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ORIGINAL PAPER

The long-term decline of internal migration in Canada: the case of Ontario

Syed A. Basher · S. Fachin

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Abstract Migration between the Canadian provinces generally followed a declining trend over the period 1971–2004. In this paper, taking Ontario a case study, we seek to explain these patterns using recent panel cointegration methods that are robust to cross-section dependence. Estimation of heterogeneous models suggests that the determinants of migration vary across provinces. Overall, unemployment differential and income in the sending province appear to be the most important ones, with income and federal transfer differentials playing only a minor role.

Keywords Internal migration · Panel cointegration · Bootstrap · Canada

JEL Classification C32 · C33 · R23

1 Introduction

Canada has witnessed an explosion of internal migration over the past few decades. Research over the last four decades on the spatial pattern of migration in Canada brings out the following stylized facts. Throughout this long period three economically strong provinces—Ontario, British Columbia, and Alberta—have been the principal net gainers from interprovincial migration; whereas the remaining seven economically weak provinces tended to be the consistent net losers through internal migration. Stronger economic growth and better employment opportunities are often

S.A. Basher
Department of Economic Policies, Qatar Central Bank, P.O. Box 1234, Doha, Qatar
e-mail: bashers@qcb.gov.qa

S. Fachin (✉)
Facoltà di Scienze Statistiche, Università di Roma 'La Sapienza', P.le A. Moro 5, 00185 Roma, Italy
e-mail: s.fachin@caspur.it

Table 1 Population, income and unemployment in the Canadian provinces, 1971–2004

Province	Code	y		Δu		Population	
		1971	2004	1971	2004	1971	2004
Newfoundland and Labrador	NL	67.8	82.3	2.4	**7.4**	2.4	1.6
Prince Edward Island	PE	66.4	85.4	−2.3	**3.0**	0.5	0.4
Nova Scotia	NS	77.9	89.7	**1.0**	**0.5**	3.6	2.9
New Brunswick	NB	74.6	88.4	**0.1**	**1.5**	2.9	2.4
Quebec	QC	91.6	93.0	**1.3**	**0.2**	28.0	23.7
Ontario	ON	**115.3**	**104.5**	−0.6	−1.5	**35.8**	**38.9**
Manitoba	MB	93.9	92.6	−0.3	−3.0	4.6	3.7
Saskatchewan	SK	84.3	91.8	−2.5	−3.0	4.3	3.1
Alberta	AB	96.6	**117.6**	−0.3	−3.7	**7.6**	**10.1**
British Columbia	BC	**105.9**	96.8	**1.3**	−1.1	**10.2**	**13.2**

Notes: (i) y: Disposable income, Canada = 100. Bold face: values greater than 100. (ii) Δu: differential of provincial unemployment rate $\times 100$ from simple mean across provinces. Bold face: values greater than zero. (iii) Population: share (Canada = 100). Bold face: increasing share. Provinces are ordered from east to west

taken to be the explanation of the regional pattern of migration between the two sets of provinces. Persistent change in internal population redistribution over the 1951–2001 period has helped Ontario, British Columbia, and Alberta to increase their share of Canadian population by an average of 4.6%, while the average share for the remaining seven provinces decreased by nearly 3.3% (Liaw and Xu 2007). In the last three decades this trend somehow has slowed down, so that the 1971–2004 averages are respectively 2.8% and −1.2%, with the largest share increase (3.1%) taking place in Ontario (see Table 1).

Although internal migration has been an integral part of Canada's population dynamics,[1] interestingly very little has changed in terms of specific migration flows among the provincial origins and destinations. More than 30 years later we see that the spatial pattern of migration in Canada is very much in line with the observation first made by Stone (1974). In other words, Ontario still is the most favorite destination for out-migrants from Quebec and the four Atlantic provinces. On the other hand, out-migrants from the western provinces mainly choose other western provinces as their most favored destinations. Importantly, there are no large streams originating in either British Columbia or Alberta and ending east of Ontario; whereas Ontario ranked second as a destination for out-migrants from the two westerly provinces. In this respect, Ontario is like a sort of "buffer zone" inhibiting strong flows between the eastern and western regions of Canada (see Stone 1974).

Nevertheless, an important observation that, to the best of our knowledge, has been overlooked in the literature is the fact that gross migration flows from both eastern and western provinces to Ontario have been declining steadily over the years.

