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PRICE INDEX CONVERGENCE AMONG PROVINCES AND CITIES ACROSS CANADA: 1978-2001*

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Abstract

We study the convergence of price indices for Canadian provinces and cities for the period 1978-2001 for (a) ten provinces and nine commodity/price groups; and (b) fifteen cities across Canada and four commodity/price groups using panel unit root tests. The empirical results reject the unit root hypothesis for price data across provinces and cities. The estimated rate of convergence in Canada is comparatively faster than the rates for similar studies reported for U.S. cities. The empirical results also reveal a relatively faster rate of convergence during the post-inflation targeting period (1991-2001), than earlier.

Key Words: Intra-national PPP, Panel unit root, Canada, CPI, Half-life.

JEL Classification: F41, E31

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1. Introduction

In recent times, the empirical failure of international Purchasing Power Parity (PPP) in the short-run, has led many researchers to search for its relevance within an economy (Cecchetti, Sonara and Mark, 2000; Sonora, 2001; Chaudhuri and Sheen, 2001; Culver and Papell, 1999). Given the fact that the barriers towards trade and distortions within a country are usually smaller than those between countries, there is a better chance of PPP holding in an intra-national rather than an international context.

In Canada, reforms in monetary, fiscal, structural, and internal/external trade in the 1990s have made the country to be one of the most open economies in the world with a good record of managing inflation. In the 1970s and 1980s, Canada experienced high and variable rates of inflation creating considerable economic distortions and damage. In the 1980s, the Canadian economy experienced an average of about 7% inflation. The introduction of the Goods and Service Tax (GST) (on January 1, 1991), together with oil-price shocks created concerns about the possibility of inflation escalating in Canada. It was in this context that Canada adopted inflation targeting (in February 1991), the second country to do so after New Zealand, with the aim of bringing inflation down and approaching 'price stability'.

The first formal inflation target was set for December 1992 at a rate of 3 per cent (plus or minus 1 per cent). This inflation target was subsequently reduced to 2.5 per cent in 1994 and 2 per cent by 1995. These targets were generally achieved in a fairly short period of time (Dodge, 2002). Given Canada's good inflation control record in the 1990s, it would be interesting to examine the relevance of price convergence in the pre-and post-inflation targeting period. The Agreement on Internal Trade (AIT), between the federal and provincial governments that came into force on July 1, 1995, substantially diminished barriers to inter-provincial trade flows. This, along with the Canada-US Free Trade Agreement (FTA) in 1989 and in January 1994 (North American Free Trade Agreement) has furthered trade within the economy and with U.S. in particular. Canada's trade regime is very open with 90 per cent of the imports entering duty free and an average trade-weighted tariff rate of 0.9 per cent (World Trade Organisation, 2002).

Researchers have analysed the empirical relevance of PPP using the technique of univariate unit root tests; evidence of PPP can be provided by tests of a unit root in the exchange rate or prices. If the unit root null hypothesis can be rejected in favour of a level stationary alternative, then there is a long-run mean reversion and any deviations from parity should diminish (albeit slowly) over time. One of the major problems faced by researchers with regard to unit root testing is their low power, especially in small samples. In recent years, the use of panel unit root tests has alleviated this problem to a great extent by exploiting both cross and time series variation. These tests which have power and size advantages over univariate unit root tests have also added a new dimension to the old debates as many of them found stronger support for the PPP hypothesis.

Most of the studies based on panel unit root tests have led to the rejection of the null hypothesis of a unit root. These studies have found mean reversion with estimates of rates of convergence or half lives of price disparities ranging from 9 years for the U.S. (Cecchetti *et al.*, 2000); 3-4 years for Australia (Chaudhuri and Sheen, 2001), and 4 years for European countries (Culver and Papell, 1999) as against the consensus estimates of 4 to 5 years for international price differentials. The study for Canadian cities by Sonora (2001), however, found little evidence of mean reversion among cities. However, the study by Ceglowski (2003) found price convergence among retail prices across 25 Canadian cities. The divergence in conclusions among these studies raises questions about the time period covered in these studies, the cities and commodity groups covered, and the appropriateness of various panel unit root tests, among other issues .Our study endeavours to address these issues using Canadian data for a longer time span (1978-2001) for both provinces and cities using various commodity/price groups for the pre-and post-inflation targeting periods. The study differs from that of Ceglowski (2003) in that it uses CPI data rather than retail prices and covers panels of provinces and cities.

