Estimating the Relationship Between Government Transfers and Interprovincial Migration Flows: A Gravity Model Approach

By

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Abstract

This paper uses different gravity model specifications to examine the relationship between migration flows and equalization payments and the relationship between migration flows and median total government transfers to persons. The paper's main contribution is the inclusion of a new variable, equalization payments, which previous studies using a gravity framework to study interprovincial migration did not include in their analysis. Using annual interprovincial migration flows along with annual provincial demographic, geographic and economic data from 1981-2015, this paper finds that equalization payments is a statistically significant variable in the model. However, the magnitude of its regression coefficient is small relative to the coefficients associated with population, distance, income, and employment. Using non-structural and structural gravity models, the estimates of the decrease in migration associated with the receipt of equalization payments ranges from 0.04% to 0.58% in the origin province and from 0.14% to 0.65% in the destination province. Regarding total government transfers, the paper finds that the decrease in migration associated with a 1% increase in total government transfer ranges from 0.11% to 0.68% in the origin province and from 0.40% to 0.76% in the destination province. More specifically, the results from a two-way time-invariant fixed effects model, the preferred structural approach, indicates that equalization payments and total government transfers are negatively correlated with migration but their correlations are small compared to other covariates.

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1. Introduction

In this paper, relationships between interprovincial migration in Canada and federal government transfers are examined using regression analysis. The analysis is divided into two parts. The paper begins by conducting an analysis of the relationship between gross migration flows and equalization payments, a specific type of federal transfer. The second part of the analysis examines the relationship between gross migration flows in Canada and total federal transfers to the provinces. This study makes use of a gravity framework to model gross migration flows within Canada.

Recent adaptations of theoretical trade gravity models allows for a theoretically-grounded gravity approach for migration in this study. Anderson (2011) provides a useful theoretical gravity framework developed specifically to model migration flow patterns. The paper estimates the relationship between migration flows and equalization payments and, subsequently, the relationship between migration flows and total government transfers, by using various gravity model specifications. More specifically, OLS and fixed effects estimation techniques are used to estimate the different gravity specifications. This paper develops gravity equation specifications based on past research and uses the most recent available data to contribute to our understanding or the relationship between government transfers and interprovincial migration.

Gravity studies of interprovincial migration in Canada have been conducted in the past. Courchene (1970) used a gravity model to study the determinants of migration in Canada and concludes that government transfers reduce migration below the optimal level and contribute to maintaining inequality among the provinces. He found that migrants respond to income and employment differentials between provinces. He examines total federal government transfers, which includes health, social and equalization transfers.

A more recent paper from the Bank of Canada analysed the determinants of interprovincial migration using a gravity equation, but excluded government transfers from their model. In their paper, Amirault, de Munnik and Miller (ADMM) (2012) constructed a non-traditional formulation of the gravity equation and focused on estimating the effect of provincial borders on interprovincial migration. Aside from Courchene's paper, no recent studies have been published on the relationship between equalization payments and migration using a gravity framework.

There is a great demographic imbalance between provinces in Canada and understanding the relationship between migration and government transfers can help shape future public policies. Equalization payments are also a controversial subject in Canada. Section 2 of this paper provides a brief historical summary of equalization payments in Canada and a breakdown of government transfers. The overarching goal of the system is to help the governments of poorer provinces have enough revenue to offer comparable public services to their residents without overtaxing its population. This results in the redistribution of wealth where people living in poorer provinces are net receivers and individuals living in richer provinces are net-contributors to the system. Provinces that receive payments are referred to as "have not" provinces and those that do not receive payments are referred to as "have" provinces.

The remainder of the paper is organized as follows. Section 2 provides a brief historical summary of equalization payments and deconstructs the measure of total government transfers. Section 3 summarizes gravity model theory and discusses relevant empirical studies about migration. Section 4 describes the data included in the regression analysis. Section 5 presents a preliminary analysis of the data. Section 6 outlines the estimation methods utilized and each model's specifications. Section 7 presents the results obtained from our regression analysis.

Discussion of the paper's main findings are found in Section 8. Finally, Section 9 contains the paper's concluding remarks.

2. Brief History of Equalization Payments

2.1 History of Equalization Payments in Canada

The first part of the regression analysis examines the relationship between equalization payments and interprovincial migration. It is useful to understand how equalization payments are distributed between the provinces. Di Matteo (2017) provides a detailed history of the evolution of government revenue and equalization payments in Canada. The redistribution of government revenue across provinces dates back to the Canadian Confederation in 1867, but a formal system was only ratified under the constitution in 1957 (Di Matteo, 2017). At that time, the size of payments was based on a province's ability to generate revenue from three different sources: personal income taxes, corporate income taxes and inheritance taxes. These three revenue sources were equalized by using the weighted average of the per capita revenue of the two wealthiest provinces. In 1962, the equalization formula was amended twice. First, 50% of natural resource revenues were added to the three sources of government revenues to be "equalized". Later that year, the federal government began using a 10-province per capita average but the decision was reversed following the 1963 election. The inclusion of 50% of natural resource revenues disqualified resource-rich provinces like Alberta and British Columbia from receiving payments. In 1967, significant changes were introduced yet again to the formula. The federal government reverted to the initially short-lived 10-province weighted average scheme and added 14 new revenue streams to its formula.

Volatile energy prices between 1971-1981 forced the federal government to revisit the equalization formula. During these years, rising energy costs were straining the federal government's finances, and previously non-eligible provinces such as Ontario were entitled to payments (Di Matteo, 2017). To address this problem caused by the oil price shocks, the federal government made exceptions and imposed new rules (notably the personal income override), which excluded Ontario from receiving payments.

In 1982, the federal government introduced a new formula that measured the fiscal capacities of each province across 33 different revenue sources. It compared the per capita fiscal revenue to the average of the following five provinces: Ontario, Quebec, Manitoba, Saskatchewan, and British Columbia. Alberta was excluded from this group to eliminate the problem caused by natural resource revenues (since that province is relatively resource-rich), and the Atlantic Provinces were removed to counterbalance Alberta's exclusion (since these provinces are relatively resource deprived) (di Matteo, 2017). Subsequent changes to this iteration of the equalization payment formula were not made until 2004. In 2004, the federal government introduced the Fixed Framework. Under this version, a fixed amount of funding would be divided amongst the provinces each year. The fixed pool of funds would grow by 3.5% each year (di Matteo, 2017). It maintained the five-province average rule introduced in 1982, but many provinces expressed a desire to return to the pre-1982 10-province per capita average system.

The equalization payment formula underwent additional changes in 2007 and 2009. The federal government abandoned the Fixed Framework model and reintroduced the 10-province per capita fiscal capacity average (Roy-César, 2013). They imposed a ceiling on total equalization payment growth, which follows a three-year moving average of nominal GDP growth (Roy-César, 2013). The government decided to cap payments to provinces to prevent any receiving province's fiscal capacity to exceed that of the lowest fiscal capacity among non-receiving provinces. The measure of fiscal capacity was condensed to five revenue sources: personal income taxes, corporate income taxes, consumption taxes, property taxes and natural resource revenues (Roy-César, 2013). Under the current formula, provinces have the option to include 50% of natural resource revenue or exclude them entirely from the calculation. They automatically receive payments based on the version of the formula that yields the highest per capita return (Roy-César, 2013). The federal government determines whether a province is eligible to receive payments by comparing the revenue it generates from each source to the 10-province national average using a common tax rate for each province. If a province's fiscal capacity falls below the national average, it receives equalization payments to eliminate the gap.

2.2 Breakdown of Government Transfers to Persons

The second part of this paper's regression analysis estimates a gravity equation of interprovincial migration while incorporating median total government transfers to persons (TGT) in the equation. Total government transfers to persons is the sum of all social assistance funding directed to economic families and persons.[1] Equalization payments are not necessarily included in total government transfers since provincial governments are free to spend equalization transfers how they want. They may choose to direct them to social assistance programs, which fall under Statistics Canada's definition of total government transfers. Many social programs fall under the TGT measure. For example, worker compensation benefits, the Canada pension plan, war veterans' allowances, family allowance assistance, employment insurance benefits and old age security fund payments are all components of the measure of total government transfers to persons.

[1] Statistics Canada defines an economic family as group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law or adoption. A couple may be of opposite or same sex. Foster children are included.

This paper uses the median TGT per province to represent the level of government assistance programs in each province.

3. Theory and Literature Review

3.1 Traditional and Modified Gravity Models of Migration

The most basic form of the gravity model of migration assumes that migration flows (M_{ij}) between two locations are directly proportional to the population in both regions and inversely proportional to the distance that separates them. This version of the gravity equation is referred to as the traditional gravity model of migration. Equation (1) and (2) provide mathematical representations of the traditional gravity model. Given the multiplicative form of the traditional gravity equation, it can also be expressed in logarithmic form. Equation (1) and (2) are equivalent.

$$M_{ij} = \frac{GP_i^{\beta 1}P_j^{\beta 2}}{D_{ij}^{\beta 3}} \tag{1}$$

$$lnM_{ij} = G + \beta_1 lnP_i + \beta_2 lnP_j + \beta_3 lnD_{ij} \tag{2}$$

Migration from *i* to *j* is denoted by M_{ij}. Populations (P_i and P_j) serve as a measure of the size of each region and D_{ij} serves as a measure of moving costs often proxied by distance. The "G" is a constant. The basic formulation of the traditional gravity equation dates back to the early 1940s. Greenwood (2005) provides a brief historical summary of the formulation of the traditional gravity equation.

In 1938, three economists, Makower, Marschak and Robinson (1938) observed that when controlling for distance between British counties and the size of their populations, there was a strong relationship between unemployment rate gaps between counties and labour migration. Makower et al. (1938) are often credited for being the first researchers to express the basic foundations of the traditional migration gravity equation. However, Stewart (1942) proposed the first formulation of the gravity equation by studying migration between Princeton, Harvard, Yale and MIT. Stewart observed that the distance between his student's homes and their university was reminiscent of Newton's universal law of gravitation. Equation (3) provides a mathematical representation of Stewart's migration gravity equation.

$$F = \frac{GP_iP_j}{D_{ij}^2} \tag{3}$$

Stewart assumed that the demographic force (F) was directly proportional to each location's population (P_i and P_j) and inversely proportional to the square of the distance (D_{ij}^2) separating them. Greenwood (2005) explains that this is a restrictive version of equation (1). The model is subject to empirical testing. If the square of the distance is replaced by exponent β_3 and exponents β_1 and β_2 are added to the population parameters, we get the traditional gravity equation.

In the 1960s, researchers began using a more refined version of the traditional gravity model. Additional variables were added to the traditional model to control for other factors that might be related to migration flows. The most commonly used version of the modified gravity model is given by equation (4) and is expressed in logarithmic form since the multiplicative structure of the traditional gravity equation was preserved (Greenwood, 2005).

$$lnM_{ij} = G + \beta_1 lnP_i + \beta_2 lnP_j + \beta_3 lnD_{ij} + \beta_4 Y_i + \beta_5 Y_j + \sum_{n=1}^{m} \beta_{in} lnX_{in} + \sum_{n=1}^{m} \beta_{jn} lnX_{jn} + \varepsilon_{ij} \tag{4}$$

The newly added Y_i and Y_j variables are a measure of income. The $\ln X_{in}$ term represents *n* entity-*i* specific characteristics and the $\ln X_{jn}$ term contains *n* entity-*j* specific characteristics. Migration studies using gravity models incorporated origin and destination characteristics to the traditional model. These models were not theoretically-grounded, but they used aggregate place-to-place migration data to conduct empirical tests.

Since equation (4) has no theoretical underpinnings, conducting regression analyses using this modified form is referred to as the naïve approach. It is called the naïve approach because, as we will see in section 3.2, equation (4) ignores the presence of multilateral resistance terms (Anderson (2011). In brief, equation (4)'s formulation assumes that migration flows from *i* to *j* are not affected by changes in the cost of migrating from *i* to *k*. It only considers the bilateral migration costs between *i* and *j* as if in a vacuum. Since an individual considers *k* other locations, the bilateral migration cost between *i* and *k* should matter in equation (4).

The objective of this paper is to use a theoretically-grounded gravity model to examine the relationship between migration and equalization payments, and migration and TGT while accounting for the multilateral resistance terms. The use of a theory-based gravity model to conduct regression analysis is referred to as the structural approach. The next section summarizes a modern theory-based model of migration from Anderson (2011). The theory behind this model, which account for the presence of multilateral resistance terms, will be used in this study to construct and estimate a structural gravity equation.

3.2 Overview of Theoretical Gravity Model of Migration

A small volume of work has been dedicated to developing a theoretical gravity foundation for non-goods factor flows. This section summarizes a theoretical representation of the gravity model of migration developed by Anderson (2011). Anderson (2011) constructs a structural gravity equation using market-clearing conditions and derives the necessary multilateral resistance terms associated with the migration gravity equation. He explains that each migrant faces a common cost of moving between a given pair of locations and an idiosyncratic cost. A person h who is deciding to move from i to j considers the wage rate (w_j) in j and faces an iceberg moving cost represented by $\delta_{ij}>1$. Migrant h's utility from migration is given by ε_{ijh}. Therefore, h will relocate if for any j, $(w_j/\ \delta_{ij})\varepsilon_{ijh} > w_i$, that is if the migrant's net wage multiplied by their utility from migrating exceeds their current wage. The migrant faces many possible options and will opt to relocate to the destination that offers the highest surplus. If the individual has logarithmic utility, then their utility from migrating is given by equation (5):

$$u_{ij} = lnw_j - \ ln\delta_{ij} - lnw_i \tag{5}$$

In this context, if the log of observable utility from migration follows a type-1 extreme value distribution, the probability that a randomly selected individual would chose to migrate to any destination is given by the multinomial logit form. Grogger and Hasson (2008) and Beine et al. (2009) make use of this development and use the multinomial logit to study migration patterns.

