Immigration and Housing Rents in Canada: A Panel Data Analysis

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Abstract

This study examines the impact of new immigration on housing rent, using Canadian province-level panel data from 1983 to 2010. In its estimations, it utilises econometric methods such as panel unit roots, panel co-integration regressions and panel vector error correction models. Both fully-modified ordinary least squares and dynamic ordinary least squares models suggest that immigration flow has a significant positive impact on housing rent in the long run. The panel vector error correction model analysis suggests both short run and long run causal impacts of new immigration on rent.

1. Introduction

Since the mid-1990s, the inflow of immigrants has been the main engine of population growth in Canada (Statistics Canada 2008). The National Household Survey (2011) suggests that in 2011, foreign-born people represented 20.6 per cent of Canada's total population, the highest proportion among the G8 countries. From the beginning of the 2000s, migratory increases were responsible for two-thirds of Canada's yearly population growth (Statistics Canada, 2012). Given the importance of immigrants in Canadian demography and the economy, researchers were interested in examining the impact of immigration, primarily focusing on labour market related issues (Hum and Simpson 2004; Frenette and Morissette 2005; Ferrer and Riddell 2008; Green and Worswick 2010).

However, one less researched area is the impact of immigration on the housing market. This market has an important role in macroeconomic performance and, at the same time, home ownership has an impact on individual-level wellbeing (Bratt 2002; Leung 2004). A few studies, using Canadian data, have examined the relationship between immigration and housing prices (Akbari and Aydede 2012; Carter 2005; Ley and Tutchener 2001). However, one sparse area of research is the causal analysis of the impact of immigration inflow on the housing rental market. Recent immigrants in Canada face difficulties in the labour market and, with poor income outcomes, a majority of the recent immigrants are renters rather than home owners (Hiebert *et al* 2008; Picot *et al* 2007; Schellenberg 2004). Thus it is expected that immigrant inflow will have a substantial impact on the rental market. This paper aims to fill the gap in Canadian housing literature by examining the impact of immigrant inflow on housing rent.

So far, only a few studies have investigated the relationship between immigrant inflow and housing rent. Using data from the US national and metropolitan statistical areas Annual Household Survey (AHS), Saiz (2003) investigated the changes in rental prices in Miami and three other comparison groups after the Mariel boatlift from Cuba in 1980. Using 'Mariel Boatlift' as a natural experiment, the study found that in the short run, exogenous immigration shocks put pressure on local housing markets and pushed up rents. Greulich et al (2004), using US Public Use Micro Data Sample of the Census (1980, 1990 and 2000), examined the impact of the growth of the immigrant population on housing consumption opportunities of native renter households. The study found that monthly housing expenses of the native renters were higher in metropolitan areas with larger immigrant populations. Saiz (2007) used annual US data on legal immigration flows and census data on the stock of the foreign born, housing rents and home values at the metropolitan area level, to examine the impact of immigration flow on housing rents in US cities. Utilising an instrumental variable approach, the study found that an inflow of immigrants equal to 1 per cent of a city's population was associated with an increase in average rents and housing values of about 1 per cent. All of these prior studies used data from the United States. Only a few studies have examined the relationship between immigration and housing markets using Canadian data (Akbari and Aydede 2012; Carter 2005; Ley and Tutchener 2001). However, these studies primarily focused on the impact of immigration on housing prices, rather than on rents. In a recent study, Peri and Shih (2013) used Canadian census data (1991, 1996, 2001, and 2006) to examine the impact of the inflow of foreign born STEM (Science, Technology, Engineering and Maths) workers on house rents. The study found a positive and significant effect of foreign STEM workers on rents paid by college educated workers. The study further found that impact of the inflow of foreign STEM workers on rents paid by non-college educated workers was not statistically significant.

This study expects to make several contributions to the literature:

- To the best knowledge of the author, this is the first study using aggregate Canadian data to examine causal relationships between immigrant inflow and housing rent.
- Unlike other studies on this issue, this study utilises recently developed panel co-integration techniques and thus is able to consider both short run

and long run impacts of immigration on housing rent. Further, panel data allow for more powerful statistical tests, as panel data provide a larger number of point data, leading to an increase in the degrees of freedom and a decrease in the collinearity among the regressors (Ciarreta and Zarraga, 2010).

