Geloso, Vincent; Kufenko, Vadim; Prettner, Klaus

Working Paper
Demographic change and regional convergence in Canada

Schriftenreihe des Promotionsschwerpunkts Globalisierung und Beschäftigung, No. 49/2016

Provided in Cooperation with:
PhD program "Globalization and Employment", University of Hohenheim, Carl von Ossietzky University Oldenburg, Evangelisches Studienwerk

Suggested Citation: Geloso, Vincent; Kufenko, Vadim; Prettner, Klaus (2016) : Demographic change and regional convergence in Canada, Schriftenreihe des Promotionsschwerpunkts Globalisierung und Beschäftigung, No. 49/2016, Universität Hohenheim, Stuttgart, http://nbn-resolving.de/urn:nbn:de:bsz:100-opus-12437

This Version is available at:
http://hdl.handle.net/10419/144542

Terms of use:
Documents in EconStor may be saved and copied for your personal and scholarly purposes. You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.
Demographic Change and Regional Convergence in Canada

von

Vincent Geloso, Vadim Kufenko, Klaus Prettner

Stuttgart-Hohenheim
ISSN 1618-5358
Unemployment is persistently high in many European countries. It is frequently attributed to ‘functional deficiencies of labor markets’, even though to a large extent caused by demand and supply shifts in goods markets and financial markets. The PhD program Globalization and Employment therefore focuses on the employment effects of structural change and macroeconomic developments and encourages research by granting scholarships. The dissertation projects address topics such as new technologies, processes of internationalization and system transformation, endogenous finance constraints and various strategies of fiscal and monetary policy.

Work and supervision in the PhD program follows the structures of a standard graduate school. Coordinators and editors of the discussion paper series are the following professors:

Prof. Dr. Harald Hagemann  
Department of Economics (520H)  
University of Hohenheim  
D-70593 Stuttgart  
harald.hagemann@uni-hohenheim.de

Prof. Dr. Heinz-Peter Spahn  
Department of Economics (520A)  
University of Hohenheim  
D-70593 Stuttgart  
peter.spahn@uni-hohenheim.de

Prof. Dr. Hans-Michael Trautwein  
Department of Economics and Statistics  
Carl von Ossietzky University Oldenburg  
D-26111 Oldenburg  
michael.trautwein@uni-oldenburg.de

PhD projects in the program can be funded by grants of the Evangelisches Studienwerk e.V. Villigst. Application forms can be ordered from:

Evangelisches Studienwerk e.V.  
Promotionsförderung  
Iserlohner Str. 25  
D-58239 Schwerte  
Phone: +49 (2304) 755-215, Fax: +49 (2304) 755-250

For further information about the PhD program Globalization and Employment as well as the PDF-files of the discussion papers see:

http://www.globalization-and-employment.de
Abstract: We examine the role of demographic change for regional convergence in living standards in Canada. Due to economies of scale within a family, decreasing household size has an impact on convergence in living standards, while per capita income convergence remains unaffected. We find that, by relying on per capita income, the dispersion of living standards between Canadian regions is overestimated prior to the 1990s and underestimated thereafter. As a consequence, relying on income per capita results in overestimating the speed of convergence in living standards.

JEL CODE: O47, J12, N12.

KEYWORDS: Regional convergence, living standards, demographic change, household size.
**Introduction**

Within western countries, poorer regions have typically been catching up with richer regions since the 19th century. The same is true for Canada (Brown and Macdonald 2015; Macdonald 2015; Gunderson 1996; Coulombe and Lee 1995; DeJuan and Tomljanovich 2005). Since larger households command economies of scale and household sizes have changed considerably over the last century, calculating convergence in living standards by relying on *per capita* income might be misleading (Deaton, 1997; Deaton and Muellbauer 1980; Deaton and Paxton 1998). Buhmann et al. 1988 and Citro and Michael 1995 have suggested using equivalence scales instead of *per capita* measures, where household income is divided by the square root of the number of household members to calculate an adult equivalent (AEQ). We follow this approach and show that such an adjustment for household size leads to substantial changes in the calculated dispersion of living standards at various points in time and, consequently, also results in substantial changes in the calculated rate of convergence.