Anderson (2011) expands on this micro-oriented representation and aggregates the migration decision. At the aggregate level, the probability that a migrant selects a given destination j is equal to the proportion of people who move from i to j. Anderson (2011) posits that the expected level of migration from i to j must be given by equation (6) where N_i represent the origin country's pool of migrants.

$$M_{ij} = G\big(u_{ij}\big)N_i \tag{6}$$

$$G(u_{ij}) = \frac{\exp(u_{ij})}{\sum_k \exp(u_{kj})}\,. \tag{7}$$

Once again using a logarithmic utility function to rewrite $G(u_{ij})$ and represent aggregate migration flows, Anderson (2011) obtains equation (8).

$$M_{ij} = \frac{(w_j / \delta_{ij})}{\sum_k (w_k / \delta_{ik})} N_i \tag{8}$$

Equation (8) is the share equation and its connection to the structural gravity equation is obtained by using the labour market clearing equation (equation (9)) to solve and replace the equilibrium wage rate (w).

$$L_j = w_j \sum_i ((1/ \delta_{ij})/W_i)\, N_i \tag{9}$$

$$W_i = \sum_k (w_k / \delta_{ik}) \tag{10}$$

The world supply of labour is given by $N = \sum_i N = \sum_j L$. Under the labour market clearing condition that the labour force supplied to j from all possible origins must equal the number of migrants that relocate to j from all i, Anderson derives the equilibrium wage rate.[2] Solving and substituting the equilibrium wage into the share equation, Anderson obtains the following equation.

$$M_{ij} = \frac{L_j N_i}{N} \frac{1/\delta_{ij}}{\Omega_j W_i} \tag{11}$$

Equation (11) is Anderson's structural gravity equation for migration. Equation (11)'s first quotient equals the level of expected migration in a world without any frictions. In the absence of any frictions, the proportion of i's contribution to j's labour force would equal i's share of the world population in all possible j destinations. The second ratio naturally represents the effect of

[2] For a more detailed explanation of Anderson's mathematical process, please refer to page 31 of Anderson (2011).

frictions on migration flows. The inverse of the bilateral friction variable is given by $1/\delta_{ij}$, which lowers the number of migrants moving from *i* to *j*. This term is divided by the product of the weighted average of the inverse of migration frictions. The variable Ω_j denotes the inward multilateral resistance term that controls for the fact that migration from *i* to *j* depends on the cost of migrating to *j* from all possible origin regions while W_i represents the outward multilateral resistance terms that controls for the fact that migration to *i* from *j* depends on migration costs from between all possible *i* and *j* regions. The Ω_j and W_i terms are analogous to the multilateral resistance terms derived in Anderson Van Wincoop (2003) for structural gravity models of trade.

The inclusion of the multilateral resistance terms to the gravity equation allows researchers to control for the effect of changes in bilateral migration costs across migration flow routes between two regions. This addresses the glaring issue with the traditional gravity model (equation (1)). According to Anderson (2011), migration flows depend on the multilateral resistance terms and excluding them from the model leads to omitted variable bias.

3.3 Migration Studies Within Canada Using a Gravity Approach

Many papers have studied migration patterns within Canada. Courchene (1970), Foot and Milne (1984), Day and Winer (2006), Coulombe (2006) and Amirault, de Munnik and Miller (2012) all model migration flows within Canada at the aggregate level. These papers focus on estimating the importance of specific determinants of migration. Notably, Courchene (1970) and ADMM (2012) use a gravity approach to study interprovincial migration flows.

Courchene (1970) conducted a study to test 14 hypotheses about the laws of migration within Canada. Using 1961 census data as well as annual provincial migration data between 1952 and 1967 for people who receive family support allowances, Courchene studied the determinants of interprovincial migration. Courchene (1970) used a naïve gravity framework to measure the effect of various province specific characteristics on labour migration flows. His study included total government transfers and unemployment benefits variables into its modified gravity equations.

Courchene (1970) utilized different specifications of a modified gravity model using the OLS estimation method. He presented two sets of findings, one for each dataset used. The first set of findings was obtained by estimating a series of naïve gravity equations using census data. Using this dataset, Courchene was able to compare the importance of the determinants of migration across different age groups. He noted that migration rates peak in the younger age groups. He found that younger individuals are much more responsive to wage differentials across regions. More importantly however, the coefficients associated with the total government transfers variable were all found to be negative when estimating the full model's gravity equations using census data. Courchene concluded that these results suggest that government transfers inhibit interprovincial migration.

The second round of results were obtained by estimating naïve gravity equations using the family allowance dataset. Courchene included the total government transfers and the unemployment benefits variables in his model. He found that the receipt of government transfers and unemployment benefit transfers are negatively correlated with outmigration from the origin province. If one were to assume causation, his results suggests that an increase in unearned and earned income in the origin province inhibits migration, but higher earnings in the destination province increase outmigration. A 1% change in total federal transfers leads to a 0.343% decrease in migration and a 1% change in unemployment insurance benefits leads to a 0.227% decrease in migration.

Courchene also estimated how labour income and unemployment might influence gross migration rates. To proxy earned income, the author used labour income per employed person. His results suggest that labour income in the origin province and outmigration are negatively correlated. A 1% increase in per employed person labour income in the origin province leads to a 2.45% decrease in outmigration. Courchene's results also suggest that the unemployment rate in the origin province is positively related with outmigration. Again, if causation is assumed, a 1% increase in the unemployment in province *i* leads to an increase in migration flows to destination *j* by 0.194%.

Amirault, de Munnik and Miller (ADMM) (2012) studied migration flows between 69 census divisions across Canada from 1991-2006. The paper is a study on interprovincial and intraprovincial migration. The authors were interested in measuring the impact of provincial borders on migratory flows. The use of census division data allowed the authors to estimate the effect of provincial borders. ADMM's gravity model of migration builds on the modified gravity equation we discussed in section 3.1. They used equation (12) to model migration flows between census divisions in Canada.

$$M_{ij} = F(lnPop_i, lnPop_j, lnDist_{ij}, HomeProv_{ij}, DiffEmRateGr_{ij}, DiffLnMedHldInc_{ij},$$
$$AbsDiffFrePop_{ij}, MR_{ij}, Adjacent_{ij}, HomeOwnRate_i AvgHomeValue_j DiffLowTax_{ij},$$
$$DiffMidTax_{ij}, DiffHighTax_{ij}, Pop15to29_i, DiffOtherInc_{ij}, AboPop_i, AboPop_j,$$
$$DiffJanTemp_{ij}, DiffRain_{ij}, AT_i, QC_i, PR_i, BC_i, AT_j, QC_j, PR_j, BC_j, 2001, 2006) \qquad (12)$$

ADMM (2012) included fixed effects and time dummies to measure the impact of various time-varying census division characteristics. As seen in equation (12), they included many province specific variables and constructed bilateral variables such as "DiffJanTemp_{ij}". They did not use the multiplicative form of the traditional gravity equation. They included continuous variables without taking their log values. As an example, they did not log the difference in employment gap variable, “$DiffEmRateGr_{ij}$”, but they used the log of the difference in median household income “$DifflnMedHldInc_{ij}$”.

One of the issues they faced was the presence of many zero-valued entries for the dependant variable. Because they used census division level data, migration flows equal zero for many division pairings across their sample. They used two different estimation methods to address this problem and compare their results. They estimate their gravity equation using a Poisson pseudo-maximum likelihood (PPML) estimation method, and a negative binomial (NB) estimation method.

The PPML and NB estimation results both suggest the presence of a provincial border effect that inhibits migration. When estimating the coefficients associated with census division specific variables, the authors found that the employment rate gap and median household income gap were statistically significant variables. According to their model, a 1% increase in the employment rate gap is associated with a 2.35 to 2.45 increase in migration, and a 1% increase in the median household income gap is associated with increase in migration of 0.64 to 0.65. ADMM (2012) compared the magnitude of the coefficients from each model and concluded that to compensate for a 1% increase in employment in the destination, median household income should be 3.67% to 3.77% higher in the origin.

Another interesting finding in the paper is that the negative impact of distance on migratory flows decreases over time. ADMM (2012) constructed interaction variables using intercensal dummy variables and logged distance to evaluate the relationship between distance and migration over time. The interaction variables were found to be positive and statistically significant suggesting that migration costs decrease over time.

3.4 Migration Studies Outside Canada Using a Gravity Approach

Research has also been conducted to model migration patterns outside Canada. Li, Liu and Tang (2014) used a gravity-type framework to model interprovincial migration flows in China. Ramos and Suriñach (2013) constructed a modified naïve gravity model to estimate migration flows between the European Union and neighbouring countries. Kim and Cohen (2010) studied the determinants of migration inflows in 17 different countries and modeled migratory outflows from 13 of those countries using a gravity framework. This section summarizes the approaches and findings from these selected papers.

Li et al. (2014) used newly available Chinese data to estimate the determinants of interprovincial migration and monitor their change over time between 1985 and 2005. They constructed a modified gravity model by adding several potential determinants of migration such as house prices, average labour income, and employment structure data. They used OLS to estimate the parameters in their equation. They used a multiple stepwise regression procedure to determine the set of variables to include in their regression over four different time periods.

The authors found that income and employment are the most important determinants of migration in China, and that their importance grew over time. They also found that social-cultural factors were less important determinants of migration over time. They noted that the increase in the importance of factors like income and employment coincided with the decline in the importance of factors such as distance. They concluded that migration flows in contemporary China are driven by income and labour market conditions.

Ramos and Suriñach (2013) used European data to study migration flows between EU nations and neighbouring non-EU countries (ENC). They estimated a structural gravity equation for almost 200 countries over a time frame spanning 50 years (1960-2010). They estimate their log-linear gravity equation using OLS and included country-time fixed effects to control for the multilateral resistance term. The authors' bilateral migration flow variable contained a large amount of zero-valued entries (55%). To address this problem, they changed the zero-valued entries equal to "1", a solution that has been shown to yield inconsistent estimators. Ramos and Suriñach selected long-run determinants to add to their gravity model such as a common language indicator, the ratio of origin and destination GDPs and a border dummy variable.

The authors' results indicated that migration flows from ENCs to the rest of the world (excluding EU countries) are much higher than what their model had predicted. The excess migration flows were found to be even higher for flows from ENCs to the EU countries. The authors used these results to argue that ENCs could exert significant migratory pressures on EU countries in the medium-run. Their study provides evidence of the strong ties EU countries share with ENCs.

Finally, Kim and Cohen (2010) constructed two models to measure the determinants of migratory outflows from 13 countries and the determinants of migratory inflows into 17 countries between 1950 and 2007. The countries that were included in the sample are Australia, Belgium, Canada, Croatia, Denmark, Finland, France, Germany, Hungary, Iceland, Italy, New Zealand, Norway, Spain, Sweden, the United Kingdom, and the United States. They estimated a naïve gravity equation using OLS and incorporate geographic, demographic, historical and social factors into their model. They also made use of generalized estimating equations (GEE) and obtained results that were comparable to their OLS estimations.

The authors' main finding was that the most important determinants of inflows and outflows for the countries included in their sample are demographic and geographic factors. The origin and destination populations, areas and infant mortality rates were the most important determinants of inflows and outflows. The social and historical factors such as common language and common colonial heritage were found to be statistically significant but the magnitude of the coefficients were small relative to demographic and geographic variables.

3.5 Canadian Interprovincial Migration Studies Using Non-Gravity Approaches

Day and Winer (2006) and Coulombe (2006) used non-gravity approaches to model interprovincial migration. The methods used in these papers are not related to our study but their results are still relevant for analytical purposes. In the case of Day and Winer (2006), they provided a better understanding of the relationship between migration and government transfers. Coulombe (2006) echoes the importance of the inclusion of province fixed effects.

Day and Winer (2006) did not use a gravity approach, but they did study the impact of government policies on migration in Canada. They estimated the parameters of Cobb-Douglas expected utility functions across three different income groups. They estimated this type of model to control for employment uncertainty. In their model, Day and Winer (2006) account for federal government spending and unemployment insurance. However, they did not explicitly study the relationship between equalization payments and migration. They added distance, earned income differentials and varying states of employment to their model.

Day and Winer (2006) find that migration in Canada is primarily driven by earning differentials and employment gaps. Their model predicted that regional variation in federal spending, unemployment insurance, personal income taxes and social assistance programs inhibit migration by 0.5% at the least and 5% at most. The combined effect of regional variation in unemployment insurance and federal spending only reduces migration by 1%. Day and Winer (2006) argued that these effects are relatively small compared to regional variation in other variables like labour earnings and possible employment states. It would appear, based on their study's results, that government policies are unimportant determinants of migration relative to income and employment gaps.

