INCOME INEQUALITY MEASUREMENT SENSITIVITIES

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Executive summary

Income inequality has been an animating policy issue over the last number of years. Unfortunately, it has too often been treated simplistically. This study measures both the current state of income inequality and its change over time (since 1982), paying particular attention to how different definitions of income and the choice of economic unit (individuals or families) influence the results.

A number of important analytical results emerge. *Earnings*, a narrow definition of income consisting largely of wages, salaries, and net small business income, have the highest level of inequality, one which has increased sharply since 1982. But this measure ignores a number of critical factors that temper inequality and its growth over time. Specifically, fewer families (and individuals) have earnings than was the case 30 years ago, many more people (students, seniors, welfare recipients) are receiving government transfers now, and families have gotten smaller. Accounting for these important changes—and choosing a broader definition of income—provides a very different view of inequality.

After-tax income includes government transfers and income taxes. Adjusted for family size to take account of the number of people supported by the family's income, it is therefore a much better reflection of the family's actual living standard. Using this measure, we find that family income inequality between 1982 and 2010 has risen between 6.5 and 12.9 percent, depending on the inequality indicator used. This is a far more modest increase than many other studies show.

Moreover, the results using after-tax incomes of individuals show that income inequality is essentially the same or perhaps even slightly less than in 1982. This important result stands in contrast to the simplistic view that income inequality is unambiguously rising.

Table A presents the share of income received by the top 10 percent (also known as the top decile) of families and individuals in 2010, as well as the change in this measure of inequality between 1982 and 2010.

Table A

Share of income earned by the top ten percent, and its change over time

	Families		Individuals	
Income definition	*Income share, 2010*	*Change, 1982–2010*	*Income share, 2010*	*Change 1982–2010*
Earnings	36.8%	+34.2%	41.7%	+13.2%
Total income	30.2%	+22.1%	33.5%	+5.0%
After-tax income	27.6%	+17.3%	30.0%	+2.2%
Adult-equivalent after-tax income	25.3%	+12.9%	n/a	n/a

In 2010, the top 10 percent of families received between 25.3 and 36.8 percent of income, depending on its definition. **Changing the definition from *adult-equivalent after-tax income* to *earnings* increases the level of family income inequality by 45.5 percent.**

Similarly large variances are observed when the change in family income inequality over time is measured. Increases in income inequality range from a low of 12.9 percent (for adult equivalent after-tax income) to a high of 34.2 percent (for earnings). In other words, the measured growth in inequality can be increased by 165.6 percent simply by changing the definition of income.

Looking at individuals rather than families, the level of income inequality again varies depending on the definition of income. The income shares for the top 10 percent of individuals in 2010 vary from a low of 30.0 percent (for after-tax income) to a high of 41.7 percent (for earnings)—a 39.0 percent increase in the level of income inequality entirely due to the choice of definition.

The Gini coefficient, an alternative to the recently popular top-decile share measure of inequality, also shows large differences in both the level of income inequality and its change over time depending on the definition of income—and it shows smaller inequality increases for all income measures and family types. **Indeed, individual total and after-tax incomes actually show inequality *declines* between 1982 and 2010 when Gini coefficients are used**.

Choices about income definition, family size, and the inequality indicator itself are clearly important. A simplistic approach shows a relatively high level of inequality, and one that is considerably higher than three decades ago. However, caution needs to be employed given the sensitivities of the results to the underlying definitions. Unlike individual earnings, adult-equivalent after-tax family income shows less inequality, increasing only modestly over time.

Introduction

In December 2013, President Obama called America's growing income gap "the defining challenge of our time."[1] Other political leaders, economists, columnists, and business leaders have all voiced opinions on the state of inequality and what should be done to correct perceived problems.

There is, however, a serious problem with the approach taken by most commentators and advocates when it comes to inequality. Too often this incredibly complex social issue is treated in a simplistic manner, with advocates rushing to judgment and calling for the same type of reforms they have recommended for decades. In rushing to judgment about the state of inequality and summarily accepting solutions, there is a real risk of making legitimate social problems worse rather than better.

It is in this context that the Fraser Institute has launched a series of papers to clarify aspects of this debate. Over the coming year and a half, more than half a dozen studies will be published on a variety of inequality-related issues, including income vs. consumption inequality and income mobility.

This particular study focuses on the current state of income inequality, its change over time, and measurement issues relating to income inequality in Canada. Specifically, it calculates the current state of income inequality using a host of different income and economic unit definitions. In addition, the study quantifies changes in income inequality over time. Finally, the paper examines how different definitions of income, economic units (individual, family, or household), and the indicator used can all alter the measurement of inequality and its change over time. This latter point is critical to understanding inequality. Too often, improper measures of inequality are used to arrive at results supportive of an advocate's pre-existing position. This study provides a number of different measures of income inequality and demonstrates how each changes over time in order to highlight how these definitions influence the outcome of inequality measurement.

The first part of the paper explains the many definitional choices faced when measuring inequality. Definitions are provided, for example, for the

1. See <http://www.whitehouse.gov/the-press-office/2013/12/04/remarks-president-economic-mobility>.

different measures of income available as well as for the different economic units employed when measuring inequality. The second section provides a series of inequality measurements based on these different definitions. Critically, this section discusses how changes in the underlying definitions alter the level of inequality and its changes over time. The empirical section is followed by a discussion of various issues influencing the measurements. In addition, an expanded discussion of how changes in households over time affect income inequality is presented. The paper ends with some brief concluding comments. Appendices provide detailed results and robustness checks.

Definitions and selected measures

Changes in the definition of income, of the recipient of income (economic unit), or of the particular indicator of inequality all influence the measurement of inequality and its change over time. This section outlines and explains the different definitions of income and economic units available when measuring inequality. The main indicators available to gauge inequality are also discussed.

Measures of inequality

Economic inequality refers to differences in living standards between persons, households, regions, and nations. Since the "standard of living" has a number of possible interpretations, proxies such as income or wealth (most often the former) are used to represent an economic unit's living standard.[2] A common way to look at economic inequality is to examine differences in the incomes of individuals, families, or households within a specified region in a specified time period, normally a year.

Income inequality itself can be measured in a number of ways. Arguably the most common methods employed are quintile or decile shares and the Gini coefficient.

Table 1 presents the most common approach to measuring inequality. This approach ranks every family's income from highest to lowest, and then separates the total number of families into five equal groups. This is referred to as a quintile share analysis. The result is a ranking of families, based on total income, from the lowest group (bottom 20 percent) to the highest group (top 20 percent). Sometimes the analysis is based on ten groups, or what is called a decile share analysis.

2. This is not to suggest that income fully represents one's standard of living. There are of course a number of other aspects of living standards that would be important (consumption, wealth, and economic and personal security, for example); however, income is commonly used as a proxy for living standards and is used here consistent with the focus of this paper.

Table 1
Quintile distribution of total income of economic families, Canada, 2010

Quintile	Share (%)
Bottom 20%	4.2
2	9.6
3	15.4
4	23.7
Top 20%	47.1

Sources: Statistics Canada, SLID microdata file, 2010; calculations by C. Sarlo.

The data in table 1 are for families in Canada, based on total income in 2010.[3] It is important for readers to understand the number of choices underlying this data. First, families were selected rather than individuals or households. Second, total income was selected rather than other measures of income. It is these choices and their impact on measured inequality that are explored and analyzed in this paper.

To the extent that the information collected by the survey is accurate, the quintile distribution presented in table 1 illustrates income inequality in Canada.[4] Based on reported incomes, the top 20 percent of families in 2010 had 47.1 percent of the total income whereas the bottom 20 percent had 4.2 percent of total income. In other words, the top 20 percent had about 11 times the income of the bottom 20 percent, resulting in a quintile inequality ratio of 11.2.

Recent work, particularly Piketty's *Capital in the 21st Century* relies on a variant of the decile/quintile share ratios: the top decile share of income.[5] Rather than measure the *ratio* of the top 10 percent and the bottom 10 percent, the decile share measures the share of income received by the top 10 percent of individuals or families.

