How Does Immigration Impact Canada's Housing Prices : Evidence from a spatial panel perspective*

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Abstract

In the face of an emerging real estate bubble, Canadians are now struggling to afford a home, making housing a critical issue of the country's politics and economics. With immigration making up almost all of Canada's population growth that will generate more need for housing, there exists a debate over the relationship between Canada's immigration and the rising rents and house prices. With the main goal to reveal how immigration impacts Canada's housing prices and prove into the effectiveness of NRST in Ontario, this paper employs a Spatial Durbin Error Model and pooled Linear Regression on a panel data to examine the relationship between immigration and housing prices. The main findings are as follows: first, immigration has a significantly positive impact on the housing prices; second, immigration into one province will reduce the housing prices in the neighboring provinces; third, the NRST in Ontario is effective in lowering the housing prices but does not interact with immigration factor.

JEL classification: C21, H29, J15, O18

Keywords: Housing Price; Immigration; Spillover Effects

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1 Introduction and Motivation

1.1 Introduction

Since 2022, Canada has experienced consistent and significant increases in real estate prices, with short-period intermittent declines. Especially in recent years, these trends have raised concerns among various global organizations, leading to the characterization of Canada's housing market as a potential real estate bubble. In both 2019 (Shah, 2019) and 2021 (Curran, 2021), Bloomberg Economics ranked Canada as having the second-largest housing bubble among OECD countries, while in 2022, Toronto ranked highest globally in the real estate bubble index by Swiss bank UBS, with Vancouver also ranking among the top 10 riskiest cities (UBS, 2023). The unaffordability of housing put a lot of people on heavy debts: by 2023, Canada's nonfinancial debt exceeded 300% of GDP, and household debt surpassed 100% of GDP, surpassing levels observed in the United States before the 2008 global financial crisis (IMF, 2024).

Canadians are now struggling to afford a home, making housing a defining issue of the country's politics and economics (RBC, 2024). The government and society have been working to find the mechanisms that drive the housing crises and coping approaches. The imbalance between housing demand and supply is a significant reason for the crisis, especially in urban areas. On the demand side, four broad sets of demand factors were mentioned by Schembri (2015) : macroeconomic factors (rising income and lower long-term interests), demographic factors (population growth driven mainly by migration and population structure shift), credit conditions (more access to mortgage and financial tools), and other factors, out of which immigration and foreign investment have been talked about extensively as key determinants in the price rise as they drive up the demand for housing. On the other hand, reasons on the supply side have also been argued for: RBC (2024) says that the housing shortage can be attributed to a higher residential construction price due to shortage of skilled workers and raw materials.

Currently, there exists a debate over the relationship between Canada's immigration and the rising rents and house prices. Given the country's aging demographics, immigration accounts for nearly all population growth in Canada (Mallees, 2024). A report by the Environics Institute showed that around 20% of Canadians believe that immigrants are driving up home prices and making them unaffordable for others (Baxter, 2023), pointing the finger at Canada's record-level immigration rates. While others argue that immigration is not the only thing putting a strain on the housing market (Zimonjic, 2024) and even that high numbers of immigrants are key to solving the housing crisis as it will help build the national labour force to provide affordable housing (Robitaille, 2023).

1.2 Motivation

To dive into this debate with empirical evidence, more specifically, to answer the question: "How does immigration impact Canada's housing prices" in an emerging housing bubble in Canada, this project uses a panel dataset from 2008 to 2023 to conduct a Spatial Durbin Error Model to reveal the relationship as well as the spillover effects of immigration on Canada's housing prices. The second goal of this project is to probe into the effectiveness of Non-Resident Speculation Tax, Ontario's foreign home buyer tax on housing prices, as well as the tax's impact on the immigration-housing relationship, using a linear regression model with interaction terms. Lastly, based on the empirical findings, this project attempts to provide analyses and suggestions on how to leverage immigration to address the current housing crisis.

Following this motivation, this paper will be structured as follows: (1) A literature review on previous research of Canadian housing price and immigration, and housing price research methodology and econometrics model; (2) Models and relevant hypotheses; (3) Data and empirical data analysis; (4) Empirical regression results and analyses; (5) Conclusions; (6) Limitations and future steps.

