year, and interactions between the mentioned variables.

They use microdata from the three countries' censuses. Due to the limited information provided by the Mexican census, the only findings regarding immigrant-induced labour supply shifts and native-worker outcomes are in the Canadian and U.S. context. The Canadian census data covers all available files from 1971 to 2001. U.S. census data are taken from the 1960, 1970, 1980, 1990 and 2000 Integrated Public Use Microdata Sample of the decennial Census. The study's sample is restricted to males aged 18 to 64 who participate in the labour force.

The authors emphasize their assumption that supply shifts caused by immigration are exogenous; because migrants will want to settle in a destination with relatively high wages, and migrate from where wages are relatively low, the true impact of immigration in destination countries is understated. The results suggest that for Canadian natives, a 10 percent increase in the immigrant share of the total labour market causes native annual earnings in a specific skill group to fall by 3.2 percent, while the fraction of weeks worked falls by 1.5 percent. For U.S. native workers, the displacement effect is more pronounced; a 10 percent increase in the U.S. labour supply induced by immigrants in a given skill group leads to a 6.2 percent fall in the annual earnings of native workers within that same skill group, and a 2.5 percent fall in the fraction of weeks worked.

2.2 U.S. Context

Altonji and Card (1991) estimate the effect of an increase in labour supply as a result of immigration, specifically on less-skilled native workers' wages and labour supply. They also seek to determine whether immigrants and natives residing in the same city compete in that labour market, and to determine the relationship between immigrant shares of the labour market and employment outcomes of natives.

The authors use a linear model based on a two-sector labour market, comprised of skilled and unskilled labour; they do not differentiate between earlier or newer immigrant workers and native workers within skill categories. Specifically, they consider four groups of less-skilled native workers: white males with less than twelve years of completed education; black males with less than thirteen years of completed education; white females with less than thirteen years of completed education; and black females with less than thirteen years of completed education. The authors examine the following outcome variables: the labour force participation rate, the employment rate, the employment population ratio of the current year and the previous year, and the natural logarithms of weeks worked and average weekly earnings in the previous year. Their explanatory variables are aggregated into race and gender groups (the native groups), and include controls for fraction of immigrants in a given city, the share and skill composition of immigrants, and educational attainment. In addition, since there is potential endogeneity regarding immigrant flows, the authors include an instrumental variable following the supply-push component methodology. To control for this potential correlation, they use the fraction of immigrants in a specific city in a specific year to predict the change in the fraction of immigrants over the following decade. The reason for this is that "immigrant inflows are strongly correlated with the initial fraction of immigrants in a city," and that these instrumental variables could be strong predictors of future changes in the immigrant share (p. 219). The data are observed for a given native group in a given city. The data employed are 1970 and 1980 for 120 major U.S. cities. The sample is restricted to individuals who are between 19 and 64, excluding students.

The authors find that when the four groups are pooled, the cross-sectional results suggest that if there is a 10 percentage point increase in the immigrant share, there would be a fall in the employment to population ratio of less-skilled native workers by about two percent; the employment rate would also fall by one percent, and average weeks worked would fall by about two percent. However, they find that weekly wages for native workers are positively affected by immigration, which the authors explain can only occur if the labour supply elasticity of less-skilled native workers is negative. However, the first-differenced results suggest a positive effect on the employment outcomes of native workers, in contrast to the first set of results. In general, these results combined suggest immigration has a small (potentially zero) effects on labour market outcomes of native workers.

When examining the results for the four different groups, the authors observe a modest degree of competition between immigrant workers and less-skilled native workers. For all four groups, the results are similar in that there are small negative effects of immigration on less-skilled native workers'

outcomes, and the effect is even less pronounced for the first-differenced results. Overall, the study's results suggest that immigrant shares barely, if at all, affect less-skilled native employment outcomes.

Borjas, Freeman and Katz (1996) estimate the effects of immigration on the U.S. labour market in a twofold manner: they first apply the spatial approach, which focuses on concentrations of immigrants in gateway cities or states, then turn to the factor-proportions approach, which is borrowed from international trade theory. They use the 1980 and 1990 Censuses of Population, and restrict their sample to individuals aged 18 to 64 who are employed in the labour market, excluding those who report as self-employed.

In their first approach, the authors conduct cross-sectional analysis using a linear-log model to first estimate the natural log of weekly earnings as a result of increasing immigrant shares, where the exogenous variables include vectors of age dummies, educational attainment dummies, where both sets of dummy variables are at the level of an individual, as well as a fraction that measures the ratio of immigrants to natives, in a given region. In further regressions, they control for regions as well. Following this cross-sectional analysis, the authors model the same equation as earlier, but fitted to a first-difference model, for which they observe the change in wages for area-education groups as a result of a change in the ratio of immigrants to natives for a given area-education group, including other regressors such as region, changes in labour demand, education variables, and changes in demand for workers by education group. They use the first-differenced analysis approach because of its advantage in eliminating any bias that arises due to city-specific fixed effects (the correlation between immigrant shares in a city and native labour market outcomes).

Following their analysis based on the spatial approach on the labour market framework, Borjas, Freeman and Katz (1996) apply the factor-proportions approach, which examines actual labour supplies in specific skill groups compared to the labour supplies that would have been if it were not for immigration. This approach involves obtaining estimates of immigrant skill levels, changes in labour supply due to trade shocks, and elasticities of relative wages to relative labour supplies in order to estimate relative wage consequences of supply shocks.

They find a similar result to Altonji and Card (1991) for the 1980 census data; immigration has a negative effect on native male wages, but it is of smaller magnitude compared to the former authors' results. The 1990 census data yields the opposite pattern—the effect of immigration on native male wages is positive. The findings suggest that immigration and trade have a negative effect on the wages of high-school dropouts (in this case though, immigration more than trade) and the wages of high-

school-equivalent workers. The authors conclude that the results generated by this method are unstable and differ with respect to the results from the spatial approach as a result of the effect of native migration flows across regions, as well as not having included other regional labour market conditions in area comparisons.

After having tested the factor-proportions approach in the previous study, the same authors conduct a similar study the year later, examining the effects of immigration and trade on labour market outcomes in the U.S. labour market (Borjas et al., 1997). As before, they maintain that immigration and trade are two shocks that have hit the U.S. labour market, and specifically, its supply. In this study, the authors use PUMS (Public Use Microdata Samples) from 1960, 1970, 1980 and 1990; their samples include individuals aged 18 to 64. The exogenous variables of this study include educational groups (skill groups), geographic area (census regions, metropolitan areas and states), age and gender. The findings suggest that when controlling for region, immigration does not have a consistent effect, and specifically that "other regional factors dominate the ups and downs of area economics;" however it is noted that migrant flows to the U.S. do have a negative effect on the "economic status of the least skilled U.S. workers (high school dropouts and those in the bottom 20 percent of the wage distribution)" (p. 3).