[1] The annual average (between 1971–2004) migration flow from one province to another is approximately 31,279 persons, or 1.17% of the total population (excluding the territories).

Save for British Columbia, the logarithm of gross migration flows to Ontario is mostly trending downward, with only some temporary upward swings around the early 1990s.[2] This is interesting, as Ontario has consistently been one of the most attractive provinces in terms of both income and employment opportunities. What is the cause of the declining trend in migration flows to Ontario from rest of Canada, particularly the eastern provinces? Only the narrowing of income gap and unemployment differentials, or have other factors been at play?

Our goal in this article is to empirically examine the long-run determinants of this decline using a panel of interprovincial migration data from 1971–2004. Obviously, there have been several attempts to explain interprovincial migration pattern using long-span data. Shaw (1986) finds that fiscal variables (e.g., unemployment insurance) matter more over traditional market variables (e.g., job creation or wages) for Canadian migration during the period of 1956–1981. Day and Winer (2006) use individual tax records to construct in-migration and out-migration data over the period 1974–1996 and find that regional differences in (fiscal) policy variables do not have significant influence on interprovincial migration. Finally, both Day and Winer (2006) and Coulombe (2006) point the importance of structural factors such as regional differences in earnings, employment prospects, and labor productivity as the main drivers of interprovincial migration in Canada.

However, all these empirical studies share a serious methodological weakness: the problem of non-stationarity of the data is never taken into account. This is somehow puzzling, as it has been known for more than thirty years (Granger and Newbold 1974) that neglecting the non-stationarity in the data can lead to finding relations between the levels of trending time series that are actually independent (the so-called *spurious regression* problem).

In fact, the issue of non-stationarity seems to be largely ignored even in the most recent contributions to the empirical literature on interprovincial migration in Canada (e.g., Day and Winer 2006; Coulombe 2006). Therefore, the objective of this paper is to fill the gap in the literature by applying recent advances in panel data econometrics to examine the long-run determinants of interprovincial migrations to Ontario over the period 1971–2004. This exercise will, first of all, hopefully produce results of interest for their own sake, and, second, define a methodological and empirical approach which may be used to understand immigration trends in other Canadian provinces.

The rest of the paper is organized as follows. Section 2 describes data and empirical model. Section 3 briefly reviews the econometric methodology used. Section 4 presents the empirical results. Section 5 concludes.

2 Modeling internal migrations: data and models

2.1 Data

The primary source of our data is Statistics Canada (E-STAT database), which records annual migration streams by province of origin and destination. All data are annual

[2] Due to space limitations, we refrain from presenting these figures, but they are available from authors on request.

and all income figures are expressed in Canadian dollar. Per capita figures are obtained by normalizing by the population. The data is available from authors on request.

- *Migration (persons)*: Interprovincial migration flow data by province of origin and destination, 1971/72 to 2005/06, E-STAT Table 051-0019. For convenience, we treat annual years as 1971 to 2004.
- *Population (persons)*: Total population by province, 1971 to 2006, E-STAT Table 051-0001.
- *Disposable income (dollar)*: Personal disposable income by provinces, 1981 to 2004, E-STAT Table 384-0013. Data for the period 1971–1980 is available from E-STAT Table 384-0035.
- *Unemployment rate (percent)*: Data for 1976–2004 is taken from E-STAT Table 282-0002. Remaining data for 1971–1975 come from E-STAT Table 384-0035.
- *Federal transfer (dollar)*: Federal government current transfer to persons, 1981–2004, E-STAT Table 384-0004. Remaining data for 1971–1980 come from E-STAT Table 384-0022.

The migration series can be interpreted as *gross migration* indicating migration from home area h to the destination area i.[3] The advantage of using migration data with a *defined origin* and *defined destination* is that it will allow us to see how the provinces of origin react to economic fundamentals when choosing Ontario as their favorite destination. In particular, we will be able to ascertain why one region respond to more of a certain kind of attributes than another.

2.2 Models

Let us now discuss the variables used in some detail. First of all, we normalize the migration flows with the population in the destination region, Ontario, rather than with those of the sending provinces. Although somehow unusual, this choice is in fact natural, since the aim of our analysis is understanding the reasons of the decline of *inflows* in Ontario, rather than the determinants of *outflows* from the sending provinces, as more common in the migration literature.