Coulombe (2006) studied the drivers of interprovincial migration in Canada and found that migrants respond to regional employment rate gaps and labour productivity. Using provincial annual net migration data between 1981 and 2000, Coulombe (2006) employed a pooled time-series cross-sectional approach to estimate the relationship between migration and labour productivity, and migration and unemployment across different age groups. The results suggest unemployment is negatively correlated with net migration. People also tend to migrate to regions where labour productivity is higher. Even after adding provincial fixed effects, provincial labour productivity remains statistically significant. Coulombe (2006) stressed the importance of including province fixed effects in an interprovincial migration analysis. His analysis suggested that provinces display varying levels of structural outmigration. For example, Coulombe (2006) explained that the statistically significant and relatively large and negative coefficients associated with Manitoba and Saskatchewan's fixed effect variables imply, all else being equal, that provinces are subject to outmigration across all age groups. The coefficient for provinces like Ontario or BC were found to be smaller in magnitude indicating that there might be more opportunities for local migration.

4. Data Description

This section of the paper describes the data used for the analysis presented herein. Each variable used the analysis is defined and their sources provided. The reason each variable was chosen for inclusion is discussed. Also included are basic summary statistics for each variable and information about the expected relationship each shares with the dependent variable, migration flows.

Most of the data used in this paper was retrieved from the Canadian Socio-Economic Information Management System (CANSIM) (Statistics Canada). Annual provincial data was obtained to build a gravity panel dataset to conduct the analysis. The dataset includes pairwise migration flow observations for all 10 provinces from 1981-2015. It provides economic and demographic data for each possible origin-destination province pairing for each year in the sample. The gravity models chosen for this study estimate interprovincial migration flows as a function of population, distance and other variables. The later are divided into two groups. The first group includes the particular variables of interest: equalization payments and TGT. The second group includes control variables that are believed to be related to migration, which will be described below. Table 1 contains definitions for each variable included in the study's models. Table 2 provides the mean and standard deviation for the primary variables of interest. Finally, Table 3 provides summary statistics for the control variables used in the regression analysis along with the expected sign of the relationship each of them share with migration.

The decision to include specific economic variables in the study is partially based on the model of interprovincial migration flows found in ADMM (2012). The dataset contains a total of 3,150 observations. This represents fewer observations than the ADMM (2012) because they modeled migration flows between sub-provincial economic regions (Census Divisions) across three census years from 1991-2006. Their study aimed to estimate interprovincial as well as intra-provincial migration flows whereas this paper focuses only on the former.

Table 1: Variable names and definitions

Variable Name	Definition
Ln(GrossMig_ijt)	Log of gross migration from origin i to destination j in year t
Ln(Dist_ij)	Log of distance in km between i and j
Ln(Pop_it)	Log of province i's population in year t
Ln(Pop_jt)	Log of province j's population in year t
Ln(RatioEmRate_ijt)	Log difference of province j's and province i's employment rates in year t
Ln(EmRate_it)	Log of province i's employment rate in year t
Ln(EmRate_jt)	Log of province j's employment rate in year t
Ln(RatioMedAftTaxInc_ijt)	Log difference of province j's and province i's median after-tax income in year t
Ln(AftTaxInc_it)	Log of the median after-tax income in province i's in year t
Ln(AftTaxInc_jt)	Log of the median after-tax income in province j's in year t
Adjacent_ij	Equals 1 if migration is between adjacent provinces
ORI_Receiver_it	Equals 1 if province i is receiving equalization payments (EP)
DEST_Receiver_jt	Equals 1 if province j is receiving EP
Ln(RatioRealEpayCap_ijt)	Log difference of province j's and province i's per capita EP in year t (non-zero values)
RealEpayCap_it	Level of province i's per capita EP in year t
RealEpayCap_jt	Level of province j's per capita EP in year t
Ln(RatioRealMedGT_ijt)	Log difference of province j's and province i's median total government transfers (TGT) in year t
RealGT_it	Level of province i's TGT in year t
RealGT_jt	Level of province j's TGT in year t
Ln(RealGT_it)	Log of province i's TGT in year t
Ln(RealGT_jt)	Log of province j's TGT in year t

The dependent variable in this study is gross migration flows. The “LnGrossMig_ijt” variable is a measure of the number of individuals that moved from province *i* to province *j* during a specific year t. The dataset does not contain any zero valued entries for this variable. An objective of this paper is to estimate the relationship between migration and the two variables of interest, equalization payments and total government transfers, while controlling for other factors that influence migration.

The first variable of interest in the study is equalization payments (EP). Data on equalization payments was obtained from Livio di Matteo, who generously provided his dataset spanning from 1957 to 2016. There are zero-valued entries in this data. The presence of a zero-valued entries means that a province is not eligible to receive payments. It is not due to a reporting mistake and it is not a missing value. One method used to circumvent the presence of zero-valued entries is to use dummy variables indicating if the origin and destination provinces are receiving equalization payments. Although, this approach is not ideal because it limits the interpretation of the estimated coefficient, the transformation allows for the usage of the traditional multiplicative from of the gravity equation. The variable "ORI_Receiver_it" takes the value "1" if the origin province is receiving equalization payments and "0" if otherwise. The same applies to the "DEST_Receiver_jt" variable for the destination province.

Another method consists of including an equalization payment variable containing all non-zero entries by replacing all zero values observations with 1. This particular solution to the presence of zero-valued entries was used by Ramos and Suriñach (2013). The "LnRatioEpayCap_ijt" variable measures the logarithmic difference of the destination's equalization payments and the origin's equalization payments.

Table 2: Summary Statistics for Variables of Primary Interest

Variables	Mean (Standard Deviation)
Ln(GrossMig_ijt)	6.953
	(1.592)
ORI_Receiver_it	0.677
	(0.467)
DEST_Receiver_jt	0.677
	(0.467)
Ln(RatioRealEpayCap_ijt)	0.000
	(1.330)
RealEpayCap_it	683.301
	(614.514)
RealEpayCap_jt	683.301
	(614.514)
Ln(RealEpayCap_it)	6.689
	(0.879)
Ln(RealEpayCap_jt)	6.689
	(0.879)
Ln(RatioRealMedGT_ijt)	0.000
	(0.873)
RealGT_it	5669.445
	(3207.378)
RealGT_jt	5669.445
	(3207.378)
Ln(RealGT_it)	8.467
	(0.621)
Ln(RealGT_jt)	8.467
	(0.621)

Finally, another method consists of including the equalization payments variable without taking its log. The inclusion of this variable means that the model does not adhere to the traditional multiplicative form of the gravity equation. This approach was inspired from ADMM (2012) since they chose to abandon the traditional multiplicative form of the gravity equation. As discussed in section 3, ADMM do not log-transform every continuous independent variable in their regression. The final specification in each of our models for equalization payments uses the real level of per capita payments to circumvent the zero-valued entries problem. “RealEpayCap_it” and “RealEpayCap_jt” measure the real dollar value of equalization payments for the origin and destination provinces respectively.[3]

The second variable of interest is the median of total government transfers (TGT). Data on median TGT from 1981-2015 was obtained from the CANSIM database. TGT data is used because equalization payments are a potential subset of total government transfers and comparing the relationship between migration and these two variables separately could yield interesting findings. the zero-valued entry problem encountered with equalization payment data is avoided since TGT data does not contain any zero-valued entries.

Other control variables included in this study represent possible “pull” and “push” factors for migrants within Canada. When individuals decide to relocate to another province, they consider multiple economic factors to maximize their net benefits. These economic variables are referred to as “push” and “pull” factors. “Push” factors encourage individuals to move away from regions where they experience adverse economic, political, and social conditions. Low earning potential and low employment opportunities “push” individuals to relocate to destinations that offer better opportunities. “Pull” factors draw people to relocate to regions that offer strong job opportunities and high earnings potential. The dataset contains variables that represent “push” and “pull” factors.

[3] Another possible solution which is not used in this paper is to remove all observations which have zero-valued entries for destination province receiving payments. This approach is flawed because it leads to selection bias. Removing all these entries implies excluding Alberta, British Columbia, and most of Ontario from our sample. For this reason, I do not use this specification.

To proxy earning potential in the origin and destination provinces, after-tax median income data is utilized. The "LnRatioAftInc_ijt" variable measures the logarithmic difference of the destination's after-tax median income and the origin's after-tax median income. To proxy employment opportunities annual provincial employment rate data was collected. Employment data rather than unemployment is used since employment takes into account the working age population rather than only people included in the labour force. This provides clearer depiction of labour market conditions. The "Ln(RatioEMrate_ijt)" variable measures the logarithmic difference of the destination's employment rate and the origin's employment rate.

As discussed in Section 3, the traditional gravity equation incorporates the origin and destination population levels to control for the size of each province. The "Ln(Pop_it)" variable measures the number of people that live in the origin province in year *t*. It represents the pool of potential people that can move from *i* to *j*. The "Ln(Pop_jt)" variable measure the number of people that live in the destination province in year *t*. This variable is used as a proxy for "pull" factors. As an example, provinces with larger populations tend to have larger urban centers. Individuals are possibly drawn to these large urban centers because they offer more diverse job opportunities.

The dataset also contains information about distance. The measure of distance between any two provinces was derived measuring the road distance between the capital city of each province and is a fundamental component of the gravity equation. The distance variable represents both the physical and psychological cost of moving. People incur higher migration costs if they increase the distance they must travel to relocate. As most people that relocate in Canada use ground transportation, kilometers of road are used as a measure of distance. This is a better representation of migration costs. I also include a provincial border dummy variable in my regression equations.

If two provinces share a common border, the cost of migrating from *i* to *j* might be lower than what the distance variable suggests.

Table 3: Summary Statistics and Expected Direction of Effect for Control Variables

Variables	Mean (Standard Deviation)	Sign
Ln(Dist_ijt)	7.715 (0.819)	Negative
Ln(Pop_it)	14.215 (1.255)	Positive
Ln(Pop_jt)	14.215 (1.255)	Positive
Ln(RatioEmRate_ijt)	0.000 (0.151)	Positive
Ln(EmRate_it)	4.067 (0.109)	Negative
Ln(EmRate_jt)	4.067 (0.109)	Positive
Ln(RatioMedAftTaxInc_ijt)	0.000 (0.142)	Positive
Ln(AftTaxInc_it)	15.355 (0.354)	Negative
Ln(AftTaxInc_jt)	15.355 (0.354)	Positive
Adjacent_ij	0.2 (0.400)	Positive/Negative

5. Preliminary Analysis

Preliminary non-econometric analysis of relationships of interest in the data is provided prior to the regression analysis in order to assess how the dependent variable, gross migration, is related to the two variables of interest, equalization payments and total government transfers. Section 5.1

focuses on examining equalization payment data and section 5.2 examines total government transfer data.

5.1 Equalization Payments

To gain a better understanding of the relationships between equalization payments and gross net migration, the Hodrick-Prescott filter is employed to remove the trend component of each variable. Since the study uses annual data, the smoothing parameter is equal to 100. The cyclical component of each variable is plotted for the provinces of Newfoundland, Prince-Edward Island, Nova Scotia, New Brunswick, Quebec and Manitoba. The results for the provinces that have qualified over most of the sample's time frame are presented. Secondly, the proportion of outmigration towards "have" and "have not" provinces is examined. There is no need to omit any province from this exercise since I use a binary variable indicating whether a province received equalization payments or not. This preliminary analysis will allow me to posit two hypothses regarding the relationship between migration and equalization payments.

Figure 1 plots the detrended time series for equalization payments and net migration for a subset of provinces in my sample (the "have not" provinces). Apart from the series in the New Brunswick panel, the series in Figure 1 suggest that net migration and equalization payments tend to move in opposite directions.

The resulting correlation coefficients between the cyclical component of net migration and equalization payments offer a clearer picture. The correlation coefficients in Table 3 range from -0.355 for Newfoundland to 0.227 for New Brunswick. The negative correlation coefficients suggest that cyclical net migration and cyclical equalization payment share a weak negative relationship. This preliminary data analysis suggests that higher levels of equalization payments are associated with lower levels of net migration. However, it is important to note that the relationship appears to be weakly negative given the magnitude of the coefficients. None of the correlation coefficients are found to be statistically significant at the 5% level.