Card (2001) examines the immigration effect on occupation-specific labour market outcomes of natives and earlier immigrants using 1990 U.S. census data that contains labour market outcome data from 1989. This dataset includes 324 individual metropolitan statistical areas and subcities; Card uses the largest 175 cities from this total. His sample is restricted to individuals, both male and female, who are aged 16 to 68 and who have at least one year of potential labour market experience in 1989. The sample excludes students, but includes workers who are self-employed as well. The author estimates log-log equations for both the wage rate and employment-population rate of each occupation in each city, while including city-specific, occupation-specific and relative population share measures in the model. The definition of occupation groups is derived from an estimation of logit models (by gender and immigrant status). Card estimates these models for the probabilities of individuals working in six different occupation groups, and these models included variables for age and education, race, marital status and disability status. Card then uses the coefficients derived from these models to assign probabilities of individuals working in different occupations. He assumes that the city fixed effects absorb any citywide variables that might otherwise influence native labour market outcomes, while occupation-specific effects remain in the error terms. City-specific fixed effects are meant to capture

unobserved characteristics of a given city that may cause variation in the inflows or outflows of both immigrant and native workers.

The findings suggest that the immigration effect during the 1985 to 1990 period caused up to a 1 percent decrease in the relative employment rates of natives and earlier immigrants in lower-skilled occupations. The effect is greater in high-immigrant cities such as Los Angeles and Miami, where there is a 3 percent decrease in relative employment rates due to immigration. Card notes that the aggregate effect of immigrant inflows reduced the relative wages of native less-skilled workers in high immigrant cities by no more than 3 percent; the effects in other cities were much smaller.

Llull (2018) examines the effect of immigration on native earnings by exploiting exogenous variation of immigration and comparing the results across various countries, including Canada and the United States, but also France, Ireland and Switzerland. For the purpose of this literature review, I will focus on the analysis done for Canada and the United States. The specification used in this study is an extension of work done by Borjas (2001), extended to a multi-country setting. The author uses the geographical approach, but like many, notes that the estimates may be biased as a result of immigrant allocation to specific areas may not be random and that generally when this is the case, one resorts to the instrumental variable of historical immigrant settlements as an instrument for current immigration inflows.

The main dependent variable in this study is the natural logarithm of wages of natives, where the data are specified at the individual level by education, experience, country/region and time. The variation of immigration is across skill cells (made up of education crossed with experience), destination countries or regions, and time. The exogenous variables include immigration to native population ratio, education, skill level, and country. The equation also includes market-specific effects that capture systematic differences across labour markets. To adjust for the endogeneity of immigrant flows, Llull allows for variation across skill cells (combining education and experience), countries/regions and time. He refers to this instrumentation in his estimation as push-distance interactions with heterogeneous first stage coefficients for different skill cells; the four push factors are: wars, political regimes, natural disasters and economic variables. Llull (2018) argues that the theory behind the use of push factors is that the presence of wars, natural disasters and adverse economic conditions fosters migration, while political regimes may promote attractive areas for immigrants to reside. The push factors are examined with a sub-sample from a two stage least squared estimation (Canada and the United States alone). For these two countries, the data comes from the

1970, 1980, 1990 and 2000 Censuses. Immigrant share data are drawn from the Minnesota Population Center 2011, while the data for the four push factors are constructed from Peace Research Institute Oslo, the Polity IV index, EM-DAT 2010 (the international disasters databases) and the Penn World Tables.

The OLS results for Canada and the United States suggest that a ten percent increase in immigrant shares within a particular skill group would reduce the earnings of natives in that skill group by 3.4 to 4.8 percent. The results using the instrumental variables, the four push factors, show that the OLS results are biased, where the elasticities to immigration are double that of their OLS counterparts; this suggests that the effect of immigration on native earnings is much more pronounced (and negative) when instrumenting with the four push factors.

2.3 International Context

Manacorda, Manning and Wadsworth (2011) seek to examine the effect immigration has on native workers' wages using British cross-sectional micro data. The authors disaggregate labour demand by skill and age, and treat immigrant workers and native workers as different production inputs within each skill and age group, rather than using a geographical region approach. They then assume that each age-education specific labour input is a combination of both types of workers, and estimate an equation for the natural logarithm of relative wages of native to immigrant workers (gross weekly earnings) to vary by immigrant status, skill, age, and time levels of observation (years) in each education-age-time cell. The wage equation also includes exogenous variables to account for the elasticity of substitution between immigrant and native workers. Variation in the relative wages of natives to immigrants are thus driven by differences in age-year cells within education groups. Data on wages and employment are taken from the UK Labour Force Survey and the General Household Survey for the years 1970 to 2000. The main sample contains males aged twenty-six to sixty who are full-time workers, and excludes students, but results for females are also produced.

They find that immigration has a negative impact on the wages of workers who are earlier immigrants instead of native workers. However, although the effect is small (mainly because of the small proportion of immigrants to total share), the results suggest that immigration flows to the UK increase total output, thus including wages as well, for a given skill and age group. The findings suggest that immigrant workers and native workers are imperfect substitutes, while it is earlier immigrants who settled prior to these new immigrants who are sensitive to new immigrant inflows, similar to the

findings in Islam (2003). The findings hold when the authors include marginal workers (students and part-time workers), women, and when using hours worked instead of population as a measure of labour supply.

Dustmann, Fabbri and Preston (2005) also investigate the effect that immigration has on native labour market outcomes in Britain. The authors note the flaws in using the spatial correlations approach, specifically, using geographical labour markets as units in model estimation can be problematic because levels of immigrant shares and levels of labour market outcomes can have this spatial correlation. But, as it is also noted as in previous studies, a solution to this issue is using historical immigrant patterns as an instrumental variable. The argument here is that new arriving immigrants will want to settle in areas where there are existing networks, thus the high concentration immigrant areas. They use the spatial correlations method for their estimation strategy, examining the outcome variables of employment, participation and wages for each region in each time period. The explanatory variables include the ratio of immigrant to native population, aggregated native skill group populations and their sizes (to allow for the effect of native outflows), average ages, and are also all specified for each region in each time period. The model also includes year effects and regional effects terms.