2 Literature Review

2.1 Housing Price and its Determinants

There has been ample research on housing price and its determinants (including macroeconomic determinants and housing characteristic determinants), which can be categorized by countries.

For international housing market, the research of Adams and Fuss (2010) suggested that house prices increase in the long run by 0.6% in response to a 1% increase in economic activity. For developing countries and economies, Zhang et al. (2012) applied a Nonlinear Auto Regressive Moving Average model with Exogenous inputs (NARMAX) combined with the Vector Error Correction Model (VECM) to identify some key monetary and price variables in interpreting housing price dynamics including mortgage rate, producer price, broad money supply, and real effective exchange rate. They also found that real economic variables such as income are not independently significant. Other papers focused on the property characteristics to explain the housing price: Aliyev et al. (2019) used OLS to conclude some major price determinants for Azerbaijan flats and houses respectively; Koramaz and Dokmeci (2012) measured the effect of spatial characteristics on housing prices in Istanbul, Turkey; forecasting approaches like Classification and Regression Tree (CART) have also been adopted to make implications with regard to the housing market in Istanbul, Turkey (Ozsoy and Sahin, 2009).

For more developed countries and economies, the housing prices in Australia, USA, Canada, and other European countries are the main research objects. Ch'ng et al (2022) found that population as a significantly positive impact on housing prices in selected developed countries while inflation rate, unemployment rate, and construction cost has significantly negative impacts. Jafari and Akhavian (2019) studied the driving forces from property characteristics on housing transaction prices in the USA, while Cohen and Karpavičiūtė's study (2017) showed that inflation, interest rate and emigration are not causal deter-

minants of housing prices in Lithuania, which mostly depend on GDP, unemployment, the means of macroprudential policy and the average housing prices in the previous period.

There is also research dedicated to the housing price volatility with time series approaches. Hossain and Latif (2007) employed GARCH and VAR models to provide evidence for the time-varying housing price volatility in Canada. They also conducted Granger Causality check to reveal the two-way Granger Causality between housing price volatility and GDP growth rate, housing price appreciation and volatility itself. Lee (2009) employed EGARCH model to find volatility clustering effects (ARCH effects) in Australian capital cities. Kaulihowa and Kamati (2019) conducted their research around house price volatility in Namibia with ARCH, GARCH, and VEC models. Their results support the hypothesis that house prices in Namibia exhibits persistent volatility and that past period volatility, GDP and mortgage loans are the key determinants of house price volatility.

2.2 Housing price and Immigration

More specifically, some research papers are focused on Canadian housing prices and their determinants among which immigration is a frequently mentioned factor that has a significant positive impact.

Akbari and Aydede (2012) constructed panel data at census division levels to indicate a statistically significant but small effect of immigration on Canadian housing prices, while Nistor and Reanu (2018) presented a panel data econometric model with census division data to suggest that one cause of the high prices in Ontario is large inflows of immigrants together with low mortgage interest rate. Similarly, there has been research on the relationship between immigration and housing prices in the USA that (Mussa, et al. 2017), with a spatial econometric model, found that an increase in immigration inflows into a particular metropolitan statistical area (MSA) is associated with increases in rents and with house prices in that MSA while also seeming to drive up rents

and prices in neighboring MSAs.

2.3 Research Methodology

As mentioned above, previous research mainly used panel data econometrics models or time series models to study the housing prices and its determinants. Few research had conducted spatial econometric analysis on immigration and housing.

Spatial econometrics accounts for the presence of spatial correlation in regression analysis and is used in regional science, urban and real estate economics, and economic geography (Katchova, 2013). A spatial econometric model can help detect the direct effects of independent variables on the dependent variable in its own region as well as the spillover effects on the dependent variable in its neighboring regions. This is especially applicable in studying housing prices since it is reasonable to assume that the more prices in a given neighborhood increase, the stronger the incentives for potential buyers to search for cheaper homes in the nearest surrounding (Fischer, et al. 2018). For Canadian housing market, there exists a significant unevenness in the spatial distribution of housing affordability problems in major Canadian census metropolitan areas (CMAs) (Bunting, et al. 2004), which also indicates a possible spatial correlation in the housing prices. Spatial models have also been seen in studies on housing price determinants in Turkey (Sayın, et al. 2022) and China (Wang, et al. 2017).

