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POVERTY INDICES AND POLICY ANALYSIS

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Our aim in this paper is to show how recent developments in the theory and methods of poverty measurement can be applied to provide more accurate descriptions of poverty trends to the typical consumers of these statistics—policy analysts, policy-makers and their critics. Since Amartya Sen's (1976) classic critique of the "headcount" approach to poverty measurement, considerable progress has been made in constructing axiomatically-driven measures of "poverty intensity." These measures have had little influence outside the small world of experts who devised them largely because their mathematical representation has made their meaning obscure to potential users. We focus on the Sen–Shorrocks–Thon (SST) index and its elaboration by Osberg and Xu which provides the information contained in the index in a format that is easily accessible within traditional categories of poverty analysis. The SST index and its decomposition provide an analytical framework for discussing the underlying components of aggregate trends that allows for unambiguous answers to the usual policy-related questions concerning the components of change as well as their magnitude and direction.

INTRODUCTION

Since Sen's (1976) classic article on the topic, there has been considerable progress in both the theory and methods of poverty measurement. Standard academic practice and public policy debates, however, have been scarcely touched by these developments. Although several alternative measures with desirable theoretical and statistical properties for indexing poverty have been available for some time, standard practice continues to rely heavily on the less than desirable but easily understood poverty *rate* or headcount approach.

The basic flaws of the headcount method are well known. A reasonable test for any poverty index is to ask whether an increase or decrease in the index unequivocally indicates an increase or decrease of poverty in the population. As Sen (1976) pointed out, a poverty *rate* does not meet this standard. Sen outlined a number of basic axioms that any poverty index should satisfy. The *monotonicity axiom* states that, given other things, a reduction in the income of a poor household must increase the poverty index. The *transfer axiom* states that, given other things, a pure transfer of income from poor household to any other that is richer must increase the poverty index. A poverty *rate* does not satisfy these axioms and in this sense does not satisfy the criterion of construct validity. A falling poverty rate, for example, may conceal the fact that families below the poverty line are

Note: The views presented in this paper are those of the authors only, and do not necessarily represent the views of Statistics Canada. Thanks to Lars Osberg and Kuan Xu for helpful comments on previous drafts of this paper.

poorer than in the past. The average poverty gap (or depth of poverty among the poor) is frequently calculated but it ignores the number of poor people and the degree of inequality among the poor (Osberg and Xu, 1999). Since these several indicators may move in opposite directions, the researcher is left in the difficult situation of providing complex answers to seemingly straightforward questions. Did poverty rise or fall last year? Is poverty higher in country A than in country B? Faced with the challenge of providing concise answers to interested publics (including policy-makers and other scholars) the temptation is to revert to the readily understandable (though often misleading) poverty rate.

The headcount method is also severely limited for answering important questions about the process of income formation underlying poverty trends. Redistribution is a major activity of the modern state and both policy-makers and publics are naturally curious about the impact of these efforts on the lower tail of the income distribution (the "poor"). The usual strategy for measuring "transfer effectiveness" by comparing poverty rates before and after transfers (Blank and Hanratty, 1993; McFate, Smeeding, and Rainwater, 1995) is not much help in this regard. From a Rawlsian standpoint (Rawls, 1972), any change that reduces the poverty of the most disadvantaged always represents an improvement in social welfare but this is the sort of test the poverty rate clearly fails. Other things being equal (i.e. in the level and depth of pre-transfer poverty and the size of the transfer budget for the poor), a transfer system that disproportionately benefits the most indigent will almost certainly raise fewer families out of poverty than transfer systems that are less targeted.

Our aim in this paper is to show that these issues are not mere quibbles and to demonstrate how they can be addressed with recent developments in the measurement of poverty *intensity* (Sen, 1976; Foster, Greer, and Thorbecke, 1984; Shorrocks, 1995). We focus in particular on the Sen–Shorrocks–Thon (SST) index and its elaboration by Osberg and Xu (1999, forthcoming). Measures of poverty intensity have not been widely used in policy circles in part because their abstract mathematical presentation has not provided policy-makers, scholars or the public with an intuitive understanding of their meaning. Osberg and Xu overcome this hurdle by presenting the SST index in a format that makes it easily accessible within traditional categories of poverty analysis. Their (multiplicative) decomposition of the SST index into the poverty *rate*, the poverty *gap*, and *inequality* in the distribution of the gap provides a general framework for identifying the underlying components of aggregate trends including the relative contribution of alternative sources of income such as earnings and transfers.

As we also show, application of this general framework aids in clarifying a number of related issues concerning the choice of poverty lines. A typical frustration of policy-makers is that incremental efforts to raise the incomes of the most indigent often have little impact on the poverty rate.[1] The temptation in this situation is to move the goal posts to a lower poverty standard in the (usually misguided) hope that a lower cut-off will register the change. Changes that affect the most indigent are always reflected in measures of poverty *intensity* irrespective

[1]For example, recent Canadian efforts to develop a new "market basket measure" of poverty were motivated at least in part to create a poverty line that would be sensitive to the impact of Canada's National Child Benefit. See Canada (1998).

of where in the distribution the poverty line is drawn but moving the goal-posts will not necessarily improve the sensitivity of the poverty *rate* to these changes.

The paper is organized as follows. Section I briefly discusses the rationale for and calculation of the SST index. Section II provides an extended application to trends in "low-income" intensity among Canadian children for the period 1981–96. Due to the conceptual problems associated with the definition of poverty, Statistics Canada has stressed that its various *low-income* cut-offs do not constitute "poverty" lines. As a result, we use the terms "poverty" and "low-income" interchangeably in our review of the scholarly and technical literature. The empirical illustration, however, is based on an analysis of low-income trends among Canadian children. To keep the presentation focused on issues of application and interpretation, we address technical and statistical issues in footnotes and appendices wherever possible and with references to the related literature.

I. Indexing Poverty Intensity

The SST index of poverty intensity was initially advocated by Sen (1976) and recently adapted by Shorrocks (1995). Since Thon (1979, 1983) proposed a revision of the Sen index that in the limit is identical to the Shorrocks formulation, Osberg and Xu identify it as the SST index. It satisfies the monotonicity and transfer axioms, takes on values between 0 and 1, and, analogously to Lorenz curves (see Shorrocks, 1995 for a graphical illustration), can be interpreted as the fraction of the area below the line of maximum poverty (the poverty profile obtained when all incomes are zero) filled by the observed poverty gap profile (the cumulative sum of poverty gap ratios after ordering all individuals by the size of their poverty gap from largest to smallest).

