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Income Inequality and Polarization in Canada's Cities: An Examination and New Form of Measurement

Alan Walks

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Executive Summary

Canadian cities are becoming less equal, and more polarized, at a host of different spatial scales. This report examines changes in income inequality and income polarization in Canada's largest Census Metropolitan Areas over the period 1970 through 2005. It does so first by examining changes in inequality and polarization among households at the metropolitan scale, using data from the 1971, 1981, 1991, 2001, and 2006 censuses of Canada. It then moves to examine how income inequality and polarization are spatially expressed at the neighbourhood level using census tracts as the units of analysis for a smaller sample of very large "global" cities at the municipal level: Toronto, Montréal, and Vancouver.

Inequality and polarization are distinct concepts, and require their own indices. To deal with the limitations involved in calculating established indices of polarization using census tracts as the units of analysis, a new index – the coefficient of polarization (COP) – is proposed. The non-spatial analysis conducted using households as the unit of analysis shows that this new form of measurement tracks very closely other established indices of income polarization, making it suitable for use in analyzing polarization trends when data are aggregated into ranges (making some other indices unworkable), and into spatial units such as census tracts and municipalities.

The findings show that Canadian metropolitan areas have trended toward greater inequality and polarization over the period 1970 through 2005, regardless of the index being used, although the trajectories of inequality and polarization show some distinct patterns among metropolitan areas. Inequality and polarization are occurring among all households, among neighbourhoods, and among municipalities. The findings also demonstrate how the properties of the proposed coefficient of polarization make it useful in studies of income polarization, particularly when applied to aggregated spatial units such as neighbourhoods or municipalities, for which the primary existing measures of income polarization are not suitable.

Author

Alan Walks is associate professor of geography and planning at the University of Toronto and an associate of the University of Toronto Cities Centre. He has written a number of scholarly articles on urban social inequality and polarization, gentrification of the inner city, economic restructuring, and neighbourhood-based political attitudes and ideology. He is a co-author/editor of the book *The Political Ecology of the Metropolis.*

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1. Introduction: Canada Growing Unequal?

Mirroring trends noted across the globe, Canada, and Canadian cities, are becoming more unequal and more polarized. Inequality – and the related issues of poverty and regional and occupational polarization – is becoming ever more difficult to ignore. An important report published by the federal government's Standing Senate Committee on Social Affairs, Science and Technology, Subcommittee on Cities (Eggleton and Segal, 2009), not only highlights growing problems of poverty and homelessness, but calls for policy reforms for dealing with poverty, including reforms to employment insurance that increase eligibility for assistance, a federal minimum wage, and the extension of funding for social housing and affordable housing programs. Even the Conference Board of Canada has criticized Canada's record on inequality, and called for increases to social assistance and more redistributive taxes (Conference Board of Canada, 2011).

On the extent and rise of inequality in Canada as a whole, the evidence is clear and telling. In its report titled *Growing Unequal*, the Organisation for Economic Co-operation and Development (OECD) shows that Canada experienced the second-largest increase in inequality (as detected by the most common measure of inequality, the Gini coefficient, discussed in detail below) among all the countries under its umbrella between the mid-1990s and the mid-2000s (OECD, 2008). Only Finland saw a (slightly) greater increase in inequality over this time, and yet Finland still finished the period with much lower inequality (Gini=0.27) than Canada (Gini=0.32).

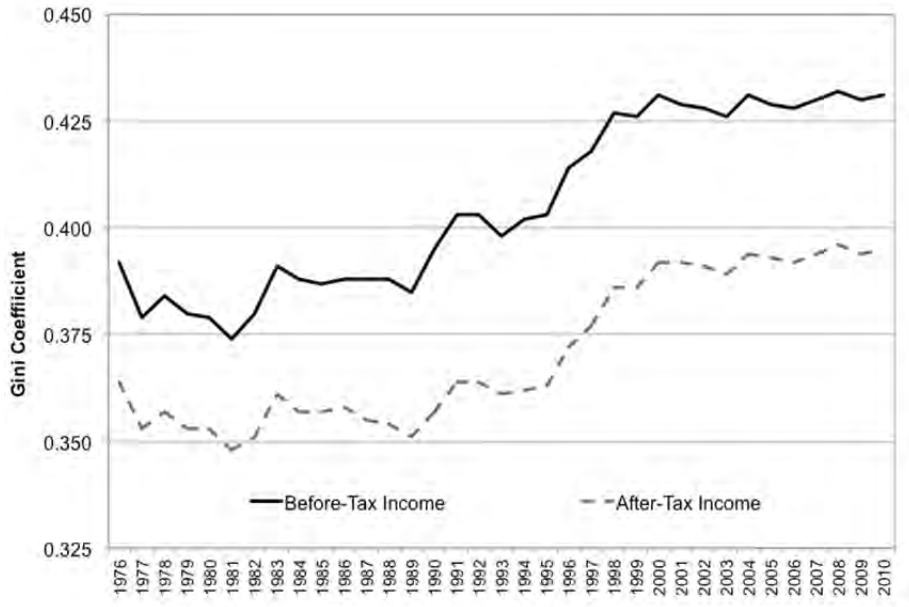
A similar finding is borne out by the work of Heisz (2007), who calculated both the Gini coefficient of income inequality, and the Wolfson index of income polarization (P) (see Foster and Wolfson, 2010, originally 1992; Wolfson, 1997), using national income data for Canadian families between 1977 and 2004. (While the terms *inequality* and *polarization* are often used interchangeably in mainstream discourse, they have distinct meanings, properties, and ways of measurement, as discussed in Chapters 2 and 3 below.) Heisz found that the distribution of family income originally trended toward greater equality in most years between 1977 and 1989, with both the Gini and Wolfson coefficients for family income reaching their lowest levels nationally in 1989 (the Gini went below 0.28, indicating a moderately low level of income inequality, while the Wolfson index of polarization reached a low of 0.235). However, after 1990 both inequality and polarization began to rise persistently. By 2004, the level of inequality in family income as measured by the Gini coefficient had grown by over 15 percent (to 0.32), while the

Wolfson index of polarization rose by almost 13 percent (to 0.265). To be sure, Canada's level of inequality is not yet as high as that in either the United Kingdom (Gini=0.34) or the United States (Gini=0.38) (OECD, 2008). Nonetheless, the rapid growth in inequality in Canada is troubling, as it has occurred while inequality either remained stable, or actually fell, in many other nations (including the United Kingdom). One aspect of Canada's rising inequality concerns the growth in income of the top 1 percent (as well as the top 0.1, 0.05, and 0.01 percent) of income earners, just as has been occurring in the United States (Yalnizyan, 2010).

Of course, inequality (or polarization) in income is not the same as inequality (or polarization) in wealth, although over time the former would typically be expected to result in the latter. Yet both income inequality and wealth inequality are indicators of class inequality. The research conducted in Canada demonstrates that wealth inequality is much higher than income inequality. Using the same measure of inequality – the Gini coefficient – Morissette, Zhang, and Drolet (2002) found that among all family units, wealth inequality rose from Gini=0.691 in 1984, to Gini=0.727 in 1999. The latter, it might be noted, represents an extreme level of inequality, far higher than any recorded measures of income inequality, even in the most unequal countries (which rarely surpass Ginis of 0.6). The highest level for the Gini is 1.00.

The trend toward rising income inequality has continued up to the present, with the Gini coefficient reaching its highest point ever (in terms of the incomes of all family types) in 2010, the most recent year for which data are available (Figure 1). The same basic pattern is true whether one looks at before-tax income or after-tax income (both income measures are post-government transfers).

Figure 1: Level of Income Inequality (Gini Coefficient), Before-Tax and After-Tax Family Income of All Family Types, Canada, 1976–2010



Source: Calculated by the author from Statistics Canada, CANSIM II database, Table 2020705. Gini coefficients are for all family types (economic families and unattached individuals). However, as Heisz (2007) and Fortin et al. (2012) have shown, a virtually identical pattern is evident if only economic families are examined.

Clearly, the tax system reduces considerably the level of inequality (compare the two lines in Figure 1). However, Frenette, Green, and Milligan (2009) demonstrate that while the tax and transfer system worked largely to counteract the rise in inequality over the 1980s and early 1990s, since the mid-1990s, it has been much less efficient in tempering the increase in inequality, most of which has originated in the labour market. An important recent study by Fortin et al. (2012) likewise found that family income inequality (among economic families) has risen substantially over time, and suggests that "policy developments since the mid-1990s have likely reinforced rather than countered this trend" (p. 29), including declining transfers and taxes. They discuss some of the policy options for mitigating the rise in inequality.

A number of factors are driving inequality and polarization in the economies of developed-world nations such as Canada. Perhaps most salient are labour market shifts originating in globalization (more intensive and extensive trade, and immigration), deindustrialization, and declining rates of unionization (Breau, 2007; Breau and Rigby, 2010; Harrison and Bluestone, 1988; Walks, 2001). Polarization in particular is said to occur as manufacturing jobs relocate under globalization, declining unionization reduces the pay of the remaining blue-collar workforce, and decent-paying middle-income jobs disappear, only to be replaced either by high-income jobs in business services, finance, sales and management, or by low-income service jobs with little protection (driving taxis, retail sales, etc.). Occupational polarization, and hence income polarization, is hypothesized to operate most strongly in the larger, global cities characterized by disproportionate flows of domestic and international migrants, who are themselves particularly vulnerable labour market vagaries (Sassen, 2001). Meanwhile, there is a noted increase in the tendency for men and women of similar class backgrounds and incomes to marry, facilitating the transfer of labour market inequality (and/or polarization) among income earners, into the realm of inequality between families and over time to generational inequalities (Myles, 2010). Finally, deregulation and the rolling back of the welfare state have removed many of the protections for unemployed workers and forced low-income households to work more for lower wages and/or take on more debt, while stimulating the financialization of the economy and increasing the incomes of a financial-managerial elite (Lapavitsas, 2009; Walks, 2011, 2013, forthcoming).

Of course, the exact processes driving expressions of inequality (or polarization – the differences between them are discussed in Chapter 3) in any given place and time may differ due to uneven development processes under variegated capitalism (Peck and Theodore, 2007). Regardless of the factors driving them, it has been argued that polarization in particular is likely to produce social conflict, tension, and political distrust, and thus it is important to examine not only inequality but also polarization (Esteban and Ray, 1994; see Chapter 3).

The vast majority of Canadians live within Canada's cities (approximately 82 percent in the 2011 census), and processes occurring in cities have largely produced rising inequality and polarization in Canada. It is therefore important to understand how income inequality and polarization are expressed within the Canadian city. A limited but established literature examining inequality at the urban scale has resulted in important contributions (reviewed in the next chapter). However, important gaps remain. This paper fills some of these gaps, updates previous work using the most recent data available, introduces a new measure of polarization, and examines its properties.

This paper analyzes trends in inequality and polarization in the Canada's metropolitan areas, both those that are non-spatial (or "socio-structural" – occurring among all households in a metropolitan area) and those that are socio-spatial (among neighbourhoods, and as well, among municipalities). The primary objective is to ascertain the extent to which Canadian metropolitan areas may have grown more unequal and more polarized and how socio-structural trends might relate to socio-spatial trends.

The analysis uses a range of different measures. In light of problems with existing polarization measures, including the difficulties associated with calculating standard indices of polarization given the typical structure of census data, it introduces a new measure – the coefficient of polarization. It examines the characteristics of this new measure, and compares its performance to other measures of polarization (and inequality). Thus, a secondary objective of this report is to test the merits of this new index for application in urban contexts, including within spatial units such as municipalities and neighbourhoods.

Chapter 2 reviews the literature concerning inequality and polarization in Canada, showing the important contributions that have been made and the gaps that remain.

Chapter 3 examines the measurement of inequality and polarization, and discusses the indices selected for inclusion in this study. It introduces a new index – the coefficient of polarization – and compares the properties of this index to those of other indices of polarization.

The substantive findings of the study are presented in three separate chapters. In Chapter 4, social (non-spatial) indices of income inequality and polarization – among households at the CMA level – are analyzed for certain CMAs between 1980 and 2005, depending on the data available, which varies depending on the census year and dataset. Some of the socio-structural factors producing inequality are explored.

In Chapter 5, indices of socio-spatial inequality and polarization are reported and analyzed at two distinct spatial scales: the neighbourhood and the municipality over the period 1970–2005. The segregation of income at the neighbourhood scale is examined among census tracts in those Census Metropolitan Areas (CMAs) large enough (population 300,000+) for which the neighbourhood structure can be adequately tracked over time. Then, the same set of socio-spatial measures are applied to municipalities, with their boundaries adjusted so that they are comparable over time, within Canada's three largest (global) cities (for which there are enough municipalities to facilitate calculation of the indices).

Chapter 6 studies individual neighbourhoods and municipalities, to calculate intra-unit (non-spatial) indices of income inequality and polarization within census tracts, and within municipalities, in Canada's three largest metropolitan areas. This analysis can examine household income only up to 2005, because the decision to cancel the long form of the 2011 census means that there is no accurate household income at relevant spatial scales for 2010.

Chapter 7 summarizes the findings and discusses the implications of this research.

2. Inequality in Canada's Cities: State of the Literature

In the Canadian context, less attention has been given to the issue of inequality and polarization at the urban level than at the national or provincial level. Nonetheless, there is by now an established literature on the subject and important contributions have been made in recent years. This section reviews the literature to date and identifies the gaps that remain.

There are two ways that inequality can be expressed and measured at the urban scale. First, inequality may be viewed as the divergence in incomes between (all) households, families, or individuals within a given labour market or metropolitan economy. Such forms of "non-spatial" inequality and polarization can be examined using non-spatial metrics. The studies and data regarding changes in the main measures of inequality – such as the Gini coefficient – over time in Canada employ such measures at the national level, typically using families (under slightly varying definitions) as the units of analysis.

Only a few studies, however, have analyzed the level of non-spatial inequality in Canada's cities. One important example is a recent study by Bolton and Breau (2012), who examine the level of employment income inequality (as measured by the Gini coefficient) among income earners within each of Canada's Census Metropolitan Areas (CMAs) and Census Agglomerations (CAs). Unfortunately, the actual Gini coefficients are not published in their article, likely due to the journal's restrictive policies regarding text length and number of tables. The study seeks to ascertain the factors driving both the level, and changes in the level, of earnings inequality in the 1996, 2001, and 2006 censuses (pertaining to income data from 1995, 2000, and 2005). The authors find that larger cities have more unequal distributions of employment income, as do cities in declining or stagnant regions with higher unemployment. However, deindustrialization, as well as immigration, and an aging population, are the factors that best explain rising earnings inequality in Canada's cities since the mid-1990s, while rising female labour force participation was found to reduce inequality. To date, no studies have attempted to measure polarization (as opposed to inequality) non-spatially for Canada's metropolitan areas.

In contrast to the non-spatial analysis described above, inequality and polarization can also be expressed as a divergence between spatial aggregations of households, families, or individuals. Typically, this approach has involved an analysis of divergence among neighbourhoods: the average income (of households, families, or individuals) is first calculated for each neighbourhood, and then used as the unit of analysis in the calculation of the index. When measures

of income inequality and polarization are calculated using neighbourhoods as the unit of analysis, they are in effect producing estimates of income *segregation*. However, these kinds of studies contain information on both the general level of inequality among households, families, or individuals, as well as the degree to which these households, families, or individuals are spatially concentrated or segregated – the two are not easily disaggregated. Typical inequality measures, when applied to neighbourhoods, thus capture not only processes of sorting (or of active segregating), but also income changes occurring in place, due to labour market shifts or changes in government assistance (Hulchanski, 2010; Kim and Jargowsky, 2005; Walks, 2001). Thus, it may be best to talk of such indices as measuring the level of "socio-spatial" inequality and polarization. Of course, these kinds of measures are not restricted to neighbourhoods, but can be applied to any spatial aggregations as long as data are available.

Research on inequality and polarization in Canada's cities has more often adopted this second, spatialized, approach of measuring the level of income inequality between neighbourhoods, with census tracts used as a proxy for neighbourhoods. The seminal papers in this vein are by Ray (1976), Bourne (1989, 1993, 1997), and MacLachlan and Sawada (1997). MacLachlan and Sawada (1997) examined changes between 1970 and 1990 in the (socio-spatial) inequality of average household income among neighbourhoods, using census tracts as the unit of analysis. They applied the Gini coefficient (specifically, the Gini concentration ratio) to measure socio-spatial (between-neighbourhood) inequality, and demonstrated that the rise in this inequality in Canadian metropolitan areas was associated with deindustrialization. Furthermore, they noted, correctly, that many researchers have mistakenly equated inequality and polarization, and vigorously argued that different measures are needed to measure the latter. However, the measure that they adopted – changes in the proportion of census tracts with average incomes in the middle of the income distribution – does not constitute a true index of polarization (since it does not meet the criteria for polarization indices, discussed below), and neither do the measures adopted by Bourne (1989, 1993, 1997).

This initial research was followed up with a similar study by Myles, Picot, and Pyper (2000), which largely confirmed the trends toward inequality established by MacLachlan and Sawada (1997). Not only is this research ripe for updating, but it demonstrates the need for robust measurement of polarization alongside that of inequality.

Studies of the multidimensionality of income segregation using census tracts as proxies for neighbourhoods then followed, showing that the spatial organization of income segregation in Canada's cities is moderately complex, exhibiting a three-dimensional structure in 1996 (Townshend and Walker, 2002). Certain dimensions of income segregation would appear to be increasing faster than the underlying labour market inequality would warrant, specifically, over the early 1990s (Ross et al., 2004). However, the patterns differ significantly when the analysis is applied to other social groups, as demonstrated for Aboriginals by Starchenko and Peters (2008).

Walks (2001) examined measures of neighbourhood income segregation in different zones of Toronto over the period 1971 through 1991, and showed that neighbourhood income differentiation is highest among neighbourhoods located close to the centre (in the inner city), and declines as one moves outward toward the edges characterized by new housing. This research

also highlighted the decline of the inner-ring suburbs. Many of the same issues and patterns are evident in Montréal (Charron and Shearmur, 2005; Germain and Rose, 2000).

Others have examined the degree to which poverty (with low income used as a proxy for poverty) is concentrated in certain neighbourhoods and segregated in space. Of course, inequality and poverty are not the same thing – inequality is relational and requires one to consider the full extent of the distribution, while poverty pertains only to the extreme lower portion of the distribution.

The central ideas and methods for understanding concentrated neighbourhood poverty and its effects derive from the work of Wilson (1987) and later Jargowsky (1997) in the United States. The degree to which the low-income population is concentrated in high-poverty tracts (greater than 30 percent low-income population) or very high poverty tracts (greater than 40 percent low-income population) allows for a measurement of the extent of concentrated neighbourhood poverty. Hajnal (1995) was the first to examine this issue in Canada (using 1990 income data), and found that neighbourhood-concentrated poverty was more severe in many Canadian cities than their U.S. counterparts. As in the U.S. literature, however, Canadian research on neighbourhood concentrations of poverty has mainly been used to examine links to racial segregation. This research has found South Asians and Blacks to be more concentrated in high-poverty neighbourhoods (Fong and Shibuya, 2000, 2003; Ley and Smith, 1997). Kazemipur and Halli (2000, 2001) went on to argue (based on 1991 and 1996 census data) that ghettos were being formed in Canada. Ghettos, it needs to be stressed, are neighbourhoods in which a single racialized group is concentrated due to discrimination: high levels of poverty are not formally part of the definition (Johnston et al., 2002, 2003). Johnston et al. (2002, 2003) found ghettos in a number of cities in both the United States and United Kingdom.

Walks and Bourne (2006) calculate updated measures of concentrated poverty for Canadian cities (using the 1991 and 2001 census data) and applied scholarly definitions of ghettoization and racial segregation to demonstrate that very high-poverty neighbourhoods do not overlap with areas of racial concentration, but instead with racial diversity. Neighbourhoods with the highest concentrations of single visible minority groups typically had higher incomes and lower levels of poverty than areas of greater diversity, and in some cases, than the metropolitan averages. They concluded that there are officially no ghettos in Canada. Updates to this analysis with 2006 census data (Walks, 2010) demonstrate that the trend has not been toward ghettos, but instead toward increased racial mix and thus away from ghettos, despite the declining real incomes of immigrants and visible minorities.

Important work has also been conducted on the factors responsible for producing the geography of concentrated neighbourhood poverty in Montréal (primarily unemployment, lone-parent families, unattached individuals, recent immigrants, and part-time and less-educated workers) using census data from 1991 (Seguin and Termote, 1997) and 2001 (Apparicio, Seguin, and LeLoup, 2007). More recently, Stanger-Ross and Ross (2012) examined the level of segregation of low-income families within the central cities (only) of the 10 largest metropolitan areas in Canada, using census tracts as the unit of analysis. They found that although the level of segregation increased over the period 1981 to 2001 (representing income data from 1980 to 2000), overall, the poor (those under Statistics Canada's Low-Income Cut-Off) experienced only moderate increases in segregation, and indeed were not as segregated as members of many ethnic groups. However, because this study used the 1961 census tract boundaries, it left out signifi-

cant proportions of the metropolitan area, and could not detect changes occurring in most of the postwar suburbs where the majority of the urban population now lives.

Ades, Apparicio, and Seguin (2012) also examine degrees and patterns of spatial segregation of the poor, this time in Canada's eight largest metropolitan regions in each five-year period between the 1986 and the 2006 census (1985–2005 income data), for all census tracts in each region. They found significant unevenness in the degrees to which the poor are segregated across Canada's metropolitan areas, albeit with a general trend towards higher rates of segregation in many but not all cities, coupled with a clear trend toward the decentralization or suburbanization of poverty in the largest metropolitan areas. The latter finding reflects the fact that gentrification is displacing many renters and other low-income households, as well as new immigrants, from the inner cities of Canada's largest metropolitan areas (Ley, 1996; Walks and Maaranen, 2008a,b).

Chen, Myles, and Picot (2012) provide the most up-to-date picture of overall neighbourhood income inequality (as opposed to poverty), again only in Canada's eight largest cities. Examining each five-year census between 1981 and 2006 (1980–2005 income data), they compute both Gini coefficients and Theil coefficients of inequality using after-tax adjusted-adult-equivalent family incomes within census tracts. The latter income measure adjusts standard family income data using the adult-equivalent incomes of all individuals to control for changes in family size over time and to reflect the consumption-enhancing effects of pooling income within larger families (discussed in the methods section below). They demonstrate that neighbourhood-based income inequality has increased over the period and, using the decomposable attributes of the Theil index, examine the separate and distinct contributions made by underlying labour market divergences in income and the effect of neighbourhood sorting on the resulting level of neighbourhood inequality. Based on this analysis, they argue that most of the increase in socio-spatial inequality or segregation between neighbourhoods in most cities is due to underlying increases in the inequality of incomes among all families, and thus to labour force shifts, while a smaller proportion of the changes are explained by the active sorting of families by income among neighbourhoods. However, the effects are uneven, and in some cities a significant amount of sorting is taking place. Toronto had the highest *degree* of neighbourhood sorting, followed by Winnipeg, Montréal, and Calgary, while Calgary and Winnipeg experienced the largest *increase* in sorting (that is, independent of shifts in labour market incomes) between 1980 and 2005. However, only the largest eight metropolitan regions were analyzed and indices of polarization were not calculated.

The research on urban inequality discussed above has been particularly helpful in aiding our understanding of changes occurring within Canada's cities. However, it has not yet shed light on the issue of polarization, nor how inequality and polarization might be related. One of the reasons for this gap has to do with the difficulties of calculating existing indices of polarization using data aggregated in standard ranges, as is typically the case when census data are published for spatial units such as census tracts – although Chen, Myles, and Picot (2012) had access to the raw census data, and so could have calculated some of the established indices of polarization, as Heisz (2007) did for Canada as a whole. One of the objectives of this paper is thus to introduce a new measure of polarization that is simple to calculate and that makes up for some of the problems involved in other polarization measures.

Furthermore, researchers have not yet examined the issue of inequality or polarization among municipalities within metropolitan areas, despite a lengthy literature dealing with this kind of analysis in the United States and Australia, the two countries with which Canada shares the most characteristics. Thus, this paper also fills a gap in analysis at this scale, and shows how inequality and polarization have changed among municipalities in the three largest metropolitan areas (which are the ones with enough municipalities for this analysis).

3. Measuring Inequality and Polarization

Articles in the mainstream press and the scholarly literature on processes driving urban residents farther apart in income often use the terms *inequality* and *polarization* interchangeably. However, these are distinct concepts with distinct properties.

Inequality refers to increasing dispersion of incomes. As inequality rises and the spread in incomes among individuals widens, income becomes increasingly skewed to the right (toward high-income earners). The social structure consists of wealthy elite groups living amongst many different sub-groups with varying levels of resources, much like a pyramid in which there are small but wealthy top layers, and then many sub-layers of middle and lower-income groups. Under rising inequality, the level of social conflict and struggle in such a scenario might be limited, replaced by a feeling of increasing disconnectedness, alienation, and unfairness, but not one easily directed at any one group.

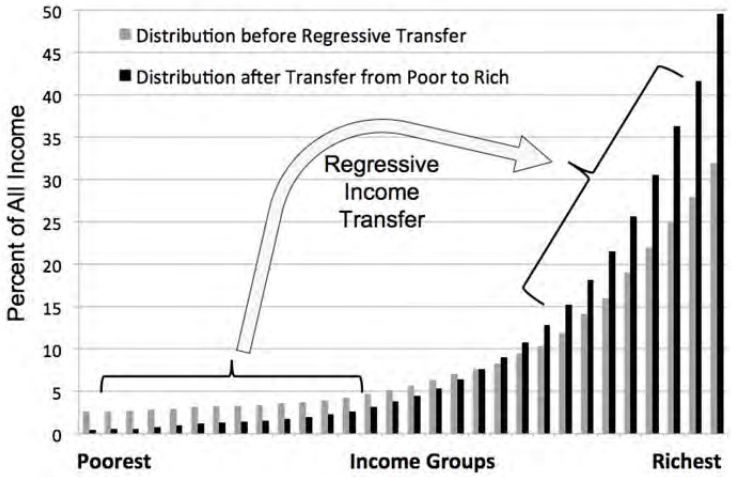
Under *polarization*, by contrast, income distribution takes an hourglass shape as the middle of the income distribution becomes hollowed out, and the population is redistributed and massed around two distinct poles. As polarization continues, the degree of within-group heterogeneity declines, while between-group differentiation rises. Over time, this process results in two disparate classes, one rich and another poor, in which experiences are increasingly shared only within each class, while differences in experience are increasingly articulated between the two poles. As polarization increases, therefore, the expectation might be that social conflict and antagonism will heighten, particularly as political struggles become organized around such antagonism (Esteban and Ray, 1994). Inequality and polarization might thus be expected to have different sociological and psychological effects.

There are distinct properties associated with inequality and polarization, and with the indices used to measure them. Inequality is governed by the Pigou-Dalton axiom, which states that inequality must always increase if, all else remaining equal, income is transferred from a poorer individual to a richer, no matter how poor or rich those individuals might be or where they might be located within the income distribution, as long as the transfer does not reverse their order within that distribution. In such cases, transfers between individuals near the centre of the distribution carry just as much weight as equal transfers occurring near the edges of the distribution. When income is transferred “up” the distribution, incomes rise higher in the distribution and decrease lower in the distribution (see Figure 2a).

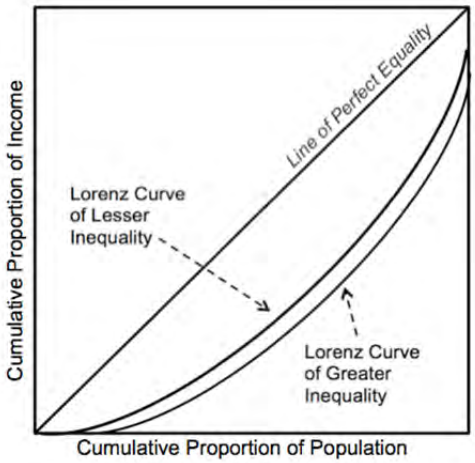
At the same time, an index of inequality should ideally satisfy the Lorenz criterion, which states that a higher inequality measure should show a Lorenz curve everywhere further from the line of perfect equality than a lower measure, without overlapping or crossing the Lorenz curve for that lower measure of inequality (see Figure 2b). The Lorenz curve is the curved line that both mathematically and visually represents how far away a particular income distribution is from that of a perfectly equal one in which everyone has the same income (see MacLachlan and Sawada, 1997, 381, and Wolfson, 1997, for a discussion of the Lorenz criterion).

Figure 2: Visualization of the a) Pigou-Dalton Axiom and b) Lorenz Criterion

a)



b)



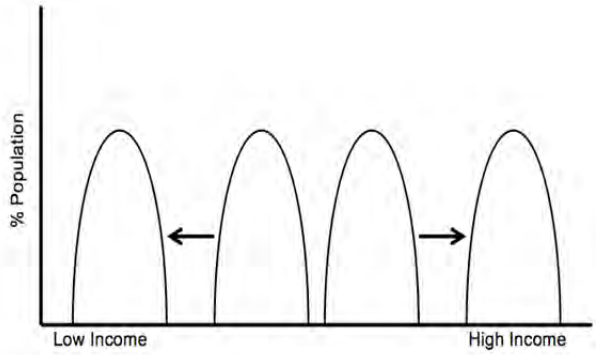
Note: Created by the author

Polarization does not adhere to the Pigou-Dalton axiom, but instead to two separate and distinct axioms (see Figure 3). The first is the "spread" axiom, whereby polarization increases if the population mass shifts away from the middle of the distribution and toward the extremes. This axiom is intuitive and is usually (although not necessarily) associated with increases in inequality, as it is often expressed as a flattening of the income distribution (from a normal distribution that peaks in the centre).

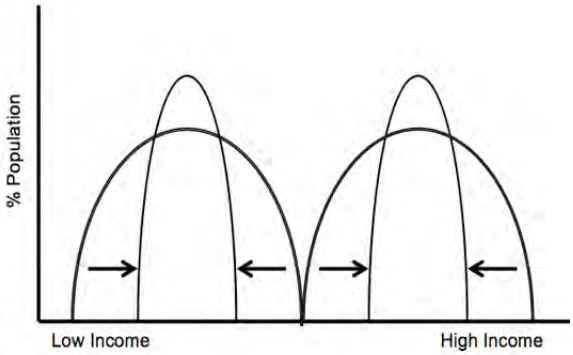
The second axiom, called the "bipolarity" axiom, states that if transfers of income concentrate the population into two (or more) existing densities that do not straddle the middle of the distribution, then this situation must increase polarization, even if the mean incomes of each of the masses do not change. Furthermore, an increasing population concentration at the centre must reduce, or at least not increase, polarization coefficients. The bipolarity axiom often works in ways that are opposite to, or at least independent of, the Pigou-Dalton axiom of inequality. It is thus possible for inequality and polarization indices to indicate quite different, even opposing, trajectories (see Esteban and Ray, 1994; Duclos, Esteban and Ray, 2004; Wolfson, 1986, 1997).

Figure 3: Visualization of the Spread and Bipolarity Axioms of Polarization

a) Spread



b) Bipolarity



Notes: Adapted by the author from Esteban and Ray, 1994; Duclos, Esteban, and Ray, 2004. The Y axis in each frequency diagram represents the proportion of the population. The X axis represents the level of income, increasing from left to right.

Indices used to measure inequality and polarization should ideally also satisfy another set of established criteria. These include:

- continuity: the index must respond smoothly to changes in the distribution;
- anonymity: the identities of the separate units examined by the index must not affect the result, and each unit must be treated equally by the index;
- normality: the measure should range from zero to 1.0, as it moves from perfect absence to perfect presence – although even the Gini coefficient can exceed 1.0 if negative incomes are included in the calculation;
- scalar independence: the measure must be independent of the units of measurement – thus if all incomes are inflated equally (for example, doubled), the index should remain unaffected.

Indices of Inequality and Polarization Adopted in this Study

Inequality Indices

The Gini coefficient (or for precision, the Gini Concentration Ratio, see MacLachlan and Sawada, 1997) is the "gold standard" of income inequality indices, as it meets all of the relevant criteria applied to inequality measures discussed above (including the Dalton-Pigou axiom), and it is the only one that actually describes the area between the Lorenz curve and the line of perfect equality.

The Index of Dissimilarity (often written as ID or IDIS) is a separate measure that is often used to calculate levels of segregation, and it works well for describing how unevenly distributed a particular group is from the general population. For this reason, it is often employed in analyses of racial segregation, or more rarely, the segregation of the poor from everyone else. The Index of Dissimilarity, while often mistaken as a form of the Gini coefficient (see MacLachlan and

Sawada, 1997), is, however, inappropriate for analyzing the distribution of income across all income groups, and it does not meet the Pigou-Dalton axiom or many of the other axioms discussed above for inequality. In fact, the Index of Dissimilarity coefficients merely describe the maximum distance between the line of perfect equality and the Lorenz curve, which could appear anywhere in the distribution. It is thus not indicative of the area between Lorenz curve and the line of perfect equality, and it does not take into account the totality of the distribution. It is thus inferior to other measures of inequality, and is not analyzed here.

In this paper, three well-established measures of inequality are applied to the analysis of Canadian metropolitan areas. These are:

- the Gini concentration ratio (GiniCR);
- the coefficient of variation squared (CV2);
- the exponent coefficient (EXP).

Wolfson (1997) argues cogently that these three indices of inequality are complementary and together produce a rounded picture of the extent of inequality, as each is more sensitive to a particular region of the income distribution. The EXP index is more sensitive to shifts at the lower end, while the CV2 index is more sensitive to shifts at the upper end, and the sensitivities of the Gini coefficient are more balanced, taking into account the totality of the income distribution (and thus it is best at detecting shifts in the middle of the spectrum). If each of these indices shows an increase in inequality, one can be sure that the Lorenz curves constructed using them do not cross, and thus that a rise in inequality at all levels is unambiguous.

Theil and entropy-based indices were not included in this analysis, despite the fact that they can be decomposed. Wolfson (1997) argues that the Theil-Entropy and Theil-Bernouilli indices, which are more sensitive to the bottom of the distribution, contain structural problems and can produce spurious results from very minor "fluctuations in the sub-populations with only a few dollars of earnings," and for this reason recommends the EXP over the Theil index for a measure more sensitive to the lower end of the distribution.

Each of the three inequality measures used here is relatively easy to calculate, not only in a non-spatial context (when the units of analysis are households, individuals, or families within an entire metropolitan area), but as well in a spatial context (when the units of analysis are neighbourhoods, municipalities, or some other spatial unit). The formulas for each of the indices of inequality and polarization used in this paper can be found in the Appendix.

Polarization Indices

Polarization indices are more recent constructs than inequality indices, formulated according to the bipolarity and spread axioms while maintaining as many of the other four criteria set out above as possible (continuity, anonymity, normality, and scalar independence; none of the polarization measures, of course, adheres to the Pigou-Dalton axiom).

The "gold standard" in polarization measures is the Foster-Wolfson "P" index, often simply referred to as the Wolfson index (Foster and Wolfson, 2010, originally 1992; Wolfson, 1986, 1997), the first fully compliant measure of polarization developed. This index effectively compares all incomes in a distribution to the median income and simultaneously measures both the

dispersion of those incomes in relation to the median as well as the extent to which they are clustered (thus, both spread and bipolarity). Like the inequality indices, the Wolfson index varies between zero (0), indicating lack of any polarization (that is, perfect equality), and one (1.0), which would indicate that half the population (the poor half below the median) has zero income, and the other half collectively has twice the mean income and that furthermore this income is relatively equally shared among this rich half.

Foster and Wolfson (2010; originally 1992) and Wolfson (1997) demonstrate that this index entails an explicit relationship with the Lorenz curve. It is in fact the area *under* the Lorenz curve or, more specifically, the proportion of the area under the Lorenz curve bounded by the line of perfect equality and the tangent line to the Lorenz curve at the 50th percentile. The values of the Wolfson index thus also depend on the slope and height of this tangent line (Wolfson, 1997, p. 407). Wolfson (1997) furthermore demonstrates that many simple indices commonly used to uncover inequality and/or polarization (including changes in the proportion of households or neighbourhoods with middle incomes, or the ratio of the 90th to the 10th percentile, or the mean or median) do not accord with either the Lorenz criterion (and thus are not proper inequality measures), nor the spread and bipolarity axioms (and thus are not proper polarization measures).

One of the few studies to use the Wolfson/Foster-Wolfson P index to detect polarization at the national level was conducted by Heisz (2007). However, P is difficult to compute, requiring, among other things, calculating both the value of the Lorenz curve at the 50th percentile (the proportion of all income held by the bottom 50 percent of the population), and the slope of its tangent at this same point. This presents problems for its application to spatial data, in which the units are neighbourhoods, municipalities, or some other spatial unit. This is because these units (neighbourhoods, etc.) have different populations. Often spatial units that are poorer (census tracts, municipalities) have larger populations than spatial units that are richer, and the bottom 50 percent of neighbourhoods in terms of their average (or median) income often contain more than 50 percent of the total income of their respective metropolitan areas, because they typically house larger residential populations. The Wolfson index essentially requires that the units be individuals, families, or households, on the assumption that each unit should be given equal weight. This requirement cannot be applied to a range of neighbourhoods in which the populations vary from very small to very large.

Esteban and Ray (1994) derive their own polarization index (ER), in this case through calculations of the relative distances between each and every observation – the "sum of all effective antagonisms," according to Duclos, Esteban, and Ray (2004). This makes the calculation of the ER index almost identical to the Gini mean distance (GMD) measure. In fact, the ER index contains a flexible quotient, the α factor in the formula, that allows it to act as a full "class" of measures, varying between a straight inequality measure (when α=0, making the ER equal to the Gini mean distance) to one of polarization (when α varies between 0.25 and 1.6, which establishes the conditions under which it adheres to the bipolarity axiom). When divided by twice the mean income, the ER index varies between zero (0) and one (1.0), just like the other indices discussed above. Like the Wolfson index, however, the ER can be calculated only using units assumed to be of equal weight in a data set (such as individuals, families, or households). The additional term added to the GMD formula to produce the ER is extremely sensitive to the population parameter but not the income parameter, and so having each observation vary in

terms of population produces an ER index that is out of proportion, often producing coefficients well in excess of 1.0. The ER index thus cannot be used to calculate indices of neighbourhood inequality or segregation.

While considered the best measures of income polarization, neither the Wolfson or ER indices can be applied using data arranged in spatial units that vary in population, as is often the case with census data aggregated to census tracts or municipalities. These indices could be used to measure socio-spatial polarization only if the spatial units were constructed such that they held exactly equal populations, in which case, each could be given a population weight of one, just as if they were individuals or households. The same issue arises in the application of these indices to income ranges in which the populations of each range vary – each range would have to have the same proportion of the population. However, the census data are not arranged in such a way, either spatially (typically, the populations of census tracts and municipalities vary considerably), nor structurally (income is typically aggregated into income ranges in equal intervals, rather than in quintiles or deciles). We are thus required to look for other measures of income polarization that could be applied to census data.

Wang and Tsui (2000) and Galster and Booza (2007) have proposed additional indices for measuring polarization that can be calculated using spatially aggregated data. Galster and Booza (2007) created a new index by comparing the results of the regular entropy index (H) to the ordinal entropy index (E) developed by Reardon et al. (2006). Like the Simpson index, the entropy index (H) indicates the degree to which observations are concentrated in a limited number of existing categories – the index is high when each category is represented equally, declining as the population is concentrated in fewer categories. The ordinal entropy index (E) measures the degree to which observations are concentrated in either of the categories at the extreme ends of the distribution – the index is higher when the extremes are over-represented. By calculating the ratio of E/H when the population divided into six income groups (based on equal-interval ranges from the census), neighbourhoods with more bipolar income structures can then be identified: an E/H ratio above 1.00 indicates that the majority of the population is found in the highest and lowest income groups, thus demonstrating polarization.

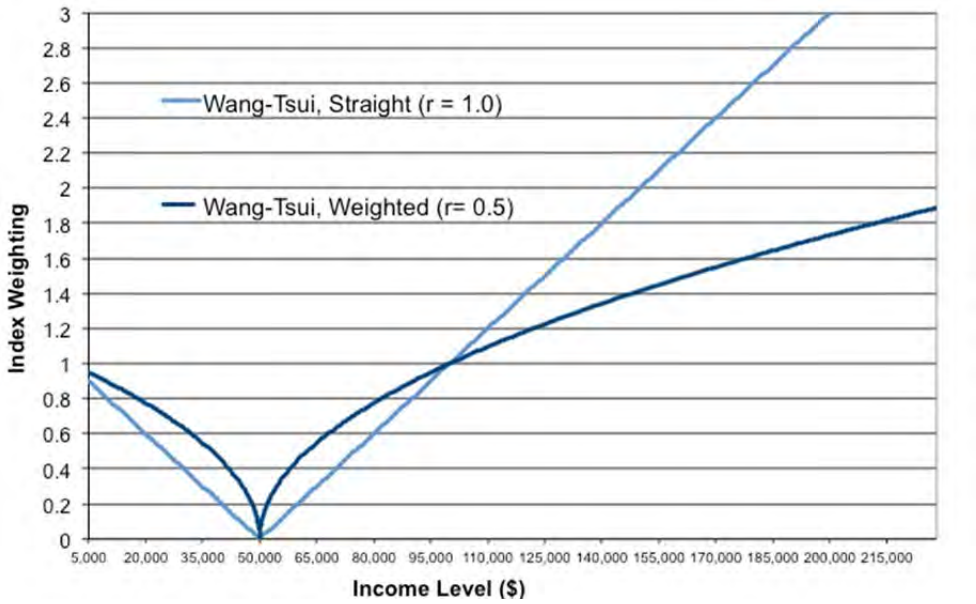
While clearly useful in ascertaining change in the number of what Galster and Booza term "bipolar neighbourhoods" over time, testing of this index revealed it to be highly sensitive to the number of categories employed and to how the distribution maps onto the cut-off points in the income ranges. Thus it is less useful when larger numbers of income categories are used, or when the means of different places vary, and it cannot provide comparability across contexts (metropolitan areas, etc.) containing different numbers of groups (neighbourhoods, municipalities). Also, it is not clear how to interpret the index itself, and the originators provide little guidance on this issue. Galster and Booza (2007) merely count the number of census tracts in which the E/H ratio rises above 1.00 to identify polarized neighbourhoods, instead of using their index to ascertain the *degree* of polarization. It is not clear that their index can be used for such purposes. Furthermore, it is not clear that this index satisfies the spread and bipolarity axioms – the logic of Wolfson (1997) suggests it would not – particularly as it is not scalar-independent of the number of categories. For these reasons, this index is not included among the indices of polarization analyzed in this paper. However, its use in future studies is still warranted, potentially when comparing the proportions of what Galster and Booza (2007) call "bipolar" neighbourhoods in Canadian cities to those in the United States.

The Wang-Tsui (WT) index, on the other hand, has been demonstrated to meet both the spread and bipolarity axioms under certain conditions (Wang and Tsui, 2000). This index was developed to produce a measure similar to the Wolfson, but one that can be calculated using income aggregated into groups. It is produced from the sum of the absolute differences in income between each individual (or the average income of those individuals in a given income range) and the median income. However, the WT index has some drawbacks. Importantly, the WT index is far more sensitive to the upper end of the income distribution than the lower end. And equal proportions of low- and high-income populations do not affect the index equally. At the lower end, the weights applied to the income distances from the median do not rise above (although they may approach) 1.0, but there is no upper limit to the weights at the top end. Indeed, if there are enough observations with income values more than twice the average income, which is very common among the populations of large metropolitan areas, the coefficients of the WT index can easily surpass 1.0, making the index difficult to interpret and compare among places with different income distributions at the top end.

To make up for this, Wang and Tsui (2000), like Esteban and Ray (1994), provide additional flexibility in their index, by allowing each of the income differences that are to be summed to be also modified, or weighted, by a power between 0 and 1.0 (the r factor in their formula, with the index satisfying the bipolarity axiom only when r lies between 0 and 1.0). This also makes the WT index into a "class" of indices, like the ER, allowing the analyst to decide on the most appropriate r factor. Although applying an r factor (power) less than one to each income difference somewhat reduces the degree of sensitivity toward the top end, it does not and cannot eliminate this problem. Meanwhile, as the r factor approaches 0, the total transfer sensitivity of the index is lost. Thus, setting r to 0.5 makes the most sense in terms of providing the best balance between maintaining the overall transfer sensitivity of the index, and limiting the undue influence of high incomes.

Figure 4 shows how the use of an r factor of 0.5 changes the weights assigned to each income distance from the median within the WT index, in comparison with the straight WT (r = 1.0). In this example, the median income is assumed to be $50,000 (the weight values in Figure 2 show how the WT index is affected by incomes further from this median – if all incomes are equal to the median, the sum of the distances is 0, and thus the index equals 0). Again, because the WT index does not have an upper bound, it does not meet the normality criteria (the upper bound should be 1.0 as required by the normality criteria), the WT can return coefficients above 1.0 in all cases.

