Income inequality in Canada: Trends in the Census 1980-2005

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Introduction

A renewed interest in income distribution has arrived at a time when many countries are facing serious fiscal pressures with large deficits projected into the future. Countries such as the United States and the United Kingdom are tangling with the question of how to raise new revenues and from whom those revenues should come. In Canada, the fiscal pressures are less acute as our federal deficit is smaller as a percent of national income. For Canada, this means that raising new revenues is more a matter of choice than necessity.

While the fiscal pressure for change may be different in Canada, recent research on inequality has suggested that many of the trends in income inequality observed in the United States also manifest in Canada. In particular, Veall and Saez (2005), Murphy, Roberts, and Wolfson (2007), and Veall (2010) have documented the rise in the concentration of income at the very top of the income distribution—in the top one percent of income earners. Fortin et al. (2012) and Veall (2012) have begun a discussion of the sources of this rise in inequality and ways that it might be addressed.

In some ways, this literature focused on the top part of the income distribution is not strongly tethered to the more traditional measures of income distribution that look at all parts of the distribution at once. In part, this reflects the administrative tax data sources being used in the recent literature. While there are many advantages to administrative tax data, these data may do worse at recording incomes at the bottom of the income distribution because of non-reporting and mis-reporting among those who do file their taxes. Frenette, Green and Milligan (2007)

argue that for many purposes, Census data may perform better than administrative data—in particular in capturing the incomes of those closer to the bottom of the income distribution.

In this paper, I make two contributions. First, I build on the previous inequality work using the Census by adding an analysis of top incomes to complement the more traditional income inequality measures. This brings together the entire-distribution measures and the high-income measures in an analysis using one source of data. Second, I extend the growing literature on high income concentration by examining the trends in a large survey data source—this contrasts with and complements the administrative data typically used in that literature. In all the analysis, I examine both before- and after-tax incomes using a comprehensive tax calculator which facilitates simulations to uncover insights into the important forces driving inequality trends.

I have several findings of interest. As other researchers have shown, I find a large increase in inequality in the top half of the income distribution in Canada since 1980, and in particular since 1995. The share of income going to those at the top of the distribution has grown markedly since 1995, and this occurs not just for individual market incomes but also family after-tax incomes. Finally, by many measures, inequality in the bottom half of the income distribution has diminished. A primary driver of this change at the bottom has been policy—in particular the growth of refundable tax credits since 1990.

In the next section, I discuss several measurement issues, both about what index of wellbeing is of interest and different available measures to gauge inequality. I then provide a detailed description of the Census and outline its advantages and disadvantages relative to administrative

tax data. Following that, I lay out how I form my dataset and variables for analysis and begin an exploration of the results. I show results for comprehensive income measures, followed by the top incomes analysis, all on a before- and after-tax basis. Finally, I use simulations of the tax systems across different years and provinces to look for the policy sources driving some of the findings in the main analysis.

Measurement

The ultimate target of the study of inequality is to understand how economic wellbeing is distributed. On this target, there is much agreement. However, measuring economic wellbeing is controversial. The controversy spans both what index of wellbeing ought to be measured and also how to summarize inequality using the chosen index. As well, Richardson (2012) emphasizes that judgments about what part of the income distribution is important are necessarily subjective, meaning that different people may reasonably want to focus on different measures. Below I first discuss different possible indexes of wellbeing, then different ways to measure the chosen index.

Which index of wellbeing?

Candidate measures for an index of wellbeing include wealth, permanent or lifetime income, consumption, and period (e.g. annual) income. One consideration governing this choice of measure is theory; and how well theory holds in practice. If individuals can perfectly insure against permanent and transitory income shocks, then period income should not affect wellbeing—consumption should reflect insured permanent income and non-bequest wealth. In

this case, we shouldn't care about period income; wealth, permanent income and consumption should provide very similar answers. Some evidence (e.g. Blundell, Pistaferri, and Preston 2008) suggests that insurance is incomplete—and more strongly so for those at lower education levels. If so, this would open the door to putting some weight on consideration of period income inequality. That is, if lower income individuals cannot easily smooth their consumption across periods when they may have low income, concern about even temporary periods of low income should increase.

Another key factor for the choice of wellbeing measure is data availability. Wealth is difficult to value because of the specificity of untraded assets, and the difficulties in valuing flows of income such as future pension annuities. Consumption measurement requires the tricky valuation of flows from durables (especially housing) and non-market items like public goods. Lifetime income requires estimation and projection of incomes into the future which are not yet observed. A broad and complete measure of period would also face challenges capturing changes in the values of assets, as untraded assets must be measured both at the beginning and end of the period to obtain the (possibly unrealized) capital gain. Moreover, income derived from assets in tax-preferred forms such as housing or special retirement accounts will not be recorded easily. In short, no measure is perfect; necessarily imperfect attempts using different measures can complement each other by contributing to a more complete picture.

In this ongoing debate about measurement, the fact that so much of the evolution of inequality seems to be driven at the top of the distribution has important implications. Consumption measurement typically comes from expenditure surveys; and these expenditure surveys don't

tend to have large samples of those at the top of the distribution. Recent evidence suggests there is greater non-response and poorer quality response among those at the very top of the income distribution for the US Consumer Expenditure Survey.[1] In contrast, income data from large surveys (such as the Census) and administrative sources (like tax data) will not suffer from small samples and may not be as susceptible to mismeasurement.

In this paper, I will use an annual measure of income.[2] I present the results both for individuals and for economic families. For the families analysis, I show 'unadjusted' results that simply add income across family members and 'adjusted' results that uses a square root divisor to adjust income to a per capita equivalent. This is an advantage over tax data which has limited information on living arrangements and therefore does not permit the construction of economic families. I show some results using a market income measure that excludes government transfers but I focus most attention on a comprehensive income measure that accords with pre-tax income as defined by the tax system. I make this choice because this is the measure of income most easily affected by policy. I also show results for after-tax measures both gross and net of the refundable tax credits that are an important part of the income tax in Canada.

One shortcoming of using an annual measure is the inability to address the important topic of income mobility. Those who are in a lower income position in one year may not stay there long. As emphasized above, when insurance is incomplete even a short spell of lower income may

[1] Sabelhaus et al. (forthcoming) examine the behaviour of high income CE responders compared to zip-code level income data, finding higher non-response and under-reported expenditure among those with the highest income. Barrett, Levell, and Milligan (forthcoming) show that the proportion of national account aggregate expenditure that can be accounted for by survey expenditure data is decreasing in the share of income going to the top one percent across Australia, Canada, the UK, and the US.

[2] For recent analyses using other approaches, please see Norris and Pendakur (2012) which uses consumption, Beach, Finnie, and Gray (2010) which looks at short and long run earnings inequality, and Milligan (2005) for an examination of wealth inequality.

have large welfare consequences if people cannot adequately smooth. Morissette and Ostrovsky (2005) provide a recent analysis of income mobility over five-year periods in Canada, finding that instability in the bottom part of the distribution is the norm and that the tax and transfer system does moderate the impact of this instability on after-tax incomes. Corak (2012) compares the level of income inequality and the degree of inter-generational (father-to-son) income mobility across countries and finds a strong relationship. Countries with lower period income inequality tend to have much stronger inter-generational mobility.

How to summarize the distribution of wellbeing?

Methods to summarize a distribution are plentiful and I do not aim for a comprehensive review here.[3] Instead I attempt to pick some measures that shed light on different parts of the income distribution. The measures I use can uncover changes at all points of the income distribution, in contrast to the high-income literature which focuses only at the top.

The most comprehensive measure I employ is the Gini coefficient. This measure captures the difference between the Lorenz curve and the 45 degree line.[4] If incomes were completely equally distributed, the Gini would take the value 0; if the top person had all income it would take the value 1.0. The advantage of the Gini is its ability to summarize the entire distribution and its comparability across countries and time. However, it cannot generally be decomposed and so is not as useful in picking out where in the distribution changes are most acute.

[3] See the classic treatment by Atkinson (1975) or the recent review in Cowell (2011) for a more comprehensive discussion.
[4] A Lorenz curve plots the cumulative proportion of income against the cumulative proportion of people.

A second general measure I employ is the ratio of decile cutoffs. For example, the ratio of the 90^{th} and 10^{th} percentile of the distribution is useful for observing what is going on near the top and near the bottom of the distribution. Burkhauser, Feng, and Jenkins (2009) explain this measure originated in the analysis of data that was top-coded or otherwise noisily measured in the tails. In addition to the 90-10, I also report some results for the 90-50 and the 50-10, which compares the 90^{th} percentile to the median and the median to the 10^{th} percentile. These comparisons attempt to elicit whether observed 90-10 changes are driven by the top or bottom half of the distribution. In my work below, I implement decile ratios by taking the log of the given ratio in order to facilitate interpretation of the ratios in terms of percentage changes. A challenge for these measures is the volatility of some incomes at the low end of the income distribution. It is not rare for individuals to have no income at all and among those who do have income, the sources tend to be more varied, which introduces measurement issues.

The third type of measure I use is top income shares. The proportion of total income received by someone above a certain percentile cutoff is compared through time. Atkinson (2007) provides a motivation for the use of these top share measures, and Leigh (2007) reconciles their use with more traditional income distribution measures. As argued by Atkinson, in a standard Lorenz curve diagram, the top one percent is barely perceptible against the right-hand axis, yet that one percent accounts for a large part of the movements in the income distribution over the past 30 years. This motivates the use of top income share measures that do a better job of highlighting these movements at the top.

Finally, I employ some measures of low income in order to draw out changes at the bottom of the distribution. I use both the Low Income Measure (LIM) and the Low Income Cutoff (LICO).[5] The LIM sets an annual cutoff at half the median of 'adjusted' household income and counts the proportion of households lying under that cutoff. In contrast, the LICO compares incomes at the family level to a cutoff set in 1992 and updated only for inflation. In this way, LIM is a relative measure of low income and the LICO is an absolute measure.

Data

In this section I discuss the data employed for the analysis presented in this paper. Many recent papers have used administrative tax data to analyze income distribution. In contrast I use the Canadian Census. I start by describing the Census in detail and comparing its advantages to administrative tax data. Following the discussion of the attributes of the Census, I provide details on how I selected the sample I use for the analysis and how I formed the key variables.