Letting the home area h and the destination area i, the migration rate is defined by $m_{hit} = Pop_t^{-1} M_{hit}$, where M_{hit} is the total migration flow from h to Ontario and Pop_t is the total population in Ontario, at time t.

The explanatory variables are those typically used in previous studies. According to standard models the key determinant of migration flows is the expected income differential, which, assuming for simplicity static expectations, is a function of current

[3] The interprovincial migration data are obtained by comparing addresses indicated on personal income tax returns over two consecutive tax years. Files for two consecutive years are matched by social insurance number to determine persons who filed returns in both years. Dependents of migrants tax-filers are obtained from Small Area and Administrative Data Division (SAADD) family file, which makes use of Canada Child Tax Benefit (CCTB) file, Statistics Canada's Vital Statistics database (i.e., births, deaths, marriages and divorces), and Historical Family file (consisting information of known family relationships obtained from tax returns). Several adjustments factors are used to take into account migrants who do not file income tax returns. See Statistics Canada (2003, Chap. 7) for additional details.

unemployment and income differentials. To capture the growth in the ability to support the unemployed population we include in the model log income per capita in the home region as well. In both cases we use disposable income, thus taking into account the regional differences in income tax rates. In addition, we have also included per capita federal transfer differentials between origin and destination provinces. Federal transfers, which includes the equalization payment[4] and unemployment benefits, are an important determinant of the so-called "fiscally-induced migration" (e.g., Day and Winer 2006). Formally, the log differentials between a home province h and Ontario are defined as $x_{hit}^{d} = x_{ht} - x_{it}$, $x = y, u, g$, with the symbols y, u, and g indicating log of disposable income per capita, unemployment rate, and federal transfer per capita, respectively, and $i =$ Ontario.[5]

Finally, we include a measure of migration chain effect. Migrants are known to move with a higher probability to destinations where people from the same area have moved to in the past, as it is easier both to obtain information and to receive material support when settling down.[6] Considering that the probability of accessing information and support is proportional to that of a contact with a past migrant, we define as a measure of the migration chain effect the total migrations from the home area to the destination area over the previous three years,[7] divided by the total population of the home area: more precisely, $c_{hit} = Pop_{ht}^{-1} \sum_{s=1}^{3} M_{hi,t-s}$.

The starting model for our empirical analysis is then the following:

$$m_{hit} = \beta_{0h} + \beta_{1h} y_{hit}^{d} + \beta_{2hi} u_{hit}^{d} + \beta_{3hi} g_{hit}^{d} + \beta_{4h} y_{ht} + \beta_{5h} c_{hit} + \varepsilon_{ht} \tag{1}$$

where $h =$ home $=$ NL, PE, NB, NB, QC, MB, SK, AB, BC,[8] $i =$ destination $=$ ON, with $h \neq i$; $t = 1974, \ldots, 2004$, as some initial observations are needed to initialize the migration chain variable.

3 Econometric methods

Since we are interested in the long-run patterns, as is usual in the literature we first need to tests whether variables in (1) are non-stationary, if variables actually are I(1)[9]

[4]The idea behind the equalization program is to provide similar levels of public services among the provinces.

[5]As pointed out by an anonymous referee that other independent variables (e.g., economic growth, employment growth) could be employed to partially explain the long-run trend in interprovincial migration. However, if we assume that output and employment are non-stationary variables, implying that their growth is stationary, these stationary economic variables cannot be reconciled with the long-run I(1) trend as posited by (1).

[6]An obvious example is the frequent case of male heads of families migrating alone first, with their wives and children joining them after some time.

[7]Using a longer time span would in principle be desirable, but it is not feasible because of the very short time sample available.

[8]For a list abbreviations see Table 1.

[9]A time series y_t is non-stationary I(1) if its mean and variance are time-dependent. A non-stationary series has no tendency to return to a long-run deterministic path (or, it does not display the property of

we can then test if model (1) describes an equilibrium relationship, and, finally, provided this is the case, estimating the values of the coefficients. However, with only 31 time periods, the power of conventional cointegration tests is known to be very low. Fortunately, a solution is readily available: considering each origin-destination pair as a "unit" our data set is naturally seen as a possibly non-stationary panel, with the number of units $N = 9$ and that of time observations $T = 31$. We can thus obtain higher power by applying some panel cointegration tests.