- To the best knowledge of the author, this is the first study to use macro-econometric techniques to analyse the relationship between immigration and housing rent.[2]

The remainder of the paper is structured as follows: Section 2 discusses the conceptual framework and data; Section 3 discusses the empirical methodology and presents the results of the study; and Section 4 contains the study conclusions.

2. Conceptual framework and data

2.1 Conceptual Framework

An inflow of immigrants in any particular area is expected to increase housing demand. Recent immigrants are more likely to become renters rather than home owners as they face initial job market difficulties, because of language barriers and lack of recognition of their previous experiences in their countries of origin. However, how much rents will increase depends on the amount of the shift in the demand curve and the elasticity of the supply curve. An influx of immigrants in the local job market may depress the wage rates and as a result, many native people may leave the area. Further, natives may leave the area even in the case when wage does not fall, simply because natives may have a preference for living closer to other natives (Sá 2014; Saiz and Wachter 2011).[3] If native outflows offset immigrant inflows one for one, then the demand curve may not shift and consequently rents will not increase. On the other hand, if there is less than complete displacement of natives, then the demand curve will shift and the amounts of rent increases will depend on the elasticity of the supply curve. In the short run, it is expected that the supply curve will be relatively less elastic. On the other hand, the supply curve will be more elastic in the long run as it is possible to create more rental space over the long run. So price increases will be expected to be less in the long run compared to the short run.

2.2 Data

This study uses provincial-level panel data extracted from the website of *Statistics Canada*. The yearly data cover 1983 to 2010. The dependent variable is 'Housing Rent', while the independent variables are 'Immigration Flow', 'Per Capita Real GDP' and 'Unemployment Rate'. The 'Immigration Flow' variable is measured as the total annual immigrant flow to a particular province, divided by the initial population of the province. Real GDP is divided by the total population of the province to estimate 'Per Capital Real GDP'. According to the definition used by *Statistics Canada*, 'Unemployment Rate' is the number of unemployed persons as a percentage of the labour force. The variables 'Housing Rent', 'Immigration Flow' and 'Unemployment Rate' are obtained from the Labour Force Survey. The 'Real GDP' and 'Population' figures are taken from *Statistics Canada* administrative files. 'Rent' is the inflation-adjusted provincial average, with 2002 as a base year. Both 'Real GDP Per Capita' and 'Unemployment Rate' are estimated on a provincial basis. All variables used in this study are in natural logarithmic form.

The Appendix of this study provides some descriptive statistics about the immigration flows and rents in Canada. Table A1 and Graph A1 show that the flow of new immigrants to Canada increases over time. Table A1 and Graph A2 suggest that the average housing rent in Canada also has an increasing trend. Data from Table A3 show that 'Economic Class' immigrants constitute the majority of new immigrants. It is noted that highly skilled and educated people belong to the 'Economic Class' immigrant category. These data are important, since highly skilled immigrants may increase rental prices by increasing demand for housing. On the other hand, low skilled immigration may decrease rental prices by increasing crime in an area.[4] Finally, Table A2 shows that immigrants mainly go to four Canadian provinces: Ontario, Quebec, British Columbia (BC) and Alberta. Each year, these provinces receive, on average, 80 per cent to 90 per cent of the total number of new immigrants.

3. Econometric Analyses and Results

This study utilises Panel Cointegration Analysis to examine the relationship between immigrant flow and rent. The panel cointegration technique involves following four steps:

1. A Panel Unit Root Test will be used to identify the order of integration for each of the variables in the model.

2. If all of the variables are integrated of order one, the Panel Cointegration Tests will be utilised to examine whether or not the variables are cointegrated.

3. If the variables are found to be cointegrated, then the study will use Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) estimators to estimate a long run relationship between rent and the independent variables.

4. To estimate short run elasticities and the speed of adjustment to the long run equilibrium, the study will employ Panel Vector Error Correction Models (PVECM).

