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Divided Landscapes of Economic Opportunity: The Canadian Geography of Intergenerational Income Mobility

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Abstract

Intergenerational income mobility varies significantly across Canada, with the landscape clustering into four broad regions. These are not geographically contiguous, and provincial boundaries are not the dividing lines. The important exception is Manitoba, which has noticeably less intergenerational mobility among eight indicators derived from a large administrative data set for a cohort of men and women born between 1963 and 1970. These indicators are derived for each of the 266 Census Divisions in the 1986 Canadian Census. They show that higher mobility communities are located in Southwestern Ontario, Alberta, and Saskatchewan, and tend to be correlated with lower poverty, less income inequality, and a higher share of immigrants.

KEYWORDS: Intergenerational mobility, equality of opportunity, geography
JEL Classification: D63, J61, J62

[*]I am professor of economics with the Graduate School of Public and International Affairs at the University of Ottawa, Ottawa Canada. The first draft of this paper was written while I was a visiting professor of economics at Harvard University during the 2015/16 academic year. I am grateful to Yuri Ostrovsky for his help in updating the data and producing the statistics upon which my analysis is based. This was possible with the cooperation of Statistics Canada through a cost recovery project, and the financial support of the Social Sciences and Humanities Research Council of Canada through Insight grant number 230936-191999-2001. Mary-Ellen Maybee and Brigit Levac of Statistics Canada kindly made Shapefiles associated with the 1986 Census available, allowing me to map the data, which was done using R. I also thank Raj Chetty, Nathan Hendren, Branko Milanovic, Martin Nybom, and Jan Stuhler for their feedback on an earlier draft. Versions of this paper have been presented at the April 2016 workshop on Inequalities and Families, organized by the Research Group on Human Capital at the Université du Québec à Montréal; in May 2016 to the 41st Congress of the Association des Économistes Québecois held in Québec City, to the 15th Annual North American Basic Income Guarantee Congress held in Winnipeg, and at the Northwestern University Global Inequality Workshop in Evanston Illinois; in October 2016 to the Sixth Annual NYU/UCLA Tax Policy Symposium on Tax Policy and Upward Mobility held at UCLA, Los Angeles California; in November 2016 as The Shoyama Lecture presented in Ottawa to the Department of Finance, Government of Canada; to the Canada Seminar at Harvard University in February 2017; to the Workshop on Interdisciplinary Approaches to Inequality and Mobility held at Duke University in March 2017; to the 51st Annual Meetings of the Canadian Economics Association held at St Francis Xavier University, in Antigonish, Nova Scotia; and in departmental seminars at the Graduate Center, City University of New York, the University of Ottawa, and the University of Waterloo. The statistics used in this paper, along with a host of supplementary information and data, as well as an online appendix examining the robustness of the findings, are available at MilesCorak.com/Equality-of-Opportunity. I can be reached at the same web site, and @MilesCorak.

1 Introduction

"Equality of opportunity"—how likely it is, how it varies, and what causes it—is an important issue in many rich countries. In part this is because of significant increases in income inequality, and the now generally accepted view that higher inequality is associated with less social mobility. Former US President Obama and his senior advisers have made reference to this (White House 2013; Krueger 2012; Furman 2016), as have important international organizations like the International Monetary Fund, the Organization for Economic Cooperation and Development, and Central Bankers like Janet Yellen (2014) of the US Federal Reserve and Mark Carney (2014) of the Bank of England. This public policy attention warrants a certain caution. "Equality of Opportunity" is a multifaceted concept that cannot be simply defined and measured, and while income mobility—the dimension most closely related to many policy discussions—may be an important aspect, it clearly is not the whole story. I offer an analysis of only this dimension, the degree to which adult incomes are related to the incomes of the families in which children were raised, in other words the extent to which economic position in one generation echoes into the next. Even with this focus, there are a host of different statistics used to describe the process. My main contribution to the understanding of intergenerational income dynamics in Canada is to offer estimates of mobility across space in a way that pays attention to a broad suite of statistics capturing the many different ways academic researchers, policy makers, and the general public view the process.

My primary objective is to estimate the degree of intergenerational income mobility within each of hundreds of sub-provincial regions. The income tax forms Canadians submit to their governments is the information source, and offers very large sample sizes, in principle the entire population upon which I focus, those born between 1963 and 1970. Up to now the advantages of these data have been exploited to very precisely measure the degree of intergenerational mobility, to examine the process by income source, and to estimate how it varies across the income distribution. All of this is for the country as a whole, yet the large sample holds the potential for more detailed sub-national analysis. I use these intergenerationally linked T1 forms to calculate and examine different dimensions of economic mobility for each of the 266 Census Divisions defined in the 1986 Canadian Census.

In this way I hope to paint a detailed picture of the extent to which adult outcomes are related to family background, and how the relationship varies across the country. Many of the factors and policies that theory suggests influence generational mobility vary significantly across space, or fall within the domain of provincial and municipal governments. Schooling, health care, employment opportunities for youth, and basic income support for families involve not just the federal government, but in a major way provincial legislatures and city councils. A sub-national portrait allows policy makers to know their own regions, and to make comparisons with others. While the existing literature suggests that Canada is an intergenerationally mobile country, and in particular more mobile than the United States, a national focus potentially masks significant geographic variation within the country, and places a blind spot over the experiences and needs of certain demographic groups and communities.

I use a suite of statistical measures that collectively offer a fuller picture of intergenerational income mobility. This process cannot be summarized with one statistic, yet the

existing economics literature puts a great deal of emphasis on the intergenerational elasticity, the percentage difference in a child's adult income for a one percentage point difference in parent income. This is a valuable relative measure of mobility that offers a summary indicator of how income inequality evolves across generations. But it is not a complete description of the process, nor does it relate to some policy-relevant ways of thinking about it. More specific measures are needed to speak to obvious concerns: to what extent does the current generation earn on average more or less than the previous generation, to what extent are rank and relative position transmitted across generations, and to what extent are low and top incomes transmitted intergenerationally? Income mobility, rank mobility, and directional mobility—particularly upward mobility from the bottom—all relate to aspects of social welfare, and capture the political imagination.

I also fully account for the role and outcomes of women, an important gap in the existing literature. Focusing on men—fathers and sons—might be a convenient simplification. If only men work in the market, then family income is the income of the father. If the participation rates of women are low and intermittent as a result of child care responsibilities falling upon them, then their income is more easily approximated by the income of their partners. Focusing on adult sons makes the analysis easier by avoiding the need to model these other dimensions. These assumptions skew our understanding of the intergenerational transmission process, and they potentially put aside significant numbers of individuals, both men and women, raised by single mothers. My analysis is based on "family" income, defined as the total income of both partners, including periods when there is only one parent present. The analysis is conducted for sons and daughters without distinction.

I find that intergenerational income mobility varies significantly across the country with a significant fraction of children raised by low income parents facing considerable chances of an intergenerational cycle of poverty, and limited opportunity of rising to the top. At the broadest level the Canadian landscape of economic opportunity should be thought of as being divided into four broad regions. These areas are not geographically contiguous, and provincial boundaries are not the dividing lines. The important exception is Manitoba, which stands out as having noticeably less intergenerational mobility along the eight indicators that I use. This exception has more to do with low average levels of income among some communities in the province, than with provincial borders. Higher mobility communities are located in Southwestern Ontario, Alberta, and Saskatchewan, and tend to be areas with lower poverty, less income inequality, and a higher share of immigrants.

2 Theoretical frameworks and statistical indicators

The analysis of the intergenerational transmission of status as measured by earnings and incomes has developed tremendously, and it is fair to say that its starting point is a statistical model that assumes a continuous linear relationship. The development of this literature reflects a constructive interaction between economic theory, availability of data, and the refinement of appropriate statistical techniques. Becker and Tomes (1986; 1979), and Loury (1981) offer the workhorse theoretical model. A window to put their framework into practice

opened in the 1990s with the maturing of the Panel Study of Income Dynamics, offering American data spanning a long enough period to link parent incomes to the adult incomes of their children. This window was also widened because of a growing understanding of a number of measurement issues and how to deal with them, mainly associated with errors in the measurement of long-term income and with its evolution over the life-cycle. Surveys of this literature include Björklund and Jäntti (2011), Black and Devereux (2011), Blanden (2013), Corak (2013; 2006), Mulligan (1997), and Solon (2002; 1999).

Becker and Tomes (1986, 1979) guide empirical research by motivating the analysis of the degree of "regression to the mean" in incomes across generations, most commonly measured as the least squares estimate of the percentage change in a child's adult income associated with a percentage point change in the parent's income. This intergenerational income elasticity is a purely relative measure of intergenerational mobility, offering a summary indicator of the degree to which children tend to occupy the same relative position in the income distribution as their parents a generation earlier.

The Becker-Tomes model formalizes the influence of "inherited" characteristics, family investments in the human capital of their children, and the labour market payoff of these skills and characteristics on the earnings outcomes of children. As adapted by Solon (2015; 2004) the model predicts that the intergenerational earnings elasticity will be lower when labour market inequality is higher. This is because more unequal labour markets—the differences in incomes reflecting rising returns to human capital—imply higher income parents have both more resources and greater incentive to invest in the earnings capacity of their children, and to engage in other activities that give them a leg-up in school and in finding jobs promoting their careers. We can think of this prediction as pertaining to both differences between communities across space, or changes within a community through time. Theory also suggests that we might quite reasonably expect the intergenerational elasticity to vary across space for a number of reasons. Communities may vary in the strength of their families—with respect to both monetary and non-monetary resources—and also in the structure of their labour markets and opportunities for the next generation to fully realize their potential. The intergenerational elasticity may also vary across space because of differences in the amount of public and community-level investments in the human capital of the next generation. Similar predictions fall out of more refined models that recognize the distinct developmental stages through which children must pass on their way to developing their full capacities, and the important role families play in this process (Heckman and Mosso 2014; Heckman 2008).

This spatial variation might be seen as a dimension of nonlinearities in the mobility process, implying either intergenerational cycles of poverty or of privilege. Certainly, the theoretical literature has from the start paid, and continues to pay, attention to the possibility of nonlinearities in the intergenerational income elasticity. These are associated, in the first instance, with credit constraints in the capacity of lower income families to finance the human capital development of their children. The implications of this failure in capital markets to permit parents to use the human capital of the next generation as collateral in financing an optimal investment in their children are examined by, among many others, Becker and Tomes (1986), Becker et al. (2015), Caucutt and Lochner (2017), Grawe (2004), Hanushek, Leung, and Yilmaz (2014), Loury (1981), and Han and Mulligan (2001).

At the same time it is fair to say that economic theory offers empirical researchers less guidance in their use of other statistics. Nonlinearities are perhaps more directly related to the concerns of sociology, which seems from the start to assume distinct discontinuities. While the intergenerational elasticity falls naturally out of the Becker-Tomes framework, it is not the only policy relevant way of measuring the process. The relationship between family background and adult attainments has a long pedigree in the social sciences, based most importantly in the sociology literature pioneered by among others Blau and Duncan (1978) in the United States, and Erikson and Goldthrope (1993) in the United Kingdom and Europe. Obviously, this is a longstanding literature with many strands, but very broadly put it views social mobility as an aspect of the intergenerational transmission of "status," often, but not always, operationalized as the influence of parental education and occupation on children's education and occupation. Canadian research in this frame is based on a number of different surveys, with landmark work being described in Boyd et al. (1981), and many other researchers contributing and following up, among others: Beland (1987), Creese, Guppy, and Meissner (1991), Djabir and Fougère (2017), Isajiw, Sev'er, and Driedger (1993), McRoberts and Selbee (1981), and Wanner and Hayes (1996.). This remains an active area of research, but the important lesson for measurement is that intergenerational dynamics are to be gauged by the degree of rank mobility across discrete categories, as captured through transition matrices.

Though this literature is often viewed as being empirically driven, and in some sense less satisfactory for not being based on clear choice theoretic models, this is not entirely the case. Durlauf (2006; 1996) recognizes that persistent poverty may be associated not simply with differences in individual investments in human capital, but also in social influences on these investments, influences associated with different forms of group membership and identity. Group membership need not have a geographic dimension. However, some models associated with the financing of local public goods, like education, certainly suggest that 'neighbourhoods' in a geographic sense can be the basis for group identity. This may be the case even if neighbourhood formation is endogenous. This perspective gives a more refined justification for the possibility that intergenerational mobility may vary across space, and in particular for what Durlauf (2006) refers to as 'poverty traps.' This calls for a certain flexibility in the way empirical research attempts to measure mobility.

Nybom and Stuhler (2015) review alternative rank-based statistics in order to highlight distinct measurement issues: the correlation coefficient, which standardizes parent and child incomes for changes in the degree of inequality over time; the rank correlation coefficient, which depicts the strength of the relationship between income ranks between parents and children; and transition matrices defined according to particular quantiles of the joint distribution of parent and child incomes. Policy makers and the general public also think of mobility in terms of the adult income of children compared to their parents at a similar stage in the life cycle. This notion is more accurately captured by measures of absolute mobility, indicating either the extent to which a birth cohort of children earns more on average than a previous generation, or more specifically the extent to which any given child rises above, or falls below, the rank his or her parents had in their income distribution (Chetty et al. 2017; Bhattacharya and Mazumder 2011; Economic Mobility Project 2012).

All of these measures may be relevant, but there is little basis to formally choose between them. In spite of the appeal of the intergenerational elasticity because of its close tie to formal economic models, it is difficult to fully appreciate its relevance over other measures. Further, to the extent that welfare economics is based on a concern for economic outcomes, as clearly is the case in the utilitarian framework that drives much of the optimal tax literature, then it too offers less guidance in structuring empirical analysis directed to equality of opportunity. If public policy is concerned with procedure and process—with equality of opportunities—and if how an outcome is attained also influences individual and social welfare, then a utilitarian framing is less than a complete guide. For example, Saez and Stantcheva (2016) suggest as much with respect to optimal tax rates. There is a plethora of measures of equality of opportunity, and they all touch in some way on individual well-being and the broader concerns of public policy. In a sense, the theoretical literature is suggesting that unless an empirical study is specifically testing a well-articulated causal process, researchers are well-advised to be agnostic in their choice of indicators, and careful in interpretation, even if at the same time it is reasonable to expect mobility to vary with geography.

3 Lessons from the empirical literature

3.1 Canadian studies and the available data

Canadian estimates of intergenerational earnings mobility have been largely focused on accurately estimating the elasticity of parent-child incomes, and take their starting point from Corak and Heisz (1999) and Fortin and Lefebvre (1998). These studies suggest that sons' earnings are higher by about two percent for every 10 percent increase in fathers' earnings. Fortin and Lefebvre (1998), Corak (2001a), Chen, Ostrovsky, and Piraino (2017) also offer information on daughters, but it is fair to say that this literature—with the exception of Blanden (2005)—has not stressed mothers and daughters to the degree merited. Fathers' income is generally taken as the proxy for family income, and they, along with sons, are focused upon to avoid issues associated with more complicated patterns in the participation rates of women and assortative mating. The Canadian literature is also limited in its understanding of the change in intergenerational mobility over time and differences across space. Fortin and Lefebvre (1998) document the evolution of relative mobility. They examine a series of birth cohorts of men and women from the post World War II period as best as they can with Census based information on earnings estimated from broad occupation categories. Their approach, which uses two-sample instrumental variable methods applied to grouped data to estimate the intergenerational earnings elasticity, is revisited and updated by Brown (2011). Ostrovsky (2017) uses tax-based information to show that absolute mobility—the share of children earning more than their parents—has held steady at about two-thirds for cohorts born between 1970 and the mid-1980s. To the best of my knowledge there are no studies examining whether and how intergenerational mobility varies across regions of the country.

Corak and Heisz (1999) introduce the use of tax-based administrative data, but focus only on the outcomes of sons born in the mid 1960s. Their analysis measures adult outcomes

when the sons were relatively young, in their late 20s to early 30s. And while Corak, Lindquist, and Mazumder (2014) estimate the statistics depicting mobility of children relative to their own parents' rank proposed by Bhattacharya and Mazumder (2011), there remains limited information on other perspectives. These data—informally known as the Intergenerational Income Data—have also been used to look at various causal mechanisms in more detailed studies by Corak (2001b), Corak, Gustafsson, and Osterberg (2004), Corak and Heisz (1998), Corak and Piraino (2016; 2011), Grawe (2004), Oreopoulos (2003), Oreopoulos, Page, and Stevens (2008). All of this research is conducted at the national level, there being no analysis at finer geography, not even at the provincial level. The notable exception is Oreopoulos (2003) who uses the postal codes individuals report on their T1 forms to establish their location. He examines the causal impact of neighbhourhoods on the long-term outcomes of teenagers growing up in Toronto, focusing on those who lived in social housing projects.

I use an updated version of these data, which incorporates both mothers and fathers, and follows them and their sons and daughters through to 2008.[1] Chen, Ostrovsky, and Piraino (2017) use these updated data to carefully and convincingly examine biases associated with measurement error and limitations in controlling for life-cycle variations of incomes. They estimate an intergenerational elasticity of 0.32 for sons, and about 0.23 for daughters. I also use these data. To be more specific, my analysis is based on men and women born between 1963 and 1970. T1 forms are first machine readable beginning in 1978, and at the time I began this study were available up to 2008.[2] In other words, I am able to observe the adult incomes of this cohort of Canadians when they were between 38 and 45 years of age. I link these incomes to the incomes of their parents in the tax years when the children were between the ages of 15 and 19. As a result, I have a very fine indicator of exactly where in the country the children were growing up as teenagers through the postal codes the parents report on their T1 forms.

An overview of the sample sizes involved is presented in Table 1, showing both the weighted and unweighted totals from the Intergenerational Income Data as well as population estimates derived from the 1986 Canadian Census of the number of people born between 1963 and 1970. More detail on the construction of the administrative data is offered in the Appendix, along with a discussion of the derivation of the weights, and data quality concerns. The unweighted sample size represents about two-thirds of the Census population estimate, while the weighted estimates are close to 90 percent of the Census totals. These ratios vary somewhat across the provinces and territories, the weighted totals for regions west of Quebec, with the exception of Saskatchewan and Yukon, being lower as a proportion of the Census totals than in the other provinces. The discrepancy in the population estimates between the administrative data and the Census is not simply due to under-coverage of the administrative data associated with the algorithm used to link parent and child income tax returns—which requires that the child have a Social Insurance Number at some point before

[1] I undertook the direct management of this updating in cooperation with Yuri Ostrovsky, and with the support of Statistics Canada. See the Appendix and Statistics Canada (undated) for more detail on the creation and structure of the data.

[2] In fact, data up to 2009 were available, but in a preliminary version not incorporating late tax filers. I also chose not to include information after 2008 because of the possible temporary influence of the Great Recession on incomes.