Figure 4: WT Index, Influence of Distance from the Median under Two Scenarios



Source: calculations by the author

A New Polarization Index: The Coefficient of Polarization

The coefficient of polarization (CoP) provides an alternative to the WT index. Like the WT and Wolfson indices, it is determined by examining the distance between observations in relation to the median income, and like the WT index can be calculated using census data in which the population of observations (households, individuals, etc.) is divided into separate groups or income ranges. However, in this case, instead of taking the absolute value of the difference between the observation and the median as a measure of each distance (as in the WT), it takes the log of the ratio of this distance to the median. The index measure is therefore calculated as the absolute value sum of the logged quotients of each income distance observation and the median income (see the Appendix for the full formula). It is thus similar to the Theil-Bernouilli index, except that it uses the median rather than the mean income, calculates the ratios with the median in the denominator (instead of the mean in the numerator), and sums the absolute values of the (logged) deviation ratios instead of just summing the logs of the ratios, which has the effect of downplaying polarization tendencies – this latter effect is one problem with using the Theil-Bernouilli index. Furthermore, just as in the WT and ER indices, a scale factor (s) is added to the formula (as a power), allowing the weights pertaining to each distance to be modified as necessary (and thus turning this index into a "class" of indices, like the WT and ER).

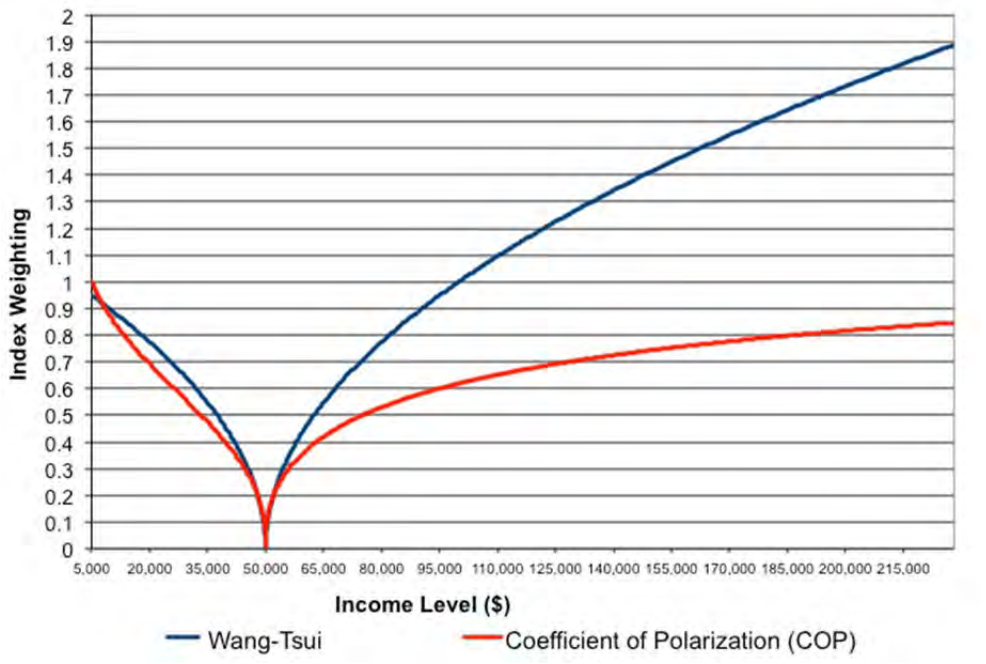
The CoP has certain properties that make it preferable to the WT index. Most importantly, it is not over-weighted to the top end of the income distribution, but is fairly equally sensitive to both the upper and lower ends. It thus better captures the essence of a polarization measure, in that it reports the greatest level of polarization when the population is divided into two equal masses opposing each other far from the median (whereas the incomes of rich have far more weight in the WT index). Precisely, the weights given to each distance from the median rise to 1.0 both at a value that is one-tenth of the median (at the lower limit, represented by $5,000 in the example

in which the median is $50,000), and at a value 10 times the median (at the upper limit, represented in the example by $500,000). Because of the high weighting of very low values (less than one-tenth of the median), the index can produce coefficients above 1.0, and there is, strictly speaking, no maximum value. Furthermore, the use of the scale factor also tends to increase the overall coefficient values, as it does with the WT index, sometimes sending them above 1.0 when polarization levels are very high. In all cases, a value of 0 indicates no polarization (all incomes are at the median), while values approaching or surpassing 1.0 indicate a high level of polarization – although, unlike the Wolfson, the maximum polarization value does not indicate that the bottom half of the population has zero income, as this index cannot accept zero incomes (see below). The CoP meets each of the remaining three criteria demanded of statistical indices of inequality and polarization (continuity, anonymity, and scalar dependence), regardless of the income value inputs.

Figure 5 compares the distribution of weights accorded to each distance from the median by the CoP and the WT indices, using the typical range of incomes arranged into groups in the census data on Canadian cities (in recent censuses). In this case, each index is scaled using a scale factor of r/s= 0.5. The CoP is clearly more balanced in its treatment of high and low incomes, with the weights at both the top and bottom ends converging on values of 1.0 (specifically, again, at one-tenth, and ten times, the median income). The CoP reaches the same index weight at 10 times the median that the WT reaches at twice the median (demonstrating just how much high incomes distort the WT index in comparison). The lower end of both indices (below the median), in contrast, reveals very similar weighting of incomes within the usual range (that is, between the median and one-tenth of the median). However, the WT and CoP measures differ in how they treat very low incomes. As income values dip below one-tenth of the median, the WT index weights slowly approach 1, while the CoP index weights instead begin to rise. Thus, the CoP reveals much higher sensitivity to extremely low incomes.

In terms of its properties, the CoP always adheres to the spread axiom and, for all values above the median, to the bipolarity axiom. The main issue, again, concerns how the CoP index reacts to the presence of low incomes. Here, the weights rise from 1.0 at one-tenth of the median to 2.0 at one-hundredth of the median value, and then rise steeply after this point as incomes approach zero. Furthermore, because the CoP is derived from the logs of ratios, it cannot be calculated using incomes of zero. While this feature is limiting, there are few instances in which the latter issue arises. When used with incomes grouped into ranges, the collective incomes of the lowest range are unlikely to average to zero, and when used with spatial units such as census tracts, rarely does a tract containing actual respondents (households, income earners, etc.) average to zero. Indeed, even if this index is calculated using individual incomes, rarely does an individual ever receive absolutely no income whatsoever in a given year; if he or she does, this is usually an artefact of the ability of the self-employed to claim expenses against their incomes on the tax forms used as the raw data, and such zero incomes are often removed from the data. Indeed, Statistics Canada routinely removes zero or negative incomes from its data in calculating indices of inequality and polarization.

Figure 5: Comparing the CoP and WT Index Weights



Source: calculations by the author. Scale factor (r/s) = 0.5

There are few occasions in which not only zero incomes, but extremely low incomes, would be expected to occur in those datasets for which the CoP has been developed for analysis. In those situations for which this index would typically be calculated – census income data grouped into ranges or aggregated into spatial units – it would be very rare for the lowest-income range or group to have an average income among those observations in the group that is below one-hundredth of the median income, or even below one-tenth of the median.

Like the WT and ER indices, in order for the CoP to adhere to the bipolarity axiom, certain conditions must be met. These conditions are determined by the scale factor(s) in the formula, and the spread of income values below the median (again, the bipolarity axiom is met for all values above the median). The bipolarity axiom is satisfied for all income values greater than approximately one-third of the median, as long as s is less than 1.0. At an s value of 0.5, the inflection point is at one-third of the median: values of s that are higher (or lower) than this shift the inflection point up (or down) the income scale slightly (to values between approximately 31 and 36 percent of the median). Income values below this inflection point, meanwhile, cause the index weights to slowly rise as income falls, which violates the bipolarity axiom (but satisfies the Dalton-Pigou axiom for this portion of the distribution). This means that, strictly speaking, if one is using incomes inputs that fall below about one-third of the median income for the population units (neighbourhood, municipality, metropolitan area, etc.), the CoP is not meeting the full specifications of a polarization index. However, there are three points to keep in mind:

1. If the income inputs being compared to the median derive from the averages of spatially aggregated units such as neighbourhoods or municipalities, one will rarely encounter an average income value less than one-third of the median income of the metropolitan area, as

this would indicate an extremely impoverished neighbourhood or (even worse) municipality. Rarely will such extremely low values arise in data aggregated in this way, such that the CoP will adhere to the bipolarity axiom in the vast majority of contexts. Canada's poorest urban neighbourhood – the Downtown Eastside in Vancouver – has an average household income 31.6 percent of the Vancouver median in 2006. This is the *only* case among census tracts in Canadian metropolitan areas in which this issue arises. In all other metropolitan areas, the average household incomes of the poorest census tract are above the threshold.

2. While the rate of change in the index weights at income values below the inflection points described above begins to rise instead of fall (thus satisfying the Dalton-Pigou axiom rather than the bipolarity axiom in this portion of the distribution), the change in index weights for incomes between one-third and one-tenth of the median is extremely minor, rising by only 0.13 percent as incomes fall from the former (one-third) to the latter (one-tenth) (when s=0.5). Thus even for income values below one-third of the median, the change in rate at which the weighting of income distances shifts remains essentially flat. The CoP, in fact, returns weighted index values in this range (below one-third of the median) not dissimilar to the WT index when r is set to 1.0 (a portion of the range for which the WT index performs well). In other words, the variation in index weights in this range will not significantly skew the index, and thus not materially affect the summed result (other than in an extremely minor way). This is true as long as the income inputs are not less than one-tenth of the median. Effectively, as long as few income values less than one-tenth of the median are included in the analysis, calculations of the CoP can be accepted as effectively representing polarization. When there are many observations with incomes less than one-tenth of the median, the CoP will be inflated. Again, this feature works in favour of the application of the CoP to the analysis of spatially aggregated units, as these rarely exhibit incomes below this range.

3. When scaled using a factor of s=0.5, the index weights of the CoP change from very low (for incomes to close to the median) to an essentially flat sliding scale over the vast majority of the range between the median and one-tenth of the median, beyond which, at the bottom end, the weights rise quickly to high levels. For example, the income structure may be tripolar, with a rich mass contrasted with *two* distinct poor masses – one larger mass in the more common range between one-tenth to one-half the median (representing, say, the general working class), and a smaller mass with very low incomes (less than one-tenth of the median – a rare occurrence but one that might be expressed in homelessness, squatting, or other extreme forms of poverty and marginalization). This situation would show up as more polarized than a bipolar situation. Thus far, none of the literature regarding indices of polarization has considered the possible existence of tripolarity, let alone ways of measuring it. The CoP is in fact much more sensitive to the rise of such a scenario than any of the other indices of inequality or polarization, due to the rapidly rising scale for incomes lower than one-tenth of the median income and its high sensitivity to extremely low incomes. However, like all the other indices developed thus far, the CoP cannot indicate how many distinct poles are evident in the dataset.

Thus, like any measure, the CoP has its benefits and drawbacks. The benefit is that it can be easily calculated using income data arranged in ranges or bands, as well as aggregated in spatial units such as census tracts and municipalities. The conditions under which the CoP would

typically be applied – the form in which census data pertaining to Canadian cities are aggregated, and the ranges of income values that is typical of data when arranged in this way – mean that it can be taken as representing a balanced measure of polarization when examining the level of urban social and spatial polarization. In addition to proposing the use of this index as a measure of polarization, this paper examines how well it performs in relation to other similar measures when applied to empirical data in Canada's metropolitan areas.

The Census Income Data

The data used in this analysis derive from the 1971, 1981, 1991, 2001, and 2006 censuses of Canada. As the income data contained in each census refer to the annual total for the year before the census (which is conducted in May), the data pertain to the years 1970, 1980, 1990, 2000, and 2005. Unfortunately, in 2011, the federal government made a decision to cancel the long form of that year's census, which is the component that collects information about income (as well as housing affordability, occupation, immigration, visible minority status, and a host of other variables). This means that there is no census household income information available at the spatial scales covered in this report for years later than 2005.

The indices of inequality and polarization are calculated in this paper for before-tax total household income. There are benefits and drawbacks to using this form of income, as opposed to the alternatives – family income, total per-capita income, or employment income/earnings.

First, employment income makes up only about two-thirds of total income and would indicate only how wages earned within the labour market have changed. The ability of the transfer system to offset incomes lost through unemployment, retirement, etc., and thus to offset rising labour market inequality, would thus not factor into the analysis. Similarly, incomes received by wealthy asset holders from investments would not factor into the analysis. These are two very important sources of income that need to be taken into account when analyzing inequality and polarization, otherwise the results will not show whether there has been a real divergence (or convergence) in incomes. Thus, the analysis uses total income. Ideally, it would also be possible to use after-tax income for this analysis, as the impacts of changes in taxation on the level of inequality would also be taken into account. However, this is not possible, as after-tax income is not available for periods before 2000. Thus, to ensure comparability over time, indices are calculated using before-tax income.

Second, it is important to align the variables used in an analysis such as this to one's objectives. In this paper, inequality and polarization are primarily examined in relation to the ability of members of the population at large to make a living in the city. It is most concerned with divergences in this capacity, which relate mainly to the consumption sector: consumption of housing, transportation, and other household goods and services necessary for negotiating the city. Households represent the "basic spending units" (Bourne, 1993), and it is the interaction between the locational choices available to households and the barriers to household neighbourhood mobility that largely determine the extent and patterning of class segregation by neighbourhood. The main alternative, per-capita income, is useful if one wants to examine how changing positions within the production sector – through labour market, asset markets, other investments, or other processes providing access to income – are related to inequality. But per-

capita income contains no information on how those individuals might pool resources to afford housing or otherwise compete for resources.

Family income is another variable that provides information on the pooling of resources and the relative ability to compete for space. Family income is the income measure that is often analyzed by Statistics Canada and other researchers working on related questions (Chen, Myles, and Picot, 2012; Heisz, 2007). However, family income leaves out non-family households, and thus a significant proportion of the population (non-family households make up 30.4 percent of all households in the 2006). Since the objective here is to examine whether Canadian cities are generally becoming more socially and spatially unequal or polarized, it is important that the variables examined are as inclusive as possible, and do not lose such a significant proportion of the population. Chen, Myles, and Picot (2012) tried to deal with this limitation by analyzing the adult-equivalent adjusted incomes of all individuals, both those in families and not in families, in constructing their income variable for economic families.

The use of household income also has its drawbacks. The main one is that household size has been declining over time, as non-family and single-person households make up increasing proportions of the total. For this reason, household income is less useful for examining socio-spatial processes for which declining household size might mask important shifts, such as with the study of gentrification (Walks and Maaranen, 2008a, 2008b). However, the objective here is to examine whether the real incomes undergirding people's ability to negotiate the city, of which the housing market is a key field of struggle, have become more or less segregated over time. Declining household size is part of this story and deserves to be factored into the analysis. Indeed, if there is to be an inclusive analysis of the role played by changes in family structure and living arrangements, and by the increasing tendency for men and women of similar socio-economic status to pair up in producing socio-spatial inequality (Myles, 2010), it is necessary to examine household income (Bourne, 1993).

It is possible to build an income variable that controls for household size and at the same time contains information on both the pooling of resources and its beneficial influence on capacity to consume, as well as the strengths of per-capita income variables in relating to the ability of individual earners to access income within the labour market. Chen, Myles, and Picot (2012) construct such a variable for their analysis. They adjust after-tax family income by a factor related to the number of adults in the family. The result is their adjusted adult-equivalent family income variable, a measure of the resources available to adults within the family after adjusting for family size and economies of scale.

This income variable is not, however, examined in this paper. First, as Chen, Myles, and Picot (2012) note, one must have direct access to the raw census data on individual families in order to calculate this variable, as the first and third authors do in their jobs at Statistics Canada. Researchers who do not have direct access to the raw data therefore must make do with alternatives. Second, it is not yet clear that the adjustments made actually represent an improvement over regular family income or household income variables, at least in meeting the objectives of this paper. For instance, the authors note that the weights applied to adults within families produce counterintuitive results: "This adult equivalent adjustment process does have the effect of making the family income appear somewhat lower than one might be used to seeing. For ex-

ample, if a family of four has an unadjusted income of $50,000, the adult equivalent adjusted income for that family would be $25,000."

The objective in this paper is to measure segregation in the actual, realized, distribution of income among households, on the basis that this reflects the reality of consumption differences and access to housing, among other things. Weighing the alternatives, it was determined that the best income measure for this purpose is the unadjusted household incomes.

Custom-tabulated data detailing the number of households and the average household incomes of households in each of 12 equivalent inflation-adjusted income ranges were ordered from Statistics Canada to compile the indices reported in this paper at the neighbourhood and municipal scales. It is necessary to have income grouped in ranges that are inflation-adjusted, so that the data are comparable over time, and to have the average incomes of each income range to calculate each of the indices. Unfortunately, in the standard data contained in the census profile files that are made public, the cut-off points dividing each income range are not inflation-adjusted, the number of ranges varies over time, the average incomes for each range are not published, and the top range is unbounded. Furthermore, the data need to be in this form to compute the non-spatial indices of inequality and polarization within spatial units – that is, among all households located within a single neighbourhood or municipality. (For information on how indices of inequality are typically calculated using income aggregated into income ranges or bands, see Cowell, 1995.)

Scales of Analysis and Data Sources

The census data are analyzed at three separate scales, with the results of the analysis at each of these three scales reported in the three separate chapters. The first scale involves "non-spatial" analyses of households within each census metropolitan area. The data for this analysis derive from the census public use microdata files (PUMF) made available by Statistics Canada. The PUMF involve samples of households within the largest census metropolitan areas (CMAs); however, no spatial identifiers are present (other than CMA) in the data. Households are hence the units of analysis for this analysis. Unfortunately, these data are available for only a limited number of CMAs on a consistent basis: 13 over the period 1980–2005 (and only two CMAs are available in the 1971 census PUMF). However, because the PUMF involves individual records (as in the raw census data), all of the indices adopted for the analysis could be calculated for those CMAs with data.

The following chapter shifts the scale to examine how the segregation of income among neighbourhoods changes over time, as measured by the various indices of socio-spatial inequality and polarization. The custom-tabulated data ordered specially from Statistics Canada at the level of census tracts for the largest CMAs are employed. Census tracts are the unit of analysis, used as proxies for neighbourhoods. Census tracts are aggregated spatial units created by Statistics Canada to represent neighbourhoods in statistical analysis, whose boundaries usually follow main transportation routes, waterways (rivers, lakes, ravines), and other environmental features (such as parks). They typically contain between 2,000 and 8,000 people (about 4,000 on average). While census tracts may not fully capture the reality of neighbourhood activity spaces (and such a question is difficult to ascertain), they are nonetheless commonly used as proxies for neighbourhoods in Canadian neighbourhood-based research due to their relative

size, the availability of data, and the fact that they are the best of only two real alternatives (dissemination areas are much smaller, have high suppression rates, and much fewer variables available).

This report also examines how income is segregated between municipalities in Canada's three largest metropolitan areas (Montréal, Toronto, and Vancouver). Only these three CMAs have sufficient numbers of municipalities over the study period to warrant such an intermunicipal analysis. Here, the custom-tabulated census data by Statistics Canada at the level of census tracts was aggregated to the municipal spatial units: census subdivisions (CSDs) in Statistics Canada's parlance. However, here a set of preamalgamation boundary-equivalent CSDs are assembled so that the boundaries can remain constant over time. Thus, any CSDs smaller than census tracts were aggregated until a common spatial boundary (between census tracts and CSDs) could be found. This method was necessary for only a few CSDs in the Montréal CMA, and one CSD in the Vancouver CMA. Elsewhere, the same set of preamalgamation CSDs is analyzed over the time period.

This report also measures the degree of socio-spatial inequality and polarization among households *within* municipalities, and *within* neighbourhoods. Again, the data examined are derived from the custom-tabulated census data, with the census tract totals aggregated to the preamalgamation boundary-equivalent proto-CSDs for the analysis of within-municipality inequality and polarization. For this analysis, households within neighbourhoods (census tracts) and/or municipalities (the consistent proto-CSDs) are the unit of analysis. Thus, even though spatial units at scales below the CMA are examined, the indices calculated here are also, like those described in the first empirical analysis, "non-spatial" indices.

The data are presented in a series of maps that show where the most unequal and polarized neighbourhoods and municipalities are located within CMAs. The results are mapped only for the three largest CMAs – Montréal, Toronto, and Vancouver – to limit the length of this report.

4. Inequality and Polarization Among Households in Canada's Census Metropolitan Areas

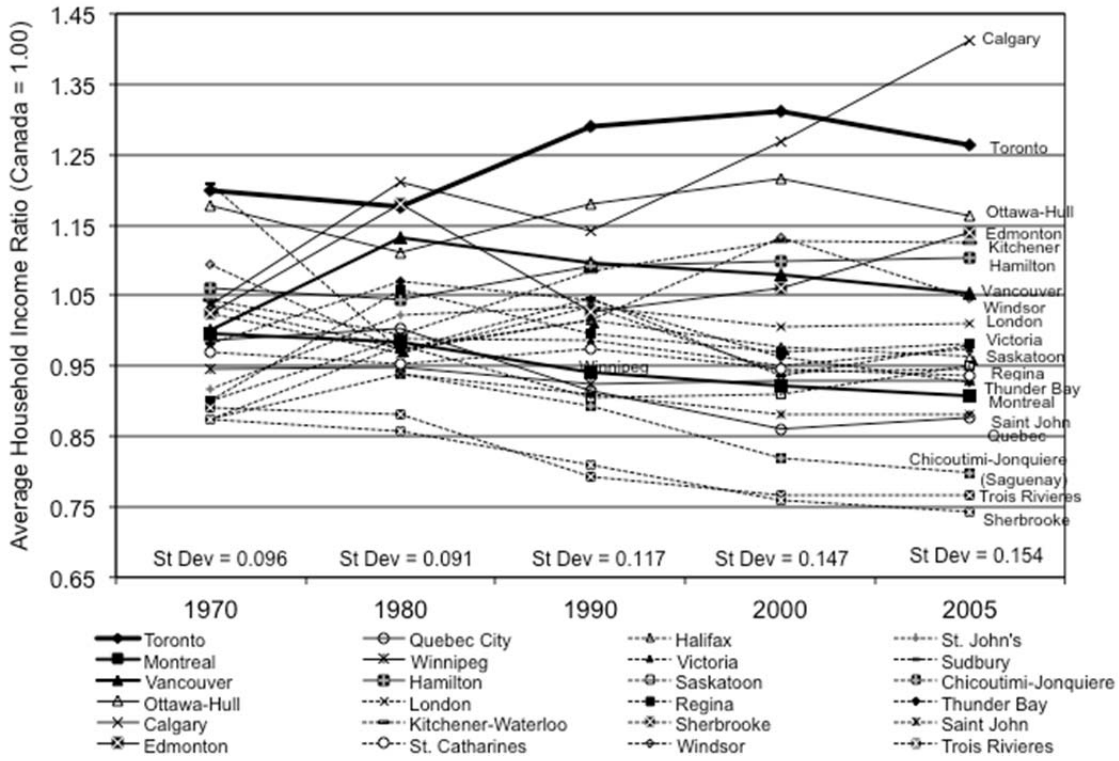
This section deals with the level of income inequality and polarization among households across the entire labour and housing market of each census metropolitan area (CMA), rather than between neighbourhoods or other spatial units. This analysis sets the scene for the analysis of income segregation that follows. First, divergence in incomes among CMAs is examined, followed by an examination of the trends in inequality and polarization among households. The performance of the coefficient of polarization (CoP) is compared to that of other indices of income polarization. This chapter ends with a discussion of some of the main trends driving or fuelling income inequality and polarization in Canada's metropolitan areas.

Inequality between Canada's Metropolitan Areas

Before we examine the issue of income inequality and polarization within Canada's CMAs, it is instructive to note that CMAs themselves have been diverging in income. Figure 6 plots the average household incomes of the 24 CMAs for which income can be traced back to 1970 as a ratio of the national average household income. Incomes are thus standardized to the national level, producing a picture of the relative incomes of each metropolitan area in comparison with the national average, and eliminating the need to adjust incomes for inflation. The average household incomes for each CMA have been calculated and published by Statistics Canada, and released in the general census data, and so in this case do not come from analysis of the PUMF.

Clearly Canadian metropolitan areas have been moving further apart since 1980, with greater dispersion of metropolitan incomes from the national mean, as indicated by the increasing standard deviations. Furthermore, there are regional shifts in income which need to be acknowledged. Importantly, metropolitan areas in Alberta (Calgary and Edmonton) have witnessed a secular increase in average household income since 1990 (and Toronto between 1980 and 2000), while virtually all metropolitan areas in the province of Québec have experienced declining average incomes over the entire period. The patterns of income change in Ontario, the rest of the Prairies, and in Atlantic Canada have been mixed, although there is a general trend toward lower incomes in those metropolises located within the resource hinterland. Thus it should be understood that trends toward greater inequality and polarization discussed in this paper are felt at all scales, even at the larger scale of comparisons between metropolitan areas.

Figure 6: Ratio of CMA Average Household Income to the Canadian Average Household Income, 1970–2005



Source: calculated from Statistics Canada, Census of Canada, 1971–2006

Income Inequality and Polarization in Canada's Metropolitan Areas

When income is examined among all households within a metropolitan area (that is, non-spatially), the results tell a story about the general social distribution of income, apart from how households might be sorted into different neighbourhoods or municipalities. Metropolitan labour markets provide one of the most important contexts in which income inequality and polarization are produced and expressed. However, in addition to the labour market earnings, income can come from investments (loans, stocks, bonds, payments from other assets), and from government income support programs. The main source of government income support include pensions (mainly the Canada Pension Plan, provincial pension plans, the Guaranteed Income Supplement, and Old Age Security), employment insurance (previously known as unemployment insurance), and provincial and municipal welfare programs.

Table 1 breaks down the sources of income for 24 of Canada's largest metropolitan areas. What becomes clear is how the source of income in virtually every CMA has shifted away from employment earnings. The exceptions are Calgary and Edmonton, where the proportion of income has remained relatively stable. The sources of income have been shifting in favour of government transfers and, to an even greater extent, investment income. This reflects the aging of the population and the increased reliance on non-employment-based income flows to sustain retirement, including both private pensions and investments, and government pension

income. However, the shifting sources of income also reflect the rise of investment-based income among the working-age population, and increasing dependence on government transfers among the poor.

Table 1: Sources of Income, by CMA

	Employment			Government Transfers			Investments/Other		
	1990	2000	2005	1990	2000	2005	1990	2000	2005
Halifax	80.0	76.7	73.8	9.5	10.8	10.9	10.2	12.6	15.3
Québec	80.0	75.4	71.9	11.2	12.6	13.2	8.6	12.0	14.9
Montréal	78.1	76.5	72.8	11.5	12.2	13.2	10.2	11.3	14.0
Ottawa-Hull/Gatineau	80.5	79.0	76.5	8.0	8.0	8.7	11.3	13.0	14.8
Oshawa	82.6	82.6	79.1	8.2	8.3	9.5	9.0	9.1	11.4
Toronto	82.0	82.0	78.8	7.5	7.9	8.7	10.5	10.1	12.5
Hamilton	78.6	78.0	73.8	10.5	10.5	11.8	10.7	11.5	14.4
Kitchener	80.5	81.3	79.0	9.3	8.8	9.5	10.0	9.9	11.4
London	77.5	76.2	72.6	10.5	11.0	12.0	12.0	12.8	15.5
Winnipeg	76.5	76.6	73.7	11.5	11.8	12.5	11.8	11.6	13.8
Calgary	82.5	82.9	82.6	7.0	7.0	5.9	10.1	10.1	11.5
Edmonton	81.0	80.6	80.5	9.0	9.9	8.6	10.0	9.6	10.8
Vancouver	77.8	78.7	76.3	9.1	9.6	9.7	12.8	11.7	14.0
Victoria	67.8	70.2	67.8	12.1	12.5	11.6	19.8	17.4	20.6

Source: Calculated by the author from Statistics Canada, Census of Canada, 1981, 1991, 2001, 2006

Inequality and polarization can be calculated for all households within each available CMA. These data are considered "non-spatial" in that they examine households located anywhere within a metropolitan area. This chapter uses data derived from the Public Use Microsample Files (PUMF). One drawback of these files is that the data are not available for every CMA. Data are available for only the two largest CMAs (Montréal and Toronto) for the 1971 census (income data for 1970), and for the 2006 census (income for 2005) the data are available for only five of the largest CMAs (Montréal, Toronto, Vancouver, Calgary, and Edmonton). For the intervening census years (income for the years 1980 through 2000), the data are available for 13 of the largest CMAs.

Another limitation is that the PUMF are a sample, and the top incomes in the PUMF vary considerably. Adjusted for inflation, the top incomes vary from $353,000 in the 1980 PUMF (in constant 2005 dollars) to a high of $1,420,000 in the 2005 PUMF (again, in constant 2005 dollars). To maintain consistency over time, an arbitrary cap of $680,000 for the top incomes (in constant 2005 dollars) has been applied to each of the files – this makes the range of data in each PUMF file (except 1980) fairly similar.

Table 2: Measures of Household Income Inequality (non-spatial), by CMA

	Measures of Income Inequality					Ratio to 1980 (1980 = 1.0)			
EXP	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.438	0.440	0.447		1.00	1.005	1.021	
Québec		0.439	0.443	0.447		1.00	1.009	1.018	
Montréal	0.348	0.449	0.453	0.455	0.459	1.00	1.009	1.013	1.022
Ottawa-Hull/Gatineau		0.440	0.442	0.444		1.00	1.005	1.009	
Toronto	0.341	0.440	0.446	0.446	0.460	1.00	1.014	1.014	1.045
Hamilton		0.434	0.442	0.449		1.00	1.018	1.035	
Kitchener-Waterloo		0.435	0.439	0.439		1.00	1.009	1.009	
London		0.442	0.446	0.450		1.00	1.009	1.018	
Winnipeg		0.444	0.445	0.448		1.00	1.002	1.009	
Calgary		0.436	0.445	0.437	0.456	1.00	1.021	1.002	1.046
Edmonton		0.437	0.445	0.443	0.448	1.00	1.018	1.014	1.025
Vancouver		0.448	0.451	0.451	0.458	1.00	1.007	1.007	1.022
CVSQ	1970	1980	1990	2000	2005**	1980	1990	2000	2005**
Halifax		0.666	0.673	0.712		1.00	1.011	1.069	
Québec		0.682	0.703	0.714		1.00	1.031	1.047	
Montréal	0.734	0.735	0.775	0.758	**	1.00	1.054	1.031	**
Ottawa-Hull/Gatineau		0.679	0.701	0.683		1.00	1.032	1.006	
Toronto	0.719	0.690	0.734	0.704	**	1.00	1.064	1.020	**
Hamilton		0.646	0.706	0.716		1.00	1.093	1.108	
Kitchener-Waterloo		0.664	0.696	0.660		1.00	1.048	0.994	
London		0.697	0.747	0.724		1.00	1.072	1.039	
Winnipeg		0.719	0.736	0.719		1.00	1.024	1.000	
Calgary		0.669	0.729	0.654	**	1.00	1.090	0.978	**
Edmonton		0.670	0.718	0.683	**	1.00	1.072	1.019	**
Vancouver		0.730	0.765	0.730	**	1.00	1.048	1.000	**
GINI CR	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.355	0.363	0.380		1.00	1.021	1.068	
Québec		0.359	0.369	0.382		1.00	1.028	1.063	
Montréal	0.348	0.384	0.396	0.402	0.420	1.00	1.030	1.045	1.093
Ottawa-Hull/Gatineau		0.362	0.367	0.374		1.00	1.015	1.034	
Toronto	0.341	0.360	0.377	0.380	0.421	1.00	1.046	1.055	1.169
Hamilton		0.343	0.367	0.386		1.00	1.071	1.126	
Kitchener-Waterloo		0.346	0.359	0.360		1.00	1.038	1.042	
London		0.367	0.375	0.389		1.00	1.022	1.061	
Winnipeg		0.371	0.375	0.383		1.00	1.011	1.033	
Calgary		0.352	0.376	0.357	0.410	1.00	1.069	1.015	1.166
Edmonton		0.353	0.374	0.371	0.393	1.00	1.060	1.051	1.114
Vancouver		0.381	0.389	0.392	0.430	1.00	1.020	1.027	1.127

Source: Census of Canada, Public Use Microsample Files (20% sample), various years, and 2006 hierarchical file. The CMAs shown are all those represented in the PUMF/hierarchical files for that census year.

* The hierarchical file structure in 2005 is different from that in earlier years. While special adjustments have been made to the 2005 file to enhance compatibility, the 2005 data are not strictly comparable to that for the earlier PUMF and should be treated as preliminary and considered separately.

** The 2006 hierarchical file produced coefficients for the CV2 with poor reliability statistics. They are thus not reported in this paper.

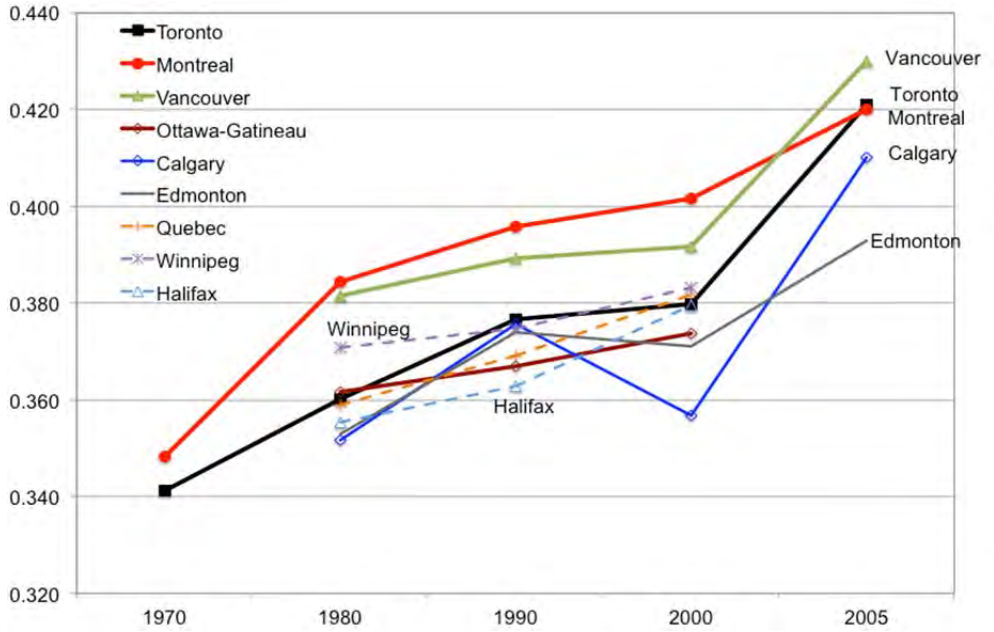
Finally, a third limitation is that the structure of the file changed in 2005, to what Statistics Canada calls a "hierarchical" file structure. While this should make the file more representative and useful for many researchers, in fact it may make the file less compatible with earlier PUMF files. However, the degree to which this structure affects the data in the file remains unknown.

When the various indices of income inequality are calculated, there is a clear trend towards rising household income inequality in most CMAs (Table 2). Montréal historically reveals the most unequal distribution of income, up through the year 2000, as measured using each of the three different indices of income inequality. Montréal is followed in most cases by Vancouver and London (Ontario), with Toronto, Hamilton, and Winnipeg also generally revealing relatively high levels of income inequality. Calgary and Kitchener-Waterloo, meanwhile, exhibit the lowest levels of inequality among these 13 CMAs through the year 2000. Inequality shows a rising trend in virtually all CMAs, and would appear to have grown particularly quickly in the three largest metropolitan areas, as well as in Hamilton, London, Halifax, and Québec over the 1980–2000 period.

The picture in 2005 is a bit different from that of earlier periods, with inequality levels measured at levels higher than previously. In 2005 Montréal is surpassed by Vancouver and Toronto in level of inequality. This is not because inequality declined in Montréal (it increased), but because inequality appears to have grown faster in the other CMAs. However, it is possible that changes to the structure of the (hierarchical) file in 2005 have affected the result.

The degree to which income inequality has changed among the largest CMAs, including the five for which data are available in the 2006 PUMF, is shown in Figure 7.

Figure 7: Gini CR index of household income inequality, selected CMAs



Source: Census of Canada, Public Use Microsample Files (20% sample), various years, and 2006 hierarchical file.

Note: The CMAs shown are all those present in the 2006 hierarchical file, plus Ottawa, Québec, Winnipeg and Halifax. Note that the hierarchical file structure for 2005 is different from that of earlier years. For this reason, the 2005 data may not be strictly comparable to those for the earlier PUMF.

The picture presented is one of rising inequality over much of the earlier study period (from 1980 through 2000), followed by a rapid spike in inequality for the largest and wealthiest CMAs (again, possibly an artefact of the different file structure in 2005). In 2005, Vancouver and Toronto, and for the first time Calgary, now all vie closely with Montréal for the top position as the metropolitan area with the most unequal distribution of income.

Some perspective on the magnitude of income inequality in Canada's CMAs can be gleaned from international comparisons of Gini coefficients, the most commonly accepted inequality index, and the one used by prominent international organizations like the United Nations. In Canadian metropolitan areas, the Gini values vary roughly between 0.350 and 0.400 in 2000, and between 0.390 and 0.440 in 2005 CMA data. While international comparisons are made difficult by different spatial scales, dates of measurement, and different income variables, the Gini values attained for Canadian metropolitan areas range between roughly that for Syria (Gini=0.358) and that for Jamaica (Gini=0.455), according to the most recent United Nations Human Development Report (UNDP, 2012) – both countries with moderate to high levels of income inequality. The United States, in the same UNHDR, exhibits a national Gini coefficient of Gini=0.408, while Canada's national Gini is 0.326.

Household Income Polarization among Households in Canada's Metropolitan Areas

Measures of income polarization generally trend in the same direction as those for inequality (see Table 3). Among all polarization measures, Montréal, Vancouver, London, and Hamilton stand out as having the most polarized income structures in 2000, with Toronto typically in fifth place among the 13 CMAs studied (often followed by Winnipeg). Meanwhile, Calgary and Kitchener-Waterloo are revealed as having, among the 13 CMAs studied, less polarized income distributions among households, again mirroring the findings regarding household income inequality. Hamilton, followed by Toronto, typically exhibits the fastest increase in income polarization over the 1980–2000 period.

However, the 2000–2005 period reveals a divergence between the direction taken by the inequality and polarization indices. While all three of the inequality indices reveal continued increases in the most recent period, two of the polarization indices – the (Foster-)Wolfson (see Figure 8) and the CoP (see Figure 9) – show mixed trends, while the ER index reveals very slight increases or stability over time. The WT index, meanwhile, indicates consistently strong trends toward growing polarization across the five CMAs in the hierarchical dataset. Again, the hierarchical dataset in 2005 differs from that in 2000 and before. However, such differences are not likely to explain the divergence in how the various indices measure inequality and polarization. Instead, the directions of the different indices provide hints as to the nature of such divergences. Notably, while measures that are more sensitive to shifts at the lower end of the spectrum show mostly minor increases or mixed trends (EXP in the case of inequality, CoP in the case of polarization), measures that are more sensitive to the upper end of the spectrum reveal a strong rising trend (CV2 in the case of inequality, WT in the case of polarization).

Table 3: Measures of Household Income Polarization (non-spatial), by CMA

	Measures of Income Polarization					Ratio to 1980 (1980 = 1.0)			
Foster-Wolfson (P)	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.319	0.332	0.376		1.00	1.036	1.136	
Québec		0.322	0.349	0.379		1.00	1.028	1.149	
Montréal	0.315	0.356	0.376	0.427	0.404	1.00	0.916	1.112	1.133
Ottawa-Hull/Gatineau		0.327	0.333	0.387		1.00	1.056	1.077	
Toronto	0.287	0.322	0.348	0.421	0.424	1.00	1.053	1.101	1.319
Hamilton		0.301	0.340	0.400		1.00	1.209	1.283	
Kitchener-Waterloo		0.293	0.320	0.364		1.00	1.225	1.122	
London		0.349	0.345	0.401		1.00	1.046	1.105	
Winnipeg		0.332	0.349	0.388		1.00	1.039	1.072	
Calgary		0.321	0.348	0.382	0.399	1.00	1.161	1.031	1.245
Edmonton		0.312	0.347	0.375	0.373	1.00	1.231	1.093	1.194
Vancouver		0.355	0.365	0.425	0.402	1.00	1.082	1.043	1.134
Esteban-Ray (ER)	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.017	0.017	0.018		1.00	1.000	1.059	
Québec		0.017	0.017	0.018		1.00	1.000	1.059	
Montréal	0.016	0.018	0.019	0.020	0.019	1.00	1.056	1.111	1.056
Ottawa-Hull/Gatineau		0.018	0.017	0.018		1.00	0.944	1.000	
Toronto	0.015	0.017	0.017	0.019	0.019	1.00	1.000	1.118	1.141
Hamilton		0.016	0.017	0.019		1.00	1.063	1.188	
Kitchener-Waterloo		0.017	0.016	0.017		1.00	0.941	1.000	
London		0.017	0.017	0.019		1.00	1.000	1.118	
Winnipeg		0.017	0.017	0.018		1.00	1.000	1.059	
Calgary		0.016	0.017	0.017	0.018	1.00	1.063	1.063	1.144
Edmonton		0.016	0.018	0.018	0.018	1.00	1.125	1.125	1.138
Vancouver		0.018	0.018	0.019	0.020	1.00	1.000	1.056	1.100
Wang-Tsui (WT)	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.674	0.689	0.711		1.00	1.022	1.055	
Québec		0.680	0.698	0.723		1.00	1.026	1.063	
Montréal	0.660	0.717	0.732	0.755	0.764	1.00	1.021	1.053	1.066
Ottawa-Hull/Gatineau		0.682	0.694	0.717		1.00	1.018	1.051	
Toronto	0.643	0.680	0.701	0.723	0.762	1.00	1.031	1.063	1.121
Hamilton		0.655	0.698	0.730		1.00	1.066	1.115	
Kitchener-Waterloo		0.649	0.678	0.699		1.00	1.045	1.077	
London		0.703	0.701	0.737		1.00	0.997	1.048	
Winnipeg		0.694	0.701	0.726		1.00	1.010	1.046	
Calgary		0.671	0.704	0.694	0.743	1.00	1.049	1.034	1.107
Edmonton		0.674	0.704	0.713	0.726	1.00	1.045	1.058	1.077
Vancouver		0.707	0.722	0.739	0.769	1.00	1.021	1.045	1.087
CoP	1970	1980	1990	2000	2005*	1980	1990	2000	2005*
Halifax		0.606	0.628	0.680		1.00	1.036	1.122	
Québec		0.612	0.638	0.673		1.00	1.042	1.100	
Montréal	0.573	0.665	0.684	0.724	0.688	1.00	1.029	1.089	1.035
Ottawa-Hull/Gatineau		0.644	0.636	0.681		1.00	0.988	1.057	
Toronto	0.554	0.615	0.641	0.695	0.700	1.00	1.042	1.130	1.138
Hamilton		0.597	0.625	0.714		1.00	1.047	1.196	
Kitchener-Waterloo		0.598	0.605	0.639		1.00	1.012	1.069	
London		0.638	0.633	0.703		1.00	0.992	1.102	
Winnipeg		0.633	0.639	0.678		1.00	1.009	1.071	
Calgary		0.590	0.634	0.626	0.647	1.00	1.075	1.061	1.097
Edmonton		0.601	0.649	0.659	0.655	1.00	1.080	1.097	1.090
Vancouver		0.658	0.654	0.722	0.710	1.00	0.994	1.097	1.078

Source: Census of Canada, Public Use Microsample Files (20% sample), various years, and 2006 hierarchical file. The CMAs shown are all those represented in the PUMF/hierarchical files for that census year.

* The 2005 hierarchical file data are not strictly comparable to those for earlier PUMF and should be treated as preliminary and considered separately.