The advantage of using panel data approach over standard time series methods is that by combining the information coming from both the cross-section and the time dimensions, the power of the tests can be increased, even without imposing any homogeneity assumption. When dealing with panel data, it is important to keep in mind the issue of cross-section dependence due to common trends and cycles in output across Canadian provinces. Ignoring the cross-section correlation[10] is known to cause severe size distortion, so that the power gain delivered by the panel dimension, which is the very reason for its use, is entirely fictitious.

In this paper, we apply the bootstrap panel cointegration tests recently proposed by Fachin (2007). This test is robust to both short- and long-run dependence across units and delivers good small sample performances, which is important since in our case $N = 9$. The basic principle of this test is to compute a summary statistic (say, G) of the no cointegration tests for the individual units on the empirical data set and on a large number of pseudo-data sets constructed under the null hypothesis of no cointegration (say, G^*). The no cointegration hypothesis is rejected if the empirical statistic G falls in the tail of the distribution of the $G^{*\prime}s$; in the classical Engle-Granger cointegration test, if the bootstrap p-value $p^* = prop(G^* < \widehat{G})$ is small. Clearly, a key point of the procedure is the construction of the series under no cointegration. These are obtained applying Paparoditis and Politis (2001) Continuous-Path Block Bootstrap (CBB); more details, which are beyond the scope of this paper, are given in Fachin (2007). Natural choices of summary statistics are the mean ($\overline{G} = N^{-1}\sum_{i=1}^{N} ADF_i$, where ADF_i is the ADF statistic computed on the residuals of the $i-th$ cointegrating regression) and the median, $G^{me} = Median(ADF_1, \ldots, ADF_n)$. In both cases the null hypothesis is 'cointegration in no units', against the alternative hypothesis 'cointegration in a large number of units'. Hence, in case of rejection we are *not* implying that in the specific time sample at hand cointegration holds in *all* units. Rather, we are implicitly taking what we may define a democratic stance: since the units are reasonably homogenous, if a long-run equilibrium exists in most of them, the exceptions are regarded as due to temporary conditions, which will vanish asymptotically.

As mentioned above, if cointegration is found to hold we can proceed to estimate the coefficients of the long-run relationships. From model (1) letting $h = NL, \ldots, BC$, we obtain a system of nine equations, likely to be characterized by strong correlation of the disturbances and cointegration of the explanatory variables across equa-

mean reversion). Besides, since the variance of the non-stationary series is time-dependent and goes to infinity as time approaches infinity, thereby causing serious problems for forecasting. A non-stationary I(1) (*integrated or order* 1) series can be made stationary by taking the first difference. A stationary series is said to be integrated of order zero, I(0).

[10]Pesaran (2004) presents a simple test of error cross-section dependence that is valid asymptotically under very general conditions for both stationary and non-stationary panels.

Table 2 ADF unit root tests

Province	m	y	y^d	u^d	g^d
NL	−1.41	-3.13^T	−0.88	−3.37*	−4.12**
PE	−1.65	-3.01^T	−3.97*	−3.73*	−3.05*
NS	−1.80	-2.36^T	-2.67^T	−2.44	−3.24*
NB	−1.84	-2.57^T	-2.80^T	−3.04*	−3.55*
QC	−0.08	-3.04^T	−1.30	−2.99	−4.33**
MB	−1.90	-2.59^T	−3.67	−2.88	-3.01^T
SK	−1.34	-3.09^T	−2.88	−2.00	-2.66^T
AB	−0.85	-3.00^T	−1.29	−2.57	−1.23
BC	−2.32	-3.03^T	−2.42	−3.36*	−2.05

Notes: m: migration flows/Ontario population; y: disposable income; y^d: disposable income differential; u^d: unemployment differential; g^d: federal transfer differential. All variables in logs, differentials with respect to Ontario. Number of lagged differentials selected on the basis of t-tests. T : linear trend included. ** and * significant at 1% and 5%, respectively

tions. Because of the second point Seemingly Unrelated Regression (SUR) estimation methods, such as FM-SUR (Moon 1999), natural in view of the first point, are unfeasible. However, according to simulation results by Di Iorio and Fachin (2008) the efficiency gains delivered by SUR estimators with respect to single-equation estimators such as Fully Modified Ordinary Least Squares (FM-OLS) are in fact essentially negligible. We can thus safely proceed to separate estimation by FM-OLS of each individual equation.