The Long Form Census

The features of the Census which make it suitable for the analysis of incomes come out of the details of sampling and survey content. I provide this detail here, taking care to compare how the Census fares against the alternative administrative tax data source.[6]

I use data from Form 2B of the Canadian Census (the 'Long Form'). The Long Form was first implemented for the 1971 Census.[7] In that year, Form 2B was distributed to one third of

[5] Statistics Canada (2012) lays out the methodology for both the LIM and the LICO.
[6] The source documents from which I gather this information are the Census Handbook and Dictionary for each year. For example, the 2001 Census documents can be found in Statistics Canada (2003abc).

Canadian households, with the balance of the households receiving Form 2A (the 'Short Form') was filled in by all households in Canada. In 1981, the proportion receiving the Long Form was changed to one fifth. As implied by the names, the Short Form asked a limited number of rudimentary demographic questions about the people in the household: age, sex, and living arrangements. The Long Form requested detailed information on ethnicity, immigration, language, labour market activity, housing, and income, although there were some differences in content over the years. Only basic information on those under age 15 is provided; income information for example is only available for those aged 15 and older. For the purposes of this paper, it is the income information that makes the Long Form Census feasible for the analysis.

The Census (including the Long Form) was conducted quinquenially from 1971 to 2006; the Long Form was discontinued in 2011 and replaced with the National Household Survey. The Census targets all Canadian citizens and landed immigrants with a residence in Canada, who are at sea or in port on a Canadian-registered vessel, as well as non-permanent residents currently living in Canada.[8] A list of all dwellings is drawn up for around 40 thousand 'Enumeration Areas', ranging in extent from about 175 dwellings in rural areas to around 600 dwellings in urban areas. At this Enumeration Area level, one fifth of dwellings are selected for the Long Form.[9] The Census is a point-in-time picture, focused on a particular day (typically in May or June). However, the income questions pertain to the previous calendar (and tax) year, so the precise timing of the Census is not important for my purposes.

[7] An antecedent to the Long Form was conducted as part of the Census in 1961. A Population Sample Questionnaire was presented in that year with questions on migration, fertility, and income.
[8] These non-permanent residents were added to the focus of the Census in 1991.
[9] Some dwellings are always given the Long Form: collective dwellings and those who are enumerated by a Census employee rather than filling in the form themselves. Those evaluated by a Census employee tend to be on Indian reserves, remote areas, or targeted urban areas.

While all collective dwellings receive the Long Form, residents of certain types of institutional dwellings (such as inmates in jails, patients in homes for the elderly, or children in orphanages) are not asked to fill in the questionnaire. Beyond the institutionalized population, collective dwellings also include places like hotels, work camps, campgrounds, and Hutterite Colonies. These non-institutionalized collective dwelling residents do receive the Long Form.

Response rates for the Long Form Census as a whole were very high. For example, in 2006 non-response was about 6 percent of households. However, item non-response for income questions is around 20 percent. Item non-response for income was dealt with through editing and imputation. For example, non-response to the question on pension income for younger people might be re-coded as a 'zero' during editing.

The source and structure of the Census Long Form data on income have evolved through time. For the years from 1971 to 2001 (except 1976 when income information was not gathered), the source was a set of survey questions on income. For the 2006 Censuses, respondents were offered the choice of having their tax records matched with the Census, obviating the need to fill in the Census income questions—and 82.4% of respondents took up this option.[10]

The quality of the Census income data has been assessed in a number of studies by comparing against other sources. For the 2006 Census, Olson and Maser (2010) find the Census provides data that are quite close when aggregated to the national level, when compared to either tax or

[10] Statistics Canada (2008) shows that the change to tax record matching resulted in less 'heaping' at round numbers. Billette, Brochu, and Morin (2012) study who does and does not opt to share the tax information with the Census in 2006.

national accounts data. Frenette, Green, and Picot (2004) find that the Census data do well in the bottom part of the income distribution.

The Census uses a different income concept than the tax system.[11] This is an advantage to the extent that items that may be part of a broad income definition are missed by the tax system. As one example, scholarship income was partly excludable during the time period under study here and the excluded portion would not be reported to tax authorities. Of greater import, non-taxable income such as the Guaranteed Income Supplement and provincial social assistance were not required to be reported on the tax form until 1992. These income items are very important to those at the lower part of the income distribution. On the other hand, the definition of income is not uniformly broader. For example, capital gains income is entirely ignored in the Census.

Census versus tax data

There are several main advantages of the Census for the analysis presented in this paper. First, the large samples are helpful because of the availability of large amounts of data even in the tails of the income distribution. Second, the income information seems to perform well in analyses comparing it to tax data and national account aggregates. Third, the Census does not rely on tax filing to be in the sample.[12] Fourth, the concept of income is arguably broader than what is captured by tax data. Finally, the Census allows one to analyze on the basis of an individual, family, or household. Tax data requires the analyst to reconstruct living arrangements based only on what information is provided to the tax authority.

[11] Statistics Canada (2008) describes in detail the Census concept of income.
[12] Abraham et al. (2001) find that non-filers come heavily from the bottom quintile of the income distribution. In that bottom quintile, 13% are non-filers. This compares to 1.1 percent in the 2nd lowest quintile, and 0.1 to 0.2% in the other three quintiles.

Tax data does have several advantages as well. First, there is no problem with respondent recall as the data come directly from the administrative source. Second, penalties for misreporting give a financial incentive to report accurately—although this factor is counterbalanced by the financial incentive people have to under-report income.[13] Third, annual longitudinal analysis is possible with tax data, but not with the quinquennial Census.

As there are advantages to each approach, the results from the Census complement those from the tax data. Burkhauser et al. (2012) perform such a comparison as they reconcile the trends in top income shares using the March Current Population Survey and IRS tax return data for the United States. In Canada, to date there has not been an analysis of top income shares using Census data, although broader inequality measures are analyzed in the Census by Frenette, Green, and Milligan (2007).

Data selection and manipulation

I describe here how I select the dataset I use for the analysis and provide some detail on how I prepare the Census data for the tax calculations.

I use the versions of the Census that are available in Research Data Centres. To date, the data from the 1981 through 2006 Censuses are available. The Censuses previous to 1981 will become available through the Research Data Centres in time, so it may be possible in the future to extend this work further back when the 1971 data become available.

[13] Hurst, Li, and Pugsley (2012) compare under-reporting of self-employment income in surveys to the well-documented underreporting in tax data, finding that self-employment income is also under-reported in surveys.

The sample selection criteria I impose on the Census data arise from two aspects of the analysis. First, since I want to calculate tax liabilities for each person in the Census, I need to have enough information on the family structure to implement the tax calculations. Since an individual's tax liability depends on children (through refundable and non-refundable tax credits) and the presence of a spouse or common-law partner (through spousal credits and pooled income for refundable credit calculations), it is necessary to have information on children and spouses. Second, I want to aggregate incomes into families and households. Both the tax calculation and the aggregation mean that collective dwellings present problems, since detailed family relationships for those in collective households are not provided and the households can be of very large size.[14] For this reason, I exclude those living in collective dwellings for parts of the analysis.

While excluding those in collective dwellings may not seem consequential, an analysis of the incomes of those in collective dwellings reveals these individuals to have lower incomes than average. Given that the proportion of Census individuals in collective dwellings is between 2 and 3 percent in the Census years I consider, this exclusion may be non-trivial for some types of income inequality calculations. While I cannot include these residents of collective dwelling in any of the household or family calculations, I do include them for some individual income calculations to check the sensitivity of the analysis to this exclusion.[15]

[14] Among the types of collective dwellings, there is one exception for information about family relations: Hutterite Colonies. The Census does provide information on the family relations of those in Hutterite Colonies. While this would permit the calculation of tax liabilities, the size of these collective households makes the aggregated household incomes noticeably different from other households. For this reason, I exclude those dwelling in Hutterite Colonies.

[15] Because of problems with income reporting, the incomes of those in Hutterite Colonies are given as zero for all Census years from 1981 to 2006. So, the analysis including collective households excludes Hutterites.

I use the Census variables on family relationships to form the 'tax family' that is put through the tax calculator. I can observe those who are married or in a common-law relationship who are residing together. I combine this information to form couples. I can also match each child in the data to the family in which the child lives. I attach the ages of each child to the parent couple or single-parent. For the tax calculations, I consider only children ages 0 to 17. Older children are kept in the analysis, but are each placed in their own 'tax family' rather than with their parents.[16]

Individual information is used for some of the analysis. I also aggregate these individuals into families and households for parts of the analysis. The family concept I employ for this aggregation is the economic family, which comprises people living together in the same dwelling who are related by blood, marriage, common-law, or adoption. The economic family is the standard setting for the analysis of the wellbeing. I use the household only for the calculation the Low Income Measure, which recently changed to using the household instead of the economic family.[17]

I use three different measures of income for the analysis. To provide some focus for the analysis, I target measures that are informative about the functioning of the income tax system. The first, is a standard measure of market income, including income from employment, self-employment, investment, and pensions. The concept here is one of 'pre-fisc' income; excluding the impact of

[16] For the formation of 'tax families' I rely primarily on the information provided in the Census on the composition and relationships of what Statistics Canada calls the 'Census Family.' A Census Family is, roughly, parents living together with their children. If the children are married or have children of their own, they become their own Census Family. This definition is very similar to that used by the income tax system.

[17] This switch for the Low Income Measure from the economic family to the household was made in order to conform with international norms. When both the economic family and household are available, it is not clear why one would prefer to use the household to measure wellbeing, since the household may contain economically unrelated people. See Murphy, Zhang, and Dionne (2010).

taxes and government sources of income. While it has no direct analogue in the tax system, it is useful to benchmark against other papers that have used this income concept. The second concept I use is total income, for which I aim to recreate as best possible in the Census the total income measure (line 150) of the income tax. Finally, I use after-tax income defined as total income less provincial and federal income taxes (including contributions to Canada / Quebec Pension Plan and Employment Insurance, provincial health premiums, and other tax measures implemented through the income tax system.) I further break the after-tax income measure into two different measures for some of the analysis, one that accounts for refundable tax credits (like the GST tax credit, the Canada Child Tax Benefit, and other similar credits) and one that does not.

