The Determinants of Gross Interprovincial Migration In Canada

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Table of Contents

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Abstract

This paper investigates the labour market determinants of Canadian interprovincial migration within the context of the gravity model of migration. Questions are also raised about whether a lagged dependent variable model estimated by the generalized method of moments (GMM) is an improvement when compared to the traditional linear models estimated via pooled least squares (PLS). The results indicate that provincial population size, labour productivity, provincial unemployment and the combined federal-provincial personal income tax rate are all strong determinants of gross interprovincial migration flows. Moreover, internal migration seems to be influenced more strongly by push factors of migration and low incomes in the province of origin can have both the effect of increasing or decreasing out-migration. The lagged dependent variable model has performed well and suggests that interprovincial migration does behave in a dynamic manner.

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The Determinants of Gross Interprovincial Migration in Canada

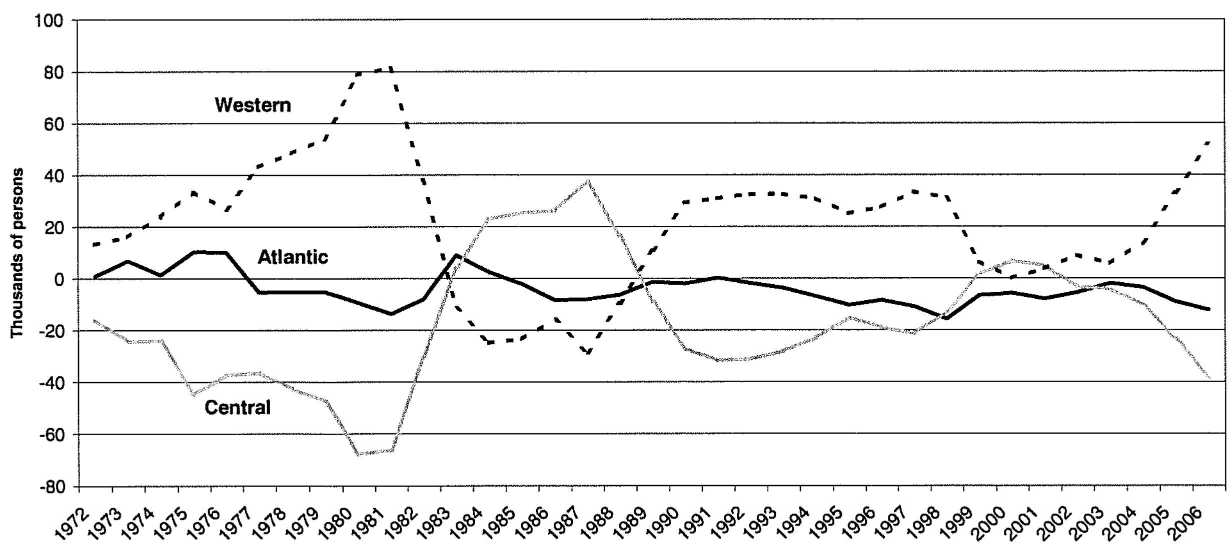
1 Introduction

Canada is a federation composed of diverse geographic, political and economic regions. Every year, thousands of Canadians migrate from province to province for many reasons. There is no doubt that interprovincial migration will affect provincial population growth and regional demographic compositions. However, migration also leads to a host of economic consequences for issues of resource allocation, income disparities and macroeconomic adjustments (Courchene 1970; Coulombe 2006). It is for these reasons that Canadian researchers and policy makers have long had an interest in identifying and measuring the determinants of interprovincial migration.

Economic theory would suggest that the principal factors in the decision to migrate are economic factors related to job market opportunities. To bring this theory into evidence, let us analyse a simple graph outlining the trends in net interprovincial migration patterns across the country (Chart 1).

In times where the oil industry is booming, such as the early 1970s and early 2000s, net migration to the Western region of Canada is almost always positive and rising while net migration from the Central and Atlantic regions is negative and falling. This would indeed suggest that individuals choose to migrate for economic reasons, displacing themselves from the Atlantic and Central regions, when job growth and wages may be particularly depressed, to the Western region of the country where oil booms are always followed by periods of high job and wage growth. This hypothesis is indeed worth investigating so that provincial and federal policy makers can better anticipate migration flows and take them into account when conducting policy analysis. This is especially of great concern when one thinks of the labour market impact that migration may have on wages and unemployment rates of both the sending and receiving regions and in turn on future migration patterns. Moreover, if interprovincial migration takes place within a particular industry, the regional labour force's skills composition may also be impacted affecting employees, employers, government training programs and new graduates trying to enter a particular field of work. Whether or not the migrant population is composed mainly of families who relocate together or single individuals, the impact of migration will have different consequences in terms of adjustment in aggregate demand for public goods such as education and health care (Finnie 1999).

Chart 1
Net Interprovincial Migration by Provincial Groupings, 1972 to 2006



Source: Statistics Canada's CANSIM II table 051-004. The Atlantic Provinces include Newfoundland, PEI, Nova Scotia and New Brunswick; the Central Provinces include Quebec, Ontario and Manitoba; and the Western Provinces include Saskatchewan, Alberta and British Columbia.

In this paper, we will identify and estimate the labour market determinants of Canadian interprovincial migration. In addition, we will also consider whether the migration process can be better explained by a lagged dependent variable model, when compared to the traditional linear specification. We will be working in the framework of the gravity model of interprovincial migration, discussing some of the econometric problems and techniques particular to such models. The contribution of this paper is the use of a gross approach to the empirical study of migration. Other studies investigating the determinants of gross flows are Courchene (1970), Vanderkamp (1971; 1977), Shaw (1986), and Day (1992). Studies, like those of Foot and Milne (1984), and Coulombe (2006), have focused on the net approach of measuring migration flows. Data on gross interprovincial migration and its determinants was collected from the Statistics Canada CANSIM II database for the 1981 to 2005 period.

After testing different specifications of the gravity model of migration our findings indicate that the lagged dependent variable has been found to be quite significant and has greatly improved the overall results of the model. This suggests that previous period migration flows do have positive effects on future migration. We hypothesise that this is because migration in previous years facilitates the feedback of information to the province of origin thus lowering the cost of information about labour market opportunities for future migrants.

The remainder of this paper will be organized as follows. Section 2 will discuss the relevant literature on Canadian studies of interprovincial migration with a particular focus on economic gravity models and econometric modeling issues; Section 3 will consider theoretical, specification, and data issues. In particular we will establish all the relevant assumptions about our variables and compare different theoretical specifications of interprovincial migration, all while noting the problems and limitations of each specification; Section 4 will describe and analyse the results obtained from our three estimated models of interprovincial migration. Finally, Section 5 will summarize our work and close with concluding remarks.

2 Literature Review

There are different perspectives from which labour force or population migration can be viewed. Some consider migration as a form of human capital investment (Sjaastad 1962). In this case the costs of investment include the present value of any foregone earnings as well as the monetary and non-monetary costs of relocation. The benefit is the discounted value of future earnings arising from migration. As with any investment decision, an individual or family will choose to relocate as long as the present value of the migration decision exceeds its costs.

Alternatively, we can think about individuals as suppliers of labour and, it follows that we can consider labour as a mobile factor of production. In this case, the migration process becomes a mechanism through which factors seek out economic opportunities yielding larger returns (Courchene 1970). Migration will still involve direct monetary and non-monetary costs but the benefits of migration are measured as the differential returns between various labour market opportunities. Individuals and families will decide to migrate as long as the benefits of doing so exceed the costs.

Regardless of the theoretical perspective one wishes to adopt, it is clear that migration decisions will largely be influenced by labour market conditions and opportunities such as regional income and/or real wages and the probability of finding employment as measured by the regional unemployment rate. In addition, the decision to migrate will follow from some form of cost-benefit analysis on behalf of the potential migrant. Empirical findings have long confirmed that Canadian interprovincial migration is negatively related to the income of the sending province, positively related to the income of the receiving province, and negatively related to the distance between the two provinces (Courchene 1970; Vanderkamp 1971; Foot and Milne 1984). However, there is mixed evidence for the effects of the unemployment rate. Some have found that migration flows are positively related to the unemployment rate of the sending province and negatively related to the unemployment rate of the receiving regions (Courchene 1970, Foot and Milne 1984; Coulombe 2006) but others have found the unemployment rate of the province of origin to be insignificant (Shaw 1986).