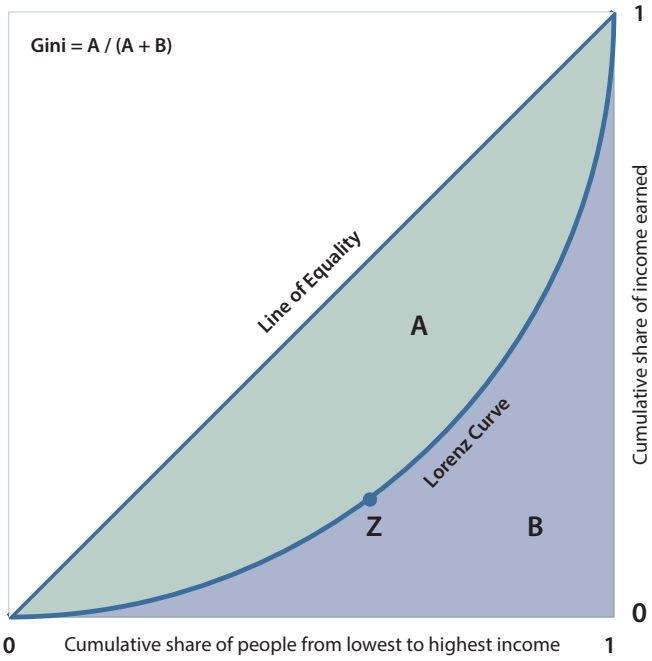
3. The data are from the Survey of Labour and Income Dynamics (SLID), which is an annual survey of roughly 17,000 households randomly selected based on demographic and economic characteristics including income. For further information on SLID please see <http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&SDDS=3889>.

4. A number of studies have concluded that there is a problem with reported income in that it can depart from actual income as a result of tax evasion, misunderstandings of what constitutes income, hastiness, or failure to take the survey seriously. For example, Wolfson and Evans (1990) concluded that there was considerable underreporting of certain types of income such as employment insurance income (roughly 20 percent) and social assistance income (40 percent). Similarly, Schuetze (2002) examined non-compliance by self-employed Canadians in reporting income and found that between 12 and 24 percent of self-employment income was underreported.

5. A number of scholarly reviews of Piketty's book that have found fairly serious errors. See Cross (2014) and Magness and Murphy (2014).

Most people are less familiar with the Gini coefficient, which is another common approach to measuring inequality, although largely used by academics and researchers. The Gini coefficient is based on the Lorenz curve, a plot of the cumulative share of income earned by a population ordered from lowest to highest income (**figure 1**).[6] The "line of equality" represents everyone in society having exactly the same income. The Lorenz curve represents the actual distribution of income; the further away the curve is from the line of equality, the less equal the distribution. Point Z in figure 1 shows that roughly 60 percent of the population earns about 20 percent of the income, so the income distribution in this society is quite unequal. In simple terms, the Gini coefficient distills this relationship into a single number between 0 and 1.[7] The value 0 represents a situation in which every single unit in society has exactly the same income—referred to as complete equality of income. The value 1 represents a situation in which a single unit in society has all of the income and every other unit has no income—referred to as complete inequality. All nations have Gini coefficients that are somewhere in between these two extremes.

Figure 1



6. There are a number of sources that explain the calculation of the Gini coefficient and its relation to the Lorenz curve. See for example <http://en.wikipedia.org/wiki/Gini_coefficient> and <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPA/0,,contentMDK:20238991~menuPK:492138~pagePK:148956~piPK:216618~theSitePK:430367,00.html; and http://www3.nccu.edu.tw/~jthuang/Gini.pdf; https://www.youtube.com/watch?v=0Vv930-sDTI>.

7. Although actually determining the values for A and B can be complicated, the Gini is calculated as area A (bounded by the line of equality and the Lorenz curve) divided by the triangle given by the line of equality and the two axis (effectively A + B or 0.5).

The principal advantage of the Gini coefficient over tables displaying quintile or decile shares of income is that it captures in a single number the overall degree of inequality. It is relatively easy to understand and brief.

Table 2 presents the Gini coefficients for a select group of industrialized countries as well as several developing countries for the late 2000s, based on adjusted household disposable income. Specifically, income is defined as earnings, self-employment, capital income, and public cash transfers less income taxes and social security contributions paid. Household income is adjusted to reflect differences in needs for households of different sizes (i.e., the needs of a household composed of four people are assumed to be twice as large as those of a person living alone).[8]

Table 2

Gini coefficients, select countries, late 2000s

OECD countries	
Slovenia	0.24
Norway	0.25
Denmark	0.25
Finland	0.26
Hungary	0.27
Netherlands	0.29
Ireland	0.29
Germany	0.30
OECD	0.31
Canada	0.32
Spain	0.32
Italy	0.34
United Kingdom	0.34
United States	0.38
Mexico	0.48
Chile	0.49
Non-OECD countries	
Indonesia	0.37
India	0.38
China	0.41
Russian Federation	0.42
Brazil	0.55
South Africa	0.70

Notes: Data used here were provided by national experts applying common methodologies and standardised definitions. In many cases, experts have made several adjustments to their source data to conform to standardised definitions. While this approach improves comparability, full standardisation cannot be achieved.

For non-OECD countries, Gini coefficients are not strictly comparable with OECD countries as they are based on per capita incomes, except India and Indonesia for which per-capita consumption was used.

Source: OECD, 2013.

8. For additional detail, see <http://www.oecd-ilibrary.org/docserver/download/3012021ec025.pdf?expires=1425420965&id=id&accname=guest&checksum=DACEF83390075FCD0E01FD20CE4D9AEE>.

Canada's Gini coefficient was 0.32, indicating a relatively more equal distribution of income compared to the United States at 0.38 and a less equal distribution than Norway at 0.25.

This study employs two indicators of income inequality—the top share (both quintile and decile), and the Gini coefficient. Each tells us something a little different about what is happening to the distribution of income, and it will be helpful to measure both.

Economic units

Economic units refer to the recipient of income. The measurement of inequality requires that a recipient unit be specified. In Canada, the economic unit can be an individual, a family, or a household.

An **individual** is fairly self-explanatory in that it refers to a single person. An economic **family** refers to a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law, or adoption. A couple may be of opposite or the same sex. Foster children are included.

A **household** refers to a person or group of persons who occupy the same dwelling and do not have a usual place of residence elsewhere in Canada or abroad. The dwelling may be either a collective dwelling or a private dwelling. The household may consist of a family group such as an economic family, of two or more families sharing a dwelling, of a group of unrelated persons, or of a person living alone.

Typically, studies of income inequality focus on either households or families, not on both. This study relies on family units rather than households because changes in family structure such as size, composition, and other characteristics explain some of the observed changes in income inequality over time.

It is also important to recognize that individual incomes should not be confused with the incomes of unattached individuals who are not members of families. Individual incomes include the incomes of all individuals whether they live alone or not. It is simply an accounting of everyone who has an income source.

We expect individual incomes to be less equal than family incomes because we have considerable pooling of incomes within families. This pooling of income pulls a lot of low and high incomes together and tends to compress (make more equal) the range of family incomes relative to the incomes of individuals. Consider for example an affluent married couple where most of the income is earned by one of the partners while the other works part-time and cares for the couple's children. If the two partners are considered as individuals, one would be categorized as living in low income while the

other would be considered to be earning high income. The reality is that the income of the working partner is shared by the entire family, which means the appropriate recipient unit is the family.

It is important to understand the levels and trends of inequality for both individual and family incomes. The former has the potential to reveal aspects of inequality masked by the pooling of incomes that happens with the latter. In keeping with the principle that more information is better than less, this study calculates and presents measures of both family and individual income inequality.

Definition of income[9]

There are a variety of income definitions that can be used when gauging inequality. Four are used in this analysis: (1) earnings, (2) total income, (3) after-tax income, and (4) adjusted after-tax income.

The measures defined below are all reasonable measures of income but will result in different perceptions of the state of inequality and its change over time. As with the choices among different indicators and recipient units, the key is deciding which income definition is the most appropriate.

Earnings refers to the sum of employment income, which includes wages and salaries, net farm income, and net income from non-farm unincorporated business and/or a professional practice. A number of recent studies noting a sharp rise in income inequality have used a measure focused on market income,[10] which is a broader definition than earnings. It adds investment income (largely capital gains, interest, and dividends) and private retirement pension income to earnings.

We favour **total income**, which captures all of the sources of income flowing into a household, and is most often used in studies of income inequality. Total income is more complicated because it includes a much broader array of sources of income. Technically, it refers to the sum of certain receipts (in cash and, in some circumstances, in kind) of the reporting unit (individual, family, or household) during a specified reference period. It refers to monetary receipts from certain sources, before income taxes and deductions. It includes active employment income from wages, salaries, tips, commissions, and net income from self-employment (for both unincorporated farm and

9. This section relies heavily on Statistics Canada's Income Reference Guide, National Household Survey (2011). Indeed, in several cases the definition was extracted directly from the reference guide. See <http://www12.statcan.gc.ca/nhs-enm/2011/ref/guides/99-014-x/99-014-x2011006-eng.cfm>.

10. See for example Fortin (2012), Broadbent (2012), Milligan (2013), Heisz (2007), and Baker et al. (2003).

non-farm activities). It also includes income from employer and personal pension/retirement sources such as private pensions, and payments from annuities and RRIFs. Income from investment sources such as dividends and interest is also included in total income. Other regular cash income such as child support payments, spousal support payments (alimony), and scholarships are included too.

