

IMMIGRANT AND MORTGAGE DELINQUENCY RATE IN CANADA

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Abstract

This article studies the effect that immigrant has on mortgage delinquency rate in Canadian housing market. We refer the paper ‘Immigrant and mortgage delinquency’ made by Lin, Liu and Xie (2016), where authors state that the immigrant flows could drive an increase in mortgage delinquency rate in the U.S. We try to replicate their method and use data sets in Canada to examine whether their conclusion still hold in Canadian housing market. Furthermore, like the paper we referred, we also subgroup the 2016 immigrant data in terms of age when immigrating to Canada and their origins to identify which group has the most significant impact on mortgage delinquency rate. After all analysis, we find that unlike the case in the U.S., immigrant flows in Canada has a negative effect on mortgage delinquency rate in the housing market, the higher the immigrant concentration, the lower the delinquency rate in that area.

Keywords: mortgage delinquency rate; immigrant concentration; impact

Executive Summary

This report replicates method used in the paper ‘Immigrant and mortgage delinquency’ made by Lin, Liu and Xie (2016), and try to examine their conclusion in Canadian market. The paper we referred provides a statement that immigrant status could lead an increase in mortgage delinquency rate in the U.S. We use similar data sets available in Canadian market and build a linear regression model to test this statement. The data we put in the model are delinquency rate (dependent variable), immigrant concentration (independent variable) and other variables, household income and housing price index in percent change, unemployment rate, crime index in percent change and three-month housing start. Furthermore, like Lin et al did in their 2016 paper, we also subgroup the 2016 immigrant data, in terms of age when come to Canada and their origins to see which group has the most significant effect on the mortgage delinquency rate.

Overall, the result of the regression shows a negative parameter of the immigrant concentration term, meaning that unlike the conclusion in the U.S. market, in Canada, an increase in immigrant concentration will lead to a decrease in mortgage delinquency rate in census metropolitan areas. Additionally, according to the subgroup test results, we find that the most significant negative effect on mortgage delinquency rate are from immigrant from China and boarded age less than 15.

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1: Introduction

This paper is desired to identify the impact that immigrant have on mortgage delinquency rate in Canadian housing market. What immigrants bring, not only their talents and skills, but also their demand in the host society; this could be reflected in housing market with impact on the household mortgage.

In paper ‘Immigrant and mortgage delinquency’ made by Lin, Liu and Xie (2016), they argued that immigrant could cause an increase in housing delinquency rate in the U.S. This inspired us that Canada is also one of the largest immigrant countries, whether the immigrant effect would be similar with that argument.

Moreover, based on research made by Pavlov and Somerville (2018), who mentioned that immigrant, at least wealthy immigrant, could drive an increase in neighborhood housing price in Canada and research made by Simone and Walks (2017), insisting that immigrants in Canada also bear a heavier burden on the house mortgage compared with natives, we made an original hypothesis that similar to the conclusion made by Lin et al. (2016), immigrant in Canada may also increase the mortgage delinquency rate in the designated city.

Stick to this hypothesis, we replicate the methodology that used in Lin, Liu and Xie’s 2016 paper to examine our thought and make a comparison between the results in the U.S. and Canada. Through comparing the immigrant concentration effect on two-time nodes 2011 and 2016, we find the result is out of our surprise. The empirical result shows that unlike the results in the U.S., in Canada, metropolitan area with higher immigrant concentration experience a lower

mortgage delinquency rate. In addition, we also find that the most significant negative effect on mortgage delinquency rate are from immigrant from China and boarded age less than 15.

This paper is separated into three major section. The first section will describe the data source and the methodology we replicated. The second part will explain the empirical result from our regression and compare the results with Lin, Liu and Xie's 2016 paper. In the third part, we will explore a further research, subgroup the immigrant in term of age when they come to Canada and original group to see which group have the most significant impact on the mortgage delinquency rate. We will also give a potential explanation on our results and demonstration limitation at the end of the third part.

2: Literature Review

Many scholars did researches on the effect of immigrant on housing market in major immigrant countries, either related to housing price, house-purchasing burden or mortgage delinquency rate, inspiring us to make this research.

According to Pavlov and Somerville's 2018 article 'Immigration, capital flows, and housing prices', they explore use a difference – in – difference method to explore the impact of wealthy immigrant on the neighborhood house prices in Vancouver, one of the metropolitan areas in Canada. The authors use semi-log regression models with multiple variables to estimate the non-parametric individual time period dummy variable, do linear trend analysis and concentration slope analysis. The empirical results from those analysis is that wealthy immigrant flows can drive the neighborhood house prices with a house demand from themselves, and the wealthy immigration movement are also associated with capital in-flows (Pavlov & Somerville, 2018).

Also, Mussa et al. (2017) examine the relationships between immigrants and housing price on U.S. market, and get a similar conclusion. The authors use a spatial Durbin model to identify the marginal effect that immigrant concentration brings to the rent price and house price. The conclusion from this research is that the increase in immigration flows into a metropolitan area can lead to the increase in rent as well as housing price. Moreover, the author also find that the immigrant in-flow could cause natives out-flow from the metropolitan area, causing the prices in neighborhood also can be affected by the immigration flows (Mussa et al., 2017).