In the earlier years of research on labour force and population migration, the main sources of data available were population censuses. In particular, Courchene (1970) used data from the 1961 Census of Canada on gross interprovincial migration between each province, providing him with 90 cross-sectional observations. He tests 14 hypotheses about labour force migration and finds most of them to be strongly confirmed. However, purely cross-sectional studies of migration are not ideal because they cannot account for temporal shocks or dynamic changes in variables over time.

Canadian panel studies of migration began to emerge as data from the Family Allowance recipients' database became available to researchers (Courchene 1970; Vanderkamp 1971; Foot and Milne 1984). Since Family Allowance payments were made monthly, this created a database with monthly information on the migration behaviour of Canadian families with children. These panel models of migration often include various combinations of explanatory variables such as the distance between the sending and receiving regions, different measures of income[1], and the unemployment rate. Regional dummies and time dummies have also been introduced to control for assumed regional or temporal shocks. In general, these models have performed well, producing statistically significant coefficients with the expected signs.

[1] Courchene (1970) uses earned income per employed person for both the sending and receiving regions, Vanderkamp (1971) includes income of both the sending and receiving regions each divided by the distance between these regions and Foot and Milne (1984) prefer to include the real wage rate of both the sending and receiving regions.

The increased use of panel regression studies have also allowed for the analysis of the dynamics of interprovincial migration. For example, Courchene (1970) ran a series of cross-sectional regressions for each year from 1952 to 1967 and notes that, in absolute value, the coefficients on both income variables are increasing over time, while the coefficient on the distance variable is decreasing over time. Shaw (1986) provides an explanation for this occurrence arguing that, as countries or individuals gain wealth over time and as technological advancements are made in the fields of telecommunications and transport, the monetary and psychological costs of relocation for a given distance is expected to decrease over time.

Subsequent to the availability of panel data, micro data became available and allowed for longitudinal studies of migration. Longitudinal analyses have helped in controlling for selection bias in migration patterns and in identifying the individual characteristics of the migrant population. Finnie (1999) has found that for men, migration is linked with higher initial income levels and, especially for younger men, often results in considerable income gains. For women, there is no evidence of a relationship between initial income levels and migration often results in income losses rather than gains.

There also exists a large Canadian literature on the influence of fiscal and public policy variables on internal migration patterns and the consequences for the efficient allocation of resources across the federation. Boadway and Flatters (1982) developed a theoretical model of policy-induced migration arguing that if fiscal capacity across provinces is not equalized through transfer payments, migration will result from rent-seeking behaviour on the part of labour and the economy will suffer from an inefficient allocation of resources. Their paper was indeed an important contribution to the literature. On the empirical side, it has been found that public policy variables that account for conditions in the province of origin, such as intergovernmental transfers and the generosity of employment insurance programs, are deterrents to out-migration and may also have a negative effect on the efficient allocation of resources within a federation (Courchene 1970; Day 1992). Shaw (1986) compares the relative impact of what he calls traditional economic variables to that of fiscal policy variables. From his findings, he concludes that, over time Canadian fiscal variables have become more important determinants of migration relative to the traditional labour market and economic determinants of migration. Day and Winer (1994) conduct a review of Canadian empirical research related to internal migration and public policy. They report compelling evidence that policy-induced migration exists within Canadian borders and the impacts of such migration are most strongly felt on provincial unemployment rates.

Canadian researchers have also taken interest in the macroeconomic determinants and consequences of interprovincial migration. Some studies have found that interprovincial migration tends to react to provincial business cycles in a pro-cyclical manner (Milne 1993). However, there is also evidence that long-term provincial economic growth is a much stronger determinant of interprovincial migration (Coulombe 2006). Moreover, there are indications that in-migration into a certain region has a small negative effect on wage growth and a positive effect on unemployment while out-migration seems to have no significant effect on wages and a negative effect on unemployment (Wrage 1981).

The literature on migration also includes gravity-type models of migration (Vanderkamp 1976 and 1977; Foot and Milne 1984, Helliwell 1997). Gravity models are based on the Newtonian physics theory that the attraction between two objects is directly related to their masses and inversely related to the distance separating them. Gravity models have had much success in the economic literature to explain the movement of goods and services within the context of international and interprovincial trade, communications, and transport (McCallum 1995; Helliwell 1997; Coulombe 2002). It is therefore not surprising that such models have also been employed to explain the movement of people and workers.

Within the framework of the gravity model of interprovincial migration, the dependent variable is always characterized by the dimensions *ij,t*; meaning that the dependent variable is measured as the *gross* migration from region *i* to region *j* at time *t*. Distance is usually measured as the distance between capital cities or main cities. However, a more modern econometric approach is that of estimating distances using the "fixed-effects" approach. As for a measure of the mass of an object, provincial population is the most widely used measure. Still, much disagreement remains among researchers about the specification of provincial population variables within migration models. For example, some enter the population variables of the sending and receiving regions as two separate linear explanatory variables (Foot and Milne 1984; Helliwell 1997). Other researchers linearly enter the product of the sending and receiving provinces' population variables in the specification (Vanderkamp 1977).

Population (in some form) may also be used to normalize the dependent variable as a gross provincial migration *rate*. Again a number of researchers argue that only the population of the sending region should be used to normalize the dependent variable while others have argued that it is the product of the sending and receiving regions' populations that should be used (Vanderkamp 1976). The question of the specification of the population variables is such a debated issue that Vanderkamp's 1976 work "The Role of Population Size in Migration Studies" is dedicated to this one question alone.

With the increased use of gravity models in economics and the availability of time-series cross-section data, many researchers have shifted their focus particularly to the issues of model specification and econometric estimation techniques. More precisely, it was recognized that with the use of panel data there might exist a problem of heterogeneity within both the time-series and the cross-section dimensions. However, research pertaining to model specification and testing has been carried out mostly in the context of gravity models of international and interprovincial trade (Matyas 1997and 1998; Cheng and Wall 2005). Even so, many of the econometric techniques are still valid within the framework of models of internal migration and recently researchers have adapted these techniques to their migration models (Coulombe 2006).

To address the problem of heterogeneity within migration models, the fixed-effect (FE) or least squares dummy variables (LSDV) model has been increasingly adopted. But, researchers still disagree on the manner in which the cross-sectional FEs should enter gravity models for estimation. For example, in their papers on interprovincial and international trade, Matyas (1997, 1998) proposes a specification with separate FEs for the sending region (i) and the receiving region (j) while Cheng and Wall (2005) argue for a specification in which each regional trading pair (every ij where $i \neq j$) has a unique FE. Other methods for handling FEs have also been proposed. Glick and Rose (2001) propose the same FE model of trade as Chen and Wall, with the only difference being the added restriction that the FEs must be symmetric (FEij = Feji) while Bayoumi and Eichengreen (1997) opt for a trade model in first difference form so as to simply subtract-out any cross-sectional heterogeneity.

As for econometric matters pertaining to the measurement of distance between the sending and receiving regions Cheng and Wall (2005) argue that following the common practice of including the measured distance between the capitals or major cities might overstate or understate the actual trading distance since the flows of goods (or in our case, people) is never uniquely between these two points. Therefore, rather than explicitly including a measure of distance, Chen and Wall argue that it is better to omit the distance variable and estimate it, along with other time-invariant effects, via their proposed pairwise FE approach.

