

Design Rationale for the CMA Census Tract Income Map & Graph Series, 1970 to 2010

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Introduction

The purpose of this map and graph series is to explore the spatial and distributional patterns of average individual income by census tracts for 1970, 1980, 1990, 1995, 2000, 2005 and 2010 in the Montréal, Toronto, Vancouver, Calgary, Winnipeg and Halifax Census Metropolitan Areas (CMAs) using a comparable, standardized methodology. Although the data were collected in June of each census year the income data are for the previous calendar year. Thus, 1970 refers to income data for the calendar year 1970 collected when the census was undertaken in June 1971.

This document explains the rationale behind the design of the maps and graphs and answers some questions that might be asked about the choices that were made. Producing a standardized and presentable set of maps and graphs for six CMAs over a forty-year period has been a challenging task. As often happens in this kind of analysis many variations of the maps and graphs were produced before the final versions were agreed upon.

Various members of the Neighbourhood Change Research Partnership (NCRP) team located in each of the six CMAs helped shape the design and content of these maps and graphs. Their local geographic knowledge and design input was invaluable to the process.

Geography and Data Definitions

Before considering the design rationale for the maps and graphs it is important to clarify some important terms and acronyms that appear in the subsequent discussion. These include Census Metropolitan Area (CMA), Census Tract (CT), Municipality and Average Individual Income. The basic definitions are taken from Statistics Canada's 2006 Census Dictionary.

Census Metropolitan Area (CMA)

An area consisting of one or more neighbouring municipalities situated around a major urban core. A census metropolitan area must have a total population of at least 100,000 of which 50,000 or more live in the urban core. After 1971, Statistics Canada began to analyze the commuting patterns of workers between municipalities and the urban core as one criterion for the inclusion of a municipality in a CMA.

The phrase "city region," as used in the NCRP analysis, usually means the CMA but it can refer to a larger area. The Greater Toronto Area, for example, is a larger area than the Toronto CMA and usually includes Oshawa to the east (centre of its own CMA) and Burlington to the west (part of the Hamilton CMA).

Census Tract (CT)

A small and relatively stable area that usually has a population of 2,500 to 8,000. Census Tracts (CTs) are located in large urban centres, including CMAs that must have an urban core population of 50,000 or more. When the population of a census tract exceeds the threshold noted above, the tract is divided within its existing boundaries and two or more tracts are created out of the original tract.

For the purpose of this map series, we often equate a neighbourhood with one CT or groups of CTs. It should be noted, however, that a CT is not necessarily a neighbourhood in the sociological sense of the term.

Municipality

An area that is a municipality or is deemed to be equivalent to a municipality for statistical reporting purposes (e.g., a Native reserve or an unorganized territory) may deviate from common usage. Laws specific to each province and territory in Canada define “municipal” status.

In census terminology, local municipalities are known as Census Subdivisions (CSDs) and regional municipalities as Census Divisions (CDs). For example, in the Toronto CMA, the region of Peel is a CD and Mississauga, Brampton, and Caledon are CSDs within Peel.

Average Individual Income

Total income is self-reported for persons 15 years of age and over from all sources, before taxes for the full calendar year prior to the census year. Income includes wages, salaries, pensions, social assistance, investments and other monetary sources. In the 2006 census income figures became more accurate as tax returns, when respondents gave consent, were used for the first time to verify income responses to the census. For the 1971 census, income data were collected from a 1/3 (33%) random sample of the population, reduced to 1/5 (20%) in all subsequent census years.

The 2010 average individual income data are based on a custom data purchase from Canada Revenue Agency. The data include all taxfilers in each CT. The taxfiler data were aggregated to the 2006 CT boundaries. These data were obtained because the National Household Survey, a voluntary survey, replaced the census long-form survey that was to be undertaken in 2011. Comparison of the 2010 taxfiler data with the 2006 census data indicates that the taxfiler data are a good substitute for the long-form census data. The National Household Survey data have not yet been released but there is considerable concern about their reliability. The 2010 Canada Revenue Agency data will enable us to compare the 2010 taxfiler data with income data from the 2011 National Household Survey.

Map and Graph Design Rationale

The percentages of each income category on the maps showing average individual income for CTs by census year for each CMA and the bar graphs for the same census years and CMAs are based on the same percentage breakdown of income. This was done to maximize comparability. Individual maps were created for each CMA for seven years of census data, 1970, 1980, 1990, 1995, 2000, 2005 and 2010. In contrast, the bar charts show the income data for all years together on the same chart by individual CMA.