As for research on immigrant's mortgage debt burden, Simone and Walks (2017) make an investigation to identify the relationship between mortgage debt burden between immigrant and

non-immigrants. The authors focus on three global cities in Canada, Vancouver, Montreal and Toronto, use descriptive statistics for analyzing an overview of the trends in household mortgage debt level, and build a multivariate inferential model to explore the relationship of immigrant concentration and the household mortgage level (Simone & Walks, 2017). After all analysis, they reach a conclusion that not only the immigrant has a higher mortgage debt burden than native Canadians, but also for the neighborhoods with a high concentration of immigrants also have higher mortgage debt than other places. The latter finding is particularly significant in the metropolitan area with a more tighter housing market (Simone & Walks, 2017).

As for the relationships between immigrant status and mortgage delinquency, Lin et al. (2016) identified the effect of immigrant status on mortgage delinquency rate using a standard probit model. They compared the mortgage delinquency rate between immigrant and native-born households in U.S. with controlling a rich set of household demographic and socioeconomic status and mortgage characteristics (Lin et al., 2016). The finding they made after analyzing the model is that the immigrants are more likely to default on their mortgage than native Americans, even after controlling those factors (Lin et al., 2016). Moreover, the authors subgroup the immigrant in terms of time they stay in the U.S. to compare the impact. They found that the mortgage delinquency rate is driven by the relatively recent immigrants who have stayed in American for 10-20 years. Also, the impacts of second generation and third generation on mortgage delinquency rate are both no significant. The conclusion seems consistent with the above finding from Simone and Walks (2017) and made us want to find whether the immigrants effect on mortgage delinquency rate turn out to be similar in Canadian housing market.

3: Data

In Lin, Liu and Xie's 2016 paper, they used the 2009 wave of the PSID, which is collected by the University of Michigan Survey Center and demonstrate three special features of the data that PSID provides. First is the data set including detailed household demographic information, socioeconomic characteristics and mortgage information, which can help authors to determine the default rate and identify the effects on the mortgage delinquency rate (Lin et al., 2016). Second, for each household in the data set, a specific identification number can be used to 'distinguish the immigrant households from native-born households' (Lin et al., 2016). Another feature is this data set can identify whether the household is a second-generation one or a native-born one in terms of a series of questions about birthplaces (Lin et al., 2016).

So, considering we want to replicate the method Lin, Liu and Xie (2016) used, we also try to find raw data with similar characteristics but in Canadian Market. However, since the availability of some data are not free in Canada, differences may exist in our data collection process.

The data we used for the regression has two main sources, the mortgage delinquency rate is from Canada Mortgage and Housing Corporation (CMHC), and the census tract data is from Statistics Canada's 2011 and 2016 Census Program.

For household delinquency rate, a difference in data availability between Canada and the U.S. is that the data is not public one in Canada. So technically we cannot get a detailed household delinquency rate for free, not to mention some detailed characteristics for determining the rate. Fortunately, we did find a quarterly basis mortgage delinquency rate from CMHC, a data set at

33 metropolitan areas in Canada from 2012 to 2016. According to CMHC, the delinquent is defined by an overdue debt minus late payments or past-due payments on a loan and is calculated based on the share of loans that are past due 90 days or more. This is different from Lin, Liu and Xie's 2016 paper where the mortgage rate is determined through the calculated current loan-to-value ratio and current debt-service ratio (Lin et al., 2016). One more thing about the metropolitan area level mortgage delinquency rate we used is that the definition of the CMA is according to the classification on Statistics Canada of Census Metropolitan Areas (CMA), meaning there is no worry about the problem of different classification in data sets from two sources. We have 18 period data for each CMA, so in total we have 576 observations.

The other data set we find is from Statistics Canada, including all other necessary data we used in our model except for the mortgage delinquency rate. In Lin, Liu and Xie's 2016 paper, the PSID data set includes all data the authors need. For explained variables, the replicated model includes five factors from the demographic information in the survey, seven factors from socioeconomic status and 9 factors from mortgage information. However, we cannot find the exact same categories of data. Differences exist compared with the paper we replicated, but we try identifying similar data set from Statistics Canada for our model. We collect immigrants, the population, median household income, new housing price index, unemployment rate, crime index, housing start. All data are CMA level data, and at two time-nodes. Some we can use directly as the paper mentioned, and some we make some adjustments.

The distribution of immigrant clusters in Canada until 2016 are in four CMAs in Canada, Vancouver, Saskatoon, Toronto and Saint John. Figure 1 shows that immigrant concentration in

these four CMAs. Moreover, the delinquency rate shows a opposite relationship with the immigrant concentration, which is we want to examine later.

For immigrant status, unlike Lin, Liu and Xie's 2016 paper mentioned, where they chose a logistic response to represent each household's immigrant status, we calculate immigrant concentration by CMA level immigrant over corresponding population. For new housing price index and crime index, we calculate their percent change as one of the inputs, and for housing start, we calculate its three-months average (quarterly basis average).

