Economic Assimilation of Immigrants in Quebec

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Abstract

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In this paper, I examine the wages and work hours of immigrants in Quebec and the rest of Canada. By analyzing data from the Survey of Labour and Income Dynamics (SLID) for the years 1999 to 2011, I explore three key questions about the economic integration of immigrants relative to native-born individuals. The first question examines the initial wage gap for new immigrants, defined as those who have lived in Canada for less than ten years at the time of data collection. The second question assesses whether this wage gap changes significantly over the sample period. The third question examines the extent of economic assimilation in immigrant earnings as their residency in Canada lengthens. The findings reveal a significant initial wage gap, with new immigrants earning 28.8% less than their native counterparts. Over the sample period, this gap narrowed by 1.3% annually. Additionally, the analysis indicates that economic assimilation is substantial, though rates vary between Quebec and the rest of Canada. Initially, assimilation occurs more quickly in Quebec, whereas over time, immigrant earnings rise more rapidly outside Quebec. To further explore the economic assimilation of immigrants, I investigate their work hours and find that new immigrants work fewer hours than their native counterparts. As with the wage gap, the immigrant-native gap in work hours narrows as immigrants stay longer in Canada. To understand these assimilation effects on both wages and work hours, I analyze a simple model of learning by doing (LBD) and show that the model can account for the key observed patterns of wages and hours worked among immigrants in the SLID.

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1 Introduction

Canada exhibits one of the highest per capita rates of immigration globally, and this trend shows no indication of abating. In November 2022, Canada released an Immigration Levels Plan[1] for the period of 2023 to 2026, intending to welcome an annual influx of 465,000 to 500,000 new immigrants for this period. Figure 1 illustrates the influx of new immigrants to Canada from 2011 to 2023, showing a substantial increase in new immigrants from 2022 onwards.[2]

With the rise in immigration to Canada, it is important to evaluate whether the decision to migrate is economically beneficial for the immigrants. According to Statistics Canada, in 2019, new immigrants to Canada had significantly lower earnings than native residents.[3] Therefore, it is important to investigate whether immigrants experience faster earnings growth compared to their native counterparts. This leads to the eventual disappearance of the immigrant-native wage gap, a phenomenon referred to as the "economic assimilation" of immigrants (Borjas, Bronars, and Trejo 1992).

Economic assimilation is a key question in the literature on immigration for several reasons. Primarily, it offers insights into the extent to which immigrants contribute positively to the Canadian economy. Secondly, it explains some aspects of immigrants' well-being by exploring how their economic status evolves as they establish themselves in Canadian society. This is also claimed by Villarreal and Tamborini (2018), who mention that parity in earnings is a strong indicator of immigrants' well-being in the country. By understanding the dynamics of economic assimilation, policymakers, researchers, and stakeholders can better address the challenges and opportunities associated with immigration.

Immigrants in Canada have historically faced lower wages than native residents. This is evidenced by Smith and Fernandez (2017) who report that in Canada immigrants earn over $200 less per month than their native-born counterparts. This phenomenon is worrying since immigrants play a vital role in labor force growth and productivity. This is evidenced by Peri (2012), who reports that immigrants to the US led to an increase in total factor productivity in the area they immigrate to.

If the wages of immigrants in Canada do not significantly approach those of native workers, it could indicate that immigrants are not substantially improving their skills af-

1. See https://www.canadavisa.com/canada-immigration-levels-plans.html

2. One of the motivations behind the influx of immigrants plan is due to the aging Canadian population. Between 2016 and 2021, there was a notable increase of 18.3% of individuals aged 65 and over in Canada. Thus, there is a worry about an aging Canadian population, which would hurt the Canadian economy. This is evidenced by the 2021 census (see https://www150.statcan.gc.ca/n1/daily-quotidien/220427/dq220427a-eng.htm).

3. See https://www150.statcan.gc.ca/n1/daily-quotidien/211206/dq211206b-eng.htm.

ter arrival. This scenario suggests a decline in the overall quality of human capital within Canada. Supporting this notion, Coulombe, Grenier, and Nadeau (2014) report that the lower human capital quality among immigrants—despite their higher education and experience level—contributes to the widening wage gap between native and immigrant workers. Consequently, Canada has reformed its immigration points system to prioritize applicants with Canadian education and experience. This adjustment aims to enhance the quality of immigrants, thereby improving their well-being by ensuring they acquire skills that lead to higher earnings.

For the period 2014 to 2018, there was a substantial uptick of 23% in the entry-level wage for new immigrants across the country.[4] This trend is indicative of a potential improvement in the alignment between more recent new immigrant cohorts and the demands of the Canadian labor market. Picot and Hou (2003) explain that this rise in the entry-level wage of new immigrants is mainly attributed to the difference in their language skills, country of origin, and experience. Therefore, this supports the claim that recent cohorts are more skilled than previous cohorts of new immigrants.

Consequently, it becomes crucial to examine the evolution of the wage gap between different cohorts of new immigrants to assess whether the quality of immigrants entering Canada has improved over the years. A decreasing wage gap between new immigrants and natives over time would indicate that more recent new immigrant cohorts are more skilled than the previous cohorts (see Picot and Hou (2003)).

It is also important to highlight the educational achievements of immigrants in comprehending the perceived economic benefits they may bring to Canada. It is reported that among immigrants in Canada, 51.5% hold a bachelor's degree or higher, compared to only 28.5% among the national population.[5] Therefore, to understand the wage gap between immigrants and natives, it is important to account for educational attainment. This paper controls for education, as well as other variables such as age and gender. However, Smith and Fernandez (2017) state that even after controlling for the education of human capital, the wage gap between immigrants and natives in Canada persists. Furthermore, Oreopoulos (2011) mentions that this gap in wages, even after factoring in education, could be due to employers valuing Canadian education more than foreign education.

This paper analyzes wages and hours of immigrants using the available data from the Survey of Labour and Income Dynamics (SLID) spanning the years 1999 to 2011. The analysis consists of the following main components.

4. https://www.ctvnews.ca/canada (2024): "New immigrants' incomes 'improved considerably' in recent years in Canada"

5. https://montrealgazette.com/news/local-news (2023): "Immigrants more likely to be university-trained than Quebec-born people"

1. I analyze the initial wage gap between *new immigrants* and native-born Canadians, specifically focusing on the province of Quebec. In this context, 'new immigrants' are defined as individuals who have resided in Canada for less than 10 years. Specifically, I trace the trajectory of this wage gap over the sample period, 1999 to 2011.
2. I measure the extent of economic assimilation employing the methodology used by Borjas, Bronars, and Trejo (1992). This is done to ascertain whether immigrants in Quebec and the rest of Canada experience accelerated wage growth compared to native-born individuals, therefore reducing the wage gap over time.
3. To further explore the economic assimilation of immigrants, I investigate their work hours. This analysis examines whether there are differences in work hours between immigrants and natives, and if such a gap exists, how it has evolved over time.
4. Finally, to understand the joint evolution of both wages and work hours, I analyze a simple model of learning by doing (LBD).

The main findings of this study are as follows.

1. There is a substantial wage gap between new immigrants and natives, and this wage gap has undergone considerable changes between 1999 and 2011. While the wage gap decreased in both Quebec and the rest of Canada, the reduction was more rapid outside of the province of Quebec.
2. Similar to their wages, new immigrants work significantly fewer hours than their native counterparts.
3. Evidence of economic assimilation in both wages and work hours was observed throughout Quebec and the rest of Canada. Initially, immigrants in Quebec have experienced faster wage growth compared to those in the rest of Canada; however, over time, their overall wage growth is surpassed by that of immigrants in the rest of Canada.
4. The model incorporating learning by doing effectively accounts for the key observed patterns of wages and hours worked among immigrants.

The remainder of the paper is organized as follows: Section 2 provides a summary of the immigration policy in Quebec. Section 3 reviews the related literature. Section 4 describes the dataset used for the analysis. Section 5 details the empirical methodologies employed in this research. Section 6 discusses the results of the wage analysis, presenting the main findings and their implications. Section 7 examines the evolution of work hours among immigrants, analyzing trends and patterns over time. Section 8 delves into the learning-by-doing model, exploring its assumptions and effectiveness in explaining the observed phenomena. Finally,

Section 9 concludes the paper, summarizing the key conclusions and suggesting directions for future research. Appendices A and B contain the tables and figures, respectively, and Appendix C outlines the procedure for solving the model.

2 Quebec Immigration

Historically, there have been differences in the immigration policy in Quebec compared to that of the rest of Canada. However, immigration is still a big part of the province of Quebec. Between 1971 and 1991, Quebec sought autonomy in immigration policies distinct from that of the federal government. In 1975, an agreement was reached granting Quebec a say in immigration applications to the province.