Calculation of the SST index begins with the usual measure of the "poverty gap," the difference (in dollars) between the poverty line (Z) and actual income of the low income family (Y_i) and expresses the gap as a ratio of the poverty line as in:

$$X_i = (Z - Y_i)/Z \tag{1}$$

where X_i is set to zero for the non-poor, thus defining a variable for the entire population (the poor and the non-poor). In effect, rather than a dichotomy (poor/not poor), poverty is measured as a continuous variable ranging from zero (for the non-poor) to its empirically observed maximum.

As with any variable, the poverty gap ratio can be described in terms of its mean (the average depth of poverty in the population) and the shape of its distribution. The SST index is a function of the average poverty gap ratio and the Gini coefficient (G) of poverty gap ratios for the entire population as in:

$$P(Y; z) = \mu(X)[1 + G(X)] \tag{2}$$

where $\mu(X)$ is the mean of the low-income gap ratios for the entire population including the non-poor and $1 + G(X)$ is an approximation of $G(X)$ for all persons based on first-order Taylor series expansion (Osberg and Xu, forthcoming).

While the Sen–Shorrocks–Thon index and related measures (e.g. Foster, Greer, Thorbecke, 1984) represent a considerable advance in both the theory and

measurement of poverty, neither the theory nor the measures have had much impact in part because such indexes do not have a readily intuitive interpretation. As Osberg and Xu point out, however, the mean of X_i, i.e., $\mu(X)$, is simply the weighted sum of the average poverty gap ratio among the poor and the average poverty gap ratio of the non-poor (i.e. zero) where the weights are the corresponding population proportions (i.e. the poverty rate and one minus the poverty rate) so that:

$$\mu(X) = (\text{Rate})(\text{Gap}) + (1 - \text{Rate})(0) \tag{3}$$
$$= (\text{Rate})(\text{Gap})$$

and the SST index can be rewritten as:

$$P(Y; z) = (\text{Rate})(\text{Gap})[1 + G(X)]. \tag{4}$$

For the purpose of decomposing the intensity measure, it is useful to express equation (3) in log form as:

$$\ln (P(Y; z)) = \ln (\text{Rate}) + \ln (\text{Gap}) + \ln (1 + G(X)) \tag{5}$$

so that the overall change in the index can be expressed as the sum of the change in its components as in:

$$\Delta \ln (P(Y; z)) = \Delta \ln (\text{Rate}) + \Delta \ln (\text{Gap}) + \Delta \ln (1 + G). \tag{6}$$

As shown by Osberg and Xu's (forthcoming) analysis of LIS data and by our results, $[1 + G(X)]$ is relatively constant, accounting for very little of the change in the overall poverty profile. Consequently, changes in low-income intensity can be approximated in practice by the product of changes in the poverty rate and the average poverty gap ratio of the poor. Moreover, when the amount of change is not large, a difference in logs is closely approximated by the more familiar percentage change as in:

(7) % change in intensity = % change in the rate + % change in the gap.

The percentage change equation is an approximation of the logarithmic identity in (6) and is reasonable when the magnitude of change is small but not when it is quite large (say over 30 percent). Since percentage changes are more easily communicated than log changes to most audiences, we make use of the percentage format for much of our analysis, drawing on the logarithmic identity when percentage changes are large.

In the remainder of the paper we illustrate the implications and advantages of the intensity index with an extended application to trends in low-income intensity among children in Canada.

II. From Theory to Practice: Low-Income Intensity Among Children, 1981–96

Introduction and Methodological Considerations

To illustrate the application of the SST index, we focus on low-income trends among Canadian children in three periods, one when low-income intensity was falling and two when it was rising. The first period (1981–89) covers a complete business cycle (peak to peak) when labor market conditions were broadly comparable. We then turn our attention to the period of recession (1989–93) and moderate recovery (1993–96) with 1996 being the last year for which data were available at the time of writing. We are especially interested in identifying the underlying patterns in earnings and social transfers associated with an unexpected increase in low income after 1993, a period of slow recovery when one normally expects low-income intensity to decline.

We first focus on low-income *trends*, and the extent to which these differ depending on whether they are measured by a traditional *rate*, or by the *intensity* measure. The use of low-income rates is not a matter of great concern if they correctly identify the direction and approximate magnitude of change. And, as with any measure, we will be less concerned if the magnitude of "error" introduced by the use of a less than perfect indicator is relatively constant through time. If, however, there is significant variation over time in the relative contribution of the rate, on the one hand, and the gap, on the other, to observed trends in low-income intensity the problem is decidedly more serious.

A second issue concerns the *sensitivity* of a low-income measure to changes in transfers or market earnings. To measure the effects of transfers on the income distribution requires a counterfactual—what would the distribution be like in the absence of transfers and taxes. We make no attempt at identifying the "real" counterfactual. To do so would require a complex model to take account of the behavioral (second-order) effects of transfers (and taxes) on the distribution of market income and no such model is available.[2] Hence, we follow the usual convention of measuring the "first-order" effects of transfers and taxes by comparing the final distribution of low income (after transfers/taxes) with the distribution of low income before transfers and taxes using the extension of Osberg and Xu's decomposition described in Appendix C. First-order effects represent the direct (accounting-based) effect of a change in transfer payments on the income of the low-income population. A $100 rise in transfer payments is seen as a $100 rise in total income and the impact of transfers and taxes on the initial (market) distribution of earnings is ignored.

Data are from Statistics Canada's Survey of Consumer Finances (SCF). While the SCF measures the largest share of income quite accurately, it underestimates some components of income, including social assistance and UI, as well as investment income. In the aggregate, approximately 80 percent of government transfers are captured by the data source. The result is that the SCF underestimates the impact of transfer payments on low-income for any given year. However, since our concern is with changes through time, we are less concerned with

[2]Furthermore, in the policy analysis world such an approach is rarely used and in this paper we are concerned with altering standard practice.

this underestimation than if we were focusing on the impact of transfers at a single point-in-time.[3]

Since the mean of the low-income gap ratio is sensitive to extreme cases, the results are calculated only for families with positive incomes. Results are reported to the third digit. The extent to which differences in the third digit are statistically significant is discussed in Osberg and Xu (1999) and Appendix A.