In order to make the tax calculations, I must find a way to take the eleven categories (nine in 1981) of income reported in the Census and translate them into income categories as defined by the income tax system. I report how this is done in Table 1. The tax calculator I employ is called the Canadian Tax and Credit Simulator (CTaCS). It is described in detail in Milligan (2012). CTaCS takes as input the income in different categories corresponding to the tax form, along with the age, family structure, and province. CTaCS takes this information and returns the tax liability, including all refundable tax credits. Importantly, I also impute amounts for certain deduction and credit categories which serves to reduce taxable income and tax paid.[18]

[18] These imputations are based on information from Tax Statistics on Individuals published by the Canada Revenue Agency. This information is available for cells defined by province, year, and narrow income groups. I impute amounts to each cell and a probability that there is any amount based on the CRA data. The imputed amounts are for donations and gifts, RRSP contributions, RPP contributions, union dues, childcare expenses, other deductions, and additional deductions from net income.

Results

I now present the results from the Census. I begin in the first section with an analysis of trends in different percentiles of the income distribution, comparing across different income measures. This is followed by examination of two measures of low income, to check the trends at the bottom of the income distribution. The Gini coefficients for some income measures are then presented to summarize what is happening across the entire income distribution.

The second section of Census results examines the top of the income distribution. I present the income thresholds and income shares for different income measures and compare the results to those found in Veall (2010) and from the recent Statistics Canada release of summary data from the Longitudinal Administrative Database.

In the final section, I present the results from simulations using the CTaCS tax simulator. Taking the 2005 distribution of income from the 2006 Census, I simulate tax liabilities for all years between 1962 and 2012 and all provinces. These simulations can help to isolate the impact of the tax system on the trends observed in the Census data.

The income distribution in the Canadian Census 1980-2005

To begin the analysis of the income data in the Canadian Census, I present in Table 2 the percentiles of the income distribution taken from various sources. The percentiles range from the 10^{th} percentile (P10) to the top one-thousandth of the population (P99.9). All data in this table are from 2005.

The first column presents income taken from the Survey of Labour and Income Dynamics (SLID). This survey has been the workhorse of intra-censal income information in Canada. I use the Public Use Microdata File for the SLID, which contains information on the income and labour market activities of 53,474 individuals age 16 and over. With the survey weights, the results aim to be nationally representative. Frenette, Green, and Picot (2004) examine the SLID and compare it to tax data and to the Census, finding some shortcomings at the bottom of the SLID income distribution, driven by differences in family sizes and possible undercoverage of the lowest-income families in the SLID.

In the next six columns I show the results from the CANSIM data based on the Longitudinal Administrative Database (also utilized by Veall 2010) and compare them to corresponding results in the Census using different definitions of income.[19] For the market income comparisons, I use a sample similar to Veall (2010) which selects only those aged 21 and older. For the Census numbers using total and after-tax individual income, I use everyone age 15 and older.[20] The final two columns of the table show measures of after-tax family income.

For market income, the three sources show remarkably similar numbers through the middle of the income distribution. At the very top, the SLID shows lower percentile cutoffs, reflecting the thinness of the sample at very high income levels. (There are fewer than 30 individuals above P99.9 in the SLID), which underscores the limited utility of the SLID in studying high incomes.

[19] The relevant CANSIM table is 204-0001, available at http://www5.statcan.gc.ca/cansim/ .
[20] The difference in sample across the columns of the table accounts for the seemingly odd result that the cutoffs for total income are lower than for market income. The total income and after-tax income cutoffs include more younger observations that have lower and zero incomes, which pulls down the cutoffs for those samples.

For Total income and after-tax income, the Census numbers match the CANSIM-LAD numbers quite closely. As mentioned above, the total and after-tax income measures here for the Census include all individuals age 15 and older which may include more very low earning teenagers than the CANSIM-LAD data. When adjusting for family size in the last column, the family data also look quite similar to the individual data in the left-hand side of the table.

Overall, the results in Table 2 reveal much similarity, but some differences relative to the SLID and the CANSIM-LAD tax-data based numbers. A number of explanations may underlie the differences. There could be non-filing of taxes in the tax data or poor coverage in some income ranges in the SLID. For the Census, misreporting of income and survey and item non-response could explain differences.

To compare the results across time, I graph in Figure 1 the 10^{th}, 50^{th}, 75^{th}, and 90^{th} percentiles of the income distribution drawn from the Census for each year. All income values are adjusted to 2005 using the CPI. Across the four panels of the table are four different measures of income, moving from market income pre-tax to family post-tax adjusted income.

Median individual pre-tax income fell at the mid-points of the 1980 and 1990 decades, following recessions. However, since 1995 median income has grown. From 20,038 in 1995, total pre-tax income has risen to 23,375 by 2005. This growth of 17 percent exceeded that at the 90^{th} percentile, which grew 12 percent to 69,462. In some contrast, the income growth for after tax income at either the individual or family level was stronger at the 90^{th} percentile than at the

median between 1995 and 2005, reflecting large cuts in top tax rates federally and in many provinces in and around 2000.

The ratio of the 90th and 10th percentiles of adjusted family income is taken and then log-transformed to arrive at the log 90-10 ratio. I present this ratio both for pre-tax income and after-tax income in Figure 2. Pre-tax, the log 90-10 ratio increases from 1.79 to 1.92 log points from 1980 to 1985, suggesting an increase of about 13 percent in this ratio. The before-tax ratio stays close to this level throughout the rest of the available Census years. In contrast, the after-tax log 90-10 ratio declines from 1.63 in 1985 to 1.52 by 2005, a drop of around 12 log points. This provides some preliminary evidence that, at least in this 10th-to-90th income range, the tax system has had a moderating effect on inequality over this time period.[21]

Figure 3 breaks down the log 90-10 ratio into two halves; the 90-50 and the 50-10. This decomposition is useful to start to pinpoint what is happening in the upper and the lower half of the income distribution. The top two lines in the Figure show movements in the log 50-10 ratio. Pre-tax income ratios seem roughly constant, but after tax there is a large drop of 15 log points from 1985 to 2005. In contrast, the log 90-50 ratio in the bottom half of Figure 3 indicates that little of the upward trend in pre-tax income is undone by the tax system.

[21] This result contrasts somewhat with Frenette, Green, and Milligan (2007) which finds increasing after-tax 90-10 ratios. In comparing the results to that paper, I found that the 90th percentile cutoffs here are quite close but that the 10th percentile differs somewhat. Given that the income of the 10th percentile depends so heavily on the tax and transfer system, the 10th percentile cutoff becomes quite sensitive to the method of imputation of taxes and transfers.

The next two figures, Figure 4 and Figure 5, look at two low income thresholds, the Low Income Cutoff (LICO) and the Low Income Measure (LIM). I graph the percentage of individuals who live in families under the respective cutoffs. In each case, I supplement my calculations from the Census with the annual survey-based LICO and LIM statistics in the CANSIM database, which spans 1976 to 2010. For the LICO in Figure 4, the Census calculations come in higher than CANSIM in the 1980s, but from 1990 onward they are quite close. For both the Census and CANSIM measures, LICO by the 2005 year is at its lowest level observed. For the LIM, the Census shows quite a bit higher LIM rates in the 1980s, but converges to the CANSIM numbers in the 1990s. Overall, LIM rates have not shown the same downward trajectory in the 1990s that is evident for the LICO. This reflects increases in the LIM cutoff driven by increasing median family income since the mid 1990s (as seen in the bottom right panel of Figure 1).

The final figure in this section summarizes the entire distribution in one measure—the Gini coefficient. I show the results from the Census along with those from CANSIM. Figure 6 shows data from both sources for three different income measures—market income, pre-tax income, and after-tax income.

In the Census, both the pre-tax and after-tax measures are rising through time. Before tax, the Gini rises from 0.352 in 1980 to 0.404 in 2005; for after-tax the increase is from .312 to .349. The CANSIM series show a similar trend. Because this measure covers the entire income distribution, any weakness of the SLID in capturing trends at the very top of the income distribution will be absent from the CANSIM measure, but will potentially be picked up by the Census.

To summarize the results thus far, pre-tax incomes at many parts of the income distribution showed some growth between 1995 and 2005, but there were sharp differences in the top and bottom halves. On an after-tax basis, the growth in incomes was larger closer to the top than in the middle. The bottom of the income distribution also gained on the middle, mostly driven by the tax system and not pre-tax income differences.

Census data on top incomes

The next results focus attention on the top of the income distribution. The work by Saez and Veall (2005) and Veall (2010, 2012) has laid out a clear set of results for income shares at the top using tax data. Here, I provide analogous calculations using Census data. The Census data allow formation of economic family units and also incorporate transfer income in addition to the market income studied by Veall.

The four panels in Figure 7 show income percentile cutoffs for the 95th, 99th, and 99.9th percentiles for four different measures of income. For all four measures of income, there is a sharp change in 1995. In particular, the income threshold to reach the 99.9th percentile explodes. In market income, this increase is 81 percent; for adjusted after-tax family income it is 106%. For the 99th percentile there is still substantial growth of 25 percent pre-tax and even more after tax.

For individual market income, the numbers here in the Census can be compared to Veall (2010). For example, in 1995, Veall finds market income (in 2005 dollars) of 78,363 at the 95th percentile, 137,247 at the 99th, and 385,396 at the 99.9th. This looks like the Census doesn't capture as much income at the very top, but does better at the 95th percentile. As here, Veall (2010) finds a large increase in top income thresholds between 1995 and 2005.

The next figure shows the top income shares. Figure 8 has the same four measures of income as the previous figure, and also displays results for the 99th and 99.9th percentile. I also show the income share of those between the 95th and 99th percentile. All four measures of income show similar patterns. There is little change in the income share of those in between the 95th and 99th percentiles. Income for those in the top one percent grows sharply after 1995; and for those in the top 0.1% it grows even more sharply. The total income share of the top one percent for total income goes from 7.8% to 11% between 1995 and 2005. Of this 3.2 percentage point increase, 61% of it comes from those in the top 10th of the group, those with incomes above the 99.9th percentile. While the level of the top income shares for after-tax family income is smaller, the percentage growth at the top is even larger than for market income or total pre-tax income.

Veall (2010) reports that the income share of the top one percent rose from 7.9 percent in 1985 to 13.2% in 2005. It appears that the Census finds the top one percent share to be about 1.3 percentage points less than the tax data. Overall, however, the results presented here confirm the trends uncovered by Veall can be reproduced in the Census data and are not reversed by adjusting for taxes or family considerations.

