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Demographic change and regional convergence in Canada

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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.

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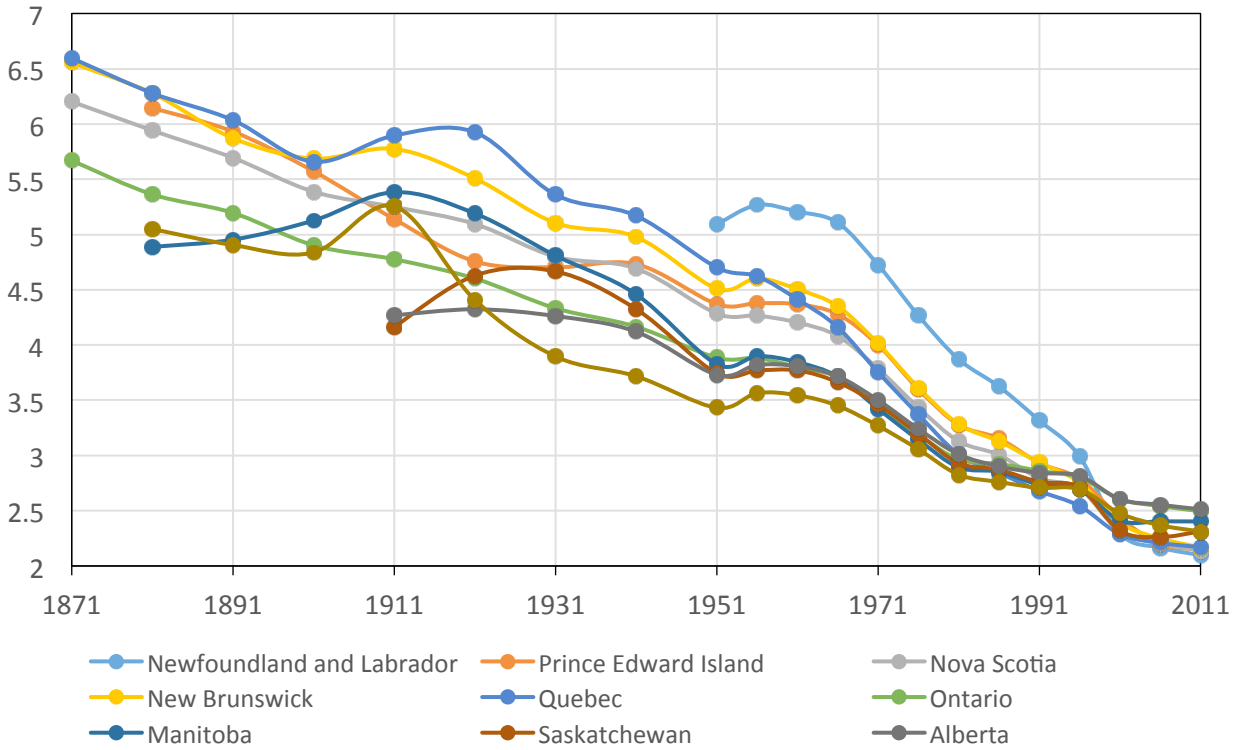
1. Introduction

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.

Figure 1: Average Dwelling Size in Canadian Provinces, 1871 to 2011



Source: Various editions of Canadian censuses, consulted at the Bibliothèque et Archives Nationales du Québec

2. Data and Methods

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

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

where σ_t^2 is the variance of regional income, β is the speed of beta-convergence, and σ_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):

$$CV_w = \frac{\left[\sum_{i=1}^{n} w_i (x_i - \bar{x}_w)^2 \,/\, \sum_{i=1}^{n} w_i\right]^{1/2}}{\bar{x}_w} \tag{2}$$

where CV_w is the weighted coefficient of variation, x_i is the value of the observation, w_i is the weight of the observation, $\bar{x}_w$ 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.

3. 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.