They estimate three different models: (i) OLS in levels; (ii) OLS in differences (within groups regression); and (iii) instrumental variable regression in differences. In the first model, these authors use period-by-period, cross-sectional correlation between relative immigrant levels and employment and wage levels. When estimating the second model, the fixed effects impacts by year no longer have influence in the model, and now the effect is identified as changes over time in the pattern of cross-sectional variation. The third estimation, using instrumental variables, addresses the issues of spatial correlation discussed above. The study uses data from the British LFS that covers the period 1983 to 2000. The sample size is approximately 60,000 households from each survey (about 0.5 percent of the population), and encompasses individuals across 17 regions. The study also draws from the New Earnings Survey (NES), which covers full-time employees on adult rates, and also draws from the Census of Population for the years 1971, 1981 and 1991.

The results suggest that there is a small, if any, negative effect of immigration on native-born labour market outcomes. The OLS results suggest a positive relationship between immigration and native employment rate; specifically, a one percent increase in immigration shares would increase native employment by 0.08 percentage points. The differences approach suggests a fall in native

employment by 0.15 percentage points as a result of a one percent increase in immigration shares. The most robust estimation results, those involving instrument variables, suggest that a one percent increase in immigration shares leads to a decrease in the native employment rate by 0.07 percentage points, but all three estimates are small in magnitude and insignificant. When testing for excluded variables in this estimation as well (whether workers are advanced, intermediate or unqualified in terms of experience), it is not indicated that there are endogenous regressors in the estimation either. When looking at the relationship between immigration and unemployment, participation and wages, all three estimates suggest that an increase in immigration increases unemployment and decreases labour market participation, except for the OLS results that suggest a positive effect on labour market participation. For all three estimations, the effect of immigration on native earnings is positive; an increase in immigration amounting to one percent of the non-immigration population would lead to just under a two percent increase in average non-immigrant wages. They do note that these results should be taken with caution as there was a smaller number of years of data available for this estimation (Dustmann et al., 2005).

A more recent study also examines the impact of immigration on average wages in Britain (Nickell & Saleheen, 2017). The authors use a log-level model whose main dependant variable is the natural logarithm of hourly wages, and each observation in the dataset relates to a specific occupation, region and year. The exogenous variables include the immigrant proportion (lagged by one year), educational attainment, age, regional productivity, regional product demand, and national occupation demand; these last three variables are measured using interaction dummy variables between occupation and region, region and time, and occupation and time. The authors note that in order to include the immigrant proportion as an exogenous variable, they had to model a separate equation dependent on the attractiveness of a region, which was based on factors such as employment in the past period and wages in the last period. This study also draws on data from the British LFS and the NES, and covers the years from 1992 to 2014.

In the first specification of the model, which is a pooled estimation whose main independent variable is the lagged ratio of immigrants and native workers, the results suggest that immigration has a significant negative impact on average wages; if there was a 10 percentage point increase in the proportion of immigrants working in a specific occupation, that occupation's average wage falls by around 0.3 percent. Following previous studies, the authors also examine whether there is a difference

between the earlier cohort and the later cohort of immigrants, and find that the effect of immigration on average wages is caused by the total stock of immigrants as a ratio to the total labour force, not by the influx of recent immigrants. The authors suggest two explanations for the downward effect that immigrant supply could have on average wages: (i) firms believe immigrants are less productive than native workers, and (ii) immigrants have lower reservation wages than natives. Then, when controlling for occupation, the authors find statistically negative effects of immigration on average wages, and specifically among skilled production workers and semi/unskilled service workers. But the authors note that if immigrants earn less than natives, this negative impact reported above could simply reflect composition changes within the occupation, toward a higher share of lower paid immigrants.

Turning to evidence from France, Edo (2015) examines the wage and employment effect immigration has on native workers in France. The study uses the French LFS data, which are richer than usual, restricting the sample to men in the labour force aged 16 to 64, who are not students or self-employed, and who have between one and 40 years of labour market experience. The author uses a log-level model and the first set of variables used in this paper uses monthly wages and number of hours worked per week as the dependent variables, and controls for the immigrant status of an individual, the type of work hours, type of employment, type of contract, firm entry year (job tenure), as well as family and social characteristics like the presence of children and marital status.

The second set of variables is specifically important, as it is used in the implementation of the main estimation technique – the national skill-cell approach, whereby cells are defined in terms of educational attainment, experience level and calendar year and identified by a skill type, into which individuals are then assigned based on their education-experience profile. This set of variables, along with a variable that accounts for the immigrant share in a certain period for men with a specific education and experience level, allows one to model the following outcomes: (i) average monthly and hourly wages; and (ii) the employment rate to population and the employment rate to labour force. The data are thus related to native men with a specific education level, experience level and at a specific time.

The results suggest that the wages of immigrants are lower than those of native works by around 2 to 3 percent. In addition, Edo (2015) finds that natives who are employed under short-term contracts are strongly affected by immigration. The results also suggest that immigrants are more likely to do late hours, work at night or on weekends compared to their native counterparts. However, the author

does find strong evidence that immigration has a negative effect on the employment of native workers; the argument here is similar to that of Nickell and Salcheen (2017); immigrants are more willing to accept lower wages and exert more effort in production relative to native workers, making them relatively more attractive for firms (Edo, 2015).

Overall, the results drawn from studies in Canada, the United States or at the international level all suggest similar findings: there is little to no impact of immigration on native earnings and employment levels, and when there are, they are small in economic magnitude and/or not statistically significant. When there are significant effects, they occur as a result of a later cohort of immigrants affecting the labour market outcomes of the earlier cohort of immigrants (Nickell & Saleheen, 2015); there are also significant effects on less-skilled native workers relative to high-skilled native workers as a result of immigration flows (Card & Altonji, 1991). Many studies discuss and address the problem of endogeneity of immigrant flows, by suggesting the inclusion of an instrument variable of historical immigrant settling patterns, while newer studies (Llull, 2018) develop a new instrumental variable disaggregating immigration flows by immigration push factors.

