Internal Migration and the Role of Agglomeration Economies: Canadian CMA Analysis

by
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Contents

1 Introduction

In a period of increasing technology and ease of commuting further distances, many Canadians, like residents of other developed countries, choose to reside in cities. Immense land area is a characteristic of many of the most populated countries. Nevertheless, as Edward Glaeser expresses in his novel *Triumph of the City*, "more and more people are clustering closer and closer together in large metropolitan areas".[1] Glaeser discusses his interest in urban cities and, while his focus is on New York City in the United States, the material that he presents can be applied to many Canadian cities. He is fascinated with human progress and the lessons that can be learned and applied from studying cities. Glaeser also presents the idea of cities as agglomerations, a notion that motivates much of this empirical analysis. Agglomeration economies are the benefits, both to individuals and society, which are a result of such clustering of individuals and, hence, firms and businesses.[2]

In Canada, the number of international migrants has grown substantially in past years, accounting largely for the country's population growth. However internal migration has also progressed over the same time period. The focus of this analysis is therefore to address the question: *what are the causes and consequences of internal migration in Canada?* In addition, a supplementary question is: *why are Canadians choosing cities?* Following the work of Puhani (2001) and Mitze and Schmidt (2015), the empirical aspect of this paper adopts a small-scale local labour market system consisting of three primary equations as a means of analyzing such questions. The influence of factors which proxy agglomeration economies in attracting mobile labour are of particular importance. Through the implementation of this labour market system, the predictions of the neoclassical and new economic geography literature

[1] Glaeser, 2011, p.1.
[2] Glaeser, 2010, p.1.

are analyzed. As a further extension of the work of Mitze and Schmidt (2015), this paper studies the causes of rural and urban migration separately. As Ye et al. (2016) observe, these topics are often simplified into one study, which they argue is a downfall of many of the previous studies regarding internal migration patterns and agglomeration. This paper contributes to the previous literature by making use of a rich set of factors proxying agglomeration economies. By doing so, it allows both urbanization and localization effects to be analyzed.

The results of the benchmark small-scale labour market system suggest that across Canadian census metropolitan areas the net in-migration rate is positively associated with the unemployment rate and after-tax income levels. The unemployment rate relationship is opposite to what standard theories would predict. This motivates future research focusing on individual expectations of unemployment rates rather than the actual level of regional unemployment, as presented by Baumann et al. (2015). The income correlation is consistent with the predictions of the neoclassical migration theory and new economic geography models. It also appears that the housing and labour market characteristics as well as agglomeration factors that are included in this analysis (with the exception of population density) attract mobile labour in Canada. Analyzing the feedback effects of migration on unemployment rate and average after-tax income level differences, it appears that the predictions of new economic geography models are more strongly complemented. Migration in Canada appears to cause a strengthening of income level differences among metropolitan areas. Furthermore, there appear to be similarities and differences among the causes of rural and urban migration when considering an extension of the small-scale labour market system following the work of Ye et al. (2016). In both instances, it appears that a higher unemployment rate acts as a means of decreasing migration levels, a prediction in line with the neoclassical migration theory. The opportunities for employment in the most populated cities appear to drive migration. As well, agglomeration economies appear to be more influential in rural migration.

The remainder of this analysis is presented as follows: Section 2 provides a literature review of relevant previous empirical studies which act as motivation for this paper. This section is focused on papers incorporating agglomeration economies in ways both different and similar to this study. There is a separation between those previous works which utilize firm-level, microdata and those which, like this paper, implement models using more aggregate data sources. Section 3 presents a brief background on the migration theories which are relevant to this study. The predictions of both the neoclassical migration theory and new economic geography models become relevant when discussing the results of the small-scale labour market system as a means of addressing the causes and consequences of internal migration in Canada. Section 4 provides a description of such a model, following the work of Puhani (2001) and Mitze and Schmidt (2015), as well as the extension of their model used to analyze both rural and urban migration patterns in Canada. Section 5 then provides the data sources and variable descriptions, followed by the results in Section 6. Finally, Section 7 provides concluding remarks.

2 Literature Review

The literature involving the topics of agglomeration and spatial concentration date back to at least the work of Marshall (1920) who recognized that productivity levels of firms are not only affected by the organization found within the firm itself, but that the characteristics of the surrounding area to the firm present additional opportunities. It is therefore argued that firms which are located in areas with a higher concentration of economic activity have advantages over those firms located in more isolated areas.[3] Agglomeration is an evolving concept, one which offers a widespread set of opportunities for research. Since the work of Marshall (1920), there has been considerable theoretical and empirical work surrounding this topic. In particular, research falls broadly into two categories. The first consists of studies utilizing firm-level microdata, or *disaggregate data sources*, and secondly those which make use of metropolitan or regional level data, or *aggregate data sources*. A consistent trend among much of the research in the former category is the analysis of agglomeration and the effects of such clustered activity in terms of differences in productivity levels among firms. Due to the limited availability of public use microdata in Canada, this paper is more similar to research in the latter category and is more focused on geographic concentration and spatial mobility.

2.1 Disaggregate data sources

The work of Henderson (2003) analyzes the extent of agglomeration economies across three hundred and seventeen metropolitan areas in the United States by estimating plant level production functions. These production functions are estimated for both the machinery and high-technology industries and include a set of variables to account for two different scale externalities which plants have varying exposure to. The first, localization economies or externalities which stem from plants located close to others in the same industry, and secondly, urbanization economies or externalities from activity occurring outside the plant's own industry.[4] The findings suggest that high-technology plants in the United States experience within-industry productivity enhancing effects. This suggests a role for local knowledge spillover effects, although this is not the case for plants in the machinery industry. High-technology

[3] Baldwin et al., 2008, p.118.
[4] Henderson, 2003, p.1.

industries also appear to be more agglomerated than do machinery industries which therefore suggests a relationship between agglomeration and the previously mentioned localization effects.[5] Another finding that Henderson (2003) presents is that firms consisting of a single plant in comparison to larger, corporate plants, generate more and benefit to a greater extent from external benefits. This hints at the particular importance of the external environment for small firms. Henderson (2003) admits that to an extent, these results are not necessarily new and have been presented by other authors. However, it is noted that previous findings do vary and it is quoted that this work is "the first study to estimate the effect of externalities on productivity using plant level data in a panel context".[6] This author's work helps eliminate the endogeneity issues that may have been presented or ignored in previous studies using more aggregate data and the panel aspect of this work allows for further hypotheses on timing to be analyzed. Plants past activity levels can therefore be incorporated into the study of production functions by analyzing the impact of the operations of previous plants on current plants activity levels.

Following a similar methodology to that of Henderson (2003), Moretti (2004) also analyzes manufacturing plant level data in the United States through the use of plant level production functions. Moretti however offers a unique approach by utilizing a data set containing firm-worker matched figures.[7] There is a focus on education levels of workers and the resulting spillover effect of human capital and knowledge among plants. In addition, the extent to which these factors are a result of agglomeration effects is looked at. Past empirical work supports the notion that high-technology industries may benefit to a great extent from such spillovers. However, Moretti (2004) notes that there is little empirical work which analyzes the magnitude of such

[5]Henderson, 2003, p.24.
[6]Henderson, 2003, p.2.
[7]Moretti, 2004, p.656.

impacts.[8] As in Henderson (2003), a data set containing plant level data over an extended time period allows Moretti (2004) to deal with issues of both endogeneity and selectivity. He also shows that his use of panel data allows for the correction of biases that may have occurred in the existing literature, since he has the ability to control for permanent as well as unobserved features both at the city and plant levels.[9] He extends the vague existing evidence which analyzes the wages of workers living in cities with different average educational attainment levels, who otherwise have similar characteristics. His results suggest that plants that are in cities with increased amounts of college and higher education graduates experience increases in productivity more so than do plants in cities with lower average levels of education. Moreover, industries which are located closer together experience a larger amount of knowledge spillovers than do industries which are further apart.