Table 1: *Number of children born between 1963 and 1970: weighted and unweighted Intergenerational Income Data sample sizes compared to estimates from the 1986 Census*

Province / Territory	Administrative Data Weighted	Administrative Data Unweighted	1986 Census Total	Ratio weighted to Census
Newfoundland and Labrador	84,050	59,000	87,000	0.97
Prince Edward Island	16,750	12,400	18,100	0.93
Nova Scotia	112,900	79,350	121,700	0.93
New Brunswick	91,500	67,600	98,600	0.93
Quebec	796,650	531,000	842,950	0.95
Ontario	1,057,550	796,800	1,191,750	0.89
Manitoba	122,150	91,650	139,500	0.88
Saskatchewan	122,500	81,600	132,700	0.92
Alberta	284,550	184,250	319,550	0.89
British Columbia	304,250	206,200	344,850	0.88
Yukon	2,950	1,700	2,950	1.00
Northwest Territories, Nunavut	7,150	3,600	8,200	0.87
Canada	3,002,950	2,115,150	3,307,900	0.91

Note: All numbers are rounded to the nearest 50.

leaving home—but also selection rules imposed to ensure that permanent income is accurately measured, an issue I detail in the following sections as well as in the Appendix.

3.2 The relevance of the recent American literature

The understanding of intergenerational earnings mobility in the United States has been advanced in a major way with the release of a series of studies by Raj Chetty, Nathaniel Hendren, and their coauthors using American tax-based administrative data. Most notably Chetty et al. (2014) document the extent to which earnings mobility varies across relatively small geographic areas of the United States, these Community Zones being smaller than States but nonetheless larger than metropolitan areas and neighbourhoods. This research is also distinguished by the use of a host of statistics that chart both relative and absolute intergenerational dynamics in ranks.

Chetty et al. (2014) put international cross-country comparisons of intergenerational mobility in a different light, suggesting that within-country comparisons are equally important for understanding the process and its policy implications. It may well be that the United States has a lower degree of mobility than many other countries as suggested by Björklund and Jäntti (2011), Corak (2013; 2006), Jäntti et al. (2006) and others, but it is also the case that many regions within the United States are equally if not more mobile than many of the most intergenerationally mobile countries, while others are considerably less mobile. It is

as, if not more, relevant for public policy to make comparisons between regions of the same country.

Their research agenda has generated a significant interest among academics and policy makers in the United States, and has opened the door for detailed examinations of underlying causal mechanisms determining intergenerational mobility, as in Chetty, Hendren, and Katz (2016) and Chetty and Hendren (2017a; 2017b). There is a longstanding European literature on intergenerational mobility using administrative data, most of it based in the Nordic countries, with Jäntti et al. (2006) offering a good example illustrating the variety of data sources. Some of this research is sub-national and even city-based as in Lindahl et al. (2015; 2014), who look at the evolution of intergenerational mobility across four generations in the Swedish city of Malmö.

But the methods used by Chetty et al. (2014) are important for introducing a different flavour to cross-national comparisons. They encourage research based on sub-national geographies. An example is the study of Sweden by Heidrich (2015). In contrast to the American research, she finds relatively little variation across Sweden using what she calls 'local labour markets' as the geographic unit. These are collections of municipalities based upon commuting patterns, and seem to be akin to Commuting Zones. The Canadian equivalent would probably be Economic Regions, as defined by the Canadian Census starting in 1996. Güell et al. (2015) offer a regional portrait of Italy using the informational content of surnames, and income tax records that can be analyzed for each of 103 provinces. My analysis is directly informed by this vein in the literature.

The geographical dimension of my analysis is rooted in the postal code, which is included on T1 forms beginning in 1982. I convert this information to Census geography codes using Statistics Canada's Postal Code Conversion file for the 1986 Census, and tabulate a host of statistics associated with intergenerational income mobility for each of 266 Census Divisions defined in that Census year. The Census Division is roughly equivalent to a municipality or county, the legal entity established by legislation and used in many provinces to deliver services, though conceptually—but not practically—it is a smaller geographic unit than the Commuting Zones used by Chetty et al. (2014).[3]

4 Measuring intergenerational mobility

Both the theoretical literature and the public policy discussion of "equality of opportunity" have many nuances, with interest expressed in a number of different dimensions of intergenerational mobility. As I've suggested, when this discussion makes reference to aspects of economic mobility it has three broad concerns in mind: a concern about income, a concern about rank, and a concern about movement through the income distribution, particularly upward mobility from the bottom, but also intergenerational cycles of poverty and of privilege. On

[3]Their online tables also report some information for counties, which would be similar to Census Divisions. See the data section of Equality-of-Opportunity.org. Economic Regions are collections of Census Divisions, but as noted are not available in the 1986 Census.

this basis, I use eight different measures of intergenerational mobility, each posing particular measurement challenges. By way of summary, these are:

Income mobility		*Regression to the mean in parent-child incomes*
1. Absolute	α_j	least squares estimate of intercept
2. Relative	β_j	least squares estimate of slope
3. Average income	$\bar{Y}_j$	average permanent income of parents
Rank Mobility		*Percentile rank-rank regression*
4. Absolute	a_j	least squares estimate of intercept
5. Relative	b_j	least squares estimate of slope
Directional mobility		*Cells of qunitile transition matrix*
6. Rags to riches	$P_{1,5}$	conditional probability of top income
7. Intergenerational low income	$P_{1,1}$	conditional probability of bottom income
8. Intergenerational privilege	$P_{5,5}$	conditional probability of top income

The analysis of income has both an absolute and a relative dimension. The economics literature has emphasized the relative dimension, and focuses attention on the regression to the mean model of incomes across generations: $lnY_{i,t} = \alpha_j + \beta_j lnY_{i,t-1} + \varepsilon_{i,j}$, with $Y_{i,t}$, representing the permanent income of a member of generation t in family i, and being related log-linearly to $Y_{i,t-1}$, the permanent income of a member of generation *t-1*. This motivates the use of β, the intergenerational income elasticity, as an indicator of social mobility: a relative measure of mobility indicating the percentage deviation from the mean income in generation t for a given percentage deviation in generation *t-1*, which may vary across communities indexed by *j*. The average adult income of children also differs from the average parent income according to the intercept α, a complementary indicator of absolute mobility that may also vary across communities. When the value of the error term is set to its expected value of zero, the anti-log of this equation—$\bar{Y}_t = e^{\alpha_j} \bar{Y}_{t-1}^{\beta_j}$—shows that the expected income of children from different communities, can vary for at least three statistical reasons: differences in absolute income mobility, differences in relative income mobility, and differences in the average incomes of parents across communities.[4] These are the first three of my eight measures, and for convenience I refer to them respectively as α_j, β_j, and $\bar{Y}_j$.

I use the information available on the T1 form to define "income" as the total income from all sources including both all market sources, and government transfers.[5] In addition, my definition of income refers to the income of both partners, when two are present: any

[4]This is true with respect to the geometric mean, but the arithmetic mean of a log-normally distributed variable is $e^{\mu+\frac{1}{2}\sigma^2}$ where μ and σ are the location and scale parameters. Ascribing absolute mobility solely to the intercept term takes liberty with this notion as both the intercept and slope determine the expected value of the child's adult income. In using this vocabulary the intent is to distinguish the two influences on the child's outcome, those associated with and those not associated with parental income.

[5]Total income is defined according to the Canada Revenue Agency. From 1982 onward this refers to: Canada/Quebec Pension Plan Benefits; Capital Gains/Loses; Earnings as recorded on the T4 including commissions; interest and investment income; Old Age Security Pension; other employment income; other income; Pension and superannuation income; rental income; self-employment income (including net business income, net commission income, net farming income, net fishing income, net professional income); employment

income mothers earn is taken into account to fully represent a family's resources. In both respects, this follows Chetty et al. (2014).

The literature has highlighted two sources of potential bias in the estimation of β, an attenuation bias due to measurement error in $lnY_{i,t-1}$ when realized annual income is used to proxy permanent income, and an associated life cycle bias when income is observed only over a limited part of the life cycle (Atkinson, Maynard, and Trinder 1983; Grawe 2006; Haider and Solon 2006; Jenkins 1987; Nybom and Stuhler 2015; Solon 1992; Zimmerman 1992). The attenuation bias arises from mis-measurement of parental permanent income, this is the classical measurement error of a model with only one right hand side variable.[6] I address this concern by averaging parental income over a five-year horizon, the years the child was 15 to 19 years of age.[7]

The bias due to heterogeneity in life cycle profiles is particularly pertinent for the accurate measurement of the child's permanent income. This refers to the fact that individuals with lower incomes at the start of their working lives may also have higher wage growth with time because of more years spent in schooling. Heterogeneity in life-cycle profiles will contribute to greater variance of incomes in the later phases of the life cycle. Using Swedish data that span practically the entire working lives of parents and children, Nybom and Stuhler (2015) show that estimates of the intergenerational elasticity are in fact very sensitive to a life-cycle bias—both if the children are observed at too young and at too old an age—with the most accurate estimate obtained when the children are between 35 and 40 years of age (Nybom and Stuhler 2015, Figure 1a). Chen, Ostrovsky, and Piraino (2017) show that life cycle bias is minimized with the Canadian data I use when the children are in their late 30s to early 40s.[8]

insurance benefits. Family Allowance benefits are included from 1982 to 1992, and there are also other additions in subsequent years.

[6]Measurement error in $lnY_{i,t}$ is not generally seen as generating bias, but rather influencing the efficiency of the estimator. This may be of little concern for a national level analysis using my data because of the large sample sizes, though it may well come into play for sub-national estimates, and vary across communities. The use of the term "permanent income" makes the implicit assumption that parental expectations governing their investment decisions are realized, and accurately captured by some long-run average of actual outcomes.

[7]A parent's annual income is assumed to be zero if there is no T1 observed in a particular year. The total annual "family" income is the sum of the father's and mother's incomes if the parents were married or in a common-law relationship in the year the child was linked to them by the algorithm creating the Intergenerational Income Data. Only if the mother does not file a T1 in a particular year, or if her Social Insurance Number is unknown, is the family income taken as the father's income. And in a similar way the total parental income is the mother's income if the family reports being married or common-law but the father did not file a tax return or if his Social Insurance Number is unknown. In these cases the annual family size is assumed to be one. Single parents, or parents whose marital status changes remain in the sample, and are reflected in changes in the family size. Parental income refers to the combined total income of the mother and the father over the appropriately defined five years divided by 10. This is done regardless of any previous changes in family structure. In cases where the parent was a single parent in the year the child is first linked to the parent, then this family structure is assumed fixed, and that individual's income is divided by five. To be clear, this is a measure of individual permanent income using all income sources, and assuming equal sharing between the adult partners in the household when more than one is present. This average individual income must be at least $500 to be included in the analytical sample. Preliminary analysis suggested that there may be measurement error at very low incomes, a disproportionate number of individuals often reporting exactly one or exactly two dollars of income on their T1 returns.

[8]This result is for sons, and depicted in their Figure 1. All of this is not to say that life cycle effects are

With this in mind, I address the possibility of a life-cycle bias by using the average income obtained between 2004 and 2008, when the children are between the ages of 38 and 45 at their oldest, which seems to be a particularly favourable span in the life cycle, annual income measures coming closest to permanent measures. As in the case of parents, my measure of individual income is based on the income of both partners—the child captured in the Intergenerational Income Data and his or her spouse, as identified from the Social Insurance Number they report on their T1 form for the spouse—when two are present.[9]

Table 3 summarizes the provincial and national estimates of these three indicators of intergenerational income mobility, the first column offering the absolute income mobility expressed in natural logarithms (α_j), the second the intergenerational income elasticity (β_j), and the third the average income of parents in the community ($\bar{Y}_j$). The standard error for the national estimate of α_j is 0.005, while for β_j it is 0.0005.[10] The maximum values of these standard errors across the regions are respectively 0.157 and 0.0152, both of these being for Yukon. The standard errors for the other regions are less than one-half as large, and for the most part about one-tenth. The implication is that there is considerable variation across the provinces in these parameters. Manitoba stands out in that all three measures of mobility indicate less equality of opportunity: absolute income mobility is lower than the country average, the intergenerational elasticity is significantly higher, and the overall average income of parents is lower.

The second dimension of mobility reflects a concern over position, or ranks. The Spearman rank correlation coefficient offers a statistical measurement of this type of intergenerational association, say between the percentile rank of children and the percentile rank of their parents. Chetty et al. (2014) emphasize this measure, making use of the least squares regression $y_{i,t} = a_j + b_j y_{i,t-1} + \epsilon_{i,j}$, where the lowercase letters are used to indicate the child

not also important for parental income. In fact, while child incomes are measured at a given age, parental incomes are measured at a given age of the children, when they are between 15 and 19 years of age. For the most part parents may well be at an appropriate age to capture their permanent income, but this said there is more slippage in this case than with the child adult outcomes. For example, higher income parents may be older when they have their children.

[9] A child is deemed "married" if marital status on the tax form is reported as married or common-law. Individuals are considered "non-married" if they are neither married nor living common-law, if the spouse's Social Insurance Number is unknown, or if they do not have a partner. The total family income is the sum of the child's income and his or her spouse's income, or just the child's income if non-married. As stated, child incomes are calculated between 2004-2008. If in any year the child does not report a T1 form and income is missing, then it is assigned a value of zero. However, the child is required to have at least one T1 during these five years to be included in the sample. The number of dependents in each year is determined by the number of non-zero birth dates for the first 6 dependents only. The 5-year average annual income is computed as the sum of all annual family incomes over the 2004-2008 period divided by the sum of the family sizes over the same period. While my definition of income follows Chetty et al. (2014), as does the use of "family" income, there are differences in how the tax systems in the two countries treat common-law relationships. The Canadian tax system is such that it is more appropriate to treat the incomes in a common-law relationship as if the partners are married. All incomes are measured in 2014 constant dollars based upon the Consumer Price Index. As with parents, I keep only parent-child pairs if the child's income is not less than $500.

[10] The intergenerational elasticity for the country as a whole is estimated to be 0.201, significantly lower than the estimates of 0.32 and 0.23 reported respectively for sons and daughters by Chen, Ostrovsky, and Piraino (2017). However, these results are not strictly comparable to the findings in Table 3, which combine sons and daughters and are also based on the incomes of both partners in both generations.

Table 3: *Intergenerational income mobility: absolute income mobility, relative income mobility, and average parental community income*

Province / Territory	Absolute mobility (α_j)	Relative mobility (β_j)	Average income ($\bar{Y}_j$)
Newfoundland and Labrador	8.69	0.180	29,395
Prince Edward Island	8.91	0.159	30,739
Nova Scotia	8.49	0.192	35,158
New Brunswick	8.54	0.189	32,871
Quebec	8.67	0.186	39,700
Ontario	8.67	0.191	44,249
Manitoba	6.98	0.341	36,518
Saskatchewan	8.19	0.238	39,768
Alberta	8.71	0.194	48,544
British Columbia	8.73	0.176	47,185
Yukon	8.62	0.187	42,444
Northwest Territories, Nunavut	8.67	0.175	29,036
Canada	8.52	0.201	42,032

Note: First two columns are least squares estimates.

and parent percentile ranks in their respective income distributions, and by implication $\epsilon_{i,j}$ is uniformly distributed. These two statistics a_j—absolute rank mobility—and b_j—relative rank mobility—are the next two of my eight measures of mobility. They refer to regional differences in child and parent ranks in the national income distribution.

Measurement error in parent and also child incomes both matter when it comes to accurately estimating rank mobility. This is the main reason why I measure child incomes as a five-year average between 2004 and 2008. The general sense in the empirical literature, however, is that life-cycle biases may not be as severe since there may be a tendency for income ranks to be established much earlier in the life-cycle, and not change with years in the labour market. Nybom and Stuhler (2015) show this to be the case, with the Spearman rank correlation not much changed once the children pass their early 30s. This suggestion is particularly important in the context of the Chetty et al. (2014) study, which is based upon adult incomes measured between the ages of 30 and 32, and is likely one of the reasons the authors pay much less attention to income based statistics. I also define a second analytical sample based upon income averaged over the years the child was 31 and 32 years of age in order to assess the robustness of rank-based measures to life-cycle considerations, and to offer a point of comparison with American research.

Table 4 presents the estimates of rank mobility for the country and each of the provinces and territories. Two sets of estimates are presented. The first three columns are based on the same data as the estimates in Table 3, measuring ranks when the children are in their

Table 4: *Intergenerational rank mobility: absolute rank mobility, relative rank mobility, and the estimated percentile rank for a child raised by the average parents in the bottom half of the income distribution*

Province / Territory	At 38 to 45 years of age			At 31 and 32 years of age		
	Absolute (a_j)	Relative (b_j)	Expected Rank	Absolute (a_j)	Relative (b_j)	Expected Rank
Newfoundland and Labrador	35.3	0.273	42.1	33.2	0.277	40.1
Prince Edward Island	35.1	0.245	41.2	35.3	0.239	41.3
Nova Scotia	32.6	0.251	38.9	32.0	0.249	38.2
New Brunswick	31.6	0.280	38.6	31.1	0.286	38.2
Quebec	36.7	0.249	42.9	36.9	0.240	42.9
Ontario	41.0	0.225	46.6	43.4	0.215	48.8
Manitoba	31.2	0.325	39.3	29.9	0.320	37.9
Saskatchewan	41.5	0.226	47.1	37.7	0.236	43.6
Alberta	44.4	0.206	49.5	41.1	0.203	46.2
British Columbia	39.6	0.184	44.2	39.9	0.185	44.5
Yukon	36.3	0.248	42.5	38.5	0.176	42.9
Northwest Territories, Nunavut	34.1	0.281	41.1	31.4	0.283	38.5
Canada	38.3	0.242	44.3	38.4	0.240	44.4

Source: Least squares estimates using Statistics Canada, Intergenerational Income Data as described in text.

late 30s and early 40s. In contrast, the last three columns present estimates based on ranks calculated when the children are 31 and 32 years of age. At the national level there is no significant difference between them.[11] Children raised by parents at the bottom percentile of the income distribution can expect to rank at the 38th percentile of their adult income distribution, a position that they would attain by their early 30s. The difference between a child raised at the very top and one raised at the very bottom is about 24 percentiles in

[11]I should note that the two sets of columns in the table are not strictly comparable because they differ not just by the age at which child outcomes are measured, but by different underlying samples. The later three columns are based on a subset of the full sample, only those born between 1967 and 1970. Because of a limitation in the construction of the data, I am only able to offer estimates for 31 and 32 year olds using this younger cohort of individuals, putting aside those who were born between 1963 and 1966. The data has information on the spouses of the sample members beginning only in 1998, and this information is required to derive the "family income." This implies that the sample members born between 1963 and 1966 were 31 between 1994 and 1997, before I can link them to their spouses. Only those born in 1966 are partially in scope, being 32 in 1998, but all those of the younger cohort turn 31 and 32 years of age after the spousal information first becomes available. This said, I also replicate the findings in this table—indeed, all the findings in the paper—using the adult information on the younger cohort. These findings are reported in the online appendix to the paper available at MilesCorak.com/Equality-of-Opportunity, and are very similar to the results in the first three columns of Table 4, so this data limitation is of no substantive consequence to the implications to be drawn from the table. It should also be noted that comparing the same cohort at two different ages also implies comparing them at two different times, and time effects may also be confounding the results. This is likely to be more important for absolute income mobility than for rank mobility.

both cases, and the expected rank of a child raised by parents in the bottom half, at the 25$^{\text{th}}$ percentile, is the 44$^{\text{th}}$ percentile.[12]

The third dimension of "equality of opportunity" is that dealing with directional mobility, particularly with upward mobility, the capacity of individuals raised by parents in the lower part of the income distribution to move to the top. This involves focusing on a particular cell of a transition matrix between parent and child ranks: $P_{o,d}$, where P is a transition probability, and $o, d = 1...Z$ refer to the origin and destination income ranks of the parent-child pair, with Z commonly set to 5 for the quintile transition matrix or even to 100 for the percentile matrix. This statistic complements the other indicators because linearity is not assumed, but also because it speaks to the direction of movement.