The rest of the paper is organised as follows: section 2 discusses the sources of data for empirical analysis and relevant descriptive statistics. Section 3 discusses the methodology adopted in our empirical exercise. Section 4 is devoted to an empirical examination of PPP hypothesis at the aggregate and various commodity/price groups for a panel of Canadian provinces and major cities. Section 5 summarises the conclusions emanating from the study.

2. Sources of Data and Descriptive Statistics

Our primary dataset consists of a panel of 90 quarterly observations of the Consumer Price Index (CPI) at an aggregate level and various commodity/price groups for the period September 1978 to March 2001. The data are compiled from CANSIM II – the online database of Statistics Canada.

The panel unit root tests have been carried out separately for the panel on (a) federal/ provincial and (b) federal/city level. At the federal/provincial level, the empirical analysis has been conducted covering ten provinces, viz., (i) New Brunswick (NB), (ii) Nova Scotia (NS), (iii) Prince Edward Island (PEI), (iv) Newfoundland (NF), (v) Ontario (ON), (vi) Quebec (QB), (vii) Manitoba (MB), (viii) Saskatchewan (SAS), (ix) Alberta (AL), (x) British Columbia (BC).

As data for full panel are not available for the territories, we have excluded them from our analysis. The commodities covered include all-items CPI and the CPI for eight commodity/price groups, *viz*., (i) Shelter (S), (ii) Food (F), (iii) Transportation (T), (iv) Health and Personal Care (HPC), (v) Recreation, Education & Reading (RER), (vi) Alcohol Beverages and Tobacco Products (ABT), (vii) Household Operations and Furnishings (HOF), (viii) Clothing and Footwear (CF).

At the city level, the analysis is confined to 15 cities and five commodity/price groups, viz., (i) All-items CPI, (ii) Shelter, (iii) Rental Accommodation, (iv) Owned Accommodation and (v) Water, Fuel and Electricity. With the introduction of new base in 1992 (as compared with the old base 1986 = 100), Statistics Canada has discontinued supply of disaggregated commodity/price groups CPI data for all series except the above five at the city level. We have included the following cities in our analysis for which the comparable data could be collected for the above mentioned commodity/price groups: St. Johns (Newfoundland), Charlottetown-Summerside, Halifax, St. Johns (New Brunswick), Quebec, Montreal, Ottawa, Toronto, Thunder Bay, Winnipeg, Regina, Saskatoon, Edmonton, Calgary, Vancouver.

Table 1 reports the average inflation rates in Canada and the provinces for various commodity/price groups. At the aggregate level, Canada recorded an average price rise of 2.1 per cent per annum during 1978-2001. Among the commodities, Alcohol Beverages and Tobacco Products (ABT) recorded a slightly higher price rise (3.4 per cent per annum), while price groups like Household Operations and Furnishings (HOF) and Clothing and Footwear (CF) recorded relatively lower price rise (1.7 per cent per annum). Among the provinces, PEI recorded a moderately lower rate of inflation (1.9 per cent per annum).

Table 1– Average quarterly inflation rates across Canada and Provinces: 1978-2001 (Per cent)

Provinces	All-items CPI	Food	Shelter	Transportation	Health & Personal Care	Recreation, Education & Reading	Alcohol, Beverages & Tobacco	Household Operations & Furnishings	Clothing & Footwear
1	2	3	4	5	6	7	8	9	10
Canada…………	2.1	1.9	2.1	2.5	2.2	2.4	3.4	1.7	1.7
(i) New Foundland…..	2.0	1.5	1.9	2.4	1.8	2.4	3.3	1.4	1.8
(ii) Prince Edward Island………..	1.9	1.8	1.6	2.1	2.4	2.4	3.7	1.8	1.6
(iii) Nova Scotia	2.1	1.9	1.9	2.3	2.2	2.4	3.5	1.5	1.8
(iv) New Brunswick…..	2.1	1.9	2.0	2.2	2.0	2.4	3.4	1.6	1.7
(v) Quebec…….	2.2	1.9	2.3	2.2	2.3	2.3	3.3	1.7	1.8
(vi) Ontario……	2.3	1.9	2.3	2.7	2.3	2.5	3.2	1.7	1.7
(vii) Manitoba...	2.2	2.0	2.1	2.5	2.1	2.5	3.7	1.8	2.0
(viii).Saskatchewan…………..	2.2	1.9	2.1	2.4	2.6	2.3	3.6	1.5	1.8
(ix) Alberta……	2.1	1.8	1.9	2.5	2.2	2.4	4.0	1.4	1.5
(x) British Columbia……	2.1	2.1	1.5	2.7	2.1	2.5	3.7	1.7	1.7