3. Data

This study draws on data from the 2001 and 2006 Census public use micro-data files. These files are comprised of samples of anonymous responses to the Census questionnaires whose files contain information on demographic, social and economic characteristics based on a 2.7 percent sample of the Canadian population. The Census' population of interest is all Canadian citizens and landed immigrants who reside in Canada or who are abroad, either on a military base or on a diplomatic mission. Non-permanent residents, refugee claimants and their families living with them are also included in the population of interest. The Census excludes residents who are institutionalized, employees who reside in the institution in which they work (as well as family members that live with them), residents of incompletely enumerated Indian reserve or settlements, and foreign residents (whether they are diplomats, members of the Armed Forces of another country stationed in Canada or temporary visitors. The Census' unit of observation is the individual, and it is a survey whose data are collected using a paper and online questionnaire. There are 801,055 initial observations in the 2001 Census and 844,476 initial observations in the 2006 Census. I did not use data from the 2011 National Household Survey (NHS) for reasons related to comparability issues and bias. Unlike the mandatory

nature of both the 2001 and 2006 Census surveys, the NHS was a voluntary survey. There were thus relatively low response rates, leading to non-response bias, and even among surveys that were responded, there were some questions left unanswered. I therefore chose to restrict my data set between the 2001 and 2006 Census surveys.

3.1 Sample Selection

Restrictions are imposed on the initial set of observations in both 2001 and 2006 in order to reach a more relevant sample to help better address the relationship between immigration and native wages. Following age restrictions imposed on data by other studies (Card, 2001; Manacorda, Manning & Wadsworth, 2011; Llull, 2018), the study excludes individuals who are under the age of 15 and over the age of 64 to retain only those who make up the working-age population. The third restriction removes all individuals who report not being in the labour force, unemployed and not looking for work, having not worked since 2000, or having worked zero hours per week. This sample then retains individuals who are currently employed at the full-time level, and earning a wage or salary. It excludes individuals who have not worked since 2000. The sample is restricted further by eliminating individuals who are self-employed, as their earnings are hard to observe. The sample excludes non-permanent immigrants, as we cannot observe their wages and as the study seeks to observe the effect of immigrants on native-born Canadians only. The total number of observations after the restrictions have been imposed is 503,261 individuals; 57 percent of the total observations come from the 2001 census file, while 43 percent of the total observations are drawn from the 2006 census file.

Summary statistics of the data exploited in evaluating the impact of immigration on the wages of native-born Canadians are reported Table 1. The first column of mean values reports those for the year 2001. The first row presents that the average proportion of immigrants to the total labour force in Canada in 2001 as 23 percent. Earnings are reported in nominal value. Average annual native earnings in 2001 amount to $34,298 CAD. The following three rows provide mean characteristics for the educational attainment groups. The largest group of native-born Canadians from this category is comprised of those holding at most a high school diploma or non-university post-secondary education certificate, at 64.3 percent, followed by those who have a bachelor's degree at about 31 percent. 27.7 percent of native-born Canadians fall within the age group comprised of those 35 to 44 years. The largest (smallest) proportion of natives came from Ontario, at 44 percent (Manitoba, at 3.9 percent). There are 215,575 observations in the 2001 sample.

There are some notable differences between the summary statistics for the 2001 sample and the 2006 sample. In 2006, the average proportion of the immigrant to the total Canadian population ratio grew to about 30 percent. Average annual earnings in 2006 increased by $944.90 CAD, to $35,242.75 CAD. In 2006, the largest group of natives held some post-secondary education or college diploma, but at a higher level of about 74 percent. In addition, the percentage of natives holding only a university bachelor's degree fell, but the proportion of the native population holding a graduate degree increased. The age category with the most natives is still the one which contains ages between 35 and 44. In 2006, the largest (smallest) proportion of native-born came from Ontario, at 43.9 percent (Manitoba, at 3.6 percent). There are 287,686 observations in the 2006 sample. The reference individual for this study is a male between the ages of 35 to 44, from Ontario (or the Toronto CMA) and who has only a high school educational attainment level.

4. Empirical Model

To explore the relationship between immigration stocks and wages of native-born workers, this paper uses a log-log model. The analysis also includes a logistic regression model to examine the relationship between immigration stocks and unemployment probability of natives. This section begins with a description of the model examining the first relationship. The first relationship was examined using two-stage least squares regression analysis, after the initial regression using ordinary least squares estimates was deemed suspect due to possible endogeneity (discussed later in this section). The two specifications are based on the following regression model:

$$lnwage_{it} = \beta_0 + \beta_1 \ln\left({}^{I}/_{N}\right)_{itsj} + \sum_{s=1}^{2} \beta_{2s}\, educ_{its} + \sum_{r=1}^{4} \beta_{3r}\, age_{itr} + \sum_{j=1}^{18} \delta_j\, CMA_{itj} + \sum_{q=1}^{2} \beta_{4q}\, divorced_{itq} + \beta_5 census_{i,2006} + \varepsilon_{ijst} \quad (1)$$

Following the procedure found in most papers of the existing literature, the regressand of the first relationship, $wage_{it}$, represents the annual earnings received by individual *i* at time *t*. Other studies (Aydemir & Borjas, 2007; Laryea, 1997) also estimate earnings, but also at the weekly or monthly level. The key exogenous variable, $(I/N)_{itsj}$, is the ratio of immigrants *(I)* to the total Canadian population *(N)* varying by educational attainment level *s* in CMA *j* at time *t*; the ratio is then calculated for the number of immigrants in a specific CMA *j* at time *t* with education level *s*

relative to all natives in that CMA with that education level. The second term of equation (1), $educ_{its}$, is a vector of educational attainment dummy variables that accounts for the effects of having obtained different levels of education, varying by individual *i*, time *t*, and education level *s*. Here, educational attainment levels are used as a proxy for skill levels among employees, assuming that higher educational attainment is associated with greater productivity. I divide the labour market into sub-labour markets while assuming immigrant and native workers are perfect substitutes within each educational level. There are two educational levels plus an omitted category (those with a high school education or less), which yields two estimated coefficients. The model's identification strategy is to aggregate individuals at a specific time into educational attainment groups crossed with groups based on the workers' CMA region; thus, variation in the key variable comes from differences in educational attainment within a given CMA region.

age_{itr} is a vector of age dummy variables (15 to 24; 25 to 34; 35 to 44; 45 to 54; and 55 to 65) which adjusts native annual earnings for age. The third age dummy variable, ages 45 to 54, is used as the reference group and is omitted, which yields four estimated coefficients. The fourth term is a matrix of dummy variables accounting for the individual's CMA of residence, *r*: CMA_{itj}. The fifth term, $divorced_{itq}$, is a binary dummy variable, which takes a value of 1 if the individual is not married or single – specifically if the individual is separated, widowed or divorced. The argument here is that falling under one of those three categories may impact the individual's employability adversely, due to potential family responsibilities.

The values of the key exogenous variable $(I/N)_{itsj}$ for each individual *i* are determined by a mapping from the individual's CMA *j* and educational level *s*. The average value for each CMA-education level cell is assigned to each individual within it. Within this specification, there is also an additional set of interaction variables included. The second equation, while controlling for the effects of CMAs, includes interaction terms between educational attainment and the ratio of immigrants to total population.