2.4 Contributions

To sum up, there are three main gaps in existing research:

(1) Only a small amount of research has been dedicated to the immigration and housing prices in Canada, which is currently the 5th OECD country with the most migrants (USNEW, 2024).

(2) No research has employed spatial econometric models to explain the effects

of immigration on Canada's housing prices.

(3) Current research on immigration and Canada's housing prices only used annual census data which does not cover a lot of time periods nor include post-COVID data.

Hence, this project employed spatial econometric model (Spatial Durbin Error Model, more specifically) on updated data of a higher frequency (monthly) with an aim to study the impact of immigration on Canada's housing prices and further examine the effectiveness of Ontario's Non-Resident Speculation Tax on suppressing the driving force on housing prices from foreign immigrants.

3 Models and Hypotheses

3.1 Models

The main economic theory behind the relationship between the housing prices and immigration is the simple demand-supply relationship. A major reason behind Canada's skyrocketing housing prices is the imbalance between supply and demand. On one hand, there exists a high demand: Canada's population is growing, leading to strong domestic desire for homeownership; meanwhile, foreign investors are often blamed for the housing crisis by the public. On the other hand, there exists a limited supply: new home construction isn't keeping up with demand, due to reasons like zoning restrictions (Jones, 2022) or high development costs. This long-lasting imbalance is pushing housing prices higher.

If the immigration inflow persists, driving the population growth as well as the increase in the demand for housing, there will occur an increase in housing prices. Meanwhile, in Ontario, with the introduction of the Non-Resident Speculation Tax, the foreign home buyer tax, some foreign investors, as well as also the non-resident immigrants, are discouraged from entering the market, hence potentially lowering overall demand and putting some downward pressure on prices, especially in luxury or high-demand areas.

Housing prices are usually assumed to have a spatial correlation or spatial effects (Katchova, 2013), i.e., the housing price in one province could be correlated with that of its neighboring province, and hence the factors impacting the price in one province will have spillover effects on the price of the neighboring province. In our project's case, some potential reasons are that: (1) Because of geographical distance, inter-provincial migration could lead to the interaction of the population in neighboring provinces, hence impacting the housing demand. (2) The economic interaction may bring effects of the development of one economy to that of the other, impacting the macroeconomic factors that have an impact on the housing prices. Therefore, a Spatial Durbin Error model on panel data is used for the main regression.

$$Y_t = \rho W Y_t + X_t \beta + W X_t \theta + \lambda W u_t + \epsilon \tag{1}$$

A Spatial Durbin Error model takes into account three interaction effects: endogenous interaction effects, exogenous interaction effects, and interaction effects among the error terms (Elhorst, 2011). In our model, Y_t is the dependent variable matrix $(n \times 1)$, the housing price in this case; X_t is the independent variable matrix $(n \times k)$, including the main independent variables and the control variables; W is the spatial weights matrix $(n \times n)$, measuring the spatial correlation between two provinces. The coefficients include the following: ρ is the Spatial autoregressive coefficient matrix $(n \times n)$, measuring the endogenous interaction effects; λ is the Spatial autocorrelation coefficient matrix $(n \times n)$, measuring the interaction effects among the error terms; β is the coefficient matrix for X_t $(k \times 1)$, measuring the effect of X_t on Y_t in the same individual as well as that of X_t on Y_t of a different individual (exogenous interaction effects). In this paper, the coefficients are estimated by Maximum Likelihood method, and then the direct and spillover effects are calculated (Details on the direct and spillover effect calculation could be found in Elhorst's paper (2011)).

Then, in order to probe into the effectiveness of the Non-Resident Specu-

lation Tax (NRST) in Ontario, a pooled linear regression shown below is conducted. The X is the same set of independent variables used in the main regression above, while three extra terms are added: *COVID* is a dummy variable which identifies if it is a year after COVID; *after_tax* is a dummy variable which identifies if it is a year after NRST; *after_tax*immigrant_ratio_employmnt* is an interaction term of the main independent variable and the NRST dummy variable.