1. Census Tract Boundaries and Where Population Lives

Census tracts (CT) are mapped using the boundaries that existed in each census year, except for the 2010 taxfiler income data which is mapped to 2006 CTs). This is a cross-sectional approach to

defining census tract boundaries. As population increases at the edge of the CMA or in newly redeveloped older parts of the CMA existing CTs are subdivided, thus creating new CTs and keeping the average population of each CT relatively stable.

Census tracts cover the entire land area of each CMA meaning they include all non-residential land uses such as parks, industrial areas and airports. Generally, the geographic size of CTs indicates population density with smaller, more densely populated CTs located in the urban core and larger, less densely populated CTs in the suburbs and rural areas. Statistics Canada has a guideline (not a strict rule) of defining CTs as areas containing at least 2,500 people, though a few CTs may have populations much less than that.

The accuracy of showing where people live in the CMA could be improved by delineating residential and non-residential areas on the maps. However, historical land use data in digital format for all six CMAs for all seven years is not available. The production of maps that combine income and land use in an easy to read way is an option for future research. We considered the use of land use data from the 2011 DMTI Spatial CanMap dataset which is available to us for all six CMAs but found the quality and accuracy of the land use classification to be inadequate.

2. Municipal Boundaries

Municipal boundaries are shown as they existed in each census year. An exception is 2010 incomes, which are mapped to 2006 census geography.

Because the names of many former municipalities continue to be used by local residents as community names long after being dissolved into a larger city we label many of these on the maps.

1970. For 1970 no official digital boundary file was available with the result that municipal boundaries were built from groupings of CTs using the 1971 Census Geography Tape File from Statistics Canada. We assume this is a reasonably accurate picture of municipalities as they existed in 1970.

Toronto. In the Toronto CMA, a few small municipalities were dissolved or reconfigured into a larger one after the 1971 census, such as Streetsville and Port Credit which became part of Mississauga. In 1998 (after the 1996 census) the former municipalities of Toronto, Scarborough, North York, Etobicoke, East York and York were amalgamated into the current City of Toronto. Over time, a few new municipalities were added to the northern edge of the Toronto CMA as population grew and more workers commuted to the urban core. These include Uxbridge, East Gwillimbury, New Tecumseth, Mono, Orangeville, Halton Hills and Milton.

Montréal. Municipal boundary shifts in the Montréal CMA are complicated. Local municipalities were originally amalgamated in 2002, and then partly de-merged in 2006. There were 91 local municipalities in the Montréal CMA in the 2006 census and many of these do not have consistent boundaries over time (e.g. there were as many as 133 in 1996 but only 87 in 1981). Therefore, it was decided not to show the boundaries of these municipalities in order to improve the legibility of the income patterns on the maps. Instead, we selectively label a few municipalities by the name of the municipality, as it existed at the time based on input from our research partners in Montréal. Given serious technical and visual difficulties in mapping Montréal CMA municipal geography over time, we opt to simply show the boundaries of the larger regional municipalities (census divisions or CDs) only on the 2005 and 2010 income maps with a subtle, thin black outline.

Halifax. In the Halifax CMA, the City of Halifax along with Dartmouth, Bedford and other municipalities were amalgamated into one single municipality in 1995 though this change was not reflected in Statistics Canada's census boundaries until 2001. In 2001 and 2006, the Halifax CMA was almost entirely defined by the City of Halifax with a few other scattered municipalities such as Cole

Harbour 30, Beaver Lake and Sheet Harbour. As stated earlier, Statistics Canada's definition of a municipality (census subdivision or CSD) in the census includes Native reserves that are deemed to be municipal equivalents for statistical reporting purposes. Some of these are included in the recent Halifax data.

Winnipeg. The City of Winnipeg was originally amalgamated in 1972 (known as the "Unicity") by combining a number of smaller municipalities but in 1993, the suburb of Headingley separated from the Unicity. Additional adjacent municipalities such as Rosser, St. Clements, Springfield and several others have been incorporated into the Winnipeg CMA over time as population increased.

Calgary. In Calgary, the City of Calgary was the same area as the CMA in 1971 and 1981. By 1991, the CMA was expanded to include nearby municipalities such as Cochrane, Chestermere and Airdrie due to population growth and economic ties (e.g., commuting workers) with the City of Calgary. The boundary of the City of Calgary was enlarged several times over the years by annexing portions of land from surrounding municipalities.