Rags to riches mobility may be a particularly pertinent dimension of intergenerational mobility for public policy, but transition matrices involve an adding-up constraint, with both the rows and columns summing to one. As such the movement from the bottom to the top is related to both intergenerational cycles of poverty—the probability that a child from bottom income parents will occupy the bottom position in the next generation—and intergenerational cycles of privilege—the probability that being raised by top income parents predisposes the child to being in the top as an adult. As Corak (2016a), Reeves (2016), and Milanovic (2016) stress, if children cannot escape from the bottom, or if others do not fall out of the top, then the extent of bottom to top movement is limited. In sub-national data there is more slack in the adding up constraint between the transition probabilities. All the transition matrices for each Census Division refer to the position of parents and children in the national income distribution. Further, children are geographically mobile, and all of the transition probabilities are based on their adult incomes wherever they may be living in the country, it is only the place in which they were raised as teenagers that defines the geography of the analysis. Geographic mobility is an aspect of social mobility.

As such, for any given Census Division rags to riches movement may not be as tightly constrained by the other cells in the transition matrix. Accordingly, the final three measures of mobility that I focus upon are three cells of the transition matrix, referring to what I will loosely call "rags to riches movement," "intergenerational cycles of poverty," and "intergenerational cycles of privilege." These are operationalized as the three appropriate cells of the quintile transition matrix for each Census Division, though finer matrices, and in the extreme a percentile transition matrix, can be imagined when sample size permits. The final three of my eight measures of intergenerational mobility are:

$$
\begin{aligned}
P_{1,5} &= \Pr\{Y_t \in top | Y_{t-1} \in bottom\} \\
P_{1,1} &= \Pr\{Y_t \in bottom | Y_{t-1} \in bottom\} \\
P_{5,5} &= \Pr\{Y_t \in top | Y_{t-1} \in top\}.
\end{aligned}
$$

[12]The use of least squares constrains the estimates of the intercept and slope to run the regression line through the midpoint of the distribution, the 50th percentile, but this is only the case for the national estimates in the bottom line of Table 4. The estimates for the provinces are not constrained in this way because the data refer to the percentile ranks in the national income distribution, regardless of where the parents and children live. Recall, that children are permitted to be geographically mobile, being ascribed the province indicated by the postal code on their parents' T1 form when they were linked to them during the teen years.

Nybom and Stuhler (2015 Figure 1(d)) find in their data that transition matrices tend to be robust to life cycle biases, for example the bottom-to-top quintile probability being accurately estimated after about the age of 27 or 28. O'Neill, Sweetman, and Van de gaer (2007) also study the statistical properties of transition matrices stressing the fact that measurement error in both child and parent outcomes need to be addressed to avoid bias. But it should be noted that the measurement error is non-classical. The diagonal elements of the transition matrix will be understated if there is measurement error in the permanent incomes of children. By implication off-diagonal elements will be overstated, and in particular there will be a tendency to overstate rags to riches movement. The extreme corners of the transition matrix, in particular $P_{1,1}$ and $P_{5,5}$, or $P_{100,100}$ in the case of a percentile transition matrix, will be at risk of being understated because ranks are bounded from below and above, any measurement error lending bias in only one direction.

As an illustration, I offer selected rows from the percentile transition matrix governing parent and child ranks. The top panel of Figure 1 shows the percentile rank of children raised by bottom percentile parents, and those raised by bottom vingtile parents. There is a clear gradient in both of these rows of the percentile transition matrix, with each probability of ranking in percentiles one through about 30 being greater than one percent, and the probabilities of rising above the median being lower. The two groups of children share very common probabilities beyond the third percentile. The major difference between them is in their chance of ranking in the bottom three, and most notably, the very bottom percentile. Children of bottom vingtile parents have a higher chance of being bottom percentile adults than their counterparts, and at the same time they also have a slightly lower chance of ranking in the second and third percentiles. The most likely outcome in adulthood of both groups is to be ranked in the bottom percentile, but the chance of this happening for the children of bottom vingtile parents is notably higher: 3.5 percent versus 2.8 percent.

These discrepancies in the lowest ranks may in part reflect non-classical measurement error leading to an underestimation at the very extreme of the percentile transition matrix, namely the probability that children raised by bottom percentile parents will also be bottom percentile adults. Children of parents ranking at the fifth percentile still have the option of falling below their parents' rank, but those of parents at the bottom percentile do not. Both sets of parents are very low ranking, and it should not be surprising that the ultimate ranks of their children are very similar. But mobility out of the bottom for children from the very bottom is possibly overstated, while at the same time the adjacent off-diagonal elements, the second and third percentiles, are overstated. These findings are of interest in their own right, but their magnitude also suggests that this type of measurement error is likely not to be strongly at play with a wider categorization, and in particular with quintile transition probabilities.

The transition probabilities at the other extreme of the income distribution are very different in both magnitudes and patterns. The bottom panel of Figure 1 shows the slice of the transition matrix conditional on having top income parents. The children of the top one percent are as likely to stay in the top fifth of their income distribution as they are to fall into the bottom 80 percent. While they face a 49.9 percent chance of being in the top fifth, their most likely outcome is, at 8.6 percent, to remain in the top one percent. For similar

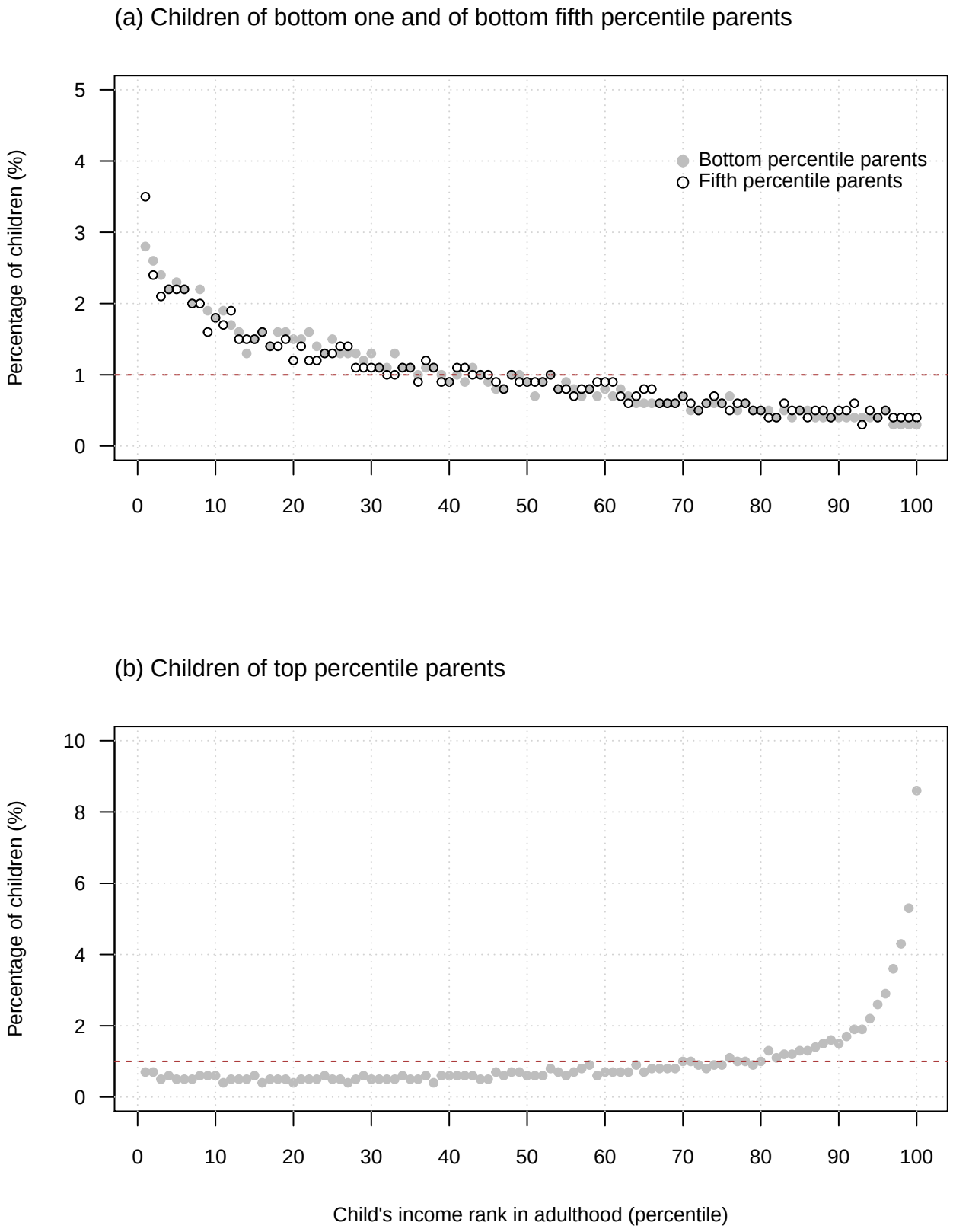

Figure 1: Intergenerational Directional Mobility: Percentile ranks of children raised by bottom ranking and top ranking parents

Table 5: *Intergenerational directional mobility based on selected transition probabilities: rags to riches, intergenerational cycle of poverty, and the intergenerational cycle of privilege*

Province / Territory	Rags to riches ($P_{1,5}$)	Cycle of poverty ($P_{1,1}$)	Cycle of privilege ($P_{5,5}$)	($P_{3,3}$)
Newfoundland and Labrador	0.087	0.321	0.295	0.210
Prince Edward Island	0.077	0.278	0.279	0.232
Nova Scotia	0.071	0.350	0.256	0.212
New Brunswick	0.061	0.352	0.264	0.214
Quebec	0.091	0.290	0.298	0.233
Ontario	0.141	0.284	0.352	0.210
Manitoba	0.076	0.414	0.296	0.238
Saskatchewan	0.141	0.277	0.333	0.222
Alberta	0.185	0.259	0.375	0.200
British Columbia	0.120	0.298	0.256	0.226
Yukon	0.117	0.371	0.295	0.196
Northwest Territories, Nunavut	0.100	0.397	0.391	0.178
Canada	0.114	0.301	0.323	0.219

Source: Selected entries from the quintile transition matrix calculated using Statistics Canada, Intergenerational Income Data.

reasons, we might well expect this to be an understatement.

Nybom and Stuhler (2015) also show that the upward mobility of the children of the very poorest parents tends to be overstated when there is measurement error in both parent and child incomes, almost without regard to whether child incomes are measured at 25, 30 or 40 years of age. They do this by contrasting transition matrices based on annual incomes with those based on lifetime incomes. The prospects of those raised by parents above the bottom quintile, including those at the very top, tend to be accurately captured if incomes are measured when the children are 40 years of age, though less so at 30 years as there can be considerable overstatement of downward mobility from the very top. This may happen because top-earners may often have short periods of low income.[13]

Table 5 shows the three quintile transition probabilities at the heart of my analysis, plus a fourth. The entries in the last column show that the probability a child raised by middle ranking parents will be a middle-ranked adult hovers around 0.2. This is a natural benchmark to assess whether a quintile transition probability is in some sense high or low, in effect signalling perfect mobility: if there were no relationship between parent and child incomes each entry in the quintile transition matrix would be 0.2.[14] A closer look at all the

[13]As the authors point out this is likely for any number or reasons: top earners may spend a period taking more leisure as top incomes are also associated with higher wealth, they could be making money outside the country, or they could be engaging in tax avoidance. This bias is not likely to apply with equal force for those with low life-time earnings as they are less likely to have an intermittent period of very high income.

[14]This said, a value of 0.2 should not be seen as an optimal, or target rate, of mobility for social welfare

underlying transition probabilities reveals that middle income parents—pretty well regardless of where they live—are as likely to witness their children fall in the income distribution as they are to witness them rise. This is in contrast with the dynamics at the two extremes, where the transition probabilities are significantly higher than 0.2. Children raised by parents in the bottom quintile stand a 30 percent chance of also being bottom quintile adults, and those raised by top quintile parents have an even slightly higher chance of staying in the top, approaching one-third. There is more variation in these probabilities, the intergenerational cycle of low income ranging from as low as 0.26 in Alberta to over 0.4 in Manitoba. Wherever this probability is above the country-wide average, the chances of moving from rags to riches are below the average (with the slight exception of Yukon). There are considerable differences in the chances that a child from bottom quintile parents will rise to the top quintile: ranging from 6.1 percent in New Brunswick to almost 19 percent in Alberta. But at first look these seem more closely and negatively related to the intergenerational cycle of poverty, than to the cycle of privilege. For example, the intergenerational cycle of privilege almost reaches 40 percent in Alberta, but the province still has the highest rate of movement from rags to riches, albeit still less than 20 percent.

This is more clearly illustrated by Figure 2, which uses the quintile transition probabilities for each of the 266 Census Divisions, and correlates the Rags to Riches probability, $P_{1,5}$, with the probabilities governing intergenerational Cycles of Privilege, $P_{5,5}$, in panel (a), and intergenerational Cycles of Poverty, $P_{1,1}$, in panel (b).[15] The horizontal and vertical dashed lines are drawn at 0.2 for reference, making clear that it is rare that Rags to Riches movement is ever greater than 0.2, while Intergenerational Cycles of Privilege and Poverty are almost always above this benchmark. Perhaps surprisingly, there is a positive relationship between Rags to Riches movement and Cycles of Privilege. The chances of moving from the bottom quintile to the top quintile in one generation tends to actually be higher, the higher the intergenerational cycle of privilege. Bottom to top mobility across the Census Divisions is more a story about the challenges of breaking out of an intergenerational cycle of poverty, than it is a challenge of breaking into the top.

Nybom and Stuhler conclude by stating that "[r]esearchers need to exercise particular caution when studying long-distance mobility, the inheritance of poverty, or the inheritance of top incomes." (Nybom and Stuhler 2015, 20) These concerns are all addressed by my choice to average both parent and child incomes over multiple years, to measure incomes at an appropriate point in the life cycle, during the late 30s to mid 40s, and also likely helped by the definition of income as encompassing the income of both partners, the use of administrative as opposed to survey data, and a focus on transitions across rather wide margins like quintiles. This said, my estimates of the intergenerational cycle of privilege may well remain understated, and the associated downward mobility of the children of the very rich—certainly those with parents in the very top percentiles—may be overstated.

comparisons and public policy. See Corak (2016c), Jencks and Tach (2006), Roemer (2004).

[15] Six observations with very high values for $P_{1,1}$ are omitted from panel (b) of the figure, though they continue to contribute to the estimation of the Lowess line depicted in red.

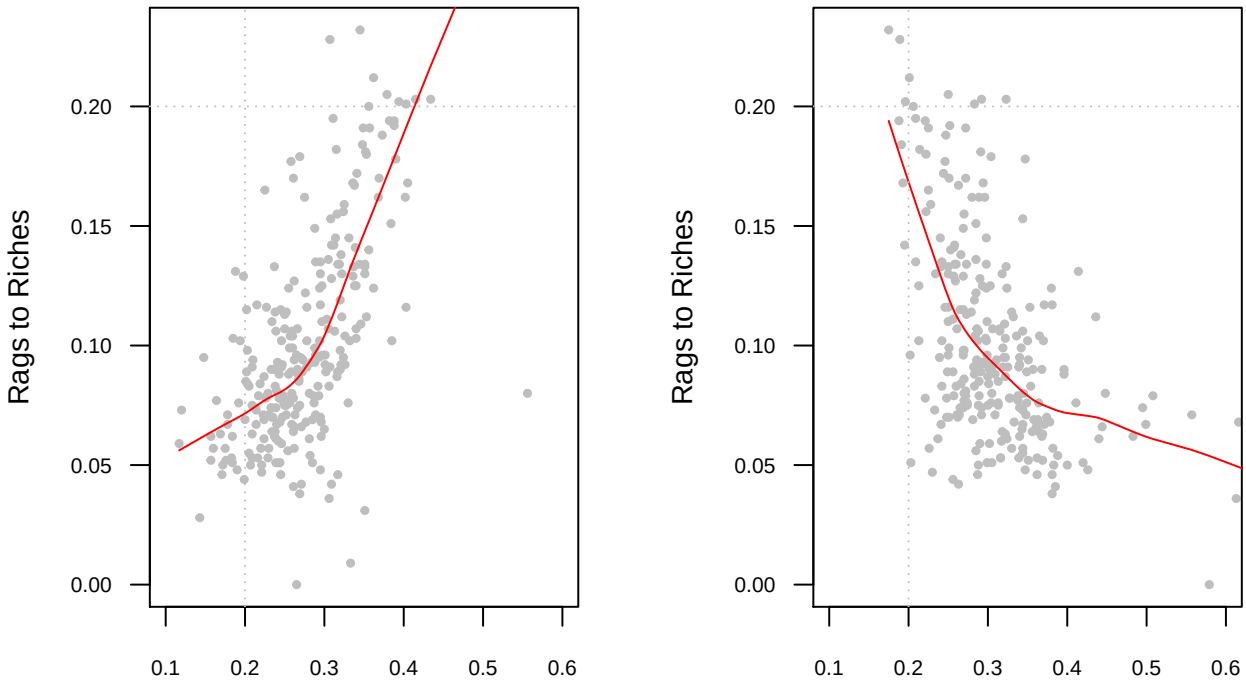

Figure 2: Rags to riches mobility across Census Divisons and its correlation with intergenerational cycles of privilege and poverty, as measured with quintile transition probabilities

5 Geography and Intergenerational Mobility

5.1 Income and rank mobility

A summary of income mobility is offered in Figure 3, which illustrates a strong positive relationship between the average income of parents and the adult income of children across the Census Divisions, the correlation being 0.742. The figure also shows that as adults children, on average, earn more than their parents in all but 4 Census Divisions.[16] The other 262 Census Divisions all lie above the 45º line in the figure. Children from these regions earn in adulthood on average $13,153 more than their parents, reaching a maximum of $28,384 in Division No. 19 AB. The Census Division estimates of α_j and β_j are tightly negatively correlated (-0.992), communities with high relative income mobility being communities with high absolute income mobility. In turn, these coefficients are respectively negatively and positively correlated with the adult income of children.