Figure 1: Cyclical net migration and equalization payments time series

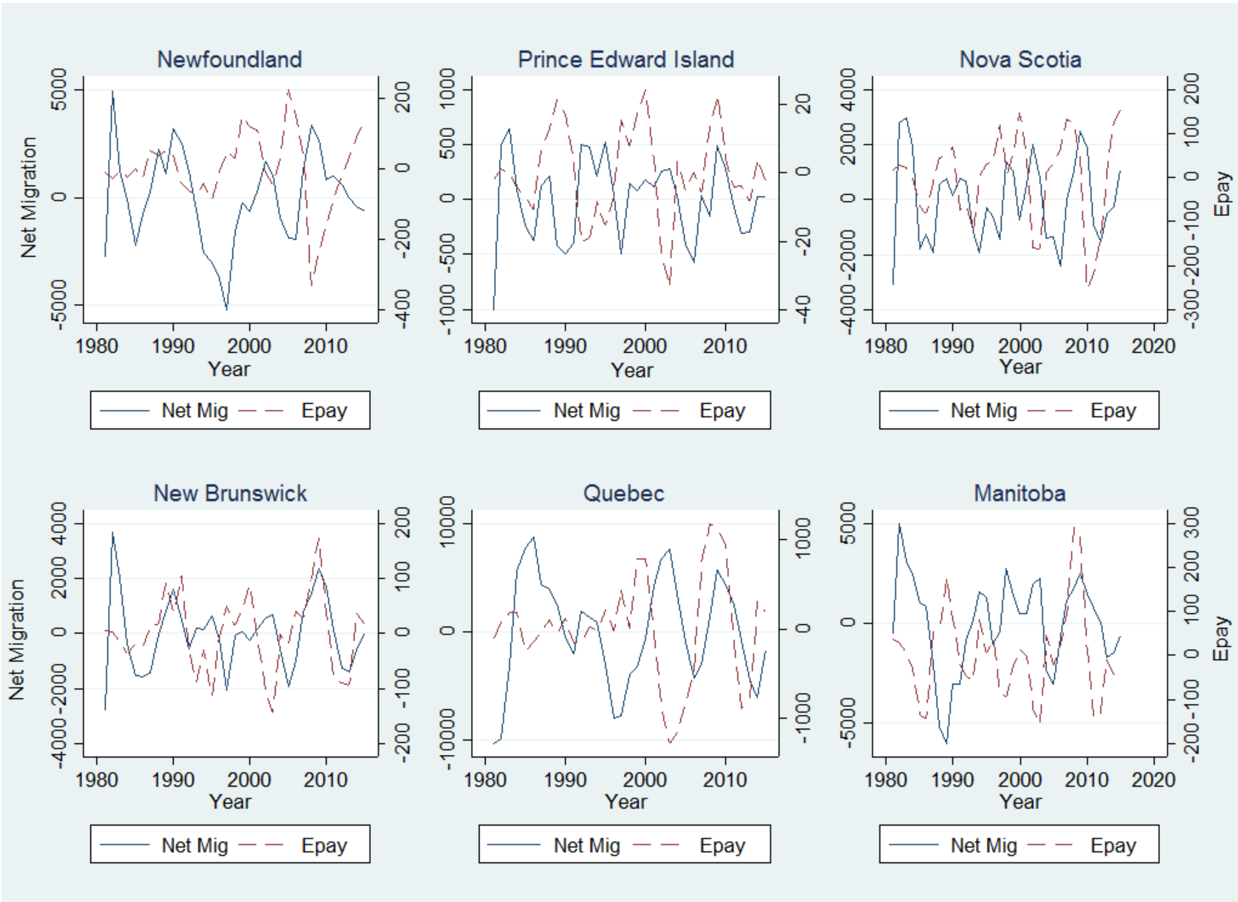


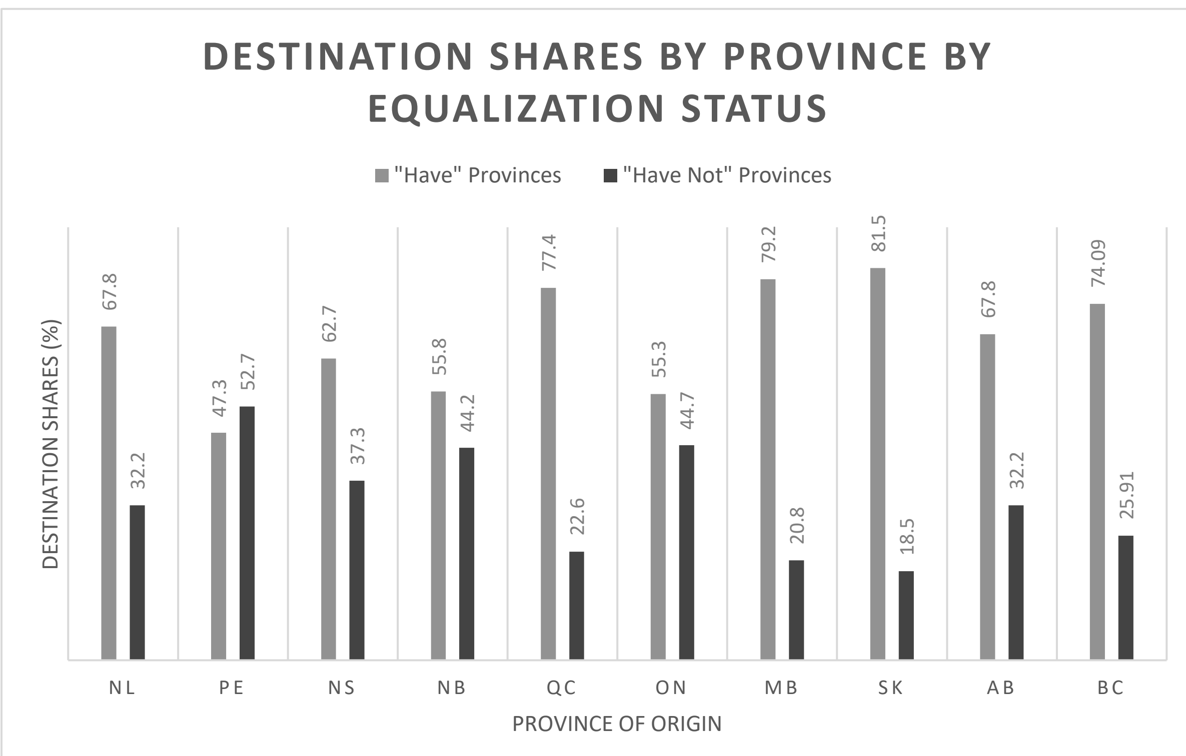
Table 3: Net Migration and Equalization Payment Correlation Coefficients

Province	Cyclical Growth Correlation Coefficient
NL	-0.3555
PE	-0.2100
NS	-0.0233
NB	0.2272
QC	-0.1396
MB	-0.1615

* p<0.05 ** p<0.01 *** p<0.001

Figure 2 shows the proportion of people that moved to a “have” province and those that relocate to a “have not” province. Figure 2 shows that a larger proportion of migrants in most provinces chose to relocate to a “have” province. This suggests that a migrant may be more likely to move to a province that is not receiving any payments. Figure 2 also shows that the gaps between the destination shares in the western provinces are much larger than those in the eastern provinces. The difference in magnitude could be attributed to the fact that the eastern provinces are all “have not” provinces and hence are close in proximity to other “have not” provinces. The western provinces are mostly “have” provinces and are also in proximity to highly populated “have” provinces. By this logic, the information provided by Figure 2 is consistent with the intuition backing the traditional gravity model of migration.

Figure 2: Proportion of migrants that relocate to each type of province



5.2 Total Government Transfers

As with equalization payments, total median government transfers for each province are detrended. There is no need to exclude any provinces from this exercise since there are no zero-valued entries in this series. The relationship between both series in each panel is not immediately evident. Figure 3 plots the detrended times series for total median government transfers and net migration for the Atlantic Provinces. Figure 4 does the same for Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. Table 4 presents the corresponding correlation coefficients. The coefficient is positive for the provinces of Newfoundland, PEI, Nova Scotia, New Brunswick, Manitoba and Saskatchewan and negative for Quebec, Ontario, Alberta and British Columbia. Only the coefficients associated with Quebec, Ontario, Manitoba and Alberta are found to be statistically significant at the 5% level.

Figure 3: Cyclical net migration and median total govt. transfers (Atlantic)

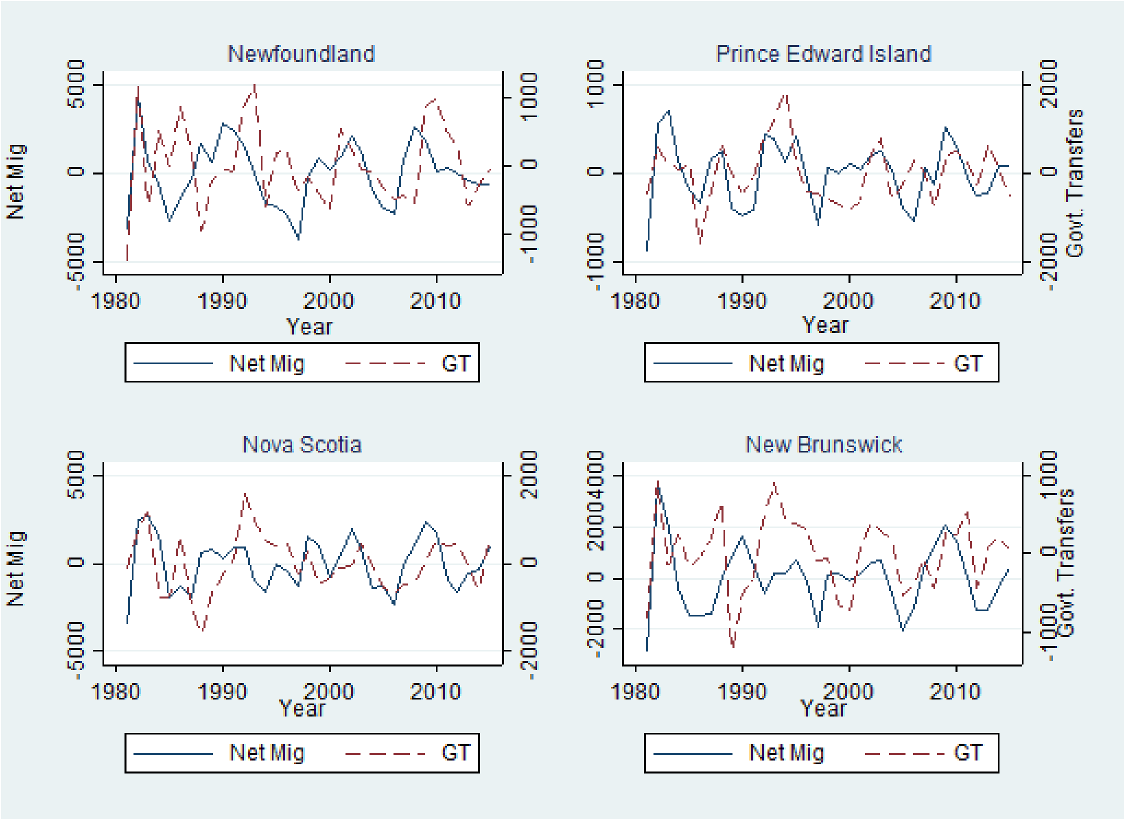


Figure 4: Cyclical net migration and median total govt. transfers (Central & Western)