3.1 Panel Unit Root Tests

To check whether shocks to a time series have permanent or transitory effects, this study utilises panel unit root tests. If the shocks have permanents effects, then the process is stated to contain a Unit Root. A series with a unit root is non-stationary, implying that the mean and variance of the series change over time. For such series, the classical least square theory will not apply and employing least square regression on such data may produce a spurious result. Thus it is important to test whether any series has a unit root or not. The study employs a number of panel unit root tests: the LLC Test (Levin *et al* 2002), the IPS Test (Im et al 2003), the ADF-Fisher Test (Maddala and Wu 1999), and the PP-Fisher Test (Choi 2001). All these tests are based on the following Augmented Dickey-Fuller (ADF) regression:

$$\Delta y_{it} = \alpha_i + \rho_i y_{it} + \sum_{k=1}^{p} \theta_{ik} \Delta y_{it-k} + \varepsilon_{it} \; ; \; i=1,2,3...N; \; t=1,2,3....T \qquad (1)$$

where y_{it} stands for each variable in the model, α_i is the individual specific fixed effect and ρ_i is the autoregressive coefficient.

The LLC test has the null hypothesis of $\rho_i = \rho = 0$ for all I, against the alternative hypothesis of $\rho_1 = \rho_2 = ... = \rho < 0$ for all i. The test statistic is $t_{\hat{\rho}} = \hat{\rho} / \mathrm{SE}(\hat{\rho})$ where $\hat{\rho}$ is estimated from the autoregressive model (Equation 1). The LLC test is based on the assumption that all cross section units have a common unit root.

The IPS test relaxes the assumption of identical unit root and allows a varying unit root across the cross section units. The null hypothesis of i =0 is tested against the alternative hypothesis of ρ_i<0. The IPS test is based on averaging augmented Dickey-Fuller (ADF) across the groups. The test statistics can be written as follows: $\bar{t} = \frac{1}{N} \sum_{t=1}^{N} t_{i,T}(P_i)$ Where $t_{i,T}$ is the ADF-t statistics for province i based on the province specific ADF regression; and P_i is the lag order in the ADF regression.

Both the ADF-Fisher test and the PP-Fisher test allow the autoregressive coefficient ρ to vary across the cross section units. These tests are based on combining the p values from the unit root test of each cross section unit i.

Table 1 and Table 2 provide results of the Panel Unit Root tests. The results of the Panel Unit Root tests in levels are shown in Table 1. The results of the four tests on the variables do not reject the null hypothesis of the presence of a panel unit root. The Panel Unit Root tests on the first differences of the variables, shown in Table 2, reject the null hypothesis of a panel unit root. Thus all four variables are integrated of order one, I(1).

Table 1: Panel Unit Root Test

	Number of immigrants level	Per Capita GDP level	Unemployment Rate level	Rent level
LLC	-0.2785	-0.0264	-1.260	0.0985
IPS W-stat	-0.5282	-1.1360	-0.344	2.4942
ADF - Fisher Chi-square	29.686	37.411	19.23	15.450
PP - Fisher Chi-square	24.703	37.964	14.86	17.999

Notes: The null hypothesis is that the variable follows a unit root process. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. The lag length is selected using the Schwarz Information Criterion.

Table 2: Panel Unit Root Test

	Number of immigrants first difference	Per Capita GDP first difference	Unemployment Rate first difference	Rent first difference
LLC	-11.101***	-27.186***	-9.300***	-5.451***
IPS W-stat	-9.895***	-26.459***	-9.218***	-36.26***
ADF - Fisher Chi-square	121.42***	289.049***	113.24***	150.58***
PP - Fisher Chi-square	121.60***	203.078***	116.11***	188.29***

Notes: Notes: The null hypothesis is that the variable follows a unit root process. Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. The lag length is selected using the Schwarz Information Criterion. *** indicates that the coefficients are significant at the 1% level. All variables are in logarithms.

3.2 Panel Cointegration Tests

Many of the macroeconomic time series are not stationary in levels, but are stationary in first differences. Such variables are stated to be integrated of order one and are denoted I(1). Regressions using non-stationary variables in levels may provide spurious results. However, there is a possible solution to this problem if the series are cointegrated, meaning that one or more linear combinations of these variables are stationary, even though individually they are non-stationary. If two or more I(1) variables are cointegrated, then they must have an equilibrium relationship in the long run, although they may differ substantially from that equilibrium in the short run.