Figure 8: (Foster-)Wolfson Index of Household Income Polarization, Selected CMAs

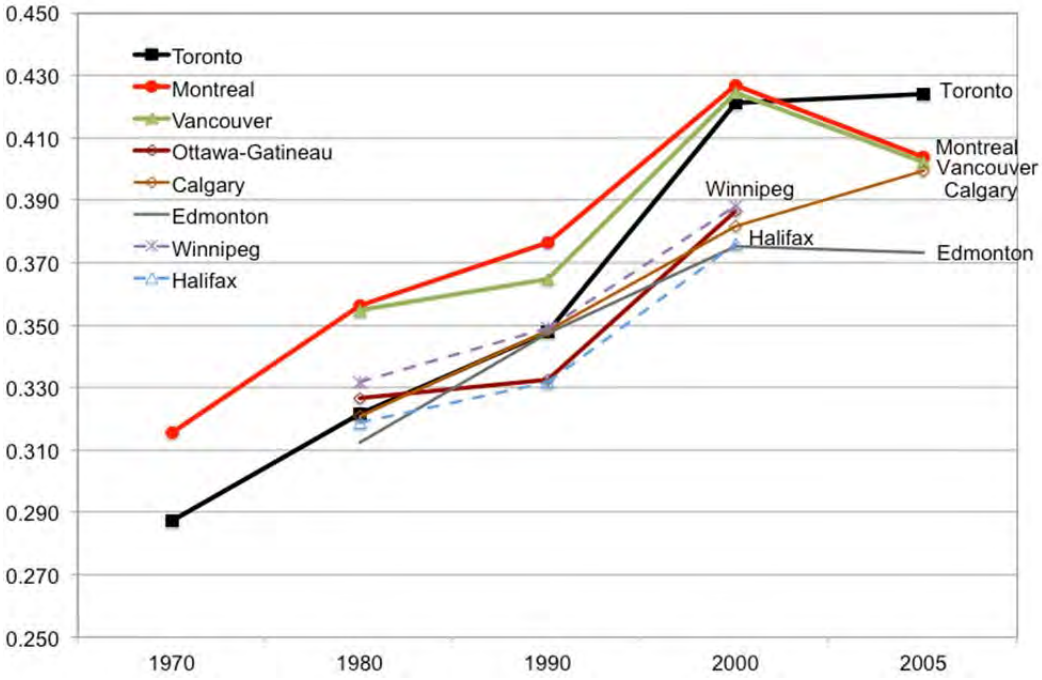
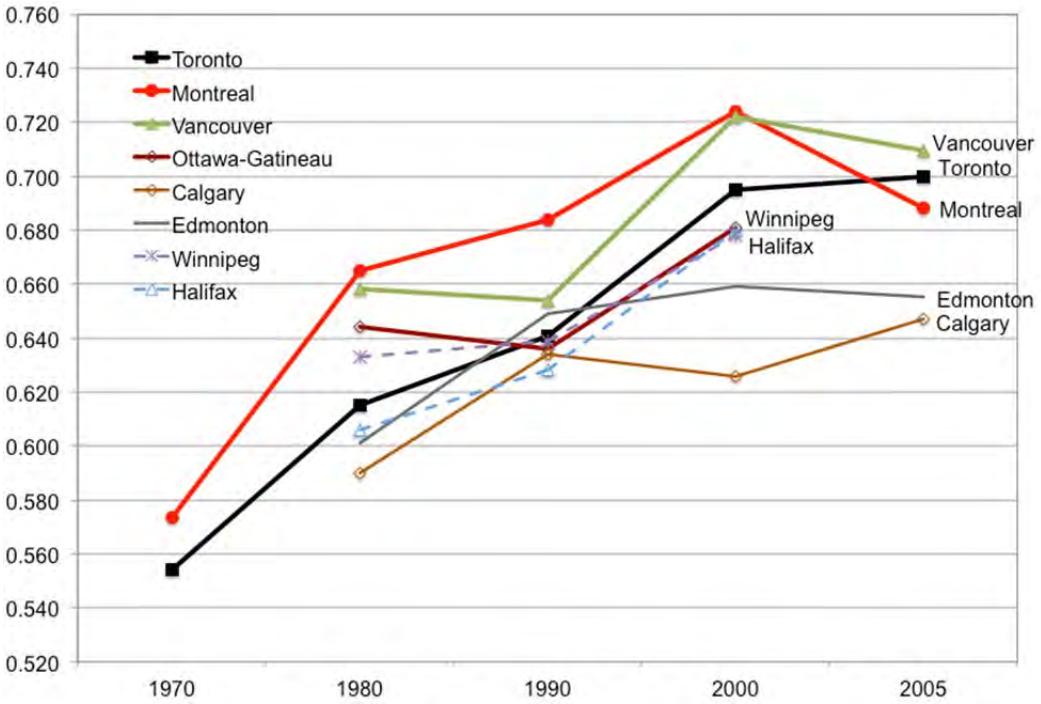


Figure 9: Coefficient of Polarization (CoP), for Household Income, Selected CMAs



Source: Census of Canada, Public Use Microsample Files (20% sample), various years, and 2006 hierarchical file.

Notes: The CMAs shown are all those in the 2006 hierarchical file, plus Ottawa, Québec, Winnipeg, and Halifax. The hierarchical file structure for 2005 is different from that in earlier years, thus the 2005 data are not strictly comparable to those for the earlier PUMF.

The early 2000s was a time of slowly declining levels of poverty, coupled with rapidly rising incomes among high-income earners, largely driven by a credit-induced shift from production-based growth (particularly in manufacturing) to finance-led growth (banking, insurance, real-estate, and the financialization of non-financial corporations). Such a scenario would appear to have led to a wider dispersion of incomes among all earners, producing greater inequality, yet at the same time, a movement away from having the population grouped into two poles, particularly as deindustrialization reduced the concentration of unionized blue-collar workers in well-paid wage bands. This hypothesis conforms to the findings of Bolton and Breau (2012), although their research examined inequality only. Thus, CMAs experiencing deindustrialization, but not the same degree of rising incomes at the top, might be expected to reveal growing inequality but stable or even declining levels of polarization. On the other hand, in CMAs with very strong growth in incomes at the top of the spectrum – particularly Toronto and Calgary – indices of polarization have continued to grow alongside inequality.

Comparing Measures of Income Polarization

While all four measures of polarization discussed above and reported on in this section can be calculated using data in which individuals or households are the units of analysis, the same is not true when the units of analysis are groups of households divided into different income ranges, or neighbourhoods, municipalities, or some other spatial units. The two most established and applied indices of polarization, the Wolfson and ER indices, cannot be calculated when the sizes of the units vary. Unit sizes often vary in the case of neighbourhoods and municipalities, as well as for groups of individuals or households when the groups are not classified by quantile methods (in which each group contains the same number of individuals or households), but using other methods, such as equal intervals. Unfortunately, the latter case is true for household income data reported in the censuses of most developed nations, including Canada, as well as for the census tracts and municipalities at which scale the data are typically aggregated. Among the three common indices of polarization, this leaves the WT index, which is overweighted to the upper end of the income distribution.

The *coefficient of polarization* (CoP) introduced in this study is meant to be used in cases where the Wolfson and ER indices cannot be used, for example, when the units of analysis are neighbourhoods, municipalities, or differently sized groups of individuals or households, as commonly reported in the census. Before the CoP is applied to such units, however, it is important to assess its qualities, similarities, and differences with respect to the other more established indices of income polarization. If the CoP is shown to track closely these other measures when the units of analysis are individual households, then one can assume that it provides a valid and accurate picture of the level of income polarization and thus is useful for measuring polarization in those situations in which other indices are not applicable.

Table 5 lists the correlations between CoP and the other three indices of income polarization attained when compared in each year separately (but across all CMAs), as well as when the inter-census five-year change is compared (across all CMAs) and finally when each CMA is examined separately (with the correlation index calculated across all census years). Due to the lack of PUMF data before 1980 for most CMAs, and to the different structure of the hierarchical PUMF file in 2005, this correlation analysis examined levels of, and changes in, polarization

among the four indices for each five-year census period between 1980 and 2000 as documented in the PUMF for these years. Each of the CMAs that is consistently present in each of these PUMF files is analyzed for this part of the research.

The coefficient of polarization (CoP) is shown to track very closely the values of the Esteban-Ray (ER) index of polarization (see Table 4). Regardless of whether the analysis is of polarization values in each single year, the changes in such values across census periods, or the trajectories of polarization in each separate CMA, the correlation is highest between the CoP and the ER. Indeed, the correlations are very high. The average correlation across all CMAs in the dataset measured in each year separately is r=0.996, while that for changes among all CMAs between each separate census period is r=0.976, and for each CMA separately (but across all census years), r=0.994. The index with the second-strongest correlations in each case is the WT index, while the correlations are weakest (but still strong in many cases) between the CoP and Wolfson measures. The CoP is thus shown to be a very close substitute for the ER index.

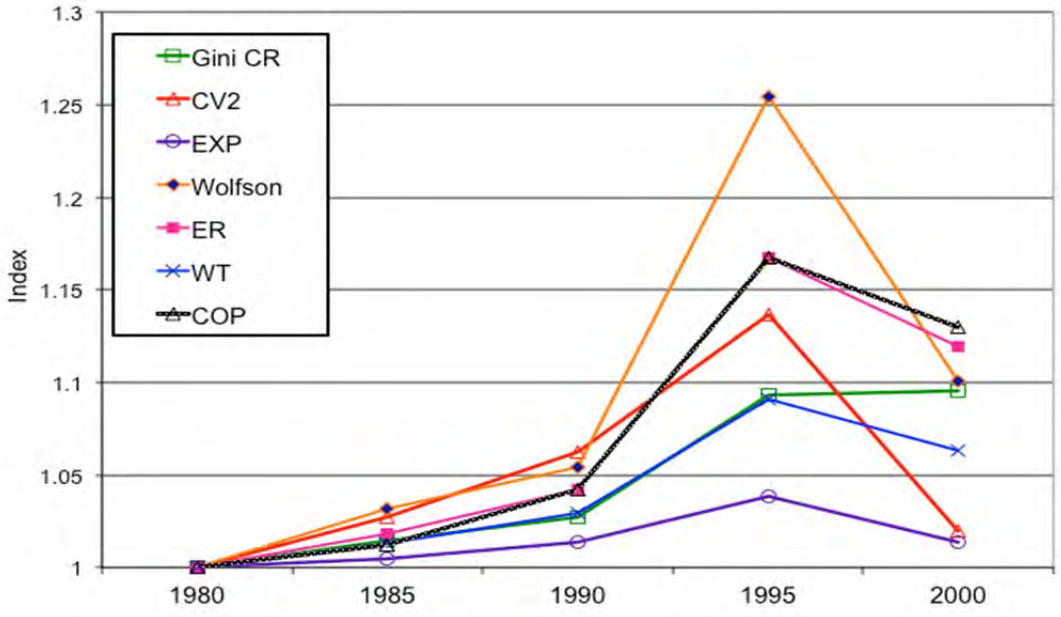
The degree to which the CoP closely tracks the values of the ER index of income polarization can be seen in Figure 10. This figure plots for the Toronto CMA the values of each of the indices of income inequality and polarization applied in this report in comparison with the value of each index in 1980. This facilitates comparison of how each index changes over time, rather than the absolute levels of each index, which often are scaled very differently. As Figure 10 shows, the CoP tracks extremely closely the ER values in Toronto, ending up only very slightly higher than the ER in 2000, and slightly lower in 1985. But the overall pattern is virtually the same. The same is also true for other CMAs (not shown). From this analysis, it is determined that the CoP index of polarization works well as a substitute for the ER index in cases in which the ER is not easily calculated. In Chapters 5 and 6 of this report, the CoP is applied to spatially aggregated data.

Table 4: Correlations among Income Polarization Indices

	CoP-Wolfson	CoP-WT	CoP-ER
By Year (across all CMAs)			
1980	0.779	0.830	0.991
1985	0.796	0.954	0.998
1990	0.127	0.936	0.996
1995	0.910	0.943	0.995
2000	0.891	0.924	0.995
Average across all years	0.681	0.939	0.996
By 5-Year Change (across all CMAs)			
1980-1985	0.590	0.779	0.986
1985-1990	0.203	0.584	0.981
1990-1995	0.584	0.606	0.968
1995-2000	0.592	0.602	0.975
Average for all 5-year change periods	0.492	0.643	0.976
By CMA (across all years)			
Halifax	0.992	0.991	1.000
Québec	0.955	0.950	0.999
Montréal	0.906	0.953	0.999
Ottawa-Gatineau/Hull	0.752	0.919	1.000
Toronto	0.921	0.992	0.998
Hamilton	0.877	0.940	1.000
Kitchener-Waterloo	0.675	0.948	0.988
London	0.878	0.976	0.998
Winnipeg	0.950	0.979	0.998
Calgary	0.863	0.971	0.992
Edmonton	0.683	0.979	0.998
Vancouver	0.509	0.915	0.997
Average across CMAs	0.811	0.951	0.994

Source: Calculated using the Public Use Microsample Files (PUMF), Census of Canada, various years

Figure 10: Indices of Household Income Inequality and Polarization, Toronto CMA (1980=1.00)



Source: Calculated using the Census of Canada, regular PUMF files

Notes: The units of analysis are households.

The Causes of Social Inequality and Polarization in Canada's Cities

A host of factors is responsible for driving the distribution of income among households toward a less equal and more polarized structure. The aim of this paper is not to provide a comprehensive explanation of all these factors, nor to make any claims about which are the most important. Nonetheless, greater understanding of the drivers of inequality and polarization can be gleaned from the highlighting a number of key trends. This overview is intended as complementary to the rigorous analysis published by Bolton and Breau (2012).

Although both inequality and polarization rose almost continuously over the study period (between 1980 and 2000/2005), poverty – at least as measured through the typical proxy variable of the incidence of low income (proportion of the population in private households below the Low Income Cut-off, or LICO) – actually fell in many (but not all) CMAs (Table 5). The rate of poverty (low income) tends to fluctuate with the business cycle, and in most CMAs this was highest in 1980 and 1995, when the economic cycle was near a trough. Many CMAs exhibited reduced levels of poverty by 2000 and 2005, and in a number of CMAs, including Québec, Montréal, Oshawa, Kitchener-Waterloo, Calgary, Edmonton, and Victoria, these rates reached their lowest levels on record in 2005. The two main exceptions to this trend are Toronto and Vancouver, where the rate of low income by 2005 had once again risen to its second-highest level of the study period – only 1995 shows a higher incidence of low income/poverty.

Table 5: Incidence of Low Income (for Population in Private Households), by CMA

CMA	1980	1985	1990	1995	2000	2005
Halifax	19.2	14.3	14.1	17.8	15.5	14.3
Québec	23.0	19.1	18.5	22.8	18.9	16.0
Montréal	24.6	21.5	22.0	27.3	22.2	21.1
Ottawa-Gatineau/Hull	18.8	14.0	14.5	18.9	15.0	14.7
Oshawa	14.5	10.1	9.3	12.4	9.4	9.3
Toronto	17.8	13.1	14.6	21.1	16.7	18.4
Hamilton	19.1	15.1	15.1	19.0	16.7	15.7
Kitchener	17.8	13.1	11.7	14.6	11.3	10.5
London	19.7	15.3	13.6	17.3	15.1	13.7
Winnipeg	22.6	18.5	20.3	23.0	19.2	18.8
Calgary	17.3	16.1	17.2	19.8	14.1	13.4
Edmonton	17.8	17.3	18.8	21.3	16.2	14.1
Vancouver	19.4	18.8	17.4	23.3	20.8	20.8
Victoria	18.8	17.6	13.6	15.4	14.4	13.2

Source: Census of Canada, various years

In other words, inequality and polarization are not rising due to growing poverty only, but instead derive from the shifting income dynamics across the income distribution. Table 6 outlines the proportions of households with low incomes (below $20,000), those with high incomes (above $100,000), and those with middle incomes between these cut-off points, for each CMA in 2000 constant inflation-adjusted dollars. The use of inflation-adjusted dollars here allows for changes in real values, since inflation in price and wages has meant increases in virtually everyone's nominal income. But when analyzed using constant dollars, which reflects real incomes, the income structure is shown to be polarizing.

There are a number of general patterns. First, virtually across the board the proportion of households in the higher-income group increased between 1980 and 2005. No CMA saw the proportion of households in the high-income category decline over the period, although in single decades some CMAs did see such declines. The average increase in the proportion of households in this top category remained fairly constant at 2.07 percent in 1980s, 1.9 percent in the 1990s, and 1.95 percent in the early 2000s.

Second, in all but two CMAs (Calgary and Edmonton), the proportions of households in the lowest-income category also increased, but such an increase continued only through to 2000. And in most cases the proportion of households in this lower-income category declined in the last period (2000-2005), with the main exceptions to this trend found in Toronto and Vancouver. The corollary is that there has been a decline in the number of households with incomes in the middle range in virtually all CMAs between 1980 and 2000, and in the vast majority of CMAs (16) in the early 2000s.

Table 6: Percent of Households with Low, Middle, and High Incomes (in 2000 Constant Inflation-Adjusted dollars)

	Low Income Households (%) Incomes < $20,000				Middle-Income Households (%) Between $20,000 and $99,999				High-Income Households (%) Incomes $100,000+			
CMA	1980	1990	2000	2005	1980	1990	2000	2005	1980	1990	2000	2005
Halifax	16.6	16.0	18.8	17.4	75.1	72.5	69.3	68.5	8.3	11.5	11.9	14.2
Québec	18.3	20.1	21.9	18.5	72.0	71.0	69.2	70.7	9.7	8.9	9.0	10.9
Montréal	20.5	21.3	22.0	20.5	69.8	68.4	66.5	67.2	9.8	10.3	11.5	12.3
Ottawa-Hull/Gatineau	15.5	13.7	14.2	13.4	71.1	68.0	64.0	63.6	13.4	18.4	21.8	23.0
Oshawa	12.4	11.5	11.7	10.7	77.9	70.9	67.0	65.4	9.7	17.6	21.3	24.0
Toronto	13.6	12.4	13.9	14.6	71.8	66.1	63.0	62.6	14.6	21.5	23.2	22.8
Hamilton	16.3	15.3	17.1	14.9	74.1	70.3	65.6	65.7	9.7	14.4	17.2	19.5
Kitchener	15.7	13.7	13.8	12.6	76.2	73.2	69.5	68.7	8.1	13.0	16.8	18.8
London	18.0	16.4	19.0	16.6	73.9	71.5	67.5	67.9	8.1	12.1	13.5	15.5
Winnipeg	19.6	20.1	20.2	18.0	72.4	70.9	69.3	69.2	8.0	9.0	10.6	12.8
Calgary	12.2	14.3	12.0	11.0	70.6	69.5	66.9	64.3	17.3	16.3	21.0	24.7
Edmonton	13.6	17.1	16.1	13.7	71.0	70.6	68.8	66.0	15.4	12.2	15.2	20.3
Vancouver	17.0	16.7	18.0	18.1	68.9	68.3	65.5	64.6	14.2	15.0	16.5	17.3
Victoria	19.2	17.7	19.3	17.1	71.1	71.5	68.6	68.6	9.7	10.7	12.1	14.3

Source: Statistics Canada, Census 1971-2006 Custom Tabulations E1171, E982

Third, the two metropolitan areas in which there has been a continuous increase in low-income households are Toronto and Vancouver. These are Canada's "global" cities, receiving the largest flows of new immigrants among Canadian metropolitan areas. In fact, immigrants to Canada have continuously declining relative incomes over the study period (see Table 7). In each of the CMAs for which these data are comparable over time, recent immigrants (those immigrating in the decade previous to the census) saw their per-capita incomes drop on average by 32 percent (in comparison with the incomes of the native-born).

The drop in immigrant incomes is steepest in global cities with the highest proportions of new immigrants, with recent immigrants in Vancouver earning on average only 52 percent of the incomes of non-immigrants, and in Toronto only 48.6 percent. In 1980, recent immigrants earned 88 percent of non-immigrant incomes in Vancouver, and 81.5 percent of non-immigrant incomes in Toronto. Immigrants to Canada seem to do best in CMAs with relatively low rates of immigration and limited concentration of either immigrants or visible minorities, such as Halifax.

Table 7: Income of Recent Immigrants as a Percentage of Native-Born Income

CMA	1980	1990	2000	2005
Halifax	109.7	95.0	61.2	73.7
Québec	88.8	72.8	63.2	64.6
Montréal	85.9	62.1	61.2	57.4
Ottawa-Hull/Gatineau	77.3	63.7	67.5	62.9
Toronto	81.5	67.9	58.5	48.6
Hamilton	105.1	69.7	65.2	61.2
Kitchener-Waterloo	89.3	74.2	71.3	65.4
London	83.3	68.3	60.9	57.4
Winnipeg	81.8	65.0	67.6	63.8
Calgary	86.4	66.4	62.1	56.0
Edmonton	91.4	63.7	65.4	62.0
Vancouver	88.0	68.5	57.3	51.9
Victoria	n.a.	75.2	74.8	65.9

Source: Census of Canada, Public Use Microsample Files (PUMF), 1981, 1991, and Special Interest Profile Tabulations, 2001, 2006. Note: Income is per-capita in this instance.

A similar pattern is evident in the changes to the incomes of visible minorities, when compared with those who are not visible minorities (see Table 8). The term "visible minority" is one created by Statistics Canada, and is meant to allow respondents to the census to self-identify as such. It is often taken as a proxy for racialized communities and individuals and is the variable with the greatest comparability with that for "race" in the United States census. Visible minorities, on average, have seen their relative per-capita incomes fall by more than 25 percent on average across the study CMAs. As with recent immigrants, the fall in relative incomes has been steepest in the largest cities, particularly Toronto, Hamilton, and Montréal, where the drop is approximately 33 percent, and in Vancouver, where it is 30 percent.

Together, these results suggest that globalization, expressed in rising rates of immigration and the changing face of Canada's largest cities over the study period (among other things), has not been as beneficial to those who immigrated to Canada's cities (on average), or to their children, as it has been to native-born white Canadians. These findings support the suggestion that globalization and racialization have contributed to rising inequality and polarization in Canada's metropolitan areas.

Table 8: Visible Minority Income as Percentage of Non-Visible Minority Incomes

	1980	1990	2000	2005
Halifax	92.5	82.4	71.8	73.7
Québec	93.8	82.2	67.0	66.7
Montréal	95.3	75.3	66.9	63.2
Ottawa-Hull/Gatineau	94.6	74.8	74.8	71.0
Toronto	86.7	75.7	67.9	58.7
Hamilton	107.2	79.6	76.0	70.9
Kitchener-Waterloo	82.6	86.0	75.6	73.3
London	94.5	73.1	78.5	69.6
Winnipeg	92.3	78.7	73.3	74.0
Calgary	86.5	72.8	68.1	60.7
Edmonton	91.9	75.6	72.5	72.3
Vancouver	86.5	77.9	66.1	60.5
Victoria	n.a.	80.1	83.2	77.8

Source: Census of Canada, Public Use Microsample Files (PUMF), 1981, 1991, and Special Interest Profile Tabulations, 2001, 2006.

Note: Income is per-capita in this table. Visible minority status was not a separate variable in the 1980 and 1990 censuses; thus a proxy was constructed using the variables for ethnic origin.

Fourth, the findings show the polarization of wages accruing to different types of jobs. Table 9 presents the employment incomes of each major occupational grouping in each CMA in relation to the average employment income in that CMA. These income values are adjusted to the prevailing incomes of the rest of the labour force in each CMA and thus represent real (rather than nominal) income values. While there is some stability in the general level of income going to each occupational group over time, and only in rare cases do the incomes associated with each group change sufficiently that they change rank, there is nonetheless also a clear pattern toward greater inequality between occupational groups. Most importantly, those in managerial, business, and administrative occupations (including many jobs in finance) have not only the highest incomes among the occupational groups in each metropolitan area, but in most cases their incomes have increased in relation to the CMA average (by more than 11 percent on average since 1980).

This trend compares to the general decline in incomes among those employed in what are normally considered average or lower-income jobs, including artistic, literary, and recreational occupations (a decline of 22.4 percent, on average), as well as sales, services, and security occupations, and in utilities, construction, and transport occupations (a decline of 12 percent on average). Those employed in manufacturing saw their incomes decline between 1980 and 2000, often significantly (by 14 percent on average), but in most cases either stabilize or increase between 2000 and 2005 (the average change is +2.4 percent). However, the positive change in the employment incomes for manufacturing jobs was short-lived, as deindustrialization set in with a vengeance after 2005.

Table 9: Average Incomes of Each Occupational Category as a Percentage of the CMA Average Employment Income

	Managerial, Administrative				Professional, Medical, Legal, Teaching			
CMA	1980	1990	2000	2005	1980	1990	2000	2005
Halifax	168.4	149.8	175.5	178.8	123.7	125.2	130.8	129.8
Québec	160.7	142.4	169.7	172.8	128.4	128.7	131.7	130.0
Montréal	168.4	153.1	180.6	186.8	131.6	124.7	130.0	128.7
Ottawa-Hull/Gatineau	176.1	145.7	170.1	174.9	129.4	122.8	125.0	127.8
Toronto	175.7	148.5	189.8	206.7	130.8	127.0	126.5	130.4
Hamilton	170.0	150.4	179.0	196.0	123.8	122.5	123.6	126.8
Kitchener-Waterloo	177.4	153.3	177.8	193.4	135.0	129.8	124.5	127.5
London	176.3	153.6	171.2	171.8	131.8	128.2	131.3	133.3
Winnipeg	162.9	157.9	180.8	184.5	127.0	124.4	130.2	132.1
Calgary	172.4	160.6	187.2	219.8	125.9	133.6	132.3	133.1
Edmonton	163.7	152.3	173.9	191.5	124.8	126.9	125.5	124.1
Vancouver	158.3	160.5	170.2	183.4	126.6	125.4	129.4	129.5
	Clerical				Arts, Literary, Recreational			
CMA	1980	1990	2000	2005	1980	1990	2000	2005
Halifax	71.4	72.8	74.2	76.6	87.5	83.5	73.3	65.7
Québec	71.8	72.8	82.1	82.8	87.7	93.2	78.6	70.3
Montréal	72.7	72.2	77.4	79.2	95.6	95.1	83.4	75.5
Ottawa-Hull/Gatineau	69.8	74.4	74.7	74.7	103.7	101.9	83.4	80.6
Toronto	70.4	71.3	70.1	71.6	97.3	93.1	82.3	66.8
Hamilton	70.6	71.8	75.8	76.9	78.0	89.8	69.3	62.4
Kitchener-Waterloo	72.9	70.0	76.0	76.3	69.9	82.5	67.4	62.0
London	72.2	77.4	77.9	80.5	82.8	89.2	60.7	60.6
Winnipeg	75.8	77.5	80.5	79.8	111.2	90.5	78.5	72.9
CMA	1980	1990	2000	2005	1980	1990	2000	2005
Calgary	64.9	71.5	69.5	65.3	80.4	79.3	71.2	56.7
Edmonton	67.8	73.7	74.6	73.4	84.5	93.7	72.3	66.1
Vancouver	71.7	73.3	76.3	78.4	90.1	86.9	82.5	73.6
	Manufacturing				Utilities, Construction, Transport			
CMA	1980	1990	2000	2005	1980	1990	2000	2005
Halifax	104.5	102.5	80.6	83.5	108.0	106.0	96.7	93.1
Québec	90.4	91.4	80.4	84.3	104.4	108.6	95.5	94.0
Montréal	85.4	90.3	75.7	88.2	106.1	105.1	95.8	91.6
Ottawa-Hull/Gatineau	90.0	88.5	67.2	87.0	94.9	92.6	82.4	74.4
Toronto	91.9	88.9	72.3	76.1	107.6	100.1	90.2	81.4
Hamilton	111.6	108.4	98.6	94.8	107.3	110.1	105.6	99.0
Kitchener-Waterloo	98.1	102.3	90.5	91.4	109.7	108.6	109.9	104.0
London	101.8	102.7	104.2	113.8	102.1	105.0	105.2	104.3
Winnipeg	98.9	94.1	80.9	71.4	115.3	112.6	102.6	96.3
Calgary	96.1	92.5	72.8	73.1	103.0	96.1	87.9	76.0
Edmonton	102.8	105.9	95.6	103.1	109.5	110.1	110.8	104.4
Vancouver	105.3	99.4	78.6	79.5	111.9	106.7	98.1	92.1
	Sales		Services, Security		Sales, Services, Security			
CMA	1980	1990	1980	1990			2000	2005
Halifax	83.0	83.4	80.8	77.5			62.3	61.3
Québec	93.4	83.4	66.5	64.7			63.6	60.9
Montréal	94.6	89.3	68.3	64.6			63.0	59.0
Ottawa-Hull/Gatineau	77.6	72.7	68.7	67.9			54.0	51.6
Toronto	98.3	95.1	61.7	61.8			58.8	54.1
Hamilton	88.8	87.7	54.5	60.0			58.9	56.2
Kitchener-Waterloo	98.7	89.3	58.0	58.9			57.0	55.0
London	91.0	82.5	64.8	57.8			57.4	55.4
Winnipeg	94.9	95.0	61.3	63.9			62.1	58.8
Calgary	100.8	91.8	61.2	55.4			54.9	48.0
Edmonton	93.3	90.0	64.4	58.9			58.4	55.7
Vancouver	102.9	92.6	59.6	61.2			62.8	59.2

Source: Census of Canada, Public Use Microsample Files (PUMF), 1981, 1991, and Special Interest Profile Tabulations, 2001, 2006. Data are not available for 1971.

The only occupational group with lower-than-average incomes in 1980 that saw any increase in employment incomes is that of clerical workers, who experienced an 8 percent increase in employment incomes on average across the study CMAs. Meanwhile, educated professionals employed in traditional middle-class occupations (medicine and health, law, teaching, social work, religion, engineering), saw their employment incomes remain remarkably flat on average, with 2005 incomes varying from their 1980 levels by less than 1 percent (on average). Indeed, Table 10 shows that professional incomes increased slightly in exactly half of the study CMAs, while decreasing slightly in the other half (and by a bit more in Kitchener-Waterloo).

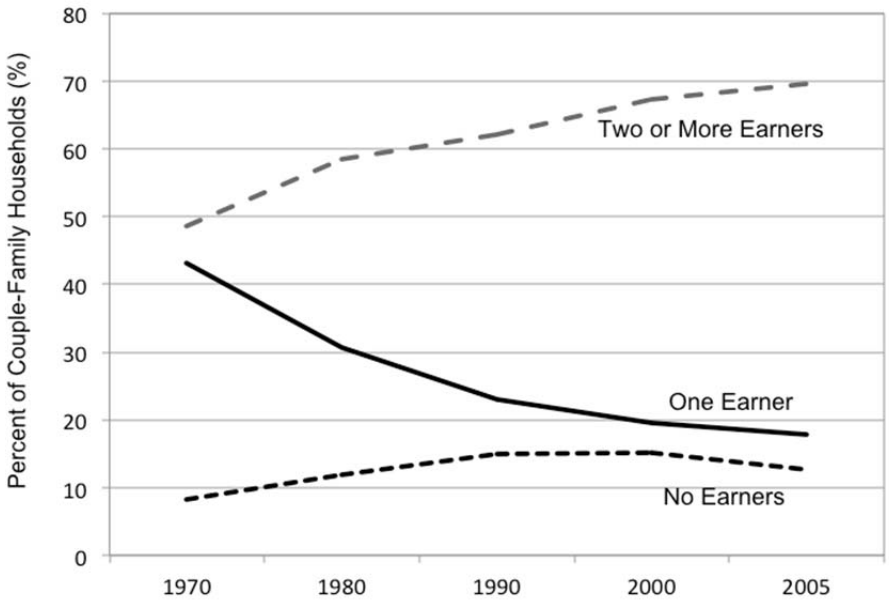
The result is a general picture of occupational polarization in which those with managerial, administrative, and business jobs – which already began the period with pay levels above the average – appropriate an ever-greater share of the total income pie over time, while most of those employed in jobs paying incomes that are traditionally below the average saw their incomes drop further. Only those employed in professional jobs requiring the most education and training saw little change in the relative value of their incomes.

Fifth, socio-demographic shifts also have an impact on income inequality. Among families and households, one important change has involved the decline of single-earner households, and rising numbers of both dual-earner households and, to a lesser but no less significant extent, no-earner households (Figure 11). Picot, Myles, and Pyper (1998, p. 19) have shown that no-earner households became increasingly dominant among those with income below the median between 1973 and 1995. Myles (2010) suggests that an important component of the structure of contemporary inequality is the coupling of those of similar socio-economic status. This in itself might be expected to lead to an increase of both no-earner and dual-earner households, as individuals sort themselves. As Myles (2010) notes, this is a difficult process to solve using policy, however, the more advanced welfare state in the province of Québec, particularly that related to child care and social reproduction, appears better able to counteract the inequality-inducing process of increasing class-based marriage pairing.

While there is a definite shift away from one-earner households and towards two-earner households across the entire country (Figure 11), it remains unknown the extent to which this trend is present within Canadian metropolitan areas. However, there is little reason to expect significant deviance from this general pattern in any given metropolitan area.

What remains to be explored is the extent to which inequality is due to shifts in the labour market opportunities of younger workers and households, and how differences in labour market experiences and outcomes among younger and older workers affect the distribution of income among households. Myles, Picot, and Wannell (1993) have suggested that deindustrialization and changes in the organization of work have been expressed in different opportunity structures between generations, such that inequality is increasing within occupations as well as between them. Fortin and Lefebvre (1998) found that between 1951 and 1994, intergenerational mobility increased, and the relationship between the class of fathers and that of sons weakened, while that between fathers and daughters increased. The latter result, it is conjectured, relates to greater female participation in the labour market, and is (although they do not state this) compatible with an explanation rooted in higher rates of class-based marriage pairing. More research is necessary to determine how all these factors come together to produce rising income inequality among households.

Figure 11: Couple-Family Households by Number of Earners, All Canada



Source: Bourne, 1993; Census of Canada, 1991, 1996, 2001, 2006.

5. Income Segregation among Neighbourhoods, and Municipalities, in Canada's Metropolitan Areas

The preceding analysis has examined changes in household-level inequality within Canada's metropolitan areas. While providing important information regarding how income is distributed in general, it does not say anything about how income is distributed across space.

When we speak of an unequal distribution of income across space, we are primarily concerned with income segregation. Segregation here refers to the spatial distribution of households with different incomes, and not necessarily to spatial sorting (or "active" segregation). Incomes in different areas of the city can become less equal and more polarized due either to greater income inequality among all households (such that already rich areas become richer and already poor areas become poorer), or to increasing segregation of households (sorting rich households into rich areas and poor households into poor areas). In reality, some combination of both processes is likely.

Analysis of the degree to which spatial sorting may be producing underlying levels of segregation can be helpful both in highlighting the direction of important urban processes, as well as in informing appropriate policies. Within urban areas, income segregation is usually measured among neighbourhoods, for which census tracts are used as proxies. It can also be measured among municipalities, which are typically larger than census tracts or neighbourhoods.

This section details trends in the segregation of income over the period 1970 through 2005, as measured using the indices of socio-spatial income inequality and polarization that are appropriate for application with spatially aggregated data. First, levels of neighbourhood-based income segregation are examined in the 24 census metropolitan areas already existing in 1970, with census tracts as the unit of analysis. This section uses custom data ordered from Statistics Canada, in which households are classified into income ranges that are inflation-adjusted over time with additional ranges specified for the upper end of the distribution. This was necessary for calculation of the polarization measures (of which only two, the WT and CoP, can be calculated with spatially aggregated data). Unlike the PUMF data, there are no caps in this spatially aggregated dataset, allowing for a more realistic assessment of the true extent of socio-spatial change.

Then, the issue of spatial sorting – the active process of segregating households – is examined, and alternative measures of sorting are compared. Finally, the analysis explores municipal-level segregation, including the potential levels of neighbourhood sorting among neighbourhoods and municipalities, within the three largest metropolitan regions.

Socio-Spatial Income *Inequality* among Canada's Metropolitan Areas

As noted above, changing levels of inequality (and polarization) among census tracts, while indicative of segregation, combine two kinds of information. First, they reflect changes in the underlying incomes of different kinds of households, even when such households do not move. Second, they reflect the spatial sorting of households based on their incomes, even if the underlying incomes of households do not change. Of course, both processes typically occur together. For this reason, it is appropriate to speak of socio-spatial inequality when assessing the results of analyses of neighbourhood-level income change – this term includes elements of both income segregation as well as the unequal distribution of incomes. The same indices of inequality selected for application to households in the previous section can also be applied to the analysis of socio-spatial inequality between census tracts (this is one of the reasons they were included).

Table 10: Socio-Spatial Income *Inequality* Between Census Tracts (Segregation of Household Income), by CMA: Gini Coefficient (Gini CR)

	Gini Concentration Ratio					Ratio to 1970 (1970=1.00)				
CMA	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Halifax	0.112	0.124	0.129	0.154	0.165	1.00	1.105	1.149	1.375	1.475
Québec	0.129	0.136	0.154	0.168	0.170	1.00	1.050	1.192	1.295	1.312
Montréal	0.157	0.169	0.185	0.198	0.207	1.00	1.071	1.162	1.261	1.316
Ottawa-Hull/Gatineau	0.144	0.155	0.163	0.187	0.185	1.00	1.073	1.130	1.294	1.283
Oshawa	0.090	0.111	0.126	0.140	0.141	1.00	1.238	1.411	1.565	1.572
Toronto	0.136	0.158	0.174	0.209	0.230	1.00	1.163	1.263	1.536	1.688
Hamilton	0.114	0.146	0.175	0.198	0.205	1.00	1.282	1.533	1.738	1.800
Kitchener	0.092	0.102	0.137	0.157	0.169	1.00	1.116	1.490	1.716	1.842
London	0.127	0.160	0.170	0.184	0.197	1.00	1.257	1.336	1.443	1.546
Winnipeg	0.150	0.158	0.182	0.197	0.207	1.00	1.053	1.212	1.312	1.374
Calgary	0.155	0.157	0.178	0.182	0.226	1.00	1.011	1.147	1.176	1.458
Edmonton	0.148	0.145	0.162	0.173	0.188	1.00	0.981	1.099	1.176	1.273
Vancouver	0.149	0.165	0.169	0.173	0.190	1.00	1.103	1.133	1.160	1.271
Victoria	0.135	0.158	0.166	0.151	0.174	1.00	1.166	1.229	1.116	1.291

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

Again, the Gini coefficient (concentration ratio) is the "gold standard" of inequality measures, and provides the best overall measure of inequality, as it captures the entirety of the income distribution (it indicates the area between the line of perfect equality and the Lorenz curve). When Gini coefficients are calculated using census tracts as the unit of analysis, the results indicate growing socio-spatial inequality and segregation in every CMA over virtually the entire study period (see Table 10). Five Canadian metropolitan areas consistently exhibit the highest levels of socio-spatial inequality: Toronto, Montréal, Winnipeg, Hamilton, and Calgary. However, CMAs in Ontario with its industrial economy, particularly Kitchener-Waterloo and Hamilton, exhibit the most rapid increase in levels of segregation since 1970.

It is also instructive to examine inequality measures that are more sensitive to the extremes of the income distribution, as this provides information on what kinds of processes might be driving overall levels of socio-spatial inequality. The EXP measure is most sensitive to the lower end of the income distribution (see Table 11).

Table 11: Socio-Spatial Income *Inequality* Between Census Tracts (Segregation of Household Income), by CMA: Exponent Measure (EXP)

	Exponent (EXP)					Ratio to 1970 (1970=1.00)				
CMA	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Halifax	0.376	0.377	0.378	0.382	0.384	1.00	1.005	1.006	1.017	1.022
Québec	0.379	0.379	0.382	0.384	0.384	1.00	0.999	1.007	1.014	1.014
Montréal	0.384	0.385	0.388	0.391	0.394	1.00	1.002	1.010	1.019	1.025
Ottawa-Hull/Gatineau	0.380	0.382	0.384	0.388	0.388	1.00	1.006	1.010	1.021	1.021
Oshawa	0.373	0.375	0.377	0.380	0.380	1.00	1.006	1.012	1.019	1.019
Toronto	0.380	0.383	0.386	0.395	0.401	1.00	1.008	1.015	1.039	1.055
Hamilton	0.376	0.380	0.385	0.390	0.391	1.00	1.012	1.025	1.039	1.040
Kitchener	0.373	0.374	0.379	0.382	0.384	1.00	1.004	1.017	1.025	1.031
London	0.378	0.383	0.385	0.388	0.391	1.00	1.015	1.018	1.026	1.035
Winnipeg	0.382	0.383	0.387	0.391	0.392	1.00	1.004	1.015	1.024	1.028
Calgary	0.383	0.383	0.386	0.387	0.399	1.00	1.000	1.010	1.011	1.044
Edmonton	0.381	0.380	0.383	0.385	0.389	1.00	0.997	1.005	1.010	1.019
Vancouver	0.382	0.384	0.385	0.387	0.391	1.00	1.005	1.008	1.011	1.024
Victoria	0.379	0.382	0.384	0.381	0.387	1.00	1.008	1.014	1.005	1.021

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

While measuring socio-spatial inequality using EXP does not significantly alter the ranking of CMAs based on level of income segregation, with the same five CMAs generally revealing the highest levels, there are nonetheless some distinct patterns to note. First, levels of socio-spatial inequality are more similar across CMAs when measured using the EXP, and CMAs in western Canada typically reveal higher levels of income segregation using this measure. Second, the increase in the EXP measures over time is much more muted, suggesting that much of the rise

in inequality between 1970 and 2005 has been driven by what is occurring near the upper end of the income distribution. Also, it is mainly those same five CMAs that have seen the EXP measure increase the most over the study period.

These last points are partially borne out through an analysis of changes in the coefficient of variation squared (CV2), an index of income inequality that is more sensitive to the upper end of the income distribution (see Table 12). The patterns of change in the CV2 measure more closely mirror those of the Gini, both across CMAs and over time, with Toronto, Calgary, and Hamilton exhibiting the most rapid increases in inequality over the study period.

There are, however, some distinct patterns related to the CV2 measure. In particular, the larger and wealthier CMAs are revealed as having the highest rates of inequality when measured this way, with Toronto in particular revealing a level that, by 2005, is more than twice that of the CMAs with the most equal socio-spatial distributions of income on this measure. A big shift occurred in the 1990s, catapulting Toronto into a level of its own through 2005 (by which time it exhibits a CV2 of 0.526). Calgary, Montréal, and Vancouver, Canada's other metropolitan areas (after Toronto) containing concentrations of headquarters, make up a second tier, with CV2 measures above 0.400. In general, CMAs in the west exhibit higher levels of socio-spatial inequality on this measure than on the Gini, while smaller CMAs in the east (including Ontario) generally reveal lower levels. Unfortunately, because of the lack of a long form in the 2011 census, we cannot gauge whether such trends have continued up to the present time.

Table 12: Socio-Spatial Income *Inequality* Between Census Tracts (Segregation of Household Income), by CMA: Coefficient of Variation Squared (CV2)

	Coefficient of Variation Squared (CV2)					Ratio to 1970 (1970=1.00)				
CMA	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Halifax	0.214	0.229	0.237	0.284	0.300	1.00	1.069	1.109	1.330	1.402
Québec	0.271	0.254	0.281	0.309	0.312	1.00	0.939	1.039	1.141	1.154
Montréal	0.334	0.326	0.360	0.402	0.444	1.00	0.977	1.078	1.205	1.328
Ottawa-Hull/Gatineau	0.278	0.280	0.296	0.341	0.340	1.00	1.006	1.065	1.228	1.225
Oshawa	0.173	0.196	0.223	0.251	0.249	1.00	1.137	1.289	1.454	1.440
Toronto	0.285	0.309	0.336	0.452	0.526	1.00	1.085	1.180	1.587	1.845
Hamilton	0.210	0.263	0.313	0.359	0.376	1.00	1.252	1.488	1.706	1.789
Kitchener	0.175	0.186	0.255	0.288	0.309	1.00	1.063	1.457	1.643	1.764
London	0.246	0.298	0.316	0.344	0.388	1.00	1.212	1.284	1.397	1.578
Winnipeg	0.300	0.309	0.340	0.371	0.388	1.00	1.029	1.132	1.235	1.293
Calgary	0.297	0.294	0.329	0.360	0.472	1.00	0.991	1.110	1.213	1.589
Edmonton	0.291	0.264	0.303	0.326	0.358	1.00	0.908	1.042	1.120	1.233
Vancouver	0.303	0.313	0.320	0.344	0.427	1.00	1.033	1.054	1.136	1.409
Victoria	0.258	0.287	0.311	0.273	0.374	1.00	1.111	1.207	1.060	1.450

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

Socio-Spatial Income *Polarization* among Canada's Metropolitan Areas

Measures of polarization highlight the trend of a disappearing middle class (Foster and Wolfson, 2010; Esteban and Ray, 1994). Only two measures of income polarization can be applied to spatially aggregated data: the WT and CoP indices. Unfortunately, as discussed in Chapter 3, neither the Wolfson or ER indices can be calculated for spatial units with varying populations. For this reason, among others, the coefficient of polarization (CoP) introduced in this report was developed. While the general trend towards socio-spatial polarization mirrors that for socio-spatial inequality, the picture of income segregation expressed in indices of polarization reveal subtle differences with those of inequality.

The WT index of polarization is more sensitive to the upper end of the income distribution (see Table 13). As in the pattern for the CV2 (which is also more sensitive to the upper end), larger metropolitan areas are revealed to have higher levels of income polarization, with Calgary, Toronto, and Hamilton the most polarized on this measure, but with Montréal and Vancouver close behind. The more industrial cities (such as Kitchener-Waterloo) also reveal strong increases in polarization over time. However, overall there is much less variation in WT scores across CMAs than for the CV2 or the Gini.