The Canada-Quebec Accord Agreement of 1991 marked a pivotal moment in immigration, granting Quebec full control over immigrant selection and acceptance of permanent residents, while the federal government retained responsibility for refugee cases. The main reason the province of Quebec pushed for this autonomy is due to their culture of enriching the French language.[6] Furthermore, it allowed for conflict between the federal and provincial governments to end with regards to the topic of immigration.

Recently, Quebec's immigration minister unveiled a plan to attract primarily skilled workers as immigrants. The plan aims to admit 50,000 immigrants annually for both 2024 and 2025. However, Quebec Premier François Legault made it clear that immigrants intending to reside in the province for more than three years must acquire proficiency in the French language.[7]

Additionally, according to "Le Plan d'immigration du Québec 2024",[8] there is an initiative to increase the permanent immigration of young individuals, aimed at addressing the challenge of an aging population in the region. The plan also considers the importance of enhancing the integration of immigrants from all categories into the labor force, which is crucial for enhancing the overall quality of the job market.

3 Literature Review

There is a large amount of previous research that has been done over the years to try to explain the immigrant-native wage gap. The majority of research stems from differences in

6. https://www.thecanadianencyclopedia.ca/en/article/politique-du-quebec-immigration

7. https://montrealgazette.com/news/local-news (2023): "Quebec sets immigration levels for two years, introduces French requirements"

8. https://cdn-contenu.quebec.ca/cdn-contenu/adm/min/immigration/publications-adm/plan-immigration/PL_immigration_2024_MIFI.pdf

experience and education between the two groups. It would be expected that individuals with similar education and experience will receive the same compensation for working. However, previous research explains that this is not the case, as native experience is favored over foreign experience (Oreopoulos 2011). Other previous work also explains that with time, there is an assimilation effect in which immigrant earnings grow faster, and there is an eventual diminishing of the wage gap. Much of the discussion below will focus on such previous literature.

3.1 Economic assimilation

Borjas, Bronars, and Trejo (1992) study how years since migration affects the earnings of migrants, which had not previously been researched. Their findings indicate that migrants begin with earnings less than native-born individuals. However, the wage differential decreases and finally disappears within a few years as migrant earnings grow faster than that of natives. This relationship is known as assimilation, as explained by the authors.

Hum and Simpson (2000) extend on this research of assimilation. They contribute to prior studies by employing panel data analysis of Canada instead of cross-sectional analysis. The results found by Hum and Simpson (2000) contradict those found by Borjas, Bronars, and Trejo (1992) in which they find that there is a lack of evidence supporting superior wage growth for immigrants. Furthermore, they suggest that assimilation during the 1990s was nonexistent.

Moreover, Borjas (1995) raises doubts about the validity of the conclusion suggesting that immigrants could surpass natives in earnings after 10 to 15 years. He proposes that employing a cohort analysis rather than a cross-sectional analysis would yield a more accurate conclusion. This study finds that a cohort analysis predicts slower rates of earnings growth for most immigrant groups.

Borjas (2015) furthered the cohort analysis by utilizing a broader dataset spanning from 1970 to 2010 to examine the progression of immigrant earnings in the United States. He finds that the more recent cohorts exhibit a smaller earnings growth rate compared to earlier cohorts. Before the 1980s, cohorts found the initial wage gap to narrow by 15% within 2 decades, while cohorts who entered in the 1990s showed no sign of assimilation.

3.2 Immigrant-native wage gap

The literature on the immigrant-native wage gap is a large one that extends away from assimilation. Oreopoulos (2011) conducts research based on the submission of resumes with differing characteristics to some job postings to help study this question. The main takeaway

from his research was that employers explained that they would discriminate by name as a precaution due to language needs. He also finds that Canadian experience is valued more than Canadian education. Fortin, Lemieux, and Torres (2016) expand on this notion of education for immigrants by using data on the location where the highest post-secondary degree was attained. They find that the location of the study helps explain up to 70% of the immigrant-native wage gap. However, this premium also varies depending on the field of study, thus some fields are more portable (smaller wage penalty) than others.

Another study done by Ferrer, Green, and Riddell (2006) uses a new measure of cognitive skill using literacy and numeracy scores to explain low immigrant earnings in Canada. It is found that literacy differences have an impact on the earnings gap. However, this impact is not as important as that from foreign experience differences.

A large contribution made by Borjas and Friedberg (2009) looks at the entry wages of new immigrants to understand the upturn in earnings that they face compared to earlier new immigrants. They find that the increase in recent new immigrants' earnings compared to that of earlier cohorts could be attributed to the United States' new immigration policy looking for high-skilled workers. Another study by Borjas (2000) also explains that there is a positive relationship between the entry wage of immigrants and the subsequent growth of earnings, such that, as new immigrants start to earn more, they will more likely see an assimilation of earnings.

3.3 Summary of literature review

Despite a significant and expanding body of literature on the immigrant-native wage gap and the economic assimilation of immigrants, these issues are still relatively underexplored in the context of Quebec. Furthermore, little is known about the temporal evolution of the wage gap between immigrants and natives in Quebec compared to the rest of Canada. This paper seeks to determine whether the wage gap for new immigrants—defined as those who have less than 10 years of experience in Canada—has narrowed over time in Quebec and the rest of Canada. This paper also replicates the work of Borjas, Bronars, and Trejo (1992) to examine whether immigrants in Quebec experience faster earnings growth compared to native-born individuals, thereby assessing if the wage gap narrows over time as immigrants accrue more Canadian experience. The analysis will use data from the Survey of Labor and Income Dynamics (SLID) for the period 1999-2011.

Finally, studies that utilize dynamic models to explore the wage gap between immigrants and natives are scant in the literature. To understand the assimilation effects on both wages and work hours, this paper analyzes a simple learning-by-doing (LBD) model. It

demonstrates that the model successfully accounts for the key patterns observed in the SLID data concerning the wages and work hours of immigrants.

4 Data

The analysis uses data from the Survey of Labour and Income Dynamics (SLID), spanning from 1999 to 2011. SLID encompasses comprehensive information on wages, salaries, and various other variables concerning individuals residing in Canada. These variables are crucial for comprehending the factors that influence income disparities among individuals over time, thus facilitating the analysis conducted in this paper. The list of characteristics from the database that will be used in the analysis includes those such as gender, age, immigration status, level of education, wages and provinces of the individuals in the sample.

This study concentrates on individuals aged 20 to 64. To ensure the consistency of our analysis, we excluded outlier wages from our sample, specifically annual labor incomes that surpass $750,000. To adjust against the impact of inflation on the analysis, wages have also been adjusted using the Consumer Price Index (CPI) for all items in Canada. The data on CPI is available from the FRED (Federal Reserve Economic Data) database. Figure 2 shows the evolution of the CPI from 1999 to 2011, where the base year is 2011.

Furthermore, to study the change in the wage gap for the sample's new immigrants, a dummy variable was created. This variable for new immigrants takes a value equal to 1 if an individual had immigrated to Canada in the last 10 years at the time he was surveyed and 0 otherwise. This gave 7,800 observations of new immigrants in the sample for the years 1999 to 2011.

Table 1 presents summary statistics of key variables spanning the period from 1999 to 2011, categorized into two groups. The top panel presents summaries for native-born Canadians, whereas the bottom panel displays summaries for new immigrants to Canada, defined as those who have been in the country less than 10 years at the time they were surveyed.

The sample shows that, on average, new Canadian immigrants are 38 years old, while native-born individuals are 42 years old. Consequently, the average age of new immigrants is four years younger, strengthening the idea that Canada wants to bring in immigrants to mitigate the impact of its aging population.

Moreover, data on gender and education level are represented by dummy variables, with values of 0 or 1 indicating the presence or absence of the respective characteristic. In the sample, 54.6% of the new immigrants are female. Additionally, the percentage of new immigrants with a university degree in the sample is 37%, which is a rate significantly higher

than the 19% of natives who have a similar educational attainment.

Additionally, Table 2 presents a summary of the mean hourly wage for both native and new immigrant groups for the years 1999, 2005, and 2011. According to the data, the average wage gap decreased from 20.33% in 1999 to 15.72% in 2005. Although the gap continued to decrease from 2005 to 2011, the reduction was smaller, going only from 15.72% to 15.26%. This will be studied more thoroughly in the analysis through the use of an OLS regression.

5 Empirical Methodology

5.1 Background

For the first part of the analysis, an Ordinary Least Squares (OLS) regression is employed to examine the relationship between the independent variables and the hourly wage for new immigrants relative to the native-born. This comparison will be conducted separately for the province of Quebec and the rest of Canada.