The results of the income distribution analysis in the Census for 1980 to 2005 are summarized in Table 3. For each of several measures, I take the value in 1980 and in 2005, and compare the change before taxes to the change after taxes. This allows a calculation of how much of the increase in pre-tax inequality was 'undone' by the tax system.

The first row shows the Gini coefficient for after-tax adjusted family income. The pre-tax change was 0.052, but post-tax it was only 0.037. This suggests that 28.7% of the increase was 'undone' by the tax system. Interestingly, there are large differences between the first and second half of this time period. Between 1980 and 1995, the tax system undid 57 percent of the change in the Gini, but from 1995 to 2005 the tax system only undid 2% of the rise in the Gini. For the log 90-10 ratio of after-tax family income, the tax system more than undid the rise in pre-tax inequality. That is, as pre-tax income inequality rose by this measure, the tax system undid those increases and also pushed this measure further toward equality. This was mostly a result of large increases at the bottom of the distribution, as the P90-P50 shows much less change in the after-tax ratios than the P50-P10.

For the P90-P50 ratio, the proportion of the pretax increase that was undone by the tax system is 22.4 percent. However, there are great differences when looking within the 1980 to 1995 time period compared to the 1995 to 2005 time period. During the first 15 year period, the P90-P50 ratio increased by 4.9 points, but 71 percent of this was undone by the tax system. In contrast, the further 2.3 point increase from 1995 to 2005 was not undone. In fact, the P90-P50 after-tax increased by 4.2 points, meaning that the tax system reinforced the increase in pre-tax income disparities over this time period. This result echoes the findings of Frenette, Green, and Milligan

(2007) who found that the pre-tax rise in income inequality in the 1980s was undone by the tax system but the similar rise in the 1990s was not.

The last two rows of Table 3 show the top one percent and top 0.1 percent shares of individual total pre-tax income. The tax system undid only around 13 percent of the large increases in pre-tax inequality at the very top. This result is important—it is possible that the rise in pre-tax income concentration at the top of the income distribution could have been substantially undone by a strongly progressive income tax. However, this does not appear to be the case for Canada over this time period as only around an eighth of the increase in pre-tax concentration in the top one percent was undone by the tax system.

Simulations across years and provinces

To provide some more insight into what is driving the trends observed in the Census data, I now present the results of some simulations performed with the CTaCS calculator. For these simulations, I take the observations from the 2006 Census and run them through the tax calculator for different years and provinces. To save on computing time, I do this with a random 10 percent sample of households. I first run simulations by varying the year, trying each year between 1962 and 2012. I follow that with some simulations by province, showing all provinces and territories for the 2012 tax year.

The first simulations are shown in Figure 9, which shows the results of the log 90-10, 90-50, and 50-10 ratios for adjusted after-tax family income. At the top of the figure, the results for the log

90-10 ratio show a striking contrast when refundable tax credits are netted out and when they are not. Without including refundable tax credits, the log 90-10 ratio is fairly flat through time. However, with the refundable tax credits included, there is a marked drop in the log 90-10 ratio of 30 log points, which is very large. The 90-50 and 50-10 analysis lower down in Figure 9 reveal that all of the effect is driven by the lower half of the income distribution. This is sensible since refundable tax credits have much larger impact on that part of the income distribution.

Figure 10 shows the proportion of families under the LICO and households under the LIM. The LICO declines substantially after 2000, again reflecting improvements in refundable tax credits at this time. The LIM shows a similar trajectory. To be clear, these policy-related results reflect changes in how income taxes and refundable tax credits affect LICO and LIM rates. Chen and Corak (2005) find that other aspects of government transfers—such as Employment Insurance and Social Assistance—have made low income rates for families with children worse since the 1990s.

Finally, Figure 11 examines how much of the changes in the after-tax top income shares observed earlier can be attributed directly to the tax system. Here I revert to individual after-tax income shares. While there is an increase of around one and a half percentage points in the top one percent share in the 1970s, the top one percent share stays fairly constant after that point. This suggests that the tax system has not been a large contributor to the increases in after-tax income shares over this period. Instead, it is the pre-tax shifts that have driven the increasing concentration of income at the top.

The last two figures examine inequality measures across the provinces and territories in 2012. Figure 12 displays the log 90-10 ratio. Among the provinces, Alberta is the highest at 1.503 and Quebec is the lowest at 1.280—Quebec is a strong outlier. In a breakdown into the 90-50 and 50-10 ratios (not shown here), Quebec's performance is equally an outlier in both halves of the income distribution. Figure 13 closes the analysis by showing how the top one percent income share would vary if all Canadians lived in different provinces and territories. Alberta again leads the way at 9.4 percent, with Quebec the lowest at 8.6 percent. Nova Scotia's introduction of a high income bracket at 150,000 allows it to come close to Quebec at 8.7 percent income share for the top one percent.

The simulations have emphasized the importance of the refundable tax credits at the bottom part of the distribution in making the tax system—by some measures—less unequal over the last 20 years.

Conclusions

This paper has examined the distribution of before and after tax income in Canada using a time series of six Canadian Censuses from 1980 to 2005. To a large degree, the results presented here echo those of the literature using administrative tax data. There has been a large increase in the before-tax incomes of those at the top of the income distribution. This increase has pulled up their income share relative to others, and this result holds even after accounting for all sources of income, income taxes, and the complete family situation. While the tax system undid much of the increase in pre-tax income inequality in the earlier part of the study period, since 1995 the tax system has not kept pace with the rise in pre-tax inequality.

In addition to confirming the results of the previous literature for high income concentration, this paper provides new results that reveal the importance of the expansion of refundable tax credits to those in the bottom half of the income distribution. For some inequality measures, such as the log 90-10 ratio and the LICO, the expansion of refundable tax credits has led to a reduction of inequality over the last 25 years.

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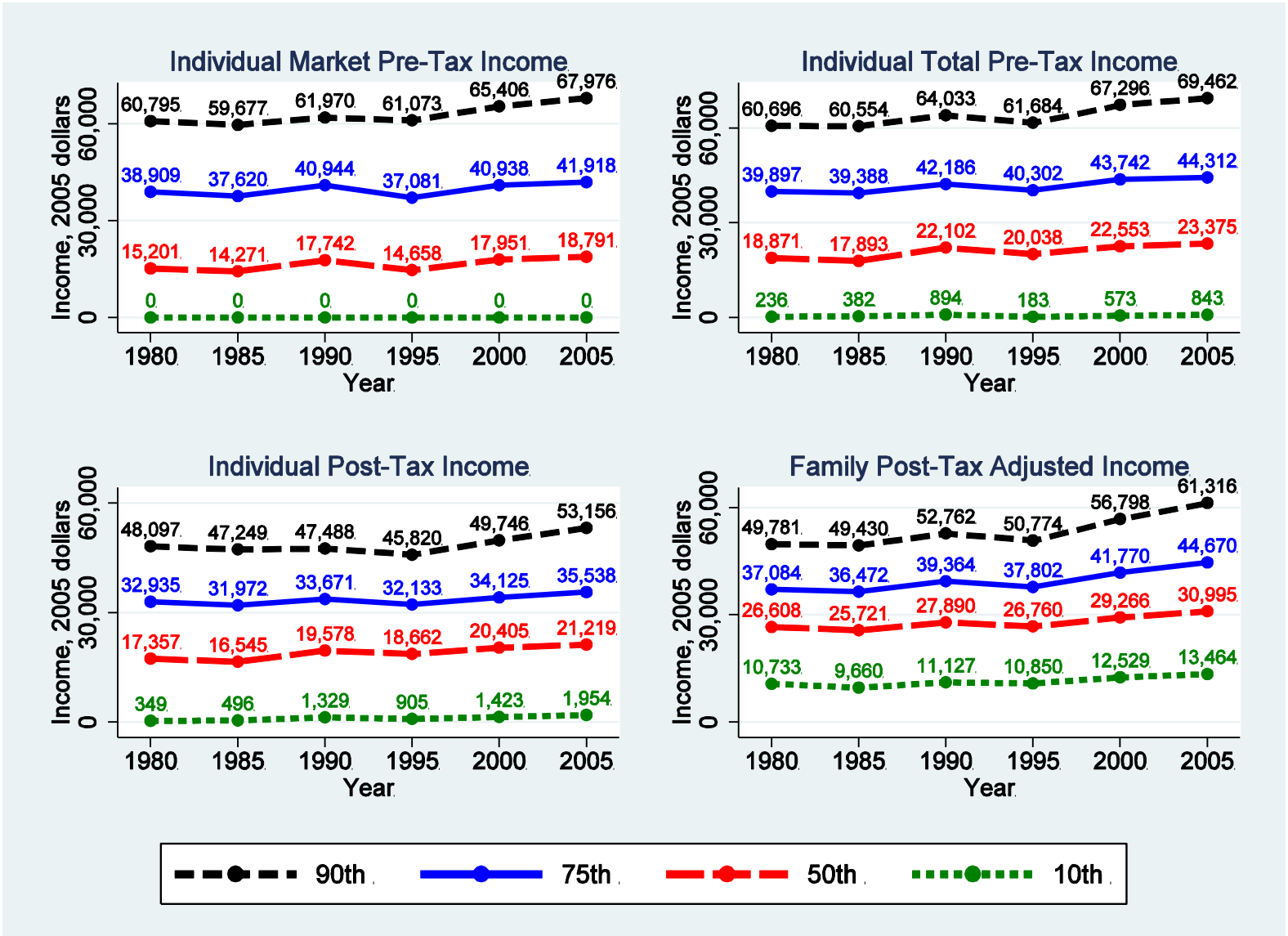
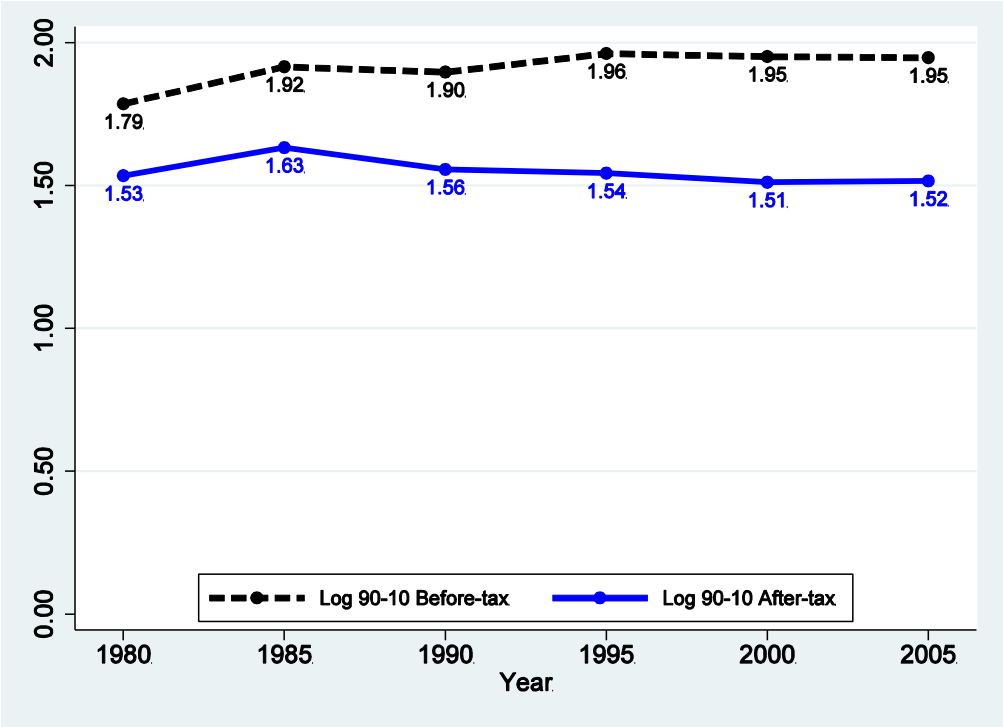
Figure 1: Distribution of Income, 10th to 90th percentiles