Together, Henderson (2003) and Moretti (2004) act as motivation for the work of Andersson and Loof (2011) who analyze manufacturing firm-level data in Sweden. Although these authors examine what they consider to be an 'old' question of whether agglomeration economies have a positive impact on firm productivity, their contribution to the existing literature lies in their use of both firm-level static and dynamic models.[10] Their work also accounts for a rich set of control variables. Andersson and Loof (2011) strengthen their definition of the firm production function by incorporating the size of the region in which the particular firm is located. This augmentation is used to reflect the possibility of agglomeration economies. The results of this study show that in Sweden there appears to be evidence in favour of agglomeration economies in both the static and dynamic models. Although the size of the firm itself does not appear to have a clear connection to the notion of

[8]Moretti, 2004, p.656.
[9]Moretti, 2004, p.657.
[10]Andersson and Loof, 2011, p.602.

agglomeration, productivity levels of manufacturing firms are higher among those located in larger regions as well as among firms located in more densely concentrated agglomerations.[11]

The work of Henderson (2003) also motivates Baldwin et al. (2008) who utilize firm-level data in Canada, also pertaining to the manufacturing sector. Contributing factors of this paper are the use of vast panel microdata (twenty thousand manufacturing firms are analyzed) as well as the incorporation of variables relating to census metropolitan areas in Canada. This results in a rich data set and the ability to test the three mechanisms presented by Marshall (1920) through which firm performance and geographical concentration are related. The purpose of this paper is to identify and understand the factors which are external to manufacturing firms and which affect performance levels. Productivity is therefore impacted by factors relating to the geographic location surrounding firms which are present in some locations and not others. The results presented by Baldwin et al. (2008) show that the factors of agglomeration economies presented by Marshall (1920), "the impact of buyer-supplier networks, labour pooling and knowledge spillovers," are all of importance in influencing productivity levels of manufacturing firms in Canada.[12] Moreover, their results show that the impact of such knowledge spillovers extends beyond the individual plant by up to ten kilometres.[13] This is an interesting and unique aspect of this paper, the ability to quantify the distance of such impacts. A possible downfall however of this paper is the lack of a dynamic model as presented by previous authors. This paper analyzes firm level data for 1999 and the variables relating to census metropolitan areas are from the 1996 census period.

[11] Andersson and Loof, 2011, p.615.
[12] Baldwin et al., 2008, p.130.
[13] Baldwin et al., 2008, p.117.

2.2 Aggregate data sources

Roos (2005) examines a similar topic to that of Baldwin et al. (2008), looking at the importance that geography plays in agglomeration. A contribution that this paper adds to the existing literature, however, is that it implements a new methodology that has not been used in similar contexts. Roos (2005) analyzes data on seventy-two planning regions in Germany and is strongly motivated by the explanations of agglomerations presented by Krugman (1993), labeled first and second nature. First nature pertains to reasons for agglomerations due to some natural factor, for example climate. Whereas second nature is representative of man-made reasons for agglomeration economies.[14] The clustering of economic activity in the real world is a result of both first and second nature. The main goal of the work by this author is to therefore look at the importance of both in the German setting. This paper analyzes features pertaining to geography and the contribution to the spatial distribution among the previously mentioned planning regions. The results suggest that approximately thirty-six percent of the spatial variation in gross domestic product measures, as a measure of economic activity, across German planning regions can be attributed to geographic effects, both direct and indirect. It is noted that this measure is much smaller than previous studies. However, after controlling for the presence of agglomeration economies, the influence that is as a result of geography is reduced substantially to approximately seven percent.[15] It is therefore concluded that in Germany, man-made factors are much more important than geographical, first nature forces for agglomeration.[16]

A less modern approach, yet one that is nonetheless closely related to the questions central to this paper is the work of Sveikauskas (1975) who analyzes the urbanization

[14] Roos, 2005, p.605.
[15] Roos, 2005, p.605.
[16] Roos, 2005, p.619.

of modern economies. A focus is on individuals decisions to reside in populated urban centres and how they reflect the concerns or downsides of living in such areas. He also concentrates on the persistence of large cities and the resulting productivity in such areas. To do so, this author examines metropolitan statistical areas in the United States. An asset of this paper is that it considers forces, both static and dynamic, which may impact productivity. The key static force being that larger cities tend to allow for more specialization and therefore increased efficiency through the division of labour. The dynamic factor, the concentration which occurs in urban cities, is what this author feels to be the more important aspect.[17] The results of this paper suggest that among metropolitan areas in the United States, a doubling of the size of a city results in an labour productivity increase of approximately six percent.[18] Sveikauskas (1975) reports that it is these productivity enhancements that play a central role not only in the existence but also the prevalence of major urban cities in the United States. This analysis is somewhat oversimplified in the sense that there are many other factors which affect the clustering of activity and the resulting urban areas in the United States. Although this may appear as a disadvantage, this paper has motivated many subsequent studies regarding agglomeration and migration to cities.

Fu and Gabriel (2012) utilize data on thirty jurisdictions in China during the 1990s in order to assess the effects of human capital agglomeration on migration among Chinese workers. In particular, skilled-based migration is an important aspect of this analysis. A motivating factor and a central focus of this paper is to contribute to the existing literature on human capital concentration and the resulting productivity levels as well as the effects of these contributors on labour mobility and

[17] Sveikauskas, 1975, p.393/394.
[18] Sveikauskas, 1975, p.410.

economic growth. The directional migration model which Fu and Gabriel (2012) implement provides many advantages over the cross-sectional analysis of previous studies pertaining to such work.[19] After accounting for factors such as skill-based pay and the cost of living, their results suggest that migrants that are higher skilled find the concentration of human capital among the destination location to be of more importance than for less skilled workers among Chinese jurisdictions. Complementary, low skilled migrants appear to have less desire to migrate to such locations where high skilled workers are in the majority.[20] This is likely due to the difficulties that such low skilled workers may have when attempting to acquire human capital investments. Over recent decades, labour migration has been unable to help lessen differences in economic development across Chinese jurisdictions. The findings that skilled migrants are attracted to and that low skilled are not attracted to regions which have a high concentration of human capital support this explanation.[21]

Ye et al. (2016) cover a similar topic to Fu and Gabriel (2012), looking at migration within China and the disparities between regions in their ability to attract human capital migration. These authors analyze data from numerous sources on a majority of the provincial-level locations in the mainland of China. In doing so, the models used by these authors incorporate both individual and regional characteristics. Ye et al. (2016) argue that the existing literature with respect to China appears to exclude to some degree the importance of urban to urban migration, henceforth denoted urban migration. However, this has become an increasingly important topic due to increases in the prevalence of such migration in recent years. Results therefore should not be grouped together with rural to urban migration, hence forth denoted rural migration,

[19] Fu and Gabriel, 2012, p.2.
[20] Fu and Gabriel, 2012, p.15.
[21] Fu and Gabriel, 2012, p.18.

as is much of the past research.[22] A major contribution of Ye et al. (2016) is their focus on the patterns of urban migration across Chinese provincial-level locations and the determinants of such migration patterns, with a focus on those migrants that have higher levels of educational attainment. Their results show that urban migration is quite widely distributed among the provincial-level locations in China and migration patterns appear to be different than was previously thought, with Western China attracting large labour flows stemming from those areas in the interior of China, particularly among more educated individuals. Complementing the work of Fu and Gabriel (2012), urban migrants appear to be attracted to areas with higher levels of human capital, again a pattern which is more pronounced among high skilled workers.

Puhani (2001) analyzes labour mobility among countries in the European Union, and, in particular, presents results for Western Germany, France and Italy. A primary focus of this paper is to the analyze whether asymmetric shocks can be adjusted for through labour mobility within these countries. Since European countries vary in currency, adjustment cannot occur by means of monetary policy.[23] Previous research finds that countries in the European Union, due to being smaller in size than for example, the United States and Germany, have experienced shocks that are more asymmetric.[24] Puhani (2001) investigates the extent to which labour mobility acts as a method of adjustment through the use of "migration-induced population changes" resulting from differences in both unemployment rates and income levels.[25] One restriction of the data used in this analysis is the lack of a distinction between internal and external migration among these countries. The results show that Germany experiences the greatest amount of labour mobility, with France and Italy following.

[22]Ye et al., 2016, p.1762.
[23]Puhani, 2001, p.1.
[24]Puhani, 2001, p.1.
[25]Puhani, 2001, p.2.

However, it is also shown that even in Germany, the adjustment process of migration in response to a shock to unemployment rates still takes several years. Therefore, it is concluded that in the European Union, adjustment to asymmetric shocks do not occur very rapidly through labour mobility.

Mitze and Schmidt (2015) extend the work of Puhani (2001) by analyzing a small-scale labour market system across municipalities in Denmark. At the core of such a system is the net in-migration rate as specified by Puhani (2001), however these authors offer an important extension. Mitze and Schmidt (2015) specify the migration variable in terms of skill level, as measured by educational attainment. This complements the work of many of the above mentioned authors, and is motivated by new economic geography literature.[26] The authors analyze the causes and consequences of internal migration across Denmark using their regional labour market system. In turn, they also evaluate the neoclassical migration theory and new economic geography literature assumptions that are further explained in Section 3. A contribution that this paper adds to the existing literature is that it uses a broad group of variables which proxy agglomeration economies. Therefore these authors are able to analyze not only housing and labour market variables, but also characteristics of agglomeration that act as pull factors in migration decisions. The proxies for agglomeration that are used in this study allow for both urbanization and localization effects to be measured. A further contribution of this paper is the emphasis on internal migration as opposed to international migration which is a prevalent topic in recent empirical work. The results of this paper suggest that across Danish municipalities, agglomeration economies–proxied using such factors as population density, patent applications as a means of representing innovation capabilities, as well as human capital endowment–act as an important source of internal migration patterns. The

[26] Mitze and Schmidt, 2015, p.4.

evidence regarding the role of housing and labour market variables as pull factors for migration across Danish municipalities appears more mixed. Looking towards the consequences of such internal migration in Denmark, the results appear in line with the new economic geography literature predictions, however, due to the limited time frame which is covered by this analysis, including the global financial crisis of 2007/2008, the authors suggest that this presents an opportunity for further research.[27] A possible criticism of this paper, following the work of Ye et al. (2016), is that rural and urban migration patterns in Denmark are not considered separately. Instead, internal migration as a whole is considered, something that Ye et al. (2016) note is common among previous research.