Table 13: Socio-Spatial Income Polarization Between Census Tracts (Segregation of Household Income), by CMA: Wang-Tsui (WT)

	Wang-Tsui Index (WT)					Ratio to 1970 (1970=1.00)				
CMA	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Halifax	0.384	0.417	0.438	0.500	0.527	1.00	1.084	1.139	1.301	1.370
Québec	0.437	0.442	0.484	0.528	0.537	1.00	1.013	1.108	1.210	1.229
Montréal	0.440	0.484	0.513	0.545	0.562	1.00	1.101	1.166	1.239	1.277
Ottawa-Hull/Gatineau	0.447	0.477	0.490	0.538	0.543	1.00	1.067	1.095	1.203	1.214
Oshawa	0.374	0.387	0.421	0.453	0.479	1.00	1.033	1.126	1.210	1.280
Toronto	0.416	0.459	0.491	0.547	0.586	1.00	1.103	1.180	1.314	1.406
Hamilton	0.390	0.447	0.492	0.554	0.573	1.00	1.146	1.261	1.420	1.467
Kitchener	0.334	0.385	0.444	0.481	0.507	1.00	1.153	1.329	1.440	1.516
London	0.393	0.488	0.505	0.528	0.529	1.00	1.241	1.286	1.345	1.345
Winnipeg	0.442	0.472	0.508	0.544	0.552	1.00	1.067	1.149	1.232	1.249
Calgary	0.431	0.458	0.492	0.508	0.608	1.00	1.063	1.143	1.179	1.411
Edmonton	0.418	0.454	0.471	0.494	0.528	1.00	1.084	1.126	1.181	1.261
Vancouver	0.418	0.476	0.502	0.529	0.568	1.00	1.139	1.200	1.265	1.359
Victoria	0.434	0.473	0.497	0.496	0.532	1.00	1.091	1.145	1.142	1.226

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

Indices of socio-spatial polarization as measured by the new coefficient of polarization (CoP) present another picture of interneighbourhood segregation (see Table 14). The CoP is fairly equally sensitive to the upper and lower ends of the income spectrum, but has additional sensitivity to very low incomes. Concentrated poverty thus factors far more into the calculation of polarization in the CoP than in the WT. Nonetheless, the trends demonstrated by the CoP are similar to those for the WT index, and indeed for the Gini index. Calgary, Toronto, Windsor, and Hamilton are demonstrated to have the most polarized neighbourhood income structure in 2005, followed by Winnipeg, Vancouver, and Montréal. The more industrial (and deindustrializing) cities of Ontario have seen the greatest growth in polarization since 1970, as measured by the CoP: Kitchener-Waterloo and Hamilton. While not reported here, the same pattern extends to other industrial Ontario cities such as Windsor and Sudbury.

Table 14: Socio-Spatial Income Polarization Between Census Tracts (Segregation), by CMA: Coefficient of Polarization (CoP)

	Coefficient of Polarization (CoP)					Ratio to 1970 (1970=1.00)				
CMA	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
Halifax	0.168	0.192	0.208	0.259	0.282	1.00	1.138	1.234	1.540	1.677
Québec	0.205	0.215	0.251	0.289	0.292	1.00	1.049	1.224	1.408	1.423
Montréal	0.216	0.250	0.274	0.301	0.315	1.00	1.157	1.269	1.392	1.456
Ottawa-Hull/Gatineau	0.213	0.244	0.254	0.299	0.302	1.00	1.148	1.196	1.407	1.421
Oshawa	0.151	0.172	0.199	0.231	0.246	1.00	1.143	1.321	1.537	1.637
Toronto	0.191	0.230	0.255	0.307	0.338	1.00	1.199	1.332	1.602	1.764
Hamilton	0.171	0.218	0.262	0.319	0.330	1.00	1.279	1.535	1.868	1.932
Kitchener-Waterloo	0.132	0.159	0.209	0.244	0.267	1.00	1.204	1.580	1.842	2.020
London	0.178	0.246	0.258	0.282	0.286	1.00	1.383	1.454	1.589	1.612
Winnipeg	0.216	0.241	0.278	0.307	0.317	1.00	1.117	1.290	1.423	1.470
Calgary	0.218	0.228	0.261	0.270	0.354	1.00	1.048	1.197	1.240	1.627
Edmonton	0.202	0.222	0.241	0.262	0.288	1.00	1.101	1.191	1.298	1.428
Vancouver	0.200	0.244	0.269	0.285	0.316	1.00	1.223	1.345	1.428	1.584
Victoria	0.203	0.242	0.256	0.252	0.283	1.00	1.191	1.264	1.240	1.395

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

Comparing Indices of Socio-Spatial Inequality and Polarization

How might the various indices of socio-spatial inequality and polarization differ in their treatment of neighbourhood-based segregation? While each index provides different information on the structure of income segregation, correlations among the various indices (measured using the CMA-level indices of income segregation shown in Tables 10 through 14) indicate similarities among particular classes of indices (see Table 15).

Clearly, indices of inequality have much in common with each other, despite their varying sensitivities to different ends of the income distribution. The average correlation of the level of inequality across CMAs over the study period varies between a "low" of 0.968 (out of 1.00, representing the correlation between the Gini and CV2) and 0.981 (correlation between the Gini and EXP). The correlations among changes in these indices over time also suggests a high degree of correspondence, ranging from a low of 0.834 (correlation between changes in the Gini and EXP indices) and 0.917 (correlation in changes in the Gini and CV2 indices). Likewise, there is a strong correlation between the levels of polarization indicated by the WT and CoP cross-sectionally (0.976) and changes in the levels of polarization as measured by them (0.966).

Table 15: Correlations among Cross-Sectional and Change Indices of Neighbourhood Income Inequality and Polarization

	By Year					Change between Censuses			
	1970	1980	1990	2000	2005	1970–1980	1980–1990	1990–2000	2000–2005
Gini/ EXP	0.984	0.979	0.984	0.983	0.976	0.755	0.839	0.907	0.755
Gini/ CV2	0.977	0.986	0.985	0.958	0.934	0.964	0.931	0.856	0.964
Gini/ WT	0.881	0.918	0.733	0.637	0.725	0.772	0.588	0.726	0.772
Gini/ CoP	0.948	0.961	0.841	0.751	0.802	0.864	0.748	0.810	0.864
EXP/ Gini	0.984	0.979	0.984	0.983	0.976	0.755	0.839	0.907	0.755
EXP/ CV2	0.991	0.992	0.983	0.977	0.977	0.755	0.913	0.889	0.755
EXP/ WT	0.853	0.878	0.713	0.599	0.705	0.560	0.672	0.813	0.560
EXP/ CoP	0.925	0.922	0.818	0.716	0.762	0.616	0.749	0.852	0.616
CV2/ Gini	0.977	0.986	0.985	0.958	0.934	0.964	0.931	0.856	0.964
CV2/ EXP	0.991	0.992	0.983	0.977	0.977	0.755	0.913	0.889	0.755
CV2/ WT	0.861	0.886	0.684	0.570	0.674	0.676	0.555	0.671	0.676
CV2/ CoP	0.920	0.931	0.785	0.666	0.704	0.767	0.673	0.715	0.767
WT/ Gini	0.881	0.918	0.733	0.637	0.725	0.772	0.588	0.726	0.772
WT/ EXP	0.853	0.878	0.713	0.599	0.705	0.560	0.672	0.813	0.560
WT/ CV2	0.861	0.886	0.684	0.570	0.674	0.676	0.555	0.671	0.676
WT/ CoP	0.978	0.985	0.966	0.972	0.977	0.973	0.951	0.973	0.973
CoP/ Gini	0.948	0.961	0.841	0.751	0.802	0.864	0.748	0.810	0.864
CoP/ EXP	0.925	0.922	0.818	0.716	0.762	0.616	0.749	0.852	0.616
CoP/ CV2	0.920	0.931	0.785	0.665	0.704	0.767	0.673	0.715	0.767
CoP/ WT	0.978	0.985	0.966	0.972	0.977	0.973	0.951	0.973	0.973

Notes: Correlations are Pearson correlations (r). Correlations less than 0.700 indicate a less than strong correlation. The second block of columns shows correlations across CMAs of the changes in each index in between each census year.

However, there is less correlation between indices of polarization and indices of inequality. Even though both the CV2 and WT indices are more sensitive to the upper end of the spectrum, this pairing reveals the lowest average cross-sectional correlation (0.735, suggesting a moderately strong correlation), followed by the correlation between the WT and EXP (0.750). Likewise, the average correlation is lower between changes in the WT and changes in the CV2 over time (0.634), followed by changes in the WT and EXP indices (0.682). The CoP, meanwhile, shows the least affinity with the CV2 index of inequality (0.801, which is nonetheless considered a strong correlation), followed by the EXP (0.828), while having higher average correlation with the Gini (0.861). The Gini is found to have the highest degree of correlation with each of the different indices, both cross-sectionally (average=0.897) and in terms of changes in each decade (0.813). This is followed closely by the EXP (0.866 and 0.777, respectively) and CV2 (0.872 and 0.780). The CoP also shows a high degree of cross-sectional correlation (0.866) and an average correlation with changes over time that is second only to the Gini (0.807). The WT index, meanwhile, is shown to have the least in common with the other indices (with average cross-sectional and change-based correlations of 0.810 and 0.744).

Also interesting to note is the incremental slow decline in many of the correlations over time, as the number of census tracts in each region grows and the distinctiveness of each index is allowed to express itself. Most notable in this sense is the declining correlation between the WT and both the EXP and CV2 measures of inequality. This is likely due to the high degree of sensitivity of the WT index to the upper end of the income spectrum, in the context of rising incomes in the wealthiest neighbourhoods. To this end, the CoP is shown to perform well, with an ability to capture patterns of increasing income segregation and to represent changes in segregation better than the WT index of polarization. Among the indices of inequality, the Gini is again shown as best at capturing rising segregation among neighbourhoods.

Neighbourhood Sorting and Segregation Processes

The question arises as to whether income segregation between neighbourhoods is driven more by increasing income among households, such that neighbourhoods reveal more unequal or polarized income structures without households having to move, or alternatively whether rising segregation is being driven by the sorting of households into neighbourhoods based on income.

A common way to measure the level of neighbourhood-based sorting is to divide the level of segregation (between neighbourhoods) by the total amount of inequality among households (Jargowsky, 1996; Kim and Jargowsky, 2005; Yang and Jargowsky, 2006). The assumption is that even if all households completely sorted themselves by income into different neighbourhoods, such that each neighbourhood contained households of the exact same income, the maximum level of intraneighbourhood inequality that could be achieved through such a process would be the level of (non-spatial) inequality among households.

The Neighbourhood Sorting Index (NSI) developed in Kim and Jargowsky (2005) and Yang and Jargowsky (2006) is calculated as the Gini coefficient of income calculated using census tracts, divided by the Gini coefficient of income calculated among all households, in a given metropolitan area. The result provides a picture of the proportion of total household income inequality accounted for by differences between neighbourhoods. They calculated this index for a number of metropolitan areas in the United States.

A similar exercise was conducted by Chen, Myles, and Picot (2012), but using the Theil index. They note that the Theil index of inequality is the only index that can be "de-composed" into constituent parts (for instance, inequality among seniors versus inequality among working-age adults). They therefore reasoned that it is possible to decompose total household inequality into the amount of inequality that is spatially structured among neighbourhoods versus that among all families/households. They calculated their Neighbourhood Sorting Index (NSI) in similar fashion to Yang and Jargowsky (2005), except that instead of comparing the between-census-tract Theil measures to the total Theil measure of family-income dispersion, they compared the latter to the level of within-tract inequality as measured by the Theil. They were able to calculate these measures because they had access to the raw census data. Because of its decomposability, the Theil is the only index that allows for a measure of neighbourhood sorting to be calculated in this way. Their analysis involved the eight largest Canadian metropolitan areas between 1980 and 2005, using adult-adjusted equivalent family income (see discussion in Chapter 3).

The first four data columns in Table 16 summarize their findings concerning the level of neighbourhood sorting in each year between 1980 and 2005. As well, I use their data to calculate a ratio of the level of sorting in each year to the base year of 1980, and also calculate the change in the level of sorting in each decade. While Toronto, Winnipeg, and Montréal end the period with the largest degree of sorting, cities in the Prairies saw the greatest increase in sorting over the period. Also, different regions went through periods of sorting at different times. The CMAs in the Prairies are shown to have seen their strongest period of sorting in the 1980s, while the larger central-Canadian CMAs of Toronto, Montréal, and Ottawa-Hull/Gatineau witnessed the greatest rise in neighbourhood sorting over the 1990s (after a period in which the increase in neighbourhood sorting shifted into reverse during the 1980s). Sorting in Vancouver is mainly traceable to the early 2000s, while sorting in Québec was moderate in the 1980s, then weak or negative over the rest of the period (Table 16).

Table 16: Neighbourhood Sorting – Based on Theil (Chen, Myles, and Picot, 2012)

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.0)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Québec	0.106	0.121	0.125	0.122	1.00	1.142	1.179	1.151	14.2	3.3	-2.4
Montréal	0.162	0.143	0.178	0.185	1.00	0.883	1.099	1.142	-11.7	24.5	3.9
Ottawa-Hull/Gatineau	0.130	0.121	0.154	0.141	1.00	0.931	1.185	1.085	-6.9	27.3	-8.4
Toronto	0.167	0.158	0.209	0.210	1.00	0.946	1.251	1.257	-5.4	32.3	0.5
Winnipeg	0.135	0.166	0.175	0.188	1.00	1.230	1.296	1.393	23.0	5.4	7.4
Calgary	0.111	0.136	0.147	0.157	1.00	1.225	1.324	1.414	22.5	8.1	6.8
Edmonton	0.088	0.116	0.117	0.116	1.00	1.318	1.330	1.318	31.8	0.9	-0.9
Vancouver	0.119	0.114	0.124	0.140	1.00	0.958	1.042	1.176	-4.2	8.8	12.9

Source: First four data columns from Chen, Myles, and Picot (2012).

The calculation of the various indices of inequality and polarization provides an opportunity to compare potential patterns of neighbourhood sorting as adduced using other indices to those calculated using the Theil index. While the Theil is the one index that is known to be decomposable, it is not clear that the creation of neighbourhood sorting indices calculated using other measures of inequality (and polarization) cannot also be employed to gauge the level of sorting. Indeed, this is exactly what Yang and Jargowsky (2006) do with the Gini index, and their results for U.S. metropolitan areas seem reasonable and within the ranges of values calculated by Chen, Myles, and Picot (2012). As well, the latter work has been conducted using only the eight largest CMAs, and for adult-adjusted family income. It is important to broaden the analysis to a greater number of CMAs and, following the method employed in this report, to examine the distribution of households, as it is all households that together through their movement through space do the actual sorting.

This section calculates measures of neighbourhood sorting for Canadian metropolitan areas, using the same method as Jargowsky (1996) and Yang and Jargowsky (2006), later adapted by Chen, Myles, and Picot (2012), but using households and the indices of inequality and polarization analyzed in the rest of this paper. I seek to compare the results to those of Chen, Myles, and Picot (2012), to see if similar patterns repeat, and furthermore to assess whether there are discernible differences in the information provided by indices of inequality versus those of polarization. The hypothesis is that similar patterns should repeat among the different measures if this method is really to be useful for highlighting consistent sorting processes.

Table 17 calculates indices of neighbourhood sorting (NSI) based on the Gini coefficients (of both household income inequality and income segregation between neighbourhoods). The results differ considerably from those presented by Chen, Myles, and Picot (2012).

Table 17: Neighbourhood Sorting – Based on Gini Coefficients

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.00)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Halifax	0.349	0.355	0.405		1.00	1.017	1.160		1.7	14.0	
Québec	0.379	0.417	0.440		1.00	1.102	1.161		10.2	5.4	
Montréal	0.440	0.467	0.493	0.493	1.00	1.062	1.119	1.120	6.2	5.4	0.1
Ottawa-Hull/Gatineau	0.428	0.444	0.500		1.00	1.037	1.168		3.7	12.6	
Toronto	0.439	0.462	0.550	0.546	1.00	1.052	1.253	1.245	5.2	19.2	-0.7
Hamilton	0.426	0.477	0.513		1.00	1.120	1.205		12.0	7.6	
Kitchener	0.295	0.382	0.436		1.00	1.294	1.479		29.4	14.3	
London	0.436	0.453	0.473		1.00	1.040	1.085		4.0	4.3	
Winnipeg	0.426	0.485	0.514		1.00	1.140	1.208		14.0	6.0	
Calgary	0.446	0.473	0.510	0.551	1.00	1.061	1.143	1.236	6.1	7.7	8.1
Edmonton	0.411	0.433	0.466	0.478	1.00	1.055	1.135	1.165	5.5	7.7	2.6
Vancouver	0.433	0.434	0.441	0.442	1.00	1.003	1.019	1.020	0.3	1.6	0.1

Source: Calculated by the author for each year/CMA by taking the Gini CR value calculated using census tracts as the unit of analysis, and dividing by the Gini CR value calculated using households as the unit of analysis (i.e., Table 10 and Table 2 above).

Not only do the NSI values suggest much greater neighbourhood-based sorting, but the timing of sorting is different. The transitions are more gradual across decades, with a fairly consistent increase in sorting over time in most CMAs. Also, Toronto, Montréal, and Vancouver have witnessed very similar patterns (of stable or even, in the case of Toronto, slightly negative levels of sorting) in the most recent (2000–2005) period. This would appear to match the census tract data for households and the experience in these three global cities. Toronto and Calgary have the highest levels of spatial sorting.

A different picture is presented when the EXP measure is used to gauge neighbourhood sorting (see Table 18). Using the EXP measure, it appears that more than 80 percent of household income inequality can be accounted for as sorting between neighbourhoods. Furthermore, there appears to be very little increase in sorting among neighbourhoods. As this measure is sensitive to the lower end of the distribution, it could be that it is picking up much greater segregation among the poor, as well as the declining degree of segregation among the poor over time (as poor neighbourhoods gentrify and the poor disperse into the older suburbs). Or alternatively, it may be an index poorly suited to measuring neighbourhood sorting.

Table 18: Neighbourhood Sorting – Based on EXP

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.00)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Halifax	0.861	0.859	0.855		1.00	0.998	0.993		-0.2	-0.5	
Québec	0.863	0.862	0.859		1.00	0.999	0.995		-0.1	-0.4	
Montréal	0.857	0.857	0.859	0.834	1.00	0.999	1.002	0.973	-0.1	0.3	-2.9
Ottawa-Hull/Gatineau	0.868	0.869	0.874		1.00	1.001	1.007		0.1	0.6	
Toronto	0.870	0.865	0.886	0.837	1.00	0.994	1.017	0.961	-0.6	2.3	-5.5
Hamilton	0.876	0.871	0.869		1.00	0.995	0.992		-0.5	-0.3	
Kitchener	0.860	0.863	0.870		1.00	1.004	1.012		0.4	0.8	
London	0.867	0.863	0.862		1.00	0.996	0.995		-0.4	-0.1	
Winnipeg	0.863	0.870	0.873		1.00	1.008	1.012		0.8	0.4	
Calgary	0.878	0.867	0.886	0.824	1.00	0.987	1.008	0.937	-1.3	2.1	-7.0
Edmonton	0.870	0.861	0.869	0.844	1.00	0.990	0.999	0.970	-1.0	1.0	-2.9
Vancouver	0.857	0.854	0.858	0.810	1.00	0.996	1.001	0.945	-0.4	0.5	-5.6

Source: Calculated by the author for each year/CMA by taking the EXP value calculated using census tracts as the unit of analysis and dividing by the EXP value calculated using households as the unit of analysis (i.e., Table 11 and Table 2 above).

The CV2, on the other hand, is more sensitive to the upper end of the distribution (Table 19). Although it is not possible to produce sorting indices for 2005 with confidence, it presents a picture of neighbourhood sorting that is very similar to that when the Gini index is used to calculate the NSI, with the exception that the 1990s was the period in which the strongest trends toward increasing sorting occurred (except for Kitchener-Waterloo). The CV2-based sorting indicates that a greater proportion of total inequality accounted for by the segregation of income among neighbourhoods than does the Gini analysis. Again, this may be due to the particular sensitivi-

ties of this index to incomes at the high end of the spectrum, which highlights tendencies toward the segregation of the wealthy. Coupled with the very weak (or negative) results concerning changes in sorting levels when the EXP measure is employed (including in the recent period), the CV2- and Gini-based NSI results suggest that much of the increase in income segregation witnessed across Canadian CMAs (at least through 2000) is the result of the sorting of the wealthy into wealthy neighbourhoods, rather than the sorting of the poor into poor neighbourhoods.

The hypothesis that the segregation of the wealthy is driving rising levels of income segregation among neighbourhoods is supported further by the results of the neighbourhood sorting analysis using the WT index (see Table 20). This is the polarization index that is more sensitive to the upper end of the distribution, and it shows a continued increase in sorting over the entire period (except Edmonton in the 1980s). Once again, as in the sorting index based on the CV2, the WT-based sorting coefficients suggest a very high level of spatial sorting, one that is seemingly much larger than could pertain to the sorting of all households. Such a hypothesis is bolstered when the sorting index derived from the WT index is compared to the level of sorting measured using the CoP (discussed below).

Table 19: Neighbourhood Sorting – Based on CV2

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.00)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Halifax	0.344	0.352	0.399		1.00	1.024	1.160		2.4	13.3	
Québec	0.372	0.400	0.433		1.00	1.073	1.162		7.3	8.3	
Montréal	0.444	0.465	0.530	*	1.00	1.047	1.196	*	4.7	14.2	*
Ottawa-Hull/Gatineau	0.412	0.422	0.499		1.00	1.024	1.211		2.4	18.2	
Toronto	0.448	0.458	0.642	*	1.00	1.022	1.434	*	2.2	40.3	*
Hamilton	0.407	0.443	0.501		1.00	1.089	1.232		8.9	13.1	
Kitchener	0.280	0.366	0.436		1.00	1.308	1.558		30.8	19.1	
London	0.428	0.423	0.475		1.00	0.989	1.111		-1.1	12.3	
Winnipeg	0.430	0.462	0.516		1.00	1.075	1.201		7.5	11.7	
Calgary	0.439	0.451	0.550		1.00	1.027	1.253	*	2.7	22.0	*
Edmonton	0.394	0.422	0.477	*	1.00	1.071	1.211	*	7.1	13.1	*
Vancouver	0.429	0.418	0.471	*	1.00	0.976	1.099	*	-2.4	12.7	*

Source: Calculated by the author for each year/CMA by taking the CV2 value calculated using census tracts as the unit of analysis, and dividing by the CV2 value calculated using households as the unit of analysis (i.e., Table 12 and Table 2 above).

* The 2006 hierarchical file produced CV2 coefficients with poor reliability statistics, preventing the calculation of neighbourhood sorting indices for 2005.

Table 20: Neighbourhood Sorting – Based on WT

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.00)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Halifax	0.619	0.636	0.703		1.00	1.027	1.137		2.7	10.6	
Québec	0.650	0.693	0.730		1.00	1.067	1.124		6.7	5.3	
Montréal	0.675	0.701	0.722	0.735	1.00	1.038	1.069	1.089	3.8	3.0	1.8
Ottawa-Hull/Gatineau	0.699	0.706	0.750		1.00	1.009	1.073		0.9	6.3	
Toronto	0.675	0.700	0.757	0.764	1.00	1.038	1.121	1.132	3.8	8.0	1.0
Hamilton	0.682	0.705	0.759		1.00	1.033	1.112		3.3	7.7	
Kitchener	0.593	0.655	0.688		1.00	1.104	1.160		10.4	5.1	
London	0.694	0.715	0.718		1.00	1.030	1.034		3.0	0.4	
Winnipeg	0.680	0.725	0.749		1.00	1.066	1.102		6.6	3.4	
Calgary	0.683	0.699	0.732	0.807	1.00	1.024	1.072	1.182	2.4	4.7	10.3
Edmonton	0.674	0.669	0.693	0.727	1.00	0.993	1.029	1.079	-0.7	3.6	4.9
Vancouver	0.673	0.695	0.716	0.735	1.00	1.033	1.063	1.092	3.3	3.0	2.7

Source: Calculated by the author for each year/CMA by taking the WT value calculated using census tracts as the unit of analysis, and dividing by the WT value calculated using households as the unit of analysis (i.e., Table 13 and Table 3 above).

Table 21: Neighbourhood Sorting – Based on CoP

	Neighbourhood Sorting (%)				Ratio to 1980 (1980=1.00)				Change in Decade		
Gini CR	1980	1990	2000	2005	1980	1990	2000	2005	1980s	1990s	Early 2000s
Halifax	0.317	0.331	0.378		1.00	1.045	1.193		4.5	14.1	
Québec	0.371	0.437	0.431		1.00	1.179	1.162		17.9	-1.5	
Montréal	0.398	0.434	0.414	0.433	1.00	1.090	1.040	1.087	9.0	-4.6	4.5
Ottawa-Hull/Gatineau	0.405	0.448	0.441		1.00	1.106	1.087		10.6	-1.7	
Toronto	0.380	0.395	0.399	0.407	1.00	1.037	1.048	1.070	3.7	1.0	2.2
Hamilton	0.404	0.451	0.458		1.00	1.118	1.135		11.8	1.5	
Kitchener	0.253	0.331	0.371		1.00	1.309	1.469		30.9	12.2	
London	0.400	0.408	0.385		1.00	1.020	0.964		2.0	-5.4	
Winnipeg	0.431	0.476	0.459		1.00	1.103	1.064		10.3	-3.6	
Calgary	0.432	0.448	0.415	0.406	1.00	1.036	0.961	0.940	3.6	-7.3	-2.2
Edmonton	0.406	0.416	0.419	0.439	1.00	1.025	1.032	1.083	2.5	0.7	4.9
Vancouver	0.395	0.398	0.339	0.341	1.00	1.006	0.859	0.863	0.6	-14.6	0.5

Source: Calculated by the author for each year/CMA by taking the CoP value calculated using census tracts as the unit of analysis, and dividing by the CoP value calculated using households as the unit of analysis (i.e., Table 14 and Table 3 above).

Finally, the sorting analysis conducted using the CoP indices suggest, as in the Gini, a moderate level of neighbourhood-level sorting (see Table 21). The coefficients are all below 0.5, suggesting that less than half (approximately 39 percent) of total household income polarization is accounted for in segregation among neighbourhoods. The analysis suggests that tendencies toward sorting became stronger in the 1980s, and then, except for Halifax and the central Ontarian cities, declined in the 1990s. Calgary in particular seems to have witnessed a decline in sorting since 1990, while Vancouver saw a decline in sorting during the 1990s. While starting at low levels, Kitchener-Waterloo had the greatest increase in neighbourhood sorting based on the CoP, while Winnipeg revealed the highest actual level of sorting.

How do the many pictures of neighbourhood sorting provided by all these analyses compare? Clearly, each is telling a different and, in some cases, contradictory story. Table 22 presents the average correlation coefficients when the indices of sorting are compared among CMAs in a single year (lower-left triangle, which can be taken as predicting the average correlation of indices between each CMA and each other CMA), as well as those calculated when indices of sorting are compared over time in each single CMA (upper-right triangle, indicating the temporal trajectories of change in the indices).

Table 22: Average Correlations of Neighbourhood Sorting Indices, by Year (across CMAs), and by City (across Census Years)

	Theil-Based	Gini-Based	EXP-Based	CV2-Based	WT-Based	CoP-Based
Theil-Based		0.840	0.032	0.551	0.780	0.207
Gini-Based	0.753		0.182	0.828	0.698	0.472
EXP-Based	0.240	0.487		0.355	-0.278	-0.037
CV2-Based	0.811	0.934	0.586		0.509	0.186
WT-Based	0.547	0.674	0.439	0.459		0.351
CoP-Based	0.125	0.431	0.407	0.086	0.517	

Lower-Left Triangle: All CMAs, Across Each Year individually

Upper-Right Triangle: All Years, Across each CMA individually

Source: calculated by the author.

Note: Pearson correlations of Neighbourhood Sorting indices calculated using each different index of inequality and polarization.

There is a strong correlation between some of the sorting indices, mainly those using the Gini and the CV2, and, to a slightly lesser degree, between both the Gini, or the CV2, and the Theil index. The latter in this case has been calculated using a slightly different income measure – adult-adjusted family income – by Chen, Myles, and Picot (2012). These results suggest the CV2 and Theil indices provide relatively similar information to the Gini, but not to each other. Meanwhile there are few other patterns to the indices of neighbourhood sorting calculated using the other measures. The EXP, WT, and CoP-based sorting analyses in particular appear to provide very different information from that provided by the Gini (or Theil or CV2).

In short, it is not evident that clear and consistent patterns related to neighbourhood sorting can be discerned using the methods for detecting neighbourhood sorting followed here. While the highest correlations relate the Theil and the CV2 to the Gini-based sorting indices, even here the stories told by each of these different indicators vary considerably, both in terms of the degree to which total socio-spatial income inequality can be explained by sorting processes, as well as the degree to which trajectories of sorting can be discerned across space and over time.

At best, the different measures suggest, but do not prove, that to the extent sorting is actually occurring in Canadian metropolitan areas, it is mostly related to the segregation of wealthy households into high-income neighbourhoods, rather than to an increase in the clustering or sorting of low-income households. However, the very different pictures painted by the different indices of sorting suggest one should be cautious in interpreting these results. Questions regarding neighbourhood sorting thus remain open.

Socio-Spatial Inequality and Polarization Among Municipalities in Canada's Global Cities

Spatial analysis of income segregation is not confined to examination of neighbourhood-level changes and indices, but can be extended to segregation among municipalities within metropolitan areas. It is at the level of municipalities that property taxes are collected and local government services delivered. A number of programs for redistributing income and delivering services, including general welfare programs, homeless shelters, and rent supplements, are delivered at the municipal level in many provinces. Furthermore, much land-use planning (which determines the proportions, sizes, locations, and forms of different kinds of housing, including rental housing, and the lot sizes and footprints of owner-occupied housing) is undertaken and regulated at the municipal level. Municipalities thus have an impact on the local expressions of income inequality. As well, the concentration of affluence and poverty in different municipalities affects their capacities for delivering services, collecting property taxes, or undertaking programs that help redistribute income and other benefits. There is a long history of analysis of socio-spatial inequality being undertaken using municipalities in the United States.

This section analyzes the extent of income inequality and polarization among *municipalities* in Canada's three largest metropolitan areas, Montréal, Toronto, and Vancouver (the "MTV" CMAs). These are the only metropolitan areas large enough to produce robust results. Of course, the municipal structures of Toronto and Montréal have been altered over time by the provincial governments of Ontario and Québec, respectively. In 1998 the Ontario government amalgamated the six lower-tier municipalities within Metropolitan Toronto with the single upper-tier municipality. In 2002, the Province of Québec "merged" (amalgamated) all of the municipalities on the Island of Montréal into a single municipality, and reduced through amalgamation the number of suburban municipalities on the North and South shores. However, in 2006, some (but not all) of these amalgamated municipalities were "de-merged" following a referendum, producing a number of separate municipalities, many of them Anglophone. Vancouver's municipal structure remained relatively constant over the period.

Since the idea of examining socio-spatial inequality among municipalities is to see whether income is becoming more or less segregated, it is necessary to use a consistent set of spatial units with consistent boundaries. For the Toronto CMA, the preamalgamation lower-tier

municipalities in existence until 1998 are used as the units of analysis across the study period, producing a consistent set of 27 municipalities for the Toronto region. The values for the now-amalgamated lower-tier municipalities were determined using the custom census tract data aggregated up to those spatial units. In the Montréal CMA, meanwhile, a consistent set of 66 proto-municipal spatial areas were built from the census tract and census subdivision (CSD) data. In some cases in the Montréal region, municipalities are smaller than census tracts, in which case, two or more municipalities had to be aggregated for this analysis (and the 2005 data had to be constructed by aggregating the census tract totals up to the larger proto-municipal spatial units). In Vancouver, there are 18 proto-municipalities, each maintaining consistent boundaries over the period, in the analysis.

The different indices of socio-spatial inequality and polarization generally mirror each other in the trends they indicate in each CMA (see Table 23). Montréal and Toronto have experienced increasing income segregation between municipalities over the entire period, on every measure. Rising inequality in these CMAs appears to be linked more to the segregation of higher-income households than to that of lower-income households. The EXP measure, which is more sensitive to the lower end of the spectrum, has risen only very slowly. However, the CV2 index of inequality and both the WT and CoP polarization indices show strong increases over time. (Montréal saw a slight decline in polarization between 1990 and 2000, but this decline was reversed between 2000 and 2005, and the city ended the period with the highest level of intermunicipal polarization.) Interestingly, Montréal is shown to have the most unequal, but the least polarized, municipal distribution of income among the three global cities. This finding provides further evidence of the distinct information delivered by the different measures of socio-spatial inequality and polarization.

Vancouver, meanwhile, shows mixed trends, depending on the index. Measured using the Gini coefficient of income inequality, which is considered to have a balanced sensitivity across the income distribution (particularly given the ranges of average household income across municipalities, which remain closer to the CMA averages than do the incomes of neighbourhoods), income segregation among municipalities reached its highest point in 1980, after which it declined. On the other hand, the CV2 index of inequality and both of the measures of polarization (WT and CoP) suggest income segregation has increased over the study period. Values of the EXP index, which is more sensitive to the lower end of the spectrum, meanwhile, suggest the poor may not have experienced much (if any) increase in segregation in Vancouver.

As in the discussion of metropolitan-wide (aspatial) income polarization (see Figure 10) and income segregation among neighbourhoods (see Table 15) in the measurement of intermunicipal income polarization, the coefficient of polarization (CoP) is shown to exhibit distinct information from other indices. First, the direction and extent of change in each of the different indices in Table 23 reveals a set of clear trajectories. The two indices with the highest correlations when applied between columns (that is, including data for all CMAs, but only two census years) are the Gini coefficient and the CV2. The CV2 index reveals correlations above r=0.900 in each of the latter three census decades (comparing 1970 and 1990, 2000, and 2005), but a negative correlation (r=-0.597) in the first study decade (1970-1980).

Second, the CoP index of polarization also reveals a consistently negative correlation with the EXP index, but the strength varies between r=-0.187 and r=-0.886, depending on the census year. For all other pairings, both the strength and direction of correlation vary widely across

census decades, and there are few clear patterns to the correlations. The average correlation, column-wise, between the CoP and the Gini coefficient is r=0.143, which is very similar to, but slightly lower than, that between the WT and Gini (r=0.145), and second-lowest to that between the Gini and the EXP (r=0.079).

Table 23: Socio-Spatial Income Inequality and Polarization Between Municipalities (Segregation of household income), Three Largest CMAs

INEQUALITY	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
GINI CR										
Montréal	0.101	0.118	0.128	0.133	0.140	1.00	1.172	1.267	1.319	1.390
Toronto	0.055	0.062	0.073	0.085	0.087	1.00	1.134	1.340	1.558	1.598
Vancouver	0.068	0.087	0.081	0.074	0.077	1.00	1.271	1.184	1.081	1.129
EXP										
Montréal	0.377	0.377	0.379	0.380	0.381	1.00	1.000	1.006	1.008	1.012
Toronto	0.369	0.371	0.372	0.372	0.372	1.00	1.003	1.006	1.007	1.007
Vancouver	0.373	0.371	0.373	0.375	0.374	1.00	0.994	1.000	1.007	1.004
CV2										
Montréal	0.243	0.242	0.262	0.276	0.301	1.00	0.996	1.080	1.136	1.238
Toronto	0.099	0.115	0.139	0.156	0.166	1.00	1.165	1.404	1.582	1.682
Vancouver	0.167	0.171	0.165	0.176	0.187	1.00	1.024	0.989	1.053	1.123
POLARIZATION	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
WT										
Montréal	0.288	0.404	0.432	0.425	0.480	1.00	1.405	1.502	1.476	1.669
Toronto	0.345	0.366	0.418	0.501	0.571	1.00	1.059	1.211	1.450	1.653
Vancouver	0.329	0.379	0.411	0.474	0.541	1.00	1.150	1.250	1.441	1.644
CoP										
Montréal	0.130	0.178	0.197	0.221	0.248	1.00	1.362	1.514	1.698	1.906
Toronto	0.129	0.143	0.175	0.242	0.304	1.00	1.104	1.350	1.875	2.347
Vancouver	0.120	0.155	0.175	0.216	0.266	1.00	1.293	1.459	1.793	2.216

Notes: The number of municipal units is kept consistent, and the scale factors for the WT and CoP were all set to 1.00 for this analysis. See the appendix for discussion of methodology in creating the proxy set of proto-CSDs.

On the other hand, when the trajectories of inequality and polarization measured by each index are compared separately for each CMA, the correlations are all very high (reflecting the fact that over the entire study period, each CMA witnessed a strong increase in both inequality and polarization, regardless of the index employed), with average correlations typically above 0.900. The shift toward increasing polarization over time as measured by the coefficient of po-

larization (CoP) introduced here reveals the most consistent and highest correlations with the WT index of polarization (r=0.982), which should be expected, given that they are both measures of income polarization. High correlations are also found with, in order, the CV2 (r=0.914), the EXP (0.796), and finally the Gini (0.675).

Table 24: Municipal Sorting, based on each Index of Inequality and Polarization, Three Largest CMAs

INEQUALITY	1970	1980	1990	2000	2005	1970**	1980**	1990**	2000**	2005**
GINI CR										
Montréal	0.290	0.307	0.323	**0.331**	0.320	1.000	1.059	1.114	**1.140**	1.104
Toronto	0.161	0.172	0.194	**0.224**	0.193	1.000	1.068	1.201	**1.387**	1.199
Vancouver	n.a.	**0.224**	0.207	0.162	0.168		**1.000**	0.924	0.724	0.753
EXP										
Montréal	**0.849**	0.840	0.837	0.835	0.807	**1.000**	0.989	0.985	0.984	0.950
Toronto	**0.849**	0.843	0.834	0.834	0.776	**1.000**	0.994	0.983	0.983	0.915
Vancouver	n.a.	**0.828**	0.827	0.827	0.774		**1.000**	0.999	0.999	0.935
CV2										
Montréal	0.323	0.329	0.338	**0.364**	*	1.000	1.020	1.048	**1.128**	*
Toronto	0.134	0.167	0.189	**0.222**	*	1.000	1.244	1.414	**1.654**	*
Vancouver	n.a.	0.234	0.216	**0.241**	*		1.000	0.921	**1.029**	*
POLARIZATION										
WT										
Montréal	0.436	0.563	0.590	0.563	**0.627**	1.00	1.291	1.352	1.290	**1.438**
Toronto	0.537	0.538	0.596	0.693	**0.744**	1.00	1.003	1.111	1.291	**1.387**
Vancouver	n.a.	0.536	0.569	0.641	**0.700**		1.000	1.062	1.197	**1.306**
CoP										
Montréal	0.227	0.267	0.288	0.306	**0.361**	1.00	1.174	1.268	1.344	**1.588**
Toronto	0.233	0.232	0.272	0.349	**0.434**	1.00	0.994	1.166	1.494	**1.858**
Vancouver	n.a.	0.236	0.268	0.298	**0.375**		1.000	1.136	1.264	**1.589**

Notes: Calculated using Table 23 and Tables 2 and 3. Note that because the 2006 hierarchical file has a different structure, the 2005 values may not be strictly comparable.

* The hierarchical file produced CV2 values with poor reliability statistics, preventing the use of those values in calculating indices of sorting using the CV2. There is no PUMF file for Vancouver in 1970 and so the index of municipal sorting could not be calculated. Bolded values indicate the highest values across census years.

** These five columns provide the ratio of each index in each year to that for 1970 (1970 = 1.00).

Thus, overall at the municipal scale, the Gini and the CoP are revealed as showing the most distinct types of information when considered in relation to changes over each census decade among all of the three largest CMAs simultaneously, as well as over the entire study period but with each CMA analyzed separately.

The indices of income segregation among municipalities presented in Table 23 can be compared with the non-spatial indices of inequality and polarization reported in Tables 2 and 3, to produce indices of municipally based spatial sorting (see Table 24). As in the analysis of neighbourhood-based sorting discussed above, these indices are calculated simply by dividing each index calculated using spatial units by the same index calculated non-spatially among all households in a metropolitan area. The resulting sorting index ranges from 0.00 to 1.00, and can be read as the proportion of total inequality that is expressed spatially. As in the neighbourhood sorting analysis, this method is useful for ascertaining the timing of shifts in intermunicipal segregation, and CMAs with more spatial units are expected to exhibit higher measures of sorting. As with the previous discussion of neighbourhood-based sorting, none of the measures produced in this analysis is decomposable, and so these indices must be taken as merely indicative.

An interesting divergent pattern arises from the results (see Table 23). All three of Canada's global cities are revealed to exhibit increasing income polarization over the period, registering their highest levels in 2005. However, there are mixed results concerning the shape and direction of the trajectories of municipally based income sorting under the different measures of inequality. The Gini (and CV2) indices suggest that 2000 most often marked the point of highest intermunicipal sorting. In contrast, the EXP measure, which is more sensitive to the lower end of the distribution, shows the degree of sorting as highest in 1970 and declining over time for each CMA (from 1980 onwards in Vancouver, as there is no 1970 PUMF data for Vancouver).

In 1970 the poor were highly concentrated in the central cities of all three metropolitan areas, after which they were incrementally dispersed outward by gentrification (Walks and Maaranen, 2008a). The gentrification of the metropolis is thus shown to lead to greater intermunicipal socio-spatial polarization over time, even if not always socio-spatial inequality. Of course, as in the neighbourhood-based sorting analysis, it is not clear how much trust to place in these measures of intermunicipal sorting. However, they appear reasonable and fit within salient explanations and understandings of contemporary metropolitan restructuring.

Summary

This section has demonstrated that income has become more segregated among neighbourhoods in Canadian metropolitan areas since 1970, reaching a peak in most metropolitan areas in the most recent census for which data are available (2005). There is a marked and growing divide between poorer and wealthier neighbourhoods in virtually every metropolitan area, as made clear by each of the different indices of socio-spatial inequality and polarization used to measure neighbourhood income segregation.

However, the pictures painted by indices of socio-spatial inequality and polarization do not mirror each other. Polarization and inequality provide distinct sets of information about the distribution of income among neighbourhoods and municipalities. The Coefficient of Polarization (CoP)

introduced in this report performs well alongside other measures of polarization in describing diverging neighbourhood fortunes, and provides distinct information in comparison with measures of socio-spatial inequality. Because the other measure of polarization appropriate for use with spatially aggregated data in analyzing neighbourhood income segregation – the WT index – provides an unbalanced sensitivity to the upper end of the income spectrum, this report recommends employing the Coefficient of Polarization (CoP) when a more balanced analysis of income polarization is required.

Income has become more polarized, and in some cases, more unequally distributed among municipalities in Canada's three largest metropolitan areas. The discrepancy in the trajectories of the coefficients between measures of socio-spatial inequality sensitive to the lower, middle, and upper ends of the income distribution suggests that gentrification has simultaneously led to the dispersal of low-income households as well as to the increased segregation of middle and especially high-income households by municipality. While measures of socio-spatial inequality provide a mixed picture of such a trajectory, the indices of socio-spatial polarization are clear in confirming an ever more polarized distribution of income across municipalities in Canada's global cities.

A number of implications flow from these findings. One concerns the processes producing increasing socio-spatial inequality and polarization, and what might be done to address or reverse them. Clearly, a significant portion of increasing income segregation (whether measured as inequality or polarization) is being produced in the labour market. Therefore policies meant to better equalize labour market incomes and opportunities would go some way to reduce socio-spatial inequalities. At the same time, the incomes of immigrants have been declining and poverty is becoming increasingly racialized in a number of cities. Policies meant to address this issue will be of particular benefit in preventing the further social fragmentation and segregation of the city. Another implication relates to the effects of increasing neighbourhood- and municipal- based income segregation. This raises the issue of "neighbourhood effects," in which the neighbourhood itself, because of concentrations of poverty and declining income mix, becomes an influence on life chances and opportunities. There is debate regarding the merits of targeting policy responses at the amelioration of potential neighbourhood effects instead of labour market or other inequalities (Slater, 2013), and past literature on this issue in Canada has questioned whether neighbourhood effects have any significant results (Oreopoulous, 2008). The rate of increase in measured levels of socio-spatial inequality and polarization warrants a fresh look at such issues, and particularly a scholarly examination of the merits of people-based versus place-based policies.

The question of whether and to what degree increased spatial sorting of households by income might be producing greater segregation among neighbourhoods and municipalities, however, remains open. While much of the analysis points to the growth of sorting processes, the different indices produce widely varying pictures, and it is difficult to piece together a coherent trajectory of sorting experiences. Further research on this issue is warranted.