Time dummies have also often been included in gravity models of trade and migration to control for various temporal shocks. In his migration model based on the family allowance database, Courchene (1970) creates an interactive time dummy variable that takes the value of one for the 1952 to 1959 period and zero for the 1960 to 1970 period. This interactive time dummy variable is used to isolate the temporal impact of income and distance over time. He finds that in the latter period there is evidence of an increased response of migration to the income differential and a decreased negative effect of distance. In many gravity models of trade, researchers have created time dummies for every period to control for common business cycle effects throughout time (Maytas 1997, 1998; Bayoumi and Eichengreen 1997; Glick and Rose 2001; Cheng and Wall 2005). An alternative approach, which is equivalent to entering time dummies in the specification, is to transform the variables in deviation from the cross-sectional mean (Coulombe 2006).

However, the linear gravity models of migration, such as those adopted by Courchene (1970), Vanderkamp (1971), Foot and Milne (1984), are not without limitations. Many researchers have adopted a log-linear gravity model to allow for non-linear effects in the determinants of migration (Courchene 1970; Helliwell 1997; Coulombe 2006; for migration and McCallum 1995; Cheng and Wall 2005; for trade). Another weakness of both linear and log-linear models is that they only take into account the characteristics of the sending and receiving provinces, ignoring all other options available to the migrant. This has been recognised by researchers who have adopted the multinomial logit (MNL) model (Shaw 1986; Day 1992; Day and Winer 1994). Contrary to the linear and log-linear models, the MNL model does take into account the characteristics of all options available to the migrant thus allowing the researcher to measure the *probability* of migration from region *i* to *j* (Day and Winer 1994).

3 Theory and Methodology

As was discussed earlier, panel data are very useful in the study of interprovincial and international migration because they extract information from both the temporal and cross-sectional dimensions. Despite its limitations, we opted to build a linear gravity model of interprovincial migration because gravity-type models are widely used in the economic literature and are known to have had much success in explaining the flows of goods, services and people between regions. Our paper has largely been inspired by the theoretical assumptions and methodologies of Courchene (1970), Cheng and Wall (2005) and Coulombe (2006).

3.1 Theoretical Assumptions: The Gravity Model of Migration

As our dependent variable, we chose to explain gross interprovincial migration flows from province *i* to province *j* between the ten Canadian provinces. The territories were excluded from the analysis because of the additional complexities arising from their inclusion. Although migration to and from the territories will often be driven by the same economic variables that explain migration between the provinces, other circumstances also greatly vary. The territories are characterized by a vast landscape with sparse population density and a harsh climate. In-migrants to the territories are often forced to migrate because of their particular choice of occupation and can be offered compensating wage differentials based on the fact that they are obligated to be stationed in a remote location for employment. Furthermore, many who migrate to the territories are temporary migrants, with prior knowledge that relocation is temporary. Therefore, to avoid the complications brought about by the particularities of migration patterns between the provinces and territories, the territories were excluded from the analysis.

When choosing our exogenous variables, we included the necessary "gravity" variables; distance between the origin and destination province as well as the total population of both provinces. Within the context of interprovincial migration, the population of the province of origin usually represents a pool of potential migrants. Thus we would assume that the size of the sending province in terms of population would have a positive impact on migration from province i to j (Foot and Milne 1984, p. 122). The population of the receiving province on the other hand can be a representation of the size of the labour market and hence of the potential for job opportunities. Under this assumption, we would expect that the size of the receiving province would also have a positive impact on migration from i to j. However, as mentioned by Foot and Milne (1984), if we hypothesise that a populous destination may be of less attraction to potential migrants, the opposite would be true. Therefore, the net impact of the destination province's population may have an ambiguous effect on the dependent variable.

The distance between the sending and receiving provinces is used as a proxy measure of the costs of migration. This is because as distance increases, it follows that the monetary costs of migration will increase in terms of the travel and accommodation costs of relocating. It is also believed that the further individuals are from a given job market the more costly is it to gain information about potential employment opportunities in the destination province. And finally, many researchers also argue that migration across larger distances also generates larger psychological and emotional costs resulting from the uncertainty of relocation and the separation from friends and loved ones (Sjaastad 1962; Foot and Milne 1984; Shaw 1986). Therefore, we assume that our distance variable will have a negative impact on interprovincial migration.

Economic theory suggests that the provincial income differential Y_j/Y_i is a strong determinant of migration (Y_j being the income per employed person in the receiving province and Y_i income per employed person of the sending province). For our income variable we chose to use labour productivity which, following Coulombe's (2006) definition, we calculated as gross domestic product (GDP) divided by employment. As long as workers are paid accordingly to their marginal productivity, increased labour productivity is tantamount to higher real wages and income. Assuming that migrants seek to improve their economic returns, it logically follows that they will relocate to places where their expected wage rate is larger. Hence, we presume that a higher labour productivity ratio Y_j/Y_i will increase migration from the province of origin to the destination province.

However, Courchene (1970) and Vanderkamp (1971) report that there is significant evidence to include the income variables separately in the regression equation. This is because the income of the sending region is also an important determinant of migration in the sense that income is needed for migration to be a financially feasible option. In other words, although a low-income region may provide incentive to migrate to a high-income region, the low income levels may not make it possible for an individual or family to bear the monetary costs of relocating. As a result, large income differentials at low levels of Y_i will not have the same impact on migration as large income differentials at higher levels of Y_i. Courchene (1970) therefore argues for the income variables for each province to enter the specification independently. He also adds that the Y_j variable will have a positive effect on migration from i to j while the Y_i variable will have a negative effect on migration from i to j. Furthermore, the coefficient on the Y_j variable should be larger in absolute value, than the coefficient of the Y_i variable. Hence, we will follow Courchene's argument and specify our labour productivity variables independently.

Income, however, is not the only determinant of an individual's expected wage rate. The probability of obtaining employment will also have an impact on the individual's expected income. Thus, the unemployment rate is almost always included in any economic model of migration as an explanatory variable (Courchene 1970; Foot and Milne 1984; Coulombe 2006). We will therefore assume that a high unemployment rate in the province of origin will increase out-migration while a high unemployment rate in the destination province will inhibit out-migration. However, as mentioned earlier, the empirical evidence is mixed with some finding that the unemployment rate of the sending province is not statistically significant (Shaw 1986).

Finally, considering the empirical success of fiscal public policy variables (Day and Winer 1994), we decided to include the combined provincial-federal personal tax rate as an explanatory variable in our models. This variable was chosen because of its complementarities with the labour productivity and unemployment variables. As much as labour productivity and unemployment are good estimates of expected incomes in each province, it is clear that, if we assume individuals behave in a utility maximizing manner, migration decisions will be based on expected personal *disposable income*. Therefore we opted to include the personal tax rate to account for this behaviour in our migration equation. The personal tax rate variable was calculated following Day's (1992) definition as:

$$\text{personal tax rate} = 1 - \left(\frac{\text{personal disposable income}}{\text{personal income}} \right) \quad (1)$$

Although Day (1992) uses the tax rate implicitly within a MNL model to adjust her wage and income variables, it is only logical that, all else being equal, the tax rate should have its own influence on migration decisions in our model. Therefore, we anticipate that a high tax rate in the province of origin will have a positive effect on out-migration while a high tax rate in the destination province will have a negative effect on out-migration from the province of origin. However, if high tax rates in the destination province are used to finance high transfer payments, this may actually be desirable to potential migrants thus increasing out-migration from the province of origin.

3.2 Specification and Other Econometric Issues

Because migration data compiled by Statistics Canada represents migration from July to June of the following year, it is wise to lag the explanatory variables. Lagging the explanatory variables also controls for the fact that the decision to migrate is often taken a certain amount of time before the actual migration process (Coulombe 2006). For our functional form, we have chosen to use a basic linear specification of the gravity model of migration. Although some researchers argue that the log-linear form is superior in that it allows for non-linear relationships between the variables, for our purpose the linear form will suffice to investigate the basic relationship between the labour market determinants of migration and their significance in the determination of gross migration flows. Furthermore, a MacKinnon, White, and Davidson (MWD) test for choosing between the linear and log linear form was also conducted. Details and the results of the test are presented in section 4.1.