Measurement of low-income requires the choice of a low-income cut-off (or "poverty line"), a topic that is highly controversial in Canadian policy circles (Wolfson and Evans, 1990). Due in part to this controversy, Statistics Canada routinely publishes series based on several different "low-income" standards. We take advantage of this fact to address two related substantive questions. First, how sensitive are results to the choice of a lower vs. a higher cut-off? And, second what are the implications of using a cut-off (or poverty line) measured in relative terms as opposed to real constant dollars?

Using a lower cut-off will magnify changes in low-income intensity when the gains or losses disproportionately affect the most indigent members of the low-income population. Conversely, gains or losses that mainly affect families closer to the cut-offs will be magnified by the higher cut-offs. In effect, a sensitivity analysis of higher and lower cut-offs provides additional useful information on where in the low-income distribution change is occurring. However, as illustrated in our analysis of the 1981–89 changes, this is only true when poverty trends are measured by the SST index and not when measured by the rate.

The debate over "absolute" (or "fixed") vs. "relative" poverty lines is a long-standing one in the social sciences.[4] Concepts of poverty based on notions of relative deprivation (or social inclusion) clearly favor the use of a relative cut-off such as the "50 percent of the median" standard common in comparative studies. Relative measures, however, are not very useful for indexing short-term changes in the real living standards of the "poor" over the ups and downs of the business cycle. To learn that *relative* poverty did not change during a recession may be heartening news but hardly instructive about its impact on the real living standards of low-income families. For policy purposes, it is important to learn the extent to which the counter-cyclical effects of social spending not only offset changes in the shape of the income distribution (indexed by a relative measure) but also the impact of rising unemployment on the real living standards of low-income households. The issue is not whether one standard (relative or "fixed") is superior to another but rather the substantive question being addressed.

To illustrate this discussion, we report results based on both standards. Because our emphasis is on changes in low-income intensity over different periods

[3]For comparisons over time, the main concern is with *change* in the underestimation of transfer payments and in particular for those years to which we pay special attention in our analysis, namely 1981, 1989, 1993 and 1996. In the aggregate, reconciliation between of SCF and National Accounts estimates indicate that the SCF captured 79 percent of total transfers in 1981 and 1989, 84 percent in 1993 and 87 percent in 1996. With respect to our main conclusions these changes *may* mean the SCF overestimates the increase in transfers we observe for the 1989–93 period somewhat and underestimates the reduction in transfers we observe for 1993–96.

[4]The concept of "absolute" poverty has two referents in the usual discussions, that of the bare minimum required for subsistence, on the one hand, and, on the other, an income standard fixed in real constant dollars, adjusted for inflation but not for changes in real living standards of the population. Here, we use the term only in the latter sense.

of the business cycle, the text of the paper focuses on measures of low-income intensity calculated using a "fixed" low-income cutoff, measured in constant dollars. Appendix B reports comparable results based on a "relative" low-income cutoff. The results are virtually identical with both series except for the period of recession in 1989–93, when they diverge dramatically.

To measure low-income intensity based on a fixed (constant dollar) cut-off, we use Statistics Canada's Low-Income Cut-Offs (LICOs). LICOs are calculated with an econometric method that estimates the amount of income spent by the average family on "basics" (food, clothing, shelter) and then adds a constant to this estimate (20 percent) to determine the point at which a family might be considered "poor" or (in Canada) "low income." Adjustments are also made for family and community size to take account of economies of scale and differences in cost of living. Unlike the U.S. poverty line, which is only adjusted for price changes, Statistics Canada adjusts the LICO for changes in real living standards every few years. Here, however, we use the 1992 cut-offs adjusted to account for changes in the CPI only. In this respect, it is similar to the U.S. practice of using a fixed (in constant dollars) rather than a relative standard, albeit measured by 1992 rather than 1955 living standards.

To illustrate the implications of the sensitivity of results to the choice of level, we use three variants of the LICO (high, medium, and low). They are:

(1) the LICO, a pre-tax (post-transfer) measure that was at about 55 percent of median income in 1992, currently, the most widely used measure in Canada;
(2) the LICO-IAT, a cut-off based on the after tax/transfer income distribution which is about 25 percent lower than the pre-tax LICO; and
(3) the 0.7 * LICO, a cut-off set at 70 percent of the pre-tax LICO that produces a cut-of that was approximately 40 percent of median family income in 1992.[5]

In Appendix B we supplement these results with a purely *relative* low income measure (the LIM-IAT) that reflects international practice of defining low income based on after-tax/transfer income set at 50 percent of the median (equivalence-adjusted) income of all persons in the reference year.[6] Its value changes annually reflecting changes in median income.[7]

[5]As a rule of thumb, the 40 percent of median income standard also approximates the usual U.S. poverty line (Smeeding, Torrey, and Rainwater, 1993).

[6]This LIM-IAT cut-off should be distinguished from a similar LIM-IAT routinely calculated by Statistics Canada. Whereas the usual Statistics Canada estimate is based on median *family* income, the standard used here is based on the median income assigned to all *individuals* derived after adjustment with an equivalence scale to reflect differences in family size (Picot and Myles, 1996). Conceptually, the difference is that between a family-weighted (LIM-IAT) and a population-weighted (LIM-IAT) social welfare measure.

[7]By definition, the low-income population defined by the 0.7 * LICO is a pure subset of the population defined as low income by the LICO. Since it is based on a different (post-tax) distribution, the same is not true of the low-income population defined by the LICO-IAT. Empirically, however, 99.7 percent of the LICO-IAT low-income population was also categorized as low-income under the LICO. Hence, comparisons among the three LICO-based cut-offs are affected only by the level at which the cut-offs are set. The low-income population defined by the relative LIM-IAT (Appendix B) is not a clear subset of the LICO low-income population. Approximately 70 percent of the LIM-IAT low-income group were also low-income under the LICO standard.