To expand on this analysis, we then explore the evolution of the wage gap of new immigrants throughout the years of the data set, spanning from 1999 to 2011. I will also look at separate regressions for males and females to see if there are gender differences in the wage gap between new immigrants and natives. This will also be repeated for the province of Quebec and the rest of Canada.

The final sub-section of the methodology will explain the assimilation study, which will compare the assimilation of earnings between the province of Quebec and the rest of Canada.

The standard OLS regression equation for this analysis is presented in equation (1) below:

$$\ln\left(Wage_i\right) = \beta_0 + \beta_1 x_{i,1} + \beta_2 x_{i,2} + \ \ldots \ + \beta_n x_{i,n} + \epsilon_i. \tag{1}$$

The components in equation (1) are interpreted as follows: x are the independent variables, $\ln(Wage_i)$ is the dependent variable, and ϵ denotes the non-explanatory error term. β_0 denotes the constant term, referred to as the intercept.

A well-known regression model that is used for analyzing wage as a dependent variable is the Mincer regression model, which is represented by:

$$\ln\left(Wage_i\right) = \beta_0 + \beta_1\, Age_i + \beta_2\, {Age_i}^2 + \beta_3\, Years\ of\ schooling_i + \epsilon_i. \tag{2}$$

5.2 The immigrant-native wage gap

This basic Mincer equation (2) is then expanded on the right side with independent variables tailored to the specific analysis. To analyze the wage gap between new immigrants and natives, the right side is expanded in this paper using a dummy variable for new immigrants. Then, the equation would become the following as shown in equation (3):

$$\begin{aligned}\ln(Wage_i) =& \beta_0 + \beta_1\, Age_i + \beta_2\, {Age_i}^2 \\ &+ \beta_3\, Female_i + \beta_4\, Years\ of\ schooling_i \\ &+ \beta_5\, New\ immigrant_i + \epsilon_i, \end{aligned} \tag{3}$$

where the variable "*New immigrant*" is a dummy variable with a value of 1 if the individual is a new immigrant (those who have been in Canada for less than 10 years at the time of data collection) and 0 otherwise. The estimated parameters $\beta_1, \beta_2, \ldots, \beta_5$ measure the impact of the independent variables on the dependent variable.

Moreover, equation (3) is a log-linear model, which allows us to measure what the effect of being a new immigrant has on the percentage change in hourly wage while controlling for the effects of age, gender, and education. A negative coefficient indicates that the variable has a negative effect on the hourly wage of an individual. Finally, the regression of equation (3) will also control for year fixed effects by including dummy variables for each year in the sample set.

5.3 The evolution of the wages of new immigrants

Furthermore, a new independent variable can be added to equation (3) to advance the research into how the wage gap of new immigrants has evolved from 1999 to 2011. This can be presented by the following equation:

$$\begin{aligned}\ln(Wage_i) =& \beta_0 + \beta_1\, Age_i + \beta_2\, {Age_i}^2 + \beta_3\, Female_i \\ &+ \beta_4\, Years\ of\ schooling_i + \beta_5\, New\ immigrant_i \\ &+ \beta_6\, New\ immigrant_i * (Year - 1999) + \epsilon_i, \end{aligned} \tag{4}$$

where the variable "$New\ immigrant_i * (Year - 1999)$" is an interaction term between the dummy variable for new immigrants and the variable (Year - 1999), which is equal to the current year minus 1999. This variable will help explain the evolution in the wage gap between new immigrants and natives from 1999 to 2011. Finally, the regression analysis using equation (4) includes dummy variables for each year of the sample to control for year

fixed effects.

For example, if $\hat{\beta}_6 = 0.05$, then for every subsequent year after 1999, the new immigrant (those who have resided in Canada for less than 10 years at the time of data collection) wage gap improves by 5%.

5.4 Economic assimilation

The final part of the analysis aims to study the economic assimilation of immigrants. This entails examining whether or not immigrant earnings grow faster than those of native-born individuals over time spent in Canada, potentially diminishing the initial wage gap observed among new immigrants.

For this, a similar methodology to that used by Borjas, Bronars, and Trejo (1992) will be employed. This expands on the basic mincer regression with the use of different individual characteristics, as well as a variable measuring the years since migration. The following model in equation (5) is used for the assimilation study:

$$\begin{aligned}\ln(Wage_i) =& \beta_0 + \beta_1\, Age_i + \beta_2\, {Age_i}^2 + \beta_3\, Female_i + \beta_4\, Years\ of\ schooling_i \\ &+ \beta_5\, Years\ since\ immigration_i \\ &+ \beta_6\, Years\ since\ immigration_i^2 + \epsilon_i. \end{aligned} \tag{5}$$

However, given the nature of the data collected, the years since immigration data are separated into different categories. Specifically, the data separates years since immigration into five ranges: less than 10 years, 10 to 19 years, 20 to 29 years, 30 to 39 years, and more than 40 years. Nonetheless, I use the midpoint of these ranges as the years since immigration for an immigrant individual (see Table 9). Moreover, the regression of equation (5) will also include controlling for year fixed effects.

The process of economic assimilation among immigrants is the idea that the earnings of immigrants grow at a faster rate compared to those of native-born individuals, given the initial wage gap they face. This is indicated by $\hat{\beta}_5 > 0$. However, this growth in earnings should decelerate as the wage gap diminishes, as evidenced by $\hat{\beta}_6 < 0$.

6 Estimation Results

In this section, I present the findings from several regression analyses investigating the wage disparity between new immigrants, defined as those who have resided in the country for less than 10 years at the time of the survey, and natives. Furthermore, I will study how this

wage gap evolves over the time of the selected data. Additionally, I discuss the regression results related to assimilation. These analyses were conducted using data from the SLID database covering the period from 1999 to 2011.

6.1 Wage gap between new immigrants and natives

With the use of the data and model described in equation (3), estimations for the coefficients (β) of each independent variable are obtained. Referring to column 1 of Table 3, the estimated coefficient for the female dummy variable, $\hat{\beta}_1$, is -0.210. This implies that, within our sample from Quebec, females earn approximately 21% less in hourly wages compared to males, which highlights the existence of a gender wage gap.

Furthermore, the data reveal that the wage gap for females in the province of Quebec is less severe than for those living elsewhere in Canada. This conclusion is drawn from the estimated coefficients of the female variable, $\hat{\beta}_1$, which are -0.210 for Quebec and -0.246 for the rest of Canada. Consequently, there exists a 3.6% wider wage gap for females in the rest of Canada within this sample. Additionally, within the Quebec sample, the coefficients for age ($\hat{\beta}_2$) and years of education ($\hat{\beta}_4$) are 0.067 and 0.061, respectively. Therefore, an individual who has more years of education will receive a higher hourly wage compared to someone lacking years of education.

Moreover, as seen in Table 3, a new immigrant, defined as an individual who immigrated within the last 10 years from when the data was collected, is expected to receive an hourly wage that is 21.4% lower than that of a native in the province of Quebec. This result is economically significant, highlighting a substantial wage disparity between new immigrants and natives in Quebec throughout the period spanning 1999 to 2011. On the other hand, in regions outside Quebec, the impact of being a new immigrant is an 19.7% lower wage than natives, which is a smaller gap than in the province of Quebec. However, a significant wage gap is found for new immigrants outside Quebec from 1999 to 2011.

6.2 Change in the wage gap over the sample period

In this section of the analysis, I use equations (3) and (4) to examine the evolution of the wage gap between new immigrants and native-born individuals throughout the dataset period, spanning from 1999 to 2011. By employing these models, I aim to shed light on how the wage disparity between new immigrants and natives has evolved, offering valuable insights into the integration of new immigrants into the Canadian labor market.

Table 4 presents the regression results of equation (3) for male individuals in the province of Quebec for the years 1999 and 2011. The purpose of this regression is to understand how

the evolution of the wage gap between new immigrants and natives changed from the 1999 cohort to the 2011 cohort of new immigrants.

From the results, the significance of years of schooling in improving an individual's wage is greater in 2011 compared to 1999. An extra year of schooling in 2011 improves hourly wage by 2% more than it would have in the year 1999. Finally, the wage gap between new immigrants and natives for the male sample in the province of Quebec decreased from 1999 to 2011, with new immigrants receiving a 28.0% lower wage in 2011 compared to 32.6% in 1999, a reduction in wage gap by around 4.6%.

Table 5 presents results for equation (3)'s regression using the sample of females in the province of Quebec. In contrast to the findings for males, the data from 1999 indicates that female new immigrants in Quebec do not show a statistically significant wage difference compared to native females in the province. Moreover, there exists a significant wage difference for the 2011 data, indicating that female new immigrants in Quebec earn 18.7% less than female natives in the province. Therefore, the wage gap between female groups is less than what we saw between male groups, as shown in Table 4.