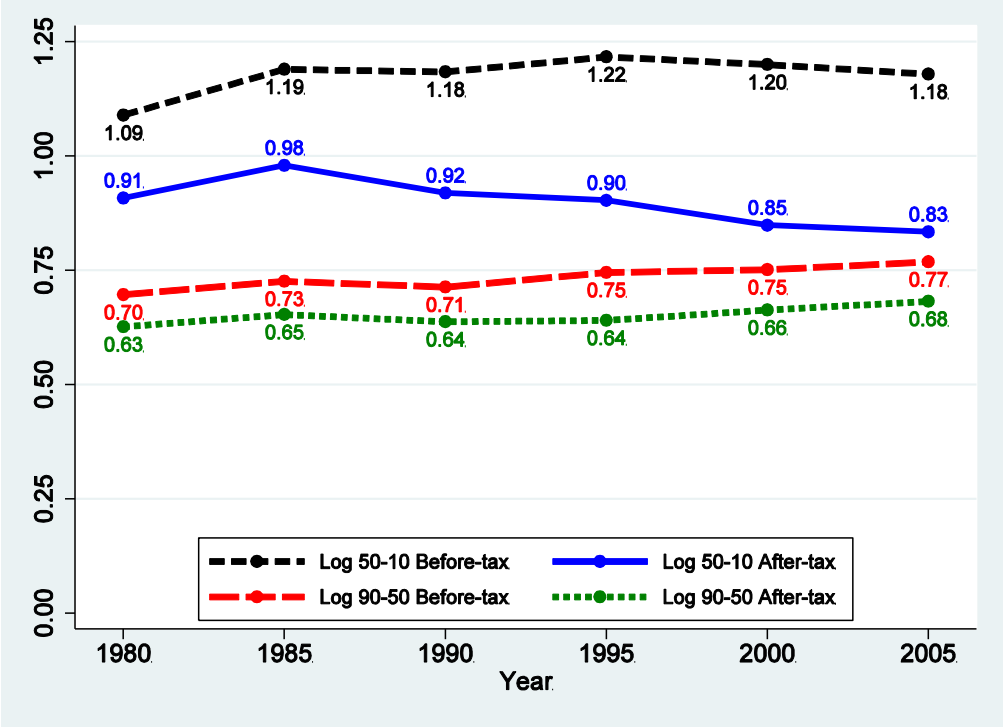
Note: Author's calculations from 1981 to 2006 master files of the Canadian census. All dollars adjusted to 2005 using CPI.

Figure 2: Log of 90th and 10th Percentiles, Before and After Tax Adjusted Family Income



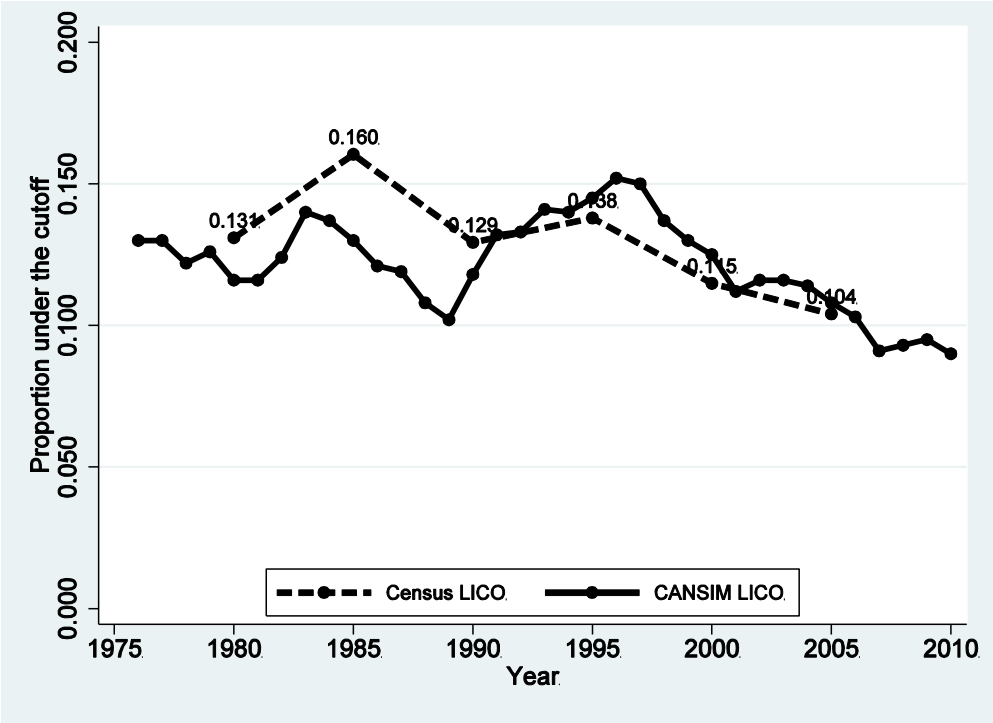
Note: Author's calculations from 1981 to 2006 master files of the Canadian census.

Figure 3: Log of 90th, 50th, and 10th Percentiles, Before and After Tax Adjusted Family Income



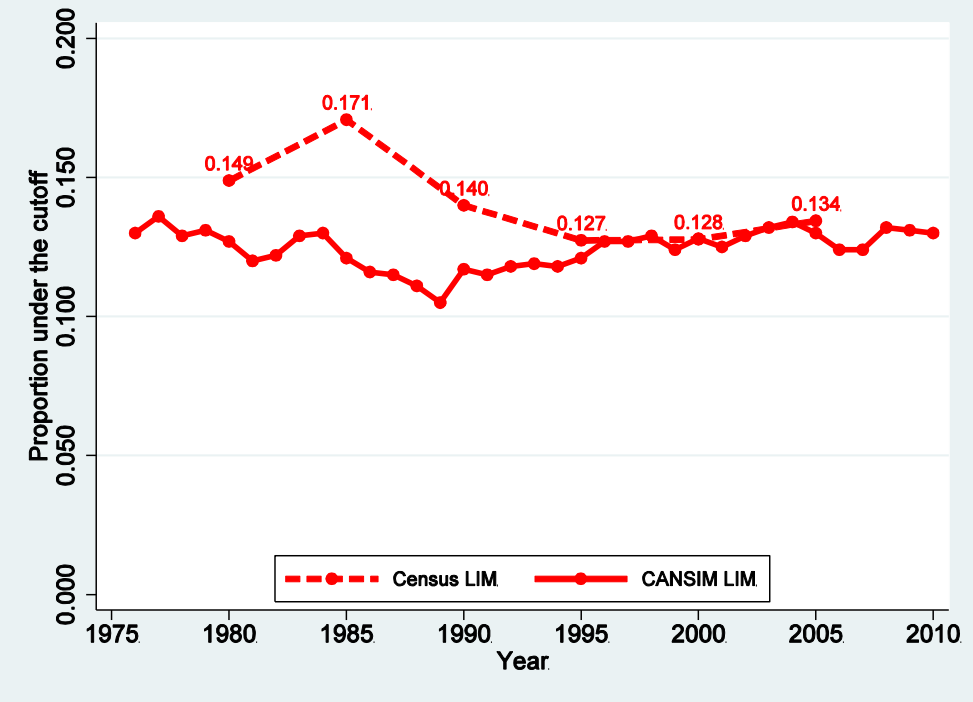
Note: Author's calculations from 1981 to 2006 master files of the Canadian census.