Changes In Transfers, Market Incomes, and Low-Income Intensity During the 1980s

The 1980s were a turbulent period for Canadian wage earners (Morissette, Myles, and Picot, 1994). As the economy emerged from the recession of the early 1980s, evidence of growing earnings polarization raised widespread concerns that the famous post-war "middle-class" was entering a period of decline. Children were particularly vulnerable to these developments. A major component of change was a real and relative decline in the earnings of younger adults (under 35), the parents of most young children (Picot, Myles, and Pyper, 1998), and inequality in *market* (i.e. pre-transfer) incomes among families with children rose significantly.[8]

Changes in low-income intensity based on market incomes (i.e. before transfers) reflected these developments (Table 1), rising by about 8 to 12 percent depending on the choice of cut-off. Change, however, was dominated by a rise in the low-income gap while low-income rates remained relatively stable. Indeed, the low-income rate measured by the pre-tax LICO actually fell slightly from 22.4 to 22.2 percent of all children. In short, while the share of families with earnings below the cut-offs changed little, average earnings among those who did were falling.

TABLE 1

CHANGES IN LOW-INCOME INTENSITY BEFORE TRANSFERS, CHILDREN AGED 0–17, 1981–89

	Low-Income Intensity LICO			Low-Income Intensity LICO-IAT			Low-Income Intensity 70% of the LICO		
	1981	1989	% Change	1981	1989	% Change	1981	1989	% Change
Low income intensity	0.206	0.222	7.8	0.173	0.191	10.4	0.155	0.173	11.6
Rate	0.224	0.222	–0.9	0.168	0.176	4.8	0.141	0.149	5.7
Gap	0.491	0.537	9.4	0.543	0.578	6.4	0.575	0.615	7.0
Inequality in the gap	1.864	1.858	–0.3	1.892	1.884	–0.4	1.907	1.898	–0.5

To illustrate, we show average income by source (Table 2) for families at risk of low-income (those with earnings below the cut-off) based on the LICO-IAT standard. Among all families with low market incomes, earnings fell by about 7 percent but losses were greatest among the most indigent, illustrated here by comparing lone-parent families whose earnings fell by 10.6 percent and two-parent families whose earnings fell by less than 3 percent. However, net transfers (transfers minus taxes) to families with low market incomes more than offset these losses, rising by almost $2,000 (a 25 percent increase). The result was a net gain of approximately $1,300 in average disposable income among families at risk.

What impact did higher transfers have on low-income levels as indexed by the components of low-income intensity (Table 3)? While rising transfers produced real gains in reducing low-income *intensity* (Table 3, Row 1), these gains were largely obscured when measured with the low-income *rate* (Table 3, Row 2). Since the largest increases in transfers went to the most indigent families, most

[8]The pre-transfer Gini for children, that is among families with children weighted by the number of children per family, rose from 0.34 to 0.37.

TABLE 2

AVERAGE INCOME BY SOURCE, FAMILIES WITH CHILDREN WHOSE MARKET INCOMES ARE BELOW THE LICO-IAT, 1981 AND 1989, BY FAMILY TYPE (1996 CONSTANT $'S)*

	Average Earnings	Average Social Assistance	Average UI Benefits	Average of Other Transfers	Average Taxes	Average Total Transfers and Taxes
All families with children in market-based low-income						
1981	$9,690	$2,930	$1,840	$3,430	–$480	$7,730
1989	$9,030	$3,890	$2,280	$4,190	–$700	$9,670
Difference ($)	–$660	+960	+440	+760	+220	+1,940
% Change	–6.8	+32.7	+23.9	+22.1	+45	+25.1
Two-parent families with children						
1981	$11,890	$2,170	$2,290	$3,860	–$612	$7,710
1989	$11,560	$2,820	$3,010	$4,800	–$995	$9,636
Difference ($)	–$330	+650	+720	+940	+383	+1,926
% Change	–2.8	+30.0	+31.4	+24.3	+62.5	+24.9
Lone-parent families						
1981	$4,040	$4,890	$680	$2,340	–$140	$7,770
1989	$4,470	$5,900	$980	$3,110	–$170	$9,720
Difference ($)	–$430	+910	+300	+770	+30	+1,950
% Change	–10.6	+18.6	+44.1	+32.9	+21.4	+25.1

*Dollar values are adult equivalent adjusted.

TABLE 3

CHANGES IN LOW-INCOME INTENSITY AND ITS COMPONENTS, CHILDREN AGED 0–17, AFTER TRANSFERS/TAXES, 1981–89

	Low-Income Intensity LICO			Low-Income Intensity LICO-IAT			Low-Income Intensity 70% of the LICO		
	1981	1989	% Change	1981	1989	% Change	1981	1989	% Change
Low income intensity	0.107	0.095	–11.2	0.076	0.064	–15.8	0.054	0.042	–22.2
Rate	0.164	0.154	–6.1	0.124	0.119	–4.0	0.086	0.079	–8.1
Gap	0.344	0.323	–6.1	0.317	0.278	–12.3	0.324	0.268	–17.3
Inequality in the gap	1.899	1.901	0.1	1.928	1.929	0.1	1.950	1.953	0.2

of the impact of rising transfers shows up in the decline in the low-income gap. The single largest change over the decade (not shown here) was a large decline in low-income intensity in single-parent families (from 0.34 to 0.25), driven almost entirely by a large decline in the low-income gap (from 0.40 to 0.30).

Strikingly, when we measure low income with a relative standard (<0.5 median), the low-income rate was, if anything, a poorer guide to the underlying changes (Appendix Table B-1). The LIM-IAT rate stood at 11.4 percent in 1981 and 11.1 percent in 1989, a decline of only 2.6 percent, in period when total low-income intensity fell by almost 15 percent.

The 1980s, then, were a period when incremental changes in social transfers were raising the real (and relative) living standards of children in families with very low incomes. Would we detect this development by simply "moving the goal posts" and calculating low-income rates with a lower standard than usual? More

generally, would a sensitivity analysis of the low-income *rate* using higher and lower cut-offs (or poverty lines) provide an accurate picture of the underlying change? For this period, the answer is no. The low-income rate estimated with the highest cut-off (the pre-tax LICO) fell by one percentage point and accounted for half the total improvement in low-income intensity. The low-income rates indexed by the lower cut-offs (the LICO-IAT and the 70 percent LICO) fell by less than a percentage point and captured only a third of the total change, changes that would scarcely be considered substantively (or statistically) significant.