In the Canadian census of 1871, the initial four provinces (Ontario, Quebec, Nova Scotia, and New Brunswick) had substantially different dwelling sizes. The richest province, Ontario, saw a precipitous and continuous decline in the average number of persons per dwelling, while poorer provinces such as Quebec saw that proportion fall at a much lower rate until the 1950s. This is illustrated in Figure 1, which shows that the average number of persons per dwelling in the Canadian provinces varied widely from a historical point of view, but eventually converged over time.
Economic theory implies that regional incomes tend to converge. Seminal empirical studies have shown that this is indeed the case for the United States (Barro and Sala-i-Martin 1991, 1992; Lindert and Williamson 2016). In our study, we rely on the concept of sigma-convergence, i.e. the reduction in the dispersion of income levels between regions, to quantify convergence processes. The connection between sigma-convergence and beta-convergence is given by

\[ \sigma_t^2 = (1 - \beta)^2 \sigma_{t-1}^2 + \sigma_u^2, \]

where \( \sigma_t^2 \) is the variance of regional income, \( \beta \) is the speed of beta-convergence, and \( \sigma_u^2 \) is the variance of exogenous shocks to income. Note that beta-convergence is a necessary but not sufficient condition for sigma-convergence (Durlauf, Johnson and Temple 2005), as sigma-convergence is the stronger concept.

For the purposes of our paper, we relied on the output series of Irwin and Inwood (2002) for the years 1871, 1891, and 1911. Their paper includes the initial four provinces of Canada.
(Quebec, Ontario, New Brunswick, and Nova Scotia) but does not include the other provinces that joined Canada later (Manitoba, British Columbia, Prince Edward Island, Saskatchewan, and Alberta). Consequently, we have to rely on Green (1971) for the years 1891, 1911, and 1921. After 1926, we can rely on the dataset provided by Brown and Macdonald (2015a and 2015b), which computes personal income per capita and per province from 1926 to 2013, particularly for the purposes of analyzing regional convergence.

The estimates of population and dwelling sizes were compiled from the volumes of the different censuses of Canada. From 1871 to 1951, censuses were decadal. After 1956, they were undertaken on a quinquennial basis. We use the number of dwellings as a measure for the number of households because, over long periods of history, it was not uncommon for younger families to share a household with another family. Using the number of families instead of dwellings would have been misleading for two reasons: First, economies of scale extend to two families in the same dwelling – both families would benefit from this arrangement. Second, the number of families per dwelling was not the same across provinces in earlier periods. Using families instead of dwellings as the unit for capturing economies of scale would therefore introduce another dimension of convergence (convergence in the number of families per dwelling).

It is well known that the variance is affected by a proportional change to the observed variable. Sheret (1984) notes that the unweighted coefficient of variation is biased in the case of changes in the sample size. Therefore, we use the weighted coefficient of variation as proposed by Sheret (1984, p. 290):

$$\text{CV}_w = \frac{\sum_{i=1}^{n} (w_i x_i - \bar{x}_w)^2 / (n-1)}{\bar{x}_w},$$

where $\text{CV}_w$ is the weighted coefficient of variation, $w_i x_i$ is the weighted value of the observation, $x_i$, $\bar{x}_w$ is the weighted average over all observations, and $n$ is the sample size. The weights are assigned according to the share of regional income in aggregate income, and the time series of the weighted coefficient of variation is calculated for each year for which the data is available.
Results

From the beginning onwards, the most populous province, Ontario, was also Canada’s richest region, followed by British Columbia. Alberta, Saskatchewan and Manitoba are close to the national average, while Quebec, Prince Edward Island, Nova Scotia, New Brunswick and Newfoundland find themselves below the national average. The poorer provinces also had substantially larger households. Due to economies of scale, one dollar of income goes further in a larger household than in a smaller one. Over time, incomes converged across provinces. However, the differences between household sizes also narrowed. Against this backdrop, we expect that income differences measured in terms of adult equivalents are lower than those measured in per capita terms. We also expect a more modest convergence trend over time: as poorer provinces catch up with richer provinces in per capita income terms, the accompanying reductions in household size imply that the economies of scale effect dissipates.

Figures 2 and 3 confirm that there is an impact of shifting from per capita measures to adult-equivalent measures. Figure 2 shows convergence in total income, while figure 3 addresses disposable income. Both figures confirm our reasoning, as the AEQ lines are lower than the lines associated with per capita income until the 1990s. It is only after 1990 that the AEQ measure of dispersion is higher than the per capita measure. This signals divergence, once households are considered in the denominator.

The increasing divergence between Canadian provinces up to the end of the first half of the 20th century is consistent with the historiography of living standards in Canada (McInnis 1968; Altman 1988, 1995, 2003; Inwood and Irwin 2002; Green 1971; Geloso 2013; Brown and Macdonald 2015). In the early decades of political unification, the eastern provinces diverged from the populous province of Ontario, while the new western provinces of Alberta, British Columbia, Saskatchewan, and Manitoba tended to exhibit income levels close to those of Ontario. The convergence of the post-war era (De Juan and Tomljanovich 2005) is visible, but its magnitude is reduced. While per capita figures show continued convergence until 2013, the adult-equivalent figures suggest a different pattern after the 1980s – a slight increase in dispersion.
When analyzing convergence, it is important to consider the role of intergovernmental transfers as well. Under the guise of equalization payments and federal transfers to the provinces,
poorer provinces gain at the expense of richer provinces (Coiteux 2009). Figure 3 shows that fiscal transfers across provinces have a weak impact on reducing income disparities. Our conclusions about divergence hold for Figure 3 as well.