Figure 4: Proportion Under the Low Income Cutoff



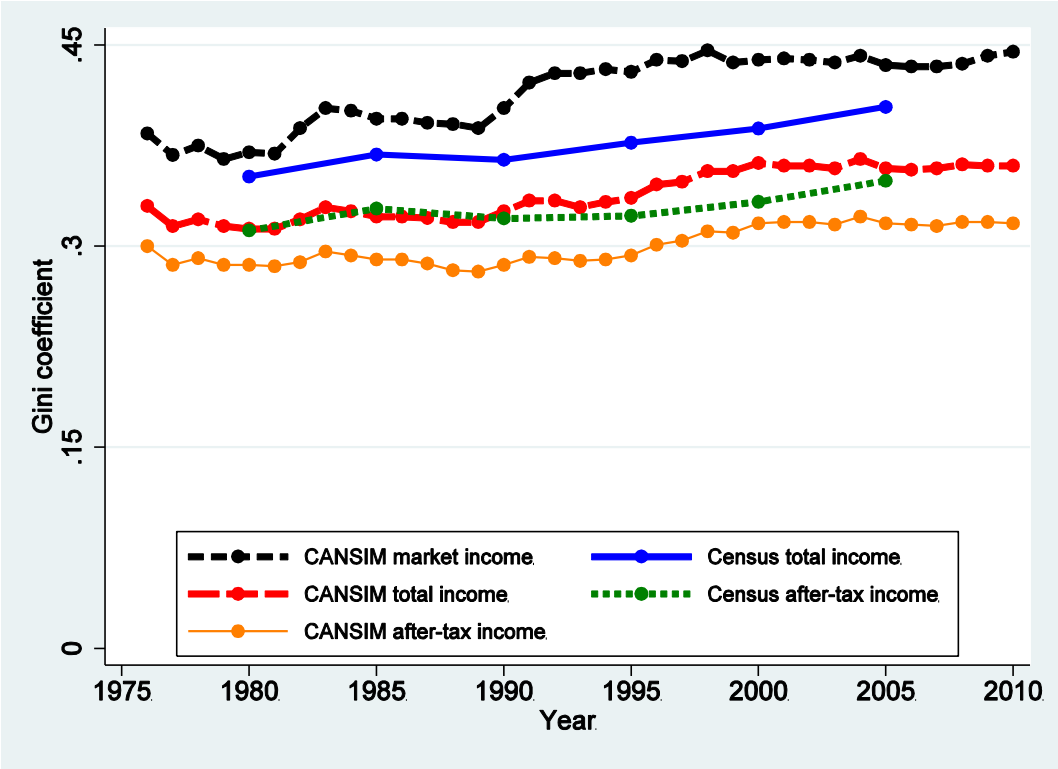
Notes: Author's calculations from 1981 to 2006 Canadian Census, and CANSIM Table 202-0283.

Figure 5: Proportion Under the Low Income Measure



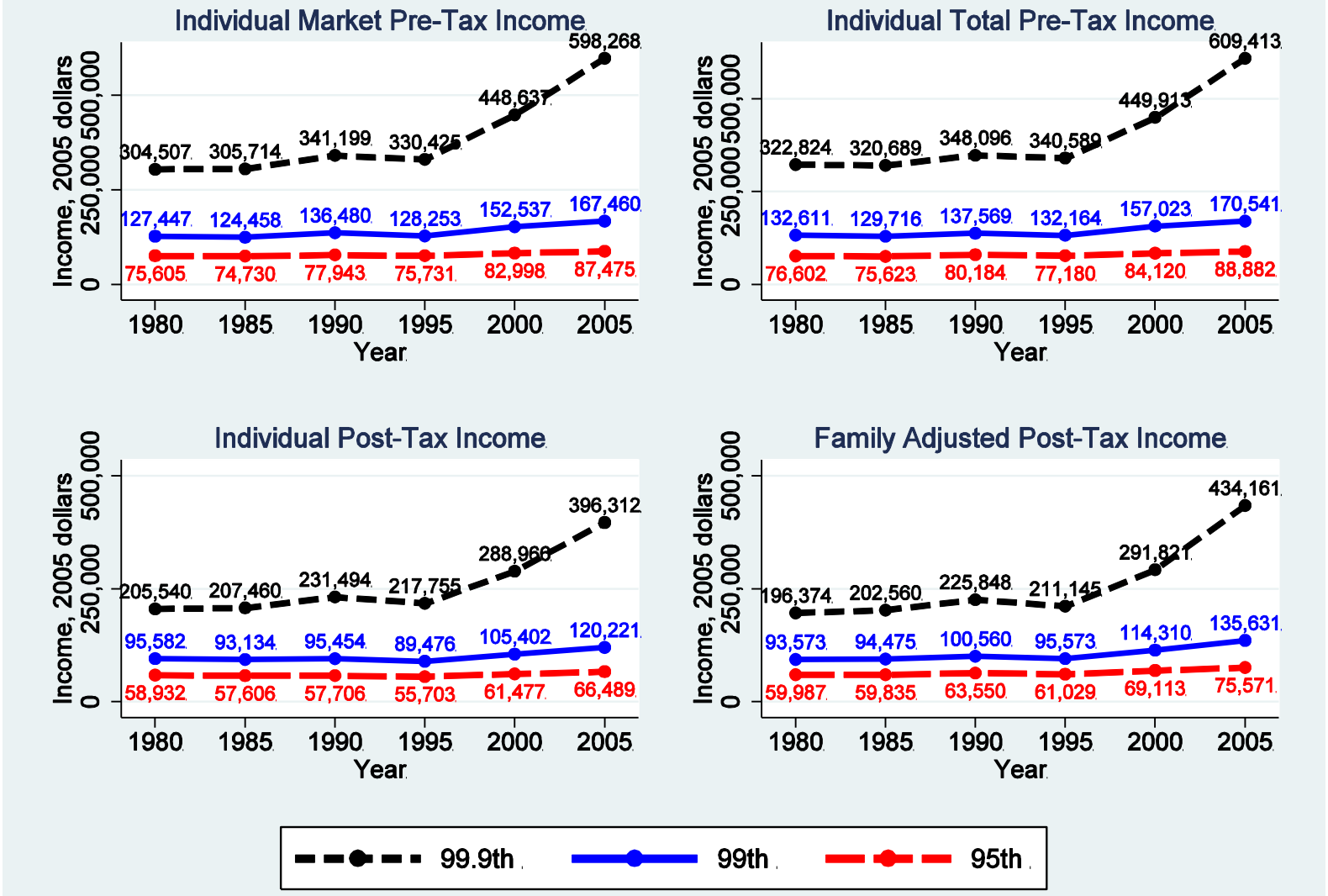
Notes: Author's calculations from 1981 to 2006 Canadian Census, and CANSIM Table 202-0283.

Figure 6: Gini Coefficients



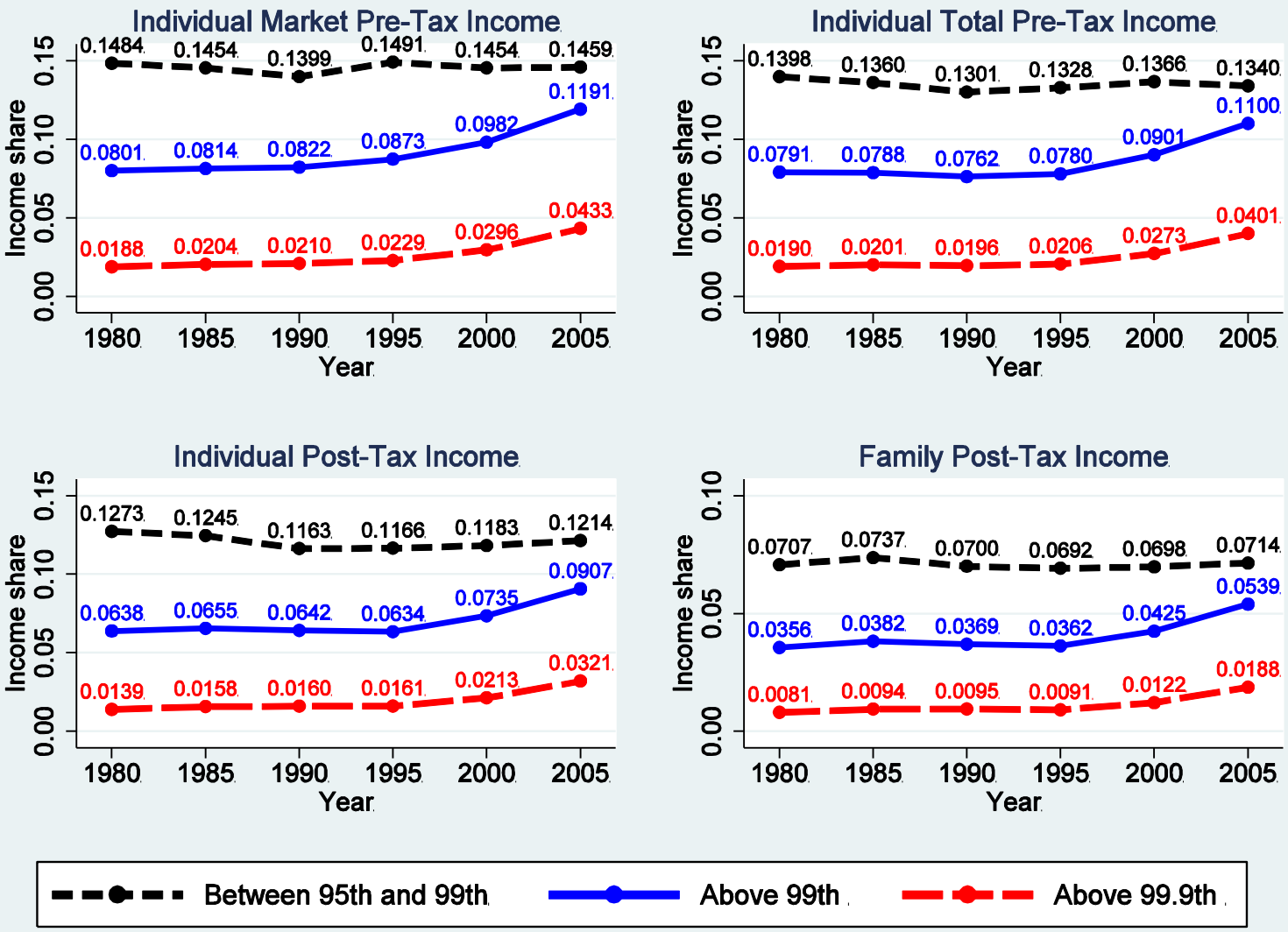
Notes: Author's calculations from 1981 to 2006 Canadian Census, and CANSIM Table 202-0709.