6. Income Inequality and Polarization Within Neighbourhoods and Municipalities

The indices of income inequality and polarization calculated in previous sections among households, neighbourhoods (census tracts), or municipalities can also be calculated for households residing within neighbourhoods and municipalities. Often it is assumed incorrectly that incomes within spatial units like neighbourhoods are relatively homogenous, and the diversity of incomes within spatial units can be masked by an analysis of income segregation that compares average incomes. However, the data and methods required for an analysis of within-unit inequality (and polarization) are more specialized. Importantly, raw data are rarely available for individual households (or families, income earners, etc.) within spatially aggregated units as census tracts or municipalities. The microdata (PUMF) released by Statistics Canada, for instance, do not code for either census tract nor municipality, for reasons related to privacy, and so it is not possible to place the individual household records in the PUMF within census tracts or municipalities. Census data are, however, typically released with households grouped into income ranges within spatially restricted areas such as census tracts or municipalities.

While clearly limiting, this arrangement facilitates the calculation of key indices of inequality and polarization. However, as in the analysis in Chapter 5 dealing with measures of income segregation, neither the Wolfson nor the ER indices can be calculated using income data structured this way (with households grouped into different income ranges), because the numbers of households in each income range vary (just as they do within census tracts and municipalities, as discussed in Chapter 5 in relation to the inability to calculate these indices using census tracts or municipalities as the units of analysis). However, both the WT and the CoP indices of polarization can be calculated using such data.

This chapter analyzes the level of inequality and polarization within spatial units. The data in this section derive from custom census data containing the numbers of households classified into inflation-adjusted income ranges, as well as the average and median household incomes of households in each range. The data must be structured in this way to calculate the indices of inequality and polarization within spatial units. This chapter first examines patterns of intra-neighbourhood inequality and polarization, and then moves to examine indices of intramunicipal inequality and polarization. This analysis is confined to the three largest metropolitan regions in Canada, given the limited number of municipalities in other metropolitan areas, as well as to space constraints related to the need to present the results of this analysis in map form.

Income Inequality and Polarization *within* Neighbourhoods

This section examines levels of, and changes to, intraneighbourhood income inequality and polarization as expressed between households. Note that it is not clear from the scholarly literature how to interpret very localized levels of income inequality or polarization. On the one hand, such measures indicate greater local differences in household incomes, which in and of themselves are troubling, as they suggest divergence in the ability of different households living near each other to attain similar standards of living and to afford similar baskets of consumption items. When local incomes diverge, households may resent or feel threatened by each other, interact less or in more superficial or conflicting ways, and/or seek to differentiate and inoculate themselves by various means (sending their children to different schools, etc.). Alternatively, they may seek to build bridges, perhaps creating cross-class alliances and local social movements based on neighbourhood issues and needs, as Castells (1978) suggested should occur under welfare-state capitalism.

There are as yet no conclusive findings in the academic literature on what diverging incomes at the local level might mean or how they might play out. Indeed, it seems reasonable to surmise that how social interaction is expressed at the local level depends on a host of contingent factors that cannot be predicted in advance, and that may have to do with more than merely income or class.

As well, increasing inequality and polarization do not occur in a regional vacuum, but react to and interact with (and against) general socio-structural trends. Thus localized inequality and polarization could just as much be a product of changing income structures as of the active spatial sorting of households. If all neighbourhoods were internally becoming less equal (and/or more polarized), while the level of equality (and/or polarization) amongst all households across the entire metropolitan area remained unchanged, this trend would indicate greater class mixing at the local level. If the rate of increase in intraneighbourhood inequality or polarization was lower than that among all households at large, this trend could indicate greater sorting of households into different neighbourhoods based on socio-economic status, which most scholars would consider a negative development, on balance. However, class-based sorting into different neighbourhoods could be interpreted as beneficial for producing greater levels of neighbourliness, understanding, shared experiences, and perhaps even enhanced levels of local (but not regional) social capital. It is an empirical question as to whether any of these processes might be present in neighbourhoods undergoing increasing (or decreasing) levels of intraneighbourhood income inequality, and an analysis of trends and levels of income distribution cannot on their own shed light on which of these processes might be present.

All three indices of income inequality, and two of the indices of polarization – the WT and coefficient of polarization (CoP) – can be calculated for each census tract (used here as proxies for neighbourhoods). This information is not easily communicated in tabular form, since there are more than 800 census tracts in each of Montréal and Toronto, and over 300 in Vancouver. It is thus much easier to present this information in map form (see below). However, to get a sense of the general trajectory involved in intraneighbourhood levels of income inequality and polarization in the three largest CMAs, Table 25 summarizes the main trends in intratract inequality and polarization.

Table 25: Average Level of Household Income Inequality and Polarization within Neighbourhoods, Three Largest CMAs (Montréal, Toronto, and Vancouver)

INEQUALITY	1970	1980	1990	2000	2005	1970*	1980*	1990*	2000*	2005*
Gini CR										
Montréal	0.407	0.423	0.427	0.428	0.432	1.00	1.039	1.049	1.052	1.061
Toronto	0.410	0.407	0.393	0.415	0.429	1.00	0.991	0.958	1.012	1.046
Vancouver	0.425	0.415	0.411	0.424	0.440	1.00	0.977	0.967	0.999	1.035
EXP										
Montréal	0.437	0.445	0.444	0.450	0.452	1.00	1.018	1.017	1.031	1.035
Toronto	0.428	0.432	0.434	0.448	0.455	1.00	1.010	1.014	1.047	1.064
Vancouver	0.436	0.439	0.437	0.448	0.455	1.00	1.008	1.004	1.029	1.045
CV2										
Montréal	0.625	0.638	0.659	0.699	0.727	1.00	1.021	1.055	1.119	1.163
Toronto	0.600	0.620	0.643	0.723	0.771	1.00	1.034	1.072	1.205	1.285
Vancouver	0.649	0.660	0.661	0.725	0.773	1.00	1.017	1.019	1.116	1.191
POLARIZATION	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
WT										
Montréal	0.648	0.683	0.694	0.712	0.721	1.00	1.053	1.071	1.099	1.111
Toronto	0.627	0.655	0.672	0.717	0.742	1.00	1.043	1.071	1.143	1.183
Vancouver	0.646	0.668	0.676	0.712	0.735	1.00	1.033	1.045	1.101	1.136
CoP										
Montréal	0.554	0.598	0.611	0.627	0.622	1.00	1.080	1.104	1.133	1.123
Toronto	0.517	0.560	0.577	0.635	0.661	1.00	1.082	1.116	1.228	1.277
Vancouver	0.560	0.589	0.582	0.637	0.665	1.00	1.052	1.039	1.138	1.187

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982

* These five columns provide the ratio of each index in each year to that for 1970 (1970 = 1.00).

There is a virtually universal trend toward greater average levels of intraneighbourhood income inequality and polarization with each successive decade, regardless of the measure. The rise in levels of intraneighbourhood inequality and polarization are in keeping with the increases in non-spatial measures of inequality and polarization noted in Chapter 4. The growth of household-level income inequality is thus not only being expresssed in greater income segregation among different neighbourhoods in each metropolitan area (Chapter 5), but also in greater income differentiation among households within the same neighbourhoods.

One potential way of ascertaining how changing income distributions at the local level interact with regional changes is to compare intraneighbourhood indices of income inequality/polarization to levels of inequality/polarization measured aspatially among households at the metropolitan

scale (Table 26). This is a similar exercise to that reported in Tables 16 through 22 in Chapter 5 above). The coefficients listed in Table 26 are simple ratios of the intraneighbourhood measures reported in Table 25 to those aspatial measures reported in Tables 3 and 4. While the ratios themselves have no intrinsic meaning (because none of the measures reported are decomposable), the trajectory of change in the ratios indicates something about the processes at work in the expression and sorting of household income inequality.

Table 26: Ratio of Intraneighbourhood Inequality/Polarization to General (aspatial) Household Inequality/Polarization, Montréal, Toronto, and Vancouver

INEQUALITY	1970	1980	1990	2000	2005
GINI CR					
Montréal	1.170	1.102	1.078	1.065	**1.029**
Toronto	1.202	1.131	1.042	1.092	**1.019**
Vancouver		1.089	1.057	1.082	**1.023**
EXP					
Montréal	1.256	0.991	**0.980**	0.989	0.985
Toronto	1.255	0.982	**0.973**	1.004	0.989
Vancouver		0.980	**0.969**	0.993	0.993
CV2					
Montréal	0.851	0.868	**0.850**	0.922	*
Toronto	0.834	0.899	**0.876**	1.027	*
Vancouver		0.904	**0.864**	0.993	*
POLARIZATION	1970	1980	1990	2000	2005
WT					
Montréal	0.982	0.953	0.948	**0.943**	0.944
Toronto	0.975	0.963	**0.959**	0.992	0.974
Vancouver		0.945	**0.936**	0.963	0.956
CoP					
Montréal	0.967	0.899	0.893	**0.866**	0.904
Toronto	0.933	0.911	**0.900**	0.914	0.944
Vancouver		0.895	0.890	**0.882**	0.937

Notes: The above ratio for each cell is calculated as the coefficients reported in the corresponding cell in Table 25 divided by the corresponding cell in Table 3 or 4. Bolded values indicate the lowest ratios for each CMA/measure.

* Values of the coefficient of variation squared indicating (aspatial) household inequality at the metropolitan scale were not reliable when calculated using the new hierarchical file for 2005, and thus could not be used to calculate the ratio here.

Two distinct patterns are worth noting. First, when the ratio is constructed comparing the respective Gini coefficients (intraneighbourhood/metro-level Ginis), the ratio declines consistently over time. Since both general (aspatial) and intraneighbourhood (local) household inequality were growing over this time, this result indicates that overall household income inequality grew faster than intraneighbourhood inequality. This pattern is consistent with the finding that inter-neighbourhood income segregation also grew. That is, while income mix within neighbourhoods grew over time, the rate of change was not enough for neighbourhoods to fully absorb the increasing income dispersion, with the remainder expressed in growing class segregation.

A second pattern is evident when the ratio is calculated using each of the other measures of inequality or polarization. For both the EXP and CV2 measures, the ratio of intraneighbourhood to general household inequality declines until 1990, and then begins rising again, albeit slowly. Meanwhile, when the ratio is constructed using either of the two measures of income polarization, the ratio is lowest in either 1990 or 2000, rising unevenly afterward. This pattern suggests that the rate of change in inequality and polarization at the metropolitan (aspatial) scale increased faster than that within neighbourhoods until some point in the 1990s: neighbourhoods were not able to internalize all of the increase in general income inequality and polarization through this point. However, after this point, intraneighbourhood income heterogeneity began to increase faster than income inequality among all households. That is, after some point in the 10-year period between 1990 and 2000, neighbourhoods themselves began absorbing at least some of the growth in inequality at a faster rate than the increase in income inequality and polarization.

While Chapter 5 clearly demonstrates that this rate of absorption was not strong enough to prevent income segregation from increasing, it does suggest that an increasing amount of income inequality and polarization is being expressed within neighbourhoods since the 1990–2000 decade. Around this time, in both Toronto and Vancouver, income declines within the (old) inner city as a whole changed into income increases relative to the rest of the region (see Table 10.3 in Walks, 2010). Shifts in the ratios of intraneighbourhood-to-metropolitan-level income inequality and polarization could be related to the gentrification of the inner city and the movement and displacement of lower-income households into what previously were relatively homogenous suburban neighbourhoods. The evidence is consistent with the filtering down of the older suburbs.

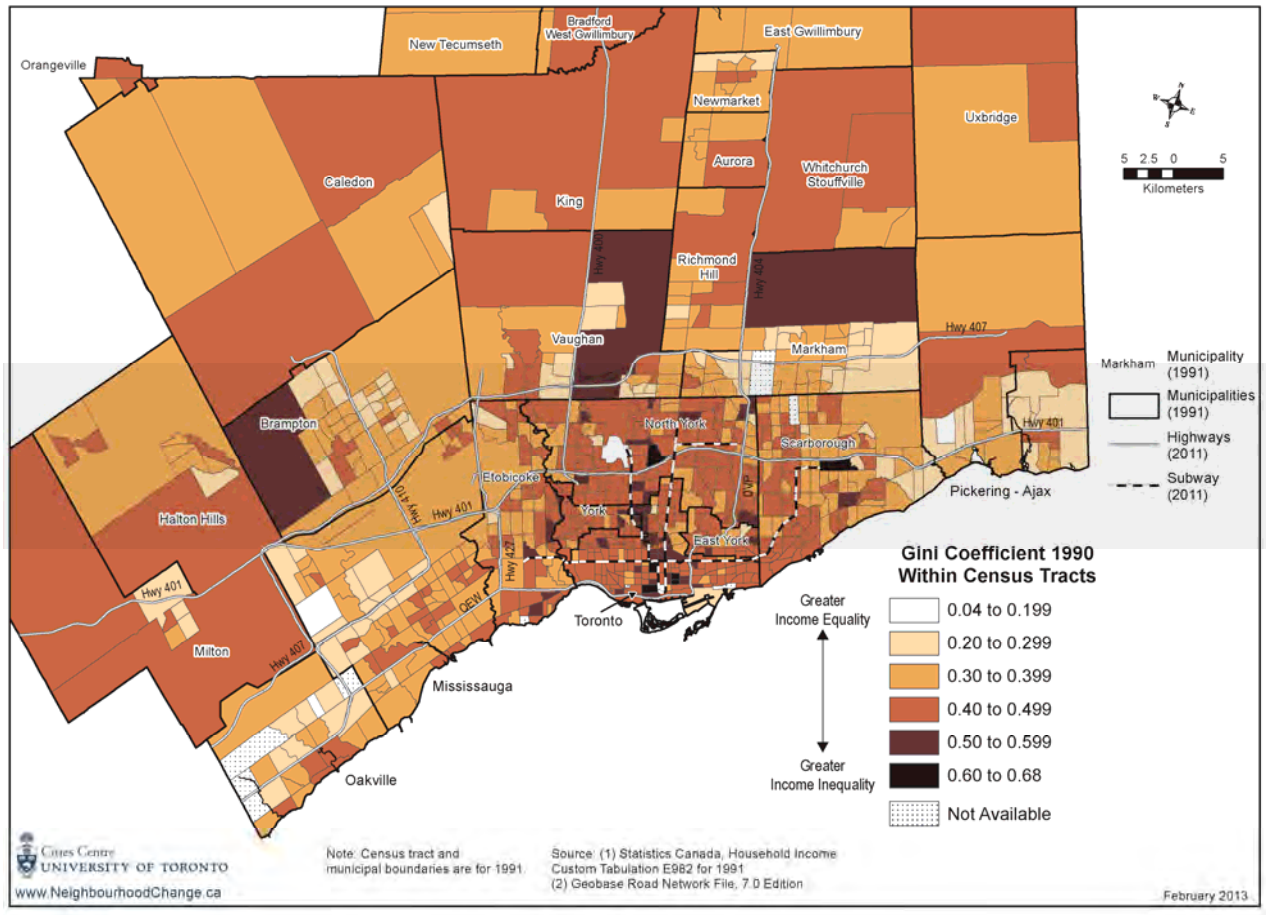
Patterns of Within-Neighbourhood Inequality and Polarization

The following section describes the spatial patterning of the measures of income inequality and polarization within neighbourhoods, with census tracts used as proxies for neighbourhoods, as well as the changes in levels of localized income inequality and polarization within neighbourhoods. Due to space constraints, this section will focus on only two such measures: the Gini coefficient (representing the best measure of income inequality) and the CoP (representing the better of the two available measures of polarization). Also, as each metropolitan area witnessed considerable expansion since the 1970s in both size and population (and, in turn, neighbourhoods and census tracts), the following maps show the pattern of intraneighbourhood income diversity, starting in 1990. Many parts of the outer areas of each CMA had not been built and thus were not included as census tracts in 1971 or 1981.

Maps showing the levels of, and changes in, neighbourhood income inequality and polarization reveal a settlement structure that is becoming more unequal at multiple scales simultaneously. Figure 12 displays the level of income inequality, as measured by the Gini coefficient, for census tracts in Toronto in 1990. For the vast majority of tracts in 1990, Gini values fall between 0.30 and 0.50, indicating a moderate level of local inequality, although a number of tracts also reveal Ginis below 0.30 (suggesting relatively lower levels of localized inequality). In general, it is newer suburbs (Mississauga, Oakville, Brampton, Markham, and parts of Scarborough) that reveal the lowest levels of inequality in 1990, while central areas of Toronto reveal more local inequality.

The highest levels of intraneighbourhood inequality (Ginis above 0.50) are typically found in the poorest census tracts in the inner city (including the Regent Park and Moss Park social housing developments, and areas near Queen Street West) and areas in the inner suburbs with both low-income high-rise apartments and newer condominium buildings (including Scarborough Town Centre, and the "Six Points" area in Etobicoke near the Islington subway station). Also revealing high levels of inequality are traditionally wealthy neighbourhoods in old Toronto where apartments are located, including Yorkville, neighbourhoods along Yonge Street near Rosedale, and Forest Hill, as well as a number of exurban census tracts.

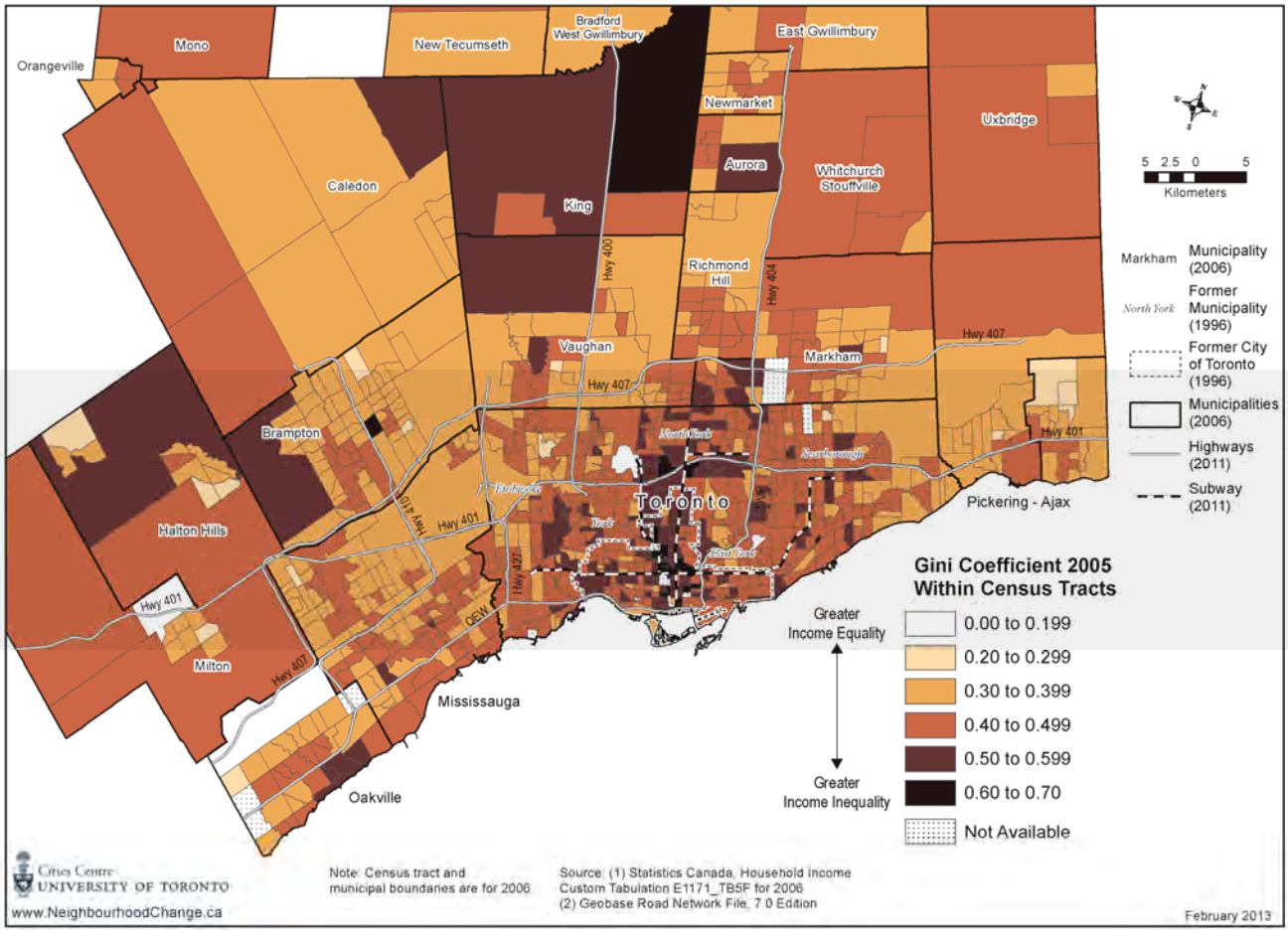
Figure 12: Gini Coefficient of Income Inequality, within Neighbourhoods, Toronto CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

The level of intraneighbourhood inequality generally grew over the intervening 15 years to 2005 (see Figure 13). Many of the census tracts that in 1990 had Gini coefficients in the 0.50–0.59 range indicated levels of inequality above 0.60, while very few census tracts in 2005 exhibited levels of inequality below 0.30. However, the general pattern for the most part persisted, with the newer suburbs continuing to exhibit lower levels of inequality than those in older areas of the city, while areas in central Toronto showed the highest levels. In both years, exurban areas that were witnessing an influx of urban development as well as rural forms of gentrification (the purchasing of rural properties as hobby farms, the transformation of agricultural lands into large estates with little farming continuing on the land) reveal high levels of within-tract inequality. This exurban fringe has been moving out to the edge of the region over time, with those exurban areas showing the highest levels of inequality in 2005 generally further from the core than in 1990.

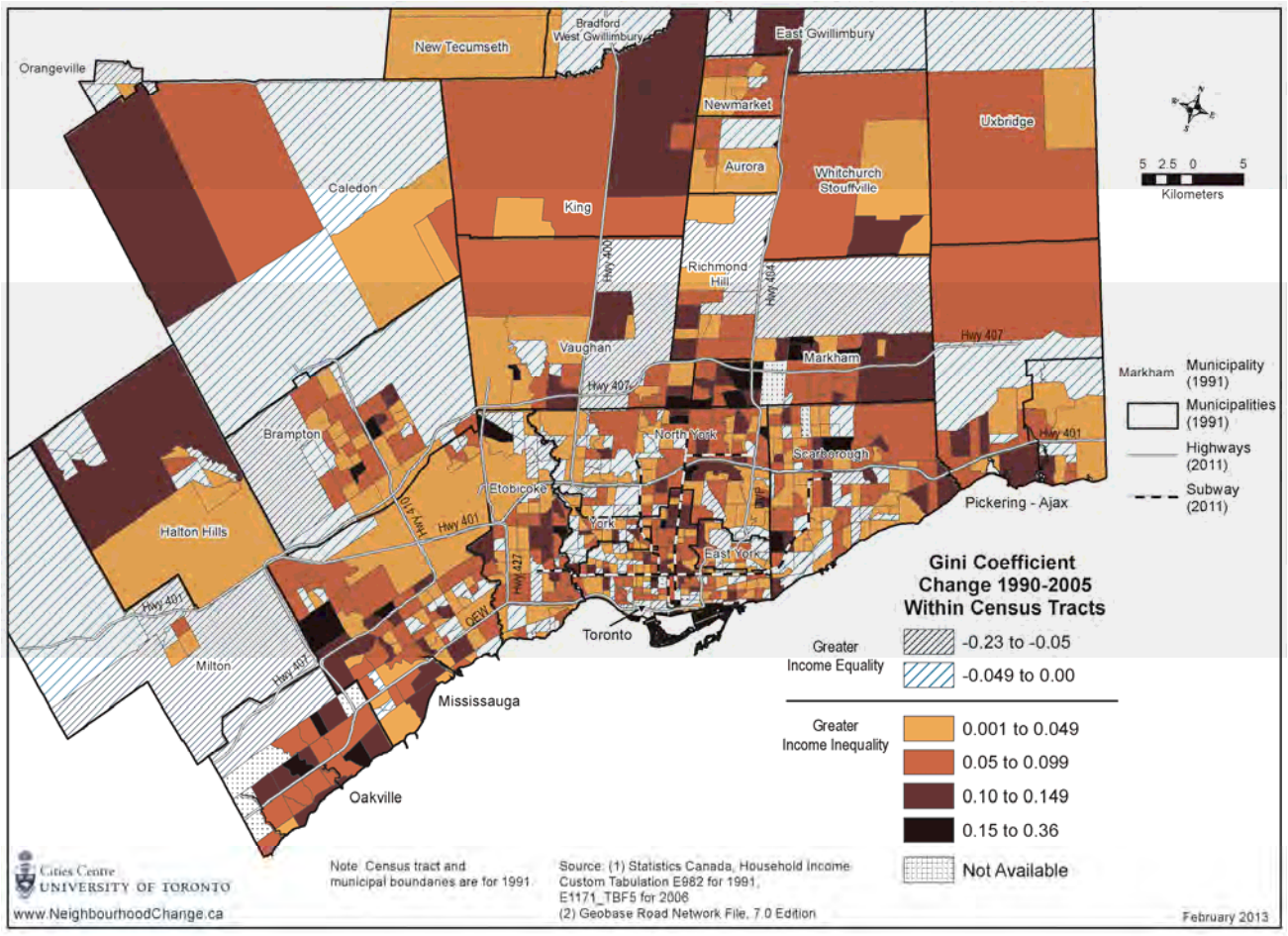
Figure 13: Gini Coefficient of Income Inequality, within Neighbourhoods, Toronto CMA, 2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

However, there is also a clear pattern of change to the areas with high and low levels of intra-neighbourhood inequality (see Figure 14). Most census tracts in the outer suburbs, in places such as Oakville, Mississauga, Brampton, Richmond Hill, Markham, and Pickering, as well as newer sections of North York and Scarborough, saw increases in local levels of inequality. Many gentrifying areas of the inner city, including Leslieville and High Park/Bloor West Village, witnessed increases in intraneighbourhood inequality. Meanwhile, inequality actually declined in many exurban tracts bordering existing outer suburban developments, as well as in many of the areas of the inner suburbs that have concentrated the poor, including areas with low-rent high-rise rental apartments, such as the Jane-Finch neighbourhood, much of Rexdale, Thorncliffe Park, Flemingdon Park, and Oakridge and Birchcliff in Scarborough. Inequality also declined where new condominium buildings were constructed along the waterfront in downtown Toronto – places where little formal housing existed prior to redevelopment. However, overall, inequality was far more likely to increase than to decrease within census tracts in the Toronto CMA over the period.

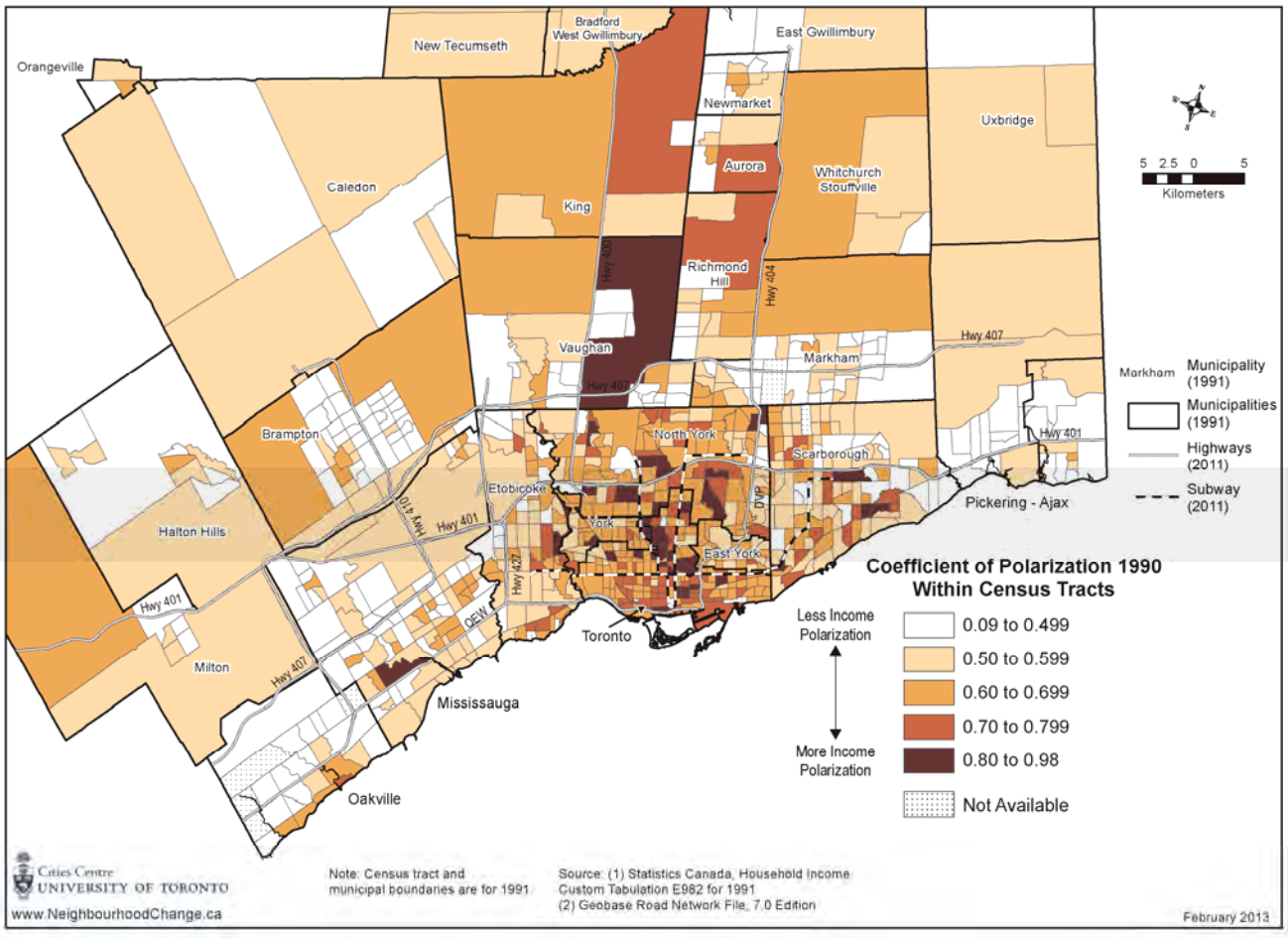
Figure 14: Change in the Gini Coefficient within Neighbourhoods, Toronto CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

The pattern for intraneighbourhood income polarization shows a number of similarities with that for inequality, but with some key distinctions. Figure 15 shows the general pattern of income polarization, as measured by the coefficient of polarization (CoP) in 1990. It is immediately evident that while there is a clear correlation between the level of inequality (Gini) and polarization (CoP) within census tracts, the difference between established areas of the city and the newer suburbs is even more stark: localized levels of polarization are across-the-board higher within central areas of Toronto than in the newer neighbourhoods in the outer suburban municipalities (particularly Brampton, Mississauga, Markham, Oakville, and Pickering). Within these outer suburban municipalities, it is typically the prewar downtowns that exhibit higher levels of polarization (the old core of Brampton, downtown Oakville, old Markham, etc.), whereas the new subdivisions reveal consistently low levels of polarization.

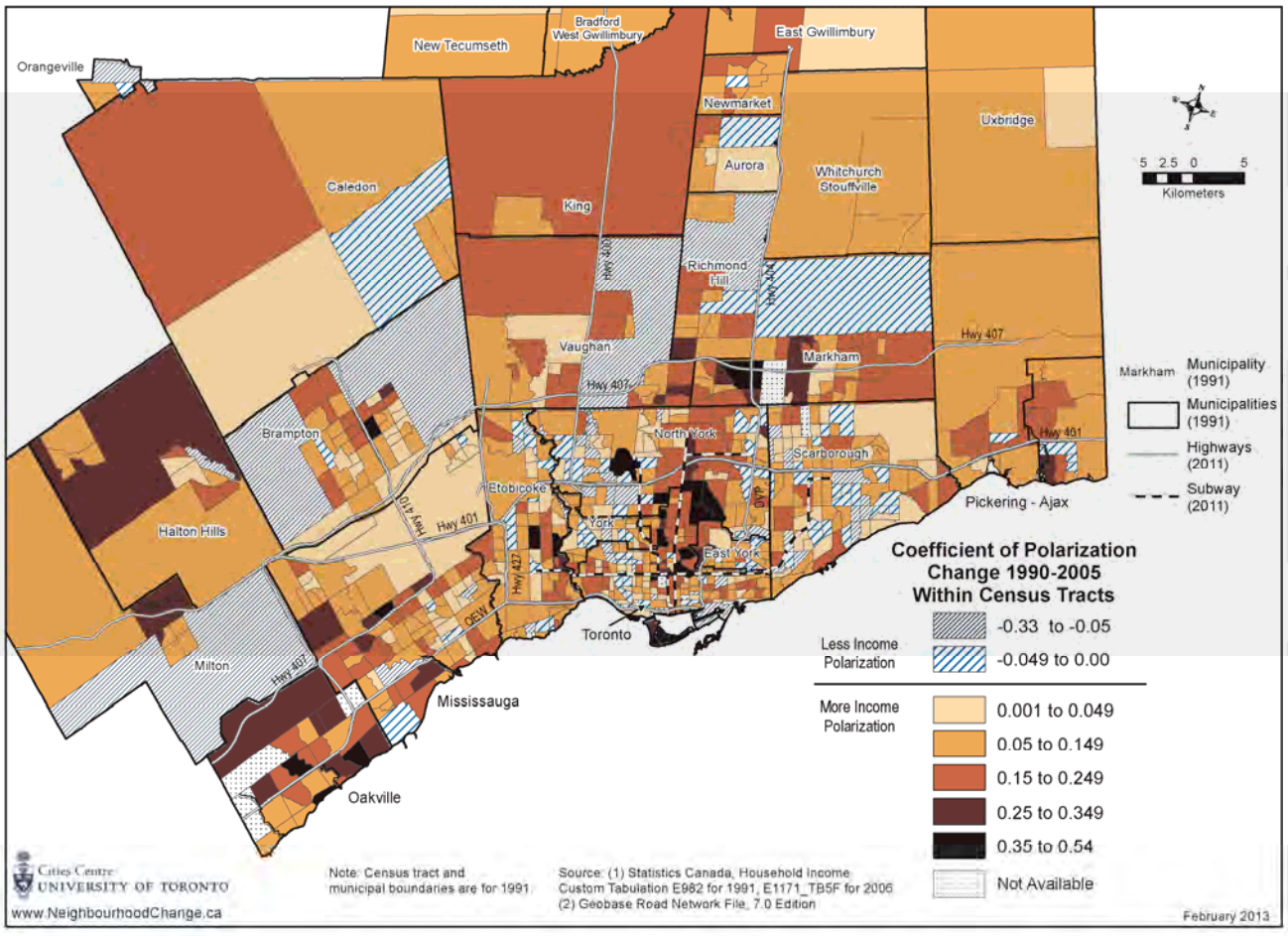
Figure 15: Coefficient of Polarization (CoP), within Neighbourhoods, Toronto CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

In the 15 years between 1990 and 2005, income polarization trended upwards in the majority of census tracts within the Toronto CMA. By 2005, the level of polarization had grown significantly, particularly in many of the wealthier tracts, as well as in the gentrifying inner city, and in many areas of the suburbs, including the newer outer suburbs (see Figure 31 in the Appendix for a map showing the spatial patterning of intraneighbourhood polarization in 2005). Figure 16 shows how intraneighbourhood income polarization has changed between the two time periods. Clearly, census tracts that were traditionally high-income have witnessed the greatest increase in levels of localized income polarization (in Toronto in neighbourhoods such as Rosedale, Forest Hill, and the Bridle Path, and in downtown and east Oakville). However, polarization has also increased substantially in the outer suburbs.

Figure 16: Change in Income Polarization (CoP) within Neighbourhoods, Toronto CMA, 1990–2005



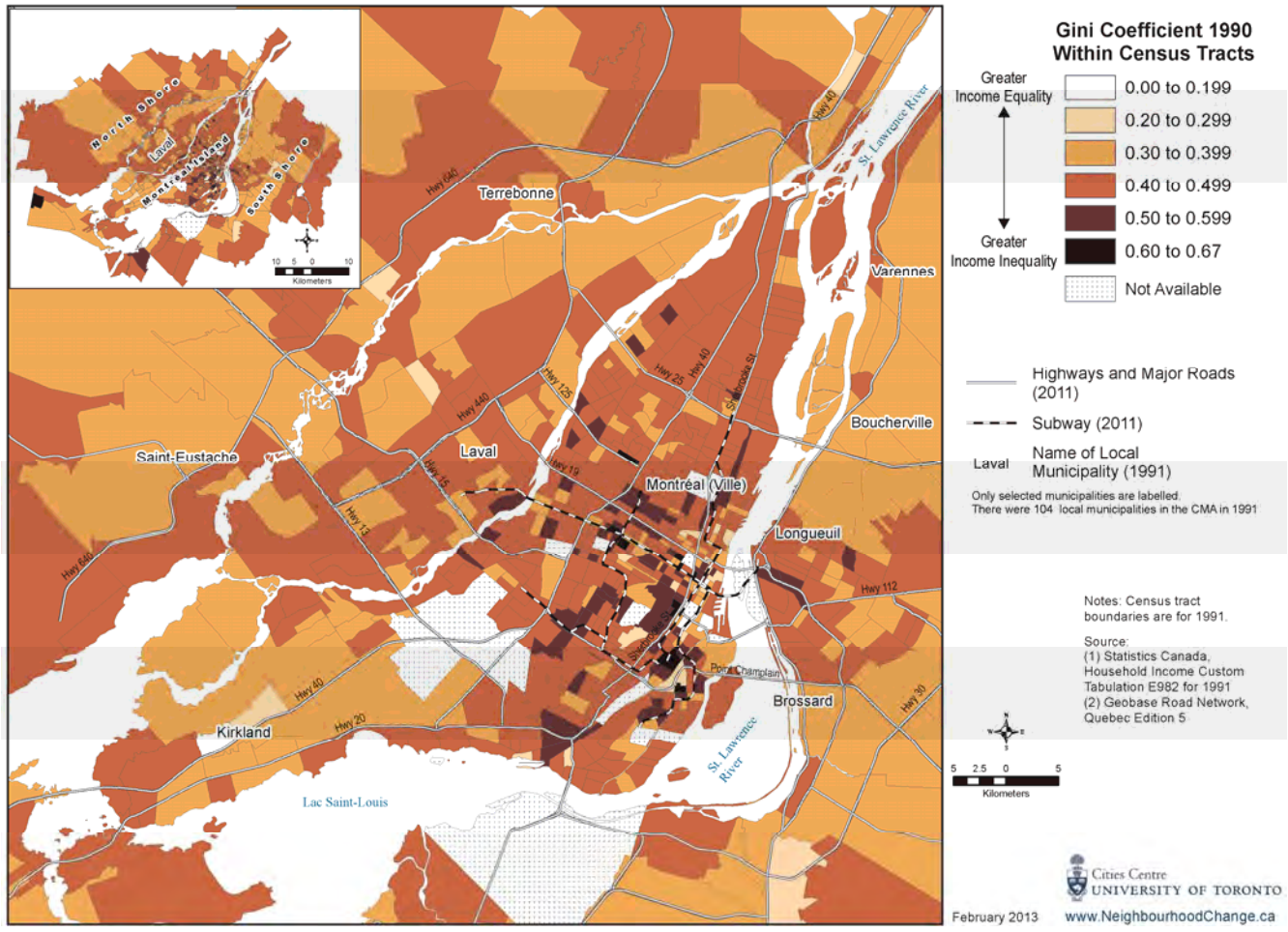
Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Meanwhile, polarization within neighbourhoods declined in many of the poorest neighbourhoods, particularly those located along what is often in Toronto called the "U" of poverty that includes the downtown and areas to the northeast and northwest, extending into Scarborough

and northern Etobicoke (Rexdale) following the lines of railway tracks. These areas have filtered down and become less polarized as upper-middle income households have been replaced with lower and middle-income households.

The spatial patterning of intraneighbourhood income inequality in Montréal reveals higher levels of inequality close to the centre of the city in 1990, particularly near the downtown and in neighbourhoods close to the Montréal subway routes, similar to the general pattern evident in Toronto (Figure 17). However, unlike the situation in Toronto, the suburbs of Montréal – both those on the Island of Montréal as well as those in Laval and on the north and south shores – reveal generally higher levels of income inequality. In relative terms, income inequality is distributed more evenly across Montréal's metropolitan landscape, leaving fewer census tracts with either very low or very high levels of inequality, at least in comparison with Toronto. In Montréal, higher levels of localized inequality are slightly more prevalent in neighbourhoods that have incomes below the average, rather than in wealthy neighbourhoods (such as those in the English-speaking west Island suburbs).

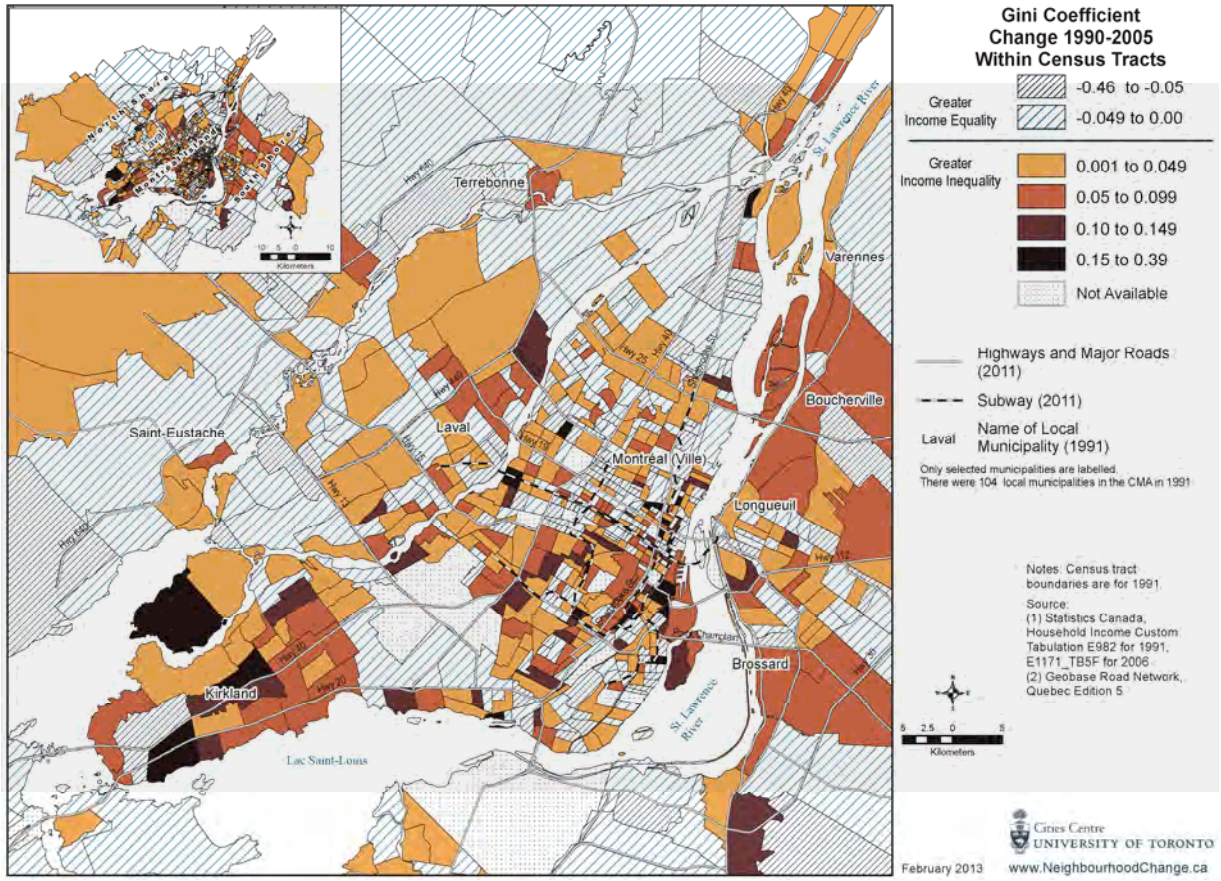
Figure 17: Gini Coefficient of Income Inequality, within Neighbourhoods, Montréal CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

There is also a spatial pattern to the changes in levels of income inequality within neighbourhoods over the 1990 to 2005 period (Figure 18). Census tracts that witnessed increases in local-level inequality are foremost found in and around the downtown (including the Port of Montréal area and Hochelaga), in areas surrounding and nearby the mountain (Outremont, Mont Royal, Westmount, Hampstead, and the Snowdon neighbourhood) and strongly across the west Island. More limited and scattered increases are also found in parts of Brossard, Boucherville, Longueuil, Montréal Nord, Montréal Est, and south-central Laval. However, at the same time, Montréal is one of the few CMAs to see declining levels of local income inequality in a significant number of neighbourhoods. Many of the newer suburban subdivisions built at the edges of the metropolitan area, as well as newer areas at the east end of Montréal Island, reveal declining levels of intraneighbourhood income inequality. (See Figure 32 in the Appendix for a map of the level of income inequality in Montréal in 2005).