3.2 Hypotheses

Based the analysis above, this paper put forward and test the following hypotheses:

1. Immigration in Canada has a positive effect on Canada's housing prices, and there also exists a positive spillover effect across provinces (i.e. the immigration into one province will have a positive effect on the housing price of its neighboring province). This will be tested through the main regression – the Spatial Durbin Error regression.

2. The introduction of the NRST has a negative effect on Ontario's housing prices and mitigates this positive effect of immigration on that in Ontario. This will be tested through the follow-up regression – the pooled linear regression.

4 Data

The dataset used in the main regression contains monthly data on 10 provinces (Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Nova Scotia, Ontario, and Prince Edward Island) over the period from 2008-04 to 2023-12. It is a balanced panel dataset where n is 10 and T is 189, arriving at a sample size of 1890.

All data are sourced from the Statistics Canada published datasets. Table

Table 1: Data Source

Variable Name	Data source
housing_land_index	https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810020501
Immigrant_ratio_employmnt	https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410008201
wage	https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3610020501
CPI	https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1810000413
unemployment	https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410001701
Population_density	population(15 and above): https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=1410008201 area: https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=9810000101
Map shapefile	https://open.canada.ca/data/en/dataset/a883eb14-0c0e-45c4-b8c4-b54c4a819edb

Table 2: Variable Description

Variable Name	Description
housing_land_index	The dependent variable, measures the level of new housing and land prices.
immigrant_ratio_employmnt	The independent variable, measures the level of immigration among employed population in Canada.
population_density	Control 1, measures the population density in one province at a certain period
unemployment	Control 2, measures the unemployment rate in one province at a certain period
wage	Control 3, the average wage in one province at a certain period
COVID	Control 4, measures if it is a post-COVID year
after$_tax$	Control 5, measures if it is a post-NRST year

1 shows all the sources for the collected data in this project. Note that CPI is eventually not used in the regression out of concern for collinearity.

5 Variables and Measurement

5.1 Variables

Table 2 and Table 3 show the names, descriptions, and constructions for all the variables used in the main regression as well as the follow-up regression.

Table 3: Variabe Construction

Variable Name	Construction
housing_land_index	New housing price index from Stats Can (2016/Dec = 100)
immigrant_ratio_employmnt	Ratio of immigrants among all employed population (aged 15 and over)
population_density	Population/Land area (Provincial land area is from 2021 Census)
unemployment	Unemployment rate from Stats Can
wage	Total distributed wage/employed population
COVID	2020 - 2023 = 1; 2008 - 2019 = 0
after$_tax$	2018 - 2023 = 1; 2008 - 2017 = 0

5.1.1 Dependent Variable: house prices

The dependent variable, house prices, is measured by the new housing price index. The New Housing Price Index (NHPI) is a monthly series that measures changes over time in the builders' selling prices of new residential houses. The reference period is December 2016, in which the NHPI equals 100.

5.1.2 Independent Variable: immigration

The independent variable, immigration, is measured by the ratio of immigrants in the employed population (aged 15 and over). This measurement is adopted in that usually only the employed immigrants will have the ability to purchase a house, hence creating the demand for housing and impacting the housing prices.

5.1.3 Control Variables

Some macroeconomic factors commonly used in the literature are adopted as control variables. (1) Population density: the population density of a province represents the housing demand from the existing population in the province. (2) Unemployment: the unemployment rate will impact the price buyers willing to pay for a house. (3) Wage: the wage will impact people's disposable income and hence impact the price buyers willing to pay for a house. (4) COVID: the housing prices is expected to have a difference before and after COVID-19 pandemic. (5) NRST tax: the housing prices is expected to have a difference before and after the tax being put into practice.

5.2 Descriptive statistics

The following table gives an overview of the variables used. As shown in the table, each province has 189 observations from 2008-04-01 to 2023-12-01. The housing_land_index varies from 74.6 to 143.6 with an average of 101.6, while the immigrant_ratio_employmnt varies from 1.157 to 33.771. In the total sample, 25.4% is post-COVID observations and 38.1% is post-NRST observations. The

data seem reasonable compared to relevant previous research (Akbari & Aydede, 2012).

In the Figure 1 and Figure 2, we can see that both independent variable and dependent variable are increasing over time.