3 Background Theory

As reported in Section 2, the topics of agglomeration and migration are complex areas of research as they are multifaceted and offer many possibilities for analysis. Investigation can aim to answer questions on these topics individually or simultaneously, the latter being a main motivation for this paper. Neoclassical migration theory studies the causes and consequences of internal migration, and in general is a common approach to the related literature. More recent theories have emerged in response to the neoclassical migration theory, acting both as a means of critiquing and updating the previously mentioned ideas. Of importance are new economic geography models and, in particular, the specification by Krugman (1991) of the core-periphery model.[28] The similarities and differences of these models will be explained and further incorporated in Section 6 through the implementation of the small-scale labour market system following the work of Puhani (2001) and Mitze and

[27] Mitze and Schmidt, 2015, p.64.
[28] Mitze and Schmidt, 2015, p.65.

Schmidt (2015) using data on Canadian census metropolitan areas.

Migration is the result of individual behaviour, yet it does have an aggregate impact on the societies that are involved. Neoclassical migration theory therefore has both micro- and macro-level components.[29] The differences in returns that exist between labour markets is perceived as a driving force in migration and therefore a motivation for migration is the real wage and income differentials that are present across markets.[30] Furthermore, both labour supply and demand differences between geographic regions play an important role in an individual's decision to migrate. The human capital theory of migration results from such notions and argues that an individual's objective when considering the migration process is to maximize their net benefits.[31] This theory coincides with the results presented by Fu and Gabriel (2012) and Ye et al. (2016) in the Chinese setting where migrants tend to be more educated and higher skilled, as these characteristics can be seen to increase the possibility of success when migrating. Extensions to the neoclassical model have been made to suggest that migration is also influenced by additional factors which may influence utility levels. These include both economic and societal elements. In line with the neoclassical migration theory, migration is also assumed to be motivated by regional income differences in Krugman's core-periphery model. In addition, it is believed that less skilled workers remain immobile while those who are more educated are more likely to migrate from the 'periphery' to the 'core'.[32]

Utility maximization and market potential are important to both of these theories as causes of migration. However, the consequences of such migration differ. Neoclassical migration theory "assumes that migration flows act as a balancing factor

[29] Kurekova, 2011, p.11.
[30] Kurekova, 2011, p.5.
[31] Kurekova, 2011, p.6.
[32] Mitze and Schmidt, 2015, p.65.

to interregional labour market disparities".[33] Since income levels of the destination region act as a pull factor, migrants are attracted by high income levels in comparison to those in their current residing location. Such migration patterns will affect the capital to labour ratios in both locations. Income levels of individuals in the destination location will experience downward pressure and opposite effects will be felt in the original residing location. Therefore, neoclassical migration theory predicts that in the long run, differences that occur in both the unemployment rate and income levels across regions will cancel out in equilibrium. On the other hand, the core-periphery model predicts that migration will cause a strengthening of income level differences among regions. Central to this prediction is the role of agglomeration economies.[34] These differences between theories will become important when analyzing the feedback effects of internal migration in Canada to unemployment rate and after-tax income level disparities across census metropolitan areas.

4 Model Specification

As previously mentioned, my empirical analysis aims to assess the causes and consequences of internal migration in Canada through the use of a small-scale labour market system. The influence of factors which proxy agglomeration economies are of particular interest. Furthermore, the neoclassical migration theory and new economic geography literature predictions as discussed in Section 3 will be evaluated. The following model specification has been developed by two sets of authors, Puhani (2001) and Mitze and Schmidt (2015).

Central to the small-scale labour market system is the net in-migration rate identified for census metropolitan areas across Canada. Such a specification follows

[33] Mitze and Schmidt, 2015, p.71.
[34] Mitze and Schmidt, 2015, p.71.

the definition of Puhani (2001). The succeeding model however involves an adjustment of the approach presented by Mitze and Schmidt (2015), following their methodology when appropriate. These authors extend the basic definition of Puhani (2001) through the incorporation of the skill level of migrants. This study employs the definition of the net in-migration rate used by Puhani (2001) rather than that of Mitze and Schmidt (2015) due to the lack of availability of public use microdata in Canada. Through an extension of the work of these authors, I aim to evaluate an alternative aspect of the question, *why do individuals migrate within Canada?* I evaluate net migration calculations from metropolitan and non-metropolitan locations to the largest cities in Canada. Differences between rural and urban migration patterns arise. This coincides with the work of Ye et al. (2016) who express the importance of studying rural to urban and urban to urban migration patterns separately.[35]

The basic definition of the net in-migration rate for region i at time t can be expressed as

$$MIG_{i,t} = \frac{NM_{i,t} + POP_{i,t-1}}{POP_{i,t-1}} \tag{1}$$

The net in-migration rate is defined by Puhani (2001) as "the migration-induced population growth factor", where net migration, denoted $NM_{i,t}$, in the case of this study is measured as the sum of net interprovincial and net intraprovincial migration for region i and $POP_{i,t}$ is the population for such region.[36] Statistics Canada defines interprovincial migrants as movers who at the time of the Canadian census resided in a different census subdivision than they had in the previous year yet in the same province, whereas intraprovincial migrants are those who resided in a different census subdivision in a different province.[37] This sum therefore presents estimates of internal

[35]Ye et al., 2016, p.1762.
[36]Puhani, 2001, p.8.
[37]Statistics Canada, 2009.

migration in Canada. The long run measure of the net in-migration rate can be defined as

$$MIG^*_{i,t} = A_{i,t}\frac{U^{\gamma_1}_{i,t-k}Y^{\gamma_3}_{i,t-k}\mathbf{X}^{\Omega'}_{i,t-k}}{U^{\gamma_2}_{j,t-k}Y^{\gamma_4}_{j,t-k}\mathbf{X}^{\sigma'}_{j,t-k}} \tag{2}$$

where $A_{i,t}$ is a residual factor and by adopting the definition of Mitze and Schmidt (2015) to this simplified analysis, can be written as $A_{i,t} = exp(c_0 + \mu_i + \lambda_t)$, where c_0 is the overall constant term, μ_i refers to the regional fixed effects and λ_t denotes to the time fixed effects. U, Y and $\mathbf{X}$ represent the unemployment rate, after-tax income per capita, and a vector of additional control variables respectively. A further explanation of variables is available in Section 5. Region i indicates the specific census metropolitan area under consideration whereas region j refers to the Canadian aggregate. The term $t-k$ indicates the implementation of a lag structure in the model of up to k lags. Section 6 implements a lag of one period. γ_1, γ_2, γ_3, γ_4, as well as Ω' and σ' are the regression coefficients in the benchmark specification and express the change in the net in-migration rate as a result of a change in the corresponding variable.

The log-linearized form of equation (2) can therefore be expressed as

$$mig^*_{i,t} = log(A_{i,t})+\gamma_1 u_{i,t-k}-\gamma_2 u_{j,t-k}+\gamma_3 y_{i,t-k}-\gamma_4 y_{j,t-k}+\Omega'\mathbf{X}_{i,t-k}-\sigma'\mathbf{X}_{j,t-k}+\upsilon_{i,t} \tag{3}$$

where the lower case letters now represent log-transformed variables. Equation (3) also introduces an error term, $\upsilon_{i,t}$. A restricted version of this expression is presented in equation (4) which implements regional differences for the log-transformed control variables. For example, a log-transformed variable z can be expressed in terms of regional differences as $\tilde{z}_{i,t-k} = (z_{i,t-k} - z_{j,t-k})$, again where region i is the Canadian census metropolitan area under study and region j represents all of Canada. This structure is one that applied research often uses as a means of controlling for the large number of variables that could exist in an equation such as equation (3). Under this interpretation

$$mig^*_{i,t} = c_0 + \omega_1 \tilde{u}_{i,t-k} + \omega_2 \tilde{y}_{i,t-k} + \theta' \tilde{\mathbf{X}}_{i,t-k} + \mu_i + \lambda_t + \upsilon_{i,t} \tag{4}$$

where $\omega_1 = \gamma_1 = \gamma_2$, $\omega_2 = \gamma_3 = \gamma_4$ and $\theta = \Omega = \sigma$. This suggests that the regression coefficients for the regional and aggregate variables are equal. For simplicity, one can denote equation (4) in matrix notation as

$$mig^* = \iota + L.\mathbf{Z}\Theta + \mu + \lambda + \upsilon \tag{5}$$

where ι is a vector with all values equalling one, $\mathbf{Z}$ is a matrix which contains the group of control variables and can be expressed as $\mathbf{Z} = [\tilde{u}, \tilde{y}, \widetilde{\mathbf{X}}]$, and L. is used to indicate the use of lagged variables. As previously mentioned, a one period lag structure is implemented in Section 6. Such a structure is implemented as the previous literature regarding interregional migration suggests that migration levels react in a sluggish manner to differences in labour market characteristics across regions. Therefore the lagged variables play an important role in the adjustment of migration levels to such factors.[38]

As a final step towards reaching the benchmark specification, a portion of the adjustment to the long run measure specified above, denoted α, is assumed to occur in a given time period. This notion is as follows,

$$(mig - L.mig) = \alpha(mig^* - L.mig). \tag{6}$$

[38]Mitze and Schmidt, 2015, p.72.