Figure 18: Change in the Gini Coefficient of Income Inequality within Neighbourhoods, Montréal CMA, 1990–2005

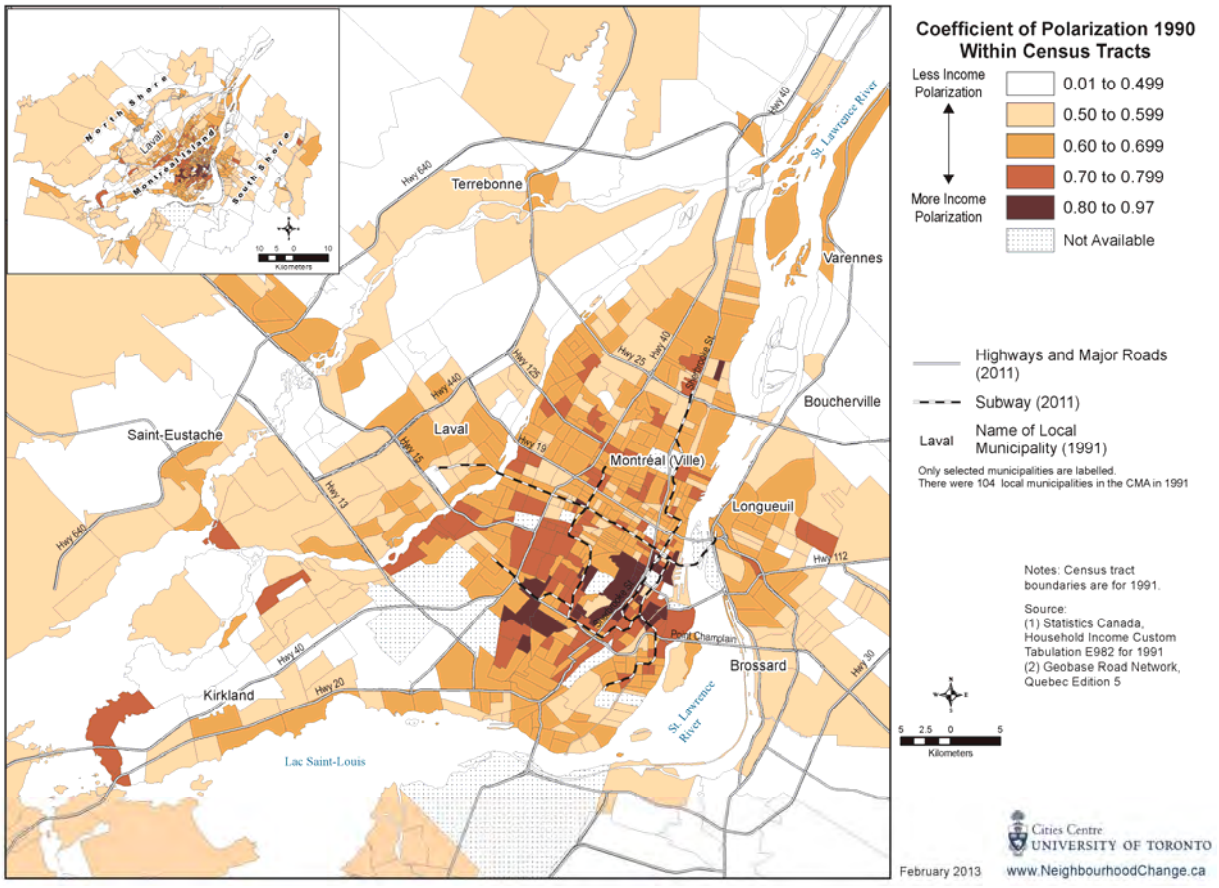


Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

The patterning of intraneighbourhood income polarization, as measured by the CoP, reveals a much more focused concentration of localized polarization near the downtown (including the

Port of Montréal) and around the mountain (particularly the southern and western areas), in comparison with that for inequality (Figure 19). Thus, as in Toronto, localized income polarization is much more a feature of the older inner city and the central business district. Likewise, many of the same areas that exhibited high levels of polarization in 1990 also witnessed the greatest increases in polarization over the 1990-2005 period (Figure 17). This includes areas within and around the central business district, the Port area, and parts of the Plateau and Mont Royal. As well, matching the pattern for localized income inequality change, areas on the west Island (particularly Kirkland, Baie D'Urfé, and Saint-Anne-de-Bellevue) also exhibit significant increases in intraneighbourhood levels of income polarization, albeit from low levels in 1990.

Figure 19: Coefficient of Polarization (CoP) within Neighbourhoods, Montréal CMA, 1990

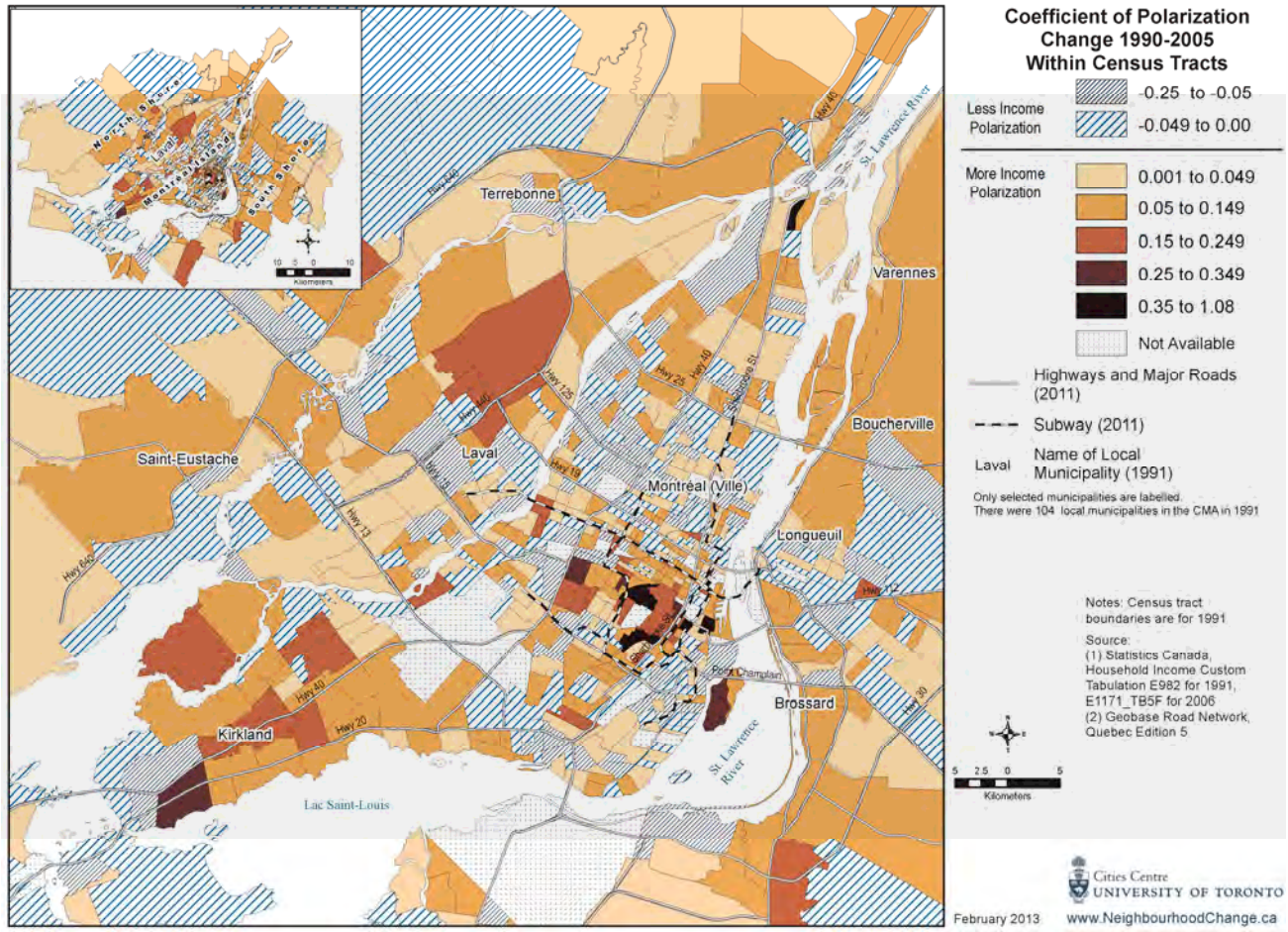


Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

At the same time, as in the patterns for local income inequality, Montréal saw within-neighbourhood levels of polarization decline in many census tracts (Figure 20). This is true of many tracts on the east Island (which began the period with generally higher levels of income polarization), as well as more established areas in Laval, Longueuil, and a number of lower-density north-shore communities. This has left Montréal with a very specific core- or mountain-centred spatial patterning to within-neighbourhood levels of income polarization in the mid-

2000s (see Figure 33 in the Appendix for a map showing the spatial patterning of local income polarization in the Montréal CMA in 2005).

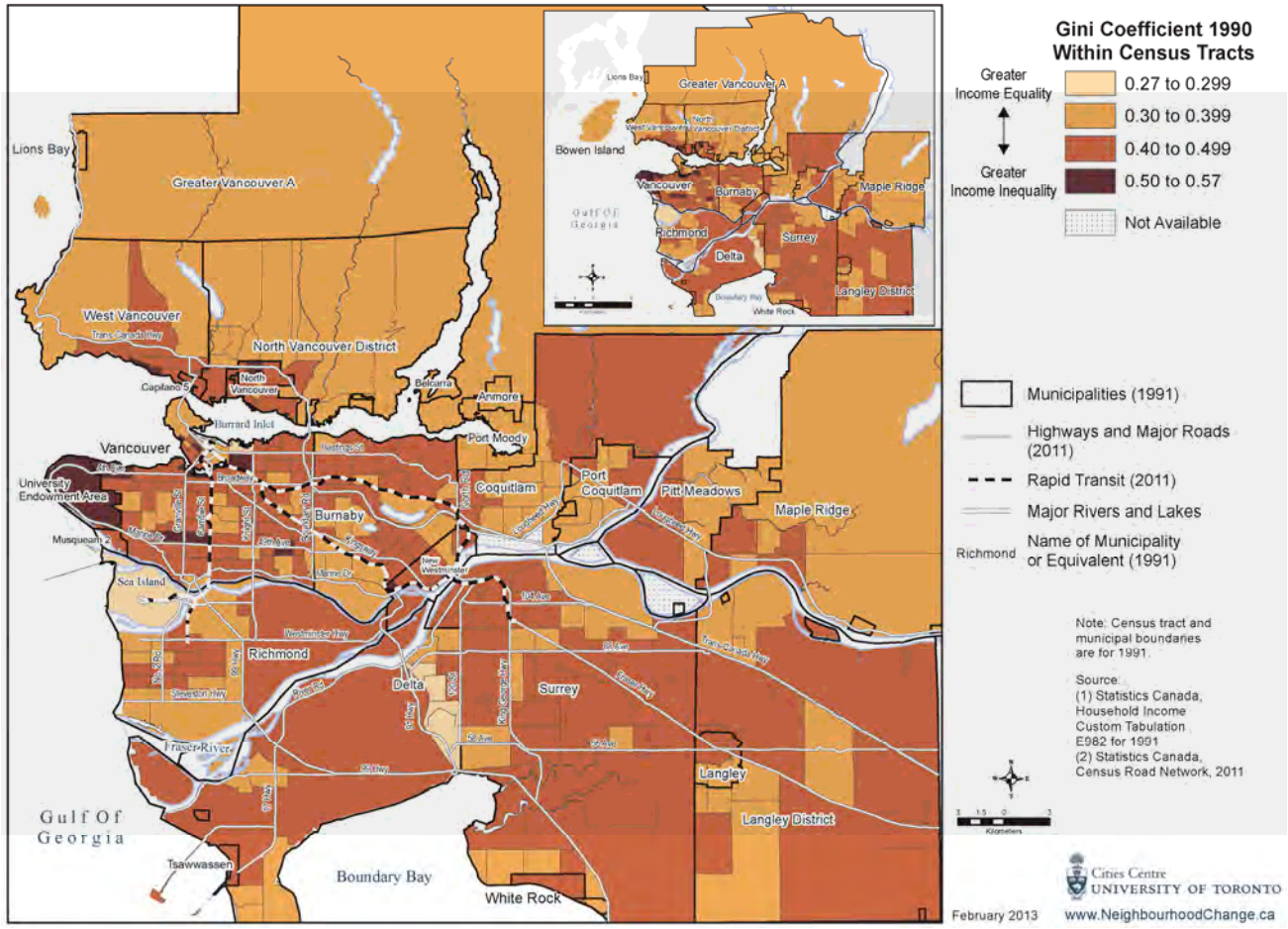
Figure 20: Change in Income Polarization (CoP) within Neighbourhoods, Montréal CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

In Vancouver, only a few tracts reveal either very high or very low Gini coefficients of intra-neighbourhood income inequality in 1990 – that is, below 0.30 or above 0.50 (see Figure 21). Those few tracts with levels above 0.50 include Strathcona (near the Downtown Eastside), parts of Point Grey, the University Endowment Lands, and North Vancouver City, scattered tracts in Kerrisdale, Killarney, the downtown west end, and the False Creek community. It might be noted that False Creek was intended to differ from the usual low-income housing project, in that it specifically catered to a mix of incomes. Hence it may not be that surprising that it shows up as one of Vancouver's less equal neighbourhoods. There are only slight differences in the levels of intraneighbourhood inequality between those areas located within the City of Vancouver and the suburban municipalities.

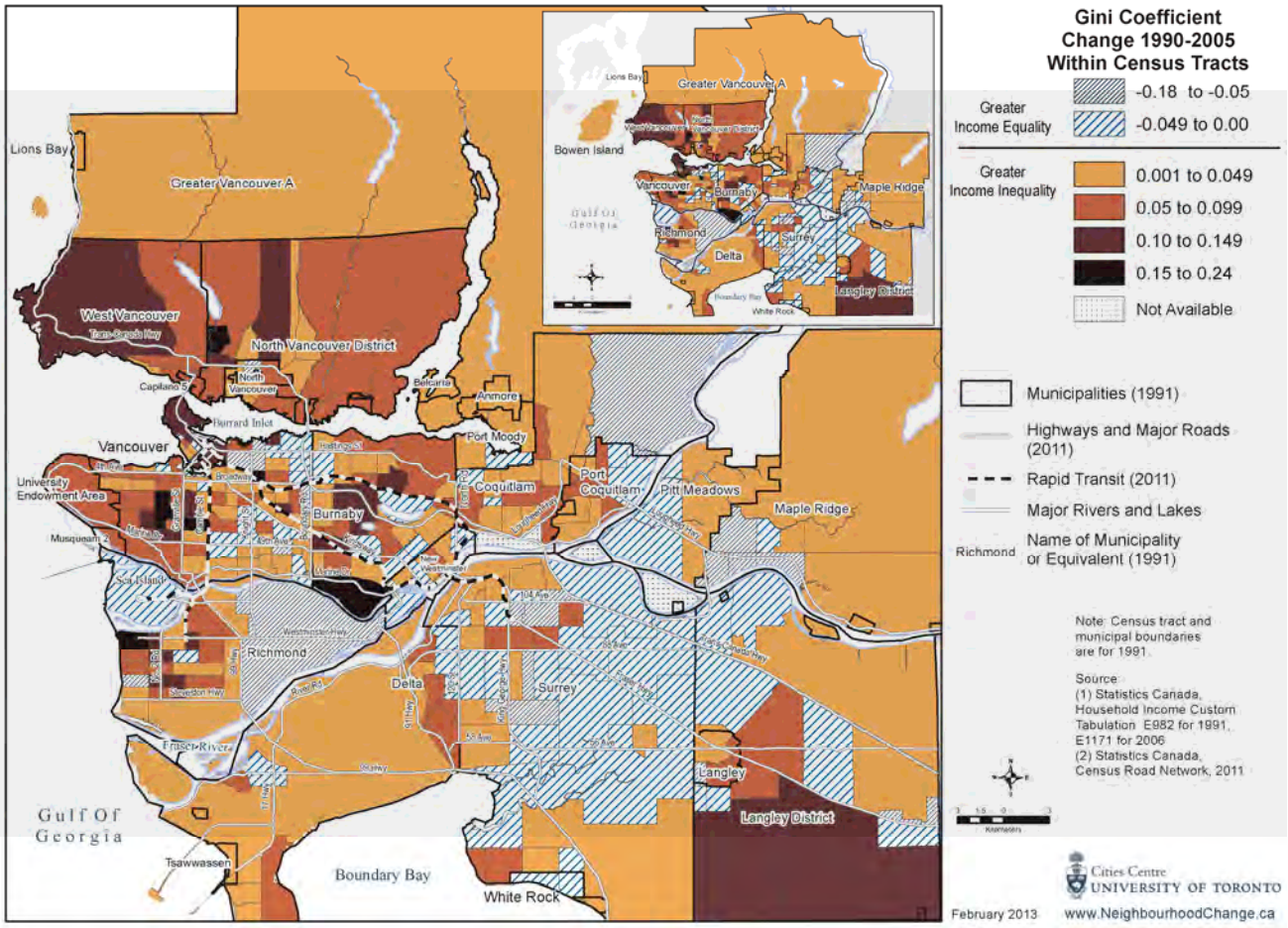
Figure 21: Gini Coefficient of Income Inequality within Neighbourhoods, Vancouver CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

However, there is a clear pattern to the changes in levels of intraneighbourhood income inequality as measured by the Gini coefficient (see Figure 22). Importantly, local income inequality has increased in many of the wealthy neighbourhoods on the west side of the City of Vancouver, in central Burnaby, in most areas of Richmond, and in the municipalities of West Vancouver and North Vancouver district. Meanwhile, intraneighbourhood inequality has decreased in a number of poorer tracts on the east side of the City of Vancouver, and across much of Surrey, Pitt Meadows, and Maple Ridge – areas witnessing the construction of many new subdivisions over the 1990–2005 period and thus an influx of new residents. (The pattern of intraneighbourhood income inequality as it existed in 2005 can be seen in Figure 34 in the Appendix).

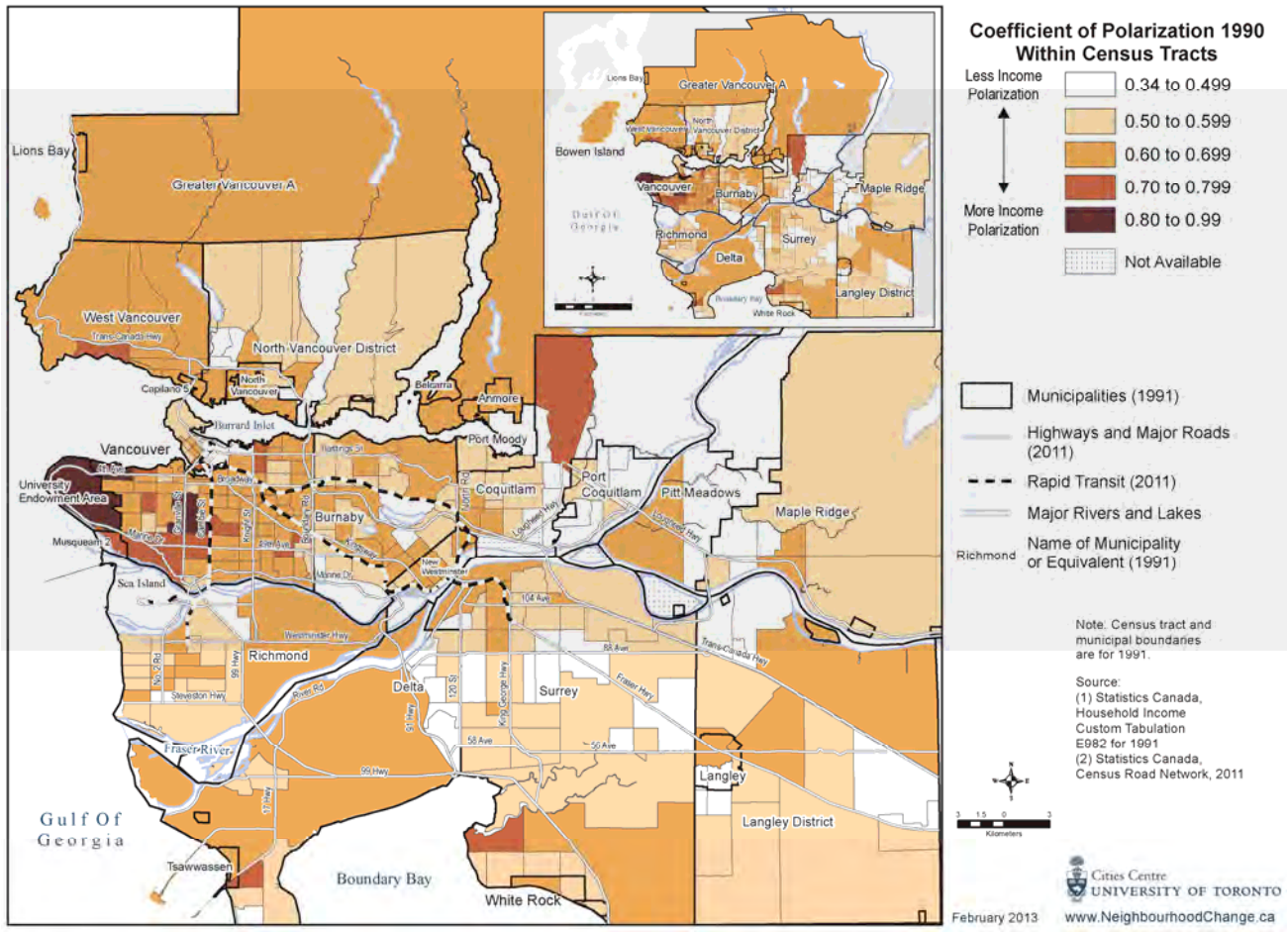
Figure 22: Change in Income Inequality within Neighbourhoods, Vancouver CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

In contrast to the intraneighbourhood patterns for inequality as measured by the Gini coefficient, which reveals a fair degree of spatial evenness across the Vancouver region (as it does in the Montréal CMA in 1990), polarization within census tracts is clearly more concentrated within the City of Vancouver, and particularly within wealthier areas of the City in 1990 (see Figure 23). The outer suburbs of North Vancouver, Richmond, and especially Surrey, Port Coquitlam, and Maple Ridge, all reveal lower levels of intraneighbourhood income polarization. Indeed, as in Toronto, the classic newer subdivisions mostly reveal quite equal and similar populations, with few households at the extremes of either wealth or poverty. The exceptions involve those places that have always housed very wealthy populations, such as the municipality of West Vancouver. This means that local-level income polarization is mostly a phenomenon of the west side of the Vancouver CMA, close to the water and the most desirable areas of the region. This pattern is still evident in 2005, albeit in the context of a general increase in intraneighbourhood polarization across the CMA (see Figure 35 in the Appendix).

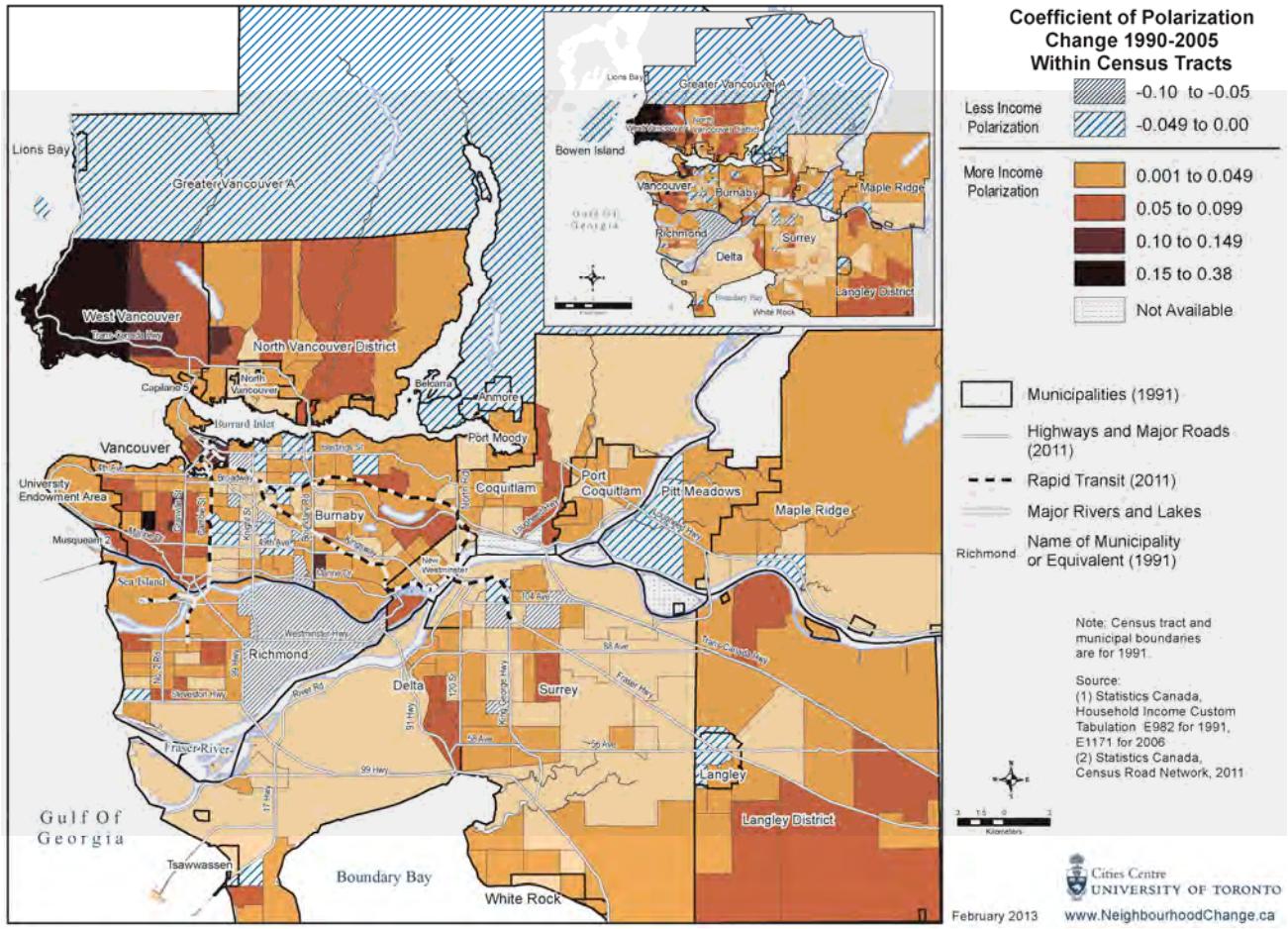
Figure 23: Coefficient of Polarization within Neighbourhoods, Vancouver CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

The pattern of local household polarization has become reinforced through changes occurring over the 1990–2005 period. The map of changes in income polarization within neighbourhoods over the 15-year study period shows some marked differences in comparison with the pattern of changes in inequality (see Figure 24). Polarization increased most rapidly in wealthy neighbourhoods in the northern suburbs close to the mountains, such as West Vancouver and North Vancouver District, as well as in Langley District, while declining in Langley City and a number of tracts on the east side of the City of Vancouver. Unlike the pattern for inequality, polarization within census tracts increased significantly in a number of census tracts in Surrey and Port Coquitlam.

Figure 24: Change in Income Inequality within Neighbourhoods, Vancouver CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Income Inequality and Polarization within Municipalities

This section examines levels of income inequality and polarization among households within each municipality. The interpretation of local-level inequality and polarization is more straightforward and less ambiguous at the scale of the urban municipality. Within Canada's large metropolitan regions, municipalities tend to be sizable and much larger than neighbourhoods (a few very small municipalities within the Montréal region notwithstanding). Rising income inequality and/or polarization within municipalities provides a window into how changes to income distribution writ large are affecting the abilities of local governments to provide services, the kinds of services they offer, and potentially the shape of future social conflict.

Increases in income inequality (or polarization) within a municipality could be due either to socio-structural processes of occupational and employment divergence, or to the sorting of higher- and lower-income households into neighbourhoods within the municipality (even in the

absence of socio-structural shifts in the income distribution). Increasing income inequality (and polarization) in a municipality therefore does not necessarily mean that there is a divergence in the incomes of different neighbourhoods within that municipality. Nor does it mean that there will be increasing inequality or polarization evident within any of the neighbourhoods located within that municipality. It is hypothetically possible for household inequality to be increasing at the municipal scale, while inequality declines at the inter- and/or intraneighbourhood scale, although this is rare.

As in the above discussion of neighbourhoods, the number of municipalities (111) analyzed in this section prevents the easy reporting of the results in tabular form. Instead, the levels and changes in income inequality and polarization at the municipal scale are presented using maps. However, it is possible to summarize trends in the level of income inequality and polarization by reporting the weighted mean levels of inequality and polarization for each of the three large CMAs for each census year (see Table 27). As in the analysis in Chapter 5, a consistent set of proto-municipal spatial units are aggregated from the CSD (census subdivision) files produced by Statistics Canada. Aggregation ensures that the boundaries of the municipal units remain the same over time, despite amalgamations, mergers, and de-mergers (see discussion in Chapter 5), facilitating comparisons over time.

What is evident from Table 27 is that average levels of household income inequality and polarization have increased consistently over time in each of Canada's three largest metropolitan areas, regardless of which measure is used. Local (municipal-scale) levels of household inequality grew slowest during the 1980s and, when the Gini coefficient of inequality is examined, average intramunicipal levels of inequality actually declined over the 1980s in Toronto and Vancouver. The extent of increase in the average level of income inequality within municipalities ranges from a low of about 6 percent using Gini measures of inequality (in Toronto and Vancouver) to more than 44 percent when the Coefficient of Variation Squared (CV2, in Toronto and Vancouver) is used to measure inequality, as well as the Coefficient of Polarization (CoP) in Toronto.

When examined within municipalities, there are clear spatial patterns to the level of household income inequality as measured by the Gini coefficient. In almost all cases, inequality is higher in the core of the region, and lower in the newer suburbs. Figure 25 shows the level of inequality in the Toronto CMA in 1990. The old "central city" of Toronto is revealed as having the highest level of resident household income inequality, with a Gini of 0.51, whereas the levels of local inequality range from 0.34 to 0.44 in the surrounding suburbs.

Table 27: Average Level of Household Income *Inequality* and *Polarization* within Municipalities, Three Largest CMAs

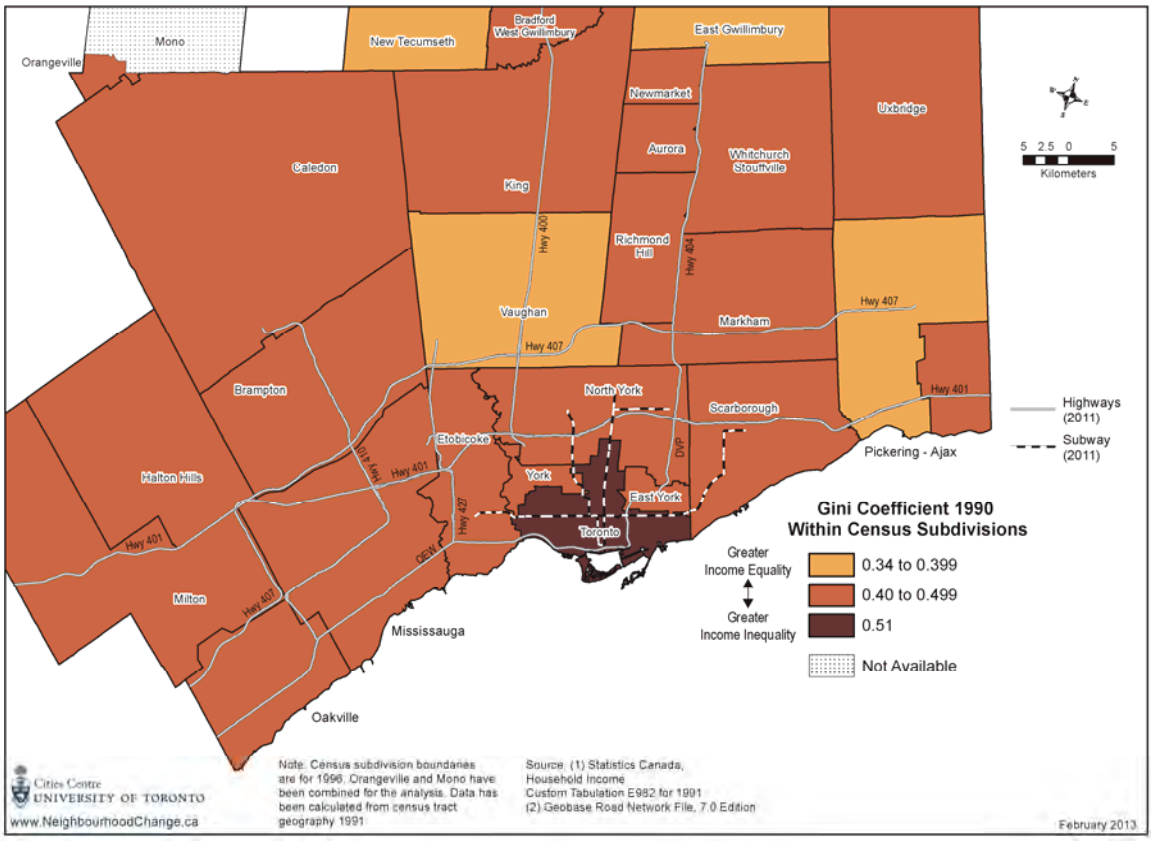
INEQUALITY	1970	1980	1990	2000	2005	1970*	1980*	1990*	2000*	2005*
GINI CR										
Montréal	0.416	0.436	0.443	0.448	0.453	1.00	1.048	1.065	1.078	1.088
Toronto	0.431	0.442	0.430	0.448	0.459	1.00	1.023	0.998	1.038	1.063
Vancouver	0.455	0.455	0.452	0.468	0.483	1.00	0.999	0.993	1.029	1.060
EXP										
Montréal	0.455	0.461	0.469	0.485	0.488	1.00	1.014	1.031	1.065	1.073
Toronto	0.463	0.492	0.500	0.514	0.521	1.00	1.062	1.080	1.110	1.127
Vancouver	0.461	0.489	0.497	0.512	0.519	1.00	1.061	1.078	1.109	1.126
CV2										
Montréal	0.746	0.723	0.773	0.873	0.949	1.00	0.970	1.036	1.170	1.273
Toronto	0.885	0.923	0.948	1.076	1.269	1.00	1.043	1.071	1.216	1.434
Vancouver	0.841	0.872	0.918	0.985	1.211	1.00	1.038	1.092	1.172	1.441
POLARIZATION	1970	1980	1990	2000	2005	1970	1980	1990	2000	2005
WT										
Montréal	0.698	0.727	0.752	0.811	0.832	1.00	1.041	1.076	1.161	1.191
Toronto	0.725	0.793	0.821	0.881	0.934	1.00	1.093	1.133	1.215	1.289
Vancouver	0.718	0.796	0.824	0.866	0.912	1.00	1.108	1.148	1.206	1.270
CoP										
Montréal	0.638	0.686	0.722	0.783	0.785	1.00	1.076	1.133	1.228	1.231
Toronto	0.612	0.715	0.759	0.831	0.879	1.00	1.168	1.240	1.358	1.437
Vancouver	0.664	0.754	0.760	0.832	0.874	1.00	1.135	1.144	1.252	1.317

Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982.

Note: The number of municipal units is kept consistent, and the scale factors for the WT and CoP were all set to 1.00 for this analysis. See the appendix for discussion of methodology in creating the proxy set of proto-CSDs.

* These five columns provide the ratio of each index in each year to that for 1970 (1970 = 1.00).

Figure 25: Gini Coefficient of Income Inequality within Municipalities, Toronto CMA, 1990

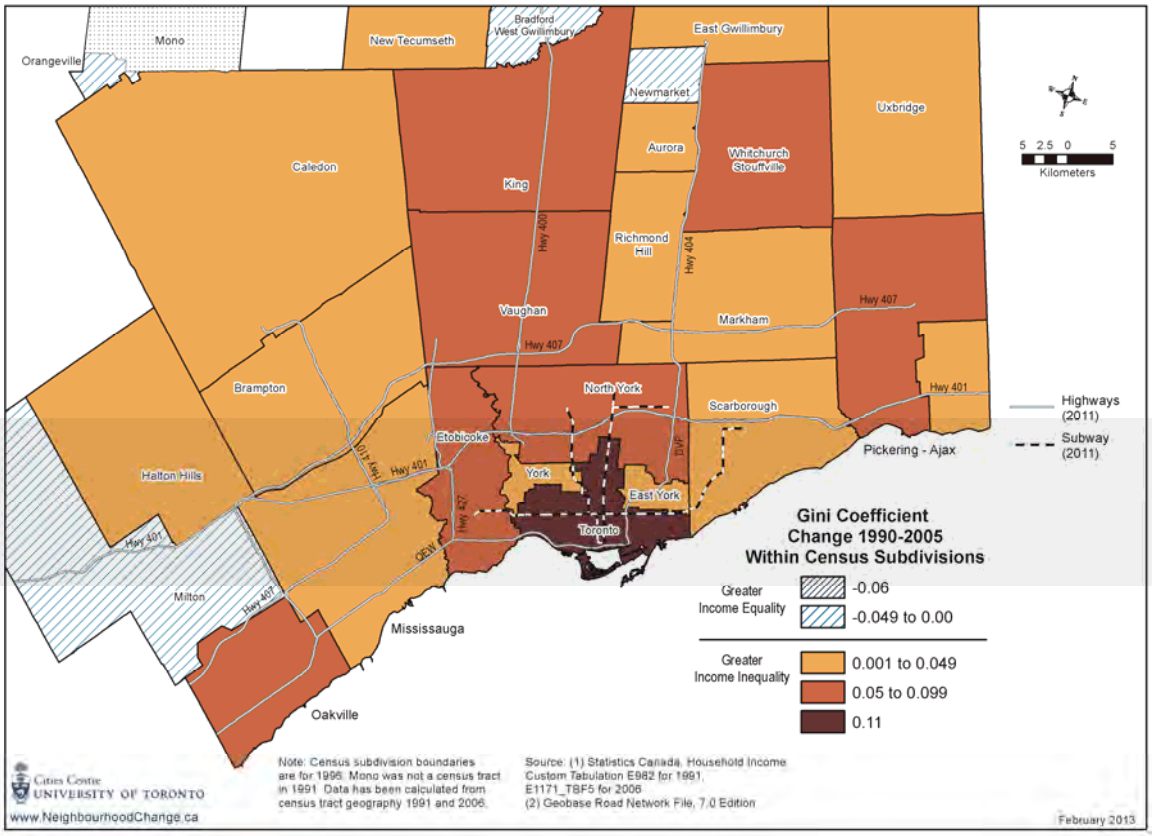


Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

This basic patterning of intramunicipal income inequality continued and was reinforced through 2005, with the old City of Toronto seeing the most rapid increase in local household inequality, but with a number of suburban municipalities also witnessing rapid increases (see Figure 36 in the Appendix).

Figure 26 shows how levels of income inequality, as measured by the Gini coefficient, have changed over the study period within each municipality. While the old City saw the most rapid increase in inequality (and began the period with the highest level of intramunicipal inequality, thus breaking further away from the pack), the inner-suburban municipalities of North York and Etobicoke, as well as the outer-suburban municipalities of Oakville, Vaughan, King, Pickering, and Whitchurch-Stouffville all saw significant increases in local levels of income inequality. Meanwhile, the suburban municipalities of Milton, Newmarket, and Bradford–West Gwillimbury, and the old Town of Orangeville, saw local levels of income inequality decline over the period.

Figure 26: Change in the Gini Coefficient of Income Inequality Within Municipalities, Toronto CMA, 1990-2005

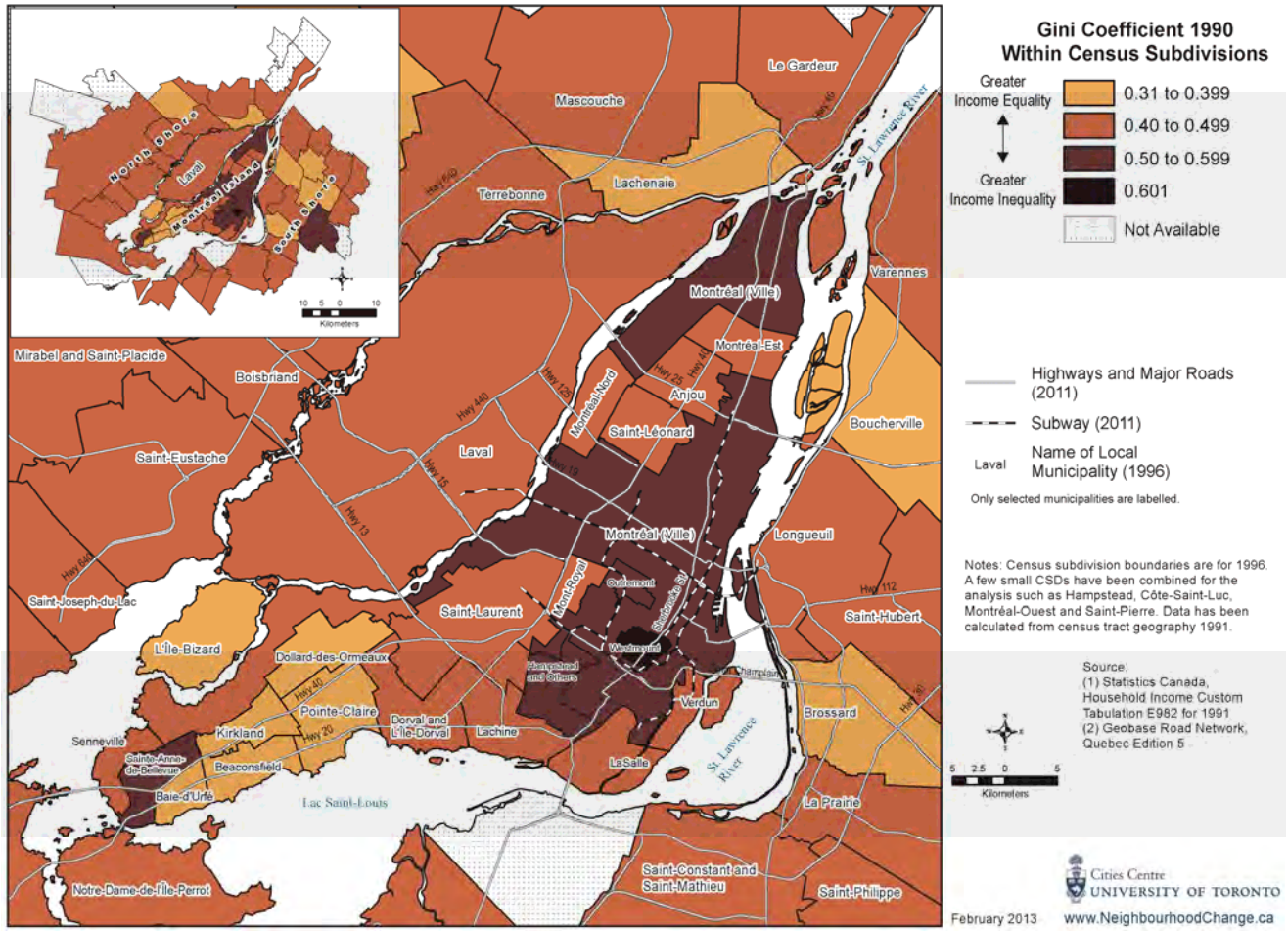


Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Intramunicipal levels of household income polarization, meanwhile, are arranged in a slightly different pattern from that for inequality (see Figures 37 and 38 in the Appendix). While the old City of Toronto still has the most polarized income structure, North York comes very close, while the remainder of the "inner" suburbs within the old Metro Toronto (now amalgamated into the new City of Toronto) – Scarborough, Etobicoke, York, and East York – come next. Oakville, traditionally the wealthiest suburban municipality in the Toronto CMA, also scored highly on polarization, particularly in 1990.

By 2005, all of the proto-municipal units with the highest levels of household income polarization are within the amalgamated City of Toronto: Toronto, North York, Etobicoke, York, and East York. Most of the municipalities within the "inner ring" of the outer suburbs, as well as Scarborough and all of the municipalities in York region, also score highly in terms of income polarization. However, an analysis of changes over time in the CoP reveals that the old City of Toronto is not the spatial unit that has witnessed the most rapid increase in income polarization (Figure 39 in the Appendix). This status belongs to the old Borough of East York, followed by the former "inner" suburban municipalities of North York and Etobicoke, then Whitchurch-Stouffville and Aurora, two wealthy outer-suburban municipalities.