This study employs panel cointegration techniques developed by Pedroni (1999; 2004) to examine whether there exists a long run relationship between rent and the independent variables. The cointegration relationship is specified as follows:

$$Rent_{it} = \alpha_{it} + \beta_{it} + \delta_{1i} IMM + \delta_{2i} PGDP + \delta_{3i} UNP + \varepsilon_{it} \qquad (2)$$

where $i = 1....,N$ for each province in the panel and $t=1........,T$ refers to the time period. The parameters α_{it} and β_i represent province-specific fixed effects and deterministic trends respectively. *IMM* represents new immigrants to the province, scaled by the initial population of the province. *PGDP* is per capita provincial *GDP* and *UNP* refers to the provincial unemployment rate. ε_{it}, the estimated residuals, represents deviations from the long run equilibrium. To test the null hypothesis of no cointegration, a unit root test is conducted on the residuals using following equation:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + w_{it} \qquad (3)$$

where ρ_i are autoregressive parameters and w_i are stationary error terms.

Pedroni (1999; 2004) proposed seven different tests to examine whether the error process is stationary. These tests are: panel v-statistic, panel rho-statistic, panel ADF-statistic, panel PP-statistic, group rho-statistic, group ADF-statistic, and group PP-statistic. The first four statistics are based on the within-dimension approach and they are known as panel cointegration statistics. The last three statistics are based on the between-dimension approach and are known as group panel cointegration statistics. Both types of tests examine the null hypothesis of no cointegration. However, the within-dimension approach restricts the autoregressive parameter to be the same across all cross sections on the estimated residuals. On the other hand, the between-dimension approach allows the autoregressive parameter to vary over the cross section units. All seven test statistics are assumed to be distributed standard normal asymptotically. The panel v-statistic is a right-sided test, while the other six statistics are left-sided tests.

This study also uses another cointegration test proposed by Kao (1999). This test assumes homogeneity across all cross-section units in the panel. The null hypothesis of no cointegration is examined using an ADF- type test.

The results of the Pedroni Panel Cointegration Test and the Kao Residual Cointegration Test are shown in Table 3. The results show that except for Panel-ρ and Group-ρ tests, the null hypothesis of no cointegration has been rejected at the 1 per cent level of significance. The Kao Residual Cointegration Test also rejects the null hypothesis of no cointegration at the 5 per cent level of significance. Thus the results of the cointegration tests confirm the presence of a panel cointegrating relationship between rent, immigrants, per capita GDP and the unemployment rate.

Table 3: Cointegration Test Results

	Statistics
Panel v-Statistic	9.963***
Panel rho-Statistic	0.631
Panel PP-Statistic	-3.466**
Panel ADF-Statistic	-2.061**
Group rho-Statistic	1.452
Group PP-Statistic	-3.800**
Group ADF-Statistic	-2.639**
Kao Residual Cointegration Test	-6.412**

Notes: The null hypothesis is that the variables are not cointegrated. ** and *** indicates that the estimated parameters are significant at the 5% and 1% level respectively. All variables are in logarithms.

3.3 Estimating the Long Run Cointegration Relationship

To estimate a cointegration relationship in the context of panel data, this study uses the following two estimators: Dynamic OLS (DOLS) and Fully Modified OLS (FMOLS). Asymptotically unbiased estimates of the long run can be achieved using DOLS and FMOLS, as both of these estimators control for potential endogeneity of the regressors and serial correlation. The issue of endogeneity is important for this study because of the possible reverse causality between rent and immigration. In deciding where to settle, the immigrants may consider the costs of housing and they may choose to go to the provinces where the rent is cheaper.

To control for endogeneity feedback, the DOLS estimation method augments the cointegrating regression with lead, lag and current values of the first difference of the I(1) regressors (Saikkonen 1991; Stock and Watson 1993). In general form, the DOLS regression can be written as:

$$Y_{it} = \alpha_0 + \beta X_{it} + \sum_{j=-k}^{k} \theta_{ij} \Delta X_{it-j} + e_{it} \tag{4}$$

where Y is the dependent variable and X represents a vector of regressors.

To correct for the endogeneity, the FOMLS method utilises non-parametric techniques that transform the residuals from the cointegration regression. In general form, the cointegrating system can be written as:

$$Y_{it} = \alpha_i + \beta_i X_{it} + u_{it} \tag{5}$$

$$X_{it} = X_{it-1} - \varepsilon_{it} \tag{6}$$

The FMOLS estimator for the i_{th} panel member is given by:

$$\beta^* = \left(X_i' X\right)^{-1} \left(X_i' y_i^* - T\delta\right) \tag{7}$$

where y_i* is the transformed endogenous variable, δ is a parameter for auto-correlation adjustment, and T is the number of years.