Substituting this expression into equation (5) yields

$$mig = \iota + (1 - \alpha)(L.mig) + L.\mathbf{Z}\beta + \mu + \lambda + \epsilon \tag{7}$$

where $\beta = \alpha\Theta$ and $\epsilon = \alpha\upsilon$.

Equation (7) expresses the benchmark specification of the migration equation. The matrix $\mathbf{Z}$ can be further broken down: $\mathbf{Z}1$ expresses a sub-matrix of labour and housing market variables ($\mathbf{Z}1 = [\tilde{u}, \tilde{y}, \widetilde{house}, \widetilde{crime}]$), whereas $\mathbf{Z}2$ denotes variables which are used to proxy agglomeration economies ($\mathbf{Z}2 = [\widetilde{popd}, \widetilde{pat}, \widetilde{kis}]$). The latter group of variables relate to the work of Henderson (2003) and suggest that this analysis offers a representation of agglomeration economies through a broad variety of variables. Population density ($\widetilde{popd}$) relates to the urbanization effects presented by Henderson (2003) by measuring market size, whereas patent intensity ($\widetilde{pat}$) and the share of employees in knowledge intensive services ($\widetilde{kis}$) relate to the localization effects by accounting for both knowledge and the resulting production spillovers that occur among firms.[39] This list of exogenous variables as well as the migration control variable, $L.mig$, are lagged by one period in an attempt to reduce simultaneity that may occur between the regressors and the dependent variable.[40]

Equation (7) is a means of assessing the causes of internal migration in Canada while equations (8) and (9) to follow are used to determine the consequences.

$$\tilde{u} = \iota + (1 - \alpha_u)(L.\tilde{u}) + (L.mig)\delta_u + L.\mathbf{Z}\beta_u + \mu + \lambda + e \tag{8}$$

$$\tilde{y} = \iota + (1 - \alpha_y)(L.\tilde{y}) + (L.mig)\delta_y + L.\mathbf{Z}\beta_y + \mu + \lambda + \omega \tag{9}$$

These equations represent the effect of migration levels on differences in the

[39] Mitze and Schmidt, 2015, p.73.
[40] Mitze and Schmidt, 2015, p.82.

unemployment rate and average after-tax income levels respectively across Canadian census metropolitan areas, henceforth CMAs. In doing so, the feedback effect of the migratory impact on such variables is accounted for.

Equations (7), (8) and (9) form the small-scale labour market system used in this analysis. Due to the lagged dependent variable which appears in each expression, estimation results may be presented with bias stemming from the correlation between the error terms and those lagged variables.[41] In Section 6, ordinary least squares results are presented, as well as bias corrected results for the dynamic panel data models following the work of Kiviet (1995).[42]

Extending the work of Mitze and Schmidt (2015) to further analyze urban and rural migration separately, as presented by Ye et al. (2016), this paper considers the benchmark specification presented in equation (7) from two different perspectives. By examining net migration from non-CMA and CMA locations in Canada to a subset of the most populated metropolitan areas, differences in the causes of rural and urban internal migration can be considered in further detail. The most populated metropolitan areas considered in this extension are Calgary AB, Edmonton AB, Montreal QC, Ottawa ON, Toronto ON and Vancouver BC, which allow a better understanding as to why Canadians continue to migrate to these locations in a period of increasing housing prices and cost of living. Equations (10) and (11) follow the benchmark specification and include net migration calculations with respect to non-CMA and CMA locations respectively, and the subset of populated locations as previously mentioned.

$$nonCMAmig = \iota + (1-\alpha_r)(L.nonCMAmig) + L.\mathbf{Z}\beta_r + \mu + \lambda + e \quad (10)$$

$$CMAmig = \iota + (1-\alpha_{ur})(L.CMAmig) + L.\mathbf{Z}\beta_{ur} + \mu + \lambda + \omega \quad (11)$$

[41] Mitze and Schmidt, 2015, p.73.
[42] StataCorp., 2001.

where the subscripts r and ur denote rural and urban respectively. The matrix $\mathbf{Z}$ contains the control variables as included in equation (7). Again, the bias corrected estimation method presented by Kiviet (1995) is used to account for bias that may arise.

5 Data

I analyze data on twenty-two Canadian census metropolitan areas over the time period 2002 to 2011. A number of the variables studied in this data set are available annually at the geographic level of the census metropolitan area beginning in 2001. However, due to the one period lag in population data that is required in the calculation of the net in-migration rate this analysis is restricted to a time period beginning in 2002.

Census metropolitan areas are defined by Statistics Canada as an area having at least one or more neighbouring district located around a populated 'core'. "A CMA must have a total population of at least 100,000 of which 50,000 or more must live in the core".[43] Examples of the most populated CMAs in Canada are Toronto ON, Montreal QC and Vancouver BC. As of the 2001 Canadian census, there were twenty-seven defined CMAs with new locations listed under each following census.[44] This analysis considers only those CMAs that were listed as of the 2001 census. However, all twenty-seven locations cannot be studied due to data availability: the five CMA locations which are excluded from this study are Kingston ON, Thunder Bay ON, Chicoutimi QC, Trois Rivieres QC and Abbotsford BC. This study considers metropolitan areas in all provinces across Canada with the exception of New Brunswick and Price Edward Island and therefore provides a reasonable representative analysis of the causes and consequences of internal migration across

[43] Statistics Canada, 2015.
[44] Statistics Canada, 2002, p.2.

Canada. Although this study is restricted in terms of years and locations, the reference period studied does include the 2007/2008 global financial crisis and is updated to a more recent time period than similar studies previously mentioned in Section 2.

5.1 Data Sources

This analysis draws upon data from three sources. The primary data source for this empirical analysis is Statistics Canada's CANSIM database which reports statistics on socioeconomic variables at various geographical rankings. Included is a considerable set of data tables recorded at the level of the CMA. The Quebec Statistical Institute provides publications and statistics on a number of subjects. From here, data used to measure patent intensity is collected. Additionally, average residential price statistics are retrieved from the Canada Mortgage and Housing Corporation. This source publishes reports using data from the Canadian Real Estate Association multiple listings service.[45] Data used in the calculation of all other variables is derived from the Statistics Canada CANSIM database, making it a vital source for this study.

5.2 Variable Description

The primary dependent variable of this analysis is the net in-migration rate (mig), an expression formed from net migration calculations and lagged total population data. Net migration for the benchmark specification is calculated as the sum of interprovincial and intraprovincial net migration in region i, as explained in further detail in Section 4. Accordingly, this variable is positive if migration into a specific area exceeds migration out of such area and vice versa. The rural and urban specifications of the net in-migration rate are calculated with net migration

[45] Canada Mortgage and Housing Corporation, 2015.

estimations specifying the location of origin and the location of destination. For rural calculations ($nonCMAmig$), all non-census metropolitan areas of provinces and territories are included in the geography of origin whereas the geography of destination includes Calgary AB, Edmonton AB, Montreal QC, Ottawa ON, Toronto ON and Vancouver BC. A similar measure is used for urban calculations ($CMAmig$). Net in-migration rate variables are expressed as log-transformed variables.