4 Empirical results

We first examine the time series properties of the series using individual ADF unit root tests, reported in Table 2. Consistently with our expectations, the migration rates are clearly non-stationary; the same holds for income level in the sending provinces. In these two cases the deterministic kernel has been chosen on a priori grounds, with a linear trend respectively included in the latter and excluded in the former. In the remaining cases (income, unemployment and federal transfer differentials) we followed the selection procedure proposed by Ayat and Burridge (2000), including a deterministic trend when significant.[11]

As to be expected, this criterion leads always to tests with constant only in the case of the unemployment differential, while for the other two differentials both cases are present. For the income differential the I(1) hypothesis is never rejected except one case, at the 5%, while this happens in three cases for the unemployment differential. For both variables there are no rejections at 1%. The federal transfer differentials appear somehow more stationary, with three rejections at 5% and two at 1% (Quebec and Newfoundland and Labrador). We decided to take a rather conservative stance, excluding from the initial models only the variables found stationary at 1%. Also, given the results on the migration rates we always included a migration chain variable.

[11] Although the idea of a linear trend in a differential may appear not plausible, this is not actually the case. If the linear trend enters the univariate Data Generating Processes of a variable with different coefficients in the home and destination regions the differential will have a linear trend also, with coefficient the difference of the regional coefficients.

To get a feeling of the size of the cross-section dependence problem in the data, we computed the short-run cross-section correlations of the regression residuals obtained from (1).[12] We find the CD test statistic of Pesaran (2004) is 11.387, with a p-value of 0.00, which strongly rejects the null hypothesis of no cross-section dependence. In addition, the average absolute correlation between all the cross-section units is 0.382, which is not negligible. Hence, overall there seems to be enough evidence suggesting the presence of cross-section dependence in model (1), confirming the need to apply a robust testing procedure.

The results of panel cointegration tests with fully heterogeneous specification (fixed effects, heterogeneous slopes) are reported in the top panel of Table 3, and FM-OLS estimates of the individual equations in the bottom part of the same table. The bootstrap algorithm used 1000 redrawings and block length fixed at 4. The p-values for both the mean and median of the individual ADF statistics are all very small, indicating that the models specified are cointegrating relationships. We can then examine the FM-OLS estimates of the cointegrating coefficients. For brevity, we report only the final specifications.[13]

The income differential (y^d) enters only in the equations for three Atlantic provinces (NL, PE, NB) but with a very large elasticity. Compared to this, home income (y) might seem to be a more important explanatory variable, as it enters in five equations. However, its elasticity is always rather small (average around 0.46 in absolute value).

Save for Alberta, we see that migrations originating in the westerly provinces are more likely to respond to changes in home income, while the case is quite mixed for provinces located east of Ontario with three out five home areas responding strongly to income differential. As argued in Faini et al. (1997), a higher home income implies that it may have become easier for households to finance protracted period of unemployment of some of their members causing migration flow to decrease.[14]

The unemployment differential (u^d) enters in seven equations with a average elasticity close to 1. As can be seen, migrations originating in the western provinces respond comparatively more strongly than those of the eastern provinces, in particular the Atlantic ones. This is not surprising given the more generous unemployment benefits existing in the maritime provinces compared to other provinces. It is instead somehow puzzling to find that Manitoba and Saskatchewan react strongly to the unemployment differential, since their condition compared to the average of the provinces has improved or remained approximately constant (see Table 1).

Next, federal transfer differential (g^d) is seen to be relevant for the two most western provinces, while the migration chain (c) measure is relevant only for the three Atlantic provinces. The latter indicates that family and friends who have previously migrated from the Atlantic region to Ontario may have provided important information about their present location which may have made the social transition easier for new migrants from their former locality.

[12] Results are not shown here to save space, but are available from authors on request.

[13] Given the small time sample available we followed the model selection procedure discussed in Fachin (2007).

[14] We are assuming that income was always high enough to make the financing effect (higher home income making it easier to finance the costs of migration, resulting in a positive income-migration link) irrelevant.