Furthermore, we also subgroup our data for factor specific test. In Liu, Lin and Xie's 2016 paper, they also divide their groups in terms of generations, such as first-generation immigrant, second generation immigrant, third or over third generation immigrant and native-born. We also want to do the similar subgroup test using the current 2016 data set to identify the specific effect, but in different classification from the replicated paper.

We consider three classification methods when we subgroup our data:

1. We divide the total immigrant into four groups in terms of age when they first time arrive Canada as immigrant: under 14 years, 15 to 24 years, 25 to 44 years and over 45 years.

Based on our age classification, we make assumptions as followed.

- People landed at the ages less than 14 share more similar characteristics with native born.
- People landed with the age of 14-25 are more likely to have local education experience and more likely to located in large city with universities

- People landed with the between 25-44 are more focus on job and working opportunities
 - People landed with the age over 45 usually finished their primitive accumulation and are more willing to locate to the area with better environment
2. We also subgroup our immigrant data in terms of origins of immigrants: from Asia or other places, from mainland China or other places.

We found that over 50% of immigrant came from Asia, and almost one fifths of Asian immigrants came from mainland China. So, we separate immigrant data to identify the Asian immigrant effect and Chinese immigrant effect (from mainland China) on the mortgage delinquency rate in Canada.

4: Methodology

In Lin, Liu and Xie's 2016 paper, they use the standard probit model to examine the immigrant impact on mortgage delinquency rate. However, since our immigrant data is not a logistic answer but a concentration data, so we use linear regression model to explore the immigrant impact. Moreover, for each variable, either dependent or independent ones, we subtract by its own average to eliminate the individual-specific effect.

The first model we build is as followed,

$$Y_{it} - \bar{Y}_i = \beta * (X_{it} - \bar{X}_i) + (\alpha_i - \bar{\alpha}_i) + (u_{it} - \bar{u}_i) \quad (1)$$

where:

- i denotes a CMA in specific time
- Y is CMA level mortgage delinquency rate.
- X_i denotes a series of independent variables, including immigrant concentration, housing price index in percent change, unemployment rate, crime index in percent change, three-months average housing start.
- β is a vector of parameters
- α_i is the unobserved time – invariant individual effect.
- u_i is the time effect
- Each data point is referring to the specific data point in each CMA (Province for some data) at a specific time
- Fixed time effect adjustment has been done for each group data point (i.e. $IC = (IC_{it} - \bar{IC}_i)$), where the IC is referring to the immigrant concentration in specific CMA in specific quarter)

- For those data, such as immigrant concentration, we use linear interpolation to find out the middle points in each quarter

This first test aims to figure out the relationship between the immigrant concentration, together with the selected fixed factors, and the delinquency in a municipal level.

The parameter we are interested is β_1 . The negative parameter would indicate that a negative effect immigrant concentration and other variables has on the CMA level mortgage delinquency rate, meaning that the increase in immigrant concentration would decrease the delinquency rate. Two set of data would fit to this model, data set in 2011 and in 2016.

The second test we run is the subgroup test. In Lin, Liu and Xie's 2016 paper, the authors used same model to test the subgroup effect, and we did the same thing. The model remains the same as model (1), only the input of the immigrant concentration changes. We replace the total immigrant concentration with the subgroups immigrant concentration, which the subgroups have been introduced in previous section. In this way we can eliminate those immigrant groups with little impact to get a more precise result.

5: Testing and Findings

Test 1 – Delinquency Rate Regression in 2011 to 2016 (Selected Data)

Delinquency Rate

$$= -0.0064 - 2.3609 * \Delta HP + 0.0012 * CI + 4.0079 * UR - 0.0008 * HS - 0.3948 * Immigrant\ concentration(Total)$$

Table 1 Highlights of regression results with independent variable of total immigrant concentration

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	-0.006376151	-1.532228491	0.126021838
Housing Pricing Change (ΔHP)	-2.360931809	-10.778844171	0.000000000
Crime Index (CI)	0.001177099	5.083262542	0.000000504
Unemployment Rate (UR)	4.007870904	9.876339542	0.000000000
Household Income (HI)	-0.000006342	-13.263049050	0.000000000
Housing Start (HS)	-0.000805637	-3.656656128	0.000279224
Immigrant Concentration (IC)	-0.394870833	-7.418420799	0.000000000
Adjusted R Square		0.502224011	
Number of Observations		576	

According to the 2016 paper by Lin, Liu and Xie, the observation shows a positive correlation between the delinquency rate and immigrant with the marginal effect of 0.157, comparing to the 0.044 marginal effect of native people. The number indicate the delinquency rate are generally higher for those place with higher immigrant concentration. And only for the second and third generation, the marginal effect would be like the one of local people.

In our model, on the other hand, we find a negative relationship between Canadian immigrants and delinquency in municipal level. With an observation of 576 data point and a 50.22% adjusted R-square, the model has a much better power of explanation than then model in the 2016 paper by Lin, Liu, and Xie, which is 19% in R-square. Historically, immigrants have been a

source of uncertainty to the society. A high concentration of immigrant has always been a sign of bad social condition, such as high level of crime rate, high unemployment rate, and low income. However, the condition has been changed recently, as more technological immigrants and high personal value immigrants contributes the largest in the immigrants' population. The immigrants bring more positive effects to the society and market.