However, this analysis is not enough to show how the wage gap between new immigrant females and native females evolved from 1999 to 2011 in Quebec due to the lack of a statistically significant result in 1999. Table 6 presents the regression results for equation (4), which expands on the previous model by incorporating additional variables to examine the evolution of the wage gap between new immigrants and natives for the full sample. Specifically those new immigrants when the data was collected from 1999 to 2011.

The findings indicate that being a new immigrant male in Canada during any year after 1999 results in a 0.7% increase in hourly wage for each subsequent year. For example, a new immigrant male in 2009 would get closer to native male earnings by 7% more than a new immigrant male in 1999 would have. Table 6 also presents the regression results studying the female sample. In contrast to the results for the male sample, there is an inverse relationship between the earnings of female new immigrants in Canada and the years that elapsed since 1999. For each year following 1999, new immigrant females earn 0.5% less than the previous years' new immigrant females.

Figure 3 illustrates the findings from Table 6 using a line graph. According to the results, the wage gap for new immigrants in the male sample (depicted by the blue line) becomes smaller by 0.7% annually, while for the female sample (shown by the red line), the wage gap widens by 0.5% each year. Consequently, by 2009, the wage gap for new immigrant males in the sample is smaller than that for new immigrant females. New immigrants are defined as individuals who have resided in Canada for less than 10 years at the time the data was collected. By 2009, the wage gap of new immigrants in the male sample was -23.7%

compared to -24.2% for the female sample.

Table 7 presents an analysis of the evolving wage gap between new immigrants (individuals who arrived in the country within the last 10 years at the time of data collection) and native-born individuals. The analysis provides specific insights for both Quebec and the rest of Canada, enabling a more detailed examination of how this wage gap has evolved over time across different regions of the country.

The findings suggest that although new immigrants in Quebec initially face a smaller wage gap compared to those in the rest of Canada, as indicated by the coefficients $\hat{\beta}_5$ being -0.288 and -0.300 respectively. The wage gap diminishes at a slower rate in Quebec than in the rest of Canada for each subsequent year after 1999. This trend is reflected in the coefficient $\hat{\beta}_6$, which is 0.013 and 0.018 for Quebec and the rest of Canada, respectively. Consequently, by 2009, the wage gap for new immigrants in Quebec would have decreased by 13% from its 1999 level, whereas in the rest of Canada, this decrease would amount to 18%.

The previous regression result presented by Table 7 is also displayed in Figure 4. The blue line which depicts the regression result for the province of Quebec shows that in the earlier years, the new immigrant wage gap was lower than that for the rest of Canada (presented by the red line). However, for every subsequent year after 1999, the wage gap decreased at a slower rate for the province of Quebec compared to that of the rest of Canada.

6.3 Economic assimilation

The final section of the analysis addresses the question of economic assimilation. Specifically, whether immigrants in Quebec experience quicker economic assimilation compared to those in the rest of Canada as their length of residence grows. This analysis covers the period from 1999 to 2011 and assesses the extent of economic integration among immigrants in Quebec, comparing it to their integration in the rest of Canada.

Table 8 displays the regression results concerning the wage gap of all immigrants for the data spanning 1999 to 2011, without considering their duration of residence in Canada or the province of Quebec. This regression is done by expanding on the basic mincer shown in equation (2) by adding dummy variables for female, high school diploma, university degree, and immigration status.

The estimated coefficient ($\hat{\beta}_7$) for immigration status indicates a negative relationship between an individual being an immigrant and their hourly wage, this is observed both in the province of Quebec and the rest of Canada. This negative relationship is stronger in Quebec, where the coefficient ($\hat{\beta}_7$) is -0.118, compared to that of -0.057 for the rest of

Canada. This result is interpreted in the following way: being an immigrant in Quebec for the period spanning 1999 to 2011 leads to an hourly wage of 11.8% lower than that of native-born individuals.

Table 9 provides a summary of how the years since immigration data was provided from the SLID database. This shows the five different range groups of years since immigration that are used for the assimilation regression. In the assimilation analysis, I use the midpoint of these ranges.

Furthermore, the regression results for equation (5), aimed at explaining the economic assimilation of immigrants, are presented in Table 10. The data reveals assimilation, evidenced by the positive coefficient $\hat{\beta}_7$ associated with the midpoint of years since the immigration variable. This reveals that with time, immigrant earnings approach those of native-born individuals, thus indicating a convergence in earnings. The findings also suggest that this relationship diminishes over time, evidenced by the negative coefficient $\hat{\beta}_8$ as immigrant earnings get closer to that of their native counterparts. The $\hat{\beta}_8$ is the coefficient on the variable for years since immigration squared.

The regression reported in Table 11 uses dummy variables representing various duration lengths of immigrants' residency. From the data spanning from 1999 to 2011, immigrants who have lived in both the province of Quebec and the rest of Canada for less than 20 years earn less than native-born individuals. However, this gap in wages decreases over time. Specifically, in Quebec, an immigrant who has resided in the province for less than 10 years earns 21.4% lower than native-born individuals. As the immigrant transition to the next duration group of those who have resided in the province for 10 to 19 years, the wage gap decreases to earning 15% lower than natives.

Moreover, the data reveals that after immigrants have resided in the province of Quebec for 30 to 39 years, particularly within the dataset spanning 1999 to 2011, their earnings surpass those of native-born individuals. Specifically, immigrants of this duration residing in Quebec earn 5.6% more than their native-born counterparts. This suggests a shift where long-term immigrants eventually achieve higher earnings than native-born individuals in Quebec. This relationship begins to decrease as we see no significant gap when the immigrant has resided in Quebec for more than 40 years.

The second column in Table 11 looks at the rest of Canada. Similar to the results for Quebec, there is also evidence that immigrants only begin to earn more than native-born individuals once they have resided in the rest of Canada for more than 30 years. Moreover, there is a significant result for an immigrant residing more than 40 years in which they earn 10.6% more than native-born individuals.

7 Work hours of immigrants

In this section, I aim to provide comprehensive insights into the findings presented in this paper by delving deeper into the SLID data. By examining the data on hours worked by individuals, we can gain a better understanding of the factors contributing to the observed results in the previous section.

Firstly, I will present the results regarding the difference in hours worked between new immigrants and natives in the SLID database for both the province of Quebec and the rest of Canada. Additionally, I will replicate the earlier analysis of the wage gap between new immigrants and natives, as shown in Tables 6 and 7. However, this time, the focus will be on hours worked as the new dependent variable.

Moreover, I will replicate the assimilation regression with hours worked as the dependent variable. Finally, I construct a simplified learning-by-doing model and compute its results. This framework aims to provide insights that may help understand wage growth patterns among immigrants.

7.1 Gap in hours worked between new immigrants and natives

In this section, I present the results of the regression analysis for equation (3). However, the dependent variable is changed from wage to hours worked. This adjustment allows for the study of the gap in hours worked between new immigrants (those who have immigrated less than 10 years ago) and native individuals.

Table 12 presents the results that show that new immigrants provide fewer hours worked than natives in both the province of Quebec as well as the rest of Canada. In the Quebec sample, the disparity in hours worked between new immigrants and native individuals is more pronounced, with new immigrants working 27.1% fewer hours than natives. In contrast, in the sample for the rest of Canada, new immigrants work 12% fewer hours than natives. This result is also similar to the results in Table 3 for the wage regression.

Additionally, the results show that females in Canada work fewer hours, as evidenced by the coefficient ($\hat{\beta}_1$) in both the province of Quebec and the rest of Canada samples. In the Quebec sample, females work 24.5% fewer hours, while in the rest of Canada sample, they work 28.8% fewer hours.

7.2 Change in the hours gap over the sample period

This section of the analysis applies the regression model from equation (4), with a modification that shifts the dependent variable from wages to hours worked per week. The

outcomes for female and male samples are reported in Table 13. The results show that new immigrants in Canada work 16.3% less than native workers. Furthermore, it shows that among the new immigrants in the male sample, there are no significant changes in their hours worked since 1999.

Moreover, the findings for the female sample reveal a notable trend: since 1999, new immigrants, defined as those residing in Canada for less than a decade, have shown a reduction in their hours worked per week compared to previous years. This effect is marked by a substantial decrease of 1.7% in working hours annually since 1999. Consequently, this result is similar to the negative result in Table 7 for the evolution of the wage gap between new immigrants and natives since 1999 for the female sample as indicated by the value of $\hat{\beta}_5 = -0.005$.