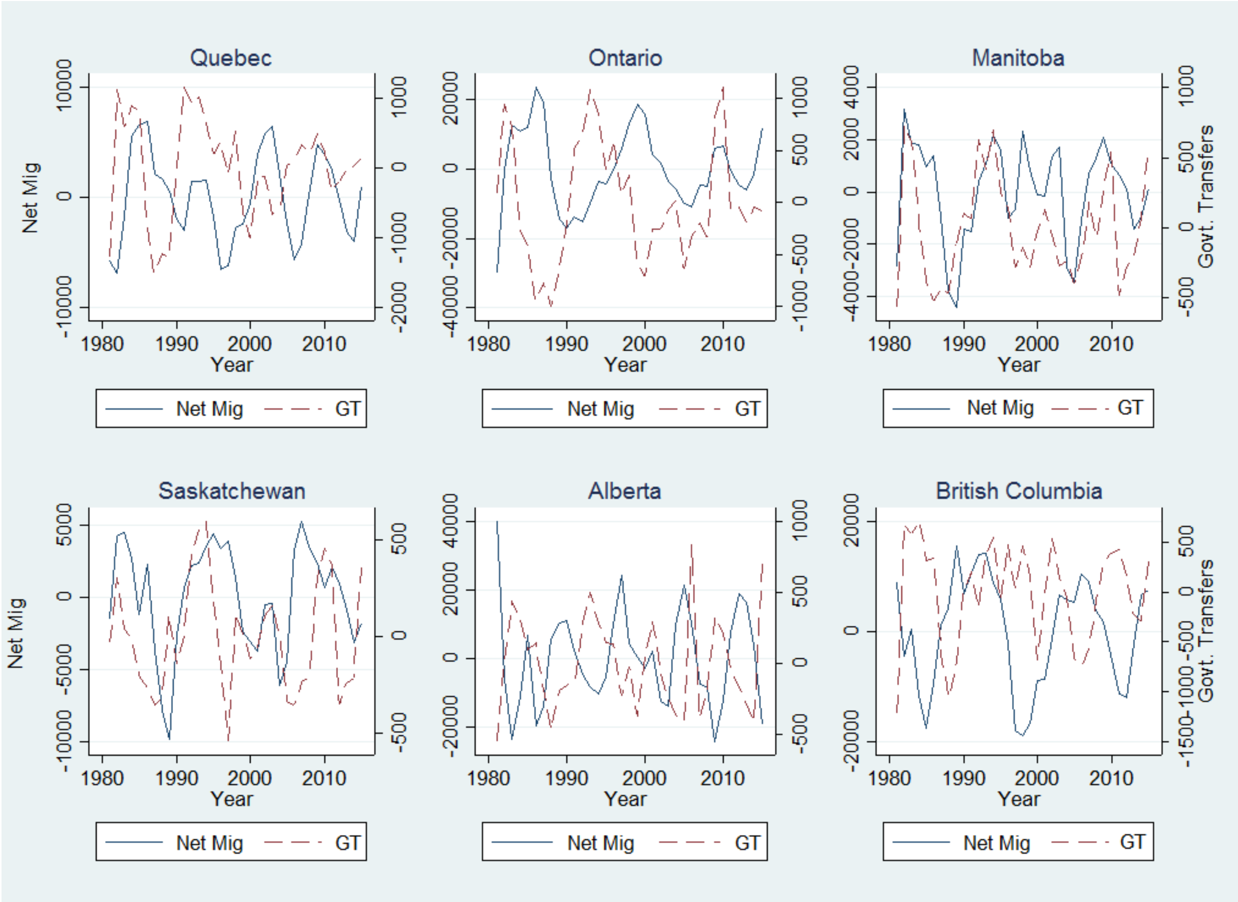


Table 4: Net Migration and TGT Correlation Coefficients

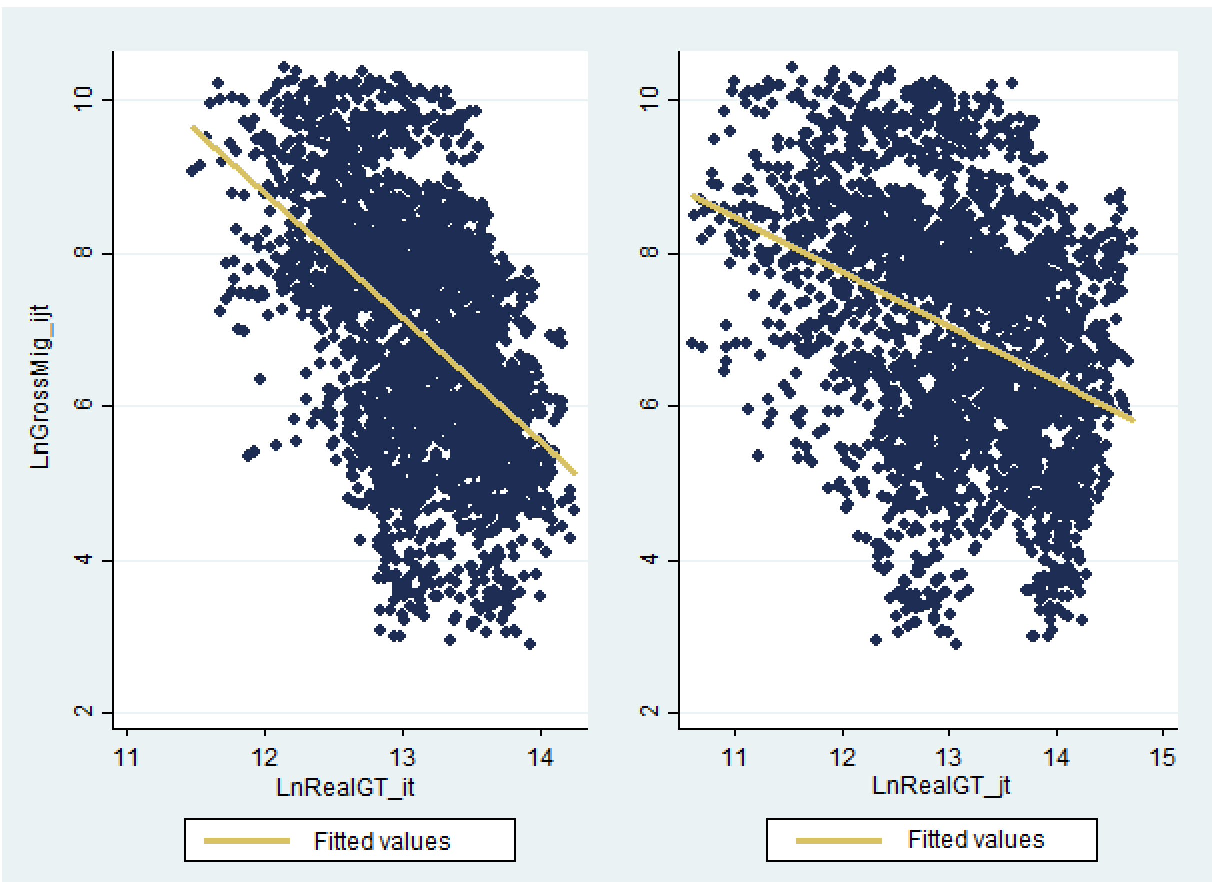
Province	Cyclical Growth Correlation Coefficient
NL	0.2920
PE	0.4429
NS	0.2316
NB	0.2958
QC	-0.0970*
ON	-0.2195*
MB	0.4470*
SK	0.2042
AB	-0.5094*
BC	-0.3938

* p<0.05 ** p<0.01 *** p<0.001

The magnitude of the coefficients in Table 4 are larger than those in Table 3. This difference suggests that the relationship between migration and total government transfers might be stronger than the relationship between migration and equalization payments.

Finally, Figure 5 is a scatter plot diagram that plots the dependent variable, “LnGrossMig_ijt”, against the variables of interest, “LnRealGT_it” and “LnRealGT_jt”. Before conducting my regression analysis, it is important to examine how these variables are related. Simple OLS estimation techniques are used to obtain the fitted values. Interestingly, the fitted lines in each panel suggest that there is a negative relationship between both pairs of variables. In both panels, the relationship is found to be negative and statistically significant at the 0.1% level.

Figure 5: Scatter point diagram plotting gross migration against TGT



6. Estimation Methods and Baseline Model

This paper uses four different estimation methods. The estimations methods include both non-structural and structural gravity equations. Model 1 is a naïve gravity equation. As discussed above, the naïve model does not include any variables that control for the multilateral resistance terms. Model 2 is a naïve gravity equation that includes non-theoretically consistent proxies for the MRTs called the remoteness terms. Model 3 is a structural gravity equation that incorporates time-invariant fixed effects to control for the multilateral resistance terms. However, under Model 3 the MRTs are assumed to remain constant over time. This is Model 3's main limitation. Finally, Model 4 is the final structural gravity equation. A two-step time varying fixed effects estimation method, as explained in Head and Mayer (2013), is used to estimate Model 4's parameters. Under Model 4, the MRTs vary over time. The following sections provide details of each estimation method and the baseline gravity equations I will be estimating.

6.1 Naïve Estimation

The first method used in our analysis is a simple naïve OLS regression. Equation (12) is a double-log representation of Model 1.

$$lnMig_{ijt} = \beta_0 + \beta_1 lnDist_{ij} + \beta_2 lnPop_{it} + \beta_3 lnPop_{jt} + \beta_4 Adj_{ij} + \beta_5 lnZ_{ijt} + F_t + \ \varepsilon_{ijt} \quad (13)$$

Common to each equation is the inclusion of both the origin and destination provinces populations, the distance which separates them and a variable which equals "1" if the origin and destination share a border and "0" otherwise. A set of year indicator variables is also added to control for a common time trend. The Z_{ijt} term represents a set of chosen covariates among the variables of interests and the control variables. More specifically, the Z_{ijt} term contains unilateral and bilateral province specific variables. Depending on how the equation is specified, the Z_{ijt} term will contain a different combination of the "push" and "pull" factors described in Section 3.

Four different specifications of the naïve gravity equation are estimated. The baseline Z_{ijt} contains information about median after-tax incomes and employment rates and constitutes our reference equation. The three other model specifications are modified versions of the baseline model. The changes that are discussed are made relative to the baseline specification (Specification (1)). Specification (2) adds dummy variables indicating the payment status of the origin and destination provinces labeled "ORI_Receiver_it" and "DEST_Receiver_jt " to the Z_{ijt} term. Coefficients estimates on binary variables like "ORI_Receiver_it" and "DEST_Receiver_jt" have a different interpretation. When the variable is equal to 1, then migration from *i* to *j* will change by [e^c-1], where *c* is the associated regressor's coefficient. Specification (3) adds the "Ln(RatioEpayCap_ijt)" continuous variable to the Z_{ijt} term. The coefficients on these variables can be interpreted as elasticities. A change in the given variable's level by 1% induces a change in percentage in migration from *i* to *j* equal to the value of the regressor's coefficient. Finally, Specification (4) adds "RealEpayCap_it" and "RealEpayCap_jt". This final specification of the naïve model strays away from the traditional multiplicative form of the gravity equation by adding continuous variables without taking their log values as in ADMM (2012).

6.2 Remoteness Estimation

The second method uses OLS to estimate Model 2's parameters. Non-theoretically based proxies for the multilateral resistance terms are added to the gravity equation. These proxies are called remoteness terms and are calculated by using equation (14). Equation (14) is based on the remoteness term equation presented in Head and Mayer (2013). Population (P) is substituted for gross domestic product (Y) since population is used to measure a provinces' size in this paper.

$$REM_i = \sum_j \frac{Dist_{ij}}{P_j / P_{cdn}} \tag{14}$$

The remoteness variable denoted REM_{it} is the measure of the average population-weighted distance from the migrant's possible destinations within Canada. The weights are calculated as the destination's share of the Canadian population (P_{cdn}).

Anderson and Van Wincoop (2003) also used these proxies when they conducted a study on the impact of the US-Canada border on trade. There is a problem associated with using these proxy as explained in Anderson (2011). The remoteness terms only incorporate one component of migration costs into their calculation. By including only distance, the remoteness terms capture only a single dimension of the barriers to migration. Anderson (2011) also adds that the remoteness terms have low correlation with the multilateral resistance terms and the omitted variable bias problem resurfaces.

Equation (15) is obtained by including the remoteness terms. Compared to equation (13), the "$lnREM_{it}$" and "$lnREM_{jt}$" variables are the only new additions to the model and represent the remoteness terms for province *i* and *j* respectively.

$$\begin{aligned} lnMig_{ijt} = \beta_0 + \beta_1 lnDist_{ij} + \beta_2 lnPop_{it} + \beta_3 lnPop_{jt} + \beta_4 Adj_{ij} + \beta_5 lnZ_{ijt} \\ + \beta_5 lnREM_{it} + \beta_6 lnREM_{jt} + F_t + \varepsilon_{ijt} \end{aligned} \tag{15}$$

Four specifications of equation (15) are estimated using OLS. The same four versions of the Z_{ijt} term as described in section 6.1 are used.

6.3 Two-Way Fixed Effects Estimation

Model 3 is a structural gravity model. Time-invariant fixed effect are used to estimate the parameters of Model 3. This particular method is used since it does not prohibit the inclusion of time varying province specific variables in the model (A Practical Guide to Trade Policy Analysis, 109). The province and time fixed effects in the model capture the effect of the multilateral resistance terms. Because time-invariant fixed effects are included in the model, the MRTs are assumed to be constant over time. This is a strong assumption because the MRTs are believed to vary over time.

The dataset is relatively small with 3150 pairwise observations and spans a low number of years (34). For small samples, the MRTs may not vary significantly over time (A Practical Guide to Trade Policy Analysis, 109). The two-way fixed effects model is given by equation (16).

$$lnMig_{ijt} = \beta_0 + \beta_1 lnDist_{ij} + \beta_2 lnPop_{it} + \beta_3 lnPop_{jt} + \beta_4 Adj_{ij} + \beta_4 lnZ_{ijt} + F_i + F_j + F_t + \varepsilon_{ijt} \quad (16)$$

Compared to equation (13), the F_i and F_j terms are new additions to the model. They control for the origin and destination effects respectively. As mentioned above, the advantage with using time invariant fixed effects approach is that we may still estimate the partial effects of the country specific characteristics contained in Z_{ijt}. The Z_{ijt} remains the same as in the naïve and remoteness approaches and undergoes the same changes across the Model 3's various specifications.

6.4 Two-Step Time-Varying Fixed Effects Estimation

Model 4 includes time-varying MRTs. Two-step time-varying fixed effects regression is used to estimate the parameters of Model 4. The technique is drawn from Head and Mayer (2013). It is used by Head and Ries (2008) to study the determinants of FDI. The advantage with this approach is that I can estimate the effect of the monadic variables of interest while incorporating time-varying MRTs in the model. The two-step process first requires the estimation of equation

(17). Since equation (17) incorporates time-varying fixed effects, all monadic variables must be dropped. The effect of these variables is captured by the province-time fixed effects (F_{it} and F_{jt}).

To further clarify, the F_{it} and F_{jt} terms contain all time-varying province specific effects on migration including the effect of the monadic variable of interest. Compared to equation (13), the Z_{ijt} term is dropped and origin-year, destination-year and year fixed effects are added.

$$lnMig_{ijt} = \beta_0 + \beta_1 lnDist_{ij} + \beta_4 Adj_{ij} + F_{it} + F_{jt} + F_t + \varepsilon_{ijt} \tag{17}$$

The fitted values for F_{it} and F_{jt} are obtained from estimating equation (17). The second step in the procedure is to use these fitted values to estimate equations (18) and (19) by regressing $\hat{F}_{it}$ and $\hat{F}_{jt}$ on the monadic variables of interest (V_{it} and V_{jt}):

$$\hat{F}_{it} = \alpha_0 + \alpha_1 V_{it} + u_{it} \tag{18}$$

$$\hat{F}_{jt} = \alpha_0 + \alpha_1 V_{jt} + u_{jt} \tag{19}$$

The V_{it} and V_{jt} terms are analogous to the previously used Z_{ijt} term. The V_{it} term contains all origin province specific variables of interest and the V_{jt} contains all destination province specific variables of interest. Two specifications for each V_{xt} term (for $x \in \{i,j\}$) is included. The V_{xt} terms under the first specifications contains only a single variable of interest, the “LnRealEpayCap_xt” variable. Under Specification (2), other monadic variables are added in V_{xt} including “LnAftTaxInc_xt”, “LnPop_xt” and “LnEmRate_xt”.

7. Results

This section presents the regression output obtained from estimating the models described in section 6. Section 7 is divided into two parts. The first section presents the results obtained from including equalization payment variables in my model. Section 7.2 present results from the same estimation methods, except the equalization payment variable is replaced with total median government transfers to persons.

7.1. Equalization Payments

Model 1: Naïve Estimation

The results from the naïve model are presented in Table 5. In Model 1's baseline specification, all the variables apart from "Ln(RatioEmRate_ijt)" are statistically significant at the 1% level. The signs on the estimated coefficients are consistent with previous gravity studies. The employment rate ratio variable is not found to be statistically significant, which is surprising since we expect labour market condition differentials to matter for migration flows.