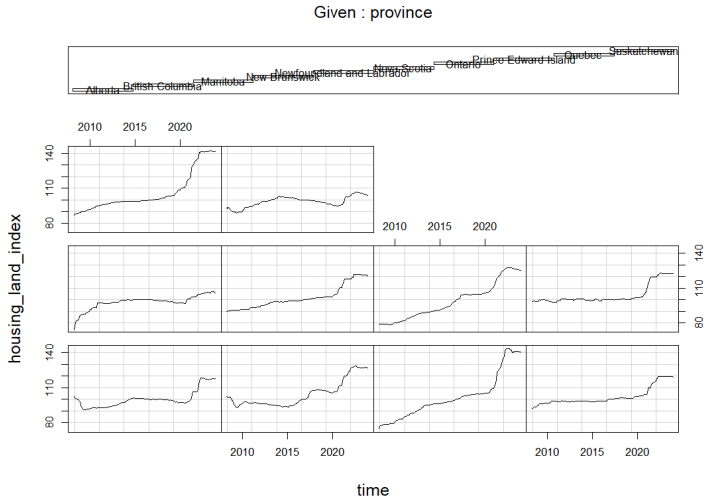

Figure 1: Independent variable over time

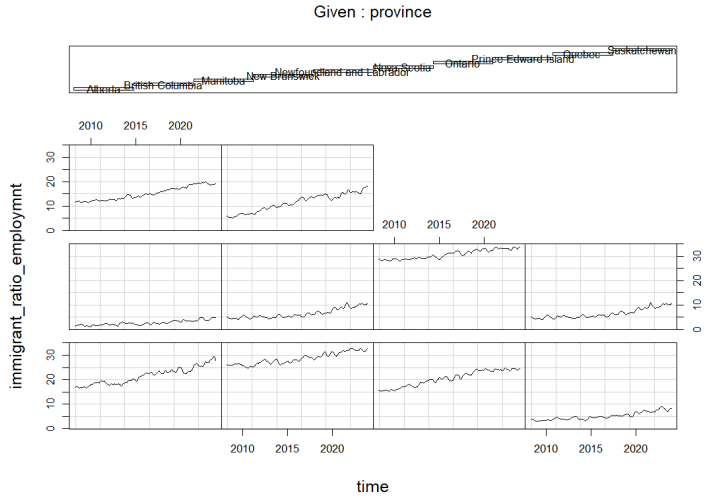

Figure 2: Dependent variable over time

A scatterplot of the trend of the dependent variable against the independent variable is shown below. We can see that if controlled for individual

differences, there is a positive correlation between these two variables, giving hint on the possible outcome of our regression: a positive impact of the immigrant_ratio_employmnt on housing_land_index.

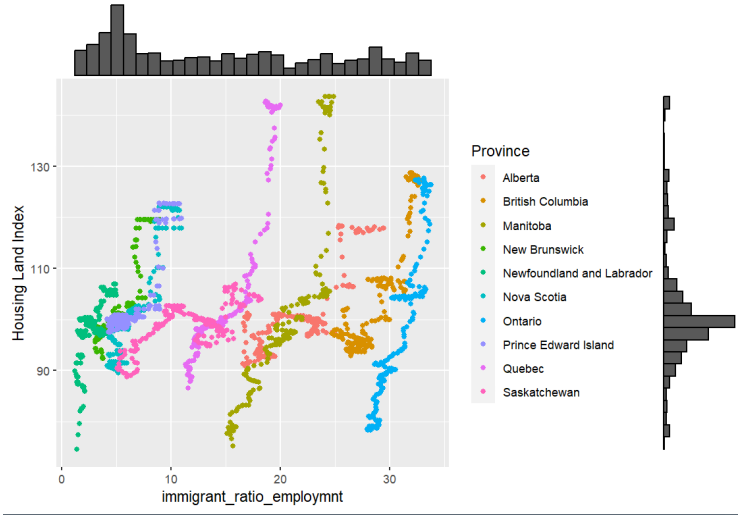

Figure 3: Scatterlot of Dependent Variable against Independent Variable

5.3 Pre-regression examinations

Before the regressions, a few tests are conducted to ensure there is no violation for the assumptions of the regression models. The following properties are examined: stationarity, spatial effects, collinearity, random effects.