Total income also includes income received from government sources such as social assistance, child benefits, employment insurance, Old Age Security pensions, Canada or Quebec pension plan benefits, and disability income.

A number of payments that are deemed one-time in nature are excluded from the definition of total income. These include lottery and gambling winnings, cash inheritances, lump-sum insurance settlements, capital gains, and RRSP withdrawals. Capital gains are excluded because they are not by their nature regular and recurring. It is further assumed that they are less likely to be fully spent in the period in which they are received, unlike income that is regular and recurring. Also excluded are employer's contributions to registered pension plans, Canada and Quebec pension plans, and employment insurance. Finally, voluntary inter-household transfers, imputed rent, goods and services produced for barter, and goods produced for own consumption are all excluded from the definition of total income.

What total income ignores, of course, is that fact that the recipient unit (household, family, individual) does not get to spend all of their total income. People pay taxes out of total income and so, if we want a better guide to the actual standard of living (the spendable purchasing power) of the unit, we need to consider **after-tax income**. After-tax income is often referred to as "disposable income" and is a better gauge of living standards than pre-tax or total income. It refers to total income from all sources minus federal, provincial, and territorial income taxes paid.

One concern with after-tax income is that it does not account for the number of people being supported by that level of income. The living standard of five people in a household with $50,000 in after-tax income will be different from that of a single person with the same $50,000 in after-tax income.

A method to adjust income so that the size of the household is accounted for is needed to make comparisons reasonable. Clearly, making a straight per-capita adjustment is not appropriate. Income of $50,000 for five people in a household does not provide the same standard of living as $10,000 for one person. It's higher. There are economies of scale that occur when a number of people live together. They share accommodation, appliances, television and cable service, furnishings, utilities, and often a family automobile. Those economies of scale mean that additional persons in a household do not cost as much as the first person, and succeeding persons cost even less.

Economists have found a mechanism for making adjustments in household income to account for household size. It involves the use of what are called equivalence scales. Equivalence scales are a set of numbers that show how much more income households of two or more people need to have in order to maintain the same (equivalent) standard of living as a household of one person.

One of the most common equivalence scales in use in studies of poverty and inequality (and the scale used in this study) is the Square Root Scale: the square root of household size is the adjustment factor for equating living standards. Specifically, the first person in a household is assigned a value of 1, two people require 1.4142 (the square root of 2) times the income of the first person to be as well off as the first person, three people require 1.7321 (square root of 3) times the income of the first person, and so on. While it may seem to be an odd and arbitrary choice, the Square Root Scale appears to be close to other scales that are based on research of poverty situations. **Table 3** displays the square root equivalence scale values by household size.

Table 3
Square Root Equivalence Scale values

Household size	1	2	3	4	5	6
Scale symbolically	√1	√2	√3	√4	√6	√6
Numerical value	1	1.4142	1.7321	2	2.2361	2.4495

Adjusted after-tax income (or adult-equivalent after-tax income) refers to after-tax income, as defined above, adjusted by a factor that accounts for family size. The adjustment factor takes into account the lower comparative needs of additional family members compared to a single person living alone.

Whatever the household's income, we divide it by the square root of household size to get the adjusted (or "equivalized" or "adult equivalent") income for that household. In the study this is referred to as AE_Income. This allows households of different sizes to be reasonably compared with each other.

Clearly, the different kinds of incomes will each have their own distributional characteristics and therefore will have a different level of inequality. Broadly speaking, earnings are likely to be more unequally distributed than total income because a substantial portion of the population have zero earnings (many students, retired persons, stay-at-home spouses, social assistance recipients, etc.) whereas almost every household and every adult within a household will have some source of income.

Furthermore, we expect that earnings inequality would increase over time if more households had zero earnings and if there were more high earners. In fact, this is exactly what has happened over the past three decades. In 1982, about 18 percent of households had zero earnings but less than one percent had zero (or less than zero) total income. As well, by 2010, 22 percent of households had zero earnings. And, by 2010 the proportion of high earning households had increased 10 fold.[11]

Similarly, we would expect after-tax income to be less unequal than total income due to the effect of a progressive income tax (which takes a greater percentage of income as one's income increases). And finally, we expect that adult-equivalent incomes would be even more equally distributed as household size is accounted for.

The next section presents calculations of income inequality based on different measures of income and different units of account to illustrate how these different definitions influence the level of and changes in inequality over time.

11. This assumes a high-income threshold of $100,000 in 1982 and the constant dollar equivalent in 2010.

Measures of income inequality with varying definitions

The main premise of this study is that measuring income inequality is not a simple matter and involves a number of definitional choices by researchers. These choices have a real and important impact on the results. Indeed, choices made about the definition of income and the recipient unit will fundamentally change the level and trend of income inequality. So there is a concern about naiveté and simplification in the measurement process.

This section briefly explains the process used in the study to calculate the level and trends in income inequality in Canada over the past several decades. The main data source for this study is Statistics Canada's Survey of Consumer Finances (SCF) and Survey of Labour and Income Dynamics (SLID). Statistics Canada has microdata files containing information on individual income and its components dating back to the 1970s. We chose 1983 (using 1982 incomes) as the starting point of the empirical research for this study because 1983 was the first year they produced separate files for both family and individual incomes. The SCF was no longer produced after 1996 and was replaced by the Survey of Labour and Income Dynamics (SLID).

The Survey of Labour and Income Dynamics (SLID) was discontinued in 2011, meaning the most recent data available from the SLID is for 2010. It was replaced by the Canadian Income Survey (CIS), which is a new cross-sectional survey developed to provide information on the income and income sources of Canadians, along with their individual and household characteristics. Its first release was based on annual income information for the 2012 reference year. The CIS reports on many of the same statistics as the SLID. However, due to methodological differences between the two surveys, the results of the Canadian Income Survey should not be compared to those produced by SLID.

The study employs a fairly long time period, 1982 to 2010, to ensure that changes in inequality resulting from short-term economic fluctuations are properly accounted for. Four individual data points were used: 1982, 1990, 2000 and 2010. The data presented are based on the Survey of Consumer Finances for 1982 and 1990, and on the Survey of Labour and Income Dynamics for 2000 and 2010.

Three income definitions—earnings, total income, and after-tax income—are used to examine income inequality for individuals. These three plus adult-equivalent after-tax income are used for family income inequality. Two separate inequality indicators are used for this study: top share (both quintile and decile shares), and the Gini coefficient.[12]

Top share measures of income inequality

The first measure of income inequality is the share of income received by the top 10 percent (decile share) and the top 20 percent (quintile share). The top share indicator is increasingly preferred and used by economists concerned with inequality.

Families

Table 4 shows data for the top decile and quintile shares of income for families over the 1982 to 2010 period. Four income measures are presented for both the decile and quintile shares of income—earnings, total income, after-tax income, and adult-equivalent after-tax income.

Table 4

Top decile and quintile shares for economic families, 1982–2010

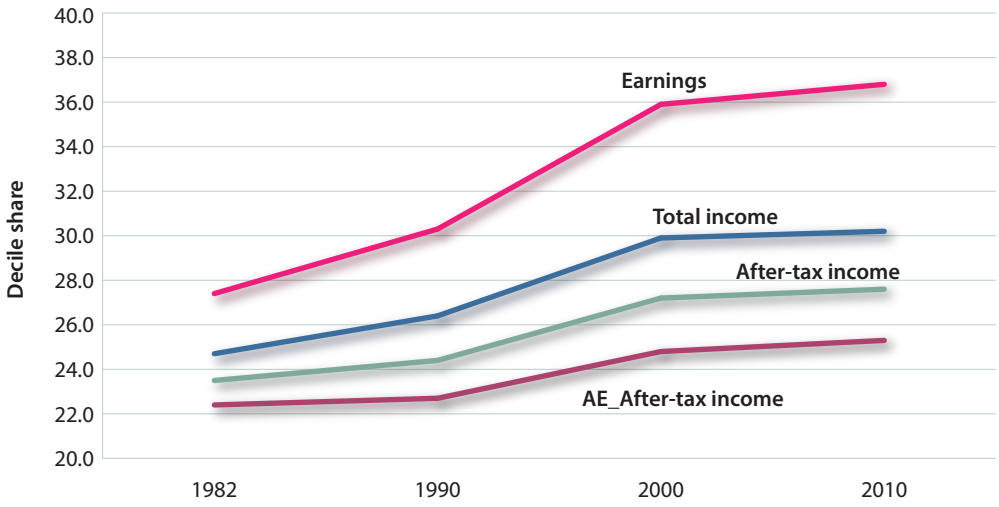
	Earnings		Total income		After-tax income		AE_After-tax income	
	Top decile	*Top quintile*	*Top decile*	*Top quintile*	*Top decile*	*Top quintile*	*Top decile*	*Top quintile*
1982	27.4	46.1	24.7	41.4	23.5	39.7	22.4	38.2
1990	30.3	49.4	26.4	43.0	24.4	40.6	22.7	38.1
2000	35.9	55.8	29.9	46.7	27.2	43.8	24.8	40.3
2010	36.8	57.0	30.2	47.1	27.6	44.2	25.3	40.7
Change, 1982–2010	34.2%	23.7%	22.1%	13.6%	17.3%	11.2%	12.9%	6.5%

Source: MISSING.