This study utilizes a set of control variables which are motivated by the work of Mitze and Schmidt (2015). The variable definitions presented by these authors are closely followed when possible, in some cases the expressions are altered slightly to best fit the available Canadian data at the level of the CMA. The unemployment rate ($\tilde{u}$) expresses the number of unemployed individuals in region i as a share of the total labour force and is stated in percentages. Average after-tax income ($\tilde{y}$) expresses the remaining income per capita after the collection of taxes. Data is expressed in 2011 constant dollars and presented for all family units.[46] Housing prices ($\widetilde{house}$) measures average residential housing prices in region i. The crime rate ($\widetilde{crime}$) is the total number of criminal code violations including traffic incidents per capita in region i, measured by actual incidents.[47] Population density statistics ($\widetilde{popd}$) express the population per square kilometer in region i. Mitze and Schmidt (2015) define their variable pertaining to patent intensity as the number of patent applications per capita. The variable used in this analysis ($\widetilde{pat}$) uses information on the number of patent applications that have been granted to Canadian inventors per capita. A research report presented by the Centre for the Study of Living Standards states that “the number of patents granted to Canadians [is] an output indicator of innovative activity”.[48] This variable is therefore an excellent proxy for

[46]Statistics Canada Table 202-0603, CANSIM (database).
[47]Statistics Canada Table 252-0051, CANSIM (database).
[48]Greenspon and Rodigues, 2017, p.i.

agglomeration economies as there is extensive literature on the concentration of such innovative activity within cities. Since data on the number of patents granted by the Canadian Intellectual Property Office (CIPO) to Canadians are not publicly available at the CMA level, this analysis includes only patents granted by the United States Patent and Trademark Office (USPTO). This provides a rough estimate of patent intensity among Canadian CMAs as Canadians in fact apply for more USPTO patents than they do CIPO.[49] The employment share in knowledge intensive services ($\widetilde{kis}$) expresses the number of individuals in region i relative to the Canadian aggregate who are employed in industries, as defined by Mitze and Schmidt (2015), "according to NACE Rev. 1.1 2-digit codes (61, 62, 64, 65-67, 70-74, 80, 85, 92)".[50] Statistics Canada provides data at the level of the CMA according to the North American Classification System (NAICS) and not the NACE specification. Therefore, the NAICS industry codes which best correspond to the definition used by Mitze and Schmidt (2015), including 52-53, 55-56, 61 and 62 are used in this variable definition. This provides data on Canadians employed in the industries of finance and real estate, health and education and business services, resulting in a similar measure to that of the previously mentioned authors. Although this data set includes a broad set of variables, there is one important control variable that is missing from this analysis. Mitze and Schmidt (2015) also include a measure of human capital in their list of proxies for agglomeration economies measured by the share of individuals with high levels of educational attainment. This may play an important role in the analysis, however, education measures are not available annually for Canadian census metropolitan areas. However, to some extent this variable is represented in the knowledge intensive services measure as mentioned above. Occupations which are

[49] Greenspon and Rodigues, 2017, p.v.
[50] Mitze and Schmidt, 2015, p.79.

included in this variable, for the most part require a high level of eduction.

A group of further control variables are also employed in the analysis which measure industry shares, defined similarly to that of the employment share in knowledge intensive services. These variables account for the number of individuals in region i relative to the Canadian aggregate who are employed in agriculture ($\widetilde{agri}$), manufacturing ($\widetilde{manu}$) and other services ($\widetilde{other}$), all of which do not include the industries accounted for the in the definition of knowledge intensive services. Following the work of Mitze and Schmidt (2015), these variables are implemented to further account for industry specific shocks. The above mentioned control variables are all expressed as log-transformed regional differences, following the definition expressed in Section 4.

For the remainder of this paper the resulting data set is separated into the following three primary categories, migration, labour and housing market ($\mathbf{Z}1$) and agglomeration economies ($\mathbf{Z}2$) as well as the further control variables as mentioned above. This categorization along with the corresponding summary statistics are presented in Table 1 for the benchmark specification and in Table 2 for the extended model of rural and urban migration.

6 Results

Estimation results are presented in the following tables for the small-scale labour market system expressed by equations (7), (8) and (9) as well as the extended model comprised of equations (10) and (11). There are common features to all tables which will be explained here. The regression coefficients represent short run effects which measure the impact of a change occurring to a regressor on the specified outcome variable of that model. There are three columns in each of the results tables: column

Table 1: Summary statistics: benchmark specification

Category	Variable	Obs.	Mean	Std. Dev.	Min	Max
Migration						
	mig	220	0.0018	0.0050	-0.0094	0.0198
Labour and housing market	$\tilde{u}$	220	-0.1069	0.2358	-0.6690	0.5205
	$\tilde{y}$	210	-0.2843	1.3789	-6.4481	0.3644
	$\widetilde{house}$	220	-0.2188	0.3459	-0.7807	0.7662
	$\widetilde{crime}$	210	-0.0250	0.3143	-0.6481	0.7205
Agglomeration economies	$\widetilde{popd}$	220	4.0002	1.1423	0.7247	5.5471
	$\widetilde{pat}$	220	-0.0429	0.7918	-2.0994	2.0816
	$\widetilde{kis}$	220	-4.0061	0.9592	-5.5415	-1.7124
Further Controls						
	$\widetilde{agri}$	148	-4.6939	0.7032	-6.4925	-3.3419
	$\widetilde{manu}$	220	-4.3186	1.2314	-6.5455	-1.5497
	$\widetilde{other}$	220	-4.0914	0.9946	-5.8928	-1.7047

Note: Variables are calculated as log-transformed regional differences.

Table 2: Summary statistics: rural and urban specification

Category	Variable	Obs.	Mean	Std. Dev.	Min	Max
Migration						
	$nonCMAmig$	60	0.0000	0.0026	-0.0074	0.0035
	$CMAmig$	60	-0.0011	0.0033	-0.0103	0.0031
Labour and housing market	$\tilde{u}$	60	-0.1416	0.2394	-0.6168	0.2877
	$\tilde{y}$	60	0.0968	0.1162	-0.1457	0.3644
	$\widetilde{house}$	60	0.1213	0.2726	-0.2500	0.7662
	$\widetilde{crime}$	60	-0.0908	0.2916	-0.5474	0.3932
Agglomeration economies	$\widetilde{popd}$	60	4.6836	0.8255	3.4026	5.5471
	$\widetilde{pat}$	60	0.4793	0.4745	-0.0884	1.5606
	$\widetilde{kis}$	60	-2.7451	0.6416	-3.4076	-1.7124
Further Controls						
	$\widetilde{agri}$	59	-4.2349	0.5451	-5.3197	-3.3419
	$\widetilde{manu}$	60	-3.0243	0.9207	-4.1783	-1.5497
	$\widetilde{other}$	60	-2.7274	0.5514	-3.3564	-1.7047

Note: Variables are calculated as log-transformed regional differences.

one presents ordinary least squares results, column two presents results implementing fixed effects and column three presents bias corrected estimation results following Kiviet (1995). Columns two and three are similar as they both allow for fixed effects, albeit by using different estimators. In each case, results for both housing and labour market variables as well as variables proxying agglomeration economies, $\mathbf{Z}1$ and $\mathbf{Z}2$ respectively, are presented. Serial autocorrelation, $(1 - \alpha)$, is presented through the coefficient of the lagged endogenous variable in each model, representing the relationship between the dependent variable and its lagged value over time. All models include the use of two further control groups. The first, regional industry shares to express the share of employees in agriculture, manufacturing and other services as presented in Section 5. Second, time dummy variables used to measure year effects in each of the models. The impact of such controls are presented through joint F tests.

Table 3 presents the estimation results for the migration equation of the small-scale labour market system. Throughout the tables, the results are similar between columns two and three suggesting that the bias associated with allowing for fixed effects in a dynamic panel model does not appear to be very large. Referring to the first row, region i's unemployment rate relative to the Canadian average is positively correlated with the net in-migration rate. This positive correlation runs counter to the predictions of neoclassical migration theory. As the unemployment rate in a city increases, migration towards that city appears to increase. It is possible that there are locations which present greater opportunities for unemployed individuals. If these opportunities are an important factor in the migration of the unemployed to these areas, this positive correlation may appear.

A study by Baumann et al. (2015) considers a puzzling notion similar to this in the American setting. Past research tests whether individuals migrate to locations with low unemployment rates and from locations with high unemployment rates due to both the belief and the actual ability of it being easier to find employment in such low unemployment regions. These authors however identify two problems with these studies. First, interregional migration has not eliminated unemployment rate differences across cities which at times are large as well as persistent. Second, there is considerable empirical research that does not in fact support these findings. Through the use of a migration model, Baumann et al. (2015) show that an individual's decision to migrate is not in response to an areas actual level of unemployment, but instead to expectations of regional unemployment rates. The results suggest that unemployment rates only have an impact on a potential migration decision if it affects expectations and that it is unlikely for migration to occur if an unemployment shock does not change an individuals expectations.[51] Since this analysis of Canadian internal migration does not account for the expectations of migrants and only considers unemployment level differences across regions, these inconclusive results present an opportunity for further research.

Conversely, the predictions of neoclassical migration theory and new economic geography are supported through the positive correlation that appears between regional average after-tax income level differences and net in-migration. As presented in Section 3, regional income level differences act as a pull factor for migrants who consider utility maximization when faced with a migration decision. Hence, when income levels increase and therefore local labour market factors are favourable, migration to such locations increases.