Our analysis started out with a basic linear gravity specification of interprovincial migration to be estimated by pooled least squares (PLS) using time-series and cross-section (TSCS) data in the *ij,t* dimension during the 1981 to 2005 period:

$$\begin{aligned} MIG_{ij,t} = {} & \alpha_1 + \alpha_2 D_{ij} + \beta_1 POP_{i,t-1} + \beta_2 POP_{j,t-1} + \beta_3 Y_{i,t-1} + \beta_4 Y_{j,t-1} + \beta_5 UR_{i,t-1} + \beta_6 UR_{j,t-1} \\ & + \beta_7 TR_{i,t-1} + \beta_8 TR_{j,t-1} + \varepsilon_{ij,t} \end{aligned} \quad (2)$$

$MIG_{ij,t}$ is gross population migration from province i to province j at time t;

α_1 is the common intercept term;

D_{ij} is the distance between province i and j;

$POP_{i,t\text{-}1}$ (and $POP_{j,t\text{-}1}$) represents the total population of the province of origin i (and destination j) at time t-1;

$UR_{i,t\text{-}1}$ (and $UR_{j,t\text{-}1}$) represents the unemployment rate in the province i (and j) at time t-1;

$Y_{i,t\text{-}1}$ (and $Y_{j,t\text{-}1}$) represents labour productivity in province i (and j);

$TR_{i,t\text{-}1}$ (and $TR_{j,t\text{-}1}$) represents an estimation of the provincial personal income tax rate in province i (and j); and

$\varepsilon_{ij,t}$ is the error term

Further examination of economic theory lead us to believe that we may be able to assume the existence of unobservable fixed-effects both within the cross-sectional and temporal dimensions. This would imply that the error term takes the following form:

$$\varepsilon_{ij,t} = \mu_{ij} + \lambda_t + v_{ij,t} \qquad (3)$$

where μ_{ij} represents the unobservable cross-sectional effects that do not vary across periods and λ_t represents a time effect that does not vary across provinces and $v_{ij,t}$ is the true error term (Baltagi 2003).

In our case, cross-sectional effects include variables that are often difficult to observe or quantify such as language, cultural and political differences. A clear example of cross-sectional fixed effects within our data is the dominance of the French language in the province of Quebec. The fact that Quebec is a French language province creates a barrier to in-migration from the rest of Canada, which is mainly Anglophone. In addition, during the 1976 to 1981 period, there was a large amount of emigration of English Canadians from Quebec following the election of a government committed to gaining Quebec's political sovereignty (Grenier 1987). This language barrier to migration is also evident from the fact that, throughout our entire sample, Quebec has negative levels of net in-migration. Therefore, it is necessary to control for the language barrier and other cross-sectional effects by either a first-difference transformation or by the introduction of cross-section dummies. Without such a correction, our results would be biased, attributing the low levels of gross migration from all other provinces to Quebec to our explanatory variables when in reality factors such as language and the political environment are responsible. The method we used to correct for the cross-sectional effects is the FE method of Cheng and Wall (2005) where each provincial pair *ij* has its own FE. We therefore proceed to eliminate distance from the equation, because it is a time-invariant cross-sectional effect, and hence perfectly collinear with the fixed provincial pair effects.

Period effects are those that are specific to a period but common to all provinces. Within our data, the recessions of the early 1980s and early 1990s are examples of period effects since they are particular to certain periods but affect all provinces. Again, if we do not somehow correct for common temporal shocks, our results will be biased, wrongly attributing these effects to our explanatory variables. We correct for period effects by transforming the data into deviations from the cross-sectional mean, as was done by Coulombe (2006). The result of the FE method is that the μ_{ij} and the λ_t component of the error term, represented by equation (3), are controlled for, thus eliminating the problem of heterogeneity and leaving us with the true error term $v_{ij,t}$ and the following specification where all variables are now expressed in deviation from the cross-sectional mean:

$$MIG_{ij,t} = \Sigma\alpha_{ij}FE_{ij} + \beta_1 POP_{i,t-1} + \beta_2 POP_{j,t-1} + \beta_3 Y_{i,t-1} + \beta_4 Y_{j,t-1} + \beta_5 UR_{i,t-1} + \beta_6 UR_{j,t-1} + \beta_7 TR_{i,t-1} + \beta_8 TR_{j,t-1} + v_{ij,t} \quad (4)$$

However, the above specification is still lacking a very important piece of information. Greenwood (1985) reports that "If a certain destination is judged preferable by an individual or group that subsequently moves to it, a conduit for the flow of information back to the origin is established. This conduit reduces the cost of information concerning the alternative and may reduce the uncertainty of moving to it for those who remain in it" (p. 535). We can also recall the reasoning of Shaw (1986) who argues that as countries or individuals gain wealth over time and as technological advancements are made in the fields of telecommunications and transport, the monetary and psychological costs of relocation for a given distance is expected to decrease over time. In other words, as people migrate from region i to j, they may remain in contact with friends and family, providing increased information about job market opportunities for potential future migrants from i to j and thus reducing the job search costs implied by the migration distance. In addition, for an individual or family contemplating migration, the prospect of an already established social network may also be very appealing and could reduce the psychological and emotional costs sometimes associated with migration. These hypotheses may also be much more relevant in recent years, given the increased use of the Internet and online social networks which make it easier for people to stay in-touch, despite the distance that separates them.

In line with the previous discussion, we include an additional assumption about the model. We assumed that migration is a dynamic process by which migration from province i to province j at time t is dependent on migration from province i to j at time t-1. In order to model and estimate this dynamic behaviour of migration, we include the lagged dependent variable in the model. In estimation, the lagged dependent variable was found to be highly significant. The resulting specification is the following:

$$MIG_{ij,t} = \Sigma\alpha_{ij}FE_{ij} + \alpha_2 MIG_{ij,t-1} + \beta_1 POP_{i,t-1} + \beta_2 POP_{j,t-1} + \beta_3 Y_{i,t-1} + \beta_4 Y_{j,t-1} + \beta_5 UR_{i,t-1} + \beta_6 UR_{j,t-1} + \beta_7 TR_{i,t-1} + \beta_8 TR_{j,t-1} + v_{ij,t} \quad (5)$$

It is very important to note however, that estimation of the above specification by the commonly used PLS method is problematic. Even after the heterogeneity within the cross-sectional and the temporal dimensions has been corrected for through transformations and dummy variables, the inclusion of a lagged dependent variable can raise additional problems. This is because there still exists correlation between the lagged dependent variable $MIG_{ij,t-1}$ and the error term $v_{ij,t}$. As discussed and Baltagi (2003), when using a lagged dependent variable model, if the number of time series observations is relatively large compared to the number of cross-sectional observations, estimation by the FE method will return consistent estimators. However, whenever the numbers of time series observations are small, estimation by FE may return biased and inconsistent results. Unfortunately there is no exact definition of what is considered a small number of time series observations. In our case we have 90 cross-section observations and 25 time series observations. Some might argue that 25 time series observations is considered large rather than small. Nonetheless, we shall anticipate that the FE estimator may be biased, and correct for this potential problem by estimating an additional equation with the generalized method of moments (GMM) estimation technique proposed by Arellano and Bond (1991).

3.3 The Generalized Method of Moments (GMM)

The GMM estimation technique is an extension of the simple method of moments (MOM) estimation technique. GMM estimators are a broad class of estimators. For example, more commonly used estimators such as PLS and the instrumental variables (IV) are actually considered to be special cases of GMM. GMM estimators are also known to have desirable large sample properties.