There are three analytical aspects of interest: (1) level of inequality, (2) changes in inequality over time, and (3) the range of results generated by the differing definitions of income employed. It is the latter observation that will be stressed in the analysis, since the main exercise of this paper to demonstrate how these different definitions influence the analysis of income inequality.

12. The top share indicator appears to be increasingly common in studies measuring inequality. Recent examples include Veall (2012), Milligan (2013), Saez (2014), Piketty (2014), and Armour et al. (2014), to name just a few.

Figure 2
Top decile shares for economic families, 1982–2010



Source: See table 4.

In 2010, the latest year of data included in the analysis, income inequality, as measured by the share of income received by the top 10 percent of Canadian families (decile share, **figure 2**), ranges from a low of 25.3 percent for adult-equivalent after-tax income to a high of 36.8 percent for earnings. The top 10 percent of families received 36.8 percent of earnings, 30.2 percent of total income, 27.6 percent of after-tax income, and 25.3 percent of adult-equivalent after-tax income.

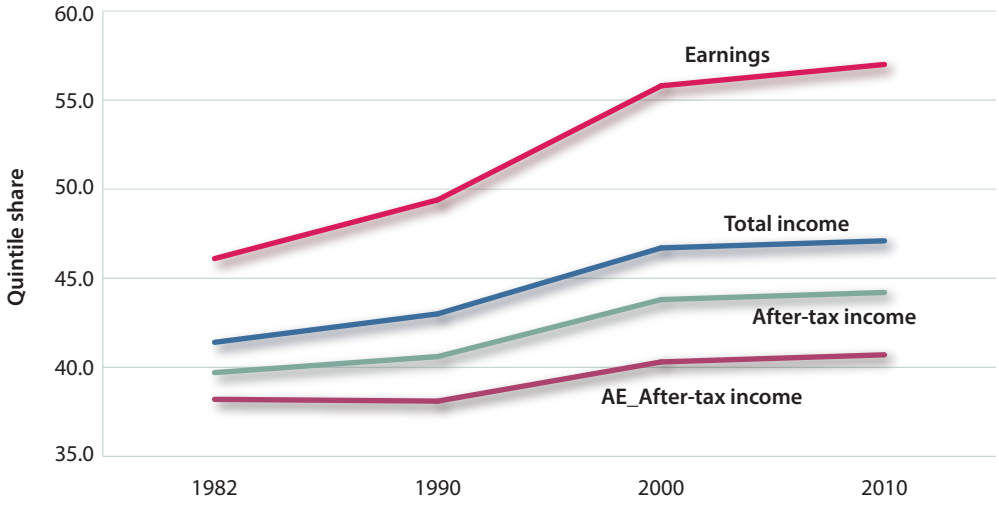
By changing the definition of income used to measure income inequality from adult-equivalent after-tax income (total income after accounting for income taxes and normalizing for the size of the household) to a narrower measure of income, namely earnings (basically employment income), measured income inequality increases by 45.5 percent in 2010.

The top-decile share of family income, when defined as earnings, increased sharply (34.2 percent) between 1982 and 2010. This is not surprising, as mentioned earlier, given that many more families now have no earnings and that, at the same time, there are many more multiple-earner families.

The share of total income and after-tax income received by the top 10 percent of families has also increased, but by less: 22.1 percent and 17.3 percent, respectively, over this period. This lower level of increase when the definition of income is broadened from earnings to total income or after-tax income suggests that the tax and transfer system is, at least temporally, equalizing income. Finally, when we adjust for family size (using the square root equivalence scale), the rise in the share of adult-equivalent after-tax income received by the top 10 percent of families is a more modest 12.9 percent over

Figure 3

Top quintile shares for economic families, 1982–2010



Source: See table 4.

the period. Put differently, the growth in the share of income received by the top 10 percent of families between 1982 and 2010 is 165.6 percent higher if we use a narrow definition of income than it is if we use a broad one.

The results for the quintile analysis (**figure 3**), which measures the share of income received by the top 20 percent of families, are similar to those for the decile analysis. In 2010, the share of income received by the top 20 percent of Canadian families ranged from 40.7 percent for adult-equivalent after-tax income to 57.0 percent for earnings. Again, changing the definition of income from adult-equivalent after-tax income to the narrower earnings makes measured income inequality higher—in this case, 40.0 percent higher.

The share of income received by the top 20 percent of families increased over time (figure 3), but by less than the increases observed for the top 10 percent of families (figure 2). This suggests that much of the increase in the incomes of the top 20 percent of families is due to increases received by the top 10 percent of families. It is important to note that it is not necessary to be a business, sports, or entertainment superstar to be in that top 10 percent category. Entry into that club required a total income of roughly $140,000 in 2010. Many professionals would be in that income category, as would many mid-level managers and successful small business owners. Critically, it would also include a large number of two-income families.[13]

13. For example, in most cases, two school teachers would be in the top 10 percent of family incomes.

The increases in income inequality over time, as measured by the share of income received by the top 20 percent of families, range from a low of 6.5 percent for adult-equivalent after-tax income to 23.7 percent for earnings. In other words, the growth in income inequality in this case changes by a factor of 2.6 depending on what definition of income is used.

Individuals

This section applies to individuals the same analysis completed above for families. **Table 5** presents the top decile (10 percent) and quintile (20 percent) shares of income received by individuals between 1982 and 2010 for three different measures of income: earnings, total income, and after-tax income.

Table 5

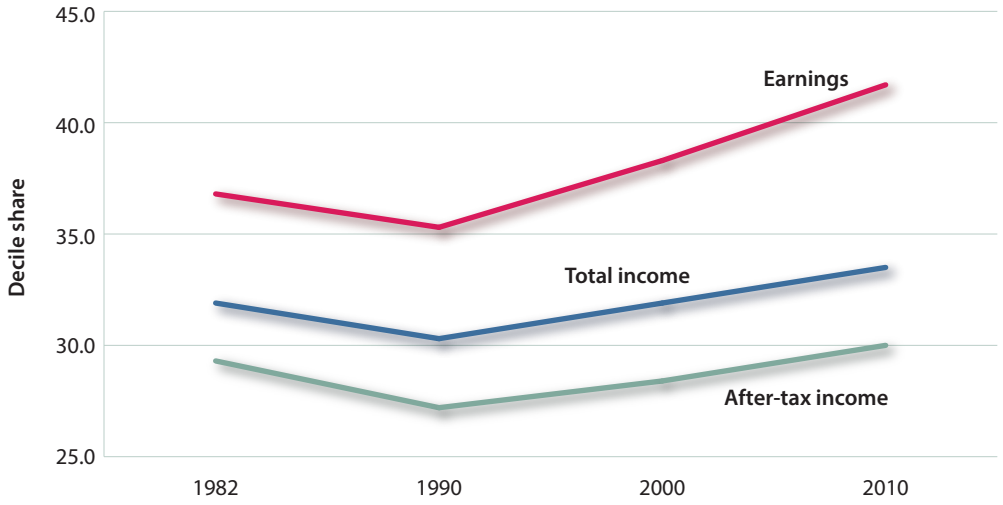
Top decile and quintile shares for individuals, 1982–2010

	Earnings		Total income		After-tax income	
	Top decile	*Top quintile*	*Top decile*	*Top quintile*	*Top decile*	*Top quintile*
1982	36.8	59.7	31.9	51.6	29.3	48.4
1990	35.3	56.8	30.3	48.7	27.2	44.9
2000	38.3	59.5	31.9	49.7	28.4	45.7
2010	41.7	63.2	33.5	51.1	30.0	47.2
Change, 1982–2010	13.2%	5.9%	5.0%	-0.9%	2.2%	-2.4%

Source: MISSING.