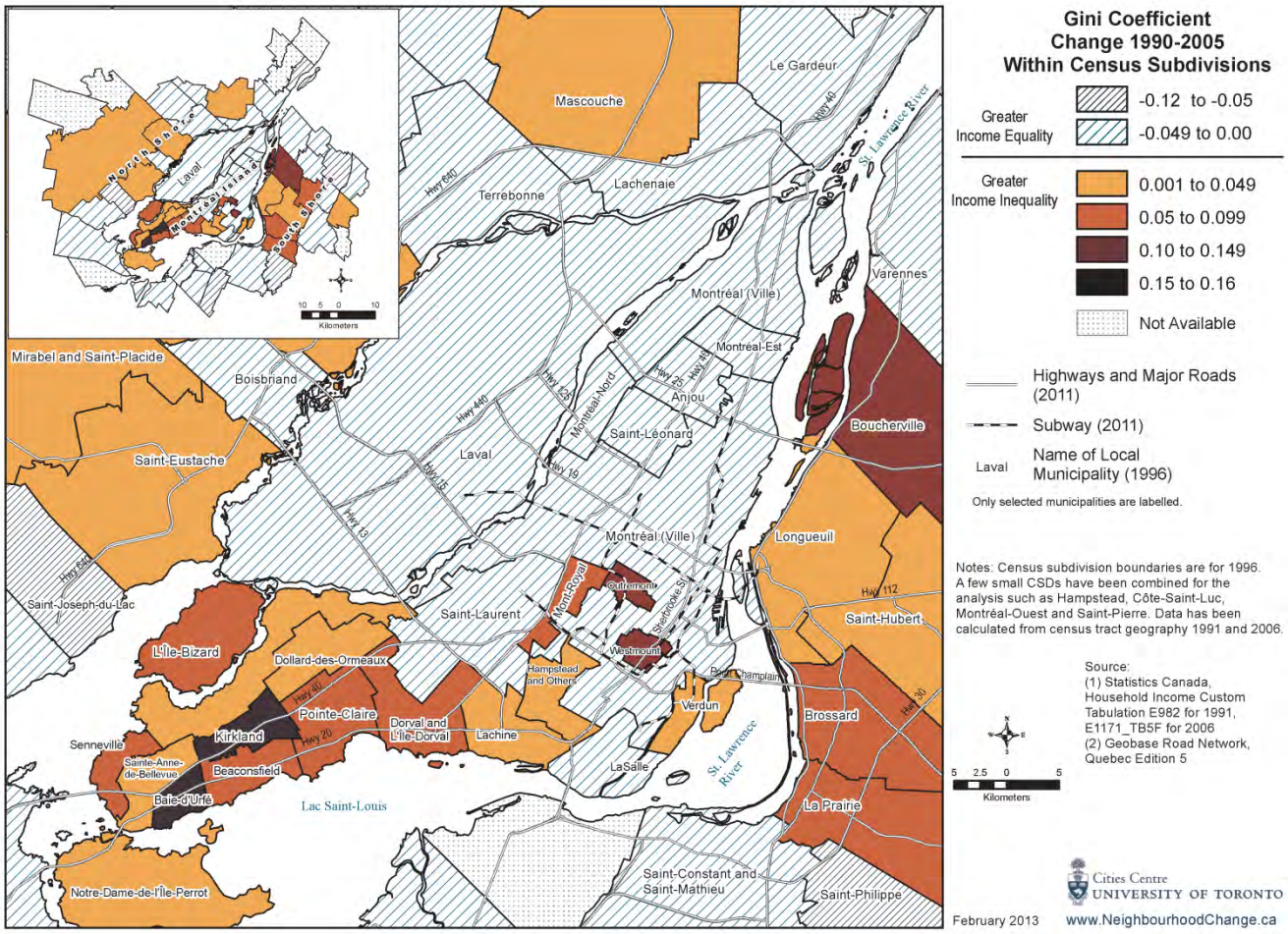
Figure 27: Gini Coefficient of Income Inequality within Municipalities, Montréal CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 27 presents the range of Gini coefficients within the set of consistent municipally based spatial units employed for this research in the Montréal region (with small municipalities aggregated together and the "mergers" disregarded). As in the census tract analysis, it is the former City of Montréal and municipalities contiguous to or surrounded by the City that reveal the highest levels of income inequality (as measured by the Gini coefficient). The very wealthy English enclave of Westmount, located on the southwest side of the mountain, emerges as the municipality with the most unequal distribution of income. Meanwhile, wealthy suburbs on the west Island that are also mainly English-speaking (many of which "de-merged" after the 2005 referendum), have lower levels of income inequality (likely because they are or were more homogenously wealthy), as do a small number of other municipalities on the north and south shores of the region (see also Figure 40 in the appendix). The pattern of intramunicipal income polarization (CoP) takes a similar shape, with the City of Montréal and a series of contiguous municipalities showing the highest levels while west Island municipalities reveal much lower levels. This pattern persists over the 15-year study period (see Figures 41 through 42 in the Appendix).

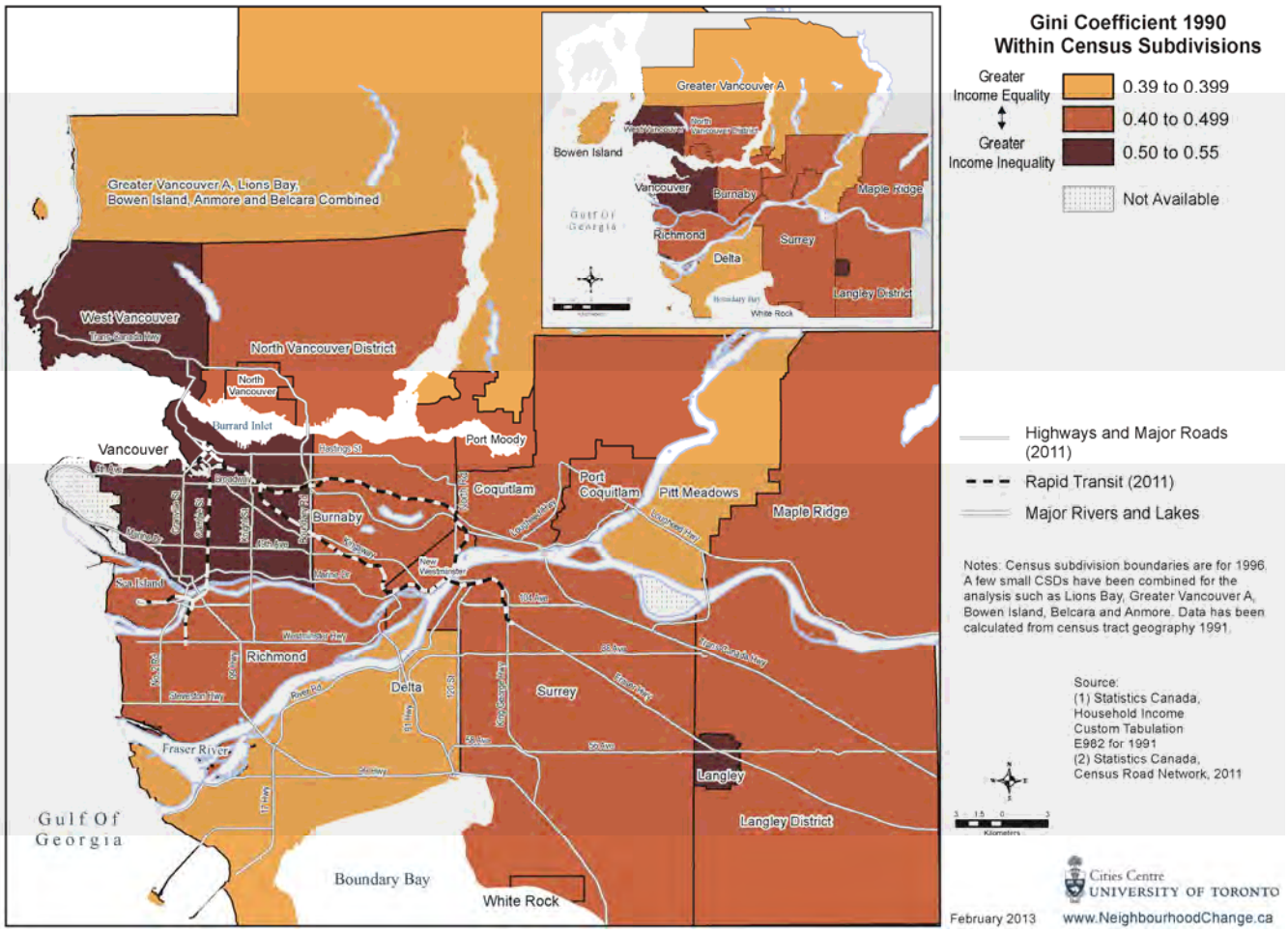
Figure 28: Change in the Gini Coefficient of Income Inequality within Municipalities, Montréal CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

When change in the level of income inequality is examined, many of the largest and most populous municipalities, including the cities of Montréal and Laval and slightly more than half of the municipalities on the north and south shore, reveal mild declines (see Figure 28). It is mostly the west Island municipalities, and those on the south shore clustered around Longueuil that experienced increases in the Gini coefficient. This finding contrasts with the results for polarization, in which only 10 (of 66) municipal units in Montréal witnessed declining levels of polarization (see Figure 43 in the Appendix). Many of these are suburbs that have traditionally housed lower-income populations, and that have since been "merged" into the City of Montréal (including LaSalle, Verdun, Anjou, and Montréal Nord), but this group also includes some outer-suburban areas. Intramunicipal polarization increased the most, meanwhile, in well-established enclaves of wealth, including Westmount, Outremont, Baie D'Urfé, and Mont Royal. Once again, trends related to inequality and polarization are expressed in very different spatial patterns.

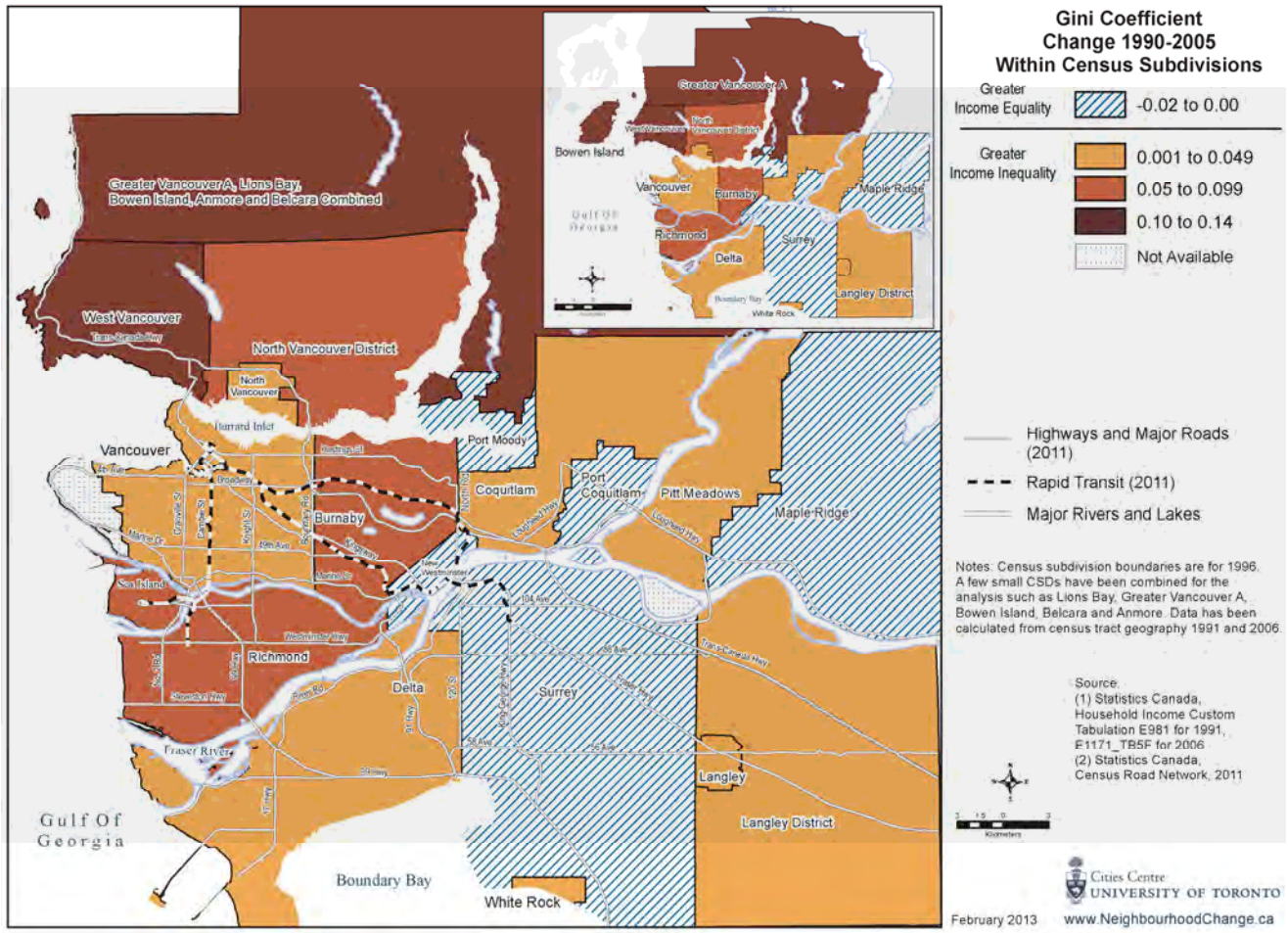
Figure 29: Gini Coefficient of Income Inequality within Municipalities, Vancouver CMA, 1990



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

In the Vancouver CMA, Gini coefficients of income inequality are highest in the Cities of Vancouver, West Vancouver, and Langley City, and lowest in the recently developed areas of Delta and Pitt Meadows (see Figure 29 and Figure 44 in the Appendix). The pattern is thus somewhat concentric, similar to the pattern evident in Toronto. Levels of intramunicipal income polarization, as measured by the CoP, are similar, albeit more stark, with high levels of income polarization within the cities of both Vancouver and West Vancouver in both time periods, and in Burnaby, Surrey, Richmond, and North Vancouver in 2005 (see Figures 45 and 46 in the Appendix). Surrey in particular is revealed as having significantly higher levels of polarization than would be expected, given levels of income inequality.

Figure 30: Change in the Gini Coefficient of Income Inequality within Municipalities, Vancouver CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Despite the persistence of high levels of inequality within the central City of Vancouver, the largest change in inequality has occurred in West Vancouver and places north along the coast, followed by the ring of older suburban municipalities bordering Vancouver: Richmond, Burnaby, and North Vancouver District (see Figure 30). The City of Vancouver experienced only a mild increase in inequality over the study period.

Similar to the neighbourhood pattern in which a majority of census tracts saw declining levels of intraneighbourhood inequality, Gini coefficients among households decreased in Surrey, Port Coquitlam, and Maple Ridge (see also Figure 44 in the Appendix). However, and contrary to these recorded shifts in inequality, income polarization among households has increased in every municipality within the Vancouver CMA (see Figure 47 in the Appendix). West Vancouver exhibits the largest increase in polarization (from an already elevated level), followed by Richmond and Port Coquitlam, each of which also witnessed increasing inequality. Meanwhile, the

City of Vancouver notably shows the smallest increase in income polarization within the region (albeit from a high starting level).

Summary

This section has analyzed the extent of income inequality and polarization among all households within neighbourhoods, and within spatial units that closely mirror preamalgamation municipal boundaries. As in the analysis presented in Chapters 4 and 5, it is clear that income inequality and polarization have been increasing on average both within most neighbourhoods and within most municipalities in Canada's three largest metropolitan areas.

Levels of inequality and polarization within neighbourhoods and municipalities and changes in these levels present some patterns worth noting. First, in both the intraneighbourhood analysis and the intramunicipal results, the areas with the highest levels of both inequality and polarization are located near the cores of the central cities, particularly in higher-income areas (and occasionally the lowest-income areas) in the inner cities. This effect is most evident when polarization measures are used, with the suburbs – particularly the newer suburbs – revealing very low levels of income polarization in the first two decades of the study (1970s through 1990s). Second, it is in the suburbs that both inequality and polarization grew most rapidly since 1990, while levels of inequality and polarization grew much more slowly in the central cities as a whole, although some gentrifying neighbourhoods reveal above-average rates of change. These data point not only to the effects of gentrification, but also to aging and filtering processes occurring in the suburbs.

While higher levels of inequality and polarization clearly have negative connotations, it is not clear that a higher level of inequality or polarization within a small spatial unit like a census tract or a small municipality must necessarily be interpreted in the same negative light as either inequality amongst households in larger spatial units (metropolitan areas, large municipalities), or income segregation between neighbourhoods or municipalities. Instead, within-unit inequality and polarization have to be interpreted in relation to the larger trends toward (or away from) inequality and polarization at larger scales.

To this end, levels of intraneighbourhood and intramunicipal inequality and polarization were compared to levels of inequality and polarization among all households. The resulting ratios suggest that although inequality and polarization have been increasing among and within metropolitan areas since the 1970s, a growing proportion of this new inequality was absorbed through higher levels of intraneighbourhood and intramunicipal inequality, at least until the mid-1990s. That is, while increasing (aspatial) household inequality/polarization has been expressed in rising income segregation and sorting, a portion has also been expressed as increasing income dispersion within neighbourhoods. Further research is needed to analyze these processes. Nevertheless, these findings are consistent with the effects of gentrification and displacement of low-income households from the inner cities of Canada's global cities, and the dispersion of lower-income households into the suburbs where incomes previously were far more homogenous (Ades, Apparicio, and Seguin, 2012).

7. Conclusion

This report has examined and compared levels, forms, patterns, and changes in income inequality and polarization at multiple scales of analysis in Canadian metropolitan areas. The results are cause for concern. Income inequality and income polarization have increased at every scale: at the metropolitan scale among all households and between metropolitan areas, at the municipal scale both among all households within municipalities as well as between municipalities, and within and between neighbourhoods in each metropolitan area. Canadian metropolitan areas, with only minor and rare exceptions, are polarizing and growing more unequal.

Chapter 4 presented a number of the correlates of the trends towards income inequality. Inequality is not a result or feature of any one single process, but a characteristic of many social cleavages in urban Canadian society. Incomes are diverging between those employed in managerial or administrative occupations and those working in manufacturing, services, sales, construction, utilities, arts, and recreation. Inequality is increasing between immigrants and the native-born, between racial minorities and the white population, between two-earner family households and single-earner or no-earner or single-parent households, and (although not examined in this report) between homeowners and tenants (Walks, 2006). When such factors overlap – for instance, when racialized immigrants become stuck in occupations with declining relative wages and cannot afford to become homeowners – such effects make it more difficult to alter established trajectories toward various forms of inequality. The literature has shown that income inequality at the metropolitan scale is partly attributed to deindustrialization of the workforce. Public policies that support industrial development and manufacturing investment would, it follows, help slow (or perhaps even reverse) trends towards inequality.

Neighbourhoods and municipalities are also shown to express trends toward increasing income inequality and polarization. Income has become more segregated among municipalities, and among neighbourhoods, within metropolitan areas. When the social cleavages at the heart of household income inequality are associated with spatial concentrations of different social groups, space itself becomes a factor in expressing if not also producing income inequality. This raises the issue of potential place-based or “neighbourhood” effects on life chances. There is debate regarding both the relevance of any place-based effects, and the efficacy of researching neighbourhood effects instead of other factors producing inequality (such as unfair labour practices) (Oreopoulous, 2008; Slater, 2013). However, regardless of its residual effects, the existence of rising income segregation is both troubling and telling.

Aspatial processes can lead to spatial segregation: increasing income inequality and polarization among all households make rich neighbourhoods and rich municipalities richer, and poorer places poorer. This is clearly happening to some extent, although the rate of increase in levels of income segregation is slightly higher than the rate of increase in overall household income inequality. The evidence thus suggests that income segregation is also at least partly a result of the sorting of rich and poor into different neighbourhoods. Gentrification is a factor in the shifting concentrations of rich and poor: this is one aspect of the sorting process that is more evident in the larger global cities (Walks and Maaranen, 2008a, 2008b). Canada's global cities are found in this report to have some of highest levels of, and continued increases in, inequality and polarization.

Such a finding bolsters arguments for using public policy to ameliorate gentrification, and to maintain an income and tenure mix within inner city and suburban neighbourhoods (Walks and August, 2008). However, different patterns of sorting were found using each different measure, and it remains unclear just how important neighbourhood-level sorting is for producing predominant patterns of income segregation in Canadian metropolitan areas. As well, it is not yet clear how the concentrations of different social groups in space – at either the neighbourhood or municipal level – contribute to overall levels of income segregation, nor whether sorting has positive or negative effects on well-being. These are areas ripe for future study.

Income inequality and polarization are also evident at the local scale among households within local places. Within municipalities and within neighbourhoods, income differentiation has grown over time, largely in tandem with the rise of inequality and polarization at the metropolitan scale. However, not all of the increase in inequality and polarization is expressed within neighbourhoods. The analysis of inequality based on the Gini coefficient suggests that instead of neighbourhoods merely reflecting the trends toward greater inequality at the local level, much of the inequality has fuelled neighbourhood sorting. Nonetheless, the trends uncovered here suggest that a small part of the growth in inequality and polarization has been expressed as increased income dispersion within neighbourhoods. Polarization trends, in particular, suggest that in the most recent period (since the 1990s) some of the increase in polarization (and extremes in inequality driven by changes at the upper and lower ends of the income spectrum) has been internalized in a greater mix of incomes in the suburbs. The policy implications of such a scenario remain unclear and demand further investigation.

In addition to tracking changes in the levels of income inequality and polarization over time at different scales, this report has sought to compare measures of inequality and polarization, and to introduce a new measure of income polarization. Measures of inequality and polarization are not the same thing, but have distinct properties. A polarized or polarizing income structure is different from an unequal one, although in practice, changes in one tend to be mirrored in the other. The research presented in this report has shown that inequality and polarization not only reveal distinct trends, but their geographic articulation is revealed in distinct spatial patterns.

This report introduces a new measure of polarization, the coefficient of polarization (CoP). The (CoP) can be easily calculated using data on households grouped into income ranges and/or aggregated to spatial units, unlike the two most established and applied measures of income polarization. The CoP has a more balanced sensitivity than the WT index, which is overly sensi-

tive to the upper end of the income distribution. Of course, the CoP has its own limitations that must be taken into account in any application. Nonetheless, it is shown to accurately reflect both the state of, and trends towards, income polarization within the ranges and trajectories of the other indices, particularly the ER index of polarization. In instances in which the Wolfson or ER indices of polarization cannot be applied, such as when income data are grouped into ranges and aggregated into spatial units, the CoP is found to be a useful and valid index.

8. References

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Appendix

The formulas for each of the income inequality and polarization indices applied and analyzed in this report, including the coefficient of polarization, are as follows:

1. Gini Concentration Ratio (GINI CR) = $\sum_{i=1}^{n-1} \left| x_i y_{i+1} - x_{i+1} y_i \right|$
2. Exponent (Exp) = $\frac{1}{N} \sum_{i=1}^{N} \exp(-x_i / \mu)$
3. Coefficient of Variation (CV2) = $(std.dev / \mu)^2$
4. General Entropy (GE0) (Theil L) = $\frac{1}{N} \sum_{i=1}^{N} \log\left(\frac{\mu}{y_i} \right)$
5. Wang-Tsui (WT) = $\frac{1}{N} \sum_{i=1}^{N} \left| \frac{x_i - m(x)}{m(x)} \right|^r$ (0 < r < 1, usually r = 0.5)
6. Esteban and Ray (ER) = $A \sum_{i=1}^{k_i} \sum_{j=1}^{k_j} f(y_i)^{1+\alpha} f(y_j) \left\| \overline{y_i} - \overline{y_j} \right\|$
7. Foster-Wolfson (P) = $\frac{\left(2\left(2T - Gini\right)\right)}{(med / \mu)}$ where $T = 0.5 - L(0.5)$ and L = % of income of bottom half of the population (below the median)
8. Coefficient of Polarization (CoP) = $\frac{1}{N} \sum_{i=1}^{N} \left| \log\left(\frac{x_i}{m(x)} \right) \right|$

Methodology for Census Subdivision (CSD) Time-Series Analysis:

The 1996 CSD geography is used as a starting point to build a set of consolidated CSD boundary files using Geographic Information Systems software (GIS). Any CSDs added to the CMA extent at the fringe *after* census 1996 are not included in the analysis. This issue occurred only in the Montréal CMA, resulting in seven small CSDs being excluded from the analysis.

This method has the advantage of ensuring and improving the comparability of CSDs over time, including the analysis and mapping of income trends, and producing cleaner, simpler, visually consistent CSD maps. It also had the added benefit of preserving the boundaries of former municipalities in the analysis that subsequently had been amalgamated.

The method involved:

1. Combining CSDs that had physical extents smaller than a single census tract, including native reserves, which in the census are considered CSDs. Often these CSDs operate as islands within a larger CSD. These were dissolved into the larger surrounding CSD. Most of these were in the Vancouver region.
2. Selectively combining CSDs that contained only a single census tract or in which the CSD boundaries did not properly overlap with any single census tracts unless aggregated with another adjacent CSD. These were mainly in the Montréal region.
3. Disaggregating amalgamated municipalities into separate CSDs, so that the amalgamation did not affect the result of the analysis. The affected CSDs were in the Toronto and Montréal regions.
4. Not counting CTs with no income data available in the CSD totals.

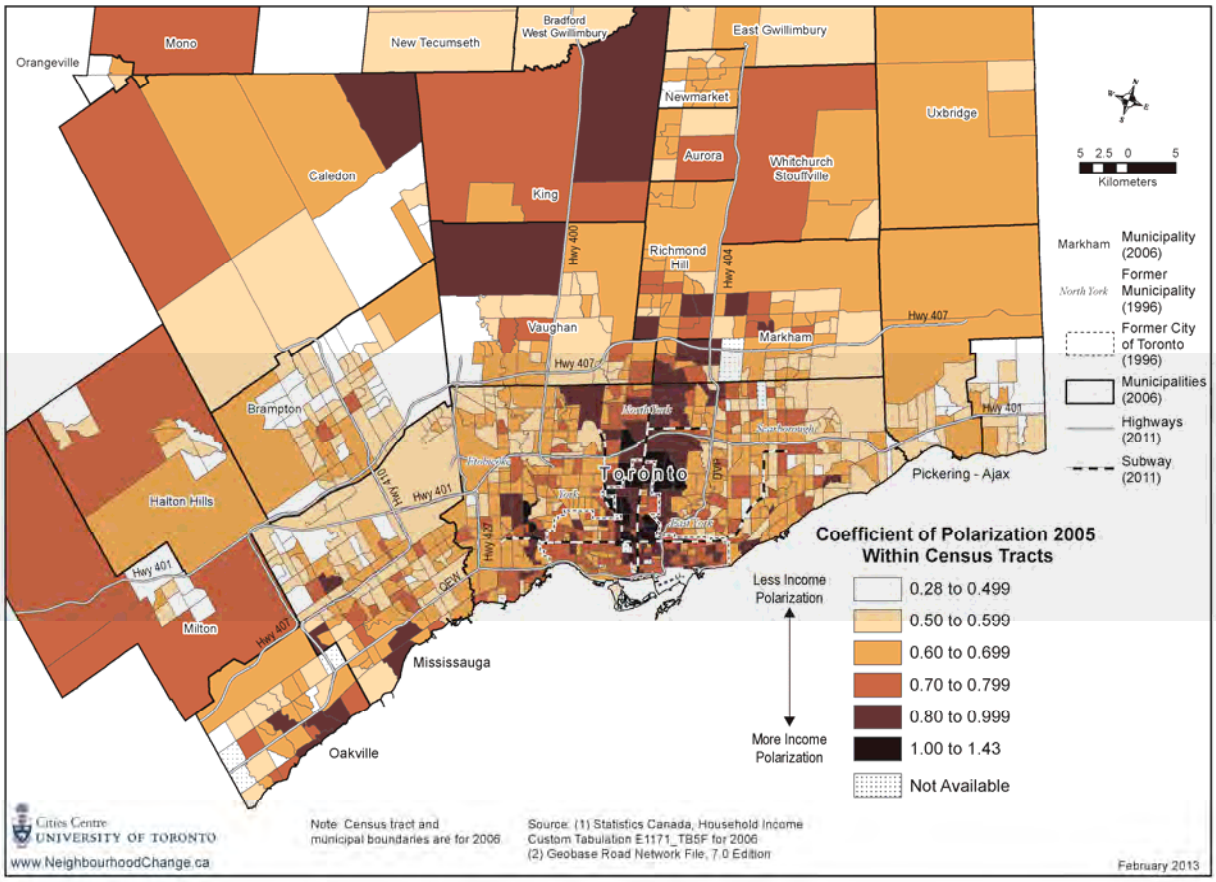
This method led to the creation of a set of consistent proto-CSD spatial units for use in the time-series analyses of municipalities in sections 5 and 6.

Census Subdivision Geography (1996) Before and After Selective Consolidations

CMA	Number of CSDs in Census 1996	Number of CSDs in Census 2006	Number of proto-CSDs in the Analysis
Montréal	113	91	66
Toronto	29	24	27
Vancouver	39	39	18

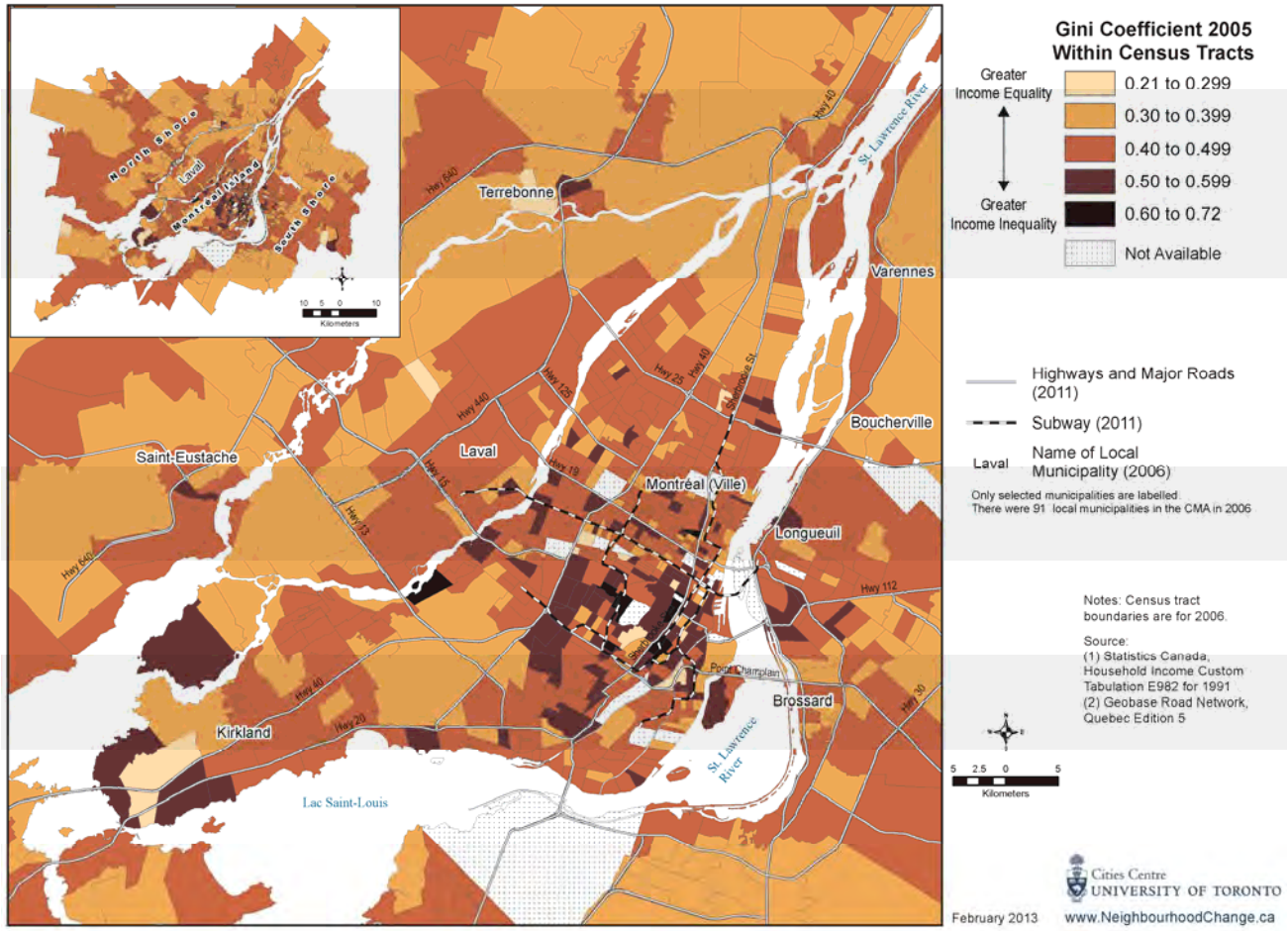
Special thanks to Richard Maaranen for his help in constructing the consistent proto-CSDs for the time-series analysis and in carrying out the empirical analysis

Figure 31: Coefficient of Polarization (CoP) within Neighbourhoods (Census Tracts), Toronto CMA, 2005



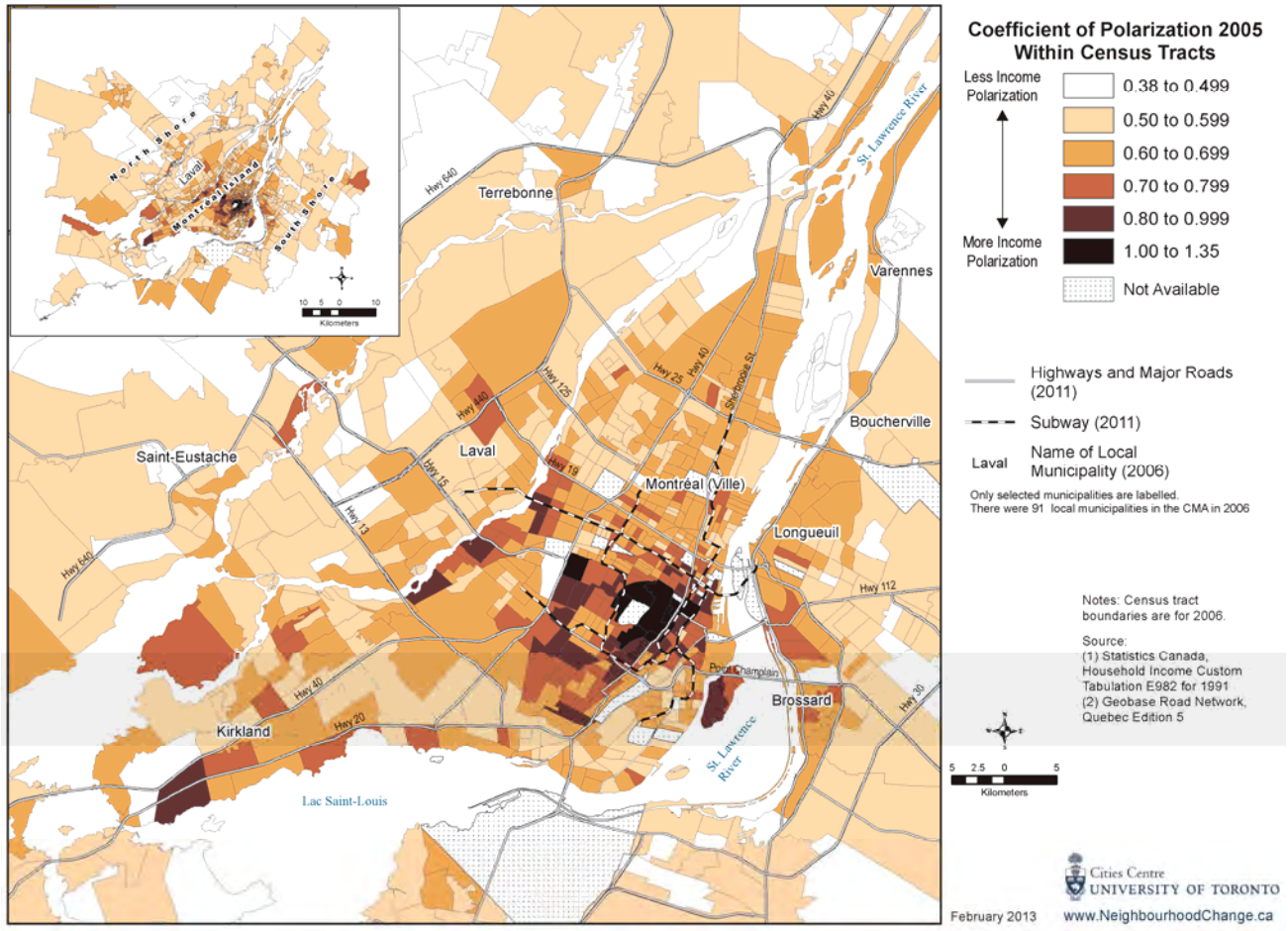
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 32: Gini Coefficient of Income Inequality within Neighbourhoods, Montréal CMA, 2005



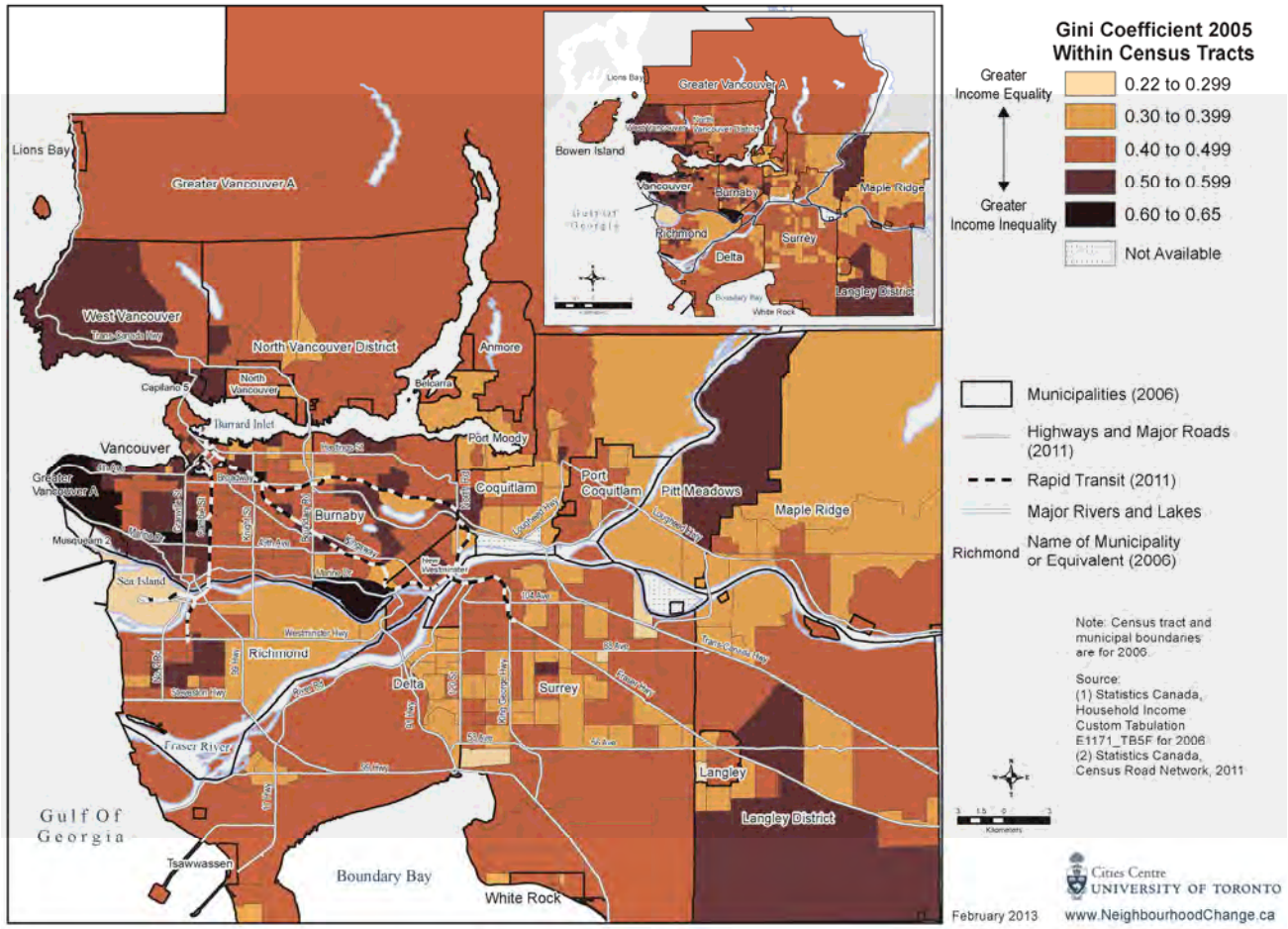
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 33: Coefficient of Polarization (CoP) within Neighbourhoods, Montréal CMA, 2005



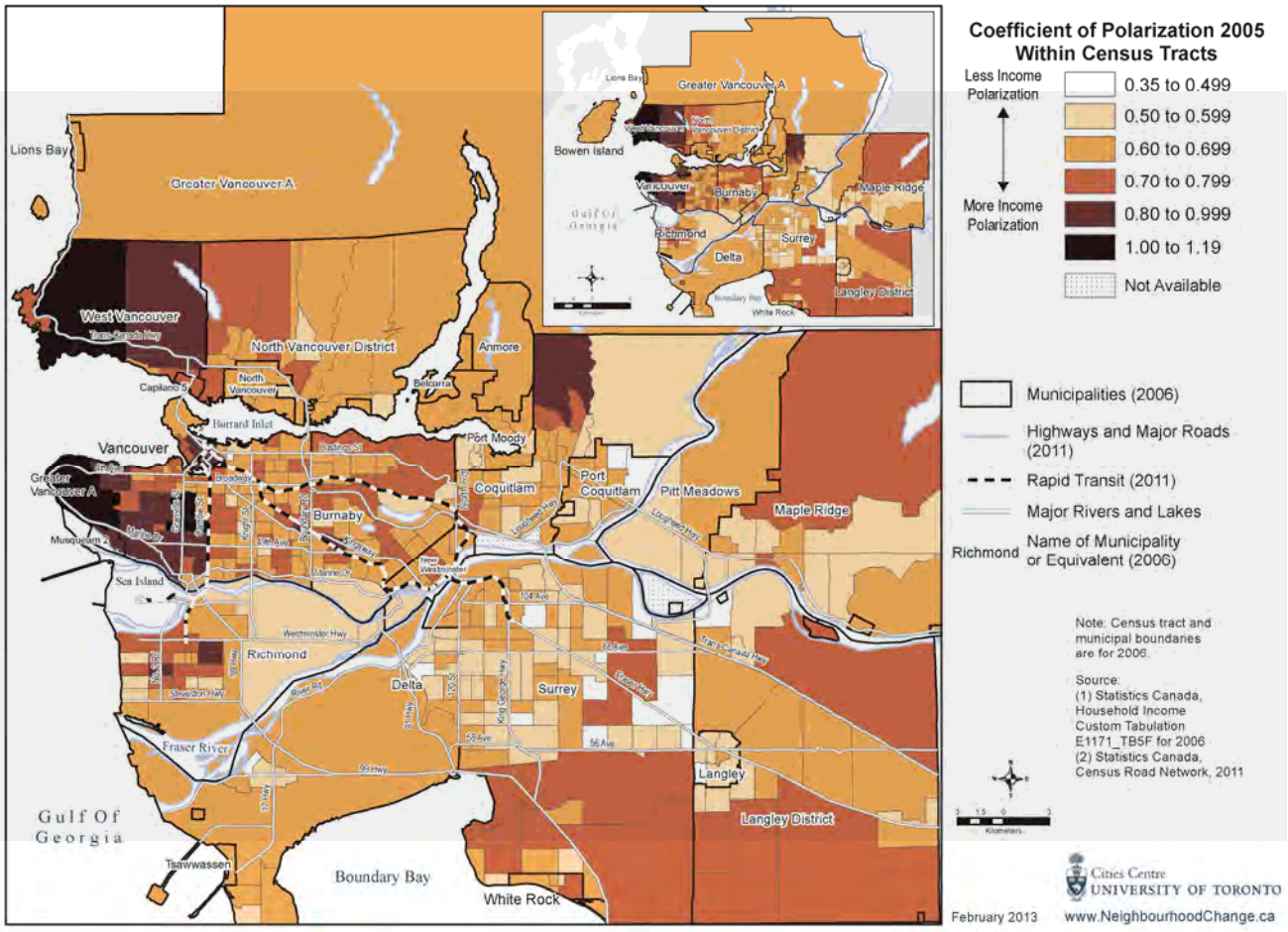
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 34: Gini Coefficient of Income Inequality within Neighbourhoods, Vancouver CMA, 2005