In Model 1's second specification, equalization payment indicator variables are added to determine if equalization payments are related to migration flows. "ORI_Receiver_it" and "DEST_Receiver_jt" are non-continuous variables. As stated above, if they are active (take on the value "1"), then gross migration flows will change by (e^{c}-1) percent where c is the variable's estimated coefficient. Specification (2) indicates that the receipt of equalization payments in either the origin or destination provinces is negatively correlated with migration flows between i and j. The model suggests that migration flows are 0.58% lower if the origin province qualifies as a payment recipient and 0.66% lower if the destination province receives equalization payments.

The magnitude of the estimated effects of equalization payments in this model is comparable to the magnitude of the change associated with a 1% change in the origin or destination population levels. The effects associated with 1% change in the after-tax income and employment rate variables are found to be much smaller than those associated with equalization payments. The sign of the coefficients in this model are consistent with previous gravity research. However, the after-tax income ratio variable becomes insignificant when I include equalization payments. This result is not consistent with past gravity studies. These variables tend to be important explanatory variables of migration.

Table 5: Naïve OLS Estimation

	(1)	(2)	(3)	(4)
VARIABLES	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt
Ln(Dist_ij)	-0.542***	-0.750***	-0.747***	-0.687***
	(-0.0289)	(-0.0234)	(-0.0326)	(0.0256)
Ln(Pop_it)	0.756***	0.611***	0.521***	0.565***
	(-0.0172)	(-0.0153)	(-0.0237)	(0.0213)
Ln(Pop_jt)	0.718***	0.573***	0.479***	0.487***
	(-0.0169)	(-0.0151)	(-0.0232)	(0.0211)
Ln(RatioEmRate_ijt)	0.265	0.250*	0.308	0.0986
	(-0.141)	(-0.12)	(-0.165)	(0.154)
Ln(RatioMedAftTaxInc_ijt)	0.561**	0.201	0.00853	0.420*
	(-0.198)	(-0.195)	(-0.383)	(0.181)
Adjacent_ij	0.220**	0.0938	0.204**	0.110*
	(-0.0678)	(-0.0512)	(-0.074)	(0.0552)
ORI_Receiver_it		-0.876***		
		(-0.0395)		
DEST_Receiver_jt		-1.077***		
		(-0.0413)		
Ln(RatioRealEpayCap_ijt)			-0.0278	
			(-0.0241)	
RealEpayCap_it				-0.000541***
				(0.0000432)
RealEpayCap_jt				-0.000722***
				(0.0000443)
Constant	-9.382***	-2.496***	-1.959***	-1.512***
	(-0.286)	(-0.311)	(-0.368)	(0.418)
Observations	3150	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Specification (3) provides evidence of a negative relationship between equalization payments and migration flows. The equalization payments variable is continuous under this specification. The coefficient on “Ln(RatioEpayCap_ijt)” is negative but the variable is not found to be statistically significant. Some of the results are different from Specification (1). For example, after-tax income is not found to be statistically significant.

Specification (4) abandons the traditional multiplicative structure of the gravity equation and includes the level of equalization payments in each province instead of their log-levels. Both “RealEpayCap_it” and “RealEpayCap_jt” are statistically significant at the 0.1% level. A change in per capita equalization payments equal to one standard deviation in the origin province ($614.50) is associated with a 0.31% inverse change in migration flows from *i* to *j*. Similarly, a change in per capita equalization payments equal to $614.50 (one standard deviation) is associated with a 0.31% change in migration. Under this specification, the after-tax income ratio is statistically significant at the 5% level.

Overall, Model 1’s results suggest that equalization payments and migration flows are negatively correlated. As a final note, the naïve model is subject to omitted variable bias (Anderson 2011). For this reason, the naïve gravity approach is not the preferred estimation technique to estimate the relationship between migration and the various covariates included in this analysis. Non-theory based proxies for the multilateral resistance terms are added in Model 2 to address the omitted variable bias problem.

Model 2: Remoteness Estimation

In Model 2, the remoteness terms serve as non-theoretical proxies for the multilateral resistance terms. The results under Specification (1) are consistent with results from past gravity literature. A 1% change in distance is associated with a 0.89% inverse change in migration. A 1%

population increase in the origin province is associated with an increase in migration of 0.65%. A 1% population increase in the destination province is associated with an increase in migration of 0.61%. The income ratio variable is found to be statistically significant at the 1% level, an improvement over Model 1's results. A 1% change in the after-tax income ratio is associated with 0.55% change in migration flows. The employment rate ratio variable coefficient has the expected sign but is not statistically significant.

Model 2's baseline specification raises an important issue. Based on these results, employment does not appear to matter which is problematic given results from past studies. More generally, the statistical significance of the employment and income ratio coefficients varies across specifications. This is a potential concern since these variables have been shown to be important determinants of migration flows in past research. Common across all specifications is the strong statistical significance of the population and distance coefficients. All these coefficients have the expected sign.

When equalization payment indicator variables are added, the results suggest that the receipt of payments is negatively correlated with migration. When the origin province qualifies for receipt of equalization payments, the model suggests that migration flows will be 0.49% lower. If the destination province receives equalization payments, results suggest that migration flows will be 0.59% lower. Interestingly, the magnitudes of these effects are smaller than those found under Model 1's second specification. When proxies for the multilateral resistance terms are introduced in the gravity model, equalization payments appear to become less important, in terms of the magnitude of the coefficients.

Table 6: Remoteness OLS Estimation

VARIABLES	(1) LnGrossMig_ijt	(2) LnGrossMig_ijt	(3) LnGrossMig_ijt	(4) LnGrossMig_ijt
Ln(Dist_ij)	-0.892***	-0.902***	-1.128***	-0.878***
	(0.0254)	(0.0233)	(0.0302)	(0.0253)
Ln(Pop_it)	0.655***	0.584***	0.460***	0.621***
	(0.0158)	(0.0146)	(0.0212)	(0.0202)
Ln(Pop_jt)	0.617***	0.547***	0.421***	0.536***
	(0.0152)	(0.0143)	(0.0216)	(0.0200)
Ln(RatioEmRate_ijt)	0.246	0.268*	0.386*	0.112
	(0.140)	(0.127)	(0.161)	(0.142)
Ln(RatioMedAftTaxInc_ijt)	0.541**	0.202	0.262	0.441*
	(0.168)	(0.193)	(0.384)	(0.172)
Adjacent_ij	-0.107*	-0.0615	0.0146	-0.0847
	(0.0522)	(0.0476)	(0.0613)	(0.0513)
LnREM_ORI_it	0.664***	0.383***	0.785***	0.579***
	(0.0287)	(0.0274)	(0.0512)	(0.0379)
LnREM_DEST_jt	0.686***	0.361***	0.594***	0.512***
	(0.0284)	(0.0273)	(0.0524)	(0.0367)
ORI_Receiver_it		-0.678***		
		(0.0407)		
DEST_Receiver_jt		-0.889***		
		(0.0421)		
Ln(RatioRealEpayCap_ijt)			-0.0494*	
			(0.0218)	
RealEpayCap_it				-0.000116*
				(0.0000524)
RealEpayCap_jt				-0.000346***
				(0.0000527)
Constant	-22.13***	-10.89***	-15.85***	-16.82***
	(0.457)	(0.537)	(0.801)	(0.920)
Observations	3150	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Under Specification (3), the equalization payment variable is found to be statistically significant at the 5% level. The results also suggest that the relationship between equalization payments and migration flows is negative. The size of the coefficient suggests however, as it did in Model 1, that the magnitude of the associated change is small relative to the other variables in the model. The employment rate variable is found to be significant at the 5% level such that that a 1% increase in the employment ratio is associated with an increase in migration flows by 0.38%.

Finally, results from Specification (4) also provide evidence of a negative relationship between equalization payments and migration flows. A change in equalization payment levels equal to one standard deviation ($614.50) is associated with a 0.07% inverse change in migration flows. Except for specification three, the magnitude of the coefficients associated with equalization payment variables are all smaller than those associated with their counterparts under Model 1.

To summarize, the size of the coefficients once again suggests, as it did under specification (3), that the migration and equalization payments share a weak relationship. Interestingly, when including non-theoretical proxies for the MRTs, the relationship between equalization payments and migration appears to be weaker compared to results from the first model. This result suggests that the equalization payment variable may be becoming less important as more sophisticated estimation methods are used to incorporate the MRTs in the gravity equation.

Model 3: Two-Way Time-Invariant Fixed Effects Estimation

Model 3 estimates the relationship between equalization payments and migration using two-way time-invariant fixed effects estimation. This is a structural approach since the province and time fixed effects will capture the effect of multilateral resistance terms. In Model 3's baseline specification, the employment and after-tax income variables are found to be statistically significant at the 0.1% and 1% level respectively. More generally, the employment rate variable is found to be statistically significant across each specification. This is a major improvement over the results in our previous two models. Specification (1)'s results are consistent with those found in the gravity literature with respect to the population and distance variables.

The inclusion of indicator variables representing equalization payments under specification (2) yields results which differ from Model 1 and Model 2. Firstly, the "ORI_Receiver_it" variable coefficient, although negative, is not found to be statistically significant. This suggest that there is no relationship between migration and the receipt of payments in the origin province. Secondly, the "DEST_Receiver_jt" variable coefficient, although negative and statistically significant, has a much smaller magnitude than its counterparts under Model 1 and Model 2. If the destination province is a recipient of payments, there is evidence to suggest that migration flows will be 0.142% lower. Based on Model 3, migration flows are only related to the destination province's equalization payment status. Moreover, the magnitude of the coefficient associated with "DEST_Receiver_jt" suggests that this relationship is weaker relative to other covariates included in the model.

It is possible to compare Model 3's results with those obtained by ADMM (2012). ADMM (2012) found that to compensate for the change in migration due to a 1% increase in the employment rate in the destination economic region, average median household income in the origin region would need to increase by 3.67%-3.77%. Under Specification (2), to compensate for the change in migration due to a 1% increase in the employment rate in the destination province, after-tax median income in the origin province would need to increase by 2.49%.

Specification (3)'s results indicate that the magnitude of the coefficient associated with the equalization payments variable is relatively small, which provides evidence to suggest that the relationship between equalization payments and migration is weak. Based on Table 7's results, a

1% change in the equalization payment ratio is associated with a 0.0421% inverse change in migration. Specification 3's results are problematic as the population variables are no longer found to be significant.

Table 7: Two-Way Time-Invariant Fixed Effects Estimation

	(1)	(2)	(3)	(4)
VARIABLES	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt
Ln(Dist_ij)	-0.940***	-0.940***	-1.172***	-0.940***
	(0.0125)	(0.0124)	(0.0159)	(0.0124)
Ln(Pop_it)	0.526***	0.596***	0.0595	0.477***
	(0.122)	(0.126)	(0.333)	(0.123)
Ln(Pop_jt)	0.892***	1.065***	0.142	0.996***
	(0.124)	(0.128)	(0.312)	(0.125)
Ln(RatioEmRate_ijt)	1.219***	1.073***	1.080**	0.948***
	(0.227)	(0.235)	(0.338)	(0.228)
Ln(RatioMedAftTaxInc_ijt)	0.398**	0.266	0.00505	0.260*
	(0.128)	(0.139)	(0.209)	(0.129)
Adjacent_ij	0.0692**	0.0692**	-0.0457	0.0692**
	(0.0253)	(0.0253)	(0.0303)	(0.0253)
ORI_Receiver_it		-0.0443		
		(0.0283)		
DEST_Receiver_jt		-0.154***		
		(0.0291)		
Ln(RatioRealEpayCap_ijt)			-0.0424*	
			(0.0167)	
RealEpayCap_it				0.0000944**
				(0.0000366)
RealEpayCap_jt				-0.000152***
				(0.0000371)
Constant	-4.887	-8.778**	16.71*	-5.782*
	(2.595)	(2.776)	(7.539)	(2.694)
Observations	3150	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Under Specification (4) every coefficient is found to be statistically significant at the 5% level and the signs associated with each variable are consistent with previous studies. The estimated coefficients associated with the level of equalization payments are smaller in magnitude than their corresponding coefficients under the previous two models. A $614.50 change in per capita equalization payment (one standard deviation) in the origin province is associated with a -0.058% change in gross migration. A similar one standard deviation change in the destination province's equalization payments is associated with a -0.093% change in migration. Overall, the results in Table 7 indicate that equalization payments and migration are negatively correlated, but there is little evidence to suggest that changes in equalization payments are associated with meaningful changes in gross migration as is made evident by the magnitude of the estimated coefficients relative to those associated with other covariates.

The magnitude of the coefficients associated with equalization payment variables are small relative to those associated with other variables in the model like distance or the employment rate. For example, a change 0.151% change in the employment rate ratio (one standard deviation) is associated with a 0.15% change in migration. Model 3's most interesting result is that the employment rate variable is found to be statistically significant across all specification and the coefficients are relatively large compared to its counterparts in the previous two models. Apart from Model 3's third specification, these results most closely resemble results obtained in the gravity literature. For this reason, Model 3 is the paper's preferred model.

Model 4: Two-Step Time-Varying Fixed Effects Estimation

The results from the Model 4 are presented in Table 8. Only the results from the second step, regressing $\hat{F}_{it}$ and $\hat{F}_{jt}$ on the monadic variables of interest, are present in Table 8. To obtain these fitted values, it was necessary to regress “Ln(GrossMig_ijt)” on distance, a border dummy variable, origin-time, destination-time and time fixed effects. The preferred specifications for this model are presented under the first and third columns. The results under Specification (2) and (4) serve as robustness exercises to verify if results under Specifications (1) and (2) hold when I add other control variables.