We can also see the effect of unemployment rate and the housing index has play an important role in the model. Both t-stat, 9.87 and -10.77 respectively, shows a high degree of significance in the model. Unemployment rate is strongly correlated to the delinquency, which shows the importance of income source for the mortgage risk. On the other hand, the housing index change, which represent the increase of housing price during certain periods, provides a strongly negatively correlation with the delinquency. This observation shows that, when observing an increase of housing price, people have higher wellness to pay for the mortgage, because the mortgage amount is set with the initial price. Another factor, income, does not show a very strong relationship with de delinquency rate, because even in the relative low-income cities, the income is enough to afford the payment of mortgage and people tends to put the mortgage payment in a relative higher priority.

In the 2016 paper by Lin et al., they also discuss the immigrant issue in smaller sub groups, which divide the total immigrant population into three sub groups in terms of how long they have been in the United States. They found the longer the time they stayed in the Unites States, the lower marginal effect will be, in other words, they will act more link the local United States people. In our case, we will discuss in different methods as introduced in pervious section. In our

Test 2, we will dig into the sub group of Asian people, who are the largest group of immigrants; and the Chinese immigrant, who also considered to be a major source of immigrants in a single country.

Test 2-1 – Delinquency Rate Regression in 2011 to 2016 – Original Group Asia (Selected Data)

Delinquency Rate

$$= -0.0060 - 2.4140 * \Delta HP + 0.0012 * CI + 4.2421 * UR - 0.0009 * HS - 0.2999 * Immigrant\ concentration(Asian)$$

Table 2. Highlights of regression results with independent variable of Asian immigrant concentration

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	-0.006025870	-1.405737339	0.160347934
Housing Pricing Change (ΔHP)	-2.414056276	-10.712093935	0.000000000
Crime Index (CI)	0.001249304	5.044032625	0.000000614
Unemployment Rate (UR)	4.242080258	10.179454731	0.000000000
Household Income (HI)	-0.000006020	-12.268852779	0.000000000
Housing Start (HS)	-0.000881015	-3.888017346	0.000112986
Asian IC FE	-0.299931511	-4.437125474	0.000010950
Adjusted R Square		0.472337496	
Number of Observations		576	

With the same amount of observation, 576, the adjusted r-square are over 47.23%, and t Stat are all much larger than the critical value. We observed a marginal effect of -0.2999 of the immigrant concentration originally from Asia. Comparing to the marginal effect of -0.3949, the effects of group Asian is slight smaller, however in a similar range. Thus, we can conclude the Asian immigrants can mostly representation the behavior of the entire immigrant population in Canada.

Test 2-1 – Delinquency Rate Regression in 2011 to 2016 – Original Group China (Selected Data)

Delinquency Rate

$$= -0.0060 - 2.4686 * \Delta HP + 0.0011 * CI + 4.1652 * UR - 0.0009 * HS - 1.6338 * Immigrant\ concentration(Chinese)$$

Table 3. Highlight of regression results with independent variable of Chinese immigrant concentration

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	-0.005905561	-1.389952338	0.165086876
Housing Pricing Change (ΔHP)	-2.468586119	-11.044170412	0.000000000
Crime Index (CI)	0.001096566	4.648374126	0.000004162
Unemployment Rate (UR)	4.165199521	10.077812455	0.000000000
Household Income (HI)	-0.000005986	-12.305679464	0.000000000
Housing Start (HS)	-0.000889019	-3.965634045	0.000082538
Chinese IC FE	-1.633759617	-5.494802797	0.000000059
Adjusted R Squared		0.481588234	
Number of Observations		576	

With the 576 observations, the test result comes with an adjusted R-square of 48.15%, combined with the -5.4948 in t-Stat of immigrant concentration of Chinese immigrants. The marginal effect of this group is -1.6337 about 4 times larger than that of the total immigrant's test. The model indicates high contribution of this original group to the low delinquency rate. This result can also be explained by the overall education and wealth of this group.

Test 3– Delinquency Rate Regression in 2011 to 2016 – All Age Group (Selected Data)

Delinquency Rate

$$= 0.0074 - 2.4235 * \Delta HP + 0.0010 * CI + 4.3813 * UR - 0.0009 * HS - 0.3944 * \text{Immigrant concentration(All Age)} - 0.0037 * D1 - 0.0084 * D2$$

Table 4. Highlight of regression results with independent variable of immigrant concentration with all age group

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	0.007472739	1.635338332	0.1021152746
Housing Pricing Change (Δ HP)	-2.423556817	-21.36198409	0.0000000000
Crime Index (CI)	0.00101422	8.434693114	0.0000000000
Unemployment Rate (UR)	4.381293469	20.93352607	0.0000000000
Household Income (HI)	-5.97486E-06	-24.14837174	0.0000000000
Housing Start (HS)	-0.000858031	-7.416315516	0.0000000000
Immigrant Concentration	-0.394389604	-5.25343171	0.0000001631
D1	-0.003717356	-0.864378717	0.3874702137
D2	-0.008387216	-1.850467217	0.0643746748
Adjusted R Square		0.463868547	
Number of Observations		2304	

In this section, we drive a regression for all the age groups to compare with all the age group in later section. By all age group, we define the immigrant concentration as the total number of immigrants landed in each age group and perform the regression with all the data. With all the 2304 observations, our model has an adjusted R-square of 46.39%. and a negative marginal effect of -.033723 which is very close with the marginal effect in Test 1.