The above regression is also repeated to understand the evolution of the wage gap between new immigrants and natives for the province of Quebec and the rest of Canada. Table 14 shows that, in the province of Quebec, there has been no significant change in the hours worked by new immigrants since 1999. However, for the rest of Canada, there is a significant result with new immigrants working progressively fewer hours since 1999. Specifically, the result indicates that for each year after 1999, the hours worked by new immigrants decrease by 0.6% annually. Furthermore, it is also interesting to see that for the province of Quebec, new immigrants have a large gap in hours worked compared to native-born individuals of 27.7%. While for the sample of the rest of Canada, this gap in hours worked is only 8.5%.

7.3 Assimilation of hours worked

In this section, I use the regression detailed by equation (5), however, I change the dependent variable from wage to hours worked. The results are presented in Table 15. Initially in the province of Quebec, immigrants start increasing their work hours faster than those immigrants in the rest of Canada as they increase their duration of stay. However, as seen by the result of the coefficient on years since immigration squared ($\hat{\beta}_8$), the increase in hours worked decelerates faster in Quebec than in the rest of Canada.

8 Model with Learning by Doing

In this section, I explore a model that incorporates the concept of learning by doing (LBD). LBD models assume that productivity increases as a result of direct experience. As workers repeatedly perform their tasks, they become more proficient, leading to increased productivity.

Specifically, I analyze a two-period LBD model of Heckman, Lochner, and Cossa (2002). The model accounts for the following key empirical patterns.

1. A significant wage gap exists between new immigrants and native-born individuals in Quebec and the rest of Canada, with new immigrants earning 20% less than their native-born counterparts (see Table 3).

2. As the duration of stay of immigrants increases, they experience substantial earnings growth. Consequently, the immigrant-native wage gap declines (see Table 10).

3. New immigrants work fewer hours than natives in Quebec and the rest of Canada (see Table 14).

4. As the immigrants spend more time in Canada, their work hours increase (see Table 15).

8.1 Model setup

A worker lives for two periods, denoted by $t = 0$ and $t = 1$. The worker's human capital in these periods is denoted by K_0 and K_1. Let h_t represent the number of work hours in period $t \in \{0, 1\}$. In the LBD model, *skills are produced by work*:

$$K_1 = K_0 + F(h_0), \tag{6}$$

where the human capital formation function F meets the following criteria:

$$\begin{cases} F(0) = 0, & (7) \\ F'(h_0) > 0 \text{ for all } h_0 \in [0, 1], & (8) \\ F''(h_0) < 0 \text{ for all } h_0 \in [0, 1], & (9) \\ \lim_{h_0 \to 0} F'(h_0) \to \infty. & (10) \end{cases}$$

Let R_t represent the price per efficiency unit of human capital in period $t \in \{0, 1\}$. Then, the realized wages in periods 0 and 1 are

$$\begin{cases} w_0 = R_0 K_0, & (11) \\ w_1 = R_1 K_0 + R_1 F(h_0). & (12) \end{cases}$$

Therefore, labor incomes in periods 0 and 1 are as follows:

$$\begin{cases} I_0 = R_0 K_0 h_0, & (13) \\ I_1 = R_1 K_1 h_1. & (14) \end{cases}$$

A worker can lend or borrow money at an interest rate of r. The initial assets of a worker are a_0.

The lifetime utility of a worker is given by:

$$U(c_0, l_0) + \beta U(c_1, l_1),$$

where:

- U is the utility function, which is strictly increasing and strictly concave with respect to its arguments,
- c_t is consumption in period $t \in \{0, 1\}$,
- l_t is leisure in period $t \in \{0, 1\}$,
- β represents the time discount factor, satisfying $0 < \beta < 1$.

The endowment of time is normalized to one:

$$l_t + h_t = 1 \text{ for } t \in \{0, 1\}. \tag{15}$$

8.2 Wage growth

If $R_0 = R_1 = R$, the realized wages in equations (11) and (12) become

$$w_0 = RK_0, \tag{16}$$
$$w_1 = RK_0 + RF(h_0), \tag{17}$$

implying that

$$w_0 < w_1. \tag{18}$$

This means the LBD model can naturally account for the wage growth among immigrants.

8.3 A worker's problem

A worker solves the following problem

$$\max_{c_0,l_0,c_1,l_1} \{U(c_0,l_0) + \beta U(c_1,l_1)\} \tag{19}$$

subject to

$$\begin{cases} c_0 + a_1 = a_0 + R_0 K_0 (1 - l_0), & (20) \\ c_1 = (1+r)a_1 + R_1 K_1 (1 - l_1), & (21) \\ K_1 = K_0 + F(1 - l_0), & (22) \\ a_0 \geq 0, & (23) \\ 0 \leq l_0 \leq 1, & (24) \\ 0 \leq l_1 \leq 1. & (25) \end{cases}$$

8.4 Parametric specifications

We assume that the per-period utility function is given by

$$U(c_t, l_t) = \ln c_t + A \ln l_t, \;\; t \in \{0, 1\}, \tag{26}$$

where $A > 0$. Furthermore, we specify the human capital accumulation function as:

$$F(h_0) = Z h_0^{\alpha}, \tag{27}$$

where $Z > 0$ and $0 < \alpha < 1$. Note that if $Z = 0$, the model is reduced to an economy without learning.

Appendix C outlines a procedure for solving the model. Using the procedure, we now analyze the model numerically.

8.5 Numerical analysis

Using the learning-by-doing model, the choice of parameter values for both immigrant and native individuals are listed in Table 16. I set the discount rate $\beta = 1/(1 + 0.1)$, which is consistent with an interest rate (r) of 10%. Additionally, the elasticity of human capital accumulation, α, is set to 0.5 to account for diminishing returns where each additional hour of work contributes less to human capital than the previous hour. The prices per efficiency unit of human capital are normalized to one: $R_0 = R_1 \equiv R = 1$. The initial assets are set to 0 for everyone: $a_0 = 0$.

For natives, I normalize the initial level of human capital K_0 to 1. Since learning by doing is relevant only for immigrants, I set $Z = 0$ for natives. Also, I set the preference

weight for leisure, denoted as A, to 2 for natives, ensuring that they spend one-third of their available time working.

For immigrants, I set the efficiency of the skill accumulation technology at $Z = 0.5$ and the preference weight for leisure at $A = 2.7$. These parameters ensure that both wages and work hours for immigrants remain below those of natives. Additionally, the initial value of human capital, denoted K_0, is set at 0.7 for immigrants to reflect their partial adaptation to the Canadian labor market relative to natives.

It is important to note that the parameter values chosen that indicate that immigrants have a higher preference for leisure and lower initial human capital are chosen by myself and have not been estimated.

The numerical results, using the specified parameter values, are shown in Table 17. In period 0, immigrants start with an initial wage of $w_0 = 0.7$, while natives begin with an initial wage of $w_0 = 1.0$. In the subsequent period, the wage gap between immigrants and natives narrows, with the immigrant wage in period 1, w_1, rising to 0.948, while the native wage remains steady at 1. This finding aligns with the empirical analysis of the SLID data, which indicates a substantial assimilation of immigrant wages.

Furthermore, the computational results for hours worked mirror those for wages. At the outset of the model in period 0, immigrants work 0.246 hours, denoted as h_0, in contrast to natives who work 0.333 hours. However, in the next period, immigrants increased their hours worked to 0.325, thus closing the gap with hours worked by natives which remains at 0.333. This result is consistent with the results of the SLID database highlighted in Table 15, which states that immigrants increase their hours worked as they stay longer in Canada.

In summary, the simple LBD (learning by-doing) model successfully accounts for the four main patterns outlined at the beginning of this section.

9 Conclusion

This paper adds to the ongoing discussion on immigration through the use of the SLID database covering the period from 1999 to 2011. It addresses three key questions: firstly, what is the initial wage gap between new immigrants and natives? Secondly, how does this wage gap change over the sample years? And finally, what disparities exist in economic assimilation between Quebec and the rest of Canada?

The findings indicate a substantial wage gap between new immigrants and natives in both Quebec and the rest of Canada despite the controlling of variables such as age and years of education. Furthermore, this wage disparity diminished over the sample years, with a faster rate observed in the rest of Canada at 1.7% per year, compared to 1.3% in Quebec.

Also, the use of a similar methodology as that of Borjas, Bronars, and Trejo (1992) allowed for the drawing of assimilation conclusions from this sample. It was observed that while economic assimilation occurs both within Quebec and outside of it, the rapid growth in immigrant earnings is initially more pronounced in Quebec, which is eventually surpassed by even faster earnings growth outside the province.

The results on assimilation are backed by the learning-by-doing (LBD) model. The model brings forward the story that immigrants' human capital is not fully adapted to the Canadian labor market requirements initially. Over time, as immigrants accumulate experience in Canada, they enhance their human capital to more closely align with the demands of the Canadian labor market. This progressive adaptation contributes to narrowing both the wage and work hours gaps between immigrants and native-born workers.