5.3.1 Stationarity

An ADF test is conducted on the dependent variable and results show that the alternative hypothesis of stationarity should be accepted. To consider panel-specific tests that account for both individual heterogeneity and time-series, a Levin–Lin–Chu test is also conducted and showed that the stationarity assumption holds. Both tests show that it is safe to include a temporal lag in the regression, which however was proved different in the regression which includes a temporal lag of the dependent variable as the R-square reaches 99%. Therefore, even though the stationarity test passed, we decided not to go forward

with a temporal lag in the final regression model.

5.3.2 Spatial effects

A Moran's I test measures the spatial autocorrelation for continuous data. To conduct a Moran's I test, this paper follows the following steps: define a neighbor list and weight matrix (contiguous neighbor or k-nearest neighbor, KNN neighbor and weights are adopted in this paper); calculate Moran' I statistics and conduct a hypothesis test. In general, an I value close to - 1 means strong positive autocorrelation; a value close to -1 means strong negative autocorrelation; a value of 0 means no autocorrelation. In our results, our Moran's I value is around 94% at a p-value of less than 2.2e-16, which can be concluded that our dependent variable possesses a significantly strong positive spatial autocorrelation and therefore that it is reasonable to use a spatial econometric model.

5.3.3 Random effects

For panel data analysis, we also need to conduct the Breusch–Pagan Lagrange Multiplier Test (LM test) and the Hausman Test to decide if/which panel analysis method to be used. Our results suggest random effects to be adopted. Therefore, random effects Spatial Durbin Error model will be used in the regression.

5.3.4 Collinearity

Since multiple macroeconomic variables are used in the control variables, we should also check if any of them will cause serious collinearity problem which might impact the results. In a panel data model containing the main independent variable and all the control variables (except for after_tax), CPI is highly suspected to cause collinearity and therefore it is removed from the model. After removing the CPI, all explanatory variables have a reasonable variance inflation factor.

6 Regression Results and Analysis

6.1 Random Effects Panel Regression

As a preliminary check, a random effects panel regression is conducted. As shown in the table below, all coefficients are significant, and the model explains 76% of the variance. Immigration, like in hypothesis (1), has a positive impact on the housing prices: with every 1% increase in the immigrant ratio in the employed population, the housing price index will rise 0.3. Other variables that positively impact the housing prices are population density, wage, and COVID, while unemployment negatively impacts the housing prices.

```
Coefficients:
                            Estimate  Std. Error  z-value  Pr(>|z|)
(Intercept)              47.69197406  2.14996688  22.1827 < 2.2e-16 ***
immigrant_ratio_employmnt  0.30667476  0.06924293   4.4290 9.468e-06 ***
population_density         0.53853466  0.12798269   4.2079 2.578e-05 ***
unemployment              -0.83159924  0.07124239 -11.6728 < 2.2e-16 ***
wage                       0.01266884  0.00044509  28.4632 < 2.2e-16 ***
COVID                      6.27780157  0.46065882  13.6279 < 2.2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:    245380
Residual Sum of Squares: 58733
R-Squared:      0.76064
Adj. R-Squared: 0.76001
Chisq: 5987.01 on 5 DF, p-value: < 2.22e-16
```