Vancouver. In the Vancouver CMA, several new municipalities were created following the 1971 census. These were often split off from areas within the large Greater Vancouver Subdivision A municipality (GVSA) covering the northern section of the CMA. Bowen Island, which is a single census tract, was added to the CMA after the 1971 census becoming part of the GVSA. In 1999, Bowen Island was incorporated into its own municipality and separated from the GVSA. Other new municipalities that were incorporated after census 1971, splitting off from existing municipalities include Belcarra, Anmore, Capilano 5, Burrard Inlet 3, Mission 1, Seymour Creek 2 and several others. Some of these are Native reserves which can be very small in area, sometimes smaller than a single census tract, and counted as municipal equivalents in the census. The University Endowment Area (UEA) was its own census subdivision up until census 1996. In census 2001, the UEA was dissolved into the much larger GVSA municipality and the UEA name is no longer used in the census boundary files.

3. Highways and Rapid Transit

The maps show key highway and road thoroughfares and rapid transit routes (for CMAs with subways or light rail transit) for all years as they exist in the present. They are not intended to show the historical evolution of these transport systems. Instead, they are used to provide visual consistency between the different years and help users orient themselves, find approximate locations, and identify particular neighbourhoods.

The rapid transit lines for Toronto, Montréal, Vancouver and Calgary CMAs are from the "CanMap Route Logistics 2010" dataset by DMTI Spatial.

For the highways and major roads, we consulted two different data sources as they were each found to have shortcomings: Statistics Canada 2011 Census Road Network Files (CRNF) and the Geobase Road Network Files (GRNF) which is spatial data produced by various federal and provincial government agencies (see www.geobase.ca)

For example, in the Calgary CMA, the CRNF was missing features like the recent Stoney Trail extension, which was captured in the GRNF. In the Winnipeg CMA, the GRNF has numerous coding errors for road attributes so the CRNF was used instead.

The decision about which highways and major roads to show on the maps began with a review of the spatial coverage provided by various road network file attributes (such as road type = "highway", road class = "arterial", road rank = "1"). The road selection was subsequently refined with the input of local NCRP team members.

4. Water Bodies

The maps display some water body and river details for geographic reference and visual consistency but since the focus is on the spatial pattern of neighbourhood incomes and not the physical landscape their full detail is not shown. The exception is the Halifax CMA where we show all the inland lakes found in the lake water boundary file for the 2006 census.

The cartographic generalization (or level of detail) of digital census boundaries in relation to shorelines, census tracts and municipalities has been improved by Statistics Canada over time and this has the disadvantage of causing alignment inconsistencies when attempting to produce a time series of maps. This was especially problematic in Halifax and Vancouver where there were inconsistencies in the shorelines and the small islands of their harbours over time.

For the 1991 and 1996 censuses Statistics Canada provided both a "digital boundary file" (DBF) and a "digital cartographic file" (DCF) for mapping purposes. The DBF generally has boundary lines that extend into the water while the DCF clips the lines to the shoreline.

For the 2001 census, the DBF/DCF were replaced by a new "cartographic boundary file" (CBF) which integrates the census boundaries and shorelines into a single layer, although inland lakes are stored in a separate layer of water features.

For the 2006 census, separate CBF and DBF files were available.

In 2012, the University of Toronto Map Library re-released the 1981 census tract boundary files for Canadian CMA's with improved detail in the shorelines and alignment with 2011 census tract boundaries. We have incorporated these updated boundary files in this series.

All these boundary files were reviewed in the process of producing the maps. However, it was still necessary to perform many tasks such as clipping census tract boundaries to shorelines, moving municipal polygon nodes to align properly, and removing small lake holes within census tracts in order to make the maps more aesthetically presentable and consistent over time. A significant portion of this work was performed along Halifax harbour and Vancouver's Burrard Inlet and Gulf of Georgia. This is not a simple and quick process and it is recognized that some flaws still remain in the map boundary lines but major improvements to the original data sources have been made.

5. Income Categories are Standardized

Five income categories with the same fixed intervals were defined for each year in order to easily compare one map year with another and one CMA with another. For example, by keeping the middle-income category a fixed width of 20% above/20% below the CMA average, the movement of neighbourhoods into and out-of the middle range can be easily detected. Other data classification methods such as quantiles (division of the income data into equal size categories) make map comparisons over time and between CMAs very difficult as the income categories will not be standardized.