Rank mobility is summarized in Figure 4, which is based upon the estimates of absolute and relative rank mobility for each of the Census Divisions. The least squares estimates of a_j and b_j are used to predict the expected percentile ranks of children whose parents were in

[16]These exceptions are: Central Coast Regional District BC, Stikine Region BC, Skeena-Queen Charlotte Regional District BC, Alberni-Clayoquot Regional District BC.

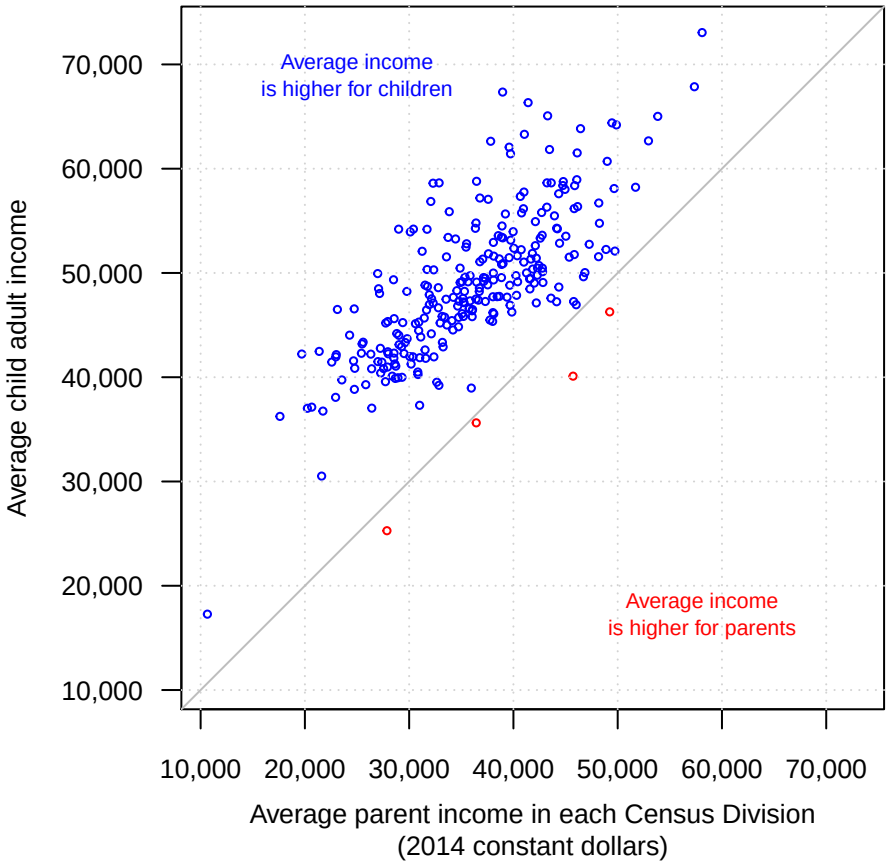

Figure 3: Average incomes of parents and children in each of 266 Census Divisions

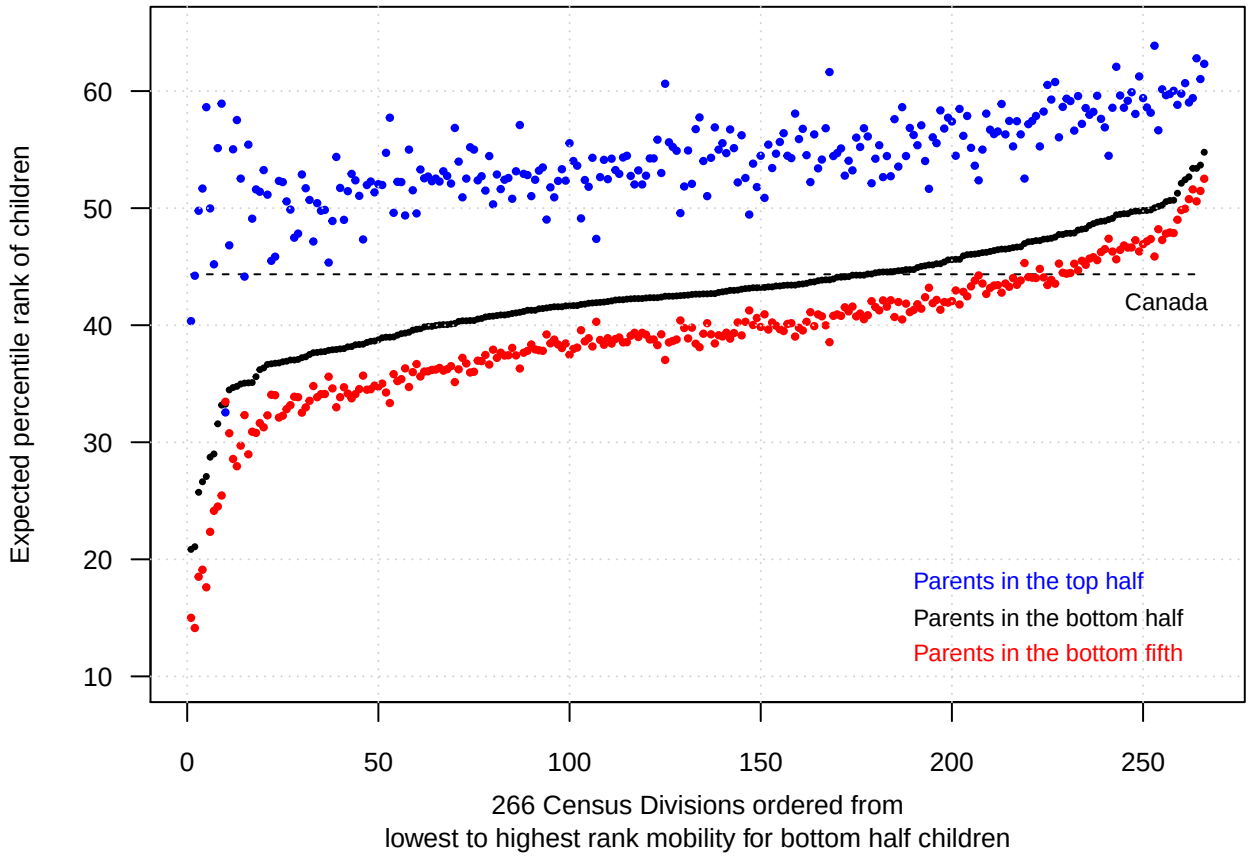

Figure 4: Expected rank outcomes for children from top half, bottom half, and bottom fifth parents by Census Division

the top half, the bottom half, and the bottom fifth of their income distribution. For example, using the estimates presented in the bottom row of Table 4 suggests that a child raised by the average parent in the bottom half of the income distribution—those ranking at the 25th percentile—would be expected to rise to the 44th percentile, a summary measure of rank mobility that incorporates the influence of both absolute and relative rank mobility.

Figure 4 shows similar chances for each of the 266 Census Divisions, ordered according to the expected value for children raised by bottom half parents. In only 14 of 266 Census Divisions would the typical bottom half child rise above the median, that is, move into the top half. This said, these children do rank above the country wide estimate in 89 Census Divisions. The typical child raised further down in the income distribution is even less likely to move to the top half. In only 5 Census Divisions is the typical child raised by bottom quintile parents expected to move into the upper half of the income distribution.

The unweighted standard deviation of the expected percentile rank of children from bottom half parents is 5.06, this is slightly less than the value of 5.68 Chetty et al. (2014, 1592) report for the United States with data defined over Commuting Zones. The population weighted standard deviation is 4.52, which in contrast is higher than the estimate of 3.34 for the American data. In sum, the variance across regions does not seem too different than in the United States, a contrast with the results for Sweden reported by Heidrich (2015). This said, differences in the size of the geographic units between the countries may limit the extent to which these statistics are comparable.[17]

The expected outcome of children raised by parents in the top half of the income distribution is also depicted in the figure. The typical child raised by parents in the top half, parents who ranked at the 75th percentile, is expected to face downward rank mobility, but unlikely to fall below the median, into the lower half. These children are estimated to remain in the top half in fully 237 of 266 Census Divisions, and in only 4 do they fall below the expected rank of the typical bottom-half Canadian child.

5.2 Upward mobility

The Canadian landscape of upward mobility is depicted in the map presented as Figure 5, which places each of the 266 Census Divisions defined by the 1986 Census into one of six categories according to the probability of moving into the top quintile for children whose parents were in the bottom quintile. Most children—36 percent—live in the 144 communities where the chances of moving to the top quintile are between 5 and 10 percent, and a further 34 percent in the 68 Census Divisions recording a probability of at least 0.10 but not as high as 0.15.

There are only 2 Census Divisions in which the probability of rags to riches movement is

[17]In addition, my statistics are calculated using data on ranks at a much later point in the life cycle. The expectation is that this should not matter that much if ranks are in fact stable. The standard deviation of expected rank mobility for these children using ranks when they are 31 and 32 years of age is 5.16, and the population weighted estimate is 5.68, reversing the relative magnitude of the estimates for the Canadian data but not altering the conclusion relative to the United States.

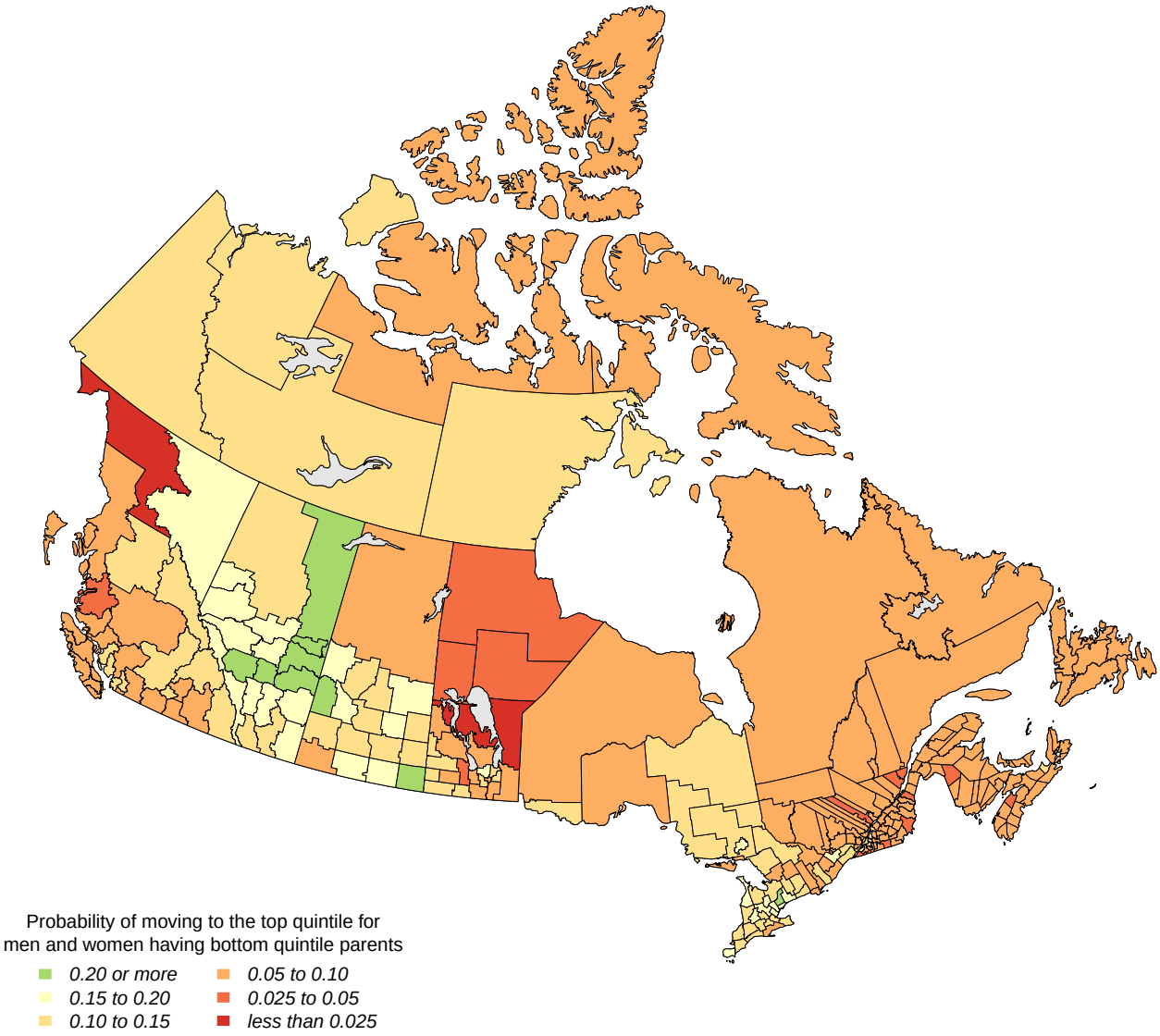

Figure 5: Rags to riches mobility: Census Divisions classified according to the probability that children of bottom quintile parents have adult incomes in the top quintile

Table 6: *Income and rank mobility statistics for the Census Divisons with a probability of moving from the bottom to the top quintile of less than five percent*

Census Division	Number of children	Income mobility			Rank Mobility	
		Absolute (α_j)	Relative (β_j)	Average Parent Income	Absolute (a_j)	Relative (b_j)
Stikine Region BC	200	4.6	0.540	36,435	13.7	0.481
Division No. 19 MB	1,350	6.2	0.338	10,649	9.5	0.463
Central Coast Regional District BC	300	7.0	0.253	27,869	11.1	0.390
Division No. 22 MB	3,250	2.9	0.710	31,004	11.3	0.631
Division No. 21 MB	3,000	5.2	0.496	38,007	23.4	0.455
Victoria County NB	2,900	7.9	0.243	24,746	27.9	0.338
Huntingdon QC	1,650	8.0	0.236	28,928	28.6	0.304
Montmagny QC	3,950	8.8	0.176	31,761	35.6	0.284
Division No. 23 MB	750	3.8	0.614	35,961	14.1	0.501
Frontenac QC	3,650	9.0	0.149	28,623	33.7	0.212
Kings County NS	6,450	8.2	0.212	33,258	29.4	0.290
Charlevoix-Est QC	2,700	9.0	0.150	32,126	35.5	0.215
Brome QC	1,800	8.2	0.223	35,757	29.7	0.329
Charlevoix-Ouest QC	1,950	9.4	0.116	27,954	39.8	0.173
Maskinonge QC	3,300	8.6	0.187	27,549	31.5	0.266
Division No.8 MB	1,650	5.5	0.487	22,947	29.2	0.307

Note: Census Divisions are ranked from lowest to highest transition probability conditional on being less than 0.05. Numbers are rounded to nearest 50.

less than 2.5 percent, and further 14 with chances higher than 2.5 percent but not as high as 5 percent. Together they account for 38,727 children in the weighted sample, or only about 2.5 percent of the total. These Census Divisions are listed in Table 6, ranked from the lowest to the highest transition probability. The table also offers the statistics associated with intergenerational income and intergenerational rank mobility.

There is no one pattern in these statistics that explains the very low rate of upward mobility. In some cases absolute income mobility is very low, but in a number of cases it rivals, and even exceeds, the national estimate of 8.52. In a similar way the estimates of the intergenerational income elasticities in these Census Divisions are in some cases markedly above the national estimate of 0.201, but in others notably lower. These are all, however, lower income communities, the average parental income in the 1980s being significantly lower than the national average of $42,032, but even in this case there is a wide range, from as low as $10,649 to as high as $38,007. In one way or another, income mobility is limited for the children of these communities. As a result, absolute rank mobility, the rise in ranks that all children in the community can in the very least expect, is notably lower, another way of simply saying that there is limited upward mobility to any degree, and hence much lower chances of rising as far as the top quintile. For the country as a whole, children—as shown in Table 4—can expect to rise at least 38.3 percentiles, a rate that is matched by only one of the communities listed in Table 6. But in this case—Charlevoix-Ouest—the relative rank coefficient is so low, that there is little extra kick from parental standing, and in any case the

Table 7: *Income and rank mobility statistics for the Census Divisons with a probability of moving from the bottom to the top quintile of at least twenty percent*

Census Division	Number of children	Income mobility			Rank Mobility	
		Absolute (α_j)	Relative (β_j)	Average Parent Income	Absolute (a_j)	Relative (b_j)
Division No.8 AB	13,850	9.2	0.146	43,282	48.3	0.153
Division No.9 AB	2,250	8.0	0.259	36,464	44.0	0.230
Division No.7 AB	5,150	8.9	0.177	39,592	48.3	0.165
Division No. 12 AB	5,600	7.4	0.327	32,290	43.1	0.277
Division No. 16 AB	7,500	8.2	0.240	49,448	43.1	0.253
York Regional Municipality ON	38,750	8.9	0.175	53,845	43.9	0.191
Division No.1 SK	4,150	8.7	0.202	41,409	51.0	0.151
Division No. 13 SK	3,750	9.3	0.144	41,052	49.5	0.127
Division No.10 AB	10,650	9.5	0.125	37,818	50.0	0.147

Note: Census Divisions are ranked from lowest to highest transition probability conditional on being at least 0.20. Numbers are rounded to nearest 50.

average parental community income being so low as to suggest parents are not high ranking to begin with.

At the other extreme there are 9 Census Divisions in which the probability of a rags to riches movement is 0.2 or higher. Only about 3.1 percent of all children were from these regions. As such, this degree of mobility is a rare feature of the Canadian landscape. These Census Divisions are listed in Table 7, ranked in ascending order of the bottom to top quintile transition probability. Six of these Census Divisions are in Alberta, and an additional two in Saskatchewan. But the only Census Division outside of Alberta and Saskatchewan with this exceptionally high rate of bottom to top movement—York Regional Municipality, which is north of and adjacent to what the 1986 Census labels as Toronto Metropolitan Municipality—is the most populous, some of the others being around a tenth, or even less, in size. This one Census Division accounts for 42.3 percent of the children who were raised in these high upward mobility communities.

There is a high degree of absolute income mobility in all of these regions. Income mobility seems to benefit all the children, the tie to family income background, as indicated by the elasticity, being weaker than the national average in all but three of these Census Divisions. The average income of parents tends to be close to or above the national average, with the exception of a couple of communities in Alberta, one of them having an average income as low as $32,290. In a similar way, absolute rank mobility tends to be very high, while relative rank mobility is weak, at least in comparison to the country-wide estimates of these statistics.