Figure 4: Random Effects Penal Regression Results

6.2 Spatial Durbin Error Model

Now we conduct a random effects Spatial Durbin Error Model. Since the R package splm is used here, which does not allow dummy variables in the spatially lagged model, we do not include the control variable of COVID. The spatial regression results are shown in the table below. After considering the spatial autoregressive coefficient and the spatial autocorrelation coefficient, we have significant coefficients for interaction effects ρ, λ, β are all significant. The coefficients for immigrant_ratio_employmnt, unemployment, and wage stay significant. Surprisingly, after considering spatial effects, the coefficient for immigrant_ratio_employmnt increased from 0.3 to 1.6.

```
Error variance parameters:
     Estimate Std. Error t-value Pr(>|t|)
phi 18.592102   8.544677  2.1759  0.02957 *
rho  0.468065   0.029416 15.9121  < 2e-16 ***

Spatial autoregressive coefficient:
        Estimate Std. Error t-value  Pr(>|t|)
lambda -0.130695   0.029058 -4.4977 6.868e-06 ***

Coefficients:
                           Estimate Std. Error t-value  Pr(>|t|)
(Intercept)              37.1855430  7.0596053  5.2674 1.384e-07 ***
immigrant_ratio_employmnt  1.6047900  0.0867220 18.5050 < 2.2e-16 ***
population_density         0.1272718  0.2377542  0.5353    0.5924
unemployment              -0.6196428  0.0823429 -7.5252 5.266e-14 ***
wage                       0.0146105  0.0004317 33.8445 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Figure 5: Spatial Durbin Error Model Results

However, the coefficient in the Spatial Durbin Error model does not have a straight-forward explanation, hence we further check the spillover matrix which indicates the direct and indirect effects of the variables. The spillover matrix can be thought of a matrix of first order derivatives where the diagonal elements are direct effects: impact of the expected value of region i, given a change in certain variable for the same region and the off-diagonal elements are indirect effects: the impact on the expected value of location i, given a change in a certain explanatory variable in location j. As shown in the table below, the effects of immigrant_ratio_employmnt, unemployment, and wage are all statistically significant. Looking closer at the dependent variable, immigration, we can see that the direct effect is positive and as high as 1.6058 while the indirect effect is negative at a value of -0.1865. This proved testing to our first hypothesis, showing that immigration has a positive effect on the housing price in the same province but has a negative spillover (indirect) effect on that in the neighboring regions.

The positive direct impact is expected and aligned with the previous research for the US housing price: immigration inflows are associated with rising housing prices, while the negative spillover effect is not (Mussa, et al. 2017). This result suggests that although there exists a strong positive spatial correlation among housing prices across Canada, the immigration factor, which has a positive impact on the housing prices of its own province, has a negative impact on that

```
Impact measures (lag, trace):
                              Direct    Indirect       Total
immigrant_ratio_employmnt  1.60575091 -0.18645628  1.41929464
population_density         0.12734797 -0.01478737  0.11256060
unemployment              -0.62001380  0.07199464 -0.54801916
wage                       0.01461929 -0.00169756  0.01292173
========================================================
Simulation results ( variance matrix):
========================================================
Simulated standard errors
                                Direct     Indirect        Total
immigrant_ratio_employmnt 0.0856657813 0.0363201955 0.0838216913
population_density        0.2245852167 0.0258778432 0.1993577854
unemployment              0.0824601804 0.0163716894 0.0747257859
wage                      0.0004165646 0.0003215084 0.0004831245

Simulated z-values:
                             Direct  Indirect      Total
immigrant_ratio_employmnt 18.8150629 -5.039678 17.0452894
population_density         0.4631552 -0.454049  0.4628261
unemployment              -7.5598367  4.321422 -7.3955263
wage                      35.1232902 -5.168778 26.8446608

Simulated p-values:
                          Direct     Indirect   Total
immigrant_ratio_employmnt < 2.22e-16 4.6632e-07 < 2.22e-16
population_density        0.64325    0.64979    0.64349
unemployment              4.0412e-14 1.5503e-05 1.4078e-13
wage                      < 2.22e-16 2.3563e-07 < 2.22e-16
```

Figure 6: Spatial Durbin Error Model Impact

of the neighboring provinces. One possible explanation could be that, different provinces have different immigration policies, so being geographically close to each other does not mean that the effects from the immigrants into one province will spill to the neighboring provinces, and hence the neighboring provinces will not obtain the benefits nor the downsides brought about by this immigration increase; additionally, the immigrant inflows into one province indicate that the development of this province might be at advantage over that of its neighboring provinces and might encourage the population outflow from the neighboring province, which lowers the housing demand in the neighboring provinces and hence lowers the housing prices.

6.3 Pooled Linear Regression Model

To probe into the effectiveness of Ontario's NRST, a pooled linear regression with interaction term is conducted. The results are shown in the table below, Compared with the random effects panel model and the Spatial Durbin

Error model, all the significant coefficients have the same sign (the positivity/negativity of the impact did not change). The coefficient for the dummy term does not appear significant, nor does that for the interaction term.