The impact of the remaining labour and housing market variables are as one would predict: when housing prices and crime levels increase, migration is expected to decrease. The statistical significance of the housing variable in the second column

[51] Baumann et al., 2015, p.443/444.

suggests that residential housing prices may be more influential in one's migration decision in comparison to regional crime levels. As for factors proxying agglomeration economies, population density appears to have a negative correlation with migration levels whereas patent intensity and the share of employees in knowledge intensive services present the expected positive correlation. Following the predictions of the new economic geography literature regarding agglomeration economies and the role of attracting potential migrants, an increase in these latter two aspects are expected to contribute to internal migration in Canada.[52] The results suggest that in Canada migration decisions are not influenced by the actual clustering of individuals in a given location, represented by population density measures, but rather by the result of such concentration of activity acting through high innovation levels and skilled labour opportunities. Therefore, localization effects have a more important role in internal migration decisions in Canada than do urbanization effects.

The lack of statistical significance among the control variables, in general, presents a difficulty for expressing which factors are truly of most importance. It should be noted that standard errors are higher when considering Kiviet's bias corrected estimation method due to bootstrapping. The results of Table 3 also present a positive and statistically significant serial autocorrelation parameter which "show[s] that temporal adjustment processes in migration rates matter".[53] Previous empirical studies support this finding that there is a role for persistent networks linking migrants between locations.[54]

Finally, due to the time period of this analysis including the global financial crisis, shocks to the Canadian economy stemming from such an event may cause an interference with estimation results. To account for this possibility, following the

[52]Mitze and Schmidt, 2015, p.85.
[53]Mitze and Schmidt, 2015, p.86.
[54]Mitze and Schmidt, 2015, p.86.

Table 3: Benchmark migration specification: OLS and bias corrected estimation results

Dep. Variable:	*mig*	**Eq.(7)** (1)	**Eq.(7)** (2)	**Eq.(7)** (3)
Labour and housing market				
	$\tilde{u}$	0.0001	0.0041*	0.0046
		(0.0015)	(0.0022)	(0.0039)
	$\tilde{y}$	0.0007	0.0110	0.0108
		(0.0026)	(0.0072)	(0.0132)
	$\widetilde{house}$	-0.0002	-0.0062*	-0.0054
		(0.0012)	(0.0034)	(0.0062)
	$\widetilde{crime}$	-0.0008	-0.0061	-0.0061
		(0.0011)	(0.0043)	(0.0075)
Agglomeration economies				
	$\widetilde{popd}$	-0.0005	-0.0314**	-0.0189
		(0.0004)	(0.0147)	(0.0272)
	$\widetilde{pat}$	0.0004	0.0011	0.0015
		(0.0004)	(0.0010)	(0.0018)
	$\widetilde{kis}$	-0.0032	0.0013	0.0006
		(0.0020)	(0.0075)	(0.0127)
Serial autocorrelation				
	$(1-\alpha)$	0.7502***	0.4576***	0.4915***
		(0.0738)	(0.0902)	(0.1168)
Further controls				
	Industry shares Joint F test	7.76*	5.34***	5.60
	Year effects Joint F test	6.33	0.69	1.52
R-squared				
	within	0.3687	0.5244	
	between	0.9597	0.1081	
	overall	0.7521	0.1996	
Sample	Obs.	133	133	133

Note: Standard errors are noted in parentheses; column three presents bootstrap standard errors. Statistical significance is expressed at the 1, 5 and 10 % level as ***, ** and * respectively.

work of Mitze and Schmidt (2015), further controls have been included in the estimation procedure in order to control for the possibility of industry-specific and time period shocks. The results suggest however, that with the exception of industry shares in the ordinary least squares models, these factors do not act as statistically significant measures for avoiding biased results stemming from such global shocks.[55]

In an extension of the benchmark migration specification represented by equations of regional differences in the unemployment rate and average after-tax income levels, the consequences of internal migration in Canada are evaluated. Specifically, equations (8) and (9) are implemented to analyze the feedback effects of the net in-migration rate on such regional labour market characteristics. These supplemental equations follow the spirit of the migration equation and together form the small-scale labour market system.

The unemployment rate of region i relative to the Canadian average is the outcome variable for the estimation results displayed in Table 4. Columns one and two present a statistically significant negative correlation between regional differences in the net in-migration rate and the unemployment rate. As migration levels increase, unemployment rates are seen to decrease. This suggests a match between migrant's skill levels and employer's needs. These results are in line with the neoclassical migration theory predictions, that differences in the unemployment rate across regions in the long run will cancel out. A similar negative correlation is present under Kiviet's bias corrected results with the exception of the statistical significance. These results suggest that the serial autocorrelation effect is statistically significant in driving this unemployment rate equation in the three estimation procedures. This result suggests that there are clusters among Canadian census metropolitan areas with similar unemployment rates and that there is a role for persistent unemployment

[55] Mitze and Schmidt, 2015, p.86.

Table 4: Feedback effects estimation: OLS and bias corrected estimation results

Dep. Variable:	$\tilde{u}$	**Eq.(8)** (1)	**Eq.(8)** (2)	**Eq.(8)** (3)
Migration				
	mig	-10.4208***	-9.7373**	-7.9198
		(3.0234)	(3.8656)	(4.8174)
Labour and housing market				
	$\tilde{y}$	-0.0142	-0.2186	-0.1544
		(0.1059)	(0.3093)	(0.4231)
	$\widetilde{house}$	0.0443	-0.0559	-0.0222
		(0.0486)	(0.1476)	(0.1987)
	$\widetilde{crime}$	-0.0601	-0.1200	-0.0557
		(0.0454)	(0.1843)	(0.2395)
Agglomeration economies				
	$\widetilde{popd}$	-0.0056	0.7684	1.0130
		(0.0145)	(0.6280)	(0.8858)
	$\widetilde{pat}$	0.0033	0.0065	-0.0039
		(0.0175)	(0.0413)	(0.0576)
	$\widetilde{kis}$	-0.0468	0.2092	0.1983
		(0.0807)	(0.3192)	(0.4086)
Serial autocorrelation				
	$(1-\alpha_u)$	0.7992***	0.4980***	0.6989***
		(0.0622)	(0.0937)	(0.1115)
Further controls				
	Industry shares			
	Joint F test	2.25	1.20	3.16
	Year effects			
	Joint F test	6.72	0.80	3.96
R-squared				
	within	0.4567	0.5293	
	between	0.9738	0.2767	
	overall	0.8465	0.3337	
Sample	Obs.	133	133	133

Note: Standard errors are noted in parentheses; column three presents bootstrap standard errors. Statistical significance is expressed at the 1, 5 and 10 % level as ***, ** and * respectively.

rates over time.[56] The remainder of the labour and housing market variables as well as the factors which proxy agglomeration economies suggest mixed results among the three estimation procedures.

Table 5 presents the estimation results with regional average after-tax income level differentials as the outcome variable. Again, the fixed effect and Kiviet's bias corrected results are similar in columns two and three. Apart from unemployment rate differentials, all control variables appear to have a positive correlation with region i's income level relative to the Canadian average. The positive association between the net in-migration rate and income levels appears to further follow the predictions of the core-periphery model by complementing the results of Table 3 where the positive relationship between such variables was also presented. When analyzing the consequences of migratory patterns, a primary prediction of the core-periphery model is that migration is a source for the strengthening of regional income level differences. Such a feedback effect, that migratory inflows appear to increase relative to average after-tax income levels, illustrates this model prediction. As for the remainder of the labour and housing market variables, excluding the unemployment rate, as well as the factors which proxy agglomeration economies, increases in these control variables appear to increase further the differences in income levels across regions. However, as presented in Mitze and Schmidt (2015), it is important to be careful when considering these correlations as causal relationships. These authors use the example of the positive correlation that appears in their results among the crime and income level variables. It is suggested that higher crime rates may not be a cause of such increases in income levels across regions but rather is a result or 'reflex'.[57] As in the unemployment equation, serial autocorrelation is statistically significant.

[56] Mitze and Schmidt, 2015, p.90.
[57] Mitze and Schmidt, 2015, p.90.

Table 5: Feedback effects estimation: OLS and bias corrected estimation results

Dep. Variable:	$\tilde{y}$	**Eq.(9)** (1)	**Eq.(9)** (2)	**Eq.(9)** (3)
Migration				
	mig	1.6202	2.4314	2.4231
		(1.1415)	(1.4763)	(1.6953)
Labour and housing market				
	$\tilde{u}$	-0.0386	-0.0259	-0.0237
		(0.0235)	(0.0358)	(0.0443)
	$\widetilde{house}$	0.0146	0.0965*	0.0752
		(0.0183)	(0.0564)	(0.0612)
	$\widetilde{crime}$	-0.0035	0.0392	0.0199
		(0.0172)	(0.0704)	(0.0806)
Agglomeration economies				
	$\widetilde{popd}$	-0.0016	0.3594	0.1679
		(0.0055)	(0.2398)	(0.3089)
	$\widetilde{pat}$	-0.0024	0.0015	0.0030
		(0.0066)	(0.0158)	(0.0194)
	$\widetilde{kis}$	-0.0035	0.0115	0.0238
		(0.0305)	(0.1219)	(0.1375)
Serial autocorrelation				
	$(1-\alpha_y)$	0.9180***	0.4061***	0.5656***
		(0.0400)	(0.1181)	(0.1146)
Further controls				
	Industry shares Joint F test	0.08	0.99	2.25
	Year effects Joint F test	5.74	0.52	3.92
R-squared				
	within	0.4463	0.5147	
	between	0.9872	0.1374	
	overall	0.9029	0.0902	
Sample	Obs.	133	133	133

Note: Standard errors are noted in parentheses; column three presents bootstrap standard errors. Statistical significance is expressed at the 1, 5 and 10 % level as ***, ** and * respectively.