**Conclusion**

We show that convergence is affected considerably by shifting to a measure that adjusts for differences in household size. Most notably, the convergence of living standards is slower when measured in adult equivalent units instead of *per capita* units. Our results suggest an important venue for convergence studies. The differences in household sizes within Canada are small relative to those between different countries. In the late 20th century, household sizes in OECD countries hovered around 3 persons per household, while developing countries had average household sizes closer to 5 persons (Boongaarts 2001). This is a significant difference to account for, which could have sizeable effects on estimates of livings standards and convergence rates.

**REFERENCES**

**Primary Sources:**

Census of Canada, 1881, Volume 1

Census of Canada, 1901, Volume 1

Census of Canada, 1921, Volume 3

Census of Canada, 1931, Volume 5

Census of Canada, 1951, Volume 3


Secondary Sources


SCHRIFTENREIHE DES
PROMOTIONSSCHWERPUNKTS
GLOBALISIERUNG UND BESCHÄFTIGUNG

<table>
<thead>
<tr>
<th>Nr.</th>
<th>Jahr</th>
<th>Autor/Institut</th>
<th>Titel</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/1998</td>
<td>1998</td>
<td>Heinz-Peter Spahn</td>
<td>Heterogeneous Labour, the Unemployment Equilibrium, and the Natural Rate</td>
</tr>
<tr>
<td>5/1999</td>
<td>1999</td>
<td>Hagen Krämer</td>
<td>Dienstleistungen: Motor für Wachstum und Beschäftigung in Deutschland?</td>
</tr>
<tr>
<td>6/1999</td>
<td>1999</td>
<td>Jürgen Kromphardt</td>
<td>Lohnbildung und Beschäftigung</td>
</tr>
<tr>
<td>7/1999</td>
<td>1999</td>
<td>Ewald Walterskirchen</td>
<td>Beschäftigungspolitik in Österreich</td>
</tr>
<tr>
<td>8/1999</td>
<td>1999</td>
<td>Reiner Franke</td>
<td>Lohnzurückhaltung, Beschäftigung und (zu) einfache empirische Zusammenhänge</td>
</tr>
<tr>
<td>9/1999</td>
<td>1999</td>
<td>Peter Kalmbach</td>
<td>Implications of Integration for Wage Formation and Employment</td>
</tr>
<tr>
<td>10/2000</td>
<td>2000</td>
<td>Arne Heise</td>
<td>Theoretische Grundlagen einer Verhaltensabstimmung der makroökonomischen Politikträger</td>
</tr>
<tr>
<td>13/2000</td>
<td>2000</td>
<td>Bernhard Holwegler</td>
<td>Implikationen der Technologiediffusion für technologische Arbeitslosigkeit</td>
</tr>
<tr>
<td>14/2000</td>
<td>2000</td>
<td>Markus Schreyer</td>
<td>Wachstum und Beschäftigung vor dem Hintergrund des Solowschen Produktivitätsparadoxons</td>
</tr>
<tr>
<td>15/2000</td>
<td>2000</td>
<td>Mauro Boianovsky</td>
<td>Some Cambridge Reactions to The General Theory: David Champernowne and Joan Robinson on Full Employment</td>
</tr>
<tr>
<td>17/2001</td>
<td>2001</td>
<td>Daniel Hartmann</td>
<td>Taylor-Regel und amerikanische Geldpolitik</td>
</tr>
</tbody>
</table>
Nr. 18/2002  Jutta Maute, *Stabilization via Currency Board*


Nr. 20/2004  Dirk H. Ehnts, *Spatial Decisions of Multinational Enterprises and their Effect on Local Firms*

Nr. 21/2004  Theo Schewe, *Makroökonomische Probleme des extensiven Rohstoffexports in einer entwickelten Volkswirtschaft – analysiert am Beispiel der norwegischen Erdölwirtschaft*

Nr. 22/2005  Georg Erber & Aida Sayed-Ahmed, *Offshore Outsourcing - A global shift in the present IT industry*


Nr. 24/2007  Ralf Rukwid, *Arbeitslosigkeit und Lohnspreizung - Empirische Befunde zur Arbeitsmarktsituation gering Qualifizierter in Deutschland*