The GMM estimator proposed by Arellano and Bond (1991) does not involve the estimation of cross-sectional FEs as did our previous model. The alternative method used to correct for the cross-sectional effects is a first-difference transformation of the data, thus eliminating the provincial pair FEs and the μ_{ij} component of the error term. The period FEs can be estimated directly using period dummies. The final specification used, is the following:

$$\begin{aligned}\Delta MIG_{ij,t} = \Sigma\alpha_t FE_t + \alpha_2 \Delta MIG_{ij,t-1} + \beta_1 \Delta POP_{i,t} + \beta_2 \Delta POP_{j,t} + \beta_3 \Delta Y_{i,t} + \beta_4 \Delta Y_{j,t} \\ + \beta_5 \Delta UR_{i,t} + \beta_6 \Delta UR_{j,t} + \beta_7 \Delta TR_{i,t} + \beta_8 \Delta TR_{j,t} + \Delta v_{ij,t}\end{aligned} \quad (6)$$

All variables are first differences. Let us examine more closely the relationship between the dependent variable, the lagged dependent variable and the error term, in the manner done by Baltagi (2003). Ignoring the FE and all other explanatory variables we have the following relationship:

$$\left(MIG_{ij,t} - MIG_{ij,t-1}\right) = \alpha\left(MIG_{ij,t-1} - MIG_{ij,t-2}\right) + \left(v_{ij,t} - v_{ij,t-1}\right) \quad (7)$$

Clearly ($MIG_{ij,t-1}$ – $MIG_{ij,t-2}$) is still correlated with the error term because of the common t-1 observation. Therefore, it is necessary to estimate α through the use of an instrumental variable. At the first period, t=3 we will have:

$$\left(MIG_{ij,3} - MIG_{ij,2}\right) = \alpha\left(MIG_{ij,2} - MIG_{ij,1}\right) + \left(v_{ij,3} - v_{ij,2}\right) \quad (8)$$

At t=3, $MIG_{ij,1}$ becomes a valid instrument for ($MIG_{ij,2}$ – $MIG_{ij,1}$) because it is not correlated with the error term. Similarly when t=4 we have:

$$\left(MIG_{ij,4} - MIG_{ij,3}\right) = \alpha\left(MIG_{ij,3} - MIG_{ij,2}\right) + \left(v_{ij,4} - v_{ij,3}\right) \qquad (9)$$

In this case, $MIG_{ij,1}$ and $MIG_{ij,2}$ are both valid instruments for $(MIG_{ij,3} - MIG_{ij,2})$ since neither are correlated with the error term. And it follows from this logic that when $t=T$, then $(MIG_{ij,1}$, $MIG_{ij,2}$, ... , $MIG_{ij,T\text{-}2})$ represents a set of valid instruments. This is the dynamic IV technique proposed by Arellano and Bond (1991) and is the estimation method that we will also adopt for our first-differenced lagged dependent variable model. Instrumental variables are also needed for the remaining explanatory variables. For these, we shall use the lagged explanatory variables in their level form as instruments.

3.4 Data

Most of the data were collected from Statistic Canada's CANSIM II database. Data on interprovincial migration were collected from 1972 to 2005 from table 051-0019; total population data from 1972 to 2005 from table 051-0001; unemployment and employment data for the years 1976 to 2005 from the table 282-0002; data on real provincial GDP for the years 1981 to 2005 from table 384-0002; and data on personal income and personal disposable income for the years 1981 to 2005 from table 384-0012. Distance has been obtained from the Natural Resources Canada website[2] and is measured in kilometres as the shortest route between major cities using main road and including ferry distance. Labour productivity was calculated as (GDP/employment) while an estimate of the combined provincial-federal personal tax rate was calculated as [1-(personal disposable income/personal income)].

Although the data on interprovincial migration is available for the period from 1972 to 2005, limitations on the availability of GDP data (a component in the calculation of labour productivity) and the inclusion of lagged explanatory variables restricted our analysis to the 1982 to 2005 sample. In addition, equations (2) and (4) include an autoregressive AR(1) term to correct for autocorrelation, further restricting the sample to the 1983 to 2005 period for those two equations. Table 1 presents descriptive statistics of the data set used:

Table 1
Descriptive Statistics

	MIG persons	POP 000s	Y 000s of $C	UR rate	TR rate
Mean	3238.98	2845.12	56.92	10.38	20.09
Median	1178.50	1034.59	55.96	9.75	20.48
Maximum	44993.00	12541.41	83.23	20.20	25.62
Minimum	8.00	123.74	38.64	3.90	11.75
Std. Dev.	5299.90	3289.01	8.70	3.75	2.78
Observations	2250	2250	2250	2250	2250

One of the limitations of the data used is that we are using a measure of interprovincial *population* migration as the dependent variable while most of the explanatory variables are a concern to the labour force population. However, since we have assumed that individuals and/or families migration decisions are based mostly on economic incentives, our chosen dependent variables should not have harmful impact on our results.

To summarize, section 4 will present the estimation results of four equations we have discussed in detail in the preceding text. The first is equation (2) which contains no FE corrections and will be estimated by pooled least squares. The second will be equation (4) in which the data has been transformed into deviations from the cross-sectional means and provincial pair FEs have been introduced. The third will be equation (5) which is merely equation (4) with the introduction of the lagged dependent variable. And finally we shall

[2] See Natural Resources Canada (2006).

estimate equation (5), the lagged dependent variable model which will be estimated by GMM. For this estimation method, the data was first differenced and time dummies were estimated.

4 Results and Analysis

4.1 Linear vs. Log-linear Models

All models presented in our analysis were estimated using the linear form. Unreported regressions were also estimated in log-linear form for all models. The log-linear regressions estimated by GMM returned many insignificant coefficients. To formally test between the adoption of the linear or log-linear models, we followed the MacKinnon, White, and Davidson test (MWD test) as described by Gujarati (2003, p.280-282). The first step in conducting the test was to estimate both linear and log-linear models. Because it was not possible to conduct the MWD test with GMM, it was necessary to use the PLS version of our dynamic model (equation 5) to estimate the linear and log-linear models. As discussed above, a PLS estimation of the lagged dependent variable model will lead to biased results. But for the purpose of testing functional forms, we need not concern ourselves with this detail.

Secondly, we obtained the estimated $M\bar{I}G_{ij,t}$ values from the linear model and the estimated $\ln M\hat{I}G_{ij,t}$ values from the log-linear model where $M\bar{I}G_{ij,t}$ and $\ln M\hat{I}G_{ij,t}$ are the fitted values of the dependent variable from the linear and log-linear versions of equation (5) respectively. For the MWD test, we then constructed $Z1$ and $Z2$ variables which were then added as an explanatory variable in the linear and log-linear models respectively. The Z variables were calculated as follows:

$$Z1 = \ln\left(M\bar{I}G_{ij,t}\right) - \ln M\hat{I}G_{ij,t} \qquad (10)$$

$$Z2 = e^{\ln M\hat{I}G_{ij,t}} - M\bar{I}G_{ij,t} \qquad (11)$$

The main results from the MWD test are presented in Table 1 below. First we tested the null hypothesis that the linear model is the true model. If the constructed *Z1* variable is statistically significant, the null hypothesis can be rejected. From Table 1 we can see that the *Z1* variable is not statistically significant, therefore we cannot reject the null hypothesis that the linear model is the true model. Following the same approach with the log-linear model, we tested the null hypothesis that the log-linear model is the true model. In this case, the *Z2* coefficient is statistically significant at the 5 percent level. Therefore we can reject the hypothesis that the true model is log-linear.

Table 2
Results from the MacKinnon, White and Davidson Test for Linear vs. Log-linear model

PLS with FEs		PLS with FEs	
H0: True model is linear		H0: True model is log-linear	
Sample	1982-2005	**Sample**	1982-2005
CS Obs.	90	**CS Obs.**	90
Z1	-39.92	**Z2**	0.02 **
	(55.78)		(0.01)

Standard Errors are shown in parentheses.
*Null hypothesis could be rejected at the 10 percent level.
**Null hypothesis could be rejected at the 5 percent level.
***Null hypothesis could be rejected at the 1 percent level.

As a result, it was concluded that, for the lagged dependent variable model, the linear form was the appropriate specification to adopt. The linear form was therefore adopted for equations (2) and (4) for the sake of comparison with the dynamic specification.