We can summarize the changing ("first-order") impact of transfers and taxes on low-income intensity with the extension of Osberg and Xu's decomposition procedure outlined in Appendix C (i.e. by the *difference* in the percentage change before and after transfers and taxes). If the "effect" of the tax/transfer system on low-income had remained constant over the 1981–89 period, then the *change* in low-income intensity would be the same before and after taxes/transfers as illustrated in Figure 1, Panel A. For example, low-income intensity measured by the

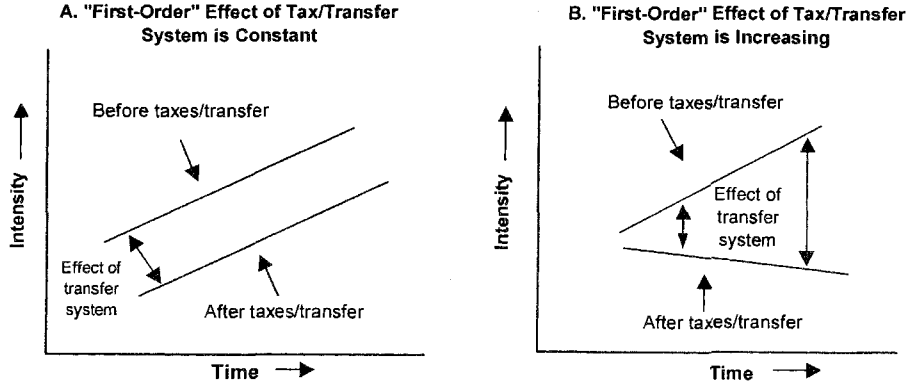

Figure 1. Hypothetical Low-Income Intensity

LICO-IAT would have *risen* by about 10 percent both before and after transfers/taxes.[9]

In fact, low-income intensity *fell* by almost 16 percent after transfers and taxes (Table 4), resembling the hypothetical example in panel B of Figure 1. The *difference* in growth rates (−15.8 − (−10.4) = 26.2), illustrated graphically in panel A of Figure 2, measures the changing impact of transfers and taxes on low-income intensity over the period. Like the intensity measure itself, the difference in growth rates can be decomposed into the changing impact of transfers and taxes on each of the components of the SST. For this period, only one-third (8.8/26.2, see Figure 2, panel B) of the impact of rising transfers on low-income intensity

[9]One can use change in "level" or the "growth rate" (percentage change) as the indicator of change in the "effect" of transfers. For ease of presentation, we use the "levels approach" in Figure 1. We use the "growth rate" approach in our calculations since it is consistent with the usual practice of focusing on the percentage reduction in low income before and after transfers (see Appendix C) and, more importantly, because it allows for decomposition into the effect on the rate and the effect on the gap.

TABLE 4

LOW-INCOME INTENSITY (LICO-IAT BASE), CHILDREN 0–17, 1981–89

	Before Transfers			After Transfers/Taxes			%
	1981 (1)	1989 (2)	% Change (3)	1981 (4)	1989 (5)	% Change (6)	Difference (3)–(6)
Low income intensity	0.173	0.191	10.40	0.076	0.064	−15.80	26.20
Rate	0.168	0.176	4.80	0.124	0.119	− 4.00	8.80
Gap	0.543	0.578	6.40	0.317	0.278	−12.30	18.70
Inequality in the gap	1.892	1.884	−0.40	1.928	1.929	0.10	−0.50

is reflected in the rate. The sharp rise in transfers over the 1980s went disproportionately to the most indigent families in the low-income population, scarcely scratching the low-income rate but producing a non-trivial reduction in the low-income gap.

In sum, trends in low-income *rates* were a poor guide to changes in the distribution of low income during the 1980s irrespective of the cut-off used and failed to register most of the impact of both falling employment earnings and significantly higher social transfers. Low-income rates based on lower cut-offs were no more effective at registering the impact of rising transfers than those based on higher cut-offs. In contrast, the underlying trend *and* the impact of falling employment earnings and rising transfers are captured by the low-income intensity measure, irrespective of the choice of cut-off. Measured against a Rawlsian benchmark, the 1980s were a period of modest policy "success" that was largely obscured when measured by the usual low-income rate. Conversely, as we show in the following section, indexing trends with the low-income rate can also mask deteriorating conditions among the low-income population.

Recession and Recovery, 1989–96

Earnings and employment levels peaked in 1989 and then declined dramatically through the ensuing recession until 1993. These trends are reflected in patterns of pre-transfer (earnings-based) low-income intensity (Table 5) which increased by about 50 percent. Unlike the 1980s, however, very substantial increases in the low-income rate dominated changes in the early 1990s. In short, the contribution of the rate and the gap to trends in low-income intensity varied considerably over the two periods. The reason for the difference is straightforward. Inspection of the underlying data (not shown here) indicates, not surprisingly, that families somewhat higher in the income distribution, especially two-parent families who normally have significant employment earnings, experience the greatest impact of rising unemployment. In contrast, rising unemployment rates have less impact on lone-parent families who rely heavily on social transfer income in both good times and bad. Social transfers continued rising through 1993 (by about 20 percent), muting the impact of recession. While low-income intensity rose by approximately 50 percent before transfers, after transfers and taxes the increase was about 28 percent.

This period of recession also highlights the significance of choosing between a low-income cut-off (or poverty line) measured in relative vs. fixed (constant