Table 4: Panel Cointegrated Regression Results

	FMOLS model	*DOLS Model*
Immigrant	0.140*** (0.018)	0.170*** (0.009)
Per Capita Real GDP	0.241*** (0.023)	0.501*** (0.019)
Unemployment Rate	-0.209*** (0.035)	-0.258*** (0.034)

Notes: Standard errors are given in parentheses. *** and ** denote that the coefficient is significant at the 1% and 5% level respectively. All variables are in logarithms.

The results of Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS) estimations are shown in Table 4. The FMOLS estimations suggest that immigrants have a significant positive impact on rent. The results further suggest that an increase in per capita GDP increases rent significantly, while an increase in the unemployment rate reduces rent significantly. As the variables are expressed in natural logarithm, the coefficients can be interpreted as elasticities. The FMOLS results can be interpreted in a way that a 1 per cent increases in immigrants will lead to a 0.14 per cent increase in rent. Further, a 1 per cent increase in per capita real GDP will lead to a 0.24 per cent increase in rent, while a 1 per cent increase in unemployment rate will reduce rent by 0.20 per cent. The results of the DOLS estimations, as shown in the third column of Table 4, are qualitatively similar to the results of FMOLS method. The DOLS results suggest that a 1 per cent increase in the number of immigrants will lead to a 0.17 per cent increase in rent. Further, a 1 per cent increase in per capita real GDP will increase rent by 0.50 per cent, while a 1 per cent increase in unemployment rate will decrease rent by 0.26 per cent.

3.4 Panel causality analysis

The cointegration relationship between a set of variables only implies that these variables move together in the long run. To examine the direction of causality, this study utilises the panel vector error correction method, based on the two-step procedure suggested by Engle and Granger (1987). The first step involves obtaining residuals from the long run model. In the second step, the lagged residuals are included as an error correction term in the dynamic error correction model. The resulting equations are as follows:

$$\Delta RENT_{it} = \theta_{1i} + \lambda_1 ECT + \sum_{k-1}^{m} \theta_{11k} \Delta RENT_{it-k} + \sum_{k-1}^{m} \theta_{12k} \Delta IMM_{it-k} + \sum_{k-1}^{m} \theta_{13k} \Delta PGDP_{it-k} + \sum_{k=1}^{m} \theta_{14k} \Delta UN_{it-k} + u_{1it} \quad (8a)$$

$$\Delta IMM_{it} = \theta_{2i} + \lambda_2 ECT_{it-1} + \sum_{k=1}^{m} \theta_{21k} \Delta RENT_{it-k} + \sum_{k=1}^{m} \theta_{22k} \Delta IMM_{it-k} + \sum_{k=1}^{m} \theta_{23k} \Delta PGDP_{it-k} + \sum_{k=1}^{m} \theta_{24k} \Delta UN_{it-k} + u_{2t} \quad (8b)$$

$$\Delta PGDP_{it} = \theta_{3i} + \lambda_3 ECT_{it-1} + \sum_{k=1}^{m} \theta_{31k} \Delta RENT_{it-k} + \sum_{k=1}^{m} \theta_{32k} \Delta IMM_{it-k} + \sum_{k=1}^{m} \theta_{33k} \Delta PGDP_{it-k} + \sum_{k=1}^{m} \theta_{34k} \Delta UN_{it-k} + u_{3t} \quad (8c)$$

$$\Delta UN_{it} = \theta_{4i} + \lambda_4 ECT_{it-1} + \sum_{k=1}^{m} \theta_{41k} \Delta RENT_{it-k} + \sum_{k=1}^{m} \theta_{42k} \Delta IMM_{it-k} + \sum_{k=1}^{m} \theta_{43k} \Delta PGDP_{it-k} + \sum_{k=1}^{m} \theta_{44k} \Delta UN_{it-k} + u_{4t} \quad (8d)$$

where Δ is the first difference operator; θ_{ij} represents province fixed effects; m is the lag length determined by the Swartz Information Criterion; $ECT_{it\text{-}1}$ is the lagged error correction term determined from the long-run cointegration relationship and the term λ_j is the adjustment coefficient; and finally, u_j is the serially uncorrelated disturbance term.