Endogeneity is a critical problem in this study as there is no way to know whether or not immigrant flow into a given city is a choice variable resulting from that city having high wages, which in turn attracts immigration. Ideally, one would follow previous studies (Altonji & Card, 1991) and use a lagged variable accounting for previous immigrant settlement in a city, specifically as "predictors of the change in immigrant fraction." However, given that this study does not use time-series data, this method is not possible and is thus not adopted.

Instead, focus is redirected to address the endogeneity of another regressor that is an individual characteristic that may be an endogenous determinant of earnings that was not discussed in the literature presented in this study: the marital status of an individual. To account for possible endogeneity, two-stage least squares regression analysis is implemented. The instrument used for an individual reporting as being married is the presence of children aged zero to 15 in a given household. If a parent, whether a male or female, is preoccupied with raising a child or tending to his or her needs, this may affect their earnings negatively. An additional problem here is that given a child present in the household, this may also have a positive effect as a result of the parental need to provide for the child financially, resulting in the parent making labour market choices that lead to earning higher wages (working another job, working more hours, etc.). Two-stage least squares regressions are carried out for both specifications mentioned above.

This paper includes a regression model to estimate the effect immigration has on the probability of a native being unemployed. The specification for this model is as follows:

$$unemployment_{it} = \beta_0 + \beta_1 \ln\left({}^{I}/_{N}\right)_{itsj} + \sum_{s=1}^{2} \beta_{2s}\, educ_{its} + \sum_{r=1}^{4} \beta_{3r}\, age_{itr} + \sum_{j=1}^{18} \delta_j\, CMA_{itj} + \sum_{q=1}^{2} \beta_{4q}\, divorced_{itq} + \beta_5 census_{i,2006} + \varepsilon_{ijst} \qquad (2)$$

where odds of the dependent variable are conditioned on taking on a value of 1, which in our data results in the dependent variable representing unemployment odds[1]. In raw form, *unemployment* is a binary variable, but I estimate the results based on the odds ratio. Similar to the *wage* regressand, the *unemployment* regressand in this specification varies by individual i with education level s in CMA j at time t. This specification does not include the interaction variable between educational attainment estimated and the ratio of immigrants to the total population. From the logistic regression, we use the coefficients to calculate the odds ratio as follows:

$$\text{odds ratio} = e^{\beta \cdot (\text{chosen percentage change in } \beta\text{'s variable})}$$

The value of the odds ratio will then provide the probability a native individual will become unemployed as a result of a chosen increase or decrease in an exogenous variable. Specifically, I want

[1] Specifically, the variable represents individuals who reported as not looking for work, or looking for part- or full-time work, while being unemployed as a result of a lay-off, or unemployed with new job arrangements.

to examine the marginal effects of the explanatory variables through. We will use this method in the discussion of this specification's results in the following section.

5. Results

This section first presents the results of the effect of immigration on native wages, and then on native unemployment probabilities. The results from the OLS regressions, the IV regressions and the logistic regression, are presented, in that order. Note that all results reported use heteroscedasticity-robust standard errors.

5.1. Examining the Effect of Immigration on Native Wages

5.1.1. Ordinary Least Squares Estimation: Controlling for CMAs

Table 2 presents the results for both specifications using OLS for which the control variable for region is the CMA. The first specification's results for our key variable of interest, the log ratio of immigrant to the total population in Canada, suggest that in 2001, a one percent increase in the ratio results in a 0.06 percent increase in annual native wages; this result is statistically significant at the 5 percent level, but is very small in magnitude. The second column presents results when interaction terms are included to control for the relationship between the ratio and educational attainment levels. In the fourth specification, a one percent increase in the ratio results in approximately a 0.1 percent increase in annual native wages in 2001. This result is statistically significant at the 0.01 percent level, and is slightly more economically significant (although still very small).

I use the census year dummy to account for the difference in effects between the year 2001 and 2006. If $census = 0$, the estimate refers to 2001. If $census = 1$, the estimate refers to 2006. With regards to the $lninterac$ variable, which is a logged interaction variable between the ratio and the census year in question, the interpretation is as follows:

$$\frac{\partial lnwage}{\partial lnratio} = \beta_{lnratio} + \beta_{lninterac} \cdot census$$

$if\ census = 0$, $\frac{\partial lnwage}{\partial lnratio} = \beta_{lnratio}$, and we calculate the effect for 2001 using the coefficient of *lnratio;*

$if\ census = 1$, $\frac{\partial lnwage}{\partial lnratio} = \beta_{lnratio} + \beta_{lninterac}$, and we calculate the effect for 2006 by adding the coefficients of *lnratio* and *linterac.*

Thus, if we look to Table 2, adding the coefficients of $lnratio$ and $lninterac$, the effect of a one percent increase in the ratio is a 0.018 percent increase in the annual wages of natives. This result is statistically significant but very small in magnitude and not very different from zero. When considering the result from the specification including the educational attainment and the ratio interaction variable, the effect in 2006 of a one percent increase is the 0.1 percent increase in annual native earnings found in 2001, down to a 0.058 percent increase in annual native earnings in 2006.

With regards to educational attainment, the results are all statistically significant at the 1 percent level. Not surprisingly, relative to the benchmark individual with only a high school educational level or less, being a holder of a bachelor's degree or a graduate degree increases the native individual's annual wages by about 35 percent and 50 percent, respectively. The magnitude once again increases when the specification includes the ratio and educational attainment interaction term. The age-group dummy coefficients suggest that relative to those between the ages of 35 to 44, native Canadians in all age groups, except those 45 to 54 years old, experience lower annual wages. The effect is most pronounced for native individuals in the youngest age category, 15 to 24, at 132 percent. This can be explained by the potential lack of experience, whether it is obtained through educational means (university, college, etc.) or in a work setting (professional), and lack of skills required to earn high wages in the labour market.

The results for the estimates of the CMAs are not all statistically significant, and thus are in general, economically insignificant. Most of the results suggests that native-born Canadians in any CMA other than Calgary experience wage reductions relative to the Toronto CMA; there is a 5 percent increase in a native individual's annual wages if that individual resides in Calgary (statistically significant at the 5 percent level). When including the interaction term of educational attainment and the immigrant ratio, the negative effects on annual native wages become smaller in magnitude. Another interesting difference is that in the Ottawa-Hull CMA, without the interaction term, the effect is negative and insignificant; when including the interaction term, the result is a 5.4 percent increase in annual native wages for an individual from that CMA, and it is statistically significant at the 5 percent level.