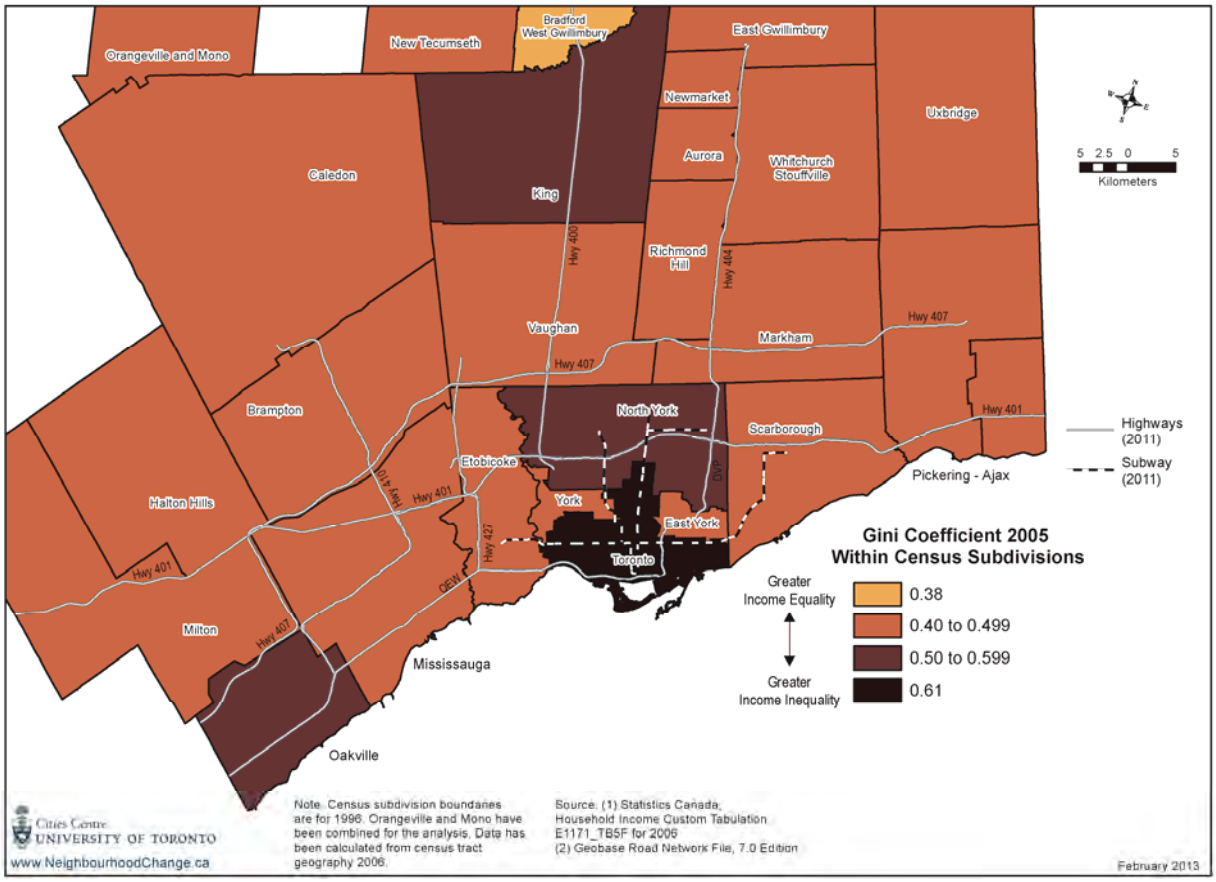
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 35: Coefficient of Polarization (CoP) within Neighbourhoods, Vancouver CMA, 2005



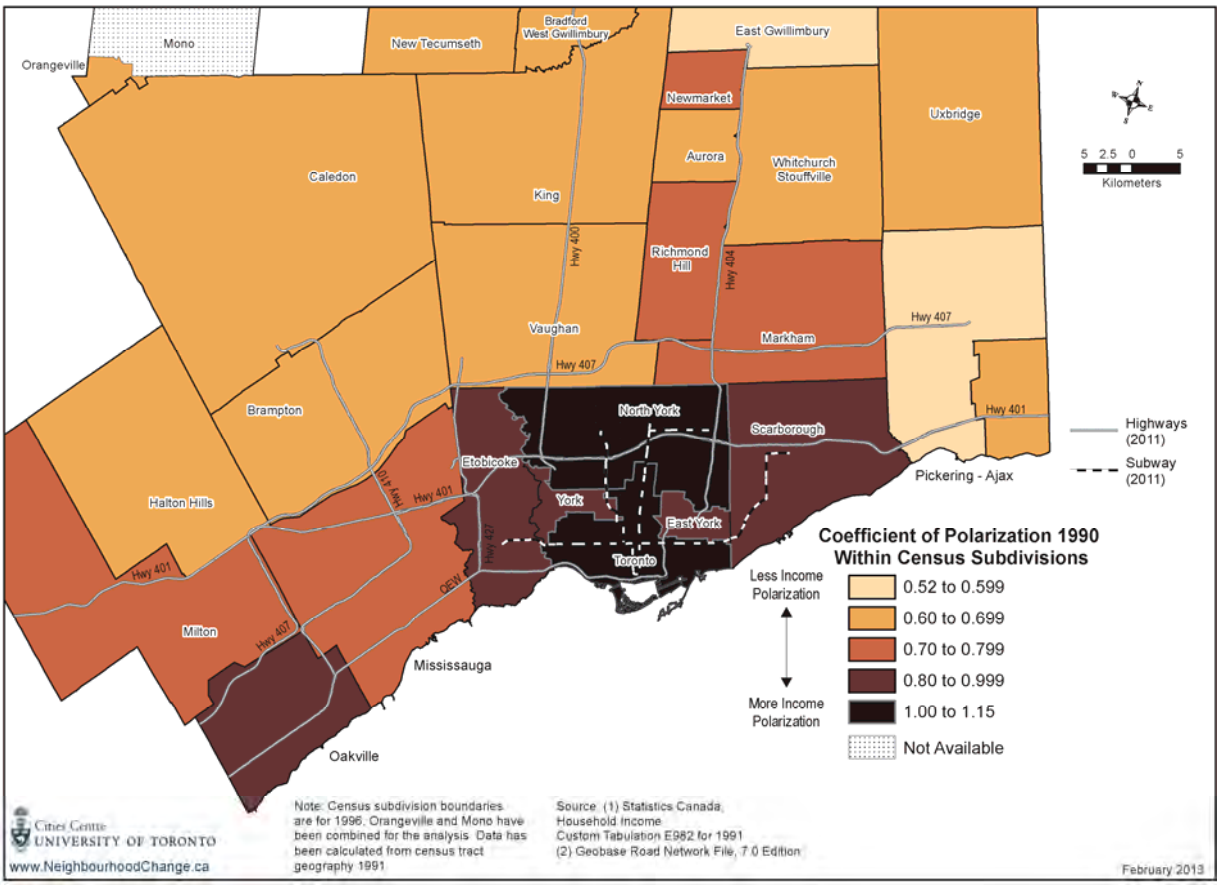
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 36: Gini Coefficient of Income Inequality within Municipalities, Toronto CMA, 2005



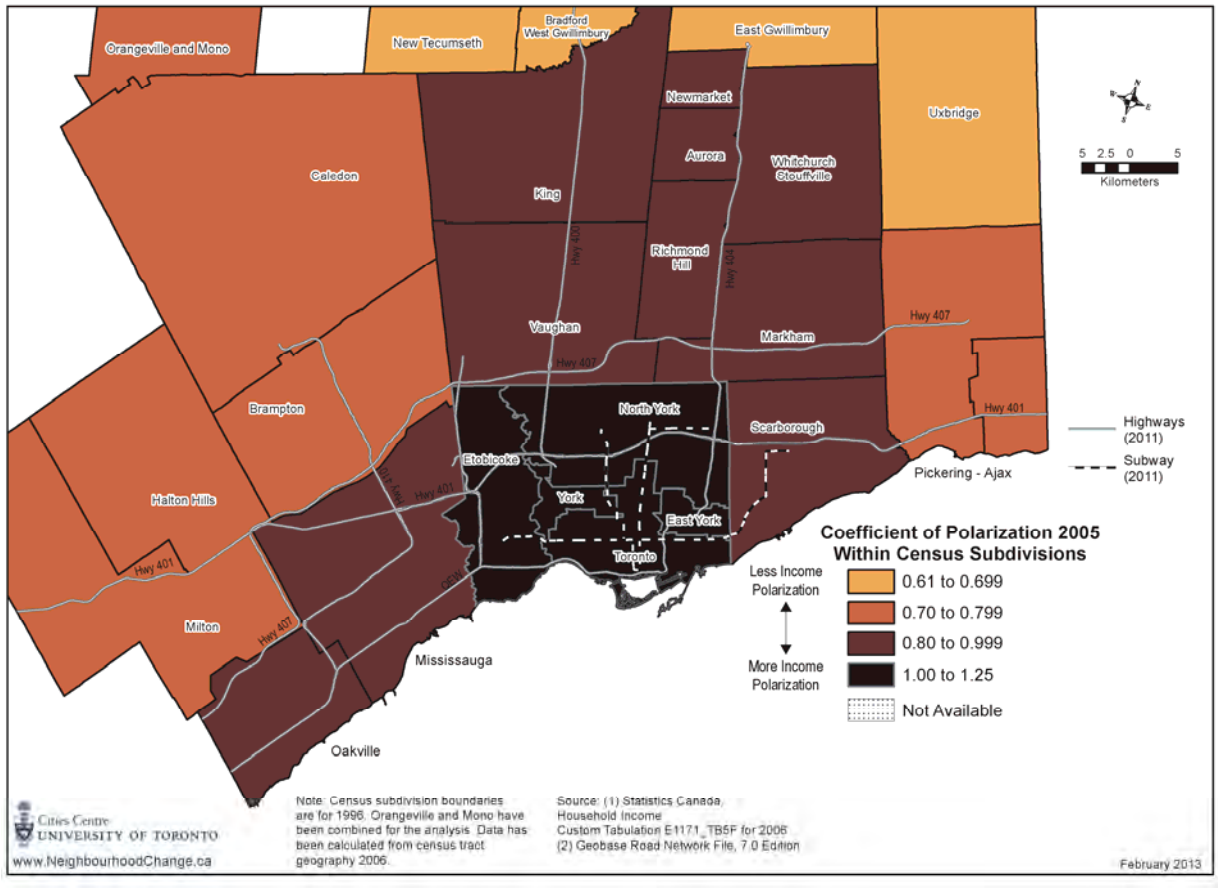
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 37: Coefficient of Polarization (CoP) within Municipalities, Toronto CMA, 1990



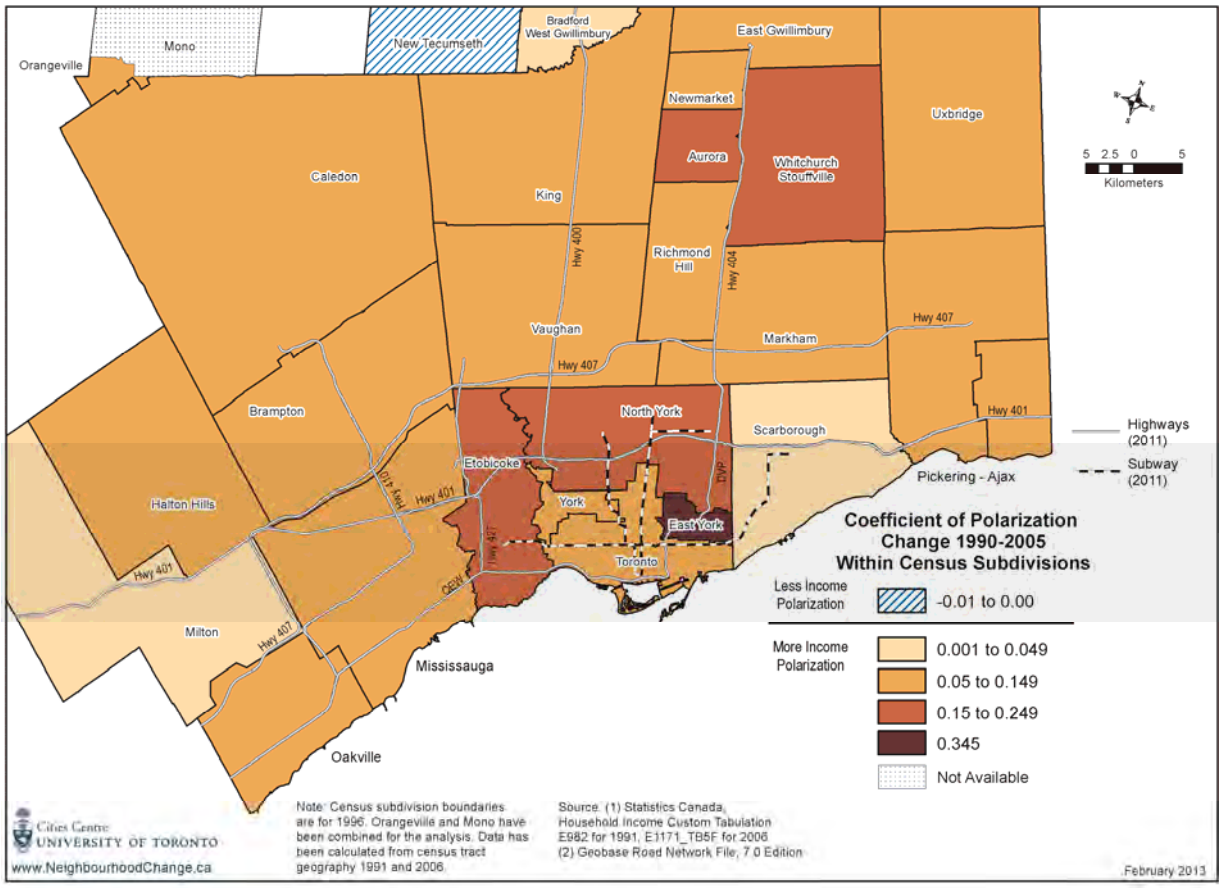
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 38: Coefficient of Polarization (CoP) within Municipalities, Toronto CMA, 2005



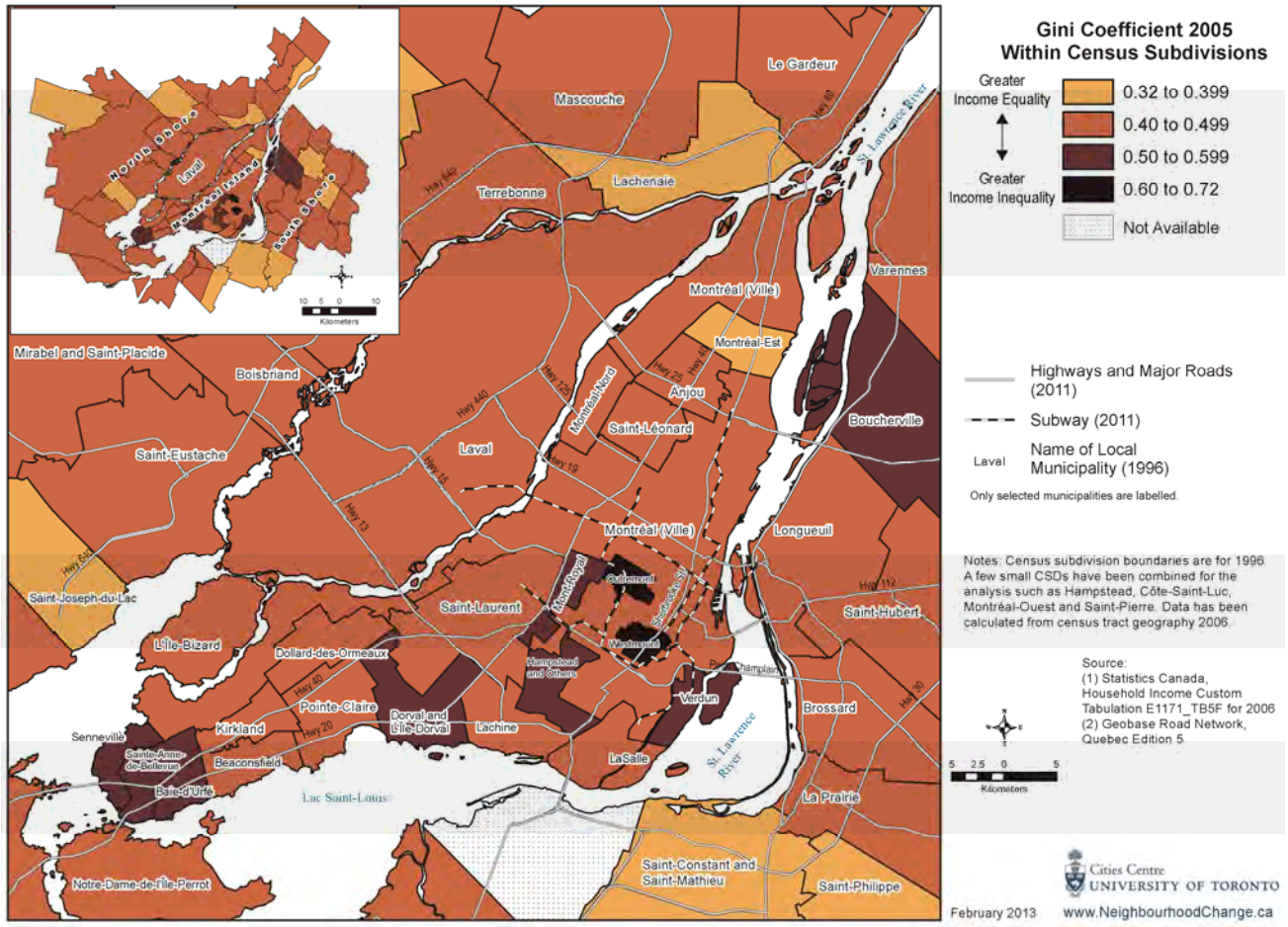
Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 39: Change in the Coefficient of Polarization (CoP) within Municipalities, Toronto CMA, 1990–2005



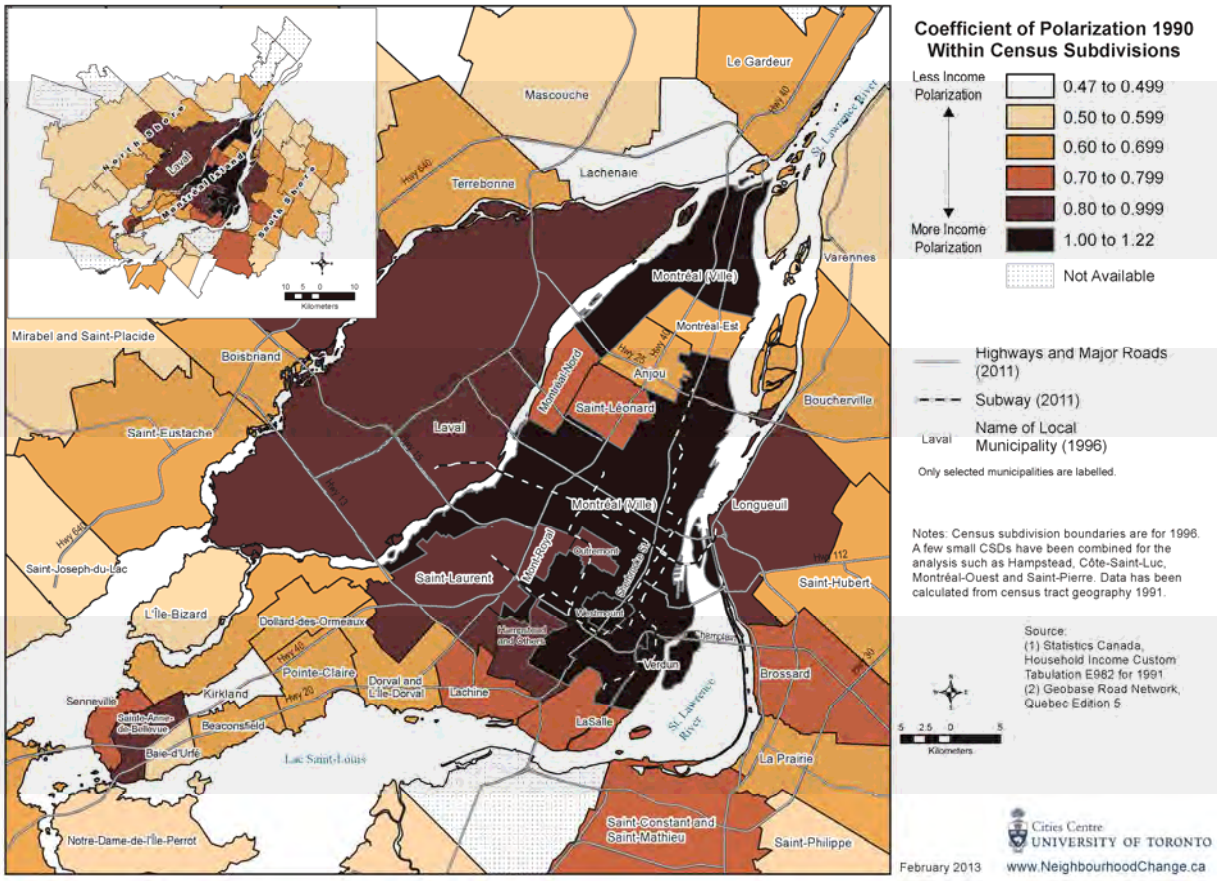
Source: Calculated from Statistics Canada, Census 1971-2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 40: Gini Coefficient of Income Inequality within Municipalities, Montréal CMA, 2005



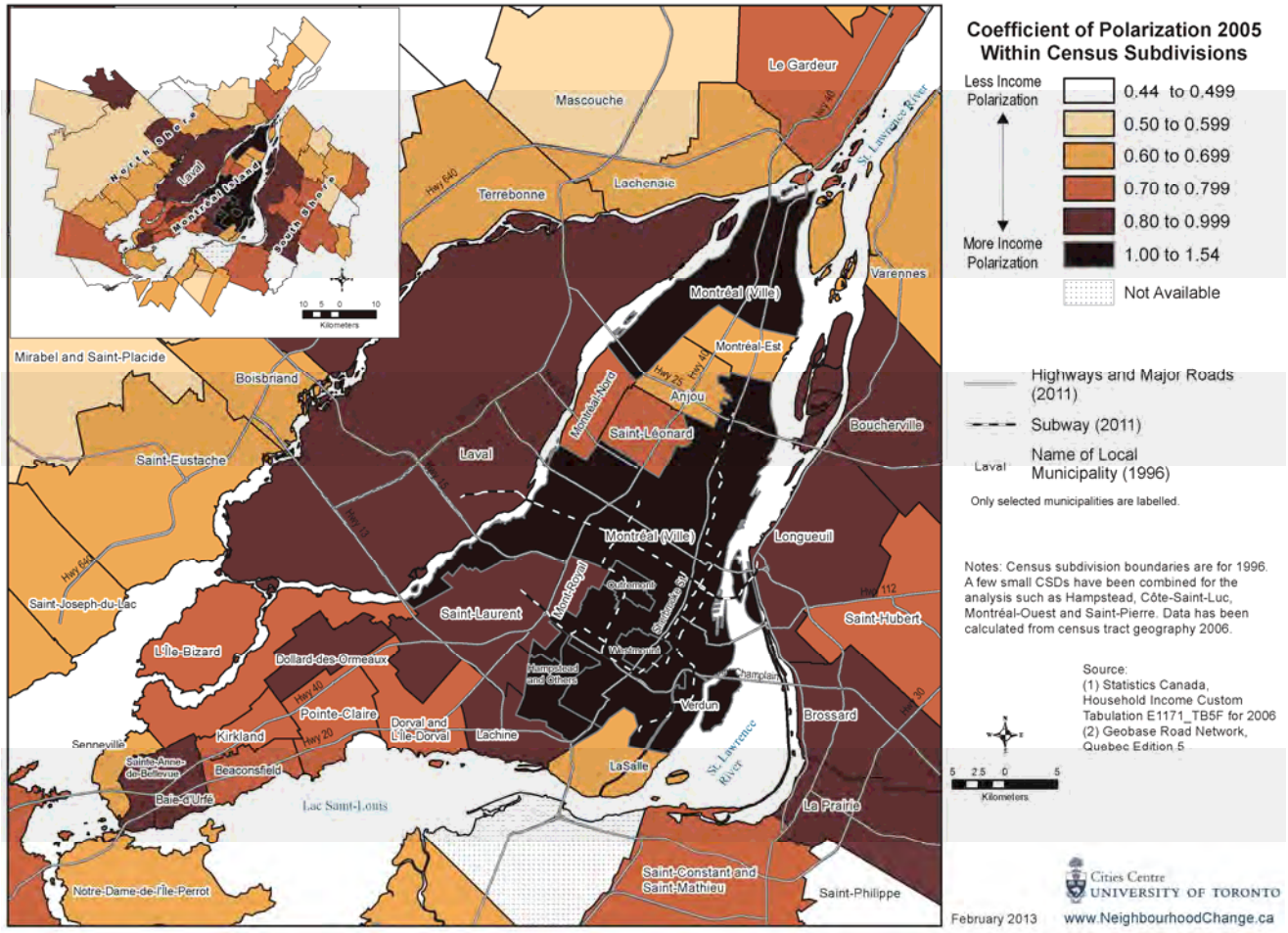
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 41: Coefficient of Polarization (CoP) within Municipalities, Montréal CMA, 1990



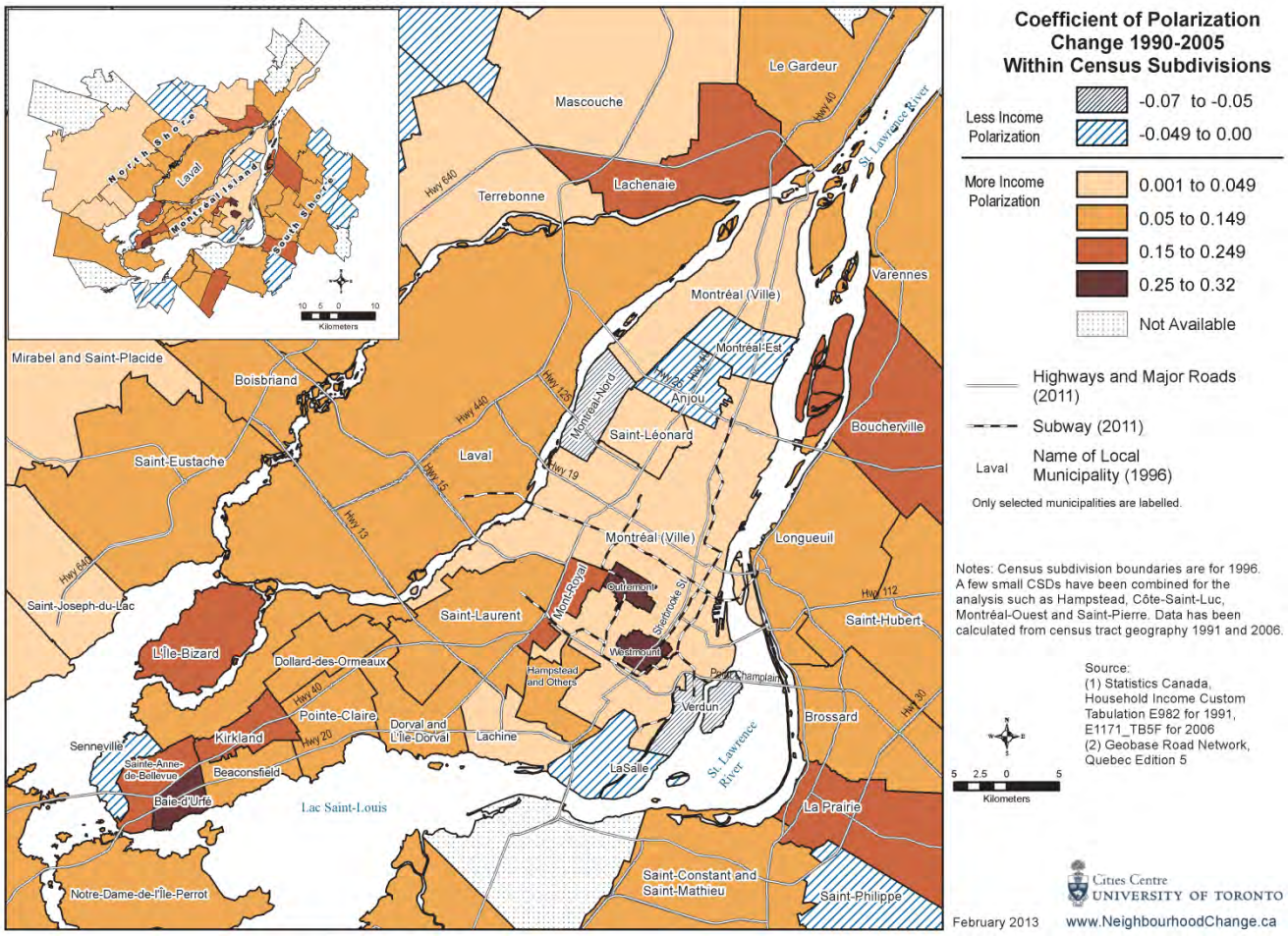
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 42: Coefficient of Polarization (CoP) within Municipalities, Montréal CMA, 2005



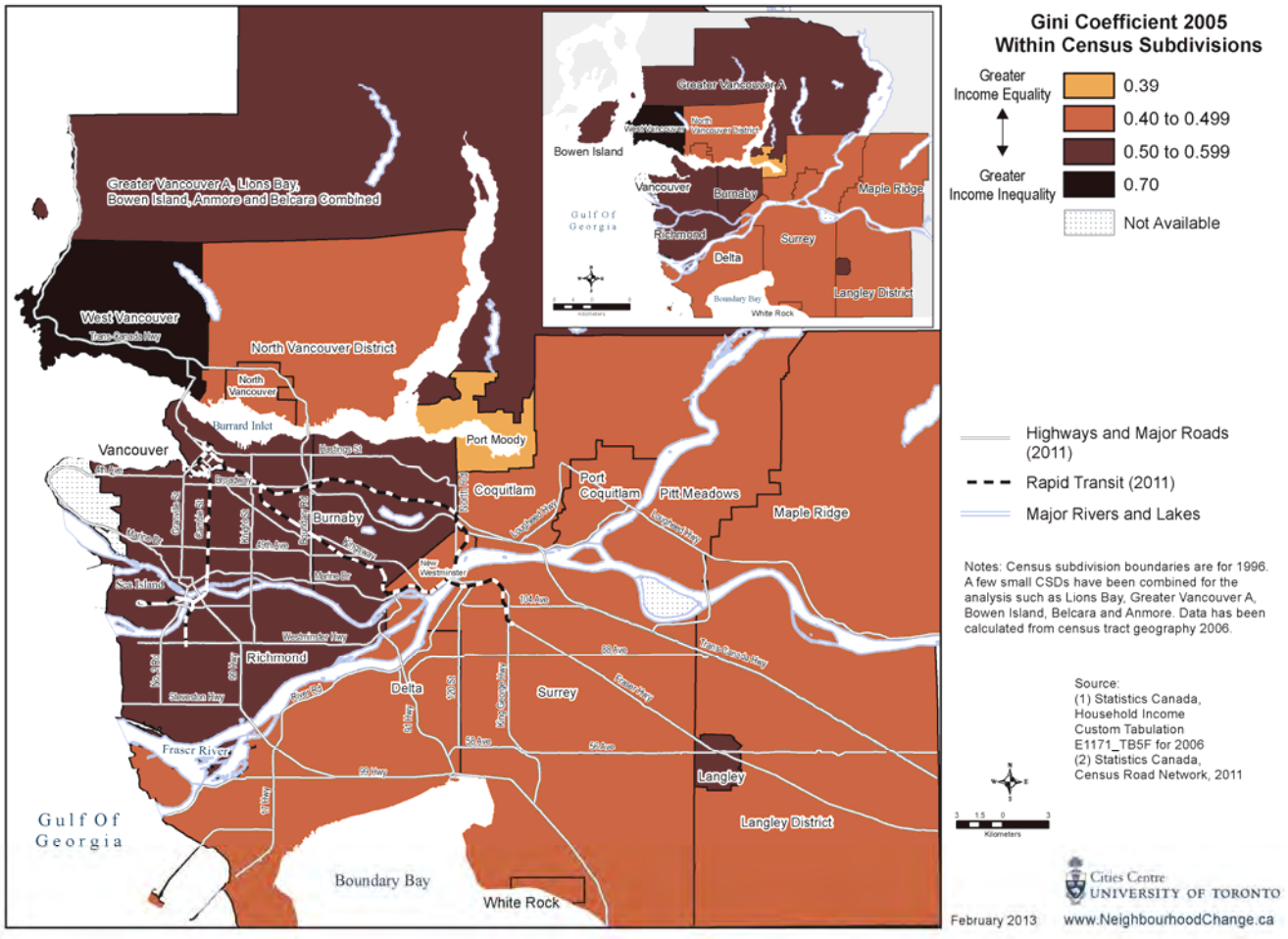
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 43: Change in the Coefficient of Polarization (CoP) within Municipalities, Montréal CMA, 1990–2005



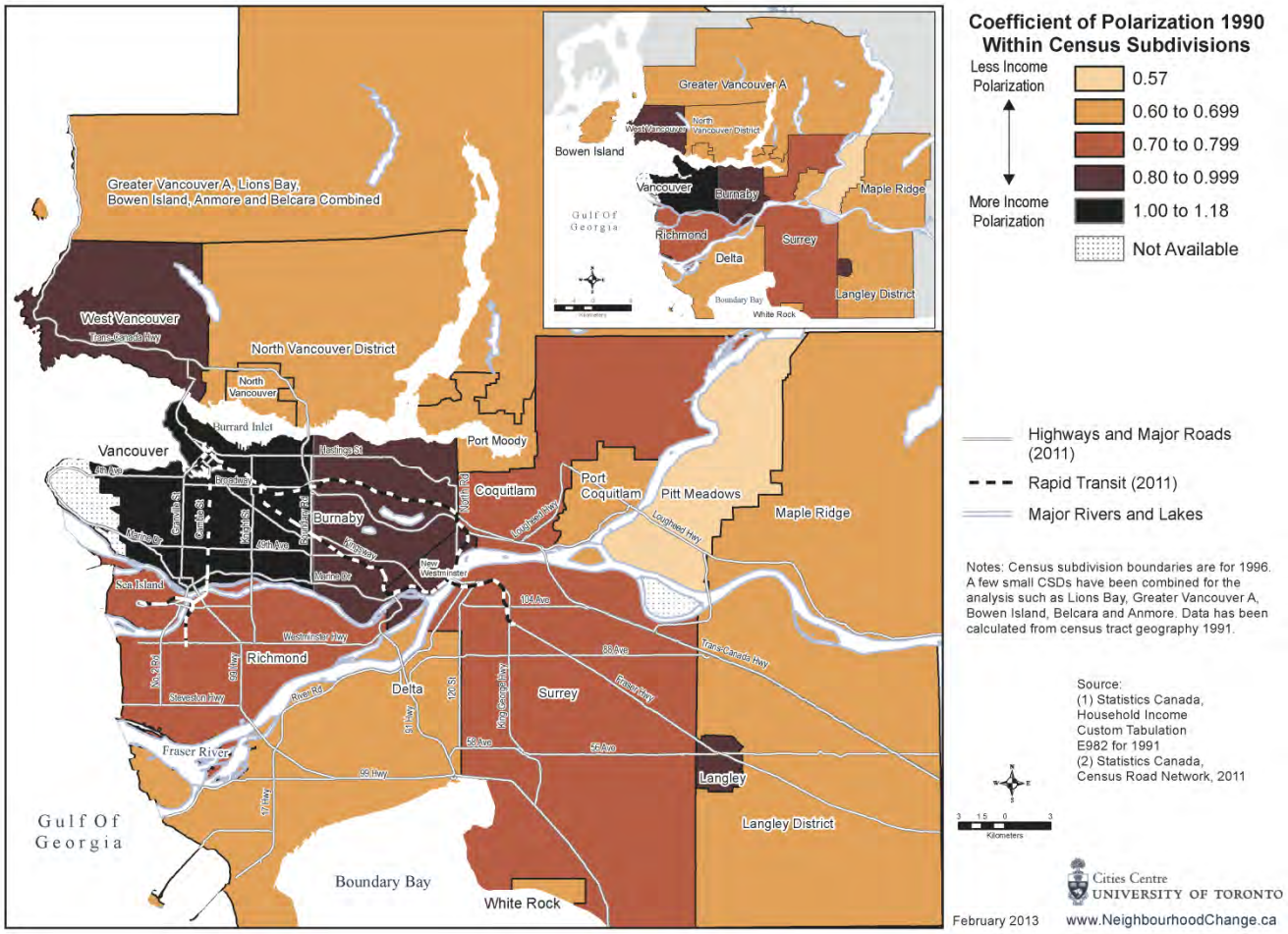
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 44: Gini Coefficient of Income Inequality within Municipalities, Vancouver CMA, 2005



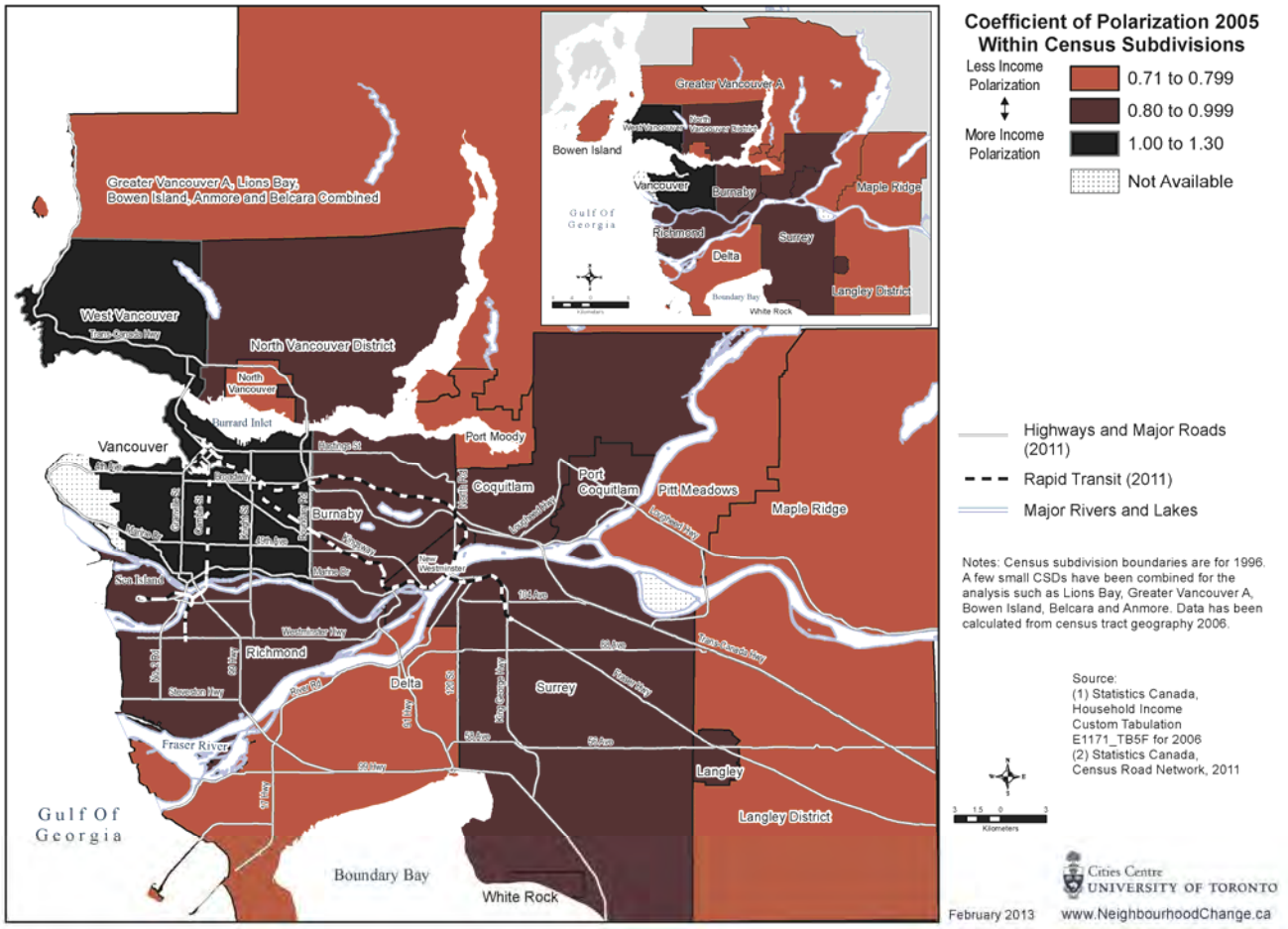
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 45: Coefficient of Polarization (CoP) within Municipalities, Vancouver CMA, 1990



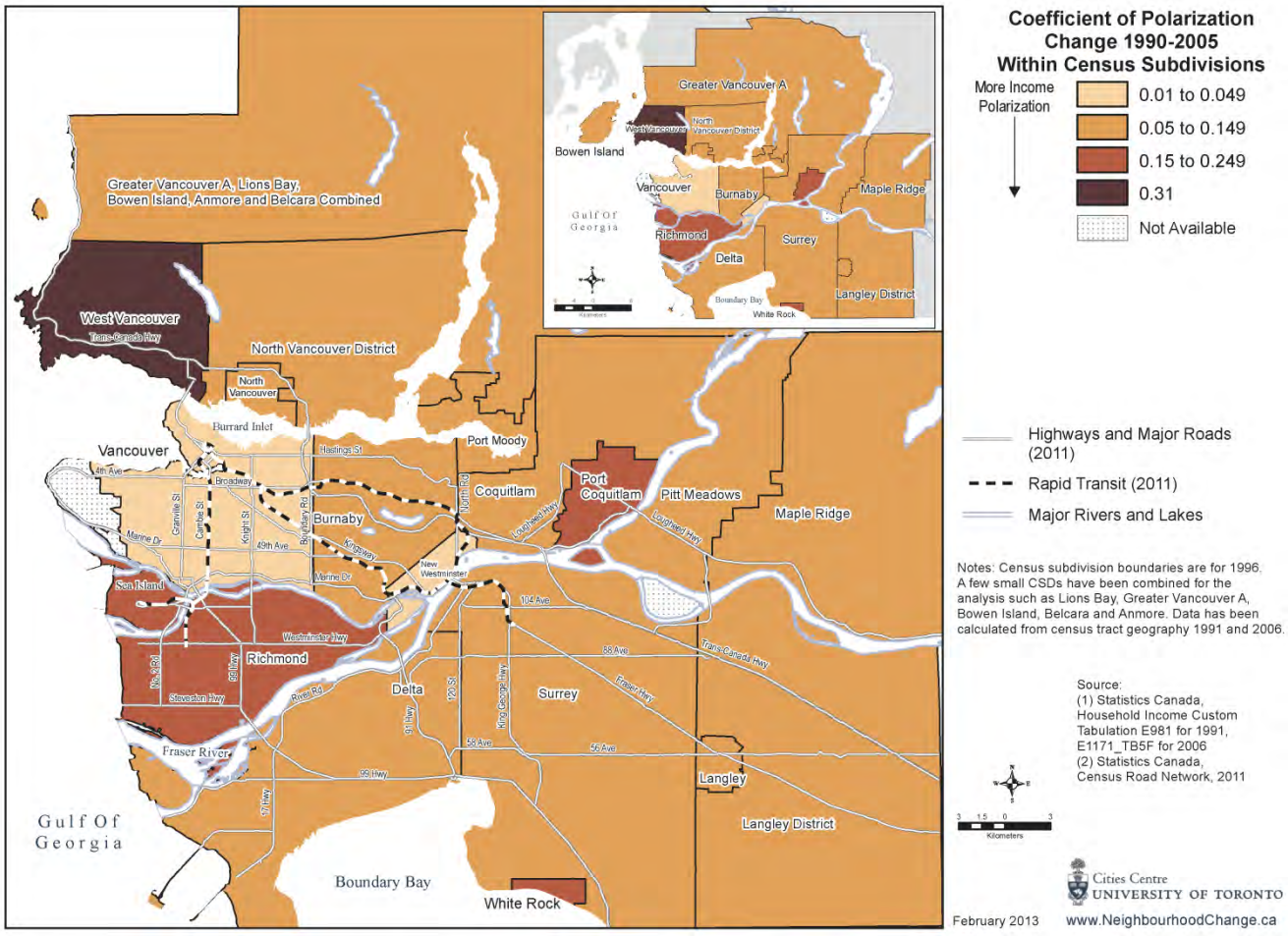
Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 46: Coefficient of Polarization (CoP) within Municipalities, Vancouver CMA, 2005



Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.

Figure 47: Change in the Coefficient of Polarization (CoP) within Municipalities, Vancouver CMA, 1990–2005



Source: Calculated from Statistics Canada, Census 1971–2006, Custom Tabulations, E1171, E982. Map by Richard Maaranen.