The panel error correction model, represented by equations 8a-8d, can be utilised to identify two types of causality: short-run causality tested using lagged difference terms, and long-run causality evaluated using error correction terms. In terms of short-run causality in equation 8a, causality runs from *IMM* to *RENT* if the null hypothesis, θ_{12k}=0, is rejected, while causality runs from $\Delta PGDP$ to $\Delta RENT$ and from ΔUN to $\Delta RENT$ if we reject null hypotheses θ_{13k}=0 and θ_{14k} =0 respectively via a Chi Square test. In equation 8(b), causality runs from $\Delta RENT$ to ΔIMM if the null hypothesis, θ_{22k}=0, is rejected, whereas causality runs from $\Delta PGDP$ to ΔIMM and from ΔUN to ΔIMM if null hypotheses θ_{23k}=0 and θ_{24k}=0 respectively are rejected. In equation 8(c), causality runs from $\Delta RENT$ to $\Delta PGDP$ if the null hypothesis θ_{31k}=0, is rejected, whereas causality runs from ΔIMM to $\Delta PGDP$ and from ΔUN to $\Delta PGDP$ if null hypotheses θ_{32k}=0 and θ_{34k}=0 respectively are rejected. Finally, in equation 8(d), short-run causality runs from $\Delta RENT$ to ΔUN if the Chi square test rejects null hypothesis θ_{41k}=0, while short-run causality runs from ΔIMM to ΔUN and from $\Delta PGDP$ to ΔUN if we reject null hypotheses θ_{42k}=0 and θ_{43k}=0 respectively.

To evaluate long-run causality, the following null hypotheses are tested: H_0:λ_1=0 in equation 8(a), H_0:λ_2=0 in equation 8(b), H_0:λ_3=0 in equation 8(c), and H_0:λ_4=0 in equation 8(d). In equation 8(a), if null hypothesis H_0:λ_1=0 is rejected, then $\Delta RENT$ responds to deviations from the long-run equilibrium. In the case of equation 8(b), rejection of null hypothesis H_0:λ_2=0 implies that ΔIMM responds to deviations from long-run equilibrium. In equation 8(c), if the null hypothesis H_0:λ_3=0 is rejected, then $\Delta PGDP$ responds if the system deviates from the long-run equilibrium. Finally, in equation 8(d), if the null hypothesis H_0:λ_4=0 is rejected, then ΔUN responds to the deviation from the long-run equilibrium.

The results of the Panel Vector Error Correction Model (PVECM) analyses, shown in Table 5, suggest that the number of immigrants has a statistically significant positive impact on rent in the short run. The results further show that, in the short run, per capita real GDP has a significant positive effect, while the unemployment rate has a negative but insignificant effect on rent. The long run dynamics, based on the significance of the error correction term, suggests that rent responds to deviations from long run equilibrium.

Table 5: Panel Causality Test Results

Independent variables	*Dependent variables*			
	Rent	*Immigrant*	*Per capita real GDP*	*Unemployment rate*
Rent	0.566***	1.969	-1.041	0.590
	(0.056)	(1.921)	(0.500)	(0.977)
Immigrant	0.012***	0.357**	0.003	0.018
	(0.003)	(0.131)	(0.034)	(0.066)
Per Capita Real GDP	0.034**	0.387	-0.092	0.361
	(0.015)	(0.510)	(0.013)	(0.259)
Unemployment Rate	-0.013	-0.560*	-0.004	-0.415*
	(0.009)	(0.325)	(0.084)	(0.165)
Error Correction Term	-0.034***	0.584**	0.017	0.223**
	(0.006)	(0.231)	(0.060)	(0.117)

Notes: Standard errors are given in parentheses. ***, **, and * denote that the coefficient is significant at the 1%, 5% and 10% level respectively. All variables are in logarithms.

The other results of the panel vector error correction model analyses suggest an absence of long run adjustment for number of immigrants, real per capita GDP and unemployment rate. However the results show that, in the short run, the unemployment rate has a significant negative impact on immigrant flow.