The results from the marital status variables suggest that native-born individuals who are married experience higher annual wages than those who are divorced, separated or widowed (a 14.8 percent increase in native annual wages for a native married individual compared to a 5.6 percent increase in native annual wages for a native divorced/separated/widowed individual).

5.1.2. Two-Stage Least Squares Method: Controlling for regional effect by CMAs

In this section, the presence of children is used as an instrument for whether or not a native individual is married. Tests for endogeneity and weak instruments (Durbin-Wu-Hausman test, specifically) indicate that using children instead of the status of a native individual being married would improve results. This section presents those results in Table 3.

The results are reported in columns (1) and (2) of Table 3. A one-percent increase in the ratio of immigrants to the total Canadian population results in a 5.5 percent increase in annual native wages in 2001, which is very small but and only statistically significant at the 5 percent level. When including the interaction term between educational attainment levels and the ratio, this increase in annual native wages rises to 0.1 percent, similar to the OLS case. When looking at the effect of a one percent increase in the ratio in the year 2006, the increase in native annual wages is reduced to 0.015 percent, which is once again not very statistically different from zero.

Once again, a higher educational attainment results in higher annual wages for natives. Relative to the individual who has only a high school education or less, holding a bachelor's degree increases native wages by 34.7 percent, whereas it increases native wages by 44.4 percent for graduate degree holders. Including the interaction term of educational attainment and the immigrant ratio augments the magnitude of these results slightly to 36.3 percent and 51.5 percent for bachelor and graduate degree holders, respectfully. The same native-born age group as in the first specification, those aged 45 to 54, experiences the only positive impact on annual wages, by 11 percent. All other age categories have negative effects on their annual earnings.

The Ottawa-Hull, Windsor and Calgary CMAs are the only ones to show statistically significant and positive impacts on annual native wages. This is similar to the results of the OLS regression, where the highest positive result is a 5 percent increase in native annual wages for those residing in the Ottawa-Hull or Calgary CMA. In addition, according to the results regarding marital status, native individuals who are married receive once again higher annual wages than those who are divorced, separated or widowed. Overall, the findings of the IV results do not differ much, with the exception of the estimated coefficients of some CMA variables gaining or losing significance, and some magnitudes changing by very small amounts. To better address the problem of endogeneity, it would be ideal to include a Heckman specification model to address the biased estimate of the effect of migration. One would need to introduce explanatory variables that have an effect on the selection equation, but do not affect the earnings equation.

5.2. Examining the Effect of Immigration on Native Unemployment

For this section, the model specification no longer uses the natural logarithm of the dependent variable, and uses a logistic regression model whose results are presented in Table 4. The dependent variable is interpreted as explained at the end of section 4. In the first column, when controlling for regional effects using CMA areas, the estimated coefficient of the main variable of interest, the ratio of immigrants to the Canadian population, is not statistically significant. The results suggest that a ten percent increase in the ratio of immigrants to the total Canadian population results in a 0.96 to one odds ratio of unemployment to employment among native-born Canadians. This result is still not economically significant, especially relative to the magnitude of the results from the previous regressions in section 5.1 (although in the earlier case, the dependant variable is wages).

As expected and consistent with the results of annual wage estimation in section 5.1, higher educational attainment leads to a lower probability of unemployment; specifically, in column (1) for the regression results using CMA areas, for an individual holding a bachelor's degree, there is a 0.90-to-one odds ratio of unemployment to employment among native-born Canadians. For an individual holding a graduate degree, there is a 0.78-to-one odds ratio. As estimated, when the level of educational attainment increases, the probability of unemployment falls. Among the different age categories from the CMA area regression specification, the results from this regression are qualitatively similar to those from section 5.1. The age group that earned the highest wages from the earlier regressions, those between the ages of 45 and 54, are estimated to have a 0.925-to-one odds of unemployment to employment; the other age groups experience a much higher odds ratio, ranging from 1.13, for those aged 55 to 64, to 2.24 for those aged 15 to 24. Examining the CMA dummy variables, the Ottawa-Hull CMA suggests a 0.94-to-one odds of unemployment to employment ratio, compared to a 1.39 odds ratio for an individual reporting from the Halifax CMA.

5.3. Robustness Checks

In order to address issues of robustness, the same regression equations discussed above were re-estimated for those in the lowest percentile of earnings, as well as those in the highest earning percentile. The idea behind this method is to split the sample into quintiles of individuals with homogenous characteristics. I use a percentile criterion to divide the original sample into one group that contains individuals in the lowest decile of earnings (lowest 10% of income earners), and another group containing individuals in the highest decile of earnings (top 10% of income earners). Estimates

derived from these sub-samples indicate that these changes do not have an impact; almost all of the coefficient estimates remained the same quantitatively and qualitatively.

An ideal robustness check for extended research would be to conduct a Monte Carlo simulation, which generates random and repeated simulations of the existing data. This has been performed by Battisti et al. (2014) as a part of their sensitivity analysis in examining the effect of immigration on native welfare, and specifically their labour market outcomes while considering labour market frictions and institutions in receiving countries. They do so by creating 10,000 artificial economies with simulated data, and are able to examine different possible drivers (GDP, wage gaps, unemployment, public policy and migrant share) that matter for native welfare in the presence of an increase in the share of foreign born workers in the labour market.

6. Conclusion

This paper seeks to determine the effect that immigration has on the labour market outcomes of native-born Canadians; specifically, it addresses the impact that an increase in the ratio of immigrants to the Canadian population has on average annual earnings among natives, as well as the impact of an increase in the ratio on the unemployment probabilities among native-born Canadians. This estimation is conducted while considering other possible key factors of wage determination, such as educational levels, CMAs as a control for regional effects, age and marital status.

The results of this study are similar to those of existing literature in that the economic significance of the statistically significant results are very minor. According to my estimates of the effect on annual native earnings as a result of an increase in immigration, it is found to be only positive across all specifications, while in some of the literature, a negative (but still small) effect is found. Specifically, when using selected controls, a one percent increase in the ratio of immigrants to the total Canadian population results in at most a 0.1 percent increase in the annual earnings of native-borns in 2001; this value falls to 0.05 when examining annual earnings of native-borns in 2006.

An extension of this research could include examining the substitutability and complementarity between immigrants and natives in labour demand in a more rigorous fashion, and between the two types of immigrants themselves (recent and settled immigrants). This analysis could provide more insight regarding the positive results obtained for native earnings, following the work of Islam (2005); it was suggested by his results that an immigrant inflow was associated with an increase in native

earnings as a result of immigrant workers and native workers being complements in production. He goes on to conclude that there is in fact no displacement of native earnings caused by immigration.