```
Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -66.992777  11.270560  -5.944 1.40e-08 ***
immigrant_ratio_employmnt         0.627631   0.310130   2.024   0.0445 *
population_density                7.804931   1.672502   4.667 5.94e-06 ***
unemployment                     -1.020674   0.151175  -6.752 1.92e-10 ***
wage                              0.012249   0.002274   5.387 2.21e-07 ***
COVID                             5.135898   1.187110   4.326 2.50e-05 ***
after_tax                        20.830043  18.733033   1.112   0.2676
immigrant_ratio_employmnt:after_tax  -0.745369   0.585188  -1.274   0.2044
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.362 on 181 degrees of freedom
Multiple R-squared:  0.9774,    Adjusted R-squared:  0.9766
F-statistic:  1121 on 7 and 181 DF,  p-value: < 2.2e-16
```

Figure 7: Pooled Linear Regression Model with Interaction Term

To eliminate the possibility of misspecification, a linear regression that includes the dummy term and not the interaction term is also conducted. Results are shown in the table below. As is shown, all coefficients are significant with the same sign as previous regressions, the coefficient for the newly added dummy term, after_tax, is significantly negative, showing that the NRST does have a significant negative impact on the housing prices in Ontario.

```
Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)              -66.471470  11.282368  -5.892 1.81e-08 ***
immigrant_ratio_employmnt   0.503342   0.294882   1.707 0.089541 .
population_density          7.968139   1.670435   4.770 3.76e-06 ***
unemployment               -0.962500   0.144357  -6.668 3.01e-10 ***
wage                        0.012426   0.002273   5.466 1.50e-07 ***
COVID                       4.352864   1.017265   4.279 3.03e-05 ***
after_tax                  -3.011223   0.757836  -3.973 0.000102 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.366 on 182 degrees of freedom
Multiple R-squared:  0.9772,    Adjusted R-squared:  0.9765
F-statistic:  1303 on 6 and 182 DF,  p-value: < 2.2e-16
```

Figure 8: Pooled Linear Regression Model with Dummy Variable

Combining the results from two pooled regressions, we can conclude that NRST does have a statistically significantly negative impact on the housing price, but not through interacting with the immigration. This is also reasonable as the NRST is mainly targeted at the foreign investors to prevent speculation in housing market, and the goal of it should not be putting strain on the newcomers

that land in Canada.

7 Conclusion and Implications

Using the panel data that span from 2008 to 2023, this paper finds, as have others, that immigration is associated with rising housing prices. More importantly, the use of spatial model helps conclude that immigration into one province will reduce the housing prices in the neighboring provinces. This paper also finds that the NRST in Ontario is effective in lowering the housing prices but does not interact with immigration factor.

Based on the empirical findings, some policy implications can be drawn. Since neither Canada's population nor the housing stress is distributed evenly geographically, also because immigration is critical to a lot of aspects of Canada's development, in order to address the housing crisis and maintain the development brought about by immigration, immigration policies can be adjusted to encourage immigration in the provinces neighboring with the provinces that have more prominent housing stress while tightening up the immigration in those "stressed" provinces. Since immigration increase in one province can reduce the housing price in its neighboring provinces, the policy adjustment above might help reduce the housing prices in those "stressed" provinces, decrease the geographical unevenness in housing price, stress, and potentially the economic development.

8 Limitations and Future Steps

There are multiple limitations in this project that will need further consideration in the future steps.

(1) Reverse causality may exist between the dependent variable housing price and independent variable immigration. Although a lot of people are attributing the housing price increase to immigration, housing price may also

impact immigration (Zimonjic, 2024), leading to the endogeneity issue in the econometric estimation.

(2) Model selection needs to be further explored. Spatial Durbin Error Model (SDEM) is adopted in this paper, but in order to obtain the most reliable results, further model selection criteria should be used to compare multiple options: OLS, SAR, SDM, DEM, SDEM, and SLX. This can be done using Bayesian posterior probabilities.

(3) This project only looks at the new house purchase prices. In reality, rent is also a key factor causing the unaffordability of housing. The research of Mussa et al. (2017) employed spatial models to study the housing price and rent in the US market and arrived at the same results in both prices. It is worth further exploration to see if it also applies to Canada.

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