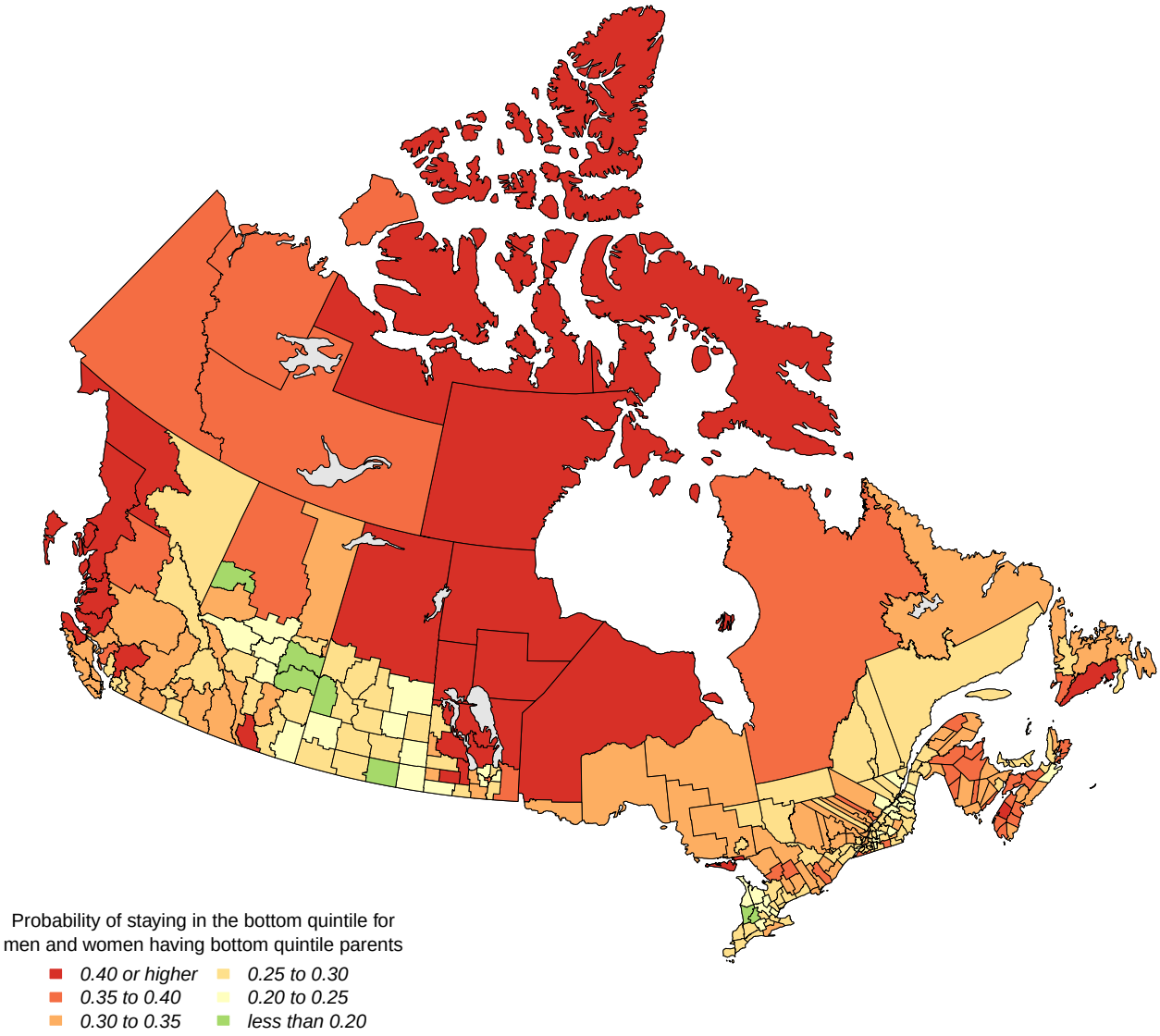

Figure 6: Intergenerational cycles of low income: Census Divisions classified according to the probability that children of bottom quintile parents have adult incomes in the bottom quintile

Table 8: *Income and rank mobility statistics for the Census Divisons with a 40 percent or higher chance that children of bottom quintile parents will be bottom quintile adults*

Census Division	Number of children	Income mobility Absolute (α_j)	Income mobility Relative (β_j)	Average Parent Income	Rank Mobility Absolute (a_j)	Rank Mobility Relative (b_j)
Division No.3 NL	3,950	8.5	0.190	25,841	31.3	0.255
Division No. 17 MB	3,550	5.7	0.466	25,585	29.6	0.375
Keewatin Region NT	900	9.5	0.094	19,697	38.5	0.167
Squamish-Lillooet Regional District BC	2,000	6.8	0.351	42,193	27.6	0.320
Division No.8 MB	1,650	5.5	0.487	22,947	29.2	0.307
Division No.3 AB	4,200	6.6	0.378	39,585	31.8	0.334
Annapolis County NS	2,800	8.2	0.213	30,062	28.1	0.280
Baffin Region NT	1,350	9.5	0.073	20,658	31.8	0.209
Kitikmeot Region NT	550	9.8	0.042	17,609	33.6	-0.014
Division No. 18 MB	3,250	5.9	0.434	20,241	24.9	0.407
Manitoulin District ON	1,750	5.5	0.464	21,731	24.5	0.407
Kitimat-Stikine Regional District BC	5,100	6.2	0.403	45,778	26.2	0.351
Mount Waddington Regional District BC	1,400	6.3	0.391	46,717	29.0	0.311
Skeena-Queen Charlotte Regional District BC	2,600	7.0	0.309	45,721	20.9	0.324
Stikine Region BC	200	4.6	0.540	36,435	13.7	0.481
Division No. 21 MB	3,000	5.2	0.496	38,007	23.4	0.455
Kenora District ON	6,700	3.2	0.692	36,043	20.3	0.515
Central Coast Regional District BC	300	7.0	0.253	27,869	11.1	0.390
Division No.7 MB	7,800	5.9	0.431	32,374	19.8	0.471
Division No. 18 SK	2,600	6.7	0.325	21,606	18.1	0.425
Division No. 23 MB	750	3.8	0.614	35,961	14.1	0.501
Division No. 19 MB	1,350	6.2	0.338	10,649	9.5	0.463
Division No. 22 MB	3,250	2.9	0.710	31,004	11.3	0.631

Note: Census Divisions are ranked from lowest to highest transition probability conditional on being at least 0.40. Numbers are rounded to nearest 50.

5.3 Intergenerational cycles of low income

The Canadian landscape of intergenerational poverty is depicted in Figure 6, which in a manner similar to Figure 5 places Census Divisions into one of six categories according to the bottom to bottom quintile transition probability. These groups range from probabilities of less than 0.20 to over 0.40.

The majority of children—54 percent—live in the 97 communities where the chances of falling into an intergenerational cycle of low income are between 25 and 30 percent, and a further 24 percent in the 70 Census Divisions where these chances are at least 0.30 but under 0.35.[18] The strong majority of children raised by lower income parents face a greater than one-in-four chance of growing up to be relatively lower income adults, and for many these odds were at least as high as one-in-three.

[18] About 10 percent of the weighted sample of children are in the 0.20 to 0.25 group, and 7.9 percent in the 0.35 to 0.40 group.

The 23 Census Divisions with a 40 percent or greater chance of bottom quintile to bottom quintile movement are listed in Table 8. These communities are all small in population, and account for 2 percent of the total number of children. This list, however, raises the possibility of another type of measurement error associated with how representative income tax data are for some communities. Sixteen of these 23 Census Divisions have at least one First Nations reservation within their boundaries, and in the others it is reasonable to suggest that the First Nations population may be considerable. While these populations—with some exceptions—are subject to income taxation, tax filing was likely considerably lower among the parents of the children in the analysis sample, than it might be for the children, and certainly in both cases lower than the overall population. The introduction of the Goods and Services Tax Credit in 1992 offered an increased incentive for filing. Furthermore, there may be an incentive for some individuals working off-reserve to claim to be living on a reserve in order to lower their taxable incomes. This would also influence the rate of reporting and the income associated with these communities. While a certain caution is therefore needed in interpreting these results, it remains the case that other indicators clearly suggest that many of these communities have lower economic status than the average.[19]

There are only 7 of 266 Census Divisions in which the probability of a cycle of low income is less than 20 percent, representing only 1.6 percent of all children. These Census Divisions are listed in Table 9, again ranked in ascending order of the bottom to bottom quintile transition probability. A common characteristic is that absolute income mobility is higher than average, and there is a weaker intergenerational elasticity between parent and child incomes. Even the children from the lowest income families have the potential for upward income mobility, and as a result for considerable upward rank mobility. The average parent income in these communities is below the national average. This raises the possibility that geographic mobility may be an important aspect of intergenerational mobility. The two Ontario communities listed in the table are not areas in which there was significant economic growth, but the distances and costs associated with moving to nearby regions that were poles of growth—more specifically Toronto—were likely low.

[19]This is clear from the Community Well-Being Index developed by Indigenous and Northern Affairs Canada, available at https://www.aadnc-aandc.gc.ca/eng/1100100016579/1100100016580, which uses income, education, housing, and labour force participation to develop an index for each Census Sub Division in the country regardless of aboriginal status. I thank Ravi Pendakur for raising my awareness of these issues. Tax filing rates on reserve are difficult to determine for a number of reasons. At one level it is not entirely clear that the base population is well-enumerated through, for example, the Census. In some cases Census enumerators are not invited onto reserves, and in others they are not able to gain access due to natural disasters like forest fires. It is difficult to determine the extent of this in 1986, but Statistics Canada reports that 31 reserves (from over 600 in total) were not enumerated in the 2011 Census, and of these 13 were not reached because of forest fires. In the 2016 Census there were 14 reserves not enumerated, none of which had to do with natural disasters. See http://www12.statcan.gc.ca/census-recensement/2016/ref/dq-qd/iir-rii-eng.cfm, accessed February 11th, 2017. There is also a tendency for tax filing to be lower. Again, it is not possible to estimate this for the late 1970s and early 1980s when I measure parent income, but policy concerns raised in 2016 are illustrative. These had to do with take-up rates associated with the newly introduced Canada Child Benefit that is delivered through the income tax system, and led to increased scrutiny to understand tax-filing behaviour. Estimates of on-reserve tax filing vary from 50 to about 67 percent, with considerable variation between reserves. I obtained this information from conversations with officials at Employment and Social Development Canada, who stressed that this issue is subject to a good deal of uncertainty, and a topic that Statistics Canada continues to study.

Table 9: *Income and rank mobility statistics for the Census Divisons with a less than 20 percent chance that children of bottom quintile parents will be bottom quintile adults*

Census Division	Number of children	Income mobility Absolute (α_j)	Income mobility Relative (β_j)	Average Parent Income	Rank Mobility Absolute (a_j)	Rank Mobility Relative (b_j)
Division No.10 AB	10,650	9.5	0.125	37,818	50.0	0.147
Division No. 19 AB	9,150	9.1	0.166	38,963	48.7	0.188
Division No. 13 SK	3,750	9.3	0.144	41,052	49.5	0.127
Division No.2 SK	3,400	9.4	0.132	43,464	50.4	0.120
Perth County ON	8,150	9.3	0.139	37,581	45.7	0.166
Huron County ON	6,950	9.4	0.123	34,450	44.9	0.160
Division No.7 AB	5,150	8.9	0.177	39,592	48.3	0.165

Note: Census Divisions are ranked from lowest to highest transition probability conditional on being less than 0.20.

6 Clustering Census Divisions

6.1 Unsupervised machine learning

Together the eight statistics I use to measure intergenerational mobility offer a broad overview of intergenerational income dynamics, depicting how strongly family and community background determine a child's adult income, where this income ranks in the national income distribution, and the chances of overcoming relative disadvantage and moving from the bottom to the top. As I've suggested, theory offers little guidance on how or even whether we should choose between them, there being little to suggest that one perspective dominates another if our objective is descriptive. And while Tables 3 through 5 sketch broad geographic differences, getting an overall picture is considerably more complicated at finer disaggregations of the income distribution, and particularly for much narrower geographies. As the discussion in the previous section implicitly suggests, conveniently summarizing eight different indicators across hundreds of regions is somewhat more of a challenge. I address this concern by treating the classification of Census Divisions into regions of high or low "equality of opportunity" as a problem in unsupervised machine learning.

Framing the descriptive analysis as an application of unsupervised machine learning allows me to cluster the 266 Census Divisions into a limited number of similar regions across all eight indicators of intergenerational mobility. Hastie, Tibshirani, and Friedman (2009) describe clustering, making clear that the objective of these data segmentation methods is to group units into subsets of greatest similarity according to a metric defined over a set of observed characteristics. I use agglomerative hierarchical—bottom-up—algorithms in order to avoid having to make an *a priori* choice of the number of clusters.[20] In part, I consider

[20]To be clear, this is not an exercise in prediction, and there is no validation procedure to verify the results. The exercise is descriptive, and exploratory. The main class of alternatives would be K-means, but I don't

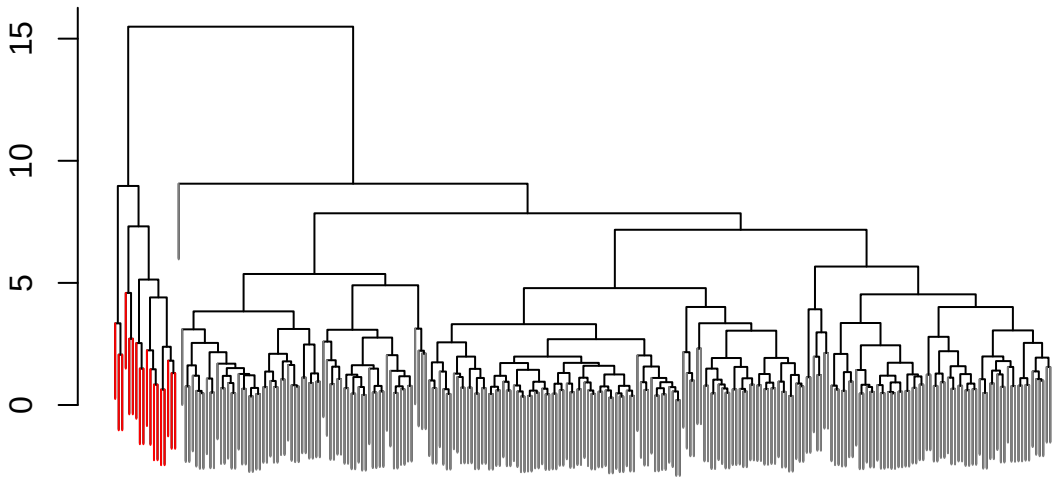

Figure 7: Preferred Dendrogram illustrating the grouping of 266 Census Divisions into two clusters, based on Complete linkage with Euclidean-Based Distance

the choice of the number of groups to be driven by a communication challenge directed to public policy, hierarchical methods being easily described through a dendrogram that readily offers a visualization in the form of a tree-like diagram.

6.2 The landscape of us and them

I offer my preferred set of results in the dendrogram depicted in Figure 7, derived from complete linkage with a Euclidean-based distance over all eight of the intergenerational mobility statistics.[21] The vertical distance, not the horizontal distance, between units guides the choice of the number of clusters, the results clearly justifying at least a two-fold division. If the country had to be divided into two groups, into the landscape of "us and them," or another way of putting it, by distinguishing a group that is most sharply different from all the other Census Divisions—in this sense characterized by less equality of opportunity—then the Canadian landscape of economic opportunity would look like the map presented in Figure 8. This is similar to, but not exactly like the intergenerational cycle of low income depicted in Figure 6 and Table 8. The regions of concern are fewer in number—there are 18—and they are all located west of the Ontario-Quebec border, though only two are in Ontario. Figure 8 also puts into sharper relief that many of the Census Divisions in this cluster are concentrated in Manitoba, covering a significant area of the province.

Do provincial borders matter? After all provincial governments have an important responsibility in many policies and institutions that theory suggests influence intergenerational mobility: human capital development associated with health care, with primary, secondary

use them because they require a pre-determined number of clusters.

[21] Clearly, the results are sensitive to modelling choices, and I examined other approaches, with average linkage leading to a broadly similar dendrogram as complete linkage. Single linkage led to different results that could not be judged sensible in the context of my problem. In all cases the intergenerational statistics are scaled.

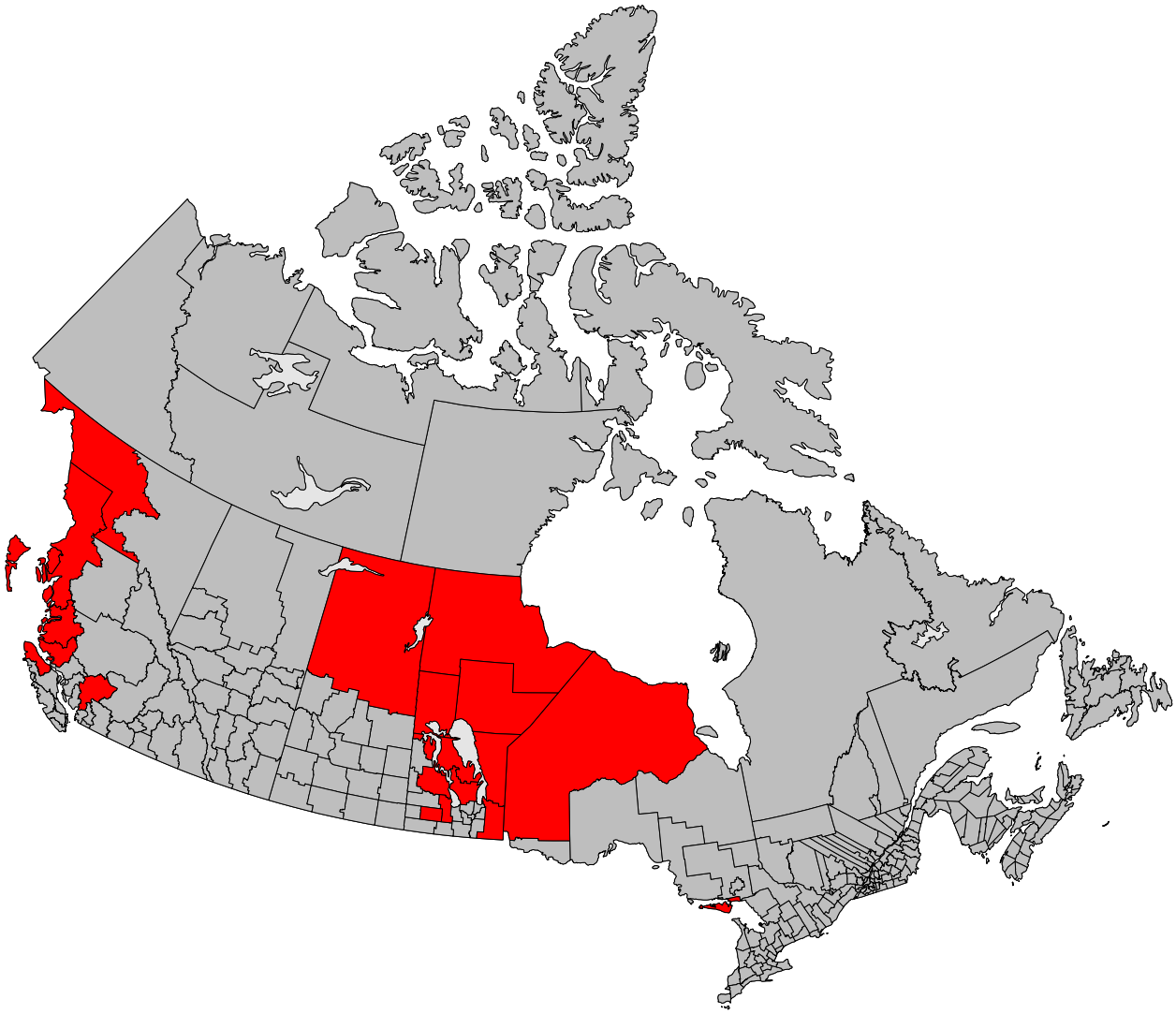

Figure 8: The landscape of us and them: Census Divisions clustered into two groups based upon similarities between all eight intergenerational mobility measures

Table 10: *Does the Manitoba border matter? Estimates from Linear probability models of whether Census Divisions are within the province of Manitoba*

	(1)	(2)
(Intercept)	**0.086**	**0.086**
	(0.016)	(0.015)
Absolute income mobility	−0.446	−0.172
	(0.483)	(0.473)
Relative income mobility	−0.250	0.023
	(0.447)	(0.438)
Absolute rank mobility	0.062	0.074
	(0.112)	(0.109)
Relative rank mobility	−0.027	−0.053
	(0.056)	(0.055)
Bottom to bottom mobility	−0.025	0.009
	(0.054)	(0.053)
Bottom to top mobiility	−0.027	−0.017
	(0.044)	(0.042)
Top to top mobility	−0.007	−0.007
	(0.023)	(0.023)
Parent mean income		**−0.076**
		(0.018)
R^2	0.196	0.247
Adj. R^2	0.174	0.223
Num. obs.	266	266
RMSE	0.256	0.248

Note: Boldface indicates a p-value of less than 0.05. All regressors are standardized.

and higher education, and with family and social capital. On the other hand, many of these services are supported by the Federal government with funding that seeks to equalize provincial capacities to provide them. If provincial borders matter in this sense, then the suggestion might be that these fundamental building blocks of capabilities are not being equally provided across jurisdictions.