3. Methodology

It is now generally accepted that traditional unit root tests such as Dickey-Fuller (DF) and augmented Dickey-Fuller (ADF) tests lack power in distinguishing the unit root null from stationary alternatives, especially in small samples. Researchers have tried to exploit the panel dimension of the data as one way of increasing the power of unit root tests. In recent years, a number of methodological developments by Levin and Lin, (LL) 1993, Im, Pesaran and Shin, (IPS) 1996; Maddala and Wu, 1997; and Sarno and Taylor, 1998, have provided foundations for the application of panel tests to a wide variety of economic and financial variables. The main advantage of panel unit root tests is that they can be used even with a small number of observations.[1]

The general model of N series and T time periods that encompass all panel unit root tests is

$$\Delta Y_{it} = \alpha_i + \beta_i Y_{i,j-1} + \sum_{j=1}^{k_i} \gamma_{ij}\, \Delta Y_{i,t-j} + u_{it} \quad ; \quad t = 1, \ldots, T \quad ; \quad i = 1, \ldots, N \qquad (1)$$

The cross-sectional means for the panel are first subtracted from each series. Y_{it} is the log price level of province or city i at time t and α_i is a province or city-specific constant to control for non-time-dependent heterogeneity across provinces or cities and k is the number of lags. In the Abauf- Jorian (1990) panel unit root test, all of the β_i's are restricted to be identical, and the lagged differences are omitted from each equation.

Levin and Lin (1992, 1993) provided the statistical foundation for panel unit root tests. Under the LL test, the null and alternative hypothesis is given by H_0: $\beta_i = 0$ and H_1: $\beta_i < 0$. Their specification, provided for lagged differences to correct for serial correlation of the error terms. However, they did not address the problem of contemporaneous cross-correlation of the errors and restricted all panel members to have identical orders of integration. This limitation becomes all the more important in panels with mixed orders of integration. Although the null hypothesis that all series have a unit root is correctly rejected, the alternative of ‘all stationary’ is also false in these mixed panels.

Recognising this problem, Im *et al.* (1997), Maddala and Wu (1997) and Sarno and Taylor (1998) presented second generation panel unit root tests that allow the auto regressive co-efficient to differ across the panel under the alternative hypothesis. Under the IPS test, the null and alternative hypothesis can be represented as H_0: $\beta_i = 0$, $\forall i$; and H_1: $\beta_i < 0$, for some i. The IPS test is constructed as a simple average of the t-statistics on the β_i's generated from N single-equation augmented Dickey-Fuller tests. The IPS test is based on N augmented Dickey-Fuller equations, which allows different autoregressive coefficient as well as heterogeneity of lag structures in the N individual series. We employ the LL and IPS panel unit procedures.

Maddala and Wu (1997) use single-equation OLS estimation similar to the IPS test except that the p-values corresponding to the individual t-statistics on the β_i's are used to construct the (Fisher) test statistic. Sarno and Taylor (1998) propose a test that also allows the autoregressive coefficient across panel members to be different. The test proposed by Sarno and Taylor is the multivariate augmented Dickey-Fuller; the test is based on SUR estimation of the unrestricted version of the model allowing both heterogeneous lags structures across the panels.

One of the common methods of measuring persistence is to calculate the half-life[2] of price deviations, *i.e.* the amount of time it takes a shock to a series to revert half-way back to its mean value. The approximate half-life of a shock to Y_{it} is computed as $-\ln(2)/\ln(\rho_i)$, where $\rho_i = \sum_{j=i}^{k_i} \gamma_{ij}$. Our primary focus is on the β_i's, the coefficients on the lagged logarithm of the price index, Y_{it}; the nearer β_i is to zero, the longer is the estimated half-life of a shock. As stated above, in the LL test, the alternative is H_1: $\beta_i < 0$; whereas in the IPS test we have H_1: $\beta_i < 0$ for at least one *i.* Studies by Bowman (1998) and Maddala and Wu (1999) find that the IPS test has more power than the LL test. The LL test has the advantage of providing us with a panel estimate of ρ, whereas the IPS procedure does not.