Two dummy variables are introduced in this test, $D1 = 0$ and $D2 = 0$ if the landed age is less than 15 and $D1 = 0$ and $D2 = 1$ if the landed age is younger than 25 but older than 15. $D1 = 1$ and $D2 = 0$ if the landed age is less than 45 and older than 25, and $D1 = 0$ and $D2 = 1$ if the landed age is above 45.

Test 3-1 – Delinquency Rate Regression in 2011 to 2016 – Age Group Less than 15 (Selected Data)

Delinquency Rate

$$= -0.0062 - 2.4117 * \Delta HP + 0.0011 * CI + 4.2761 * UR - 0.0007 * HS - 1.6627 * Immigrant\ concentration(Age < 15)$$

Table 5. Highlight of regression results with independent variable of immigrant concentration with age group less than 15

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	-0.006170108	-1.424539752	0.154838499
Housing Pricing Change (ΔHP)	-2.411683792	-10.592572081	0.000000000
Crime Index (CI)	0.001062121	4.351734704	0.000016013
Unemployment Rate (UR)	4.276098943	10.034270696	0.000000000
Household Income (HI)	-0.000005855	-11.699496730	0.000000000
Housing Start (HS)	-0.000716113	-2.915508202	0.003690965
Age Less than 15	-1.662695746	-2.809102642	0.005138709
Adjusted R Square		0.461547162	
Number of Observations		576	

With the same amounts of observations, 576, this model is coming with an adjusted R-square of 46.15%, and -2.809 of t-Stat for the immigrant concentration. The marginal effect is very high for this group. According to the assumption in pervious section, the education experience of this group of people is mostly done in Canada, and they usually have family to live together, the combination provides a strongly negative correlation to the delinquency rate.

Test 3-2 – Delinquency Rate Regression in 2011 to 2016 – Age Group 15 to 24 (Selected Data)

Delinquency Rate

$$= -0.0029 - 2.4189 * \Delta HP + 0.0010 * CI + 4.2801 * UR - 0.0008 * HS - 0.7638 * Immigrant\ concentration(15 < Age < 24)$$

Table 6. Highlight of regression results with independent variable of immigrant concentration with age group between 15 to 24

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	0.002875803	0.527124028	0.598312911
Housing Pricing Change (ΔHP)	-2.418912022	-10.628822289	0.000000000
Crime Index (CI)	0.001039471	4.292774610	0.000020742
Unemployment Rate (UR)	4.280138204	10.063982662	0.000000000
Household Income (HI)	-0.000005898	-11.835916114	0.000000000
Housing Start (HS)	-0.000789696	-3.336476225	0.000903819
Age 15 to 24	-0.763769753	-2.867592790	0.004289354
Adjusted R Square		0.461856891	
Number of Observations		576	

With the same amounts of observations, 576, this model has an adjusted R-square of 46.19% and a t-Stat of -2.8676 for the amount of observation of 576. Comparing with previous group, the marginal effect is still negative, however is lower for this group. They tend to move to those place with higher level of education rather than a nicer place to live.

Test 3-3 – Delinquency Rate Regression in 2011 to 2016 – Age Group 25 to 44 (selected Data)

Delinquency Rate

$$= -0.0037 - 2.4394 * \Delta HP + 0.0011 * CI + 4.3444 * UR - 0.0008 * HS - 0.5502 * Immigrant\ concentration(25 < Age < 45)$$

Table 7. Highlight of regression results with independent variable of immigrant concentration with age group between 25 to 44

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	0.003735851	0.631607986	0.527896725
Housing Pricing Change (ΔHP)	-2.439415577	-10.700380703	0.000000000
Crime Index (CI)	0.001095475	4.401415039	0.000012846
Unemployment Rate (UR)	4.344399291	10.272487459	0.000000000
Household Income (HI)	-0.000006077	-12.244019062	0.000000000
Housing Start (HS)	-0.000749018	-3.067720926	0.002259562
Age 25 to 44	-0.550240425	-2.580244268	0.010122537
Adjusted R Square		0.460393479	
Number of Observations		576	

With the same amounts of observations, 576, the adjusted r-square of this model is 46.18%, and t Stat is -2.5802. According to our original assumption, this group of people are aboard to seek more job opportunities and account over 20% of the total immigrants. The negative relationship between this group and the delinquency rate is lower than that of the previous two groups. Therefore, the effect of this group is less as well.