4.2 General Results

Equations (2), (4), (5) and (6) were all estimated using the EViews version 5.1 statistical software package. The results are presented in Table 3 and discussed below[3]. Equation (2) is a straightforward PLS estimation. Equation (4) is also estimated using PLS but we have transformed the data into deviations from the cross-sectional mean to eliminate the effects of temporal shocks common to all provinces. We have also omitted the distance variable and have explicitly estimated cross-sectional FEs. Equation (5) is the same as equation (4) with the addition of a lagged dependent variable. Equations (2), (4) and (5) all correct for heteroskedasticity using cross-section weighted standard errors and covariance matrices. Equations (2) and (4) include an AR(1) term to correct for serial correlation. Equation (6) is the dynamic specification estimated by GMM. The inclusion of the lagged dependent variable may lead to biased results in the PLS estimation, therefore it is prudent to also estimated by means of the GMM estimator. The data were transformed into first differences to eliminate cross-sectional fixed-effects and period dummies were used to correct for common temporal shocks as was done by Arellano and Bond (1991). The lagged dependent variable takes care of the problem of serial correlation, therefore no AR(1) term was needed. The reported standard errors are robust to heteroskedasticity.

Before we move on to the interpretation of our results, it is important to note that because our model is a linear model of interprovincial migration and that the dependent variable is simply migration from province *i* to province *j*, the absolute effect of a given change in and explanatory variable will be the same for all interprovincial migration flows, but if we consider the effect of a

[3] An appendix section also details the following: FE results from equation (4), a redundant FE test on equation (4) and the period dummy results from equation (6).

change in an explanatory variable on the migration rate, the effect will be much larger for small provinces than for large ones.

Across the entire results, the only coefficient to consistently report an unexpected sign is the population of the destination province. At first glance, this seems troublesome because, according to the gravity theory of migration, we would expect that a larger destination province, as measured by its population, to be an indication of a greater abundance of job market opportunities thus attracting more migrants. But, as mentioned above, according to Foot and Milne (1984) one could also assume that a larger destination population may in fact be a deterrent to migration, in which case, the negative sign on $POP_{j,t}$ would be expected.

Foot and Milne (1984) also discuss how the signs on $POP_{i,t}$ and $POP_{j,t}$ may be indicators of the predominance of the "push" or "pull" factors of migration. The push factors are the influences or variables from the province of origin and the pull factors are those from the destination province. According to Foot and Milne's explanation of the push-pull interpretation of the coefficients on the population variables, if push factors are thought to be dominant, we should expect a positive sign on $POP_{i,t}$ and a negative sign on $POP_{j,t}$. However, if pull factors are thought to be dominant, then the signs are expected to be reversed. In our case, the coefficients on our population variables would indicate that Canadian interprovincial migration is strongly influenced by push factors of migration. Or we can say that unfavourable conditions in the province of origin are more likely to "push" migrants out of their current province. This is strongly in line with the findings of Foot and Milne (1984) who ran separate time series regressions for all 10 Canadian provinces. In their case, the four Atlantic Provinces showed evidence of being influenced by both push and pull factors while the rest of the Canadian provinces only seemed to respond to push factors of migration.

Table 3
Regression Results of Canadian Interprovincial Migration, 1982-2005 (Dependent Variable: Gross Migration from Province i to Province j, MIGij,t)

	(2) PLS without any FE	(4) PLS with FEs	(5) PLS with FEs	(6) GMM
Sample	1983-2005	1983-2005	1982-2005	1982-2005
CS Obs.	90	90	90	90
Constant	5803.12 **			
	(2722.21)			
Dij	-59.59			
	(37.21)			
MIGij,t-1			0.70 ***	0.71 ***
			(0.04)	(0.00)
POPi,t-1	0.46 ***	0.76 **	0.27 ***	0.26 **
	(0.15)	(0.33)	(0.09)	(0.12)
POPj,t-1	0.04	-1.22 ***	-0.42 ***	-0.60 ***
	(0.16)	(0.34)	(0.08)	(0.10)
Yi,t-1	-41.16 ***	-28.07 **	-16.57 **	-82.18 ***
	(15.09)	(14.24)	(8.00)	(12.29)
Yj,t-1	45.29 ***	84.54 ***	43.01 ***	94.98 ***
	(15.06)	(14.46)	(9.00)	(8.78)
URi,t-1	93.20 ***	60.15 **	-16.91	139.32 ***
	(21.84)	(30.17)	(19.45)	(17.35)
URj,t-1	-247.00 ***	-293.87 ***	-89.30 ***	-480.83 ***
	(21.83)	(30.21)	(19.40)	(10.89)
TRi,t-1	-0.68	63.03	123.41 ***	265.79 ***
	(37.19)	(48.95)	(36.59)	(30.81)
TRj,t-1	-88.23 **	-80.55 *	-138.83 ***	-302.59 ***
	(37.21)	(48.78)	(39.02)	(17.34)
AR(1)	0.97 ***	0.75 ***		
	(0.00)	(0.04)		
R^2	0.97	0.98	0.98	n/a
D.W.	1.53	1.40	1.24	n/a

Standard Errors are shown in parentheses.
*Null hypothesis could be rejected at the 10 percent level.
**Null hypothesis could be rejected at the 5 percent level.
***Null hypothesis could be rejected at the 1 percent level.

Notice however that all other coefficients in our model can also be given a push-pull interpretation according to the relative absolute value of origin and destination variables. Throughout our models, in general, the absolute value of the coefficient of destination province variables is usually larger than the absolute value of the coefficient of origin province variables. These results would suggest that our other economic variables exert mostly a pull effect on interprovincial migration rather than a push effect. In a practical sense this would mean that migrants are strongly attracted to other provinces by favourable economic conditions such as high labour productivity and low unemployment rates.

In all our models, interprovincial migration is measured in persons while population is measured in thousands of persons. The correct manner in which to interpret the point estimates for the population variables is the following: all else being equal, if the population of the origin province increases by 1,000 persons, migration to a given province may increase by 0.46, 0.76, 0.27 or 0.26 people according to equations (2), (4), (5) and (6) respectively. Similarly, if the population in the destination province increases by 1,000 persons, migration from a given province may increase by 0.04 persons according to equation (2) or decrease by 1.22, 0.42 or 0.60 persons, according to the other models.

The variables that have performed the best in all four specifications are the labour productivity and the unemployment rate variables. In most cases the lagged labour productivity and unemployment rate variables have the correct sign and are at least statistically significant at the 5 percent level if not at the 1 percent level. The only exception is the unemployment rate of the origin province in equation (5) which has an unexpected negative sign and is statistically insignificant. This may be an indication that equation (5) is in fact biased because of the introduction of the lagged dependent variable, thus reinforcing the need to use GMM as an estimator. Overall, the results for labour productivity and the unemployment rate suggests that,, even after accounting for unemployment rate differential and provincial fixed effects, labour productivity differences do matter in the migration decision. In this case, our results confirm the findings of Coulombe (2006) who draws the conclusion that "from the economic point of view, both the probability of finding a job and the opportunity of working in a more productive environment appear to drive migration flows" (p. 206).

The labour productivity variable is measured in thousands of dollars per worker. From Table 2 we can see that if labour productivity in the origin province increases by $1,000 migration to a given province may decrease by 41, 28, 17 or 82 persons. If labour productivity increases by $1,000 in the destination province, migration from a given province may increase by 45, 85, 43 or 95 persons. As for the unemployment rate, we can see that if the unemployment rate in the province of origin increases by one percentage point, migration to a given province may increase by 93, 60, -17 or 139 persons. Similarly, if the unemployment rate in the destination province increases by one percentage point, migration from a given province may decrease by 247, 294, 89 or 481 persons.