Table 3 Modeling migration rates in Ontario, 1974–2004

Panel cointegration tests						
			Bootstrap p-values $\times$ 100			
			Base	FDB_1	FDB_2	
Mean EG	-4.21		0.00	0.10	0.00	
Median EG	-3.74		0.30	0.10	-0.10	
FM-OLS estimates						
Origin	θ	y^d	u^d	g^d	y	c
NL	-5.35 [-10.91]	-2.70 [-7.84]	–	–	–	0.90 [6.48]
PE	-7.50 [-11.62]	-2.72 [-5.23]	0.33 [3.24]	–	–	0.73 [5.65]
NS	-4.29 [-13.30]	–	1.03 [7.99]	-1.06 [2.26]	-0.21 [-7.15]	0.26 [2.48]
NB	-8.79 [-89.56]	-2.74 [-7.09]	0.65 [4.84]	–	–	–
QC	0.88 [0.98]	–	–	–	-0.73 [-7.72]	–
MB	-2.85 [-7.10]	–	1.03 [11.52]	–	-0.47 [-11.26]	–
SK	-0.60 [-1.03]	–	1.51 [15.02]	–	-0.77 [-12.71]	–
AB	-6.55 [-111.43]	–	1.44 [6.22]	-2.38 [-4.00]	–	–
BC	-5.03 [-9.27]	–	0.94 [3.80]	-1.54 [-1.80]	-0.16 [-3.10]	–

Notes: Mean/Median EG: mean/median of the Engle-Granger ADF cointegration tests for the individual equations. The bootstrap algorithm used 1000 redrawings with a fixed length of 4. FDB indicates Fast Double Bootstrap, type 1 and 2 of Davidson and MacKinnon (2000). θ: constant; y^d: log disposable income per capita differential (home-destination); u^d: log unemployment rate differential (home-destination); g^d: log federal transfer per capita differential (home-destination); y: log GDP per capita in home area; c: migration chain. t-statistics are reported in brackets

Summing up, our estimates, in line with previous work on interprovincial migration in Canada (e.g., Day and Winer 2006; Coulombe 2006), suggest the existence of a very strong link between unemployment and migrations. The evidence on income effect is mixed, with the level of home income appearing more important than relative income differentials.

5 Conclusions

We started our study from the observation that migration from the Canadian provinces towards Ontario mostly followed a declining trend over the period 1971–2004. In order to statistically test the hypothesis we have applied the recently developed bootstrap panel cointegration test of Fachin (2007). Applying this test we have been able to reach rather clear conclusions. First of all, a rather small and natural set of determinants (income, labor market and fiscal differentials, income in the sending provinces) is able to explain the observed declining trends. Second, estimation of heterogeneous models suggests that the determinants of migration vary across provinces, with unemployment differential and income in the sending province being the most important explanatory ones. Income and federal transfer differentials appear to play only a minor role. Hence, the general implication of our results is that interprovincial migration has been significantly reduced by shrinking differentials in the labor market and income growth in the sending provinces.

The minor role played by interprovincial differences in federal transfer payment in explaining the observed declining trends should come as no surprise as many have questioned the effectiveness of the equalization program[15] in addressing fundamentals problems faced by poor provinces (see e.g., Boothe and Hermanutz 1999). Setting aside the equity[16] concern, the equalization program has been sharply criticized on the efficiency ground in that it prevents efficient interprovincial migration by individuals (see e.g., Courchene 1970; Boadway and Flatters 1982). For example, persistent interprovincial differences in government-provided benefits (net of taxes) may induce individuals to migrate to capture better net benefits (i.e., economically inefficient migration), rather than migrating on the basis of better employment opportunities (i.e., efficiency-enhancing migration). Nevertheless, reviewing a good deal of empirical work, Day and Winer (1994) fail to observe any clear evidence that intergovernmental grants have a direct effect on migration. Our results confirm this finding.[17]

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[15] One of the major components of the federal transfer programs; the other being the unemployment benefits.

[16] One of the findings by Boothe and Hermanutz (1999) is that resources go from low-income families in some provinces to high-income families in other provinces. Indeed, the extent of perverse interpersonal redistribution across provinces has been a major limitation of the equalization program—see Poschmann (1998) for numerical evidence on the net cost of federal transfer (and taxes) for families of various incomes in each province.

[17] Our paper is closely related to the strand of literature that examines regional disparity in income across Canadian provinces. As such, convergence in income is likely to reduce the economic motivation for migration, while absence or lack of convergence, on the opposite, is likely to trigger migration from poorer to the richer provinces. While empirical results on convergence issue are inconclusive, a recent study by DeJuan and Tomljanovich (2005) find very strong evidence of economic convergence for most part of Canada over the period 1926 to 1996.

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