If there is something distinctive about Manitoba *per se* that is driving less equality of economic opportunities, then it should be possible to predict whether a Census Division falls within the boundaries of the province solely from the eight measures of intergenerational mobility. This is not the case. Table 10 uses the eight indicators in a series of linear probability models in which the dependent variable takes the value of one if the Census Division is in Manitoba and zero otherwise. The only statistically significant indicator is the average parent income in the Census Division. The lower the level of community income, the more likely the Census Division falls within the Manitoba borders, with a one standard deviation change in average income—which amounts to $7,536—associated with a 7.6 percent change in the probability. It is in this sense that Manitoba "matters", many communities have distinctly lower incomes and this—without suggesting causality—is associated with lower intergenerational mobility.

6.3 The divided landscape of intergenerational mobility

While this two-fold division of the Canadian landscape is useful as a communication device to point to the first priorities for future research and public policy concern, it does not represent the most accurate clustering of the Census Divisions. The dendrogram in Figure 7 can be reasonably viewed as suggesting a four-fold clustering: the grouping of Census Divisions highlighted in Figure 8, with the rest of the country divided into three additional groups.[22]

This preferred four-fold grouping is mapped in Figure 9. It offers a more general, and at the same time, a more nuanced picture of the landscape of income mobility in the country, than what any single indicator would suggest. This map is not the same as that for the intergenerational cycle of low income, or of rags to riches mobility, depicted in Figures 5 and 6.

In this grouping much of Québec, particularly outside of the major urban areas, is distinguished from Ontario, and belongs to a lower mobility cluster. In Figure 9, these Census Divisions are labelled as Cluster 3. Cluster 1 consists of the more populated areas of Ontario, including all of Southern Ontario. These areas are grouped with large parts of Alberta and the southern part of Saskatchewan. This is a high mobility cluster. It also includes Vancouver, the municipalities to the north and south of the island of Montréal, as well as Québec City and its environs. It includes the major metropolitan areas of the country with the exception of the island of Montréal, and the cities in the Atlantic provinces. The northern parts of the country are not grouped into a single cluster. In particular, it is noteworthy that the communities along the eastern shore of James Bay and Hudson Bay are distinct from those in Ontario and Manitoba, belonging to a higher mobility cluster, labelled as Cluster 2, that also collects other parts of rural Canada, particularly in the Atlantic.

6.4 Correlates of mobility among Census Divisions

Figure 10 shows a clear positive relationship between the Census Division poverty rate and the bottom quintile to bottom quintile transition probability. Children raised by low income parents are more likely to be low income adults when they are raised in regions with higher poverty rates. The transition probability is noticeably higher when the Census Division poverty rate is above about 17 percent, noticeably lower when it is below about 13 percent, but varies considerably between this range.[23]

Bivariate descriptions of this sort are a first step in determining causal relationships. Indeed, the portrait of the degree and nature of intergenerational income mobility across

[22] A fifth cluster consisting of a single Census Division is also indicated by the dendrogram, but it is a region in the very north of the country with a small population, and its selection by the algorithm as a cluster onto itself likely reflects measurement issues, rather than any substantive differences.

[23] The Lowess line depicted in the figure is based upon unweighted estimation across 260 Census Divisions. Six regions in Yukon, Nunavut and the Northwest Territories are excluded from the figure because the Low Income Cut-off is not calculated by Statstics Canada in these areas. The figure also omits a small number of Census Divisions with very high bottom-to-bottom quintile transition probabilities for the sake of exposition, though they are included in the estimation used to obtain the line.

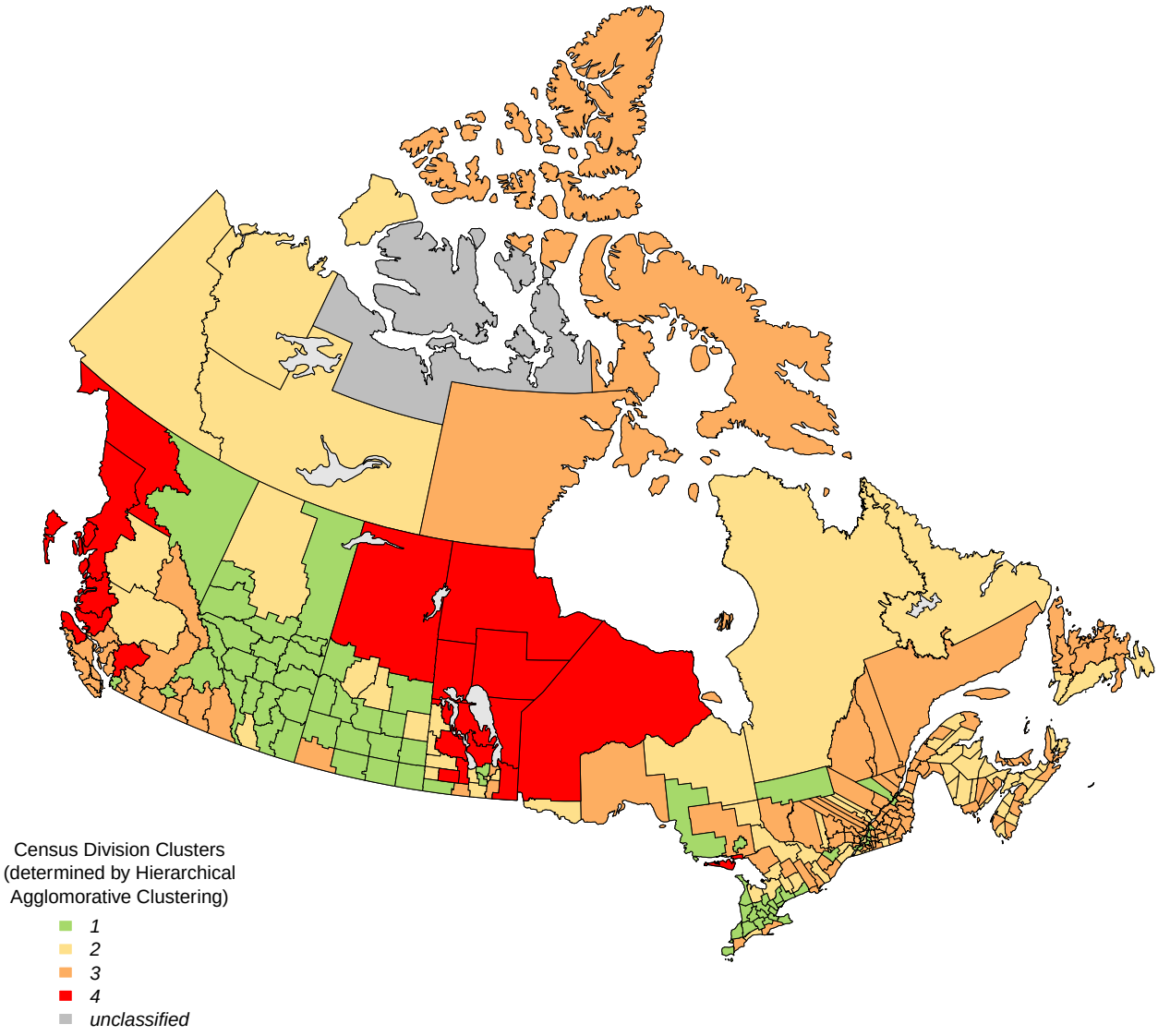

Figure 9: The divided landscape of intergenerational income mobility: four clusters of Census Divisions as determined by agglomoarative hierarchial clustering

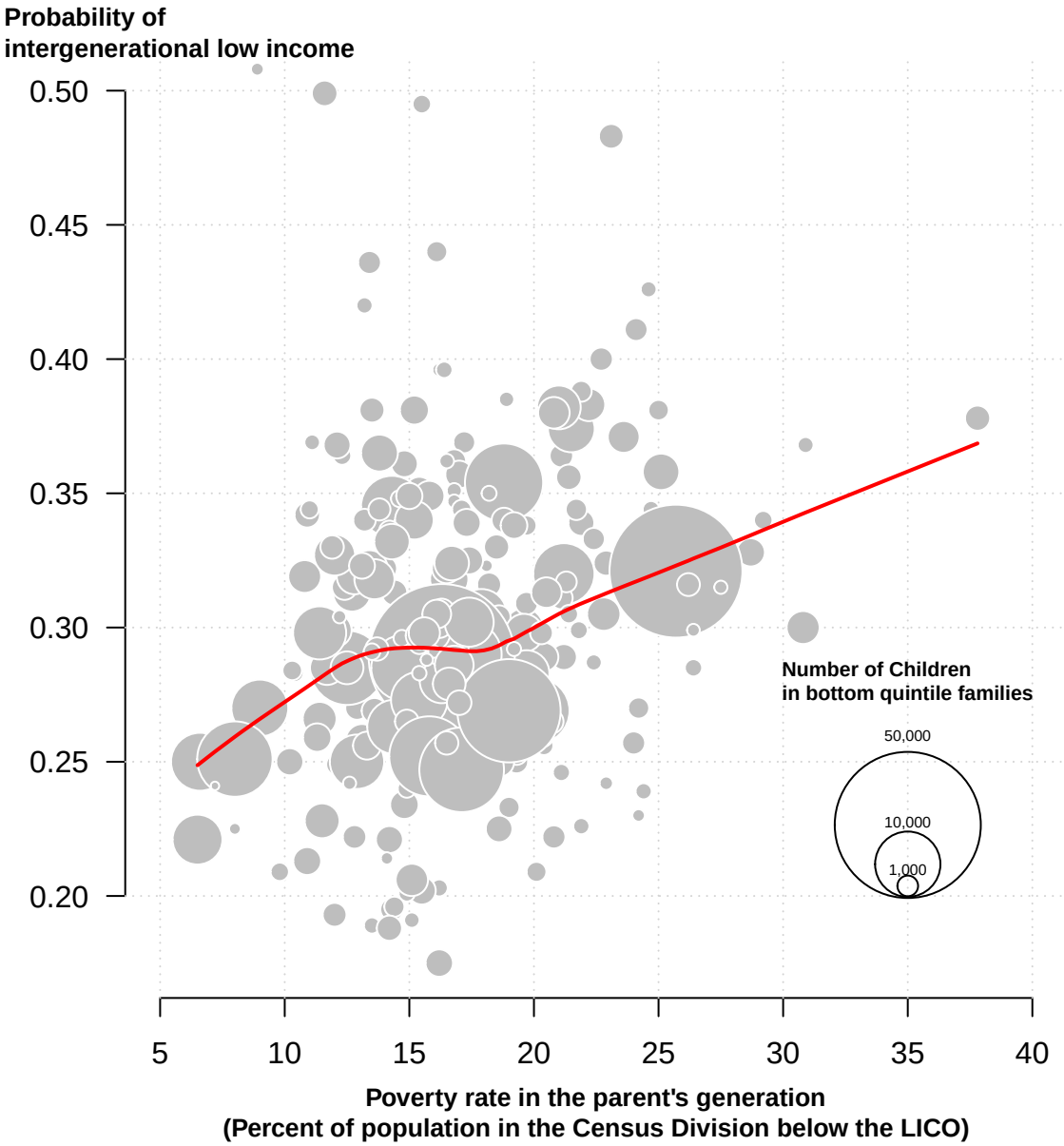

Figure 10: The relationship between the intergenerational cycle of low income and Census Division poverty rates

the country in the previous sections immediately raises questions about the factors that characterize high and low mobility communities. The relationship between community poverty and intergenerational poverty is certainly a policy relevant pairing that comes quickly to mind. But there are others. International comparisons have received a good deal of attention in part because they have motivated discussion over other correlates and causes of the significant differences between countries. Within country comparisons should do the same.

Canada generally ranks relatively well when compared to other OECD countries, as in the Great Gatsby Curve, which depicts a positive relationship between the intergenerational income elasticity and the Gini coefficient measuring cross-sectional income inequality among parent incomes. A correlation of this sort should not be given a causal interpretation, but in this case the relationship is predicted by theory (Krueger (2012), Corak (2013; 2016b), Solon (2004; 2015)), and has spurred detailed research on groupings of countries most pertinent for public policy, as in Landersø and Heckman (2016) who contrast Denmark and the United States, and Bradbury et al. (2015) who compare the United States to Australia, Canada, and the United Kingdom. This said, the Great Gatsby Curve privileges only one measure of intergenerational mobility, the intergenerational income elasticity, and has—with the exception of Chetty et al. (2014, 1612–14)—not been examined within countries.

Table 11 presents correlation coefficients summarizing the linear bivariate relationship between each of the eight statistics measuring mobility, and 21 characteristics of the Census Divisions. Some of these characteristics are derived from the analytical files used in the analysis, others are derived from the individual level micro-data associated with the 1986 Census, the so-called "Long Form" Census questionnaire distributed to roughly one-in-five Canadians.[24] The results are grouped into four broad categories, roughly corresponding to four important aspects to which theory might be interpreted as drawing attention: poverty and inequality; family and demography; social capital; and the structure of labour markets and opportunities for employment (Corak (2013)).

The correlations with the poverty rate and those with the Gini coefficient are presented in the first two rows of the table. The Census Division poverty rate is not strongly associated with absolute and relative income mobility, but is associated with lower intergenerational rank mobility and rags to riches movement. It is also associated, as Figure 10 suggests, with higher cycles of poverty. The Great Gatsby Curve is evident across the Canadian landscape, a higher Gini in parent incomes being associated with a higher intergenerational income elasticity. This finding, that inequality is associated with lower mobility, is robust across all the indicators, the one exception being rags to riches movement. Higher inequality, as measured by the Gini, is associated with lower absolute and relative rank mobility, and higher cycles of poverty and privilege.

The remaining characteristics in the first panel of the table are intended to clarify this by measuring other dimensions of inequality. The share of parents with income that places them in the middle of the national income distribution—between the 25^{th} and 75^{th} percentiles—is

[24]The results reported in the table are based upon data weighted by the number of children in each Census Division according to the analytical sample used in the previous section. The unweighted results differ, and are often heavily influenced by a few low population outliers.

Table 11: *Correlates of intergenerational income mobility: correlation coefficients based on Census Divisons weighted by number of children*

Census Division Characteristic	Income mobility			Rank mobility		Directional mobility		
	Absolute income (α_j)	Relative income (β_j)	Average income ($\bar{Y}_j$)	Absolute rank (a_j)	Relative rank (b_j)	Rags to riches ($P_{1,5}$)	Cycle of poverty ($P_{1,1}$)	Cycle of privilege ($P_{5,5}$)
Poverty rate (below low income cut-off)	-0.045	0.012	-0.351	-0.335	0.273	-0.393	0.217	-0.212
Gini coefficient (parent incomes)	-0.278	0.294	-0.081	-0.184	0.427	0.038	0.252	0.352
Parents between 25th and 75th percentiles	0.231	-0.243	-0.119	0.025	-0.171	-0.178	-0.164	-0.128
Parent incomes at 50th to 25th percentile	-0.58	0.561	-0.322	-0.398	0.522	-0.166	0.531	-0.012
Parent incomes at 75th to 50th percentile	-0.309	0.28	-0.458	-0.386	0.416	-0.283	0.309	-0.108
Parent incomes at 90th to 50th percentile	-0.187	0.174	-0.245	-0.276	0.366	-0.157	0.2	0.093
Parent incomes at 99th to 50th percentile	0.022	0.014	0.199	0.094	0.149	0.262	-0.038	0.527
Less than high school	-0.134	0.072	-0.808	-0.327	0.082	-0.391	0.214	-0.543
Lone parents	-0.121	0.124	0.229	-0.158	0.271	-0.102	0.252	0.219
Not born in Canada	0.123	-0.064	0.632	0.465	-0.229	0.599	-0.146	0.598
English mother tongue	-0.046	0.066	0.182	0.256	-0.184	0.387	0.046	0.208
French mother tongue	0.067	-0.097	-0.265	-0.308	0.182	-0.472	-0.047	-0.311
Parents not married	-0.174	0.182	0.42	-0.054	0.222	0.134	0.332	0.378
Population	0.055	-0.007	0.434	0.24	0.022	0.37	-0.044	0.567
Population 25 years and older	0.051	-0.004	0.419	0.226	0.028	0.353	-0.036	0.554
Parents filing in french	0.063	-0.09	-0.231	-0.297	0.179	-0.452	-0.05	-0.287
Moved to Census division	0.074	-0.059	0.3	0.228	-0.236	0.295	-0.155	0.101
Moved to Census sub division	0.097	-0.065	0.474	0.336	-0.26	0.45	-0.182	0.289
Employment in manufacturing	0.217	-0.234	-0.073	0.004	-0.098	-0.092	-0.113	-0.055
Employment in primary sector	-0.153	0.142	-0.467	-0.041	-0.043	-0.051	0.011	-0.29
Employment in top ten 3-digit SICs	-0.229	0.194	-0.533	-0.268	0.149	-0.304	0.204	-0.412

Note: Column entries are weighted correlation coefficients. Census Division characteristics are derived from administrative tax data and the 1986 Canadian Census.

generally associated with greater mobility. The proportion of middle income parents in the Census Division is not, however, associated with absolute rank mobility, and is negatively linked with rags to riches movement. An important result in this panel is that more inequality in the bottom part of the parent income distribution, as measured by the ratio of parent income at the 50^{th} percentile to parent income at the 25^{th} percentile in each Census Division, is strongly associated with lower mobility. This sort of inequality correlates with lower income and rank mobility in both an absolute and relative sense, and with cycles of poverty, but not at all with intergenerational privilege. Several of these correlation coefficients are greater than 0.5, among the highest in the table. Top end inequality shows similar correlations, whether measured as the 75 to 50 or the 90 to 50 ratio. But inequality at the very top, the ratio of incomes between the 99^{th} percentile and the 50^{th} percentile, only correlates with rags to riches mobility and the cycle of privilege. Inequality is negatively associated with intergenerational mobility, but it is inequality in the bottom and middle parts of the distribution that most matter, not inequality at the very top end.