Future research could consider how the wage gap of immigrants differed depending on the country they came from, particularly within Quebec, where the significance of the French language has been emphasized. It would be important to see whether the initial wage gap of immigrants from francophone countries is lower than that of immigrants from a country with a different language than French as their main language.

Another potential limitation might arise from the endogeneity of explanatory variables correlated with the error term. Thus, future research on this topic could consider employing an instrumental variable (IV) approach or by performing robustness checks to mitigate potential endogeneity issues.

Moreover, I recommend that future research utilize a dataset with a more continuous measure of the time elapsed since immigration, rather than relying on the interval-based records in the SLID. Employing such data could alleviate issues stemming from the broad ranges used in the SLID, particularly as there may be substantial differences in wages between immigrants who have stayed in the country for, say, 1 year versus 9 years. These differences may not be adequately captured in this analysis due to limitations inherent in the SLID.

Furthermore, another limitation of the dataset is the potentially insufficient number of new immigrant observations per year to provide a comprehensive understanding of the wage gap evolution. For instance, Table 5 reveals no wage gap for new immigrant females in Quebec in 1999. Therefore, the use of a data set with more new immigrant individuals per year may give a more significant result for wage gap evolution.

Both the federal government of Canada and the provincial government in Quebec state that there is an importance of bringing in immigrants to help address different challenges in the region. Hence, it is crucial for immigrants in Canada to experience earnings growth and eventual equality, ensuring the improvement of the Canadian economy and the well-being of immigrants. The empirical findings and the quantitative predictions of the learning-by-doing

model considered in this paper may provide valuable insights along these dimensions.

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APPENDIX

A Tables

Table 1: Summary statistics

Native-born Canadians					
Variable	N. Obs.	Mean	St. Dev.	Min	Max
Female	456,223	0.512	0.500	0	1
Age	456,223	41.852	12.519	20	64
Years of education	456,154	13.215	3.048	0	20
High school	456,223	0.639	0.480	0	1
University degree	456,223	0.1889	0.391	0	1
Hourly wage	327,826	22.209	12.705	2.397	187.200
Quebec resident	456,223	0.199	0.399	0	1
New Canadian immigrants					
Variable	N. Obs.	Mean	St. Dev.	Min	Max
Female	7,800	0.546	0.498	0	1
Age	7,800	37.794	10.446	20	64
Years of education	7,800	13.902	3.552	0	20
High school	7,800	0.705	0.456	0	1
University degree	7,800	0.371	0.483	0	1
Hourly wage	5,224	19.269	12.387	3.967	160.956
Quebec resident	7,800	0.141	0.348	0	1

Note: Statistics in the table were all calculated using The Survey of Labor and Income Dynamics (SLID) for Canada ranging from 1999 to 2011.

Table 2: Summary of mean hourly wage (in CAD)

	1999	2005	2011
Native	20.17	21.75	24.57
New immigrant	16.07	18.33	20.82
Wage gap (%)	20.33	15.72	15.26

Table 3: Wage regression results

Variables	Quebec	the rest of Canada
Constant	0.695	0.502***
	(0.020)	(0.010)
Female	-0.210***	-0.246***
	(0.003)	(0.002)
Age	0.067***	0.072***
	(0.001)	(0.000)
Age squared	-0.069***	-0.074***
	(0.001)	(0.001)
Years of schooling	0.061***	0.068***
	(0.001)	(0.000)
New immigrant	-0.214***	-0.197***
	(0.016)	(0.032)
Controlled for year	✓	✓
Number of obs.	65,239	267,763
Adjusted R-squared	0.292	0.304

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (3).

Table 4: Wage regression results for males in Quebec

Variables	1999	2011
Constant	0.811	0.773
	(0.083)	(0.106)
Age	0.074***	0.071***
	(0.004)	(0.005)
Age squared	-0.074***	-0.072***
	(0.001)	(0.006)
Years of schooling	0.040***	0.060***
	(0.002)	(0.003)
New immigrant	-0.326***	-0.280***
	(0.063)	(0.071)
Number of obs.	3,040	2,259
Adjusted R-squared	0.280	0.263

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (3).

Table 5: Wage regression results for females in Quebec

Variables	1999	2011
Constant	0.451	0.534
	(0.094)	(0.098)
Age	0.068***	0.062***
	(0.005)	(0.005)
Age squared	-0.070***	-0.064***
	(0.006)	(0.006)
Years of schooling	0.061***	0.079***
	(0.002)	(0.003)
New immigrant	-0.134	-0.187*
	(0.074)	(0.061)
Number of obs.	2,630	2,320
Adjusted R-squared	0.291	0.315

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (3).

Table 6: Evolution of new immigrant-native wage gap for full sample

Variables	Male	Female
Constant	0.414***	0.156***
	(0.013)	(0.014)
Age	0.080***	0.063***
	(0.001)	(0.001)
Age squared	-0.082***	-0.065***
	(0.001)	(0.001)
Years of schooling	0.051***	0.077***
	(0.000)	(0.000)
New immigrant	-0.307***	-0.192***
	(0.016)	(0.016)
New immigrant * (Year-1999)	0.007**	-0.005*
	(0.002)	(0.002)
Controlled for year and province	✓	✓
Number of obs.	165,348	165,768
Adjusted R-squared	0.314	0.320

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (4).

Table 7: Evolution of new immigrant-native wage gap: Quebec vs. the rest of Canada

Variables	Quebec	the rest of Canada
Constant	0.780***	0.611***
	(0.019)	(0.010)
Female	-0.210***	-0.254***
	(0.003)	(0.002)
Age	0.070***	0.072***
	(0.001)	(0.000)
Age squared	-0.072***	-0.074***
	(0.001)	(0.001)
Years of schooling	0.059***	0.066***
	(0.001)	(0.000)
New immigrant	-0.288***	-0.300***
	(0.031)	(0.013)
New immigrant * (Year-1999)	0.013**	0.018***
	(0.004)	(0.002)
Controlled for year	✓	✓
Number of obs.	65,239	267,763
Adjusted R-squared	0.292	0.305

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (4).

Table 8: Immigrant wage gap in Quebec vs the rest of Canada

Variables	Quebec	the rest of Canada
Constant	1.055***	0.778***
	(0.020)	(0.010)
Age	0.063***	0.070***
	(0.001)	(0.000)
Age squared	-0.064***	-0.072***
	(0.001)	(0.001)
Years of schooling	0.032***	0.044***
	(0.001)	(0.000)
Female	-0.219***	-0.252***
	(0.003)	(0.001)
High school	0.105***	0.069***
	(0.005)	(0.003)
University degree	0.294***	0.205***
	(0.005)	(0.003)
Immigrant	-0.118***	-0.057***
	(0.008)	(0.003)
Controlled for year	✓	✓
Number of obs.	67,018	19,668
Adjusted R-squared	0.338	0.293

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$.

Table 9: Years since immigration

Category	Time elapsed since migration (T)
1	$0\ years < T < 10\ years$
2	$10\ years \leq T < 20\ years$
3	$20\ years \leq T < 30\ years$
4	$30\ years \leq T < 40\ years$
5	$T \geq 40\ years$

Notes: The table lists the intervals used in the SLID for recording the time elapsed since immigration.

Table 10: Assimilation of earnings regression results

Variables	Quebec	the rest of Canada
Constant	0.942***	1.101***
	(0.126)	(0.045)
Age	0.051***	0.054***
	(0.006)	(0.002)
Age squared	-0.053***	-0.059***
	(0.007)	(0.002)
Years of schooling	0.034***	0.031***
	(0.004)	(0.001)
Female	-0.205***	-0.227***
	(0.018)	(0.006)
High school	0.071*	0.022
	(0.031)	(0.011)
University degree	0.324***	0.225***
	(0.025)	(0.009)
Years since immigration	0.019***	0.017***
	(0.003)	(0.001)
Years since immigration squared	-0.0002***	-0.0001***
	(0.000)	(0.000)
Controlled for year	✓	✓
Number of obs.	2,459	19,668
Adjusted R-squared	0.375	0.293

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (5).

Table 11: Regression results: duration of immigration intervals

Variables	Quebec	the rest of Canada
Constant	0.697***	0.521***
	(0.020)	(0.010)
Age	0.067***	0.072***
	(0.001)	(0.000)
Age squared	-0.069***	-0.074***
	(0.001)	(0.001)
Years of schooling	0.061***	0.067***
	(0.001)	(0.000)
Female	-0.209***	-0.246***
	(0.003)	(0.002)
New immigrant	-0.214***	-0.197***
	(0.016)	(0.006)
Immigrated 10 to 19 years ago	-0.150***	-0.079***
	(0.016)	(0.006)
Immigrated 20 to 29 years ago	0.020	0.011
	(0.018)	(0.007)
Immigrated 30 to 39 years ago	0.056**	0.099***
	(0.021)	(0.008)
Immigrated more than 40 years ago	0.003	0.106***
	(0.029)	(0.011)
Controlled for year	✓	✓
Number of obs.	67,018	282,887
Adjusted R-squared	0.304	0.317

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$.