Figure 7: Percentile Income Cutoffs Near the Top



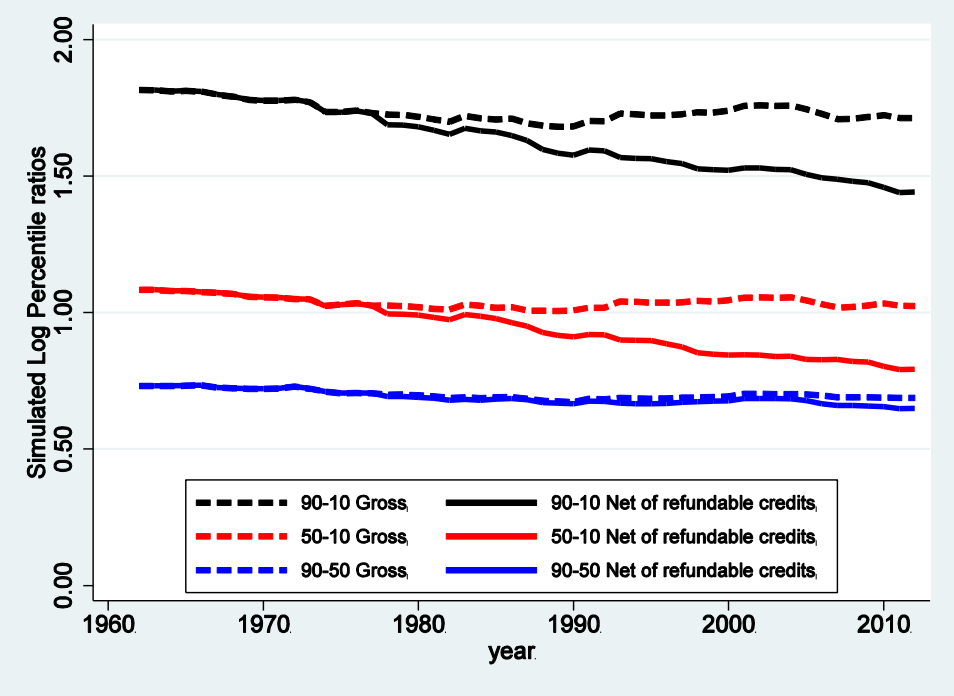
Notes: Author's calculations from 1981 to 2006 Canadian Census. Incomes in 2005 dollars.

Figure 8: Top Income Shares



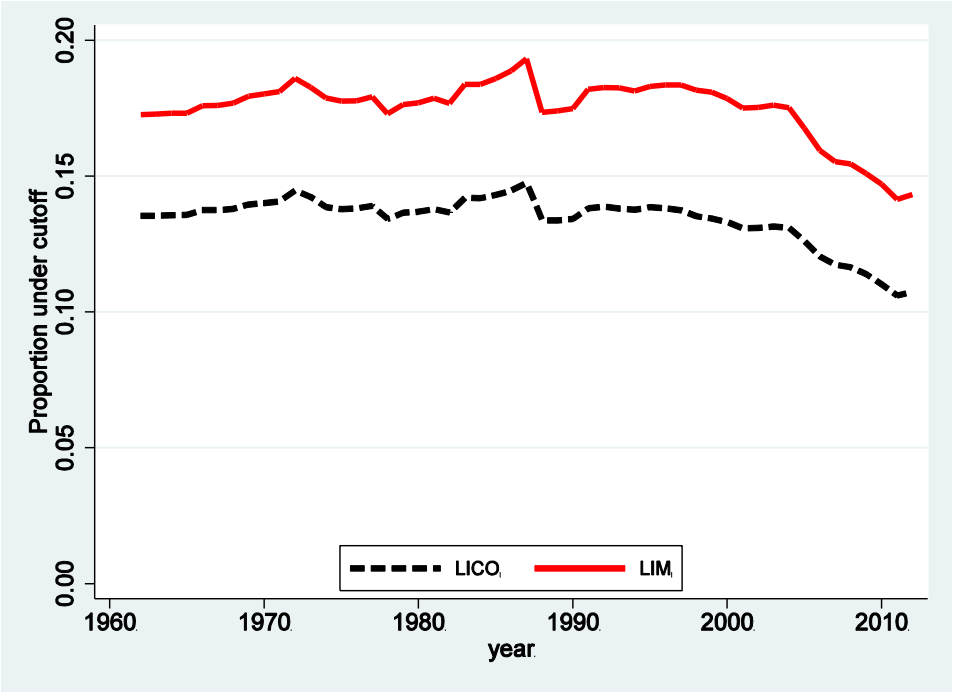
Notes: Author's calculations from 1981 to 2006 Canadian Census.

Figure 9: Log Percentile Ratios Using Simulated After-Tax Adjusted Family Incomes, 1962-2012



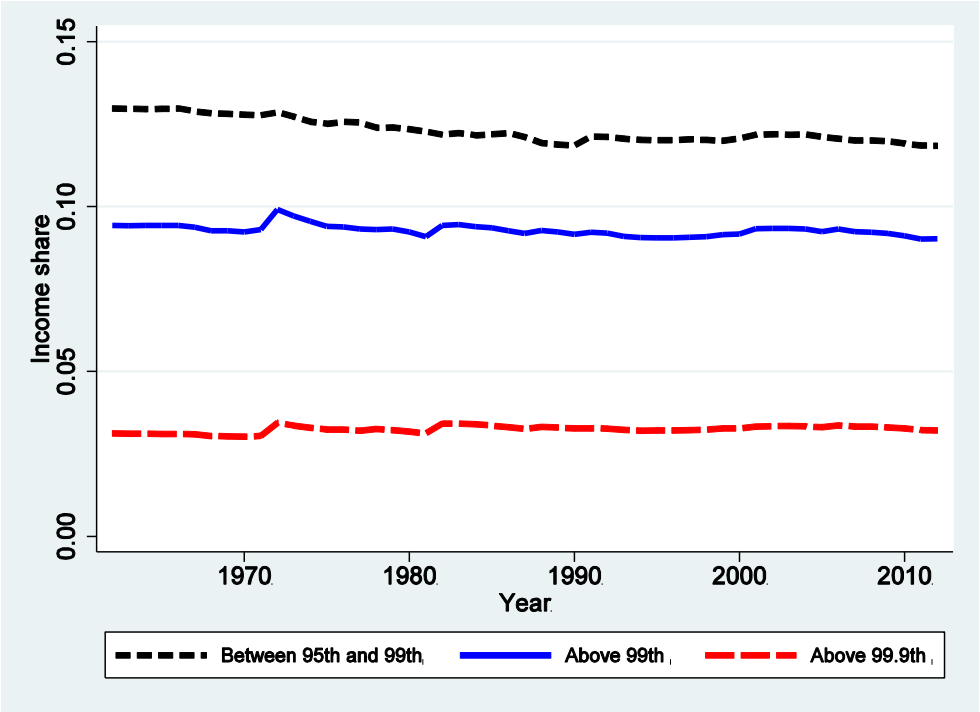
Notes: Author's calculations using the CTaCS simulator and income distribution from 2006 census. The 'Gross' series do not subtract refundable credits; the 'Net' series do.

Figure 10: Simulated LICO and LIM, 1962-2012



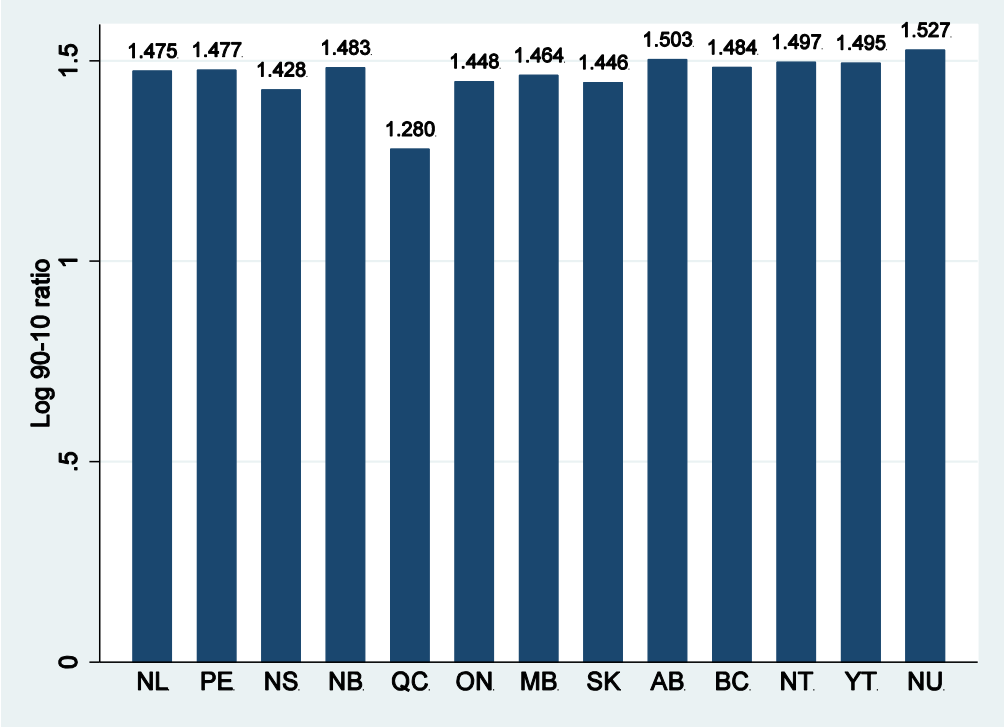
Notes: Author's calculations using the CTaCS simulator and income distribution from 2006 census.

Figure 11: Simulated Top Income Shares, 1962-2012



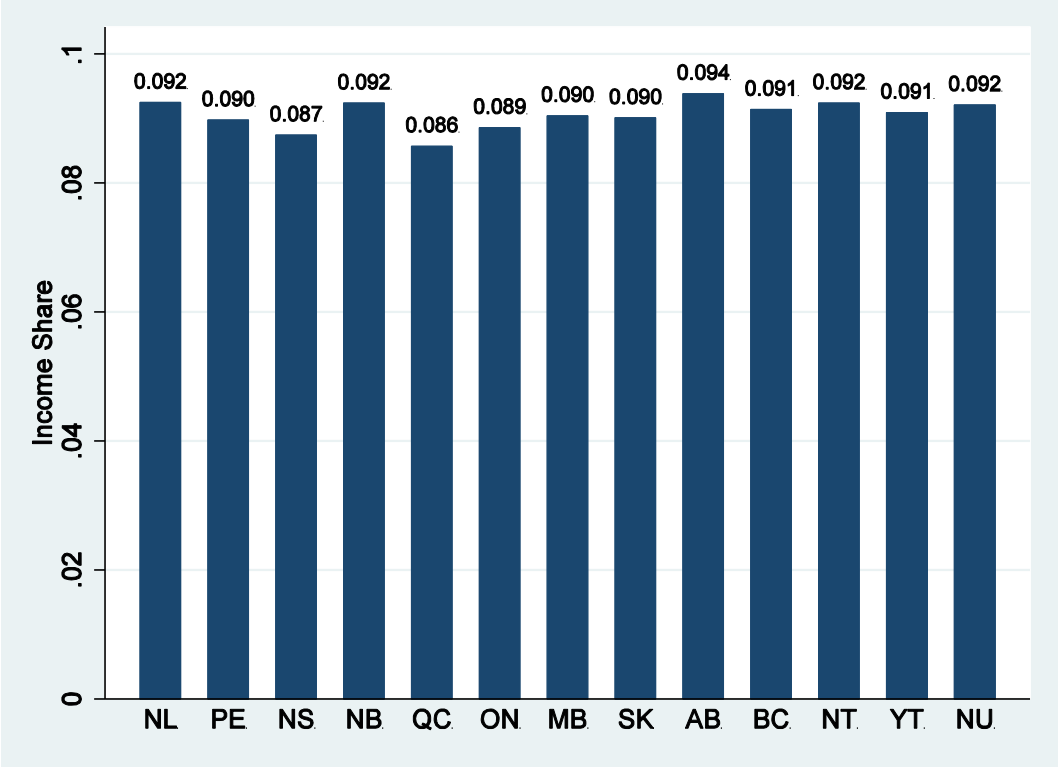
Notes: Author's calculations using the CTaCS simulator and income distribution from 2006 census.