Test 3-4 – Delinquency Rate Regression in 2011 to 2016 – Age Group Over 44 (selected Data)

Delinquency Rate

$$= -0.0165 - 2.4176 * \Delta HP + 0.0011 * CI + 4.1829 * UR - 0.0008 * HS - 0.4611 * Immigrant\ concentration(Age > 45)$$

Table 8. Highlight of regression results with independent variable of immigrant concentration with age group over 45

Independent Variable	Marginal Effect	t Stat	P-value
Intercept	0.016515470	2.446166255	0.014740169
Housing Pricing Change (ΔHP)	-2.417554234	-10.728129343	0.000000000
Crime Index (CI)	0.001124113	4.675519680	0.000003666
Unemployment Rate (UR)	4.182948439	9.980899479	0.000000000
Household Income (HI)	-0.000005824	-11.807675923	0.000000000
Housing Start (HS)	-0.000804581	-3.516356569	0.000472392
Age Over 45	-0.461149571	-4.440158495	0.000010801
Adjusted R Square		0.472361629	
Number of Observations		576	

The number of observations is still 576. With an adjusted R-square of 47.24% and -4.401 t-Stat, this model can also explain the relationship well. We can observe the marginal effect in this group is very much in the same range of the previous group, which indicate a similar likelihood of default in delinquency in this two groups.

To sum up all these observation, we have over 46% adjusted R-square in all the model with a great t-Stat indicating a high level of explanation and significance. The over all negative marginal effect shows a positive effect of the immigrants in terms of social credits. Asian, especially Chinese immigrants have made a great contribution in this case. In terms of age group, we find that the earlier one come to Canada, the more likely have a lower delinquency which shows a great social effect of Canada onto these people. Fundamentally, the characteristics of

new immigrants contributes the social credit better than native, because the immigrant application process has eliminated the bad effects of unsophisticated applicants. And as the live in the country for longer time or come as an earlier age, the positive social affects, such as education and working environment, helps immigrants better adopt into the society and make much more contribution to the society.

6: Conclusion

Canada is a country with long history of immigration. The immigrant is count for over 20% of the total population. It has become an important factor in the society. During our research process, different from the expectation, we observed a strongly negative correlation between the concentration of immigrant and the mortgage delinquency rate. As time goes by, the immigrants are more adopted into the society, and participate more economic activities. This observation highlights the importance as well as the positive impact of immigrants towards the society.

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Appendices

Figure 1: The figure shows the immigrant distribution until 2016 in four main CMAs in Canada, as a proportion of total immigrants, and the corresponding delinquency rate

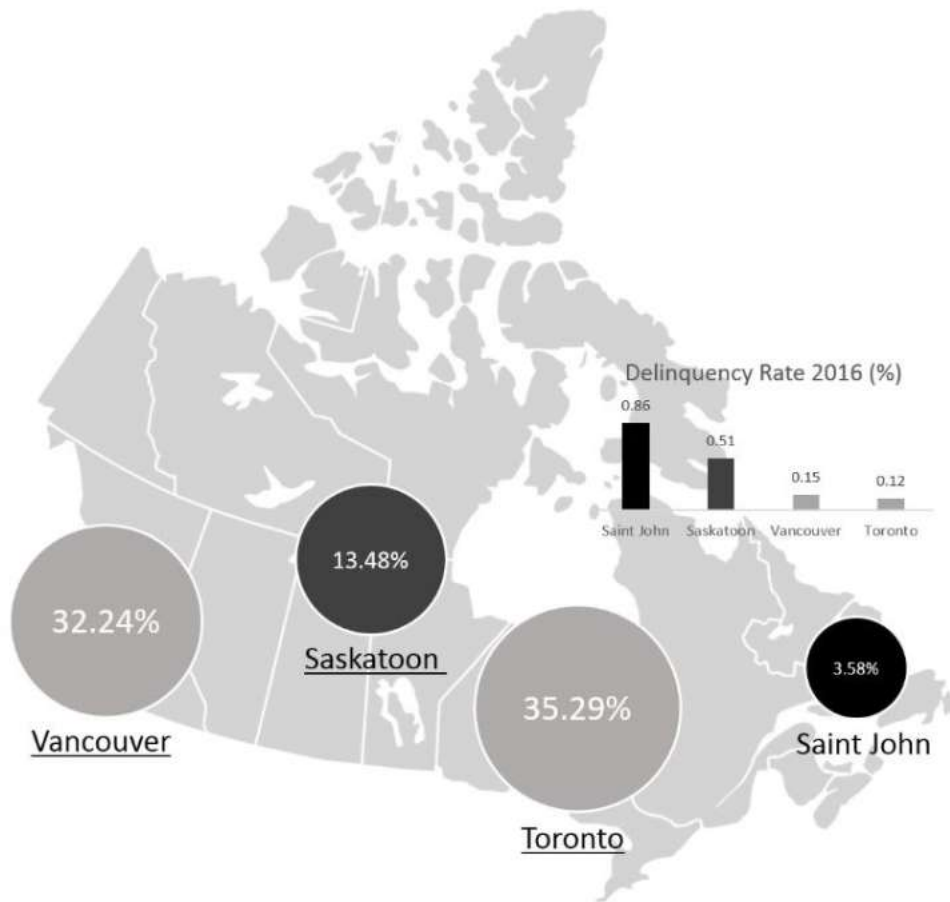


Table 9: Regression results of all parameters on total immigrant concentration groups