The second panel groups together a number of demographic and population characteristics. The majority of these are calculated from Census data and refer to population shares in each

Census Division: the share of the population 25 and older not having a high school diploma, the share of lone parent households, the share not born in Canada, and the share with English and with French mother tongue.[25] While low education and lone parenthood are associated with lower intergenerational mobility, the share of immigrants in the Census Division shows an opposite tendency. The larger the share of the population not born in the country, the greater the degree of mobility, and particularly so with respect to directional mobility. The share of immigrants is strongly positively associated with rags to riches movement and cycles of high income, the correlation almost reaching 0.6. At the same time it shows a weak negative correlation with intergenerational cycles of low income.

The third panel offers the correlations with two indicators of geographic mobility, the share of the population in the Census Division who reported living in a different Census Division in the 1981 Census, and the share who reported living in a different Census sub division. Coleman (1988) suggests that geographic mobility may serve as an indicator of social capital, the implication being that changing place breaks networks and access to broader community resources. The indicators I offer are imperfect as they are not individual-level measures of geographic mobility—whether or not the individuals in the analytical file moved—but rather community level characteristics. In this sense, a high proportion of residents who moved into or within the region may reflect the degree to which the region is a pole of growth and economic opportunity, as likely as it is to reflect a broader sense of community and engagement. The correlations seem to suggest the former is more likely, with a higher share of movers to or within the Census division being associated with greater rank mobility, greater rags to riches movement, and lower cycles of low income. These patterns echo those for the share of immigrants in the Census Division.

The fourth and final panel presents a number of indicators of the structure of labour markets, specifically of the nature and diversity of employment opportunities: the proportion of those 25 years and older employed in the manufacturing sector, in the primary sector, and the proportion working in the top-ten three-digit industries. The manufacturing share tends to be associated with greater mobility, while the primary share with lower mobility. The greater the concentration of employment in a few industries, the lower the degree of mobility.

All of these findings are descriptive and leave open important questions about the causal mechanisms. How to think about the role of place in the process determining mobility is an open question. Parents living in less rich or more unequal Census Divisions may differ along some unobserved dimensions from parents in other regions even if both groups have the same rank in the national income distribution. In this sense, geography is informative about the parents, a view that contrasts with one ascribing a causal role to place. The clearest example of this challenge might be the interpretation given to the strong positive correlation between the share of immigrants in the Census Division and the degree of intergenerational mobility. On the one hand, immigrants may be a positively selected group of parents along some dimensions or characteristics that are particularly beneficial for the mobility of their children; on the other hand, immigrants may have more of a tendency to settle in larger urban areas,

[25]The variables "Parents not married" and "Parents filing in french" refer to the information on the tax form of the parents of the children making up the analytical file, while "Population" and "Population 25 years and older" are estimates of the Census Division total population derived from the Census.

with more diversified employment opportunities and other resources that encourage mobility of all children regardless of family background. Oreopoulos (2008) reviews this literature from a Canadian perspective, suggesting that the causal role of place is less important in Canada than in the United States, but this is a topic that should be revisited in light of my findings and data. For example, Chetty and Hendren (2017a; 2017b) use a clear identification strategy based on sibling differences to examine the causal role of place, finding that it is important and offering county level estimates of the causal impact of neighbourhoods for the United States.

7 Conclusion

The Canadian geography of economic opportunity is a landscape of considerable mobility, but also of considerable diversity. The members of the cohort I examine have attained adult incomes that surpass their parents, almost without regard to the community in which they were raised. This reflects both absolute growth in their incomes, and how strongly their income relative to the average is tied to their parents' relative income.

There is also considerable rank mobility. Upward rank mobility is strong for children whose parent's were in the bottom half of the income distribution, though generally not so high as to imply a move into the top half of their income distribution. Overall the typical child raised in the bottom half of the income distribution, by parents who ranked at the 25^{th} percentile, can expect to rise almost 20 percentiles, but this varies depending upon place, amounting to almost nothing in some Census Divisions and to as many as 30 percentiles in others. Broadly speaking, upward mobility from the bottom does not seem to be constrained by the possibility that children raised by top income parents are likely to also be top income adults, but rather by the chances that children raised by bottom income parents have lower chances of moving out of low income.

A significant majority of children of low income parents live in parts of the country where their chances of growing up to be low income adults are greater than one-in-four, and for many the chances of this intergenerational cycle of poverty are as high as one-in-three. In contrast, there are only 9 of 266 Census Divisions where the chances of rags to riches movement are 20 percent or greater, everywhere else they are lower, with about one-third of low-income children living in communities where the chances of rising to the top are less than 10 percent. A rather small fraction of the low income population, less than 3 percent, face very limited opportunity to move up the economic ladder. But they are a telling group, living in communities with relatively low average incomes. Even though large swaths of Manitoba form part of this landscape, provincial boundaries should not be considered as demarcating advantaged from less advantaged communities.

The Canadian landscape of economic opportunity is divided into four non-contiguous areas. Low mobility regions tend to be outside of urban areas, distant from poles of growth, while high mobility regions tend to be urban, or close to major urban ares, but not exclusively so with children growing up in many regions throughout Alberta and Saskatchewan being among the most mobile.

In uncovering these descriptive findings I make use of a large bank of administrative data associated with the Canadian income tax system that continues to offer potential to more thoroughly explore these issues. My analysis addresses a number of potential measurement problems, but just as importantly recognizes that intergenerational mobility can be measured in a host of different ways. While economic theory offers some guidance for empirical research, the subject of intergenerational mobility is both inherently multi-disciplinary and of ongoing public policy concern, implying that this guidance is less than complete.

For this reason I am agnostic with respect to an appropriate metric, which in turn suggests the need for more research to assess the nature of the relationship between income, rank, and directional mobility. It is natural for policy makers to give priority to upward mobility among the poor, but this has both an absolute and relative dimension. Friedman (2006, 95) recognizes that these dimensions may well be substitutes in the minds of many citizens, suggesting that most

> favor equal opportunity and fairness in the abstract sense that they would certainly support furthering these aims if doing so implied no risk, and no other cost, to themselves. But in practice, taking more steps to move a society toward greater fairness or more equal opportunity typically does impose risks, as well as costs, on at least some people. The importance of economic growth for this purpose is that rising incomes make people more willing to accept these risks and costs in the interest of what they take to be a better society for themselves as well as others.

Empirical research needs more guidance in appreciating the welfare implications of the host of statistical indicators that are used in the literature. These implications very much remain an open issue in the interpretation of my descriptive results.

But this also suggests that attempts at interpreting the diversity in the findings need to appreciate the nature of economic growth, its variation across the country, and the possible spatial auto-correlation it may imply. This is an aspect of my findings that merits closer attention, and is clearly hinted at by the suggestion that the country contains four broad landscapes of economic opportunity. The suggestion that some parts of southwestern Ontario cluster into a highly mobile landscape, in spite of declining fortunes associated with restructuring of the manufacturing sector, may have something to do with the nature of growth in Toronto and its proximity. The costs of moving to capture opportunity may be relatively lower than in more outlying areas, underscoring the importance of both growth and geographic mobility. OECD (2016) recognizes that the nature of growth in cities is important for fostering inclusion and creating opportunity, and the experience of regions surrounding Toronto may hint at the importance of this auto-correlation.

There are also important issues raised concerning the interpretation of the results in some rural and outlying communities. There is considerable diversity of mobility in many areas of the country not near large metropolitan areas, suggesting that poles of growth and mobility are associated with more than proximity to large urban areas. Growing up in large sections of Alberta and Saskatchewan leads to among the highest rates of intergenerational mobility in the country. My division of the Canadian landscape into a landscape of "us and them" highlights areas that should be a first priority for future research. One response is to

suggest that this is associated with the experiences of some aboriginal communities, and this may be particularly germane to my demarcation of large parts of Manitoba being part of an extremely low mobility cluster of Census Divisions. But at the same time many first nations communities are not part of this cluster, and the contrasts between them and others requires more detailed study.

Finally, I uncover some general patterns suggesting avenues for further research by documenting the bivariate correlations between mobility and a host of Census Division characteristics. There are strong correlations between intergenerational mobility and community level income inequality, demographics, and labour market opportunities. Regions with higher mobility tend to be regions with lower poverty and less income inequality. Higher income inequality in the lower half of the income distribution is strongly associated with lower mobility, almost regardless of which statistic is used to measure the child's outcome. Higher income inequality in the upper half of the income distribution is also associated with lower mobility, with the exception of top end inequality. I link information from the 1986 Census to these tax data at the Census Division level to also show significant correlations between mobility and community demographic and labour market characteristics. Census Divisions with a higher share of the population not born in the country tend to be higher mobility communities, as do those with more diversified employment opportunities.

Appendix

The creation of the data and its representativeness

The algorithm used to construct the Intergenerational Income Data (IID) is described in the appendix to Corak and Heisz (1999), and further detail is given in Statistics Canada (undated). I first developed the IID with colleagues at Statistics Canada in the mid 1990s for the study of intergenerational income dynamics. The data have since been updated in a number of ways, most notably by adding more annual observations on income as they have become available through the tax files submitted to Statistics Canada from the Canada Revenue Agency.

The algorithm creating the file links income tax information (the T1 form) for the members of particular age cohorts through time, and to their parents whose T1 forms are also tracked through time. The data used in this paper are made up of two cohorts of men and women whose T1 forms were linked, mostly through their Social Insurance Numbers, to their parents' T1 forms: those 16 to 19 years old in 1982, and those 16 to 19 years old in 1986. The matching process between parents and children involves up to five years of tax information in order to find a child filing for the first time (and hence having a Social Insurance Number) while still at home according to their tax filing behaviour. For example, the 1982 cohort refers to those individuals who were 16 to 19 years of age in 1982 and who filed a T1 form while at home at some point between 1982 and 1986. In a similar way, the 1986 cohort refers to those in this same age bracket who first filed taxes at some point between 1986 and 1990. It is necessary that individuals file an income tax return while still at home in order to establish a link between their Social Insurance Numbers and the Social Insurance Numbers of their parents. This permits the longitudinal tracking of family members. Individuals who did not file an income tax return while still at home are not included in the IID. Parental T1 forms are available from 1978, though the first possible year that children can be linked to their parents is 1982. Both parents and children are followed through their T1 forms up to 2008, when the children are between the ages of 38 and 45. In addition, the T1 forms of the married and common-law partners of the children are also obtained from the disclosure of their Social Insurance Numbers on the child's adulthood T1 form. The spousal information, however, is available beginning only in 1998. At the time this study began the 2009 income tax data were available only in a preliminary version, and therefore not used.

The coverage of the underlying target populations varies. Detailed examinations based upon a comparison with the Census reveals an under-reporting of children with lower income parents, and those living in large metropolitan areas. The former likely reflects the tendency of children from lower income families to leave home at a younger age, and the later an under-representation of immigrants who arrived in the country in subsequent years and whose parents came to the country after the mid 1980s. The immigrant under-representation is the natural outcome of using a longitudinal data set, and is not a concern as these cohorts of parents are likely not to have any Canadian tax-based income when the children were growing up. Weights calculated from the Census and additional sub-national information on reporting patterns across the income distribution have been derived, and are used throughout the analysis. Past research estimating national level statistics has generally found that it makes little difference whether or not the weights are used. Oreopoulos (2003) pays particular attention to these issues of under-representation in the context of a study focused on Toronto, and confirms the representativeness of the data. But more caution may warranted when the objective is to cover the entire country at a relatively fine geography.

The creation of the weights

The derivation of the weights is described by Cook and Demnati (2000). The weights are constructed using the 1986 Census and the Longitudinal Administrative Databank (LAD): the former offers an anchor for the population estimates, and the latter allows adjustments by family income. The LAD is a 10 percent sample of the T1 Family File (T1FF) and includes all children who are dependents of their tax-filing parents regardless of whether or not they (the children) filed taxes or not. In this sense it is more encompassing than the IID, which is also drawn from the T1FF. However, some children are imputed in the LAD based upon other tax and benefit information. This is one reason why it is not an appropriate source for intergenerational mobility studies, along with the fact that it is a one-in-ten sample of T1 filers, and offers limited information on the child's gender.

The weights are derived by using only children from the LAD between the ages of 16 and 19 for each cohort, including tax filing and non-filing dependent children. This data allows a comparison of IID under-coverage according to parental income. Eleven income classes based on the parental total market income, in bands of $10,000 and including $100,000 and over, are defined for geographic areas determined by the first two digits of the postal code. Some aggregation of adjacent areas was undertaken when the number of observations proved to be very small. This involved the aggregation of 36 areas into 12, and combining the Yukon, Northwest Territories, and Nunavut into one area. This is to say that while the weights are distinguished by parental income, this is done within geographic areas broader than the Census Division.

Weighted counts are derived from the LAD for each cohort, by income class and these geographic areas. The counts are then used in conjunction with the 1986 Census to adjust for gender, a variable not available in the LAD because some children are imputed. The IID was adjusted with 1986 Census data by age, and for under or over-coverage of the Canadian population by the tax system. This leads to estimates of the number of children by province, age in 1986, and gender, using a weighted 20 percent file from the 1986 Census. Another set of counts are made from the IID using the basic weight created in the step outlined in the previous paragraph. These counts were made by age in 1986, gender, and province. A census adjustment factor is computed using these counts. The final weight is constructed by multiplying the basic weight, from the first step, with the adjustment factor, from the second step. Cook and Demnati (2000) describe the method. The point is that the weighted counts from the IID are meant to be representative of the Canadian population belonging to these cohorts, accounting for gender, geography, and parental income.

Assigning Census geographic information

The postal code is a six character identifier developed and used by Canada Post Corporation for mail sorting and delivery, and takes the form AnA nAn where A represents an alphabetic character and n is a numeric character between 0 and 9. The first three characters are referred to as the Forward Sortation Area (FSA), and the latter three as the Local Delivery Unit (LDU). The postal code became universal on the T1 files beginning in 1982. Every record in the Family File, the component of the IID containing the explicit link between a child and his or her parents, was linked to the underlying T1 records for the year the child was first matched to his or her parents. If the family members were first matched by the algorithm in 1982 then the postal code for that year is used as the basis for linking Census information to the IID.

Statistics Canada (undated) describes the process used in converting this information to Census

geography codes. The following summary is extracted from this source. All family members should have the same postal code on the assumption that they are co-resident. In fact this is the case for 3,227,271 of the 3,463,712 family records in the full file. Of the 236,441 families reporting at least one different postal code between the members, 190,608 had at least 2 identical postal codes and this is was used as the family postal code. The remaining 45,833 families are put aside as a "problem" file requiring special consideration. An examination of these records showed that 26,876 had at least two identical Forward Sortation Areas, and this is used as the basis for constructing the family postal code if the LDU was the same across the family members. A similar process was based on the LDU: 6,008 records had at least two family members reporting the same LDU, and this is used as the last three digits if the FSA was reported to be the same across family members. This left 12,949 records. If the postal code was not missing for these records, then the postal code of the father was used. If it was missing, that of the mother was used, and finally if that was also missing the postal code reported by the child is used. If all of these codes are missing the family's postal code was assigned to be missing, with 1,063 records falling into this last category.

Postal Codes do not necessarily correspond with the boundaries of the geographic units used by the Census. The Postal Code Conversion File (the GEORES3C Program), a SAS program written by Russell Wilkins of Statistics Canada to perform automated Census geographic coding from a list of postal codes, is used to append Census geography codes. The complete set of records processed by this program had 3,463,712 records, and of these 30,300 proved to be problematic and required further processing. In the end only 11 of these could not be assigned a valid geographic code. The Postal Code Conversion File added 1996 Census information to the Family File, and this was converted to 1986 Census information using an auxiliary program (EA96286) also written by Russell Wilkins. Version 3 of this program, written in 1998, was used. For more detail, see the Statistics Canada website: Postal Code Conversion File (PCCF), Reference Guide, 2013. Statistics Canada Catalogue no. 92-154-G, accessed at http://www.statcan.gc.ca/pub/92-154-g/92-154-g2013001-eng.pdf [accessed on May 14, 2015].

Census geographic coding

The Census of Canada is organized along three different geographic hierarchies: a national hierarchy covering the entire country; a metropolitan hierarchy that applies to urban areas; and a postal code hierarchy based on the Canada Post Corporation coding. The Enumeration Area is the basic building block that is nested within other broader geographic areas of the national hierarchy. There are 44,042 Enumeration Areas in the 1986 Census. The Census subdivision (CSD) refers to what in many provinces are legislated to be municipalities, or equivalent legislated areas like reserves or settlements. In Newfoundland and Labrador, Nova Scotia and British Columbia a CSD refers to a geographic area created by Statistics Canada in cooperation with these provinces as equivalent to municipalities for statistical purposes. The Census Division (CD) is the next broadest geographic unit in the national hierarchy, and refers to legislatively determined areas such as counties, regional districts, regional municipalities or other legislated areas at the provincial level. For the most part their boundaries are established by provincial law for regional planning and the provision of services. These areas are not legislated in four provinces—Newfoundland and Labrador, Manitoba, Saskatchewan, and Alberta—and have been created by Statistics Canada for the purposes of data dissemination. There were 266 CDs in the 1986 Census. The CSD is nested within the CD, which in turn is nested within the broadest unit within the province, the Economic Region. The Economic Region is not defined for the 1986 Census, first appearing as a geographic category in the 1996

Census. The Census geography hierarchies as they existed in 1986 are described in Statistics Canada (1987).