Q & A about the choices / compromises made

Does inflation affect the income categories?

The income categories are unaffected by inflation since the average income of a CT in proportion to the CMA average would be the same regardless of the dollar amounts used (current dollars or the original values).

Why not also map income for 1975 and 1985?

Spatial data files for the 1976 census are not available so no census information from that year can be mapped.

For the 1986 census, there are various concerns with data availability, quality, and comparability as this was a more limited census with fewer variables compared to other years. We decided that it was not necessary to deal with the limitations of the 1986 census considering better availability and data quality for the other years.

Why not map household income instead of individual income?

The variables used to map income should be consistent with the purpose of the map. If the objective is comparability over time, mapping average individual income makes the most sense. Furthermore, individual income provides the best measure of an individual's position within the labour market and thus his/her ability to command income and hence social status.

In contrast, household income provides the best measure when one is concerned with household consumption patterns, particularly with respect to the housing market. However, comparability over time and among different places is compromised due to changes in household size. The average household size in Canada has been falling since at least the 1970s. In 1971, there were 3.6 persons per household on average. By 2006, this dropped to 2.5 persons. This is driven in part by an aging population but also by many working age adults choosing to live alone. All other things being equal, fewer adults in the household mean lower household income. This makes comparisons of household income patterns more difficult to interpret, and possibly misleading with respect to the socio-economic status of individuals living in various areas of the city. For example, in previous Cities Centre research on gentrification trends in Toronto, Montreal and Vancouver 1961-2001, Walks and Maaranen, found that household income masks the effect of well-paid urban professionals moving into downtown neighbourhoods, often to newly built condominiums. Many of these people have above average individual incomes but below average household income since they live alone. Individual income has the advantage of detecting the upgrading of income levels in downtown neighbourhoods and the downgrading in other parts of the city, independent of shifts in household size, and variation in household size among and within cities.

Why not map median income instead of average income?

There are two reasons for using average income. First, in contrast to median income, average income is available in the census, for a longer period of time.

Second, median income (which divides the population equally in half by income ranking) reduces the effect of extremely high and low incomes, which in turn minimizes the full extent of the income divide in the city. Median income is also limited in its application – for example, it cannot be used to calculate most other indices of income dispersion and inequality.

By contrast, using average income avoids these issues.

Why not map after-tax income instead of income before-tax?

After-tax income did not become available until census 2006 and thus cannot be used to map historical trends.

Why not map employment income instead to remove the effect of low-income seniors?

Census data demonstrates that the population is aging and seniors are generally more prevalent in the older inner suburbs. This has an effect of dampening income measures in the inner suburbs. But that is not the whole story, and it is important that all incomes are analyzed, not just those who are working. Much income now derives from non-employment based sources. This is as true for seniors (pensions, etc.) as for younger families (the more wealthy of whom derive income from investments, stock options, capital gains, etc.). An inclusive measure of income is thus particularly important for tracing the changing spatial pattern of neighbourhood incomes, and in turn understanding the growing spatial divide. If only employment incomes were examined, this would eliminate upwards of one-third (30%) of total income within neighbourhoods.

Why is Income not available for some census tracts?

If income is available, we map it. If income is not available, there are various reasons for that. It could be because there weren't enough people living there at the time. The 1991 census dictionary states that 250 people is the minimum to release income figures and protect the confidentiality of census respondents (the 1970 and 1980 maps do show income for a couple of CTs with populations less than 250).

Or it could be an area with a concentration of people living in collective dwellings which are dwellings used for commercial, institutional or communal purposes. Examples of collective dwellings include hotels, prisons and nursing homes. Statistics Canada usually does not release the average incomes for many collective dwellings as well as areas identified as Native reserves (sometimes they do, sometimes they don't). Finally, they also do not release average incomes when a relatively large number of census responses are deemed inaccurate or incomplete.

What about the comparability of 2005 census incomes and 2010 taxfilers?

Income data in the census are based on a 20% random sample of the population age 15 and over while Canada Revenue Agency (CRA) data cover everyone who filed a tax return or about 74 % of the total population. Thus, CRA data include a much larger proportion of the population. We also examined the correlation between 2007 taxfiler incomes and 2005 census incomes, based in each case on 2006 census

tract geography, and found a very high correlation between the two data sets. Thus, we conclude that the 2010 taxfiler income data are reasonably comparable to the 2005 census income data.