3.5 Extension: Impact of immigrant inflow on native outflow

In order to better interpret the results, this study has examined the impact of immigrant inflow on native outflow. For this purpose, the study regressed the change in the foreign population of a province on the change in the total population of that province. If the coefficient is equal to 1, then the result will indicate no crowding out. On the other hand, if the coefficient is less than 1, the result will imply crowding out. As per panel data econometric methods, the study conducted unit root tests and cointegration tests. The variables met the requirements of these tests and thus the study proceeded to estimate a cointegration relationship. The results of the cointegration relationship in the form of Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square

(DOLS) are shown in Table 6. In both models, the coefficient of the change in immigration inflow has a value less than 1, suggesting possible crowding out.

Table 6: Impact of Immigrant inflow on Native outflow

	FMOLS model	*DOLS model*
Change in Immigrant Flow	0.439***	0.493***
	(0.110)	(0.190)

Notes: Standard errors are given in the parentheses. *** denote that the coefficient is significant at the 1% level

4. Conclusions

Using Canadian provincial-specific panel data from 1983 to 2010, this study has examined the impact of new immigration on housing rent. In its estimations, this study utilised econometric methods such as panel unit roots, panel co-integration regressions and panel vector error correction models. Both the FMOLS and DOLS models suggested that immigration flow had a significant positive impact on housing rent in the long run. The PVECM analysis suggested a short run causal impact of new immigration on rent. The PVECM analysis also confirmed a long run causal relationship running from immigration to rent.

To the best knowledge of the author, this is the first study to examine the relationship between immigration and rents using panel cointegration techniques. Other studies on this topic utilised OLS and instrumental variable least squares (2SLS) methods to examine the impact of immigrant flow on housing rent. However, the results of this study confirmed the findings of other studies that immigration positively impacts housing rent.

This study finds that an increase in immigration inflow equal to 1 per cent of province population leads to an increase in the average rent by 0.14 per cent to 0.17 per cent. Saiz (2007) found that an immigration inflow equal to 1 per cent of a city's population was associated with increases in average rents and housing values of about 1 per cent. Saiz (2003) found that the Mariel boatlift immigration shock increased rental prices in the Miami area by 8 per cent to 11 per cent between 1979 and 1981. Finally, Peri and Shih (2013) found that inflow of STEM workers led to an increase in rents paid by college educated workers by 4 per cent. As shown above, the point estimates of this study are much smaller than other papers. A possible reason for small point estimates is stronger native outflow. This study found substantial crowding out and consequently immigration inflow did not lead to a large increase in the net demand for rental units. As a result, the rents did not increase substantially.

Our results have important implications. Canada encourages immigration flow to tackle the problem of labour shortages due to an aging population. However, policy makers need to be aware of some unwanted consequences of immigration such as rent increases. These increases may negatively impact the wellbeing of Canadians, particularly of people belonging to low-income groups. Increasing the supply of new housing may help to solve this problem and thus it is important to provide incentives to encourage investments in the housing sector.

One drawback of this study is data limitations. The provincial level panel data on housing rents and other relevant variables were available only from 1983 and consequently, this study restricted its data from 1983 to 2010. Future studies with more data may get more precise results. Further, future studies may focus on the relationships between immigrant flows and rents in other major immigrant receiving countries like Australia, the United Kingdom, and Germany.

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APPENDIX

Table A1: Immigrant Flow vs Rent (Canada)

Year	*Number of New Immigrants*	*Rent index*
1983	89,377	60.6
1984	88,599	63.6
1985	84,339	66.3
1986	99,343	69
1987	152,031	71.6
1988	161,534	74.4
1989	191,516	78.4
1990	216,424	81.5
1991	232,776	84.3
1992	254,856	86.6
1993	256,754	88.5
1994	224,395	90.1
1995	212,875	91.5
1996	226,061	92.6
1997	216,034	93.7
1998	174,184	94.6
1999	189,971	95.5
2000	227,429	96.6
2001	250,638	98.1
2002	229,049	100
2003	221,349	101.5
2004	235,824	102.5
2005	262,240	103.3
2006	251,644	104.3
2007	236,754	106
2008	247,247	107.8
2009	252,177	109.5
2010	280,682	110.8