Figure 12: Log 90-10 Ratios, Simulated Provincial After-Tax Adjusted Family Income



Notes: Author's calculations using the CTaCS simulator and income distribution from 2006 census and tax parameters from the 2012 tax year.

Figure 13: Top 1% income Share Simulated After-Tax Individual Income



Notes: Author's calculations using the CTaCS simulator and income distribution from 2006 census and tax parameters from the 2012 tax year.

Table 1: Income definition in the Census

Census Item	Definition from 2001 Census Dictionary (Statistics Canada 2003)	How treated
Wages and Salaries	Gross wages and salaries before deductions for such items as income tax, pensions and Employment Insurance. Included in this source are military pay and allowances, tips, commissions and cash bonuses, benefits from wage-loss replacement plans or income-maintenance insurance plans, as well as all types of casual earnings during calendar year 2000. The value of taxable allowances and benefits provided by employers, such as free lodging and free automobile use, is excluded.	Fully allocated to CTaCS variable *earn*, corresponding to line 101 of the T1 tax form.
Net non-farm self-employment income	Net income (gross receipts minus expenses of operation such as wages, rents and depreciation) received during calendar year 2000 from the respondent's non-farm unincorporated business or professional practice. In the case of partnerships, only the respondent's share was reported. Also included is net income from persons babysitting in their own homes, persons providing room and board to non-relatives, self-employed fishers, hunters and trappers, operators of direct distributorships (such as those selling and delivering cosmetics), as well as freelance activities of artists, writers, music teachers,hairdressers, dressmakers, etc.	Fully allocated to CTaCS variable *self*, corresponding to lines 135, 137, 139 or 143.
Net Farm self-employment income	Net income (gross receipts from farm sales minus depreciation and cost of operation) received from the operation of a farm, either on the respondent's own account or in partnership. In the case of partnerships, only the respondent's share of income was reported. Included with gross receipts are cash advances received in 2000, dividends from cooperatives, rebates and farm-support payments to farmers from federal, provincial and regional agricultural programs (e.g. milk subsidies and marketing board payments) and gross insurance proceeds such as payments from the Net Income Stabilization Account (NISA). The value of income 'in kind' such as agricultural products produced and consumed on the farm, is excluded.	Fully allocated to CTaCS variable *self*, corresponding to line 141.
Family Allowances / Child Benefits	Payments received under the Canada Child Tax Benefit program during calendar year 2000 by eligible parents with dependent children under 18 years of age. No information on these benefits was collected from respondents. Instead, these were calculated and assigned, where applicable, to one of the parents in the census family on the basis of information on children in the family and the family income. Included with the Canada Child Tax Benefit is the National Child Benefit Supplement (NCBS) for low-income families with children. The NCBS is the federal contribution to the National Child Benefit (NCB), a joint initiative of federal, provincial and territorial governments. Also included under this program are child benefits and earned income supplements provided by certain provinces and territories.	This is not included. Instead, I impute child benefits based on reported income for the year. For the 1981, 1986, and 1991 Census, I impute (taxable) Family Allowance.
Old Age Security	Old Age Security pensions and Guaranteed Income Supplements paid to persons 65 years of	This is split between the CTaCS

/ GIS / Allowance	age and over, and to the Allowance or Allowance for the survivor paid to 60- to 64-year-old spouses of old age security recipients or widow(er)s by the federal government. (Combined with CPP/QPP income in 1981)	variables *oasinc* and *gisspainc*. I impute the OAS given age, and allocate the rest to GIS/SPA. If higher income, I assume it is all OAS. This corresponds to lines 113 and 146 of the tax form.
Canada/ Quebec Pension Plan benefits	Benefits received during calendar year 2000 from the Canada or Quebec Pension Plan (e.g. retirement pensions, survivors. benefits and disability pensions). Does not include lump-sum death benefits.	CTaCS variable *cqpinc* corresponding to line 114 For 1981, this is split from OAS and GIS and Allowance.
(Un)Employment Insurance benefits	Total Employment Insurance benefits received during calendar year 2000, before income tax deductions. It includes benefits for unemployment, sickness, maternity, paternity, adoption, work sharing,retraining and benefits to self-employed fishers received under the federal Employment Insurance Program.	CTaCS variable *uiinc*. Corresponding to line 119.
Other income from government sources	all transfer payments, excluding those covered as a separate income source (Canada Child Tax Benefits, Old Age Security pensions and Guaranteed Income Supplements, Canada or Quebec Pension Plan benefits and Employment Insurance benefits) received from federal, provincial or municipal programs during the calendar year 2000. This source includes social assistance payments received by persons in need, such as mothers with dependent children, persons temporarily or permanently unable to work,elderly individuals, the blind and persons with disabilities. Included are provincial income supplement payments to seniors and provincial payments to help offset accommodation costs. Also included are other transfer payments, such as payments received from training programs sponsored by the federal and provincial governments, regular payments from provincial automobile insurance plans, veterans pensions, war veterans allowance, pensions to widows and dependants of veterans, and workers compensation. Additionally, refundable provincial tax credits, the Alberta Energy Tax Refund and refunds of the Goods and Services Tax (GST), Harmonized Sales Tax (HST) or Quebec Sales Tax (QST) received in 2000 are included.	This variable is included as Social Assistance income, CTaCS variable *sainc*. This corresponds to line 145. The tax treatment of social assistance income is identical to workers' compensation income. Social assistance and workers' compensation are the two most empirically relevant components here. Imputed values for GST, HST, and QST refundable credits are subtracted off to avoid double counting.
Interest and dividends	deposits in banks, trust companies, cooperatives, credit unions, caisses populaires, etc., as well as interest on savings certificates, bonds and debentures, and all dividends from both Canadian and foreign corporate stocks and mutual funds. Also included is other investment income from either Canadian or foreign sources, such as net rents from real estate, mortgage and loan interest received, regular income from an estate or trust fund, and interest from insurance policies.	This amount is allocated between CTaCS variables *dvdinc* and *intinc*. It is split between these variables using a 55/45 split. This allocation corresponds to the ratio of dividend and interest income in the 2005 CRA Income Statistics

		(Green Book).
Retirement pensions, superannuation, and annuities	All regular income received by the respondent during calendar year 2000 as the result of having been a member of a pension plan of one or more employers. It includes payments received from all annuities, including payments from a matured Registered Retirement Savings Plan (RRSP) in the form of a life annuity, a fixed-term annuity, a Registered Retirement Income Fund (RRIF) or an income-averaging annuity contract; pensions paid to widow(er)s or other relatives of deceased pensioners; pensions of retired civil servants, Armed Forces personnel and Royal Canadian Mounted Police (RCMP) officers; annuity payments received from the Canadian Government Annuities Fund, an insurance company, etc. Does not include lump-sum death benefits, lump-sum benefits or withdrawals from a pension plan or RRSP, or refunds of overcontributions.	CTaCS variable *peninc*. Corresponds to line 115 of tax form.
Other money income	Regular cash income received during calendar year 2000 and not reported in any of the other nine sources listed on the questionnaire. For example, alimony, child support, periodic support from other persons not in the household, income from abroad (excluding dividends and interest), non-refundable scholarships and bursaries, severance pay and royalties are included. (Combined with retirement income for 1981.)	This is assumed to be non-taxable income.

Table 2: Income Percentile Cutoffs

	Individuals							Families	
	SLID Market	CANSIM Market	Census Market	CANSIM Total	Census Total	CANSIM After-tax	Census After-tax	Unadjusted Census After-tax	Adjusted Census After-tax
P10	3,550		0		843		1,954	19,512	13,464
P25	11,050		5,541		9,665		10,124	33,252	20,376
P50	24,250	19,800	22,000	25,000	23,375	22,700	21,219	53,369	30,995
P75	44,000		44,452		44,312		35,538	79,861	44,670
P90	69,075	69,000	70,246	70,300	69,462	55,700	53,156	111,942	61,316
P95	87,500	89,000	90,112	90,100	88,882	69,400	66,489	138,606	75,571
P99	165,375	174,300	175,000	175,800	170,541	124,300	120,221	247,544	135,631
P99.9	411,850	656,200	658,015	658,000	609,413	419,800	396,312	786,303	434,161

Notes: Reported are percentiles of the income distribution in 2005 from various sources. The first 7 columns show individual income. The last two columns show adjusted after-tax family income.

Table 3: Change 1980 to 2005 and Impact of Tax System

	1980		2005		Change		
	Pretax	Posttax	Pretax	Posttax	Pretax	Posttax	% Undone
Gini	0.352	0.312	0.404	0.349	0.052	0.037	28.7%
P90-P10	1.786	1.534	1.948	1.516	0.162	-0.018	111.3%
P90-P50	0.697	0.626	0.769	0.682	0.072	0.056	22.4%
P50-P10	1.089	0.908	1.179	0.834	0.090	-0.074	182.5%
Top 1% share	0.079	0.064	0.110	0.091	0.031	0.027	13.2%
Top .1% share	0.019	0.014	0.040	0.032	0.021	0.018	13.8%

Notes: Each row shows the value of an inequality measure in 1980 and 2005 and the change between those dates. The last column shows how much of the pre-tax change was 'undone' by the tax system, calculated as one minus the post-tax change divided by the pre-tax change.