The analysis in this paper uses the national hierarchy at the provincial and Census Division level. Information at the Census subdivision level is also derived, but used and presented in future research only for Census Divisions with larger populations. This information is available as a spreadsheet at MilesCorak.com/Equality-of-Opportunity.

Data quality issues

I create a number of different analytical files that allow me to assess the robustness of the analysis. The first alternative file includes all incomes, rather than using a lower cut-off of $500 as the basis of selection into the analytical file. The second alternative is based upon this cut-off but includes only the 1986 cohort of individuals. I point out below that their geographic locations as teenagers might be considered to be more accurately determined. In similar ways, alternative files are also developed for boys and girls separately. The core of the analysis, that reported in the text, is based upon the file that uses all cohorts. This maximizes the sample size, and maintains an income cut-off of $500 because this is a better approximation of permanent income, avoiding measurement error in the lower end of the distribution and permitting the derivation of logarithms used in the assessment of income mobility. I also create similar analytical files from the 1986 cohort that is based on the children being 31 and 32 years of age. These alternatives allow me to assess measurement issues associated with life-cycle biases, and make comparisons to a similarly aged cohort used by Chetty et al. (2014).

As alluded to, the IID weights will not perfectly correspond with the sub-national geography at which the analysis is actually conducted. The weights are based upon province and broad regions defined by the first two digits of the postal code. As a result, there is no guarantee that weighted population counts from the IID will correspond with Census counts for areas as small as the Census subdivision. For this reason the analysis has been conducted at a level no finer than the Census Division, and with both weighted and unweighted data. This paper reports only the results from the weighted data, the choice not making substantive differences.

Figure 11, however, illustrates an important data concern by presenting a very loosely defined estimate of the "coverage ratio" for each Census Division, based upon the analytical file used in the analysis. This is the ratio of the population estimate in the tax-based analytical files—unweighted and weighted—to the population estimate for this age cohort of Canadians as derived from the 1986 Census. These should be loosely interpreted. For example, it is not clear that these ratios should be equal to one since the analytical file is based on a number of selection rules to ensure that the individuals are still alive and present in Canada in the five year period ending in 2008, and also that a reasonable estimate is made of their permanent incomes. The unweighted coverage ratios range from as low as 0.3 to as high as 0.85, and on average are 0.64. The weighted ratios are, as the Figure also shows, higher, and on average are equal to 1. But many are greater than one, though most range between 0.75 and 1.25. This requires an explanation.

There are two reasons these ratios deviate from one. To some degree it reflects the slippage between the way in which the weights are calculated according to the first two digits of the postal code, while the placement of children into particular Census Divisions is done according to the full six-digit postal code. There are 9 Census Divisions in which the ratio of population weighted

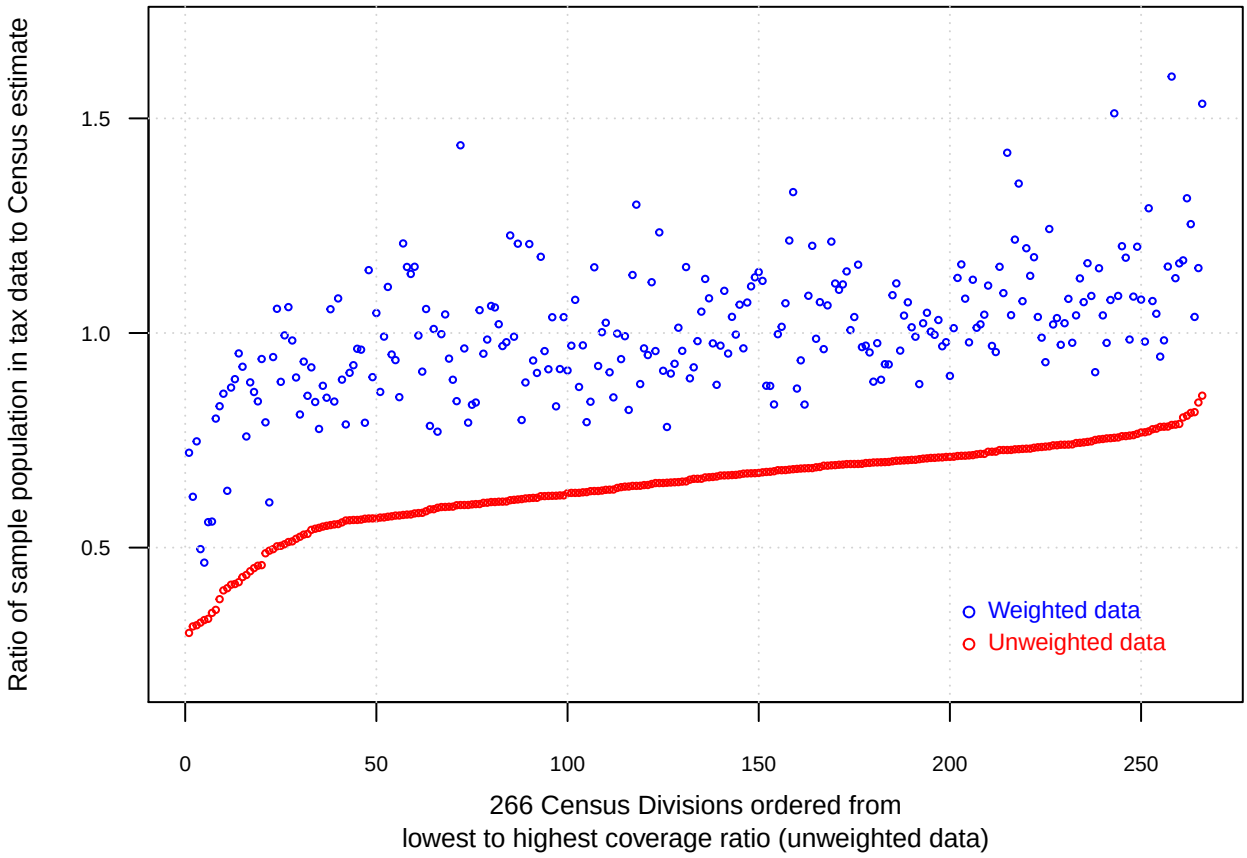

Figure 11: Coverage ratios of the population of children in each of 266 Census Divisions: ratio of sample population in tax data relative to Census estimate, weighted and unweighted

Table 12: *Census Divisions in which the ratio of weighted sample population in tax data to 1986 Census estimate of children born between 1963 and 1970 is less than 0.75*

Census Division, Province/Territory		Administrative Data Weighted	Administrative Data Unweighted	1986 Census Total	Ratio weighted to Census
Division No. 23	MB	725	525	1,575	0.47
Division No. 15	AB	1,950	1,275	3,925	0.50
Division No. 14	AB	1,850	1,100	3,325	0.56
Territoire-du-Nouveau-Quebec	QC	3,150	1,950	5,625	0.56
Sunbury County	NB	2,300	1,875	3,800	0.60
Division No. 18	SK	2,575	1,325	4,175	0.62
Division No. 22	MB	3,250	2,075	5,150	0.63
Central Coast Regional District	BC	300	125	400	0.72
Kitikmeot Region	NT	525	225	700	0.75

Note: All numbers are rounded to the nearest 25.

counts from the tax data to the Census data are less than 0.75, and 11 with ratios greater than 1.25. These groups of Census Divisions are listed, respectively, in Tables 12 and 13. The results for these communities should be interpreted with caution, though they selectively continue to be included in some of the results reported in this paper. In particular, they continue, with one exception, to be included in the cluster analysis, where there is no explicit reporting or use of any one mobility statistic. All of these communities are very small in population for the age group of individuals that is the focus of attention.

The second reason for the coverage ratios being very low or very high is related to how accurately children may be placed in particular Census Divisions. This has to do with the child's age in the year linked to the parents. Recall that children are assigned to a geographic area according to the postal code on the T1 files in the year they are linked by the IID algorithm to their parents. As suggested, at one extreme this involves using individuals who are 16 to 19 years of age in 1986, and linked to their parents in that year. Situating these children geographically with 1986 Census information is probably an accurate link to the communities in which they were growing up between the ages of 15 to 19, when parental income is measured. But at the other extreme the linkage algorithm involves a cohort who were 16 to 19 years of age in 1982, and some being as old as 23 when linked with their parents in 1986 and when the Census geography is also established. Some fraction of these children and their parents may well have been living in a different Census Division when the children were between 15 and 19, which would date from 1982 and earlier. This raises a question as to how accurately the region in which they actually lived is captured by ascribing them to a Census Division in 1986. Figure 12 illustrates by replicating Figure 11 for the youngest cohort in the IID, those who were 16 to 19 in 1986. The weighted coverage ratios are much more likely to be less than one. There are 31 of 266 Census Divisions with a coverage ratio greater than one, and only 2 with a ratio greater than 1.25.

However, the differences between the two samples described in Figures 11 and 12 don't lead to substantive differences in the findings. When the results for all cohorts presented in the body of the

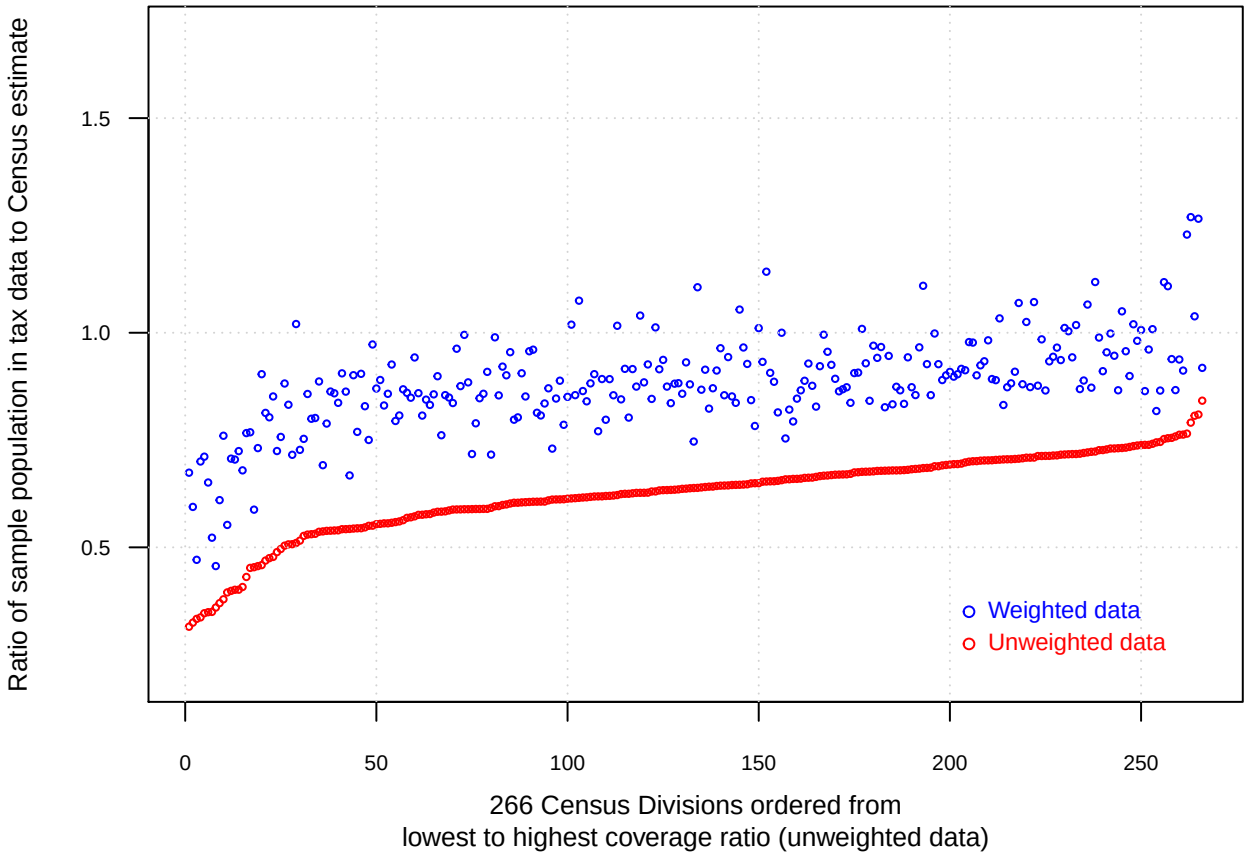

Figure 12: Coverage ratios of the population of children 16 to 19 years of age in 1986 in each of 266 Census Divisions: ratio of sample population in tax data relative to Census estimate, weighted and unweighted

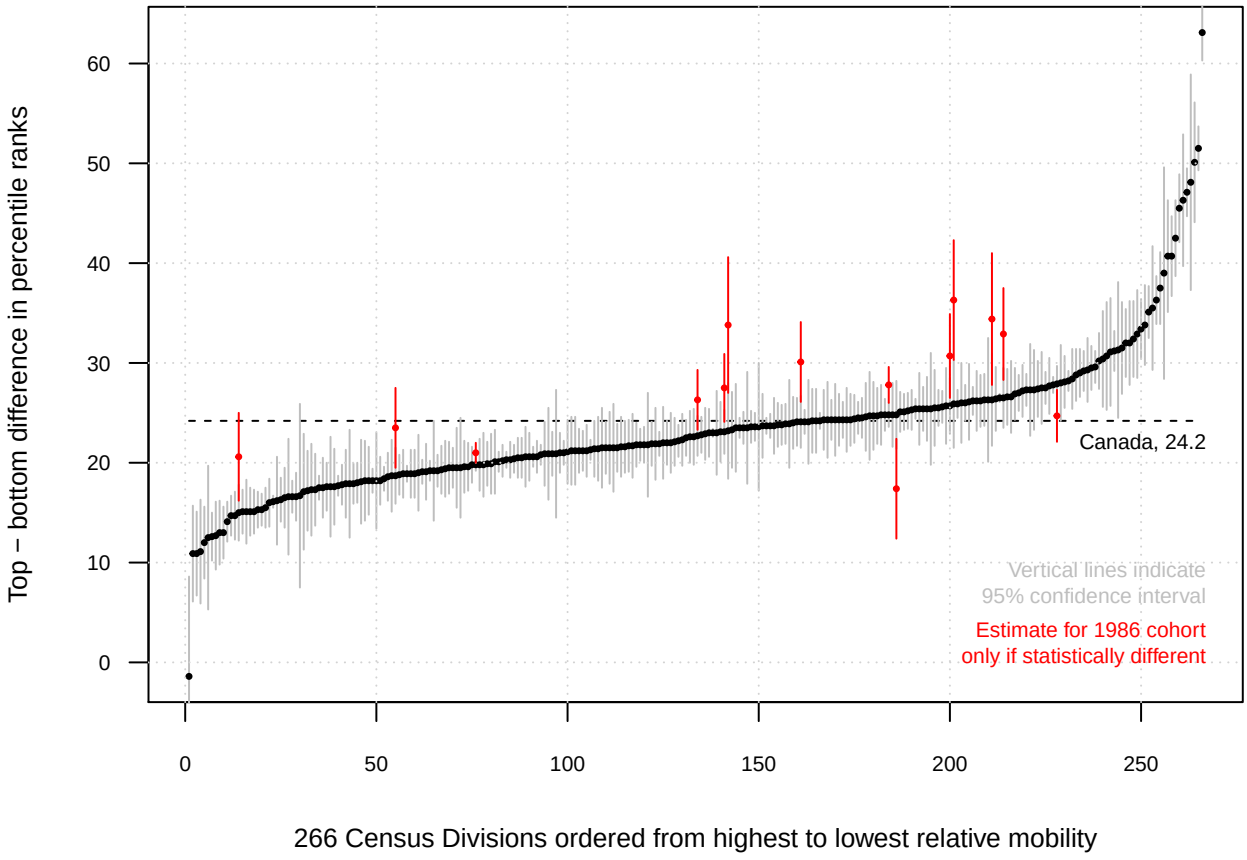

Figure 13: Least squares estimates of relative rank mobility for all children and for the subset of those 16 to 19 years of age in 1986 in each of 266 Census Divisions

Table 13: *Census Divisions in which the ratio of weighted sample population in tax data to 1986 Census estimate of children born between 1963 and 1970 is greater than 1.25*

Census Division, Province/Territory		Administrative Data Weighted	Administrative Data Unweighted	1986 Census Total	Ratio weighted to Census
Division No. 16	MB	1,450	950	1,150	1.25
Richmond County	NS	2,000	1,200	1,550	1.29
Lotbiniere	QC	5,350	2,650	4,100	1.30
Division No. 18	MB	3,275	2,000	2,475	1.31
Muskoka District Municipality	ON	5,700	2,925	4,300	1.33
Parry Sound District	ON	5,150	2,775	3,825	1.35
Portneuf	QC	9,600	4,925	6,750	1.42
Manitoulin District	ON	1,725	725	1,200	1.44
Montmorency No. 2	QC	1,100	550	725	1.51
Napierville	QC	2,825	1,575	1,825	1.53
Montmorency No. 1	QC	4,375	2,150	2,750	1.60

Note: All numbers are rounded to the nearest 25.

paper are compared to those from the subset belonging to the 1986 cohort, there are differences, but generally only to the extent that might be expected from chance. Figure 13 offers one illustration. The data in this Figure contrast least squares estimates of relative rank mobility—$100 \times b_j$—between the two samples used in Figures 11 and 12. The vertical lines represent the 95 percent confidence interval around the estimated b_j for the full sample. The estimates for the 1986 cohort and their confidence intervals are presented only for those Census Divisions in which the null hypothesis of no difference between the estimates can be rejected. Relative rank mobility is estimated to be statistically different—as determined by a z-test at the 95 percent confidence level—between these two samples in 14 of the 266 Census Divisions. This is not greater than what would be expected by chance. This said, when the estimates are found to be statistically different, they tend to be higher using the 1986 cohort in all but 2 cases.

An online appendix available at MilesCorak.com/Equality-of-Opportunity replicates all the tables and figures in the text using the younger cohort. The differences do not overturn the major conclusions. This said, there are some differences in the classification of Census Divisions into the particular groupings used to create the maps and some tables. These groupings are not based on any notion of statistical significance, so slight differences in the values of the statistics around the cut-offs defining the groupings, may lead to different classifications. The most important substantive difference is the clustering of the 266 Census Divisions into four groupings, as mapped in Figure 9. The online appendix also separately compares each of the eight mobility statistics used in the clustering. In general, there is no systematic difference between the two sets of statistics with the exception of the estimates for absolute income mobility and for the average parent income in the Census Division. Both these statistics show a tendency to be higher when the full sample is used. This may also influence the classifications resulting from the clustering algorithm. However, in some sense this result is to be expected given that the children and their parents have a tendency to be older in the full sample, and as a result likely to be earning slightly higher incomes.

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