In the empirical estimation, equation (1) is augmented with an additional variable (θ) to take into consideration common time effects, as in equation (2):

$$\Delta Y_{i,t} = \alpha_i + \theta_t + \beta_i Y_{i,t-1} + \Delta \sum_{j=1}^{k_i} \gamma_{i,j} \Delta Y_{i,t-j} + u_{i,t} \quad (2)$$

where the γ_{ij}'s are the lag coefficients. The common time effects, θ_t, capture the influence of macroeconomic shocks that induce cross-sectional dependence in prices. We incorporate these effects by subtracting the cross-sectional mean of the series each period and basing the tests on the transformed data.[3] Computationally, this is identical to including common time dummy variables in equation (2).

The OLS estimator of ρ is downward biased in small samples (Kendall, 1981). In order to correct for the small sample bias, we follow the popular method of adjustment recommended by Nickel (1981) for adjustment of the $\hat{\rho}$ values. The estimated bias adjusted ρ along with the approximate half-life calculation[4] are reported in Tables 2 and 3.

To control for the residual dependence across provinces and in the cities panel, we follow Chechetti, Sonara and Mark, (2000), and calculate critical values of the test statistics using the bootstrapping procedure with 5,000 replications using the estimated variance-covariance matrix from our data.

Table 2: Panel Unit-Root Results – Provinces[5]

	A, Levin and Lin (LL)		B. Im, Pesaran and Shin (IPS)			
Period	τ Statistic	p-value	τ-bar statistic	p-value	Adjusted $\hat{\rho}$	Adj half-life
All-items CPI						
1978:09-2001:03	-3.624**	0.06	-1.47**	0.05	0.9762	28.8
1978:09-1991:01	-3.211**	0.14	-1.40**	0.05	0.9759	28.4
1991:02-2001:03	-2.44**	0.18	-0.92**	0.04	0.9748	27.2
Food						
1978:09-2001:03	-6.59***	0.09	-1.32*	0.08	0.9769	29.6
1978:09-1991:01	-6.28*	0.16	-1.55*	0.08	0.9813	36.6
1991:02-2001:03	-15.64	0.18	-1.32*	0.06	0.9979	326.0
Shelter						
1978:09-2001:03	-3.03*	0.05	-1.26*	0.08	0.997	230.7
1978:09-1991:01	-3.06*	0.09	-1.31*	0.08	0.985	45.9
1991:02-2001:03	-2.08	0.17	-0.80*	0.07	-	-
Transportation						
1978:09-2001:03	-4.79*	0.09	-1.88**	0.05	0.98	34.3
1978:09-1991:01	-3.90*	0.14	-1.42**	0.04	0.998	346.2
1991:02-2001:03	-5.34	0.25	-1.76**	0.04	0.998	346.2
Health & Personal Care						
1978:09-2001:03	-4.01*	0.06	-1.46*	0.07	0.9781	31.3
1978:09-1991:01	-3.76*	0.14	-1.52*	0.07	0.9809	35.9
1991:02-2001:03	-4.13*	0.16	-1.50*	0.07	-	-
Recreation, Education & Reading						
1978:09-2001:03	-4.41*	0.05	-1.71*	0.05	0.9746	27.0
1978:09-1991:01	-4.99*	0.17	-1.60**	0.05	0.9812	36.6
1991:02-2001:03	-3.74	0.16	-1.42**	0.04	0.9747	27.0
Alcohol, Beverages & Tobacco						
1978:09-2001:03	-5.16		-1.75*	0.08	0.997	230.7
1978:09-1991:01	-3.04	0.14	-1.20**	0.05	0.9930	99.3
1991:02-2001:03	-4.87*	.16	-1.79**	0.05	0.954	14.7
Household Operations & Furnishings						
1978:09-2001:03	-2.91**	0.04	-1.05**	0.05	0.999	692.8
1978:09-1991:01	-4.19*	0.09	-1.48**	0.04	0.987	53.0
1991:02-2001:03	-5.77**	0.09	-1.81**	0.04	-	-
Clothing & Footwear						
1978:09-2001:03	-4.08*	0.11	-1.49*	0.06	0.9837	42.1
1978:09-1991:01	-3.16	0.22	-1.38**	0.03	0.9791	32.8
1991:02-2001:03	-2.91	0.32	-1.20**	0.04	0.861	4.6

Notes:
(i) *****, **, *** denote significance at 1%, 5% and 10% level of significance.
(ii) The p-values are obtained by bootstrapping over 5,000 simulations and the lower the value; the stronger is the evidence against the null of a panel unit root.
(iii) The adjusted $\hat{\rho}$ are 1+ the common or groups mean coefficients of the lagged level of the particular series (iv) The method for computing the half-life (measured in quarters) is also given in footnote 4.