Source: Statistics Canada

Table A2: Number of New Immigrants in Canada and Selected Provinces

Year	Canada	Quebec	Ontario	BC	Alberta
1983	89,377	16,416	40,121	14,483	10,725
1984	88,599	14,698	41,700	13,231	10,740
1985	84,339	14,885	40,774	12,256	8,989
1986	99,343	19,476	49,735	12,556	9,673
1987	152,031	26,846	84,781	18,898	11,974
1988	161,534	25,588	88,930	23,131	14,007
1989	191,516	33,946	104,638	25,292	16,173
1990	216,424	41,043	114,770	29,140	19,087
1991	232,776	51,947	120,075	32,382	17,061
1992	254,856	48,838	139,247	37,037	17,798
1993	256,754	44,977	134,996	45,969	18,578
1994	224,395	28,094	117,635	49,146	18,021
1995	212,875	27,228	115,944	44,603	14,360
1996	226,061	29,806	119,719	52,025	13,889
1997	216,034	27,934	117,716	47,848	12,833
1998	174,184	26,626	92,346	35,990	11,198
1999	189,971	29,179	104,165	36,106	12,089
2000	227,429	32,502	133,502	37,413	14,349
2001	250,638	37,604	148,654	38,484	16,406
2002	229,049	37,581	133,590	34,057	14,782
2003	221,349	39,560	119,733	35,233	15,837
2004	235,824	44,245	125,096	37,026	16,474
2005	262,240	43,315	140,533	44,775	19,405
2006	251,644	44,689	125,906	42,085	20,717
2007	236,754	45,213	111,340	38,970	20,866
2008	247,247	45,209	110,903	44,002	24,204
2009	252,177	49,489	106,866	41,439	27,017
2010	280,682	53,981	118,115	44,185	32,643

Source: Statistics Canada

Table A3: Immigrants to Canada, By Category of Admission (% of Landed immigrant)

Year	*Economic class*	*Family class*	*Refugees*
1991	37.2	37.8	23.2
1992	37.6	39.7	20.5
1993	41.2	43.9	11.9
1994	45.6	42.0	9.1
1995	50.1	36.4	13.2
1996	55.5	30.2	12.6
1997	59.4	27.8	11.3
1998	56.2	29.2	13.1
1999	57.5	29.1	12.8
2000	59.9	26.6	13.2
2001	62.1	26.6	11.1
2002	60.2	27.2	11.0
2003	54.7	29.4	11.7
2004	56.7	26.4	13.9
2005	59.6	24.2	13.6
2006	54.9	28.0	12.9
2007	55.4	28.0	11.8
2008	60.3	26.5	8.8
2009	60.9	25.9	9.1
2010	66.6	21.5	8.8

Source: Statistics Canada

Endnotes

1. Department of Economics, Thompson Rivers University, Kamloops, BC, V2C 0C8, Canada. Email: elatif@tru.ca. The author is grateful to the editor and two anonymous referees for their valuable comments and suggestions.

2. Studies on the relationship between immigration and housing rent primarily utilised an instrumental variable approach to deal with the potential endogeneity between immigrant flow and housing rent (Saiz 2003; Saiz 2007). The most common instrument was based on annual immigrant inflows by country of origin and year. However, data on immigrant inflows by country of origin are not available in the Canadian context. Consequently, this study uses macro-econometric techniques such as Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Square (FMOLS) to control for endogeneity. The cointegration techniques used in this study have a number of positive attributes. The resulting estimates from the macro-econometric cointegration techniques can deal with a variety of econometric problems such as omitted variables, endogeneity and measurement errors (Pedroni 2007). Under cointegration,

parameter estimates are super consistent, implying that endogeneity does not affect the results (Engle and Granger 1987). The presence of cointegration relationships among non-stationary variables also implies that there are no missing non-stationary variables and that no additional non-stationary variables are needed to produce unbiased estimates (Herzer and Strulik 2013). Further, the Panel Vector error correction model can identify the direction of causality.

3. The author is grateful to an anonymous referee for this point.

4. The author is grateful to an anonymous referee for this point.

5. These techniques are asymptotically equivalent for more than 60 observations (Banerjee 1999).

6. The author is grateful to an anonymous referee for suggesting this method.

7. The results of the unit root tests and cointegration tests are not shown in the text.

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