Figure 4

Top decile shares for individuals, 1982–2010



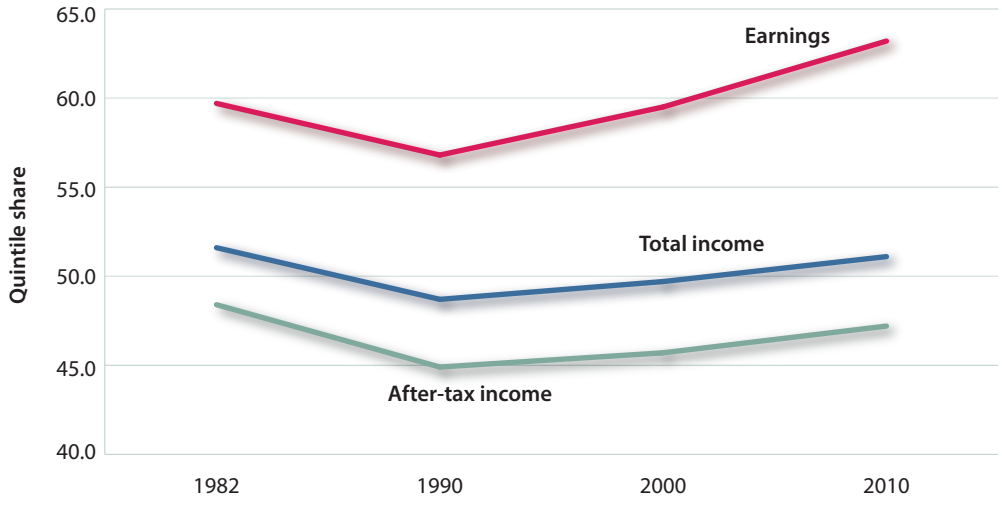
Source: See table 5.

Figure 4 illustrates the data from table 5 for the top 10 percent of individuals and the income they received between 1982 and 2010. Their income shares in 2010 vary from a low of 30.0 percent when after-tax income is used to a high of 41.7 percent when income is defined as earnings. Put differently, the level of income inequality, as calculated using the share of income received by the top 10 percent of individuals, increases by 39.0 percent when the definition is changed from a broad measure of income, namely after-tax income, to a narrow measure of income, namely earnings.

The growth in income inequality on this measure also varies considerably depending on what definition of income is used. The growth in the share of income received by the top 10 percent of individual Canadians between 1982 and 2010 is a mere 2.2 percent when after-tax income is used, but income inequality increases by 13.2 percent when earnings are used to define income. The growth in income inequality in this case can be increased by a factor of 6 depending on the definition of income. It is worth noting again that after-tax income is the measure of income that most closely indicates living standards.

Similar results are observed when the top share is calculated on a quintile (top 20 percent) basis (**figure 5**). The share of income received by the top 20 percent of individuals in 2010 ranges from a low of 47.2 percent when after-tax income is used to a high of 63.2 percent when income is defined as earnings. The level of income inequality in this case increases by 33.8 percent when the definition is changed from a broader (after-tax income) to a narrower (earnings) measure of income.

Figure 5
Top quintile shares for individuals, 1982–2010



Source: See table 5.

The change in income inequality between 1982 and 2010 also varies considerably depending on the definition of income used. Income inequality increased by 5.9 percent if a narrow (earnings) definition of income for individuals is used. On the other hand, income inequality actually *decreases* by 2.4 percent if the definition of income is switched to the broader after-tax income measure. Indeed, income inequality in this case also decreased during this period, albeit marginally (0.9 percent), if total income is used to define income. On the basis of top quintile shares of individual income (total and after-tax), it would be impossible to make a case that income inequality was decreasing over the specified time period.

As with the previous section that examined the top shares of income for families, large variances are observed in the level of income inequality and the growth in income inequality for individuals depending on what definitions are employed. These large differences in calculated income inequality illustrate the importance of the underlying definition of income.

Income inequality according to the Gini coefficient

The Gini coefficient is arguably the most popular and the single most important summary indicator of inequality, though it is largely used by academics and researchers. This is because it does not just focus attention on the top share (decile or quintile) of incomes. Rather it considers the entire distribution of income. In that sense, it is a comprehensive indicator and that undoubtedly explains its popularity.

Table 6 contains the results for the Gini coefficients for Canada for 1982, 1990, 2000, and 2010 for both individuals and families. Four measures of income are used to calculate the Gini coefficients for families: earnings, total income, after-tax income, and adult-equivalent after-tax income. The first three of those measures are used to calculate the Gini coefficients for individuals. This section focuses on three aspects of these results: the level of income inequality in 2010, the change in income inequality between 1982 and 2010, and finally how the results vary when different measures of income are employed.

Figure 6 illustrates Gini coefficients for families in Canada. In 2010, these ranged from 0.341 (when income is defined as adult-equivalent after-tax income) to 0.584 (when just earnings are used to define income). In other words, the value of the Gini coefficient in this case can increase by 71.3 percent—implying greater inequality—depending on what definition of income is used.

Between 1982 and 2010, growth in income inequality for families, based on the calculation of Gini coefficients, also indicates great variability depending on the measure of income used, ranging from a low of 9.6 percent

Table 6

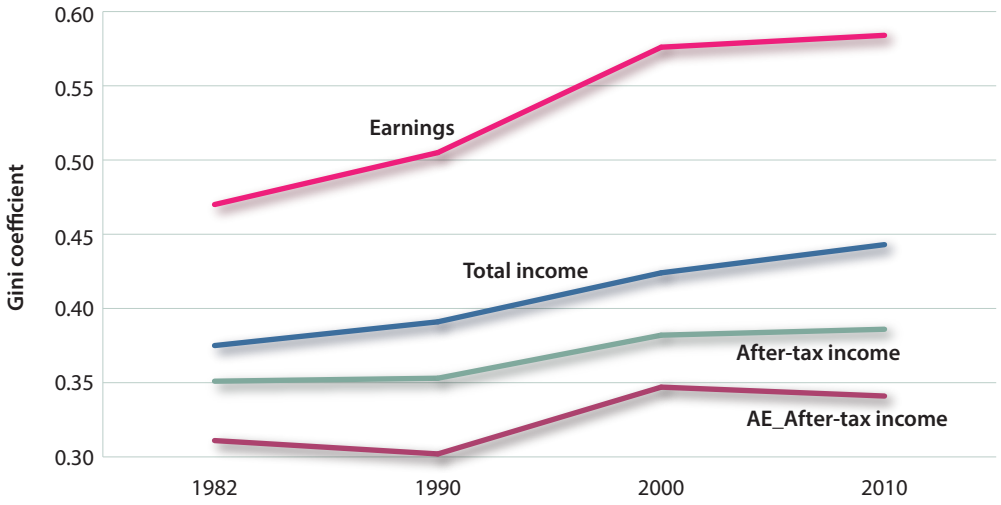
Gini coefficients for economic families and individuals, 1982–2010

	Earnings		Total income		After-tax income		AE_After-tax income	
	Families	*Individuals*	*Families*	*Individuals*	*Families*	*Individuals*	*Families*	*Individuals*
1982	0.470	0.625	0.375	0.519	0.351	0.489	0.311	n/a
1990	0.505	0.594	0.391	0.479	0.353	0.437	0.302	n/a
2000	0.576	0.607	0.424	0.482	0.382	0.435	0.347	n/a
2010	0.584	0.665	0.443	0.489	0.386	0.468	0.341	n/a
Change, 1982–2010	24.4%	6.4%	18.3%	-5.9%	10.2%	-4.2%	9.6%	n/a

Source: MISSING.

Figure 6

Gini coefficients for economic families, 1982–2010



Source: See table 6.

(adult-equivalent after-tax income) to a high of 24.4 percent (earnings). In other words, the growth in income inequality based on the Gini coefficients for families increases by a factor of 1.55 when the definition of income is changed from a broad measure that adjusts for household size to a more narrow measure.

Similar results are observed when the Gini coefficients are calculated for individuals rather than families. **Figure 7** depicts the Gini coefficient results from table 6 for individuals in Canada. In 2010, the Gini coefficient for individuals ranged from 0.468 when income is defined as after-tax income to 0.665 when just earnings are used. The value of the Gini coefficient increased by 42.0 percent simply by changing the definition of income.

Figure 7

Gini coefficients for individuals, 1982–2010

Source: See table 6.

Similar results are again observed when the growth in Gini coefficients are examined. Income inequality for individuals *drops* by 4.2 percent between 1982 and 2010 when after-tax income is used, and by 5.9 percent for total income, but *increases* by 6.4 percent when just earnings are used. Only the narrowest definition of income results in an increase in income inequality based on Gini coefficients for individuals.

This section clearly illustrates the sensitivity of income inequality results to decisions about whether to measure individuals or families (receiving unit) as well as what measure of income to employ (earnings, total income, after-tax income, or adult-equivalent after-tax income). The range in the level of income inequality as well as the variability in changes over time are significant. Great care needs to be taken when analyzing and discussing income inequality to ensure that proper measures are employed based on the questions being asked.