4. Empirical Results of Panel Unit Root Tests

(a) *Canada and Provinces*

Table 2 reports the results for aggregate and commodity/price groups for the Canada/ provinces panel. The IPS test overwhelmingly rejects the null hypothesis of panel unit root. Similar tests for various commodity/price groups also corroborate this evidence.

The estimated half-life for Canada is 28.8 quarters or 7.2 years. Among the different commodity/price groups, recreation, education and reading have the lowest half-life (26.9 quarters or 6.7 years), followed by food (29.6 quarters or 7.4 years), health (31.4 quarters or 7.8 years), clothing & footwear (42.1 quarters or 10.5 years) and transportation (34.3 quarters or 8.5 years). Price groups like shelter, alcohol, beverages and tobacco and household operations and furnishings show little evidence of convergence.

(b) Canada and Cities

The empirical results for 15 major cities and four commodity/price groups are reported in Table 3. The IPS test for the cities panel also rejects the null hypothesis of panel unit root.

The estimates of half-life for overall CPI for the period 1978-2001 comes to 29.3 quarters or 7.3 years, which is closer to the panel estimates for provinces. Price groups for shelter and owned accommodation did not show any evidence of convergence. However, these estimates are considerably higher than the half-life estimates of 22 months reported by Culver and Papell (1999).

Table 3: Panel Unit-Root Results – Cities[6]

	A. Levin and Lin (LL)		B. Im, Pesaran and Shin (IPS)			
Period	τ-statistic	p-value	τ-bar statistic	p-value	Adj $\hat{\rho}$	Adj half-life
All-items CPI						
1978:09-2001:03	-3.57*	0.08	-1.47**	0.06	0.9767	29.3
1978:09-1991:01	-3.25	0.14	-1.52**	0.05	0.9714	23.9
1991:02-2001:03	-2.73	0.13	-1.15**	0.05	-	-
Shelter						
1978:09-2001:03	-4.31*	0.08	-1.53*	0.07	0.999	692.8
1978:09-1991:01	-2.55	0.11	-1.15**	0.05	0.988	57.4
1991:02-2001:03	-1.82	0.13	-1.05*	0.06	-	-
Rental Accommodation						
1978:09-2001:03	-2.40*	0.12	-1.84*	0.09	0.9717	24.1
1978:09-1991:01	-2.36*	0.09	-1.55*	0.06	0.9842	43.5
1991:02-2001:03	-3.08*	0.08	-1.73**	0.05	0.9959	169.3
Owned Accommodation						
1978:09-2001:03	-5.09**	0.05	-1.75**	0.05	0.997	230.7
1978:09-1991:01	-3.17	0.11	-1.21**	0.06	0.999	692.8
1991:02-2001:03	-2.70	0.16	-1.20**	0.05	-	-
Water, Fuel & Electricity						
1978:09-2001:03	-3.52**	0.07	-1.58*	0.09	0.9760	28.5
1978:09-1991:01	-2.96	0.15	-1.10*	0.06	0.955	15.0
1991:02-2001:03	-2.82	0.24	-0.87**	0.06	-	-

Note: See the notes for Table 2.

Among the four commodity/price groups, rental accommodation has a half-life of 6 years; water, fuel and electricity have an estimated half-life of 7.1 years; the corresponding estimates for commodity groups like shelter, owned accommodation either show very slow convergence or no convergence at all. Interestingly, the convergence rates for cities across Canada (7.3 years) are relatively faster than those reported for cities across the United States (9 years).

5. Concluding Observations

In this paper, we have examined the issue of convergence of prices (CPI) in Canadian provinces and cities panel at the aggregate and various commodity/price group levels for the

period 1978-2001. The size of panel was ten and fifteen for provinces and cities, respectively.
Based on panel unit root test for the period 1978-2001, we found evidence against a panel unit root and thus support for intra-national PPP for provinces and cities. We also found evidence of mean reversion among the majority of price groups.