The results also show that the sending province's personal income tax rate variable in equations (2) and (4) are not statistically significant and that of equation (2) also reports an unexpected sign. However, the tax rates of the receiving province are significant at the 5 and 10 percent level. In equations (5) and (6) both tax rate variables are statistically significant at the 1 percent level. This tax rate variable is one of many fiscal variables included in Day (1992) who also concludes that fiscal variables, including the combined federal-provincial income tax rate, are strong determinants of interprovincial migration decisions. According to the results in Table 2, if the combined federal-provincial tax rate in the origin province increases by one percentage point, migration to any given province may decrease by 0.68 or increase by 63, 123 or 266 persons. Similarly, if the tax rate in the destination province increases by one percentage point, migration from any given province may decrease by 88, 81, 139 or 303 persons.

Recall also from section 3.1 that Courchene (1970) argues that, in absolute value, the coefficient of the Y_j variable should be greater than the coefficient of the Y_i variable, reflecting the fact that a lower level of income in the province of origin might introduce a financial constraint to migration despite also being an incentive for migration. We can say without a doubt that all three of our models indeed confirm Courchene's hypothesis and thus, levels of labour productivity in the sending province do indeed have a dual role in an individual or family's migration decision.

4.3 The Dynamic Specification

Of particular interest in our results, is the performance and interpretation of the lagged dependent variable. Overall, the results from Table 1 suggest that the dynamic specification in equation (6) is better for estimating the determinants of gross interprovincial migration. All coefficients are statistically significant at the 1 percent level with the exception of $POP_{i,t-1}$ which is significant at the 5 percent level. These results do indeed suggest that the previous year's migration will have an effect on the current period migration. More precisely, previous year's migration will have the effect of changing the long-run equilibrium migration rate.

The dynamic specification can therefore be given a long-run convergence interpretation. For example, let equation (12) below represent the lagged dependent variable specification. For simplicity, X will be a vector representing all other explanatory variables, γ is the vector of coefficients, and $v_{ij,t}$ is the error term:

$$MIG_{ij,t} = \beta MIG_{ij,t-1} + \gamma X + v_{ij,t} \tag{12}$$

If the model converges to a long-run equilibrium, $MIG_{ij,t} = MIG_{ij,t-1} = MIG_{ij}^{*}$. The long run expression of equation (12) then becomes:

$$MIG_{ij}^{*} = \beta MIG_{ij}^{*} + \gamma X + v_{ij,t} \tag{13}$$

Rearranging (13) and setting the expected value of the error term to zero, the long-run equilibrium level of migration will be determined by the following:

$$MIG_{ij}^{*} = \frac{\gamma X}{(1-\beta)} \tag{14}$$

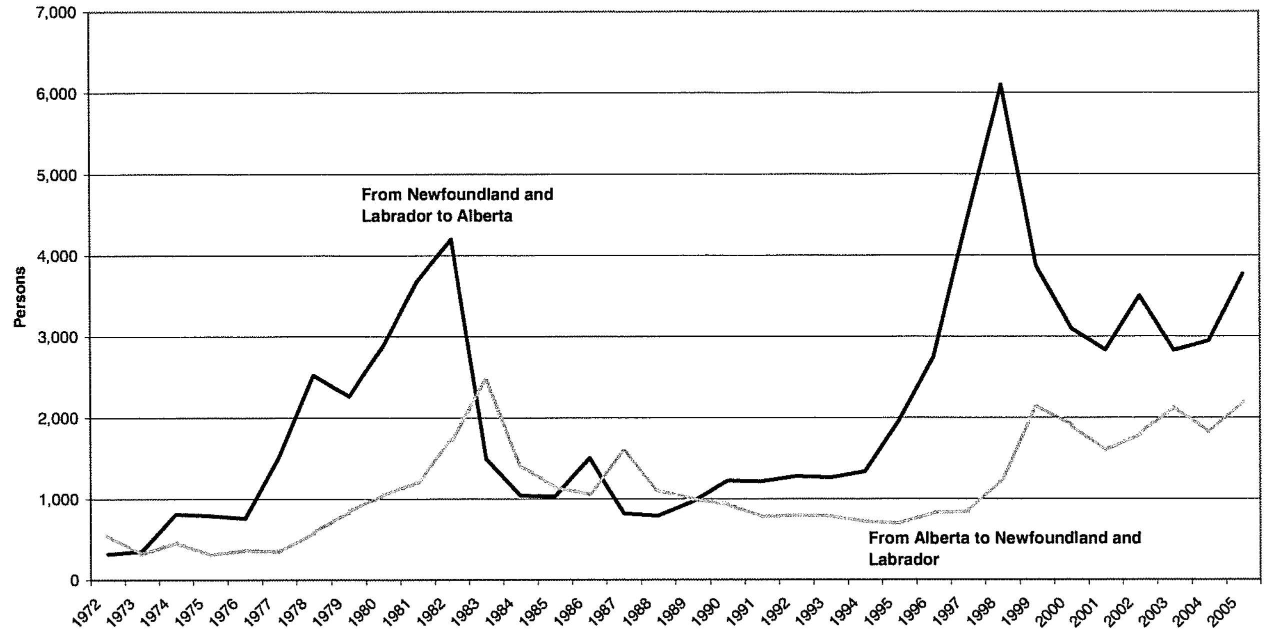
where $(1-\beta)$ represents the speed of convergence. The speed of convergence is the speed at which the migration level moves to a new long-run equilibrium. In our case $\beta = 0.71$ and $(1-\beta) =$ 0.29. The speed of convergence is therefore 29 percent. From this information, we can also calculate the half-life. The half-life is defined as the amount of time needed for to complete half of the adjustment to the new long-run equilibrium level of migration. The half-life can be calculated roughly as 70 divided by the convergence speed in percentage. In our case it is 70/29 = 2.4. Therefore, according to our estimates, it takes 2.4 years for gross interprovincial migration to complete half of the transition to a new long-run equilibrium MIG_{ij}^{*}.

Now that we have discussed the interpretation of the lagged dependent variable, let us shift the discussion to the other explanatory variables contained in the X vector of equation (14). Within the framework of the dynamic specification of migration the long-run effect of the variables contained in the X vector on gross interprovincial migration is defined by $[\gamma/(1-\beta)]$. Therefore, to determine the true long-run effect of each explanatory variable on migration, it is necessary to divide its point estimate by the speed of convergence. For example, the long-run effect of the sending province's labour productivity and unemployment rate will be -82.18/0.29 = -283.38 and 139.32/0.29 = 480.41 respectively. It is not a surprise that these numbers are large in magnitude since they do represent long-run effects.

4.4 Reduced Costs of Migration Over Time

The findings from the dynamic specification suggest there exists a great deal of validity to our assumption that past migration from i to j may facilitate future migration in the same direction by means of less costly job market information from the destination province and also through reduced psychological costs from already established social networks for those considering relocation. And as these social networks grow over time, their impact on reducing the costs of migration may become larger and larger. In other words, there may be a diaspora effect leading to decreasing costs of interprovincial migration over time. To illustrate this phenomenon, Chart 2 below represents gross interprovincial migration from Newfoundland and Labrador to Alberta during the 1972 to 2005 period.

Chart 2
Gross Migration Between Newfoundland and Labrador and Alberta, 1972 to 2005



Source: Statistics Canada CASNSIM II Table 051-0019

It is a well-known occurrence to Canadians that during expansions in the oil sector, many Newfoundlanders migrate to Alberta in search a higher wages and better job opportunities. We can see from Chart 2 that migration from Newfoundland and Labrador to Alberta follows a cyclical pattern that can most likely be captured by the labour market variables included in our model of migration. In addition, migration from Newfoundland and Labrador to Alberta is almost always much larger than migration from Alberta to Newfoundland and Labrador. We can therefore suppose that many Newfoundlanders decide to stay in Alberta thus increasing the Newfoundlander community in Alberta. Therefore, we can safely assume that Newfoundlanders in Alberta may be reporting back to friends and family about labour market opportunities in Alberta or may even offer temporary accommodations for fellow job seekers, thus reducing job search costs. The growing community of Newfoundlanders in the Alberta may also reduce the emotional and psychological costs of moving for individuals and families. But the results from our dynamic specification suggest that there exists a long-run equilibrium level of migration.