Other considerations

As interesting and important as these results are, there are other considerations that have not been accounted for but which are likely to impact on the extent of income inequality. While most of these considerations are difficult or impossible to accurately quantify, they nevertheless bear mention in the discussion of the empirical results.

Equivalence scales

While the square root scale is by far the most popular choice for studies of this type, there are other alternatives worth consideration—and it is not at all clear that the same equivalence scale is relevant or valid at all income levels. The square root scale (and others with similar values) was designed for low-income situations. Is it the case that in middle and upper income households a second person would add about 40 percent to costs and a third person another 30 percent in order to maintain the same standard of living as the first person? It can certainly be argued that a scale with lower values might be more appropriate for higher income families where households (and most facilities, furnishings, and appliances therein) are typically already in place.[14]

Sarlo (2008) briefly considered whether these alternatives would materially and meaningfully change the inequality results. Inequality results were determined to be somewhat but not strongly sensitive to changes in equivalence scales. Two different equivalence scales were used to estimate

14. For example, Browning (1992) specifically rejected the idea that the same scale could be applied across the board at all levels of income. Browning (1991) developed a scale designed to be applied to middle income, intact families living in Ontario only. If we take the approximate averages (for the various family situations considered by Browning), his 20/10 scale means that the first child in an intact family costs an additional 20 percent, and the second child about an additional 10 percent, of the two parents' costs. As well, Gray and Stanton (2010) examined the range of equivalence scales using a variety of approaches. While the estimated scales vary widely, a significant number lie in the range of 20/10.

poverty in Canada; while one produced results that were consistently higher, the differences were not sharp and the trend was broadly the same.[15]

However, this is a study of income inequality and a single scale is expected to reflect economies of scale in living across the full distribution of income and not just at the poverty level. It is a valid question as to whether a single scale can adequately represent economies of scale at different income levels. Perhaps two or more scales should be employed at different income ranges. The difficulty is that there is little guidance in the research as to exactly where those adjustments ought to be made. Any choice would be quite arbitrary, defeating the purpose of having a more careful and precise process. The alternative, one that most researchers choose, is to use a single scale across the board.

The biggest advantage of a single scale is computational simplicity. In that regard, the square root scale is ideal. A single transformation tied solely to family size (without regard to living standard, age, gender, or location) certainly makes the calculations easier and avoids the problem of having to make a number of arbitrary choices (instead of a single one). And, as mentioned, the square root scale does resemble the values generated by some other scales used in the study of poverty.

The problem of unreported income

The measurement of inequality relies on accurate information about income (and its components) collected from surveys. In recent years, a high proportion of respondents to Statistics Canada's surveys allow the use of their tax returns as a source of information. Ideally, this should increase the accuracy of the data, assuming that the proportion of the population who misrepresent their income on their personal tax return is stable.

Sarlo (2001: 41–42; 2009: 11–14) addressed the issue of unreported and underreported income, presenting evidence that showed underground economic activity increasing during the 1980s and 1990s and that it could be as high as 15 percent of GDP.[16] The studies further suggested that, overall, the bias was at the lower end of the distribution because of the industries where this activity is more common (service sector, sex business, trades, and crime) and because of the absence of a paper trail with cash transactions. To the extent that incomes, especially those at the lower level, are understated because of unreported income and to the extent that the problem is growing,

15. The square root scale was compared to a scale developed by the US National Research Council.

16. This evidence was drawn from scholars who did original research on aspects of the underground economy, e.g. Wolfson and Evans (1990), Giles and Tedds (2002), Schuetz (2002), and Tedds (2005).

this would mean that measured income inequality is overstated and increasingly so over time.

But is the problem of income underreporting only at the lower end of the distribution? What about high income earners who are able to cheat or find legal loopholes to understate their true income? A recent paper by Wolfson et al. (2014) examines this question particularly in the context of "tax planning" and (legal) funds transfers using private corporations by wealthy individuals, effectively lowering their reported incomes. The authors conclude that true income inequality is understated because of this consideration. This new line of research is interesting and important. It clearly bears on the question of the adequacy of reported incomes in measuring inequality. Conclusions about the net impact of underreporting (at both ends of the distribution) must await a more comprehensive study. In the meantime, it is best to reserve judgment about the likely net bias of unreported and underreported income on income inequality.

Different surveys

Different Statistics Canada data generate different estimates of income and its components. Ideally, if the surveys that produce the data sets are random and if the execution and editing phases of the process are at a high standard, then different surveys of the same population at the same time should generate broadly similar results in terms of key indicators. However, that clearly does not always happen. Sarlo (2008) used two different Statistics Canada data sources for income over the same time period (early 1970s to 2005) and found that the trend in poverty sharply differed by data source. While each data source had a different focus, both surveyed income (and its components) and both claimed to be random surveys representing Canadians across the country. The resulting differences in poverty rates and poverty trends were of sufficient magnitude that this at least raises suspicion that they might generate different inequality results as well.

Data coding

Some researchers "bottom code" their raw data. This simply means that they either eliminate non-zero values altogether or they "edit" those values to positive numbers. Some researchers also "top code" the data to take out extreme

outliers and to make the data comparable to other data sets.[17] While Sarlo has experimented somewhat with both top and bottom coding and is persuaded that the resulting inequality values (for the Gini coefficient, for example) are only modestly different, it does open the possibility to data adjustments leading to different results. For this study, the authors did not "code" the data in any way but did do some coding experiments after the main research was completed.

Other compensation and benefits

Is it possible that income itself (even assuming it is accurately reported) is less and less an adequate reflection of people's true living standard? Are there certain benefits that clearly improve the individual's living standard but that are missing if we just look at income? This possibility is particularly germane when discussing measures of income inequality in the United States. For example, Don Boudreaux and Mark Perry point out that measured income excludes fringe benefits (such as various types of insurance, health benefits, and pensions) which now amount to about 30 percent of total compensation (in the US). Including these benefits may serve to increase inequality if taken into account (and added to income). That is because they are connected to employment and are typically unavailable to people who do not work. Moreover, much low wage and part-time work carries with it little or no fringe benefits. On the other hand, if such benefits largely impact the middle class, then including fringe benefits could potentially reduce inequality by increasing the income of the middle groupings.

However, there is a more important omission that, if included, would clearly be equalizing. Fitzgerald (2008) and Burkhouser et al. (2012) examined the impact of including health insurance benefits on the measured well-being of middle class Americans. But this inclusion is far more important in the Canadian context because health insurance is provided to all Canadians equally by government[18] and funded by general tax revenues. Currently, government spending on health care totals about $215 billion, or about $6,000 per Canadian resident.[19] If this spending is an adequate proxy for the average

17. Heisz (2007: 15) describes the process of top and bottom coding (which he employs in his study of inequality in Canada) and attributes the idea to the Luxembourg Income Study (LIS) researchers who use the process routinely in their international studies of inequality.

18. This is not to say that there are not significant issues with Canadian health care, its universality, and its accessibility.

19. <http://www.cihi.ca/CIHI-ext-portal/internet/EN/SubTheme/spending+and+health+workforce/spending/cihi015954>

value flowing to Canadians of this benefit, then including that value for every person would lower the level of inequality. [20] To the extent that the value of this benefit has increased over the past several decades, such inclusion would be increasingly equalizing.

Changing nature of households

There have been important cultural, social, and demographic changes to Canadian households over the past several decades that have impacted income and income inequality. Rising divorce rates, increasing female participation in the labour force, increasing participation in post-secondary education, increasing numbers of multiple income families, falling family size, increasing longevity, and an increase in the reach and scope of government welfare all have potential effects on income inequality.

In some cases, the impact of these changes on income inequality is fairly easy to predict. For example, the increase in the number of multiple earners in a family in combination with assortative mating is likely to increase inequality as those families without multiple earners are left behind.[21] The rise in the female participation rate in the labour force has a similar impact.

The rise in divorce rates is likely to increase inequality in two ways. First, it results in more single parents who typically have lower than average incomes. Second, it tends to decrease the incomes of both parents, at least in the short term, as both adjust to one of life's most jarring traumas. The often substantial decrease in incomes tends to stretch out the distribution of income and increases inequality.

The increase in participation in post-secondary education will increase income inequality for two reasons. While they are still students, people largely live on their own with little or no reported income.[22] And over time, those people who graduate tend to do much better in the modern labour market, leaving the less educated further behind.

The decline in family size, except to the extent that it is a symptom of increasing lone-parent families, is likely to have an ambiguous impact on income inequality. In any case, an equivalence scale adjustment should, if carefully done, account for such changes in family size as we are then only comparing equivalized incomes.