With regard to the degree of persistence of deviations from PPP after a shock, our empirical estimates showed a half-life of 7.2 years for Canada, which is lower than similar estimates for US cities (9 years) (Cecchetti *et al.*, 2000). Among, the commodity/price groups, there was either very slow or hardly any convergence in the case of shelter, alcohol, beverages and tobacco and household operations and furnishings. As regards the various sub-periods, the post inflation-targeting period (1991-2001) had relatively faster convergence (27.2 quarters, or 6.7 years) in prices.

The empirical results for 15 major cities and four-commodity/price group also rejected the null hypothesis of panel unit root. The estimates of half-life for the full panel period (1978-2001) comes to 7.3 years which is closer to the panel estimates for provinces. Among the four commodity/price groups rental accommodation has a half-life of 6 years, water, fuel and electricity has an estimated half-life of 7.1 years; the corresponding estimates for commodity groups like shelter, owned accommodation do not show any evidence of convergence.

The results overwhelmingly show that the speed of mean reversion across Canadian provinces and cities is relatively faster than those reported for U.S. cities and this is in consonance with the results of previous studies (Cecchetti *et al.*, 2000). This raises a number of interesting policy questions: does faster price index convergence in Canada indicate a relatively more efficient and flexible product/non-product market or has it to do with the inclusion of non-traded goods in CPI (in other countries). Studies on Canada provide some interesting insights: In Canada, trade between provinces is estimated to be anywhere from 2 ½ times to 20 times (McCallum, 1996). The potential benefits of eliminating internal trade barriers show gains ranging from 1 to 1.5 per cent of GDP (Trebilcock and Behboodi, 1995; Migue, 1994). McCallum's (1995) study showed that trade between two Canadian provinces is more than 20 times larger than trade between a province and a U.S. state. Similarly, the study by Engel and Rogers (1996) of comparing the disaggregated data from 9 Canadian cities and 6 Canadian provinces with that of 14 U.S. cities found that crossing the border was comparable to adding about 75,000 miles of distance. These explanations need to be revisited and re-examined in future research.

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Footnotes:

*A preliminary draft of the paper was presented by the authors at the Pacific Northwest Regional Economic Conference (PNREC) held in Portland, Oregon, USA during 15-17 May 2002.

[1] For a comprehensive survey and analysis of these tests, see Banerjee (1999).

[2] Given $S_t = \rho_1 S_{t-1} + \rho_2 S_{t-2} + ...\rho_{k+1} S_{t-k-1} + \varepsilon_t$, the approximate measure for the time needed to eliminate half of any shock to ε is $-\ln(2)/\ln(\rho_1)$. The approximate measure is always a real number for our discrete models and so the half-life must be the rounded-up value. To compute the exact half-life, note that any $k+1^{th}$ order difference equation can be written as 1^{st} order $(k+1)^{th}$ vector difference equation of the form $S_t = AS_{t-1} + e_t$, where $S_t = \{S_t, S_{t-1}, ...S_{t-k-1}\}$' and matrix A and e_t are defined accordingly. Then $ES_T = A_T S_1$. Setting s_0 to 0 and then allowing $S_1 = \varepsilon_t > 0$, we can determine the value of T that makes $E(S_T) = \varepsilon_t/2$.

[3] We did not consider the need to designate a numeraire city or province in our panel econometric analysis since the cross-sectional mean or common time effect captures the cross-sectional dependence in prices.

[4] Half-life calculations are based on a bias-adjusted ρ estimates, applying Nickel's (1981) formula, which is given by: $p \lim N \rightarrow \infty (\hat{\rho} - \rho) = A_T B_T / C_T$ where $A_T = -(1+\rho)/T - 1), B_T = 1 - (1/T)(1-\rho T)/1-\rho),$ and $C_T = 1 - 2\rho(1 - B_T)/1 - B_T)/((1-\rho)(T-1))$. This bias arises in any AR (1) fixed effects model and is always negative for positive ρ. As with the Kendall bias adjustment, we recognize that it is a first order approximation of the bias for an AR (k+1) process, and that all k+1 coefficients will suffer from bias.

[5] In addition to Canada, the following provinces have been included in our empirical analysis: Nova Scotia, New Brunswick, Newfoundland, Prince Edward Island, Quebec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia

[6] The following cities are part of our analysis: St. Johns (Newfoundland), Charlottetown-Summerside, Halifax, St. Johns (New Brunswick), Quebec, Montreal, Ottawa, Toronto, Thunder Bay, Winnipeg, Regina, Saskatoon, Edmonton, Calgary and Vancouver.