Nr. 26/2008  Andreja Benković & Juan Felipe Mejia, *Tourism as a Driver of Economic Development: The Colombian Experience*

Nr. 27/2009  Julian P. Christ & André P. Slowak, *Standard-Setting and Knowledge Dynamics in Innovation Clusters*

Nr. 28/2009  Constanze Dobler, *The Impact of Institutions, Culture, and Religion on Per Capita Income*

Nr. 29/2009  Julian P. Christ & André P. Slowak, *Why Blu-ray vs. HD-DVD is not VHS vs. Betamax: The Co-evolution of Standard-setting Consortia*

Nr. 30/2009  Patricia Hofmann, *Die neue neue Außenhandelstheorie: das Melitz-Modell*

Nr. 31/2010  Julian P. Christ, *The Geography and Co-location of European Technology-specific Co-inventorship Networks*

Nr. 32/2010  Julian P. Christ, *Geographic Concentration and Spatial Inequality: Two Decades of EPO Patenting at the Level of European Micro Regions*

Nr. 33/2011  Finn Marten Körner, *An Equilibrium Model of ‘Global Imbalances’ Revisited*


Nr. 36/2012  Georg Erber und Harald Hagemann, *Wachstums- und Investitionsdynamik in Deutschland*

Nr. 37/2012  Ralf Rukwid, *Grenzen der Bildungsexpansion? Ausbildungsunadäquate Beschäftigung von Ausbildungs- und Hochschulabsolventen in Deutschland*

Nr. 38/2012  Vadim Kufenko, *Empirical Analysis of Regional Economic Performance in Russia: Human Capital Perspective*
| Nr. 39/2013 | Harald Hagemann und Vadim Kufenko, *The Political Kuznets Curve for Russia: Income Inequality, Rent Seeking Regional Elites and Empirical Determinants of Protests during 2011/2012* |
| Nr. 40/2014 | Danila Raskov und Vadim Kufenko, *The Role of Old Believers’ Enterprises: Evidence from the Nineteenth Century Moscow Textile Industry* |
| Nr. 41/2014 | Harald Hagemann, Georg Erber, Niels Geiger, Johannes Schwarzer und Oliver Zwiessler, *Wachstums- und Investitionsdynamik in Deutschland* |
| Nr. 43/2015 | Christine Clement, *The Formal-Informal Economy Dualism in a Retrospective of Economic Thought since the 1940s* |
| Nr. 44/2015 | Niels Geiger, *The Rise of Behavioural Economics: A Quantitative Assessment* |
| Nr. 46/2015 | Niels Geiger und Vadim Kufenko, *Business Cycles in the Economy and in Economics: An Econometric Analysis* |
| Nr. 47/2015 | Alex Arsenault Morin, Vincent Geloso und Vadim Kufenko, *Infant Mortality and the Role of Seigneurial Tenure in Canada East, 1851* |
| Nr. 48/2016 | Vadim Kufenko, *Spurious Periodicities in Cliometric Series: Simultaneous Testing* |
| Nr. 49/2016 | Vincent Geloso, Vadim Kufenko und Klaus Prettner, *Demographic Change and Regional Convergence in Canada* |

Die Betreuung und Vernetzung der Arbeiten im Promotionsschwerpunkt entspricht der Arbeitsweise eines Graduiertenkollegs. Betreuer des Schwerpunkts und Herausgeber der Schriftenreihe sind folgende Hochschullehrer:

Prof. Dr. Harald Hagemann
Institut für Volkswirtschaftslehre (520H)
Universität Hohenheim
D-70593 Stuttgart
harald.hagemann@uni-hohenheim.de

Prof. Dr. Heinz-Peter Spahn
Institut für Volkswirtschaftslehre (520A)
Universität Hohenheim
D-70593 Stuttgart
peter.spahn@uni-hohenheim.de

Prof. Dr. Hans-Michael Trautwein
Fakultät II – Institut für Volkswirtschaftslehre
Carl von Ossietzky Universität
D-26111 Oldenburg
michael.trautwein@uni-oldenburg.de

Dissertationsprojekte im Schwerpunkt können durch Promotionsstipendien des Evangelischen Studienwerks e.V. Villigst gefördert werden. Bewerbungsunterlagen können unter folgender Adresse angefordert werden:

Evangelisches Studienwerk e.V.
Promotionsförderung
Iserloher Str. 25
58239 Schwerte
Tel.: 02304/755-215, Fax: 02304/755-250

Weitere Informationen zum Promotionsschwerpunkt sowie die Diskussionsbeiträge der Violettten Reihe im PDF-Format finden sich im Internet unter der Adresse:

http://www.globalization-and-employment.de