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20. Adding a constant dollar amount to everyone's income reduces the dispersion of incomes and reduces measured inequality.

21. Assortative mating refers to the long observed tendency for people to marry within their own socioeconomic class.

22. Student loans do not formally count as income even though they count as part of the student's resources used to cover expenses.

The rise in the number of seniors could increase measured income inequality because seniors have traditionally had lower incomes. However, that may change as more well-pensioned baby boomers retire into the middle of the income distribution.

The increase in the reach and scope of government welfare could be equalizing to the extent that it lifts recipients up off the bottom to higher living standards. However, to the extent that it increases dependency and keeps people at a lower level than would have been the case without the assistance, it may, in fact, tend to increase inequality over time.

The point here is that many of the dramatic changes in society, even in the past few decades, tend to increase income inequality. The increase in multiple-earner families, the rise in lone-parent families, and the increasing population of students is particularly noteworthy here.

In terms of family compositional changes, in 1981, 16.6 percent of families with children were lone-parent families. By 2006, that proportion had reached 25.8 percent. According to the Survey of Labour and Income Dynamics (SLID), the average income of lone parents (mostly female headed) in 1982 was about $18,700 or $41,910 in 2010 constant dollars. This was about 56 percent of the average income of all intact families.

By 2010, lone-parent incomes had risen to about $48,000, about 51 percent of the $93,600 figure for all intact families. As well, by 2011, lone parents had more than twice the rate of low income as Canadians in general.[23]

According to the Survey of Consumer Finances, the portion of intact families with two earners in 1982 was 58 percent. By 2010, using the SLID survey, it had reached 77.5 percent. Heisz (2007) has specifically focused on dual earner families as a "probable driver" of the rise in earnings inequality since the late 1970s.

In terms of post-secondary participation, in 1982, the rate for young people aged 20–24 was about 29 percent (both college and university). By 2010, the rate had risen to about 37 percent. In total, there are now about 2 million students enrolled full-time at a post-secondary institution in Canada. While some of them do live at home with parents, a significant proportion live on their own with little or no income. The rise in the proportion of students would tend to increase income inequality.[24]

23. Sources for the data in this paragraph include Statistics Canada (various years), <http://www4.hrsdc.gc.ca/.3ndic.1t.4r@-eng.jsp?iid=37>, <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/famil21a-eng.htm>, and calculations by C. Sarlo.

24. Sources for post-secondary participation and enrolments include <http://www.statcan.gc.ca/pub/11f0019m/11f0019m2003210-eng.pdf>, <http://www.cli-ica.ca/en/about/about-cli/indicators/know-pse.aspx>, <http://www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/educ71a-eng.htm>.

Robustness checks

While the empirical work in this paper is largely concerned with the impact of making different choices among inequality indicators and income definitions, there are other choices made along the way. The square root equivalence scale is not the only scale that could have been used, although it is clearly the most popular one. As well, the choice not to code the data prior to estimating the various inequality measures stands in contrast to some research on income inequality (notably much of the LIS work on the subject). Finally, researchers are aware that different software programs have the potential to yield different results using the same raw data. This study performed several experiments to test the robustness of the results to changes in scale: the addition of coding and the employment of other (independent) software routines calculating the inequality measures. These robustness checks are discussed and reported in Appendix 2.

Conclusion

While there are no "true" definitions of income, there are certainly some definitions that make more sense in a particular context. For example, if one wanted to look at the inequality of family living standards, then the preferred income definition would clearly be after-tax income adjusted for family size, rather than just earnings. It is essential that those interested in the issue of inequality understand both the complexity of the issue itself but also its sensitivity to different underlying definitions of income and economic units.

There are a great many choices facing researchers who wish to measure inequality. With each choice there is significant scope for variation in results. For example, income can be defined in a number of ways and each will produce different results. The choice of income recipient (the family or the individual) will lead to variations in results as well, as we saw in our tests.

The empirical results show that there is a fundamental difference in the trend in income inequality if we compare economic families to individuals. Over the almost three-decade period of the study, family (adjusted after-tax) income inequality increased between 5 and 10 percent depending on the inequality indicator used. However, the inequality of individual incomes actually declined over the same period. The decline was also quite modest, in the range of 2 to 6 percent, depending on the indicator, but is very important and is consistent with results using US data.

The many inequality studies of families or households that focus on narrow measures of income like earnings, market incomes, or even total income present an incomplete picture of levels and trends in income inequality. The story they tell is flawed because they do not take account of the equalizing role that taxes play and they do not account for differences in family size. After-tax income is a much better representation of the living standards of families and so is a fairer and more reasonable indicator for comparative purposes.

Furthermore, unless family size is accounted for, we ignore economies of scale in living conditions and miss something important in making comparisons. Unless adjustments are made to consider taxes and family size, we will be overstating the degree of income inequality in our society.

At the very least, the results of the analysis in this study suggest that inequality studies need to be somewhat more cautious with claims about income inequality, at least for Canada.

Appendix 1

Raw results of decile and quintile shares

Table A1

Decile and quintile shares, 1982–2010: Economic families

	Earnings				Total income				After-tax income				AE_After-tax income			
	1982	*1990*	*2000*	*2010*	*1982*	*1990*	*2000*	*2010*	*1982*	*1990*	*2000*	*2010*	*1982*	*1990*	*2000*	*2010*
Decile shares																
Top 10%	27.39	30.27	35.90	36.75	24.72	26.39	29.90	30.18	23.49	24.39	27.24	27.55	21.98	22.29	24.80	25.26
2	18.67	19.17	19.89	20.25	16.70	16.65	16.84	16.89	16.22	16.19	16.57	16.61	15.57	15.20	15.51	15.45
3	15.17	15.15	15.08	14.98	13.74	13.40	13.26	13.14	13.49	13.27	13.22	13.23	13.07	12.81	12.79	12.68
4	12.55	12.25	11.49	11.30	11.56	11.15	10.73	10.56	11.55	11.22	10.92	10.81	11.28	11.13	10.89	10.84
5	10.23	9.76	8.55	8.20	9.72	9.32	8.69	8.52	9.85	9.55	9.05	8.89	9.79	9.69	9.36	9.34
6	7.99	7.29	5.79	5.43	7.98	7.65	6.95	6.87	8.25	8.05	7.45	7.36	8.47	8.39	8.02	7.96
7	5.54	4.62	2.93	2.74	6.32	6.05	5.47	5.46	6.71	6.55	6.07	6.01	7.20	7.16	6.76	6.70
8	2.44	1.55	0.50	0.43	4.65	4.53	4.10	4.17	5.14	5.12	4.69	4.69	5.81	5.94	5.58	5.44
9	0.08	0.00	0.00	0.00	3.08	3.16	2.78	2.85	3.53	3.69	3.32	3.29	4.45	4.75	4.29	4.22
Bottom 10%	-0.05	-0.06	-0.11	-0.07	1.52	1.69	1.28	1.36	1.77	1.98	1.48	1.56	2.38	2.64	2.02	2.11
Quintile Shares	1982	1990	2000	2010	1982	1990	2000	2010	1982	1990	2000	2010	1982	1990	2000	2010
Top 20%	46.06	49.44	55.78	56.99	41.43	43.04	46.74	47.07	39.71	40.58	43.81	44.16	37.55	37.49	40.31	40.71
2	27.73	27.40	26.57	26.28	25.30	24.56	23.99	23.70	25.04	24.49	24.14	24.04	24.35	23.95	23.68	23.52
3	18.21	17.05	14.34	13.63	17.70	16.97	15.64	15.39	18.10	17.60	16.49	16.26	18.25	18.08	17.37	17.30
4	7.98	6.17	3.43	3.17	10.97	10.58	9.57	9.63	11.85	11.67	10.76	10.70	13.01	13.10	12.34	12.14
Bottom 20%	0.02	-0.06	-0.11	-0.07	4.60	4.85	4.06	4.21	5.30	5.67	4.80	4.84	6.83	7.38	6.30	6.32
Gini coefficient	0.4696	0.5054	0.5763	0.5844	0.3745	0.3906	0.4235	0.4432	0.3505	0.3527	0.3823	0.3864	0.3114	0.3019	0.3474	0.3412