Extending the work of Mitze and Schmidt (2015) by considering separately the notions of rural to urban and urban to urban migration as presented by Ye et al. (2016), migration to the most populated metropolitan areas in Canada is studied. These areas include Calgary AB, Edmonton AB, Montreal QC, Ottawa ON, Toronto ON and Vancouver BC. Table 6 presents net migration flows for these cities between 2002 and 2011. These trends are also expressed in Figure 1. Net migration levels for all twenty-two census metropolitan areas are included in Table A1 of the appendix. Net migration is calculated as the sum of interprovincial and intraprovincial net migration levels and is expressed as the number of migrants. It appears that in Calgary AB, Edmonton AB and Ottawa ON, the number of in-migrants exceeds out-migrants. In the years following the 2007/2008 financial crisis, migration to Alberta has especially increased and in fact, the net migration levels of Calgary AB and Edmonton AB are highest among the twenty-two census metropolitan areas analyzed in this paper. Internal migration therefore appears to contribute to the high population levels of these cities. Specifically, interprovincial migration is important for these patterns.[58] During the oil boom in Alberta, migrant workers were attracted to these cities because of employment opportunities, high wages and increasing average income levels.[59] Montreal QC, Toronto ON and Vancouver BC however present negative net migration calculations, as out-migrants exceed in-migrants. Population levels of these cities are increasing each year, therefore it appears that international migrants contribute substantially to the high populations of these cities. Net migration is positive for these cities when international migration flows are included.[60] Toronto ON experiences fluctuations in net migration calculations from year to year, whereas Montreal QC and Vancouver BC present more stable measures.

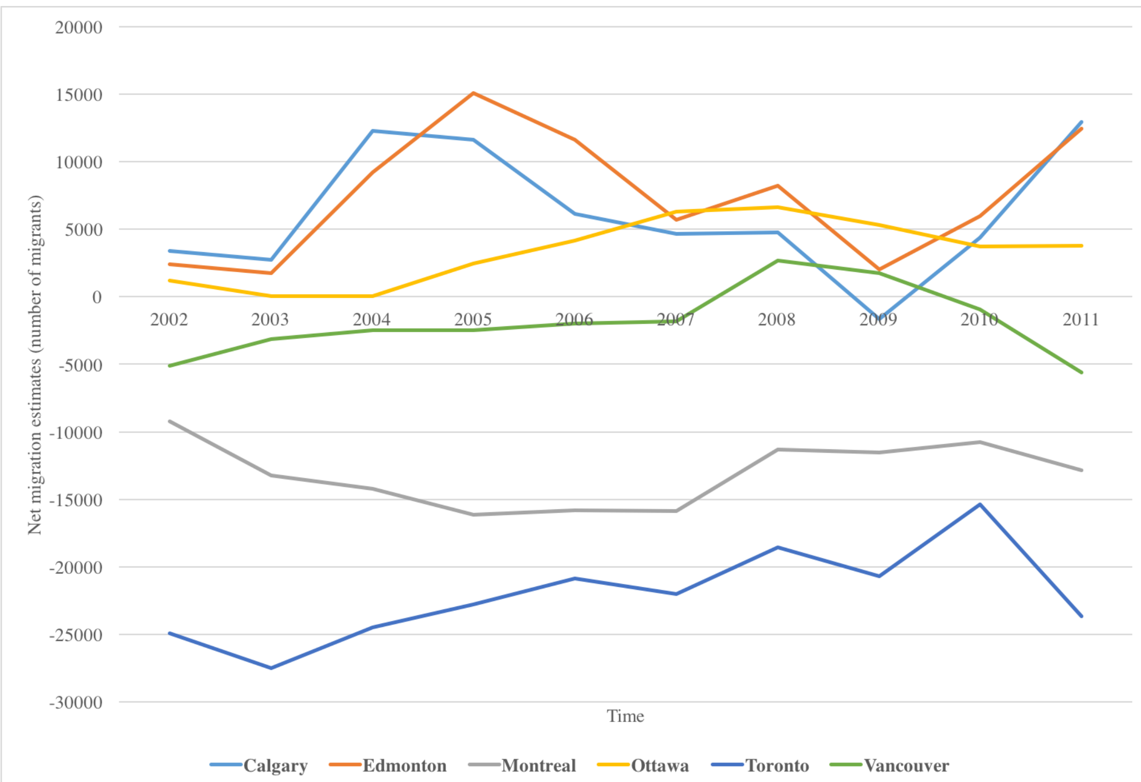
[58]Statistics Canada Table 111-0029, CANSIM (database).
[59]Statistics Canada, 2006.
[60]Statistics Canada Table 111-0029, CANSIM (database).

Table 6: Net migration rate of populated Canadian census metropolitan areas

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calgary	3414	2722	12299	11637	6153	4659	4750	-1628	4367	12924
Edmonton	2379	1726	9213	15081	11609	5714	8246	2008	5982	12423
Montreal	-9248	-13248	-14213	-16133	-15831	-15889	-11310	-11505	-10759	-12856
Ottawa	1182	67	41	2438	4176	6291	6618	5306	3709	3793
Toronto	-24898	-27489	-24451	-22798	-20881	-22004	-18536	-20689	-15369	-23634
Vancouver	-5112	-3159	-2496	-2483	-1999	-1791	2669	1732	-957	-5618

Source: Statistics Canada. Table 111-0029: In-, out- and net-migration estimates, by provincial regions, migration type and sex, annual (number), CANSIM (database). *Statistics Canada*.

Figure 1: Net migration rate of populated Canadian census metropolitan areas



Source: Statistics Canada. Table 111-0029: In-, out- and net-migration estimates, by provincial regions, migration type and sex, annual (number), CANSIM (database). *Statistics Canada*.

Tables 7 and 8 present results separating the migratory patterns into those from rural or *non-CMA locations* and urban or *CMA locations*, respectively. This separation is used to further examine the factors which cause individuals to migrate within Canada to the most populated cities. The results suggest that there are differences in the pull factors of rural and urban migration patterns in Canada. Again, the following two tables present similar results under the three estimation procedures in columns one through three. This is especially so for the two methods which implement fixed effects.

Table 7 presents the estimation results for the extension of the benchmark migration equation presented in equation (10) to determine the causes of rural migration. It is evident that the negative correlation between the unemployment rate and migration levels follow the predictions of the neoclassical migration theory, contrary to the results presented in Table 3. Furthermore, higher levels of unemployment do not act as a contributing factor into one's migration decision. Individuals aim to maximize utility when considering migration, and high unemployment rates in general decrease the likelihood of finding employment. On the other hand, contrary to both the neoclassical migration theory and new economic geography model expectations, there appears to be a negative correlation between regional after-tax income levels and migration. This is a result similar to that found in the benchmark specification of Mitze and Schmidt (2015) who explain that although this is an unexpected finding, it suggests that migrants appear to put a stronger weight on the possibility of finding employment rather than the income level of the destination location. Therefore, unemployment levels act as the primary and more influential labour market signal.[61] A further explanation is offered by Mitze and Schmidt (2015) and poses as a possibility for the Canadian setting of this paper. The

[61] Mitze and Schmidt, 2015, p.85.