When estimating the effect of an increase in immigration on employment levels, however, the results do suggest that there is a positive effect on the unemployment odds among native-born Canadians. A ten percent increase in the immigration to Canadian population ratio is suggested to result in a 0.96-to-one odds ratio of unemployment to employment among natives in Canada. However, the unemployment odds for a native-born Canadian are higher when considering other factors alone, such as being in the age category comprising 15 to 24 years (with an odds ratio of 2.24 to one). This is to be expected, as these individuals generally do not have the skills or experience, whether professional or academic, to be as employable as, for example, individuals who fall in the category of 45 to 54 year olds (whose unemployment odds ratio is relatively low at 92.5 to one).

It is important to note, however, that there are potential issues of endogeneity, such as omitted variable bias, as it is difficult to include or measure all the possible factors determining the wage. The correlation of these unspecified and omitted factors with the key exogenous variable, the immigrant to Canadian population ratio, causes the estimated coefficient of interest to be biased.

An analysis that would have allowed this study (especially with regards to the first relationship examining native annual earnings) to go a step further is if sample selection bias could have been addressed; specifically, when individuals who are not *earning* a wage (for reasons such as their reservation wage being higher than the going wage) are excluded from the sample. The results generated by those remaining in the sample will show higher earnings now that there is an exclusion of individuals who are not in the sample for reasons such as, for example, that they prefer to not work because the going wage is less than their reservation wage.

Following the empirical strategy employed by Card (1991) or Llull (2018), having been able to use a lagged value of the key exogenous variable (past immigration settlement patterns) as an instrumental variable would have also been a useful way to observe whether immigrants locate themselves where high earnings and employment levels occur, or whether earnings and employment level changes among native-born Canadians are caused by immigration flows. Such an empirical analysis would complement the existing literature involving an analysis of causality related to migrant and native labour demand or supply.

7. Works Cited

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8. Tables

Table 1: Summary statistics

Explanatory variables	*Means (2001)*	*Means (2006)*
A. Immigrant to Canadian Population Ratio		
(I/N)	0.234 (0.133)	0.299 (0.167)
B. Annual Earnings		
Wage	34297.85 (27954.88)	35242.75 (50422.01)
C. Educational Attainment		
High School (or less)	0.422 (0.494)	0.370 (0.483)
University, Bachelor's degree	0.535 (0.499)	0.393 (0.488)
University, graduate degree	0.043 (0.204)	0.236 (0.425)
D. Age Groups		
15-24	0.172 (0.377)	0.173 (0.378)
25-34	0.237 (0.425)	0.209 (0.407)
35-44	0.277 (0.448)	0.235 (0.424)
45-54	0.223 (0.417)	0.224 (0.417)
55-64	0.091 (0.287)	0.123 (0.329)
E. CMA		
Halifax	0.021 (0.144)	0.020 (0.138)
Quebec	0.039 (0.194)	0.037 (0.189)
Montreal	0.184 (0.389)	0.178 (0.382)
Sherbrooke/Trois-Rivières	0.015 (0.123)	0.016 (0.124)
Ottawa/Hull	0.061 (0.240)	0.057 (0.233)
Oshawa	0.017 (0.130)	0.017 (0.129)
Toronto	0.242 (0.428)	0.250 (0.433)
Hamilton	0.036 (0.187)	0.034 (0.181)
St. Catherines/Niagara	0.020 (0.141)	0.019 (0.138)
Kitchener	0.025 (0.155)	0.023 (0.151)
London	0.024 (0.153)	0.023 (0.149)
Windsor	0.017 (0.130)	0.016 (0.124)
Sudbury/ Thunder Bay	0.015 (0.122)	0.014 (0.117)
Winnipeg	0.040 (0.195)	0.036 (0.186)
Regina/Saskatoon	0.024 (0.152)	0.022 (0.148)
Calgary	0.056 (0.231)	0.060 (0.238)
Edmonton	0.054 (0.226)	0.057 (0.232)
Vancouver	0.092 (0.289)	0.104 (0.305)
Victoria	0.016 (0.126)	0.017 (0.130)
F. Marital Status		
Married	0.473 (0.499)	0.472 (0.499)
Divorced/Seperated/Widowed	0.128 (0.334)	0.126 (0.332)
Single	0.399 (0.490)	0.401 (0.490)
Observations	215,575	287,686

NOTES: Standard errors are reported in parentheses.

Table 2: Impact of Immigration on native annual wages, OLS

Explanatory variables	*(1)*	*(2)*
A. Log Immigrant to Canadian Population Ratio		
(I/N)	**0.058 (0.018)***	**0.104 (0.020)****
B. Educational Attainment	-	-
High School (or less)		
University, Bachelor's degree	**0.347 (0.005)****	**0.363 (0.012)****
University, graduate degree	**0.442 (0.013)****	**0.514 (0.023)****
D. Age Groups		
15-24	**-1.327 (0.008)****	**-1.326 (0.008)****
25-34	**-0.227 (0.005)****	**-0.227 (0.005)****
35-44	-	-
45-54	**0.102 (0.005)****	**0.102 (0.005)****
55-64	**-0.125 (0.008)****	**-0.125 (0.008)***
E. CMA		
Halifax	**-0.191 (0.038)****	**-0.083 (0.046)****
Quebec	-0.678 (0.038)	0.084 (0.062)
Montreal	**-0.096 (0.169)****	**-0.051 (0.020)***
Sherbrooke/Trois-Rivières	**-0.162 (0.517)***	-0.016 (0.062)
Ottawa/Hull	-0.002 (0.020)	**0.054 (0.024)***
Oshawa	-0.002 (0.023)	0.052 (0.027)
Toronto	-	-
Hamilton	**-0.084 (0.016)****	**-0.047 (0.019)***
St. Catherines/Niagara	**-0.212 (0.023)****	**-0.158 (0.026)***
Kitchener	**-0.054 (0.018)***	-0.014 (0.020)
London	**-0.122 (0.021)***	**-0.072 (0.024)***