Figure 2: Income: WCV, all regions

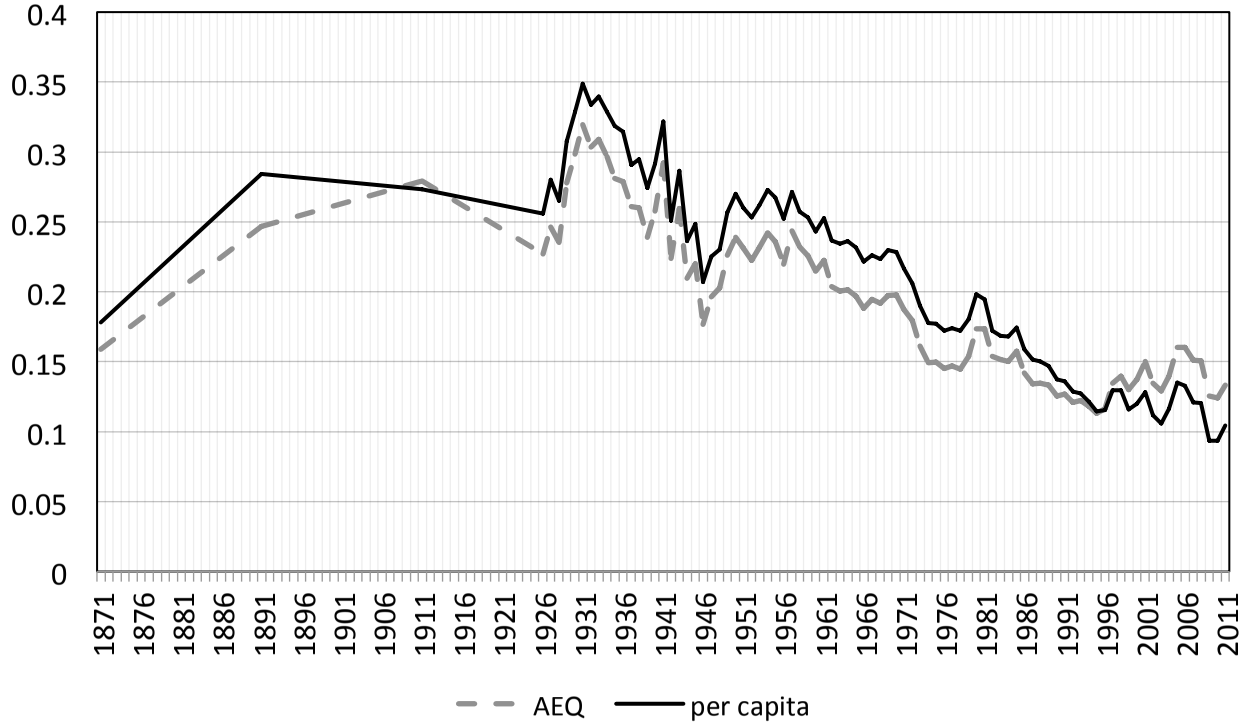
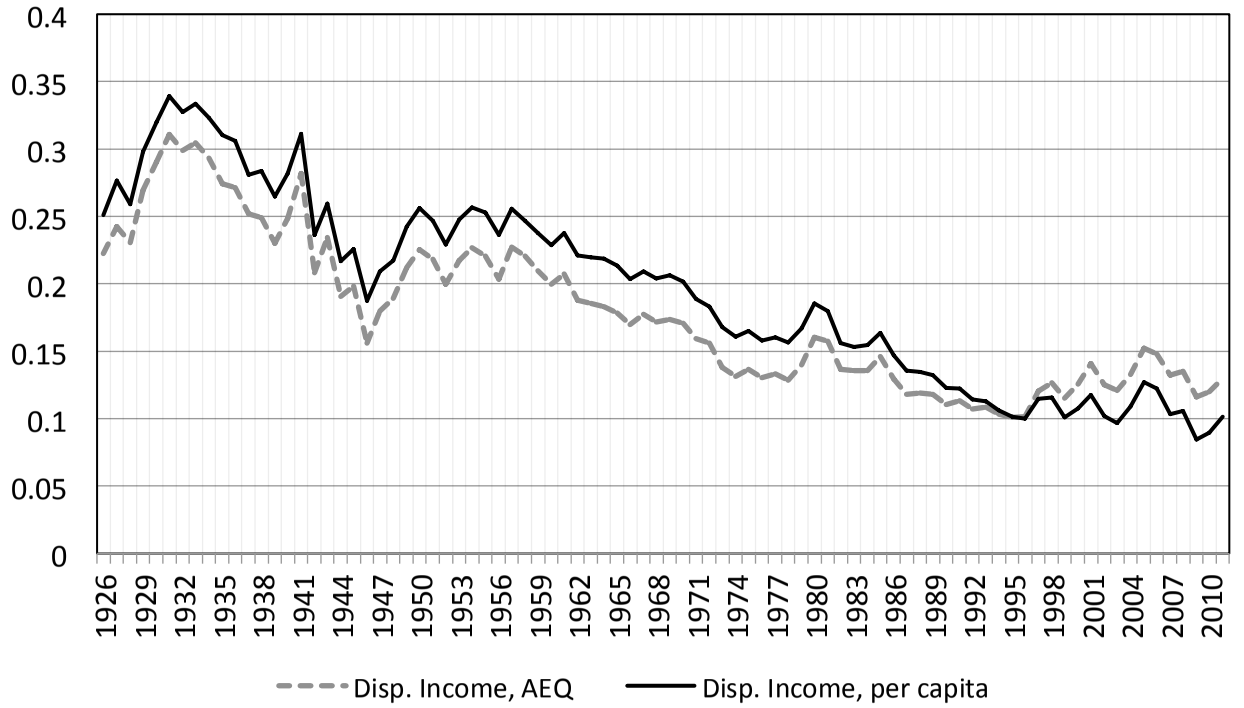


Figure 3: Disposable Income: WCV, all regions



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.

4. 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.

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