Regression Statistics			df	SS	MS	F	Significance F
Multiple R	0.712332924	Regression	6	5.652881982	0.942146997	97.68967988	3.43148E-84
R Square	0.507418195	Residual	569	5.487597482	0.009644284		
Adjusted R Square	0.502224011	Total	575	11.14047946			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 90.0%	Upper 90.0%
Intercept	-0.006376151	0.004161358	-1.532228491	0.126021838	-0.014549648	0.001797346	-0.013232137	0.000479836
Housing Pricing Change	-2.360931809	0.219033857	-10.77884417	8.87681E-25	-2.791145387	-1.930718231	-2.721797972	-2.000065646
Crime Index	0.001177099	0.000231564	5.083262542	5.04142E-07	0.000722275	0.001631923	0.000795589	0.001558608
Unemployment Rate	4.007870904	0.405805297	9.876339542	2.44161E-21	3.210811712	4.804930096	3.339292069	4.676449739
House Hold Income	-6.34231E-06	4.78194E-07	-13.26304905	3.55907E-35	-7.28155E-06	-5.40307E-06	-7.13015E-06	-5.55447E-06
Housing Start	-0.000805637	0.000220321	-3.656656128	0.000279224	-0.001238379	-0.000372896	-0.001168624	-0.000442651
IC	-0.394870833	0.053228422	-7.418420799	4.33356E-13	-0.499419007	-0.290322658	-0.482566574	-0.307175092

Table 10: Regression results of all parameters on Asian immigrant concentration groups

Regression Statistics			df	SS	MS	F	Significance F
Multiple R	0.69126228	Regression	6	5.323406143	0.887234357	86.7852821	4.87397E-77
R Square	0.47784354	Residual	569	5.817073321	0.010223327		
Adjusted R Square	0.472337496	Total	575	11.14047946			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.00602587	0.004286626	-1.405737339	0.160347934	-0.014445412	0.002393672	-0.014445412	0.002393672
Housing Pricing Change	-2.414056276	0.22535802	-10.71209394	1.61961E-24	-2.856691407	-1.971421145	-2.856691407	-1.971421145
Crime Index	0.001249304	0.00024768	5.044032625	6.13906E-07	0.000762826	0.001735781	0.000762826	0.001735781
Unemployment Rate	4.242080258	0.416729616	10.17945473	1.79876E-22	3.423564155	5.060596362	3.423564155	5.060596362
House Hold Income	-6.0203E-06	4.90698E-07	-12.26885278	7.26124E-31	-6.98409E-06	-5.0565E-06	-6.98409E-06	-5.0565E-06
Housing Start	-0.000881015	0.000226597	-3.888017346	0.000112986	-0.001326085	-0.000435945	-0.001326085	-0.000435945
Asian IC FE	-0.299931511	0.067595905	-4.437125474	1.09495E-05	-0.432699461	-0.167163562	-0.432699461	-0.167163562

Table 11: Regression results of all parameters on Chinese immigrant concentration groups

Regression Statistics			df	SS	MS	F	Significance F
Multiple R	0.69785224	Regression	6	5.425388413	0.904231402	90.02615414	3.30287E-79
R Square	0.486997748	Residual	569	5.715091051	0.010044097		
Adjusted R Square	0.481588234	Total	575	11.14047946			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.005905561	0.004248751	-1.389952338	0.165086876	-0.01425071	0.002439588	-0.01425071	0.002439588
Housing Pricing Change	-2.468586119	0.22351938	-11.04417041	7.94237E-26	-2.907609901	-2.029562338	-2.907609901	-2.029562338
Crime Index	0.001096566	0.000235903	4.648374126	4.16222E-06	0.000633219	0.001559913	0.000633219	0.001559913
Unemployment Rate	4.165199521	0.413303933	10.07781246	4.33901E-22	3.353411945	4.976987097	3.353411945	4.976987097
House Hold Income	-5.98633E-06	4.86469E-07	-12.30567946	5.06629E-31	-6.94182E-06	-5.03083E-06	-6.94182E-06	-5.03083E-06
Housing Start	-0.000889019	0.000224181	-3.965634045	8.25377E-05	-0.001329341	-0.000448696	-0.001329341	-0.000448696
Chinese IC FE	-1.633759617	0.297328162	-5.494802797	5.90809E-08	-2.217754321	-1.049764913	-2.217754321	-1.049764913

Table 12: Regression results of all parameters on age less than 15 immigrant concentration groups