Table 7: Rural migration: OLS and bias corrected estimation results

Dep. Variable:	*nonCMAmig*	**Eq.(10)** (1)	**Eq.(10)** (2)	**Eq.(10)** (3)
Labour and housing market				
	$\tilde{u}$	-0.0045***	-0.0067***	-0.0068
		(0.0017)	(0.0022)	(0.0149)
	$\tilde{y}$	-0.0034	-0.0192**	-0.0189**
		(0.0060)	(0.0090)	(0.0614)
	$\widetilde{house}$	-0.0011	0.0001	-0.0001
		(0.0027)	(0.0040)	(0.0240)
	$\widetilde{crime}$	-0.0016	0.0045	0.0047
		(0.0024)	(0.0044)	(0.0352)
Agglomeration economies				
	$\widetilde{popd}$	0.0030**	0.0540**	0.0533
		(0.0013)	(0.0205)	(0.1426)
	$\widetilde{pat}$	-0.0006	0.0007	0.0007
		(0.0009)	(0.0025)	(0.0173)
	$\widetilde{kis}$	0.0049	-0.0085	-0.0082
		(0.0044)	(0.0106)	(0.0647)
Serial autocorrelation				
	$(1-\alpha_r)$	0.3591**	0.3816*	0.3816**
		(0.1577)	(0.2135)	(0.1917)
Further controls				
	Industry shares Joint F test	5.22	3.55**	0.19
	Year effects Joint F test	18.35**	2.35**	0.39
R-squared				
	within	0.5608	0.6703	
	between	0.9998	0.8674	
	overall	0.8865	0.6660	
Sample	Obs.	54	54	54

Note: Standard errors are noted in parentheses; column three presents bootstrap standard errors. Statistical significance is expressed at the 1, 5 and 10 % level as ***, ** and * respectively.

time frame of this empirical analysis includes the global financial crisis. While this economic downfall significantly affected unemployment rates, average after-tax income levels remained fairly constant.[62] It is also important to note that the regional after-tax income levels utilized in this study do not directly reflect wage levels.[63]

Population density measures are statistically significant and positively associated with migration levels in columns one and two. There is evidence in Canada that areas more densely populated pose opportunities for higher crime levels.[64] This may help explain the positive correlation between crime levels and rural migration. It is likely that increased crime levels do not cause individuals to migrate, but rather, potential migrants are attracted to higher levels of population density. An increased crime rate being the result of this concentration. Population density therefore appears to be an important factor in regional attractiveness and increasing rural migration levels, a result not found in the original migration equation. Patent intensity also acts as a pull factor. Rural migrants are attracted to the largest cities in Canada due to opportunities for innovation. It appears that both urbanization and localization effects are important for rural migration.

Past migration patterns are positively correlated with current migration levels. However, for this rural migration analysis, the results appear to be less significant. It is also important to note that time effects are a statistically significant factor for rural migration patterns. Furthermore, these controls act as means of avoiding possible bias that may be present in the estimation due to global shocks from the time period covered.

Table 8 evaluates the causes of urban migration to the largest Canadian cities. This analysis is used to determine the similarities and differences among these results

[62]Statistics Canada Table 202-0603, CANSIM (database).
[63]Mitze and Schmidt, 2015, p.85.
[64]Di Matteo, 2014, p.28.

Table 8: Urban migration: OLS and bias corrected estimation results

Dep. Variable:	*CMAmig*	**Eq.(11)** (1)	**Eq.(11)** (2)	**Eq.(11)** (3)
Labour and housing market				
	$\tilde{u}$	-0.0010	-0.0049	-0.0063
		(0.0032)	(0.0033)	(0.0043)
	$\tilde{y}$	-0.0225***	-0.0252**	-0.0228
		(0.0083)	(0.0111)	(0.0161)
	$\widetilde{house}$	0.0092**	0.0118***	0.0114*
		(0.0039)	(0.0040)	(0.0063)
	$\widetilde{crime}$	-0.0021	-0.0034	-0.0016
		(0.0029)	(0.0058)	(0.0096)
Agglomeration economies				
	$\widetilde{popd}$	-0.0051**	0.0430	0.0485
		(0.0020)	(0.0263)	(0.0377)
	$\widetilde{pat}$	-0.0004	-0.0017	-0.0012
		(0.0012)	(0.0033)	(0.0046)
	$\widetilde{kis}$	0.0114*	-0.0021	-0.0047
		(0.0063)	(0.0116)	(0.0169)
Serial autocorrelation				
	$(1-\alpha_{ur})$	0.5299***	0.4843***	0.6214***
		(0.1663)	(0.1580)	(0.1771)
Further controls				
	Industry shares Joint F test	9.92**	3.31**	4.74
	Year effects Joint F test	7.43	1.42	6.00
R-squared				
	within	0.6119	0.7469	
	between	0.9920	0.5864	
	overall	0.8554	0.4098	
Sample	Obs.	54	54	54

Note: Standard errors are noted in parentheses; column three presents bootstrap standard errors. Statistical significance is expressed at the 1, 5 and 10 % level as ***, ** and * respectively.

and those for rural migration patterns. Similar to the previous findings, the unemployment rate and regional after-tax income levels have a negative correlation with migration. Low unemployment levels act as a pull factor for urban migrants, however due to the statistical significance of these results in Table 7, this factor appears to be more dominant for rural migration. Average residential prices appear to be positively correlated with urban migration levels. This contrasts the rural migration relationship, however one must be careful when considering this correlation as a causal relationship. It is plausible that migration impacts the housing market and causes property prices to rise rather than vice versa. It appears that of the factors proxying agglomeration economies, population density acts a pull factor in urban migratory decisions. Furthermore, agglomeration economies and localization effects contribute more to the rural rather than urban migratory decision in this analysis. Again, past migration decisions are statistically significant and positively correlated with current migration patterns and therefore suggest a role for migratory networks that persist over time. For urban migration patterns, the addition of controlling for time effects does not act as a statistically significant factor, contrary to the rural case.

7 Conclusion

The role of labour and housing market characteristics have been central to traditional migration theories in explaining internal migratory patterns. This paper however incorporates aspects of more modern theories pertaining to the role of agglomeration economies.[65] Cities such as Toronto ON and Vancouver BC are drawing the attention of potential migrants. Population levels of these cities continue to rise and residing in such cities is becoming more desirable. Utilizing data on twenty-two

[65] Mitze and Schmidt, 2015, p.96.

census metropolitan areas in Canada, this paper implements a small-scale labour market system to discuss the causes and consequences of internal migration in Canada. Following the work of Puhani (2001) and Mitze and Schmidt (2015) where appropriate, this paper aims to evaluate internal migration patterns in Canada while evaluating the neoclassical migration theory and new economic geography model predictions. In an extension of these authors work, this paper contributes to the existing literature by also evaluating rural and urban migration in line with Ye et al. (2016). The results suggest that income level rather than unemployment rate differentials act as a pull factor in migratory decisions in Canada. As well, labour and housing market variables and agglomeration factors (with the exception of population density) contribute to attracting mobile labour. The feedback results complement new economic geography model predictions through the income equation. This suggests that migration patterns contribute to the strengthening of differences in income levels across regions. Rural and urban migration are both strongly influenced by regional unemployment levels. Employment opportunities are therefore an important consideration for potential migrants to the most populated Canadian cities. Agglomeration economies appear to be more important for rural migration patterns. Furthermore, there are differences in the causes of rural to urban and urban to urban migration patterns in Canada.

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9 Appendix

Table A1 presents net migration flows for the twenty-two Canadian census metropolitan areas considered in this analysis. Net migration is calculated as the sum of interprovincial and intraprovincial net migration levels and is expressed as the number of migrants.

Table A1: Net migration rate of Canadian census metropolitan areas

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calgary	3414	2722	12299	11637	6153	4659	4750	-1628	4367	12924
Edmonton	2379	1726	9213	15081	11609	5714	8246	2008	5982	12423
Halifax	1112	-464	-912	-153	468	1410	1391	2163	1953	742
Hamilton	1428	195	-669	-979	-38	292	574	2652	2270	3052
Kitchener	1352	1897	1086	211	-25	262	-395	428	1190	686
London	12	706	-186	626	1076	462	-379	228	356	688
Montreal	-9248	-13248	-14213	-16133	-15831	-15889	-11310	-11505	-10759	-12856
Oshawa	6156	6127	4128	2897	2547	2932	2962	3400	3076	4056
Ottawa	1182	67	41	2438	4176	6291	6618	5306	3709	3793
Quebec	2195	3192	744	2099	2707	2859	2263	1976	2476	2091
Regina	-135	-321	-1060	-459	1025	772	1361	530	666	1218
St. Catherines	431	873	241	-465	-875	-598	-212	800	395	736
St. John's	777	1182	15	508	867	1802	2006	2139	1849	1785
Saint John	-172	-102	-537	-679	-352	52	14	-45	-274	-909
Saskatoon	-589	-78	-1010	207	1648	1912	2010	2411	2573	3188
Sherbrooke	379	-50	358	-98	103	-7	213	461	1071	900
Sudbury	118	138	401	778	382	358	-388	-1071	-351	92
Toronto	-24898	-27489	-24451	-22798	-20881	-22004	-18536	-20689	-15369	-23634
Vancouver	-5112	-3159	-2496	-2483	-1999	-1791	2669	1732	-957	-5618
Victoria	1661	1633	1872	1425	2523	3508	4265	3510	2212	2830
Windsor	-65	-596	-1382	-2067	-2752	-3139	-2955	-1647	-657	305
Winnipeg	-1619	-1393	-4776	-4860	-3187	-1946	-1130	-1655	-1471	-2093

Source: Statistics Canada. Table 111-0029: In-, out- and net-migration estimates, by provincial regions, migration type and sex, annual (number), CANSIM (database). *Statistics Canada.*