Table 8: Two-Step Fixed Effects Estimation

VARIABLES	(1) $\hat{F}_{it}$	(2) $\hat{F}_{it}$	(3) $\hat{F}_{jt}$	(4) $\hat{F}_{jt}$
Ln(Pop_it)	3.013***	1.618**		
	(0.805)	(0.544)		
Ln(Emrate_it)		67.22**		
		(23.71)		
Ln(RealAftTaxInc_it)		0.331		
		(4.841)		
ORI_Receiver_it	-4.922***	0.844		
	(1.280)	(1.514)		
Ln(Pop_jt)			0.438***	0.402***
			(0.0131)	(0.0132)
Ln(Emrate_jt)				1.055***
				(0.118)
Ln(RealAftTaxInc_jt)				-0.235***
				(0.0555)
DEST_Receiver_jt			-1.144***	-1.037***
			(0.0380)	(0.0375)
Constant	-45.11***	-307.6**	-3.198***	-3.436**
	(12.10)	(111.5)	(0.206)	(1.064)
Observations	3150	3150	3150	3150

Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

When controlling only for the size of the origin province, results indicate that there is a negative relationship between the origin-time fixed effects and the receipt of equalization payments. The results from Specification (1) suggest that the receipt of payments in the origin province is associated with a 0.98% decrease in gross migration from *i* to *j*. When only controlling for the size of the destination province, results show that destination-time and equalization payment dummy variable are also negatively related. The results from Specification (3) suggest that the receipt of payments in the destination province is associated with a 0.68% decrease in gross migration from *i* to *j*. These findings are consistent with the results from my previous three estimation methods.

When additional variables are added to the model the results are different. Under Specification (2), the "ORI_Receiver_it" variable is not found to be statistically significant. In turn, this suggests that there is no meaningful relationship between the receipt of payments in the origin province and gross migration. The employment rate is found to be statistically significant at the 1% level but has a positive sign. This is not consistent with previous the results from previous studies.

The fourth column of results indicates that receipt of equalization payments in the destination province is negatively related to the destination-time fixed. The statistical significance of the "DEST_Receiver_jt" variable does not change when additional covariates are added. The results from Specification (4) suggests that the receipt of payments in the destination province is associated with a 0.65% decrease in the destination-time fixed effects compared to 0.98% from the third specification. In turn, this means there is evidence to suggest that the receipt of equalization payments in the destination province is negatively correlated with gross migration and that these results are robust. Under Specification (4), employment is also found to be statistically significant with the correct sign. The after-tax income variable is also found to be statistically significant at the 0.1% level but has a negative sign which contradicts previous findings in the paper.

7.2. Total Government Transfers

The analysis conducted in section 7.2 focuses on estimating the relationship between interprovincial migration and total median government transfers to persons. Except for Model 4, each estimation method is used to estimate three specifications. The first specification is the baseline model. It contains all the traditional covariates but excludes any variable pertaining to total government transfers. This specification is identical to the baseline specification used in 7.1. The results from this specification are reproduced in each table to draw comparisons with the results from the other two specifications. For this reason, the output of the first specifications will not be discussed in this section. The second specification adds the “Ln(RatioRealMedGT_jit)” to estimate the relationship between the ratio of median government transfers and migration. The third specification adds the variables “Ln(RealGT_it)” and “Ln(RealGT_jt)”. This version of the model is less restrictive as it allows each province specific TGT variable to have different coefficients.

Model 1: Naïve Estimation

The results from the estimation of the naïve gravity model are provided in Table 9. The output from Specification (2) suggests that government transfers and interprovincial mirtron are negatively correlated. “Ln(RatioRealMedGT_ijt)” is found to be statistically significant at the 0.1% level. The model’s results indicate that a 1% change in the ratio of the median of total government transfers is associated with a 0.12% inverse change in migration between i and j. Under Specification (3), the government transfers coefficients are also found to be statistically significant at the 0.1% level and are both negatively correlated with gross migration. The model suggests that a 1% change in median TGT is associated with a -0.681% change in interprovincial migration when the change occurs in the origin province. The coefficient on "Ln(RealGT_jt)" is larger, which suggests that

Table 9: Naïve OLS Estimation

	(1)	(2)	(3)
VARIABLES	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt
Ln(Dist_ij)	-0.542***	-0.542***	-0.674***
	(0.0289)	(0.0288)	(0.0225)
Ln(Pop_it)	0.756***	0.765***	0.646***
	(0.0172)	(0.0180)	(0.0157)
Ln(Pop_jt)	0.718***	0.709***	0.457***
	(0.0169)	(0.0176)	(0.0169)
Ln(RatioEmRate_ijt)	0.265	-0.152	-0.440*
	(0.141)	(0.221)	(0.190)
Ln(RatioAftTaxInc_ijt)	0.561**	0.288	-1.044***
	(0.198)	(0.208)	(0.184)
Adjacent_ij	0.220**	0.220**	0.0906*
	(0.0678)	(0.0678)	(0.0455)
LnRatioRealMedGT_ijt		-0.126*	
		(0.0505)	
LnRealGT_it			-0.681***
			(0.0498)
LnRealGT_jt			-0.755***
			(0.0458)
Constant	-9.382***	-9.382***	15.10***
	(0.286)	(0.285)	(0.742)
Observations	3150	3150	3150

Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

interprovincial migration flows might be more sensitive to changes in government transfers in the destination province if the existence of a causal relationship is assumed.

There are some glaring issues with some of the coefficients in Table 9. First, the sign of the employment rate coefficient under Specifications (2) and (3) are both negative. This could be due to the inclusion of the government transfers variables since they share a high degree of collinearity. Table 13 in the appendix provides the results from estimating a naïve gravity equation that excludes the employment rate variable under the first and second columns. When the employment rate ratio variable is excluded from Specification (2), the results remain mostly unchanged but the magnitude of the coefficient associated with the ratio of government transfers changes to -0.10. Excluding the employment rate variable from Specification (3) yields similar results. The magnitude of the "Ln(RealGT_it)" and "Ln(RealGT_jt)" slightly increase (in absolute terms) and remain negative. The after-tax income ratio variable becomes positive but is not found to be statistically significant. Model 1 provided evidence that total government transfers and migration are negatively correlated which suggests that TGT and equalization payments share similar relationships with gross migration.

Model 2: Remoteness Estimation

Model 2 results are provided in table 10. The results in Table 10 also suggest that TGT and migration are negatively correlated. Firstly, the "Ln(RatioRealMedGT_ijt)" variable is larger than its counterpart from Model 1. If the ratio of TGT changes by 1%, there is evidence to suggest that migration flows will change by -0.165% if we assume a causal relationship. Under Specification 3, both "Ln(RealGT_it)" and "Ln(RealGT_jt)" are included in the regression model and have negative estimated coefficients. The magnitude of the coefficients has decreased relative to their counterparts in the naïve model. The smaller magnitude of the coefficient suggests that the relationship between TGT and migration is weaker under Model 2 compared to Model 1.

The signs on the remaining coefficients across all of Model 2's specifications are not consistent with earlier results and my expectations. The after-tax income and employment rate variables are not found to be statistically significant under Specifications (2) and (3). The coefficients associated with the employment rate variable is found to be negative in Table 10's third column. If the employment rate variable is excluded from Specifications (2) and (3) [4] as we did with model 1, the coefficients attached to the TGT variables change slightly, but remain statistically significant. Under Specification (2), the coefficient associated to "Ln(RatioRealMedGT_ijt)" changes from -0.165 to -0.119. Under specification 3, "Ln(RealGT_it)" change from -0.396to -0.442 and "Ln(RealGT_jt)" changes from -0.726 to -0.68. The after-tax income variable is not found to be statistically significant but has the correct sign.

To summarize, when covariates that are highly correlated with the variable of interest are removed from the remoteness gravity equation, the results from the model provide evidence that suggests that TGT and migration are negatively related.

Lastly, when the results from Specification (3) under the naïve and remoteness estimation methods are compared, the magnitude of the coefficients attached to the "Ln(RealGT_jt)" are all larger than those associated with "Ln(RealGT_it)". If we assume that migration and TGT share a causal relationship, there is evidence to suggest that migration is more sensitive to changes in government transfer in the destination province compared to changes in the origin province.

[4] (see columns three and four of Table 13 in the Appendix)

Table 10: Remoteness OLS Estimation

	(1)	(2)	(3)
VARIABLES	LnGrossMig_ijt	LnGrossMig_ijt	LnGrossMig_ijt
Ln(Dist_ij)	-0.892***	-0.892***	-0.799***
	(0.0254)	(0.0254)	(0.0230)
Ln(Pop_it)	0.655***	0.665***	0.577***
	(0.0158)	(0.0160)	(0.0162)
Ln(Pop_jt)	0.617***	0.607***	0.519***
	(0.0152)	(0.0155)	(0.0155)
Ln(RatioEmRate_ijt)	0.246	-0.223	-0.223
	(0.140)	(0.204)	(0.184)
Ln(RatioMedAftTaxInc_ijt)	0.541**	0.263	0.263
	(0.168)	(0.193)	(0.180)
Adjacent_ij	-0.107*	-0.107*	-0.0249
	(0.0522)	(0.0522)	(0.0444)
LnREM_ORI_it	0.664***	0.708***	0.330***
	(0.0287)	(0.0324)	(0.0355)
LnREM_DEST_jt	0.686***	0.642***	0.264***
	(0.0284)	(0.0329)	(0.0354)
Ln(RatioRealMedGT_ijt)		-0.165**	
		(0.0584)	
LnRealGT_it			-0.396***
			(0.0598)
LnRealGT_jt			-0.726***
			(0.0595)
Constant	-22.13***	-22.13***	-0.451
	(0.457)	(0.456)	(1.152)
Observations	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Model 3: Two-Way Time-Invariant Fixed Effects Estimation

The third model includes origin, destination, and time fixed effects to the model. The results from Model 3's baseline regression differ from the previous two models. The employment and after-tax income variables are found to be statistically significant at the 0.1% and 1% level respectively. The remaining results from Table 9 are consistent with previous findings in the gravity literature. Nearly every single variable in Table 9 is statistically significant at the 5% level.

Under Specification (2), the results are consistent with those found in the literature. TGT are negatively correlated with gross migration. Interestingly, the coefficient associated to "Ln(RatioMedAftTaxInc_ijt)" is larger (in absolute terms) than its counterparts in the previous two models. It is also statistically significant at the 0.1% level, an improvement over the results from the naïve and remoteness models. This finding stands in contrasts with what occurred to the coefficients associated with equalization payments in Section 7.1. As increasingly sophisticated models were constructed, the statistical significance and magnitude of the equalization payments coefficient decreased.

Under Specification 3, the "Ln(RealGT_it)" and "Ln(RealGT_jt)" variables are found to be statistically significant at the 5% and 0.1% level respectively. The magnitude of the coefficients are smaller relative to their counterparts in Table 9 and Table 10. This pattern is identical to the one observed in Section 7.1 with equalization payments. The results under Specification (3) also suggest that TGT and gross migration are negatively related. The coefficient associated with TGT in the destination province is once again found to be larger than the coefficient attached to "Ln(RealGT_it)". This result suggests that migration flows are more sensitive to changes in TGT in the destination province relative to changes in the origin province.

Under Specification (3), "Ln(RatioMedAftTaxInc_ijt)" is negative and statistically significant. The "Ln(RatioEmRate_ijt)" variable is removed from the model to address the high degree of multicollinearity between the TGT and employment rate variables. The results are presented in columns 5 and 6 of Table 13 in the Appendix.

Table 11: Two-Way Time-Invariant Fixed Effects Estimation

VARIABLES	(1) LnGrossMig_ijt	(2) LnGrossMig_ijt	(3) LnGrossMig_ijt
Ln(Dist_ij)	-0.940***	-0.940***	-0.940***
	(0.0125)	(0.0124)	(0.0124)
Ln(Pop_it)	0.526***	0.563***	0.454***
	(0.122)	(0.121)	(0.119)
Ln(Pop_jt)	0.892***	0.855***	0.964***
	(0.124)	(0.124)	(0.124)
Ln(RatioEmRate_ijt)	1.219***	0.878***	0.513*
	(0.227)	(0.252)	(0.253)
Ln(RatioMedAftTaxInc_ijt)	0.398**	0.0934	-0.467**
	(0.128)	(0.144)	(0.157)
Adjacent_ij	0.0692**	0.0692**	0.0692**
	(0.0253)	(0.0253)	(0.0251)
Ln(RatioRealMedGT_ijt)		-0.174***	
		(0.0432)	
LnRealGT_it			-0.109*
			(0.0523)
LnRealGT_jt			-0.397***
			(0.0518)
Constant	-4.887	-4.887	1.338
	(2.595)	(2.569)	(2.488)
Observations	3150	3150	3150

Robust standard errors in parentheses
* p<0.05 ** p<0.01 *** p<0.001

The results from Table 13 also provide evidence to support the claim that TGT and migration are negatively correlated and that migration is more sensitive to changes in TGT in the destination province. The coefficient attached to the income variable is found to be positive, but not statistically significant.

To summarise, after estimating three different models, there is evidence to suggest that, as with equalization payments, gross migration is negatively correlated with TGT. In addition, when the results of each model's third specification are compared, migration and TGT in the destination province share a stronger relationship compared to the relationship between migration flows and TGT in the origin province.