Table 12: Hours worked regression results

Variables	Quebec	the rest of Canada
Constant	5.571***	5.721***
	(0.030)	(0.016)
Female	-0.245***	-0.288***
	(0.005)	(0.003)
Age	0.087***	0.082***
	(0.001)	(0.001)
Age squared	-0.102***	-0.095***
	(0.002)	(0.001)
Years of schooling	0.008***	0.007***
	(0.001)	(0.000)
New immigrant	-0.271***	-0.120***
	(0.023)	(0.010)
Controlled for year	✓	✓
Number of obs.	72,674	305,603
Adjusted R-squared	0.086	0.082

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (3) with hours worked as the dependent variable.

Table 13: Evolution of new immigrant hours worked for full sample

Variables	Male	Female
Constant	5.553***	5.331***
	(0.018)	(0.024)
Age	0.091***	0.075***
	(0.001)	(0.001)
Age squared	-0.105***	-0.086***
	(0.000)	(0.001)
Years of schooling	-0.001	0.017***
	(0.000)	(0.001)
New immigrant	-0.163***	-0.032
	(0.022)	(0.029)
New immigrant * (Year-1999)	0.004	-0.017***
	(0.003)	(0.003)
Controlled for year and province	✓	✓
Number of obs.	193,158	182,528
Adjusted R-squared	0.072	0.038

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (4) with hours worked as the dependent variable.

Table 14: Evolution of new immigrant hours worked: Quebec vs the rest of Canada

Variables	Quebec	the rest of Canada
Constant	5.571***	5.720***
	(0.030)	(0.016)
Female	-0.245***	-0.288***
	(0.005)	(0.003)
Age	0.087***	0.082***
	(0.001)	(0.001)
Age squared	-0.102***	-0.095***
	(0.002)	(0.001)
Years of schooling	0.008***	0.007***
	(0.001)	(0.000)
New immigrant	-0.277***	-0.085***
	(0.047)	(0.019)
New immigrant * (Year-1999)	0.001	-0.006*
	(0.006)	(0.003)
Controlled for year	✓	✓
Number of obs.	72,674	305,603
Adjusted R-squared	0.086	0.082

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (4) with hours worked as the dependent variable.

Table 15: Assimilation of hours worked regression results

Variables	Quebec	the rest of Canada
Constant	5.207***	5.449***
	(0.199)	(0.067)
Age	0.087***	0.091***
	(0.009)	(0.003)
Age squared	-0.094***	-0.100***
	(0.011)	(0.003)
Years of schooling	-0.002	-0.008***
	(0.006)	(0.002)
Female	-0.219***	-0.242***
	(0.028)	(0.009)
High school	0.062	0.063***
	(0.047)	(0.016)
University degree	0.045	0.026*
	(0.039)	(0.013)
Years since immigration	0.021***	0.014***
	(0.004)	(0.015)
Years since immigration squared	-0.00033***	-0.00026***
	(0.000)	(0.000)
Controlled for year	✓	✓
Number of obs.	2,885	22,875
Adjusted R-squared	0.086	0.081

Notes: Standard errors are in parentheses. The number of asterisks explains the p values, such that: * $p<0.05$, ** $p<0.01$, and *** $p<0.001$. The results in this table are the regression results of equation (5) with hours worked as the dependent variable.

Table 16: Parameter values of the LBD model

	Common parameters	
r	0.1	
α	0.5	
β	$\frac{1}{1+r}$	
R	1	
	Immigrants	Natives
A	2.7	2
K_0	0.7	1
Z	0.5	0

Notes: Summary of parameter values for the computation of the LBD model in section 7.3

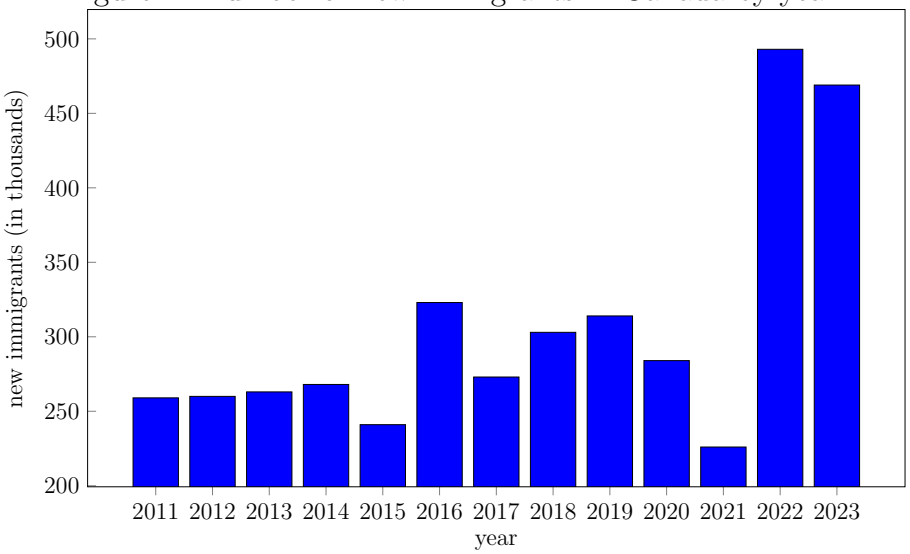
Table 17: Computational results of LBD model

Variable	Immigrant	Native
w_0	0.700	1.000
w_1	0.948	1.000
h_0	0.246	0.333
h_1	0.325	0.333

Notes: Computational results of model with the use of MATLAB.

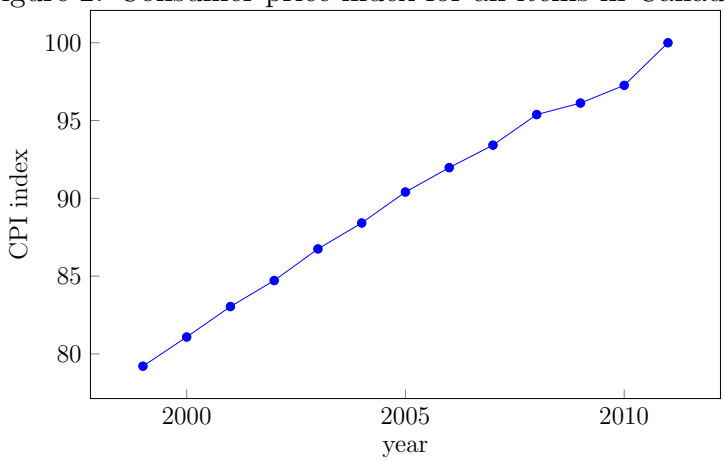
B Figures

Figure 1: Number of new immigrants in Canada by year



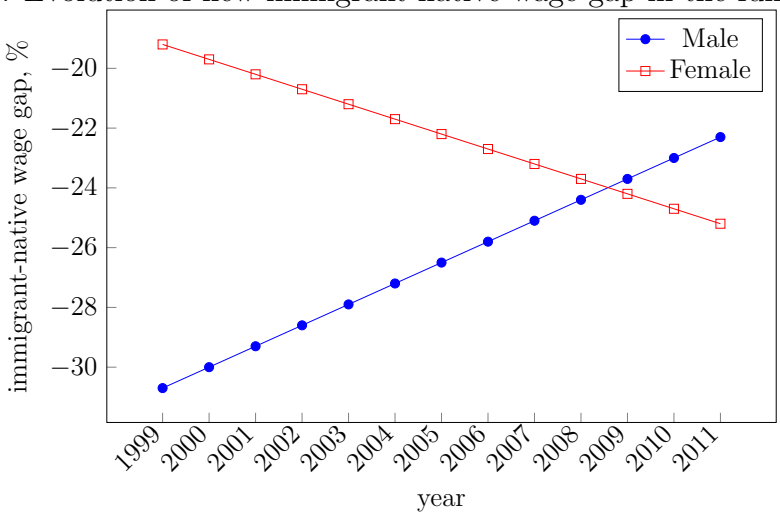
Note: The data for this graph is obtained from https://www.statista.com/statistics/443063/number-of-immigrants-in-canada/.