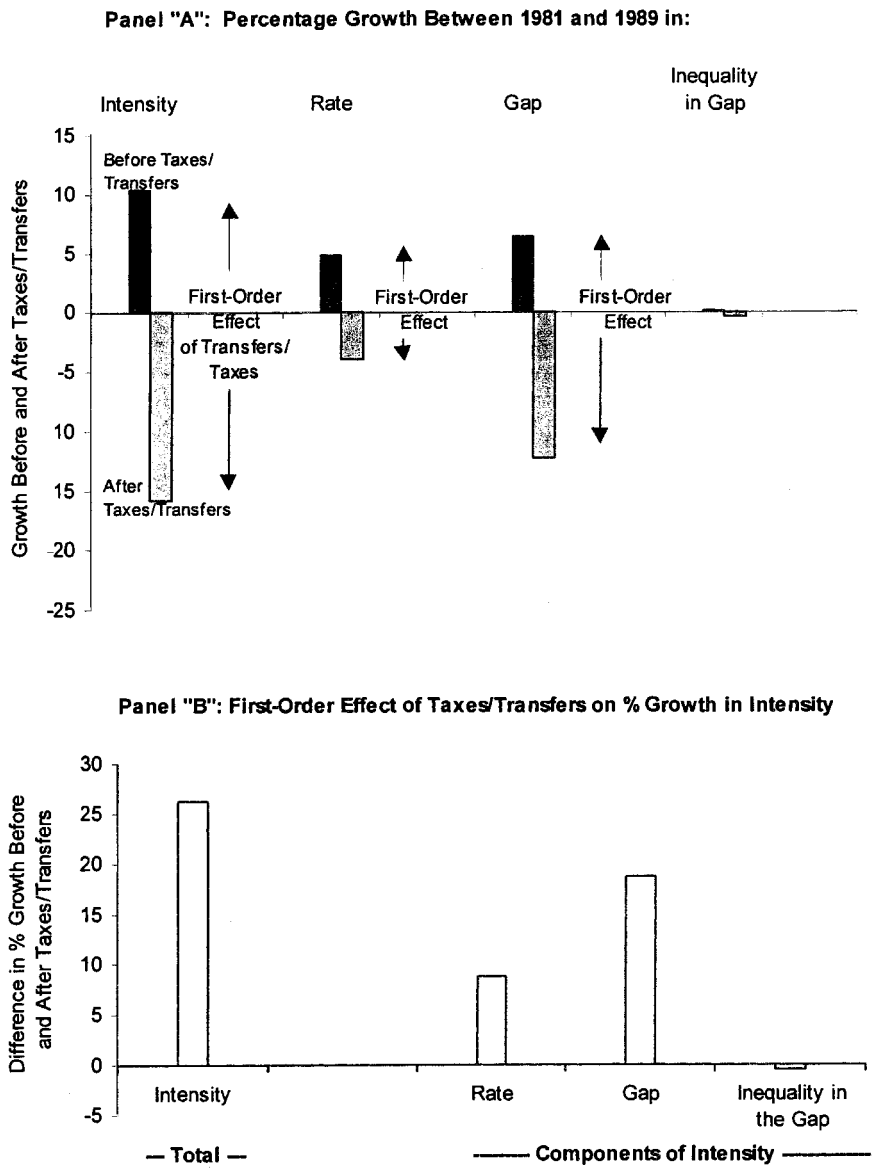

Figure 2. The First-Order Effect of Taxes/Transfers on Intensity is the Difference Between the Growth Rate of Intensity Before and After Taxes/Transfers (Based on LICO-IAT)

dollar) terms. Measured in real terms (e.g. by the LICO-IAT), low-income intensity rose by about 28 percent during the recession. In contrast, when measured by a relative low-income standard (LIM-IAT, Appendix Table B-3), low-income intensity *declined* by 13 percent implying, counter-intuitively, that recession actually enhanced the welfare of low-income children. In relative terms this was in fact the case since the income of the median family fell more during the recession

TABLE 5

CHANGES IN LOW-INCOME INTENSITY AND ITS COMPONENTS, BEFORE AND AFTER TRANSFERS AND TAXES, CHILDREN AGE 0–17, 1989–93

	Low-Income Intensity					
	LICO					
	Before Transfers			After Transfers		
	1989	1993	% Change 1989–93	1989	1993	% Change 1989–93
Low-income intensity	0.222	0.323	45.5	0.095	0.124	30.5
Rate	0.222	0.303	36.5	0.154	0.212	37.7
Gap	0.537	0.593	10.4	0.323	0.312	–3.4
Inequality in the gap	1.858	1.796	–3.3	1.901	1.865	–1.9
	Low-Income Intensity					
	LICO-IAT					
	Before Transfers			After Transfers/Taxes		
	1989	1993	% Change 1989–93	1989	1993	% Change 1989–93
Low-income intensity	0.191	0.289	51.3	0.064	0.082	28.1
Rate	0.176	0.251	42.6	0.119	0.158	32.8
Gap	0.578	0.629	8.8	0.278	0.274	–1.4
Inequality in the gap	1.884	1.826	–3.1	1.929	1.905	–1.2
	Low-Income Intensity					
	70% of the LICO					
	Before Transfers/Taxes			After Transfers		
	1989	1993	% Change 1989–93	1989	1993	% Change 1989–93
Low-income intensity	0.173	0.267	54.3	0.042	0.052	23.8
Rate	0.149	0.222	49.0	0.079	0.105	32.9
Gap	0.615	0.653	6.2	0.268	0.255	–4.9
Inequality in the gap	1.898	1.843	–2.9	1.953	1.940	–0.7

than the incomes of low-income families. This was due to the fact that while median earnings were falling, transfers to families with very low earnings were rising. Our point here is not to diminish the importance of measuring low-income (or poverty) with a relative benchmark; rather, the aim is to highlight the nature of the information it provides, information that does not always answer the question at hand. This is particularly true during short time periods of significant change in economic conditions.

As employment opportunities slowly improved after 1993, low-income intensity before transfers fell slightly (Table 6). However, transfers were falling faster than earnings were rising so that after transfers (and taxes), low-income intensity continued rising despite recovery. Based on the LICO-IAT, low-income intensity in 1996 was 20 percent higher than in 1993 and fully 50 percent above the level observed at the peak of the last business cycle, 1989. For this period, similar results are observed with the relative LIM-IAT cut-off (Appendix Table B-3).

As noted earlier, reliance on the low-income rate as an indicator largely concealed the impact of rising transfers on low-income intensity during the 1980s.