Windsor	-0.025 (0.021)	0.017 (0.023)
Sudbury/ Thunder Bay	**-0.140** **(0.035)****	-0.047 (0.413)
Winnipeg	**-0.186** **(0.020)****	**-0.132** **(0.024)****
Regina/Saskatoon	**-0.151** **(0.035)****	-0.054 (0.042)
Calgary	0.009 (0.017)	**0.05** **(0.019)***
Edmonton	**-0.039** **(0.019)***	0.009 (0.022)
Vancouver	**-0.070** **(0.010)****	**-0.056** **(0.011)****
Victoria	**-0.162** **(0.024)***	**-0.108** **(0.027)****
F. Marital Status		
Married	**0.218** **(0.005)****	**0.218** **(0.005)****
Divorced/Seperated/Widowed	**0.105** **(0.007)****	**0.105** **(0.007)****
Single	-	-
G. Interaction Terms		
Log (I/N) x University, Bachelor's degree	-	0.013 (0.007)
Log (I/N) x University, graduate degree	-	**0.077** **(0.021)****
Census x Ratio	**-0.040** **(0.005)****	**-0.046** **(0.005)****
Census x Log (I/N)	**(0.005)****	**-0.046** **(0.005)****
H. Census Year Dummy		
Census	**-0.086** **(0.181)****	**-0.104** **(0.120)****
F-Statistic	1837.71	1708.64
R^2	0.4338	0.4339
Number of observations	345,975	345,975

NOTE: * and ** denote statistical significance at $p < 0.005$ and $p < 0.001$, respectively. Standard errors are reported in parentheses.

Table 3: Impact of immigration on native annual wages, Instrumental variables estimation

Explanatory variables	*(1)*	*(2)*
A. Log Immigrant to Canadian Population Ratio		
(I/N)	**0.055 (0.018)***	**0.101 (0.020)****
B. Educational Attainment	-	-
High School (or less)		
University, Bachelor's degree	**0.347 (0.005)****	**0.363 (0.012)****
University, graduate degree	**0.444 (0.013)****	**0.515 (0.023)****
D. Age Groups		
15-24	**-1.371 (0.013)****	**-1.370 (0.013)****
25-34	**-0.247 (0.007)****	**-0.247 (0.007)****
35-44	-	-
45-54	**0.110 (0.005)****	**0.110 (0.005)****
55-64	**-0.113 (0.008)****	**-0.113 (0.008)***
E. CMA		
Halifax	**-0.194 (0.038)****	-0.087 (0.046)
Quebec	**-0.084 (0.512)**	0.064 (0.062)
Montreal	**-0.107 (0.017)****	**-0.062 (0.020)***
Sherbrooke/Trois-Rivières	**-0.176 (0.052)***	-0.032 (0.062)
Ottawa/Hull	**-0.053 (0.020)***	**0.050 (0.024)***
Oshawa	-0.002 (0.023)	**0.055 (0.027)***
Toronto	-	-
Hamilton	**-0.082 (0.016)****	**-0.045 (0.019)***
St. Catherines/Niagara	**-0.210 (0.023)****	**-0.158 (0.026)****
Kitchener	**-0.050 (0.018)***	-0.012 (0.020)

London	**-0.122**	**-0.072**
	(0.021)*	**(0.024)***
Windsor	-0.022	0.017
	(0.021)	(0.023)
Sudbury/ Thunder Bay	**-0.140**	-0.049
	(0.035)**	(0.413)
Winnipeg	**-0.186**	**-0.133**
	(0.020)**	**(0.024)****
Regina/Saskatoon	**-0.151**	-0.055
	(0.035)**	(0.042)
Calgary	0.009	**0.05**
	(0.017)	**(0.019)***
Edmonton	**-0.039**	0.009
	(0.019)*	(0.022)
Vancouver	**-0.072**	**-0.058**
	(0.010)**	**(0.011)****
Victoria	**-0.165**	**-0.108**
	(0.024)*	**(0.027)****
F. Marital Status		
Married	**0.148**	**0.148**
	(0.015)**	**(0.015)****
Divorced/Seperated/Widowed	**0.056**	**0.105**
	(0.012)**	**(0.007)****
Single	-	-
G. Interaction Terms		
Log (I/N) x University, Bachelor's degree	-	0.012
		(0.007)
Log (I/N) x University, graduate degree	-	**0.075**
		(0.021)**
Census x Ratio	**-0.040**	
	(0.005)**	
Census x Log (I/N)	**-0.040**	**-0.044**
	(0.015)**	**(0.005)****
H. Census Dummy		
Census	**-0.086**	**-0.104**
	(0.011)**	**(0.012)****
F-Statistic	1365.41	1432.43
R^2	0.4112	0.4322
Number of observations	345,975	345,975

NOTE: * and ** denote statistical significance at $p < 0.005$ and $p < 0.001$, respectively. Standard errors are reported in parentheses.

Table 4: Impact of immigration on native unemployment probability, Logistic Regression

Explanatory variables	
A. Immigrant to Canadian Population Ratio	
(I/N)	0.178 (0.586)
B. Educational Attainment	-
High School (or less)	
University, Bachelor's degree	**-0.105** **(0.021)****
University, graduate degree	**-0.245** **(0.052)****
D. Age Groups	
15-24	**0.810** **(0.028)****
25-34	**0.238** **(0.027)****
35-44	-
45-54	**-0.077** **(0.029)***
55-64	**0.125** **(0.037)***
E. CMA	
Halifax	**0.326** **(0.148)***
Quebec	-0.046 (0.157)
Montreal	0.016 (0.098)
Sherbrooke/Trois-Rivières	0.225 (0.160)
Ottawa/Hull	**-0.053** **(0.112***
Oshawa	**0.302** **(0.119)***
Toronto	-
Hamilton	-0.084 (0.927)
St. Catherines/Niagara	0.162 (0.117)
Kitchener	0.044 (0.101)
London	0.165

	(0.112)
Windsor	**0.322**
	(0.107)*
Sudbury/ Thunder Bay	**0.539**
	(0.143)**
Winnipeg	0.101
	(0.112)
Regina/Saskatoon	0.078
	(0.146)
Calgary	-0.106
	(0.096)
Edmonton	0.064
	(0.106)
Vancouver	0.028
	(0.048)
Victoria	0.049
	(0.124)
F. Marital Status	
Married	**-0.574**
	(0.025)**
Divorced/Seperated/Widowed	**-0.113**
	(0.032)**
Single	-
Number of observations	386,698
Log-likelihood value	-75471.713

NOTE: * and ** denote statistical significance at $p < 0.005$ and $p < 0.001$, respectively. Standard errors are reported in parentheses.

Table 5: Test for Endogeneity of *married*

H_0: variables are exogenous

Robust score chi2(1)	= 26.395	(p=0.0001)
Robust regression F(1,215545)	= 24.356	(p=0.0000)