Figure 2: Consumer price index for all items in Canada



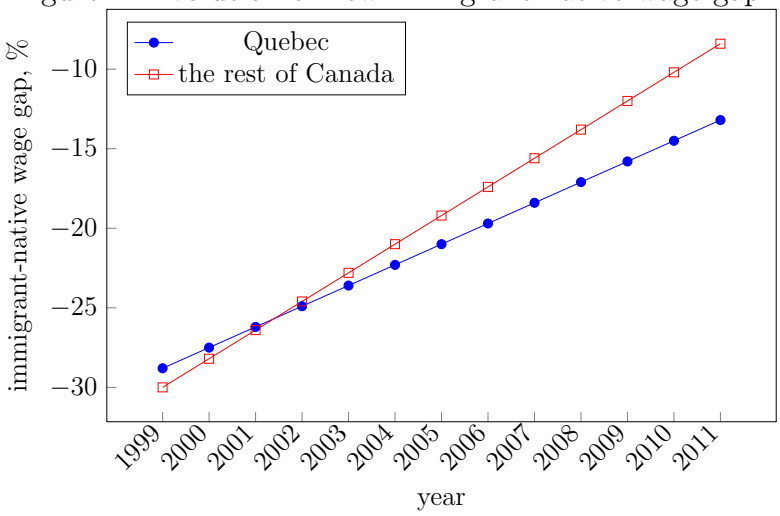
Note: The base year is 2011. The data for the CPI is available from the FRED database at https://fred.stlouisfed.org/series/CPALCY01CAM661N.

Figure 3: Evolution of new immigrant-native wage gap in the full sample



Note: The figure is constructed using the estimation results in Table 6.

Figure 4: Evolution of new immigrant-native wage gap



Note: The figure is constructed using the estimation results in Table 7.

C Procedure for Solving the Model

C.1 Intertemporal substitution

Combining equations (20) and (21), once can obtain the following:

$$c_0 + \frac{c_1}{1+r} = a_0 + R_0K_0(1-l_0) + \frac{R_1K_1(1-l_1)}{1+r}. \tag{28}$$

Inserting equation (22) into equation (28) yields

$$c_0 + \frac{c_1}{1+r} = a_0 + R_0K_0(1-l_0) + \frac{R_1K_0(1-l_1)}{1+r} + \frac{R_1(1-l_1)F(1-l_0)}{1+r}. \tag{29}$$

Equation (29) represents the main consolidated budget constraint.

Our numerical analysis of the model focuses on the interior solution of the model. Therefore, assuming an interior solution, we obtain the following first-order conditions:

$$U_1(c_0, l_0) = \lambda, \tag{30}$$

$$\beta U_1(c_1, l_1) = \frac{\lambda}{1+r}, \tag{31}$$

$$U_2(c_0, l_0) = \frac{\lambda}{1+r}((1+r)R_0K_0 + R_1(1-l_1)F'(1-l_0)), \tag{32}$$

$$\beta U_2(c_1, l_1) = \frac{\lambda}{1+r}(R_1K_0 + R_1F(1-l_0)), \tag{33}$$

where λ represents the Lagrange multiplier associated with the main budget constraint in equation (29). The solution to the worker's problem is captured by equations(29) to (33).

Using equations (30) and (31), intertemporal substitution of consumption can be written as

$$U_1(c_0, l_0) = \beta(1+r)U_1(c_1, l_1). \tag{34}$$

Using equations (32) and (33), intertemporal substitution of leisure can be written as

$$\frac{U_2(c_0, l_0)}{U_2(c_1, l_1)} = \frac{\beta((1+r)R_0K_0 + R_1h_1F'(h_0))}{R_1K_0 + R_1F(h_0)}. \tag{35}$$

In the right hand side of equation (35):

- the denominator is the wage in period 1, as can be seen from equation (12);
- the numerator is the opportunity cost of leisure in period 0.

C.2 Optimality conditions

Using the specifications in equations (26) and (27), we now rewrite the above optimality conditions.

- Equation (34) becomes
$$c_1 = \beta(1+r)c_0. \tag{36}$$

- Furthermore, inserting the latter into equation (29),
$$(1+\beta)c_0 = a_0 + R_0K_0h_0 + \frac{R_1(K_0+F(h_0))h_1}{1+r}. \tag{37}$$

- Combining equations (30) and (32) results in
$$\frac{A}{1-h_0} = \frac{1}{c_0}\left(R_0K_0 + \frac{R_1h_1F'(h_0)}{1+r}\right). \tag{38}$$

- Similarly, combining equations (31) and (33) results in
$$\frac{A}{1-h_1} = \frac{1}{c_1}(R_1K_0 + R_1F(h_0)). \tag{39}$$

- Equation (35) becomes
$$\frac{1-h_1}{1-h_0} = \frac{\beta((1+r)R_0K_0 + R_1h_1F'(h_0))}{R_1K_0 + R_1F(h_0)}. \tag{40}$$

C.3 Finding the optimal choice

- Inserting equation (36) into equation (39) for c_1 yields
$$1-h_1 = \frac{A\beta(1+r)c_0}{R_1K_0 + R_1F(h_0)}. \tag{41}$$

- Combining equation (37) with equation (41)

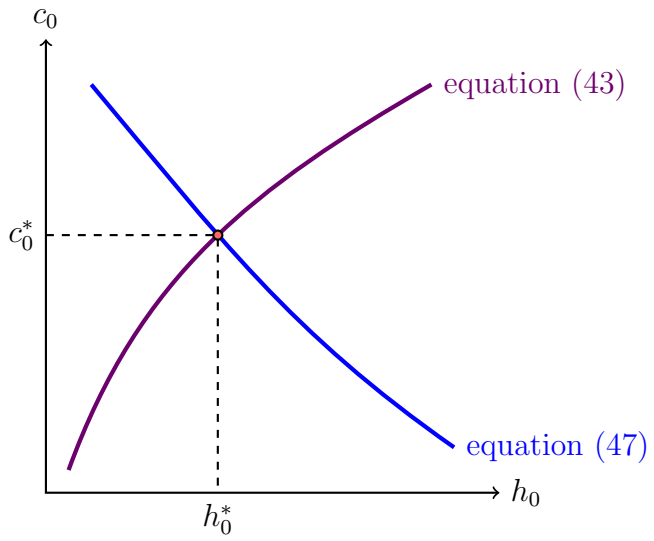
$$
\begin{aligned}
(1+\beta)c_0 &= a_0 + R_0K_0h_0 + \frac{R_1(K_0+F(h_0))}{1+r}\left(1 - \frac{A\beta(1+r)c_0}{R_1K_0+R_1F(h_0)}\right) \\
&= a_0 + R_0K_0h_0 + \frac{1}{1+r}(R_1K_0 + R_1F(h_0) - A\beta(1+r)c_0) \\
&= a_0 + R_0K_0h_0 + \frac{R_1K_0+R_1F(h_0)}{1+r} - A\beta c_0. \qquad (42)
\end{aligned}
$$

Then, it follows that

$$
(1+\beta+A\beta)c_0 = a_0 + R_0K_0h_0 + \frac{R_1(K_0+F(h_0))}{1+r}. \qquad (43)
$$

Equation (43) is illustrated in Figure 5

Figure 5: Work hours and consumption in period 0



- Rewrite equation (38) as follows

$$
\frac{A(1+r)c_0}{1-h_0} - (1+r)R_0K_0 = R_1F'(h_0)h_1. \qquad (44)
$$

Combining this with equation (41) results in

$$
\frac{A(1+r)c_0}{1-h_0} - (1+r)R_0K_0 = F'(h_0)\left(R_1 - \frac{A\beta(1+r)c_0}{K_0+F(h_0)}\right). \qquad (45)
$$

Collecting terms,

$$c_0 \left(\frac{A}{1-h_0} + \frac{A\beta F'(h_0)}{K_0 + F(h_0)} \right) = R_0 K_0 + R_1 F'(h_0)/(1+r). \tag{46}$$

Then, it follows that

$$c_0 = \frac{R_0 K_0 + R_1 F'(h_0)/(1+r)}{\dfrac{A}{1-h_0} + \dfrac{A\beta F'(h_0)}{K_0 + F(h_0)}}. \tag{47}$$

- Now, we will outline the steps to determine the optimal values of c_0,c_1,h_0, and h_1.

  1. Optimal consumption and work hours in period 0, denoted by c_0^* and h_0^*, can be found by solving equations (43) and (47), as illustrated in Figure 5.
  2. Given c_0^*, optimal consumption in period 1 can be found using equation (36):

$$c_1^* = \beta(1+r)c_0^*. \tag{48}$$

  3. Given c_0^* and h_0^*, the optimal work hours in period 1 can be found using equation (41):

$$h_1^* = 1 - \frac{A\beta(1+r)c_0^*}{R_1 K_0 + R_1 F(h_0^*)}. \tag{49}$$