Model 4: Two-Step Time-Varying Fixed Effects Estimation

The results from Model 4 are presented in Table 12. Table 12 contains the results from the second step, regressing $\hat{F}_{it}$ and $\hat{F}_{jt}$ on the monadic variables of interest. There are two specifications for each dependent variable. Once again, the preferred specifications are presented under the first and third columns of Table 12. When the model only controls for the size of the province, the results from Specifications (1) and (3) suggest that TGT are negatively correlated with the province-time fixed effects. "Ln(RealGT_it)" and "Ln(RealGT_jt)" are found to be statistically significant at the 1% and 0.1% level respectively. The results from Specification (1) suggests that a 1% change in TGT in the origin province is associated with a 8.9% decrease in the origin-time fixed effects. The results from Specification (3) suggests that a 1% change in TGT in the destination province is associated with a 0.847% decrease in the destination-time fixed effects. In turn, these results suggest that gross migration and TGT are negatively correlated, which supports previous findings.

When additional covariates are added to the model, the results are conflicting in some cases. Under Specification (2), the “Ln(RealGT_it)” variable is found to be statistically significant at the 5% level. The positive sign of the coefficient could be due to the presence of multicollinearity. The signs of the employment rate and income variables are also counter-intuitive and contradict previous findings. In short, the output under specification (2) suggests that the results from specification (1) are not very robust.

Table 12: Two-Step Fixed Effects Estimation

VARIABLES	(1) $\hat{F}_{it}$	(2) $\hat{F}_{it}$	(3) $\hat{F}_{jt}$	(4) $\hat{F}_{jt}$
Ln(Pop_it)	1.311***	2.374***		
	(0.250)	(0.713)		
Ln(Emrate_it)		99.96**		
		(36.14)		
Ln(RealAftTaxInc_it)		3.015		
		(4.515)		
Ln(RealGT_it)	-8.941**	8.739*		
	(2.810)	(3.778)		
Ln(Pop_jt)			0.389***	0.322***
			(0.0134)	(0.0141)
Ln(Emrate_jt)				-3.737***
				(0.197)
Ln(RealAftTaxInc_jt)				-0.309***
				(0.0570)
Ln(RealGT_jt)			-0.847***	-1.456***
			(0.0243)	(0.0375)
Constant	51.48**	-566.2**	3.901***	29.95***
	(19.36)	(212.5)	(0.363)	(1.438)
Observations	3150	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

Specification (4) resutls indicate that "Ln(RealGT_jt)" is negatively correlated to $\hat{F}_{jt}$ and statistically significant at the 0.1% level. However, the signs of the coefficients associated with income and the employment rate also contradict previous findings. Despite these shortcomings, Specification (4) provides evidence that supports the claim that TGT in the destination province are negatively correlated with migration flows.

To summarize, the fourth model's results suggest that TGT and migration are negatively correlated. The model does not provide strong evidence to suggest that both TGT in the origin and destination province are negatively related to migration. When size, income, and labour market conditions variables are included in the model, only TGT in the destination province are found to be negatively correlated with migration.

8. Discussion

This section discusses the main findings derived from the previous section. It focuses on explaining results regarding the equalization payment and total government transfers variables from Model 3, the paper's preferred approach. Section 8.1 summarizes the main findings from the results of 7.1. Section 8.2 discusses the findings from Section 7.2's results. Section 8.2 discusses the limitations associated with my analysis.

8.1. Main Findings: Equalization Payments

All four models present evidence which suggest that equalization payments and gross migration are negatively correlated. Excluding Specification (2) in Model 4, the estimated coefficients associated with the various equalization payment variables are negative. Interestingly, as progressively more sophisticated methods of estimation were used, the magnitude of the coefficients associated with these same variables decrease (in absolute terms) and the statistical significance of origin province equalization payments variables diminished. For example, when the results under Specification (2) are compared between Model 1 and Model 3, the "ORI_Receiver_it" coefficient decreases to -0.044 from -0.876 and loses its statistical significance. This example illustrates the paper's first finding. The estimation of a non-structural gravity equation overstates the effect of equalization payment variables relative to estimating a structural gravity equation.

Moreover, when the results from specification (2) are compared between Model 1 and Model 3, the "DEST_Receiver_jt" coefficient decreases (in absolute terms) to -0.154 from -1.077. However, unlike "ORI_Receiver_it", it remains statistically significant at the 0.1% level. This example illustrates the paper's second finding regarding equalization payments. The estimation of a non-structural gravity equation overstates the statistical significance of equalization payments in the origin relative to the estimation of a structural gravity equation. If I suppose the existence of a causal relationship, the results from the structural gravity equation (Model 3 and Model 4) suggest that only equalization payments in the destination province help explain migration flows from i to j.

Finally, when the magnitude of the coefficients associated with equalization payments variables are compared to those associated with the control variables, it is evident that the magnitude of the equalization payments coefficients are relatively small. To illustrate this point, consider Specification (2) in Model 3. The receipt of equalization payments in the destination province is associated with 0.14% lower migration relative to a destination that does not receive equalization payments. This is a small effect compared to the change associated with a 1% increase in either provinces' population levels, distance, the employment rate ratio or the after-tax income ratio. This illustrates the paper's third main finding. Results from Model 3 suggest that equalization payments and migration share a relatively weak relationship compared to the relationship between migration and the standard gravity control variables.

In terms of policy implications, the third finding is the most interesting. If I suppose the existence of a causal relationship, the paper's findings imply that government policies that aim to change equalization payments in the hopes of influencing interprovincial migration would be relatively ineffective. Government policies that have an impact on provincial employment rates and after-tax income would be more effective approaches to stimulate interprovincial migration according to this paper's results.

8.2. Main Findings: Total Government Transfers

This section focuses on results obtained by including the total government transfers variable in all four gravity models. All four models present some evidence that suggests that TGT and gross migration are negatively correlated. Once again, Model 3 is identified as the preferred model. Since Specification (3) does not restrict "LnRealGT_it" and "LnRealGT_jt" to have the same coefficient, it is superior to Specification (2) in the first three models and is used to demonstrate the paper's main findings.

When comparing specification (3) across the first three models the magnitude of the "LnRealGT_it" and "LnRealGT_jt" coefficients decrease (in absolute terms) across models. For example, the coefficient associated with the "LnRealGT_it" variable is larger in Model 1 (-0.681) than it is in Model 2 (-0.396) and Model 3 (-0.109). The statistical significance of the variable also diminishes across the first 3 models. Under Model 4, when time-varying fixed effects and all other control origin and destination specific variables are added to the gravity equation, "LnRealGT_it" is not found to be statistically significant under Specification (2). These results suggest that non-structural models overestimate the coefficient and statistical significance of the TGT variables relative to the results obtained from estimating a structural gravity model.

Secondly, when the magnitude of the coefficients of the “LnRealGT_it” and “LnRealGT_jt” variables are compared, the coefficients associated with “LnRealGT_jt” are consistently larger across the first three models. Model 4 does not adhere to this pattern, but if we focus on the first three models, results suggest that non-structural gravity equations overstate the magnitude of the origin province TGT coefficients relative to their destination province counterparts. Interestingly, the “LnRealGT_it” variable is only found to be statistically significant at the 5% level under Model 3 rather than at the 0.1% level under Model 1 and Model 2. Unlike equalization payments, Model 3’s (with TGT) results suggest that both TGT in the origin and destination province matter. The “LnRealGT_it” and “LnRealGT_jt” variables are both negatively related to migration flows, but with varying degrees of statistical significance. The relationship between migration flows and TGT in the destination province appears to be stronger relative to the relationship between migration flows and TGT in the origin province.

Lastly, similar to the coefficients associated with the equalization payments variables, the coefficient associated with TGT variables are small relative to the estimated coefficients of the control variables in the gravity models. Based on Model 3’s Specification (3), a 1% change in TGT in the destination province is associated with a -0.39% change in migration and a 1% change in TGT in the origin province is associated with a -0.11% change in migration. These are small changes compared to a 1% increase in either provinces’ population levels, distance, the employment rate ratio or the after-tax income ratio. Results from Model 3 suggest that TGT and migration share a relatively weak relationship compared to relationship between migration and the control variables.

As mentioned before, this paper is limited to discussing correlation as it does not produce sufficient evidence to establish a causal link between the variables of interest and gross migration. If I suppose the existence of a causal link and assume that TGT is a determinant of migration, then it is possible to discuss the implication of these results on public policy. The existence of a causal relationship of this nature would imply that TGT inhibits migration. To encourage individuals to migrate from province *i* to province *j*, the government could reduce TGT. Courchene (1970) reached a similar conclusion regarding employment insurance benefits and TGT in his paper.

To summarise, the paper's most important finding is that all four models suggest that migration and TGT are negatively correlated as well as migration and equalization payments. Results from the first three models suggest that gross migration is more sensitive to changes in the destination province's level of total government transfers and equalization payments. Once again, results suggests that government policies that have an impact on provincial employment rates and after-tax income would be more effective approaches to stimulate interprovincial migration.

9. Conclusion

This paper used a gravity model framework to estimate the relationship between interprovincial migration and equalization payments and the relationship between interprovincial migration and median total government transfer to persons. The paper's main contribution is the inclusion of a new variable, equalization payments, that previous studies using a gravity framework to study interprovincial migration did not include in their analysis. The paper utilized structural gravity models to study the relationship between migration and equalization payments and introduced a two-step estimation method, which had not been prominently featured in gravity studies of migration in Canada. The paper presented the following findings.

The results from the two theoretically-consistent gravity models provided evidence to suggest that equalization payments and migration flows are negatively correlated. The size of the estimated coefficients associated with the destination province were found to be consistently larger than those associated with the origin province. The results from Model 3 indicated that migration from *i* to *j* was more sensitive to changes in the equalization payment status of province *j*. However, when compared to other variables, the magnitude of the equalization payment coefficients was found to be relatively small. The magnitude of the other demographic, geographic and economic variables were consistently larger. These results suggested that, although statistically significant, equalization payments have a very limited relationship with migration given the size of the estimated coefficients. This is similar to the conclusion reached by Day and Winer (2006).

As well as examining the relationship between equalization payments and migration flows, the paper also studies the relationship between median total government transfers to persons and interprovincial migration. This study demonstrates that TGT and migration are negatively correlated. The results from the two-way time-invariant regression indicate that the "Ln(RealGT_it)" and "Ln(RealGT_jt)" variables are found to be statistically significant at the 5% and 0.1% level respectively. However, as was the case with equalization payments, the estimated coefficents of the TGT variables are small relative to the magnitude of the coefficients associated with the other demographic, geographic and economic variables in the study.

One of the paper's limitations was that it did not establish a causal link between equalization payment and migration flows or TGT and migration flows. However, if TGT and equalization payments are believed to be determinants of migration based the results from past studies, the results from this paper suggest that these types of government transfers inhibit migration. Another weakness lies in the ambiguity of our results regarding the control variables. The variability in the statistical significance of the employment rate and after-tax income variables raised many issues during the analysis. Unlike the results in previous studies, our paper did not consistently find these variables to be statistically significant even under the preferred model. This paper argued that this flaw may have been due to the presence of strong multicollinearity between the variables of interest and the remaining control variables. It addressed the issue in section 7.2 by excluding the employment rate variable from the analysis.

Future studies should focus on examining causal links between government transfers and migration flows to determine if transfer policies could have a significant impact on migration. Future studies should also utilize two-step regression when appropriate as it captures the time-varying effect of the MRTs. The results from two-step regression in this paper provided additional evidence to suggest that TGT and equalization payments in the destination province are negatively correlated with migration. This paper encourages future studies to make use of this model when examining region time-varying specific characteristics.

Appendix

Table 13: Supplemental TGT Estimation Results

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES			LnGrossMig_ijt			
Ln(Dist_ij)	-0.542***	-0.681***	-0.892***	-0.799***	-0.940***	-0.940***
	(-18.80)	(-30.84)	(-35.13)	(-34.65)	(-75.67)	(-76.21)
Ln(Pop_it)	0.763***	0.568***	0.663***	0.574***	0.760***	0.760***
	(43.65)	(34.67)	(42.10)	(35.67)	(6.87)	(7.03)
Ln(Pop_jt)	0.711***	0.515***	0.610***	0.521***	0.658***	0.658***
	(41.57)	(32.99)	(40.15)	(33.93)	(5.74)	(5.90)
Ln(RatioInc_jit)	0.307	0.307	0.295	0.295	0.196	0.196
	(1.46)	(1.76)	(1.54)	(1.68)	(1.34)	(1.35)
Ajacent_ij	0.220**	0.0836	-0.107*	-0.0249	0.0692**	0.0692**
	(3.24)	(1.89)	(-2.05)	(-0.56)	(2.74)	(2.76)
LnRatioGT_jit	-0.0992**		-0.119**		-0.212***	
	(-3.07)		(-2.98)		(-5.37)	
LnRealGT_it		-0.658***		-0.442***		-0.0824
		(-18.00)		(-9.01)		(-1.67)
LnRealGT_jt		-0.856***		-0.680***		-0.506***
		(-24.25)		(-14.34)		(-9.43)
LnREMpop_it			0.700***	0.322***		
			(21.86)	(9.04)		
LnREMpop_jt			0.649***	0.272***		
			(20.16)	(7.70)		
Constant	-9.382***	10.25***	-22.13***	-0.451	-4.887	-0.0504
	(-32.90)	(17.36)	(-48.48)	(-0.39)	(-1.90)	(-0.02)
Observations	3150	3150	3150	3150	3150	3150

Robust standard errors in parentheses

* p<0.05 ** p<0.01 *** p<0.001

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