<i>Regression Statistics</i>			<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Multiple R	0.683495282	Regression	6	5.204451	0.8674085	83.14573278	1.47762E-74
R Square	0.4671658	Residual	569	5.936028465	0.010432387		
Adjusted R Square	0.461547162	Total	575	11.14047946			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.006170108	0.004331299	-1.424539752	0.154838499	-0.014677394	0.002337178	-0.014677394	0.002337178
Housing Pricing Change	-2.411683792	0.227676883	-10.59257208	4.72488E-24	-2.858873499	-1.964494084	-2.858873499	-1.964494084
Crime Index	0.001062121	0.000244068	4.351734704	1.60129E-05	0.000582736	0.001541507	0.000582736	0.001541507
Unemployment Rate	4.276098943	0.42614945	10.0342707	6.31561E-22	3.439080948	5.113116939	3.439080948	5.113116939
House Hold Income	-5.8549E-06	5.0044E-07	-11.69949673	1.75025E-28	-6.83784E-06	-4.87196E-06	-6.83784E-06	-4.87196E-06
Housing Start	-0.000716113	0.000245622	-2.915508202	0.003690965	-0.00119855	-0.000233677	-0.00119855	-0.000233677
Age Less than 15	-1.662695746	0.59189569	-2.809102642	0.005138709	-2.825262877	-0.500128615	-2.825262877	-0.500128615

Table 13: Regression results of all parameters on age between 15 to 24 immigrant concentration groups

<i>Regression Statistics</i>			<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Multiple R	0.683719458	Regression	6	5.207865527	0.867977588	83.24816897	1.25613E-74
R Square	0.467472297	Residual	569	5.932613937	0.010426387		
Adjusted R Square	0.461856891	Total	575	11.14047946			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.002875803	0.005455647	0.527124028	0.598312911	-0.007839863	0.013591469	-0.007839863	0.013591469
Housing Pricing Change	-2.418912022	0.227580437	-10.62882229	3.41762E-24	-2.865912296	-1.971911747	-2.865912296	-1.971911747
Crime Index	0.001039471	0.000242144	4.29277461	2.07421E-05	0.000563865	0.001515077	0.000563865	0.001515077
Unemployment Rate	4.280138204	0.425292685	10.06398266	4.88903E-22	3.444803018	5.11547339	3.444803018	5.11547339
House Hold Income	-5.89784E-06	4.983E-07	-11.83591611	4.76868E-29	-6.87657E-06	-4.91911E-06	-6.87657E-06	-4.91911E-06
Housing Start	-0.000789696	0.000236686	-3.336476225	0.000903819	-0.001254581	-0.000324812	-0.001254581	-0.000324812
Age 15 to 24	-0.763769753	0.266345262	-2.86759279	0.004289354	-1.286909645	-0.240629861	-1.286909645	-0.240629861

Table 14: Regression results of all parameters on age between 25 to 44 immigrant concentration groups

<i>Regression Statistics</i>			<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Multiple R	0.682659619	Regression	6	5.191732537	0.865288756	82.76521227	2.70335E-74
R Square	0.466024156	Residual	569	5.948746928	0.01045474		
Adjusted R Square	0.460393479	Total	575	11.14047946			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.003735851	0.005914826	0.631607986	0.527896725	-0.007881706	0.015353409	-0.007881706	0.015353409
Housing Pricing Change	-2.439415577	0.227974653	-10.7003807	1.7994E-24	-2.887190147	-1.991641007	-2.887190147	-1.991641007
Crime Index	0.001095475	0.000248891	4.401415039	1.28458E-05	0.000606616	0.001584333	0.000606616	0.001584333
Unemployment Rate	4.344399291	0.422915999	10.27248746	7.99254E-23	3.513732254	5.175066328	3.513732254	5.175066328
House Hold Income	-6.07661E-06	4.96292E-07	-12.24401906	9.25281E-31	-7.0514E-06	-5.10182E-06	-7.0514E-06	-5.10182E-06
Housing Start	-0.000749018	0.000244161	-3.067720926	0.002259562	-0.001228584	-0.000269451	-0.001228584	-0.000269451
Age 25 to 44	-0.550240425	0.213251293	-2.580244268	0.010122537	-0.969096226	-0.131384624	-0.969096226	-0.131384624

Table 15: Regression results of all parameters on age over 45 immigrant concentration groups

<i>Regression Statistics</i>			<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Multiple R	0.691279553	Regression	6	5.323672188	0.887278698	86.79358884	4.81144E-77
R Square	0.477867421	Residual	569	5.816807276	0.01022286		
Adjusted R Square	0.472361629	Total	575	11.14047946			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	0.01651547	0.006751573	2.446166255	0.014740169	0.003254422	0.029776517	0.003254422	0.029776517
Housing Pricing Change	-2.417554234	0.22534723	-10.72812934	1.40207E-24	-2.860168174	-1.974940295	-2.860168174	-1.974940295
Crime Index	0.001124113	0.000240425	4.67551968	3.66558E-06	0.000651884	0.001596343	0.000651884	0.001596343
Unemployment Rate	4.182948439	0.419095338	9.980899479	9.99048E-22	3.359785722	5.006111157	3.359785722	5.006111157
House Hold Income	-5.82414E-06	4.93251E-07	-11.80767592	6.2462E-29	-6.79296E-06	-4.85533E-06	-6.79296E-06	-4.85533E-06
Housing Start	-0.000804581	0.000228811	-3.516356569	0.000472392	-0.001253998	-0.000355164	-0.001253998	-0.000355164
Age Over 45	-0.461149571	0.103858809	-4.440158495	1.08015E-05	-0.66514301	-0.257156133	-0.66514301	-0.257156133