TABLE 6

CHANGES IN LOW-INCOME INTENSITY AND ITS COMPONENTS, BEFORE AND AFTER TRANSFERS AND TAXES, CHILDREN AGE 0–17, 1993–96

	Low-Income Intensity					
	LICO					
	Before Transfers			After Transfers		
	1993	1996	% Change 1993–96	1993	1996	% Change 1993–96
Low-income intensity	0.323	0.309	–4.3	0.124	0.137	10.5
Rate	0.303	0.291	–4.0	0.212	0.211	–0.5
Gap	0.593	0.587	–1.0	0.312	0.349	11.9
Inequality in the gap	1.796	1.806	0.6	1.865	1.862	–0.2
	Low-Income Intensity					
	LICO-IAT					
	Before Transfers/Taxes			After Transfers/Taxes		
	1993	1996	% Change 1993–96	1993	1996	% Change 1993–96
Low-income intensity	0.289	0.277	–4.2	0.082	0.099	20.7
Rate	0.251	0.241	–4.0	0.158	0.172	8.9
Gap	0.629	0.627	–0.3	0.274	0.304	10.9
Inequality in the gap	1.826	1.833	0.4	1.905	1.895	–0.5
	Low-Income Intensity					
	70% of the LICO					
	Before Transfers			After Transfers		
	1993	1996	% Change 1993–96	1993	1996	% Change 1993–96
Low-income intensity	0.267	0.254	–4.9	0.052	0.066	26.9
Rate	0.222	0.211	–5.0	0.105	0.121	15.2
Gap	0.653	0.650	–0.5	0.255	0.285	11.8
Inequality in the gap	1.843	1.851	0.4	1.940	1.929	–0.6

How well did it capture the rise in transfers during the early part of the 1990s and the subsequent decline after 1993? Since changes in this period are large, the amount of error in the percentage change approximation for decomposing the (first-order) effects of transfers/taxes is also large. Accordingly, in Table 7, we report results from the logarithmic decomposition of change based on the intermediate (LICO-IAT) cut-off. During the recession of 1989–93, rising transfers offset a non-trivial share of the increase in low-income intensity. As in the eighties, the main impact of rising transfers was on the low-income *gap* so that comparisons of the change in the low-income *rates* before and after transfers capture less than half of the change (i.e. 0.072/0.166). After 1993, the declining impact of transfers is reflected roughly equally in the rate (0.126/0.230) and the gap (0.107/0.230).

Strikingly, however, the impact of declining transfers is entirely invisible when the higher (and most commonly watched) indicator, the LICO rate, is used as the standard. Measured by the LICO, the low-income rate was more or less

TABLE 7

CHANGE IN LN OF LOW-INCOME INTENSITY (LICO-IAT BASE) BEFORE AND AFTER TRANSFERS AND TAXES, 1989–93 AND 1993–96

	1989–93			1993–96		
	Before Transfers (1)	After Transfers/ Taxes (2)	Difference (1)–(2)	Before Transfers (1)	After Transfers/ Taxes (2)	Difference (1)–(2)
Low-income intensity	0.414	0.248	0.166	–0.042	0.188	–0.230
Rate	0.355	0.283	0.072	–0.041	0.085	–0.126
Gap	0.085	–0.014	0.099	–0.003	0.104	–0.107
Inequality in the gap	–0.031	–0.013	–0.018	0.004	–0.005	0.009

unchanged at 21.1 percent in 1996 compared to 21.2 percent in 1993. In short, just as reliance on the rate may conceal incremental changes that benefit low-income families (as during the 1980s), it also may conceal changes that lower their living standards.

The stylized facts of this period of recession and recovery, then, are as follows. A sharp rise in unemployment after 1989 greatly reduced the earnings of many families and the result was a large increase in the share of families with earnings below the cut-offs. Transfers continued rising through 1993 and, as in the eighties, were disproportionately targeted at the most indigent. Indeed, separate results (not shown here) indicate that lone-parent families were scarcely touched by the recession. Recession had its largest impact on two-parent families, households that would normally have considerably higher employment income. After 1993, earnings levels stabilized but declines in UI benefits (which mainly affected two-parent families) and social assistance (which mainly affected lone-parent families) resulted in a continued rise in low-income intensity.

How well did the various indicators capture these developments? Since the low-income rate is only sensitive to changes that occur within a narrow range of the low-income distribution around the cut-off, its reliability as an indicator of trends is haphazard at best. Changes in the low-income rate accounted for most of the change in low-income intensity during the recession of 1989–93 when declining earnings meant that more families were falling below the cut-offs but were a much poorer guide during the 1993–96 period when transfers were falling. And in no period is the low-income rate an accurate gauge of the changing impact of transfers and taxes (whether rising or falling) on low-income trends. Indeed, the trend after 1993 is entirely invisible when measured by the LICO rate, the most widely watched indicator of low income in Canada. In contrast, the qualitative conclusions, if not their magnitude, are always correctly identified by the SST index irrespective of the choice of cut-off.

Importantly, the SST index allows for unambiguous answers to questions concerning the process of income formation underlying the trends that the standard headcount approach does not. For example, between 1993 and 1996, the low-income rate (indexed by the LICO-IAT) rose from 15.8 percent to 17.2 percent and transfer "effectiveness" indexed by the rate fell (Table 9, row 2). Declining transfer effectiveness indexed by the *rate*, however, might well have occurred

under conditions when overall transfer effectiveness was rising and low-income *intensity* was falling.[10] An increase in the post-transfer rate is entirely consistent with a stable, or even rising, transfer budget, but one more highly targeted on the most indigent than in the past. The SST index allows for no such ambiguity.

Conclusion

Redistribution is now a core function of government in all countries and monitoring the impact of government transfers on the economic well-being of populations has become a basic ingredient of contemporary policy analysis. Despite the never-ending debate over how to identify the "poor," assessing trends and differences in low-income levels and the "impact" of government transfers on those in the lower end of the income distribution occupies a prominent, and no doubt permanent place in these discussions. The headcount approach is unable to provide unambiguous answers to the usual questions about low income trends much less about the changing mix of earnings and transfers that underlie these trends. Typically, when there is a sharp or unexpected change in poverty rates we want to know "why?" Have the earnings at the lower end of the income distribution fallen (or risen)? Have transfers? Or has their distribution changed? The usual procedure of comparing low income rates before and after transfers is not up to the task of addressing such questions, even descriptively.

This is not news. Policy analysts and those who study income distributions have long been aware of the need to supplement information on poverty or low-income rates with additional information on the sources and levels of income among the low-income population. What has been missing is an integrated accounting framework for the analysis of the parameters of the low-income distribution. The recent developments in poverty measurement that we have drawn upon here provide a theoretically-driven accounting framework that addresses these concerns and allows for a complete description of readily available information on the distribution of low income in a population.