5 Conclusions

Interprovincial migration is not a recent phenomenon in Canada. Canadians have long been migrating from province to province to enhance the economic situation for themselves and their family. This trend has been obvious to the average person during times of oil booms in the west and economic recessions in the east.

In our paper, we have presented three gravity-type models of interprovincial migration in which gross migration flows between two provinces are expected to be directly related to population size and inversely related to the distance separating them. In our gravity models we have included labour market determinants of migration, from both the province of origin and the destination province, as other explanatory variables. These explanatory variables include provincial labour productivity, the unemployment rate and the combined federal-provincial personal tax rate. The first model was estimated by PLS containing all the above-mentioned explanatory variables. In the second model, we estimated cross-sectional and period fixed effects using the dummy variable technique to correct for heterogeneity within the data. The period fixed effects were corrected for omitted variables such as temporal shocks common to all provinces. Likewise, the cross-sectional fixed effects took into account any omitted variables that were common to provincial migration pairs but constant over time. Since distance is a time-invariant variable it was therefore omitted from the second specification. In our third and final model, we tested the hypothesis that interprovincial migration behaves in a dynamic manner such that gross migration from i to j at time t depends on gross migration at time t-1. It was then necessary to add a lagged dependent variable as an explanatory variable and evaluate the model via the GMM estimation technique.

Data for estimation was retrieved from the Statistics Canada CANSIM II database for all ten Canadian provinces. The territories were excluded to simplify the analysis. Although migration data is available from as early as 1972, restrictions on provincial GDP data used in the calculation of labour productivity limited our sample to the 1981 to 2005 period.

Our results have confirmed many previous findings in the migration literature. Firstly, when using panel data to model migration flows, it is imperative to control for heterogeneity. Not doing so will lead to biased results. We chose a combination of the methods used by Cheng and Wall (2005) and Coulombe (2006) and found these to be useful in improving our results.

Secondly, the significant positive coefficients on the population of the sending region and the negative and significant coefficients on the population of the receiving region confirm the findings of Foot and Milne (1984). It would appear that Canadian interprovincial migration is influenced more strongly by push factors of migration or that very poor labour market condition in the province of origin will have the effect of "pushing" residents towards other provinces where labour market conditions are better.

Third, we have found that even after the probability of finding employment has been corrected for via the unemployment rate, differences in labour productivity are still a significant factor in the decision to migrate, confirming the findings of Coulombe (2006).

Fourth, the significance of our combined federal-provincial personal tax rate variable confirms the hypothesis of Day (1992) that fiscal variables are also important determinants of migration. This is an important result for policy makers. However, the personal income tax rate is not an ideal variable to use directed towards migration policy, since the primary function of taxes is to collect government revenue. Rather, the evidence suggests that it would be important for policy makers, in their government financing decisions, to consider the consequential impact of tax policy on migration and subsequently the impact of migration on regional economies.

And finally, we have found that in all specifications, the absolute value of the coefficient on our labour productivity variable in the destination province is always larger than that of the province of origin. This confirms the hypothesis of Courchene (1970) and indicates that although a relatively low income in the province of origin may provide the incentive to migrate, thus increasing migration, a low income may also make it financially more difficult to bear the costs of relocation, thus reducing migration. This result also provides a rationale for both private and public employers to subsidize part or all of the moving expenses for newly hired employees to reduce the barrier to economic adjustment created by low incomes.

We have also found that a lagged dependent variable model may better explain Canadian interprovincial migration process. All coefficients in the lagged dependent variable model, estimated via GMM, were highly significant. There is also evidence of the existence of a long-run migration equilibrium. It may indeed be the case that the migration of Canadians from province *i* to *j* in a given year will have a positive effect on future migration patterns through the feedback of information toward the province of origin thus reducing cost of acquiring job market information and reducing the psychological costs of migration with pre-established social networks. It would be interesting for future research to investigate the possibility of estimating the impact that technological advancement and innovation have had on reducing the various monetary and non-monetary costs associated with migration. Another effect which would be interesting to investigate is the extent to which return migration increases knowledge of other parts of the country in the province of origin. If the effect is strong, high rates of return migration may also increase out-migration in subsequent periods.

6 Appendices

6.1 Appendix I

Fixed-effects results from equation (4)

Cross-section observation[1]	Fixed Effects
01	3112.843
02	1691.742
03	3075.914
04	-4090.506
05	-12115.28
06	4465.569
07	5098.738
08	1342.424
09	388.3925
10	1946.591
12	2572.459
13	2953.931
14	-4272.623
15	-8026.872
16	4328.231
17	4874.378
18	2995.450
19	666.6655
20	1210.531
21	2750.235
23	1307.080
24	-4754.069
25	-13677.01
26	4265.930
27	5034.915
28	1424.620
29	-650.4291
30	1840.668
31	2755.253
32	833.7981
34	-6077.643
35	-11258.99
36	4235.874
37	4944.774
38	2163.181
39	240.2320

40	6998.555
41	7968.487
42	7383.774
43	6587.783
45	-23820.41
46	8913.605
47	9736.811
48	6560.381
49	2531.206
50	5821.751
51	9774.038
52	4648.460
53	7195.503
54	-12409.89
56	7514.372
57	10665.14
58	312.8527
59	-8974.534
60	2108.706
61	3133.554
62	2926.979
63	3293.277
64	-4562.722
65	-12780.9
67	2628.663
68	-1397.692
69	-3439.054
70	1960.377
71	2941.460
72	2895.204
73	3227.104
74	-4516.643
75	-9983.291
76	1699.357
78	-8284.377
79	-3546.777
80	1887.417
81	3950.523
82	2565.639
83	3512.261
84	-4940.469
85	-19209.88
86	2229.026
87	-1243.707
89	-20523.48
90	3807.735
91	5081.657
92	3815.564
93	4976.269
94	-4143.305

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95	-18218.27
96	4163.653
97	4388.953
98	-15407.68

[1] Cross-sectional observations on gross migration flows are represented by a numeric code ij where i represents the province of origin and j represents the destination province according to the following legend:

0 = Newfoundland and Labrador
1 = Prince Edward Island
2 = Nova Scotia
3 = New Brunswick
4 = Quebec
5 = Ontario
6 = Manitoba
7 = Saskatchewan
8 = Alberta
9 = British Columbia

6.2 *Appendix II*

Redundant Fixed Effects Tests[1] for Equation (4)

Effects Test	Statistic	d.f.	Prob.
Cross-section F	4.687934	891,971	0.0000
Cross-section Chi-square	397.4604	89	0.0000

[1] H0: Fixed Effects are redundant

6.3 *Appendix III*

Period Dummy Results from equation (6), GMM Estimation

Period	Coefficient	Std. Error	t-Statistic	Prob.

1982	340.03	93.39	3.64	0.0003
1983	207.19	59.84	3.46	0.0005
1984	84.70	31.50	2.69	0.0072
1985	147.56	30.87	4.78	0.0000
1986	-8.61	35.56	-0.24	0.8087
1987	-215.02	27.97	-7.69	0.0000
1988	-254.46	27.04	-9.41	0.0000
1989	-35.13	27.26	-1.29	0.1977
1990	380.32	71.17	5.34	0.0000
1991	-37.08	58.23	-0.64	0.5243
1992	522.13	46.53	11.22	0.0000
1993	-120.09	23.12	-5.19	0.0000
1994	-244.84	33.61	-7.29	0.0000
1995	-314.07	20.92	-15.02	0.0000
1996	146.01	23.76	6.15	0.0000
1997	-88.77	33.68	-2.64	0.0085
1998	-124.33	26.41	-4.71	0.0000
1999	-610.93	40.13	-15.23	0.0000
2000	33.57	28.21	1.19	0.2341
2001	-123.50	26.65	-4.63	0.0000
2002	350.92	24.88	14.10	0.0000
2003	-387.12	15.76	-24.56	0.0000
2004	-114.42	18.49	-6.19	0.0000
2005	228.79	26.87	8.51	0.0000

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