Table A2

Decile and quintile shares, 1982–2010: **Individuals**

	Earnings				Total income				After-tax income			
	1982	*1990*	*2000*	*2010*	*1982*	*1990*	*2000*	*2010*	*1982*	*1990*	*2000*	*2010*
Decile shares												
Top 10%	36.83	35.29	40.82	41.68	31.89	30.28	33.47	33.50	29.34	27.17	29.70	29.98
2	22.87	21.50	21.37	21.53	19.66	18.39	17.82	17.60	19.06	17.77	17.35	17.25
3	16.81	16.21	15.43	15.25	14.98	14.27	13.58	13.30	15.01	14.37	13.76	13.58
4	12.09	12.16	11.00	10.66	11.53	11.32	10.65	10.57	11.91	11.72	11.20	11.11
5	7.40	8.36	6.93	6.66	8.62	8.91	8.33	8.30	9.28	9.48	9.07	8.99
6	3.40	4.80	3.63	3.46	6.13	6.79	6.28	6.33	6.95	7.56	7.17	7.09
7	0.75	1.73	1.06	0.91	4.29	5.06	4.71	4.77	5.04	5.92	5.61	5.51
8	0.00	0.07	0.00	0.00	2.44	3.44	3.26	3.45	2.88	4.18	3.98	4.02
9	0.00	0.00	0.00	0.00	0.54	1.54	1.75	1.94	0.63	1.90	2.14	2.25
Bottom 10%	-0.13	-0.11	-0.23	-0.14	-0.07	0.00	0.13	0.24	-0.08	-0.06	0.01	0.20
Quintile Shares												
Top 20%	59.70	56.80	62.19	63.21	51.55	48.67	51.29	51.10	48.40	44.94	47.05	47.23
2	28.91	28.37	26.43	25.91	26.51	25.59	24.24	23.87	26.93	26.10	24.96	24.69
3	10.79	13.16	10.57	10.12	14.75	15.70	14.62	14.63	16.22	17.04	16.25	16.09
4	0.75	1.80	1.06	0.92	6.73	8.51	7.98	8.22	7.91	10.10	9.59	9.53
Bottom 20%	-0.13	-0.11	-0.23	-0.14	0.46	1.54	1.88	2.18	0.54	1.82	2.15	2.45
Gini coefficient	0.6252	0.5942	0.6496	0.6652	0.5192	0.4786	0.5150	0.4886	0.489	0.4373	0.4337	0.4684

Appendix 2

Robustness checks and experiments

Do changes in the choices made to adjust the data make any difference in the results for income inequality? For example, would the degree of measured inequality, using the Gini coefficient for example, change if we use a different equivalence scale, or if we perform some bottom or top coding? Some modest experiments along these lines were made in the course of this research and the results are presented and discussed below.

A different equivalence scale

It was noted earlier that a range of equivalence scale values have been estimated and used in other studies. Many of those assigned a lower value to a marginal person (or child) in a household than the square root scale, which can be considered to be on the higher side of most scales in use.

A "double square root" scale could be an elegant, easy-to-employ alternative to the prevailing square root scale. It would simply take the square root of family size and then take the square root of the result as the scale. Clearly this scale assigns much lower values to marginal persons, however, it would be broadly similar to a 20/10 scale that some researchers have utilized (see Stanton, 2010). And it may be viewed as more relevant to middle and upper income families where the marginal cost of an additional person might be lower.

Double Square Root Equivalence Scale values

Household size	1	2	3	4	5	6
Numerical value	1	1.19	1.32	1.41	1.50	1.57

The result of employing this alternate equivalence scale is that there are only very minor changes in the Gini coefficient. In three of the four cases the Gini coefficient increased modestly (by less than 4 percent); in the fourth case it decreased, again very marginally. Therefore, based on this experiment, it appears that a fairly significant change in the equivalence scale will have only a slight change in measured inequality.[1]

1. This more or less confirms the results in Sarlo (2009: 9–11).

Coding

A number of researchers "code" their data prior to running their inequality routines. Bottom coding refers to a process of eliminating some of the records at the bottom of the distribution, largely to remove negative (or zero) incomes. Top coding is similar, but involves the removal of records at the very top. Heisz (2007) points out that the LIS protocol (and one that he employed in his own study) is to top code by removing any records above ten times the median income and to bottom code by removing any records that are below 1 percent of mean. Other researchers use milder versions of this kind of coding. Sarlo (2008: 16) used the LIS protocol and found only minor differences in measured inequality as a result. For this paper, a more modest bottom coding experiment (eliminating all negative and zero incomes) was conducted and, again, the differences in measured inequality were very minor. Specifically, bottom coding of the economic family data (removing any values of total income that are zero or negative) in 1982 resulted in a Gini coefficient of 0.3211, compared to 0.3114 when the data is not bottom coded. This is a difference of about 3 percent. In 2010, the difference was less than 1 percent.

What about top coding? Would there be a significance difference in the Gini coefficient if we lopped off the very top incomes? Since the top 1 percent of the income distribution is a much discussed component, a small experiment was done with total incomes in 2000. The top 1 percent was removed and the new Gini coefficients determined for the top-coded distribution, for both personal and economic family total incomes (**table A3**).

Table A3

Top coding the data for the year 2000 (removing the top 1 percent)

File	Variable	Top Coded	Not Coded	Difference (%)
Individual incomes	Total income	0.4592	0.4819	**4.71**
	After-tax income	0.4176	0.4337	**3.71**
Economic families	Total income	0.3963	0.4235	**6.42**
	After-tax income	0.3620	0.3823	**5.31**
	AE_After-tax income	0.3243	0.3474	**6.65**

This experiment shows that a top coding (removing the top 1 percent of total incomes) results in small differences in measured inequality in the order of 4–7 percent. At least 93 percent of the inequality remains after removing this top component of the distribution. Perhaps one tentative conclusion of this exercise is that the top 1 percent is clearly not the key to explaining observed inequality. Most of the explanation lies elsewhere.

Verifying the calculations

Handling large databases is complicated. From the access point, often requiring conversion, all the way to the calculations of shares and Gini coefficients, there are many places where errors can creep in. In addition, different computer programs can interpolate differently and can handle weights differently. Finally, all databases with the same name can contain some differences.[2]

Given these challenges and the scope for potential error, the author engaged in some modest verification of the results. Once the final (correct) databases were in place, the raw data was given to two other researchers (both very familiar with inequality research) to check the results. During the first pass of this exercise, the programs calculating the inequality measures (decile and quintile shares and Gini coefficents) were run without the weights (assuming every weight was equal to 1). In that case, all the values of the Gini coefficients and all share values were verified in every single case. However, because different programs handle weights differently, small differences occurred once the weights were part of the calculations (**table A4**). While the results were not identical with each other, they were acceptably close and the trends were the same. The Statistics Canada results for some comparable variables (using their own, unedited databases) are included in table A4 as well.

2. Attempts to replicate Statistics Canada results may encounter issues because the agency has access to and uses the full database, whereas most researchers only have access to the "public use" version which is edited to ensure confidentiality. As well, Statistics Canada has made changes in the weights associated with a file but not revised the existing documentation for the public use files. In the course of this research project, this happened with one of the files and was only caught, late in the process, because of the validation process described here.

Table A4

Verifiying the calculations: Gini coefficients calculated by three researchers

Year	File	Researcher	Earnings	Total income	After-tax income	AE_After-tax income
1982	Economic families	1	**0.4696**	**0.3745**	**0.3505**	**0.3114**
		2	0.4830	0.3857	0.3598	0.3441
		3	0.4709	0.3733	0.3479	0.3217
	Individual incomes	1	**0.6252**	**0.5192**	**0.4890**	
		2	0.6297	0.5230	0.4924	
		3				
	Statistics Canada results [CANSIM 202-0705]			0.38	0.351	
1990	Economic families	1	**0.5054**	**0.3906**	**0.3527**	**0.3019**
		2	0.5135	0.3903	0.3591	0.3349
		3	0.5089	0.3855	0.3519	0.3147
	Individual incomes	1	**0.5942**	**0.4786**	**0.4373**	
		2	0.5968	0.4771	0.4402	
		3	0.5952	0.4746	0.4344	
	Statistics Canada results [CANSIM 202-0705]			0.395	0.357	
2000	Economic families	1	**0.5461**	**0.4160**	**0.3718**	**0.3474**
		2	0.5708	0.4201	0.3859	0.3395
		3	0.5499	0.4122	0.3774	0.3267
	Individual incomes	1	**0.6072**	**0.4819**	**0.4348**	
		2	0.6369	0.4853	0.4450	
		3	0.6195	0.4791	0.4356	
	Statistics Canada results [CANSIM 202-0705]			0.431	0.392	
2010	Economic families	1	**0.5844**	**0.4432**	**0.3864**	**0.3412**
		2	0.5767	0.4165	0.3820	0.3308
		3	0.5861	0.4292	0.3941	0.3448
	Individual incomes	1	**0.6652**	**0.4886**	**0.4684**	
		2	0.6432	0.4788	0.4401	
		3	0.6502	0.4893	0.4493	
	Statistics Canada results [CANSIM 202-0705]			0.431	0.395	

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