Appendix A: Significant Differences in the SST Index and its Components

Osberg and Xu (1999, forthcoming) use an intensive bootstrap method to calculate a standard approximation (the average value of two standard deviations of bootstrap estimates) to a 95 percent confidence interval for the SST index and its components based on the LICO and LIM-IAT for Canada and the provinces for all families. We have not replicated this effort but results reported in Table A-1 for Canada, Ontario (a large province), and Newfoundland (a small province) give an indication of the magnitude of change required for statistical significance and sensitivity to sample size. As a rule of thumb, it is clear that in larger samples (e.g. all children) a change of 0.01 in the index or its components would be a conservative standard for statistical significance. In smaller samples (e.g. children in lone parent families) a change of 0.02 (for the rate) and 0.03 (for the gap) would be appropriate.

[10]A large increase in social assistance benefits for families with no earnings, financed in part from cuts in UI benefits for families higher in the distribution could produce just such an outcome.

TABLE A-1

STATISTICALLY SIGNIFICANT DIFFERENCES—AVERAGE VALUE OF TWO STANDARD DEVIATIONS OF BOOTSTRAP ESTIMATES

	SST Index		Rate		Gap	
	LICO	LIM-IAT	LICO	LIM-IAT	LICO	LIM-IAT
Canada	0.0028	0.0029	0.0037	0.0044	0.0089	0.0092
Ontario	0.0047	0.0049	0.0054	0.0065	0.0204	0.0226
Nfld.	0.0085	0.0145	0.0109	0.0192	0.0279	0.0255

APPENDIX B: SST RESULTS BASED ON RELATIVE LIM-IAT

TABLE B-1

CHANGE IN LIM-IAT BASED LOW-INCOME INTENSITY AND ITS COMPONENTS, PRE AND POST TAX/TRANSFERS, CHILDREN AGED 0–17, 1981–89

	Pre-Tax/Transfer LIM-IAT			Post-Tax/Transfer LIM-IAT		
	1981	1989	% Change	1981	1989	% Change
Low-income intensity	0.168	0.189	12.5	0.075	0.064	–14.7
Rate	0.156	0.167	7.1	0.114	0.111	–2.6
Gap	0.566	0.599	5.8	0.341	0.299	–12.3
Inequality in the gap	1.897	1.886	–0.6	1.932	1.933	0.1

TABLE B-2

CHANGES IN THE FIRST-ORDER EFFECTS OF TRANSFERS/TAXES ON LOW-INCOME INTENSITY AMONG CANADIAN CHILDREN, LIM-IAT BASED MEASURES, 1981–89

	Pre-Tax/Transfer LIM-IAT %	Post-Tax/Transfer LIM-IAT %	Difference %
Low-income intensity	12.5	–14.7	27.2
Rate	7.1	–2.6	9.7
Gap	5.8	–12.3	18.1
Inequality in the gap	–0.6	0.1	–0.6

TABLE B-3

CHANGES IN LIM-IAT BASED LOW-INCOME INTENSITY AND ITS COMPONENTS, PRE, AND POST TRANSFERS/TAXES, CHILDREN AGED 0–17, 1989–93, 1993–96

	1989	1993	1996	Change 1989–93 %	Change 1993–96 %
		Pre Tax/Transfer			
Low-income intensity	0.189	0.272	0.257	43.9	–5.5
Rate	0.167	0.226	0.213	35.3	–5.8
Gap	0.599	0.655	0.653	9.3	–0.3
Inequality of gap	1.886	1.840	1.849	–2.4	0.5
		Post Tax/Transfer			
Low-income intensity	0.075	0.065	0.076	–13.3	16.9
Rate	0.114	0.119	0.133	4.4	11.8
Gap	0.341	0.282	0.298	–17.3	5.7
Inequality of gap	1.932	1.929	1.921	–0.2	–0.4

TABLE B-4

CHANGES IN FIRST-ORDER EFFECTS OF TRANSFERS/TAXES ON LOW-INCOME INTENSITY, CHILDREN 0–17, 1989–93, 1993–96 LIM-IAT BASED

Log Changes in Low-Income Intensity LIM-IAT						
	1989–93			1993–96		
	Before Taxes/ Transfers	After Taxes/ Transfers	Difference	Before Taxes/ Transfers	After Taxes/ Transfers	Difference
Low-income intensity	0.364	–0.143	0.507	–0.057	0.156	–0.213
Rate	0.303	0.043	0.260	–0.059	0.111	–0.170
Gap	0.089	–0.190	0.279	–0.003	0.055	–0.058
Inequality in the gap	–0.025	–0.002	–0.023	0.005	–0.004	0.009

APPENDIX C: CALCULATING "FIRST-ORDER" TRANSFER EFFECTS

The standard method of estimating the "impact" of transfers (and taxes) on the low-income rate (e.g. McFate, Smeeding, and Rainwater, 1995) is given by a estimating the rate before and after transfers/taxes and calculating the percentage (or proportional) reduction in the rate that "results" from transfers as in:

$$(C1) \qquad TE_{rate} = (Rate_{after} - Rate_{before})/Rate_{before}$$

and equivalently for the SST index by:

$$(C2) \qquad TE_{sst} = (SST_{after} - SST_{before})/SST_{before}.$$

A change (or difference) in first-order effects (ΔTE) is given by the difference between the values of TE between t_2 and t_1. However, percentage changes in low-income intensity before and after transfers (and taxes) are usually quite large so that the percentage change approximation for this formulation rarely approximates its logarithmic equivalent, namely:

$$(C3) \qquad \Delta TE_{sst} = (\ln SST_{after} - \ln SST_{before})_{t_2} - (\ln SST_{after} - \ln SST_{before})_{t_1}$$

and a percentage change decomposition of change in SST does not work as a result. However, rearranging terms in (C3) gives:

$$(C4) \quad \Delta TE_{sst} = (\ln SST_{after\text{-}t_2} - \ln SST_{after\text{-}t_1}) - (\ln SST_{before\text{-}t_2} - \ln SST_{before\text{-}t_1}).$$

And the percentage change approximation of (C4) is simply:

$$(C5) \quad \Delta TE_{sst} = \%\text{Change After Transfers} - \%\text{Change Before Transfers}.$$

The magnitude of differences in this formulation are often small enough so that the percentage change decomposition of the SST index provides a reasonable approximation. In order that an increase/decrease in low-income intensity will have a positive/negative sign however, the sign in (C5) is reversed (by subtracting the change after transfers from the change before transfers).

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