Poverty Intensity: How Well Do Canadian Provinces Compare?

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Cet article utilise des estimés d'intensité de la pauvreté de Sen-Shorrocks-Thon pour les provinces cana-
diennes et leurs intervalles de confiance à 95 pour-cent. Les calculs sont effectués pour les années 1984,
1989 et 1991-96 de façon à comparer les provinces canadiennes dans le temps et internationalement.
L'intensité de la pauvreté en Ontario à la fin des années 1980 a diminué à un niveau similaire à celui que
l'on retrouve dans le nord de l'Europe. Cette situation coïncide avec un support d'assistance social plus
général en Ontario. Depuis 1994, les coupures dans l'assistance sociale ont coïncidé avec une augmentation
significative dans l'intensité de la pauvreté. L'Ile du Prince-Édouard a relativement bien fait, réussissant à
réduire l'intensité de la pauvreté. Au niveau national, les années 1980 ont constitué une période de déclin de
l'intensité de la pauvreté mais ces gains ont été érodés depuis 1994.

This paper uses estimates of the Sen-Shorrocks-Thon measure of poverty intensity in Canadian provinces,
and the 95 percent confidence interval surrounding such estimates, for 1984, 1989 and 1991-96 to compare
Canadian provinces over time and internationally. Coinciding with more general social assistance support,
poverty intensity in Ontario declined in the late 1980s to a level similar to Northern Europe, but since 1994
cuts to social assistance have coincided with a significant rise in poverty intensity. Prince Edward Island has
done relatively well in reducing poverty intensity. Nationally, the 1980s were a period of declining poverty
intensity, but these gains have been eroded since 1994.

INTRODUCTION

Statements about whether poverty is increasing, or whether particular governments are doing a good job in reducing poverty, are the basic ingredients of many political debates. Indeed, it can be argued that the whole point of measuring poverty is to make comparisons — either over time or across jurisdictions — and to use such comparisons to help decide whether, and how, it is possible to reduce poverty. While international comparisons of poverty have become increasingly common in recent years, they are plagued by the differences between coun-

tries in poverty norms and measurement techniques. Interprovincial comparisons within Canada do not face these problems, and are of considerable practical importance to Canadians, since the provinces bear the constitutional responsibility for social policy and directly administer most social spending and anti-poverty programs.

In a federal system of government, such as Canada's, there is often an acute tension between national standards and provincial autonomy. The ideal of equal treatment for all citizens, wherever they may live, is constantly being balanced against the

advantages of allowing provincial flexibility and experimentation with locally appropriate alternative policies. It has often been argued (e.g., by Thomas Courchene) that an important advantage of a federal system of government is the opportunity of subnational governments to learn from the social experiments of other similar jurisdictions. Furthermore, in Canadian social policy, the pendulum is clearly swinging toward greater provincial autonomy and increasing differentiation of social policy.[1] However, if greater differentiation of policy is to produce greater learning from the experience of other jurisdictions, some comparison of outcomes is required. By what benchmarks should one assess the success or failure of provincial social policies in reducing poverty? What measure of poverty should be used? What degree of difference in measured poverty is statistically meaningful? How can one decompose changes in measured poverty into underlying trends?

In the popular debate on poverty, the most commonly used measure is the poverty rate (the percentage of the population whose incomes lie below the poverty line), but such a measure does not reflect the amount by which the incomes of the poor fall below the poverty line. The average poverty gap ratio (the average percentage shortfall of individuals' incomes below the poverty line) is also a common, simple measure, but it ignores the number of poor people and the degree of inequality among the poor. As measures of poverty, both the poverty rate and the average poverty gap ratio have obvious intuitive appeal, but they may not point to the same conclusion. In 1996, for example, British Columbia had the lowest poverty rate of all Canadian provinces (at 9.51 percent) but the highest average poverty gap ratio (at 34.98 percent — see Table 1). Poverty researchers have therefore increasingly turned to measures of poverty intensity which do account jointly for the number of poor, depth of poverty, and inequality among the poor.

The measure of poverty intensity we use was initially advocated by Sen (1976), and modified recently by Shorrocks (1995). However, since Thon

(1979, 1983) proposed a revision of the Sen index which in the limit is identical to that of Shorrocks, we refer henceforth to the SST index. This paper begins by discussing the SST index of poverty intensity and its decomposition into the poverty rate, the average poverty gap ratio among the poor and the overall Gini index of poverty gap ratios. The paper then sets the international context for poverty intensity comparisons, using Luxemburg Income Study data to compare the intensity of poverty in Canada to that in other developed countries in the 1990s and to the trends observed in the United States. We then look beneath the national Canadian numbers to trace changes in poverty intensity in Canadian provinces over the period 1984-96, and rank provinces in terms of poverty intensity. To address the statistical uncertainty which arises from *estimates* based on *sample* data, we use bootstrap methods to establish the confidence interval which surrounds point estimates of the poverty intensity of Canadian provinces, and assess the statistical significance of poverty intensity differentials.

THE SST INDEX: DECOMPOSITION AND INFERENCE

Since Sen (1976) proposed a poverty index and a set of desirable criteria for evaluating a poverty index, research on poverty indices has received considerable attention.[2] Hagenaars (1991) and Zheng (1997) have summarized the properties that ethically defensible measures of poverty should possess; in particular, the property that an acceptable measure of poverty should always register an increase in poverty whenever a pure transfer of income is made from someone below the poverty line to someone who has more income. This property is not possessed by the poverty rate, the poverty gap or, as originally formulated, the Sen index. Shorrocks (1995) has therefore proposed a modified Sen index for measuring the intensity of poverty.

The SST index of poverty intensity combines the poverty rate, average poverty gap ratio and

TABLE 1

Decomposition of SST Index – Poverty Line=Half the Median Equivalent Income

		SST Index	Decomposition of Level				Decomposition of Change		
		(P)	RATE	GAP	(1+G)	Δ ln(P)	Δ ln(RATE)	Δ ln(GAP)	Δ ln(1+G)
NFLD	84	0.137	0.245	0.304	1.844				
	89	0.095	0.169	0.296	1.897	-0.370*	-0.372*	-0.027	0.028
	94	0.105	0.184	0.304	1.884	0.104	0.086	0.026	-0.007
	95	0.125	0.212	0.316	1.864	0.168	0.141	0.038	-0.010
	96	0.092	0.164	0.294	1.897	-0.307	-0.254	-0.071	0.018
PEI	84	0.070	0.138	0.265	1.922				
	89	0.068	0.141	0.252	1.924	-0.028	0.019	-0.048	0.001
	94	0.043	0.107	0.205	1.945	-0.471	-0.277	-0.205	0.011
	95	0.056	0.121	0.240	1.938	0.274	0.121	0.157	-0.004
	96	0.058	0.123	0.244	1.929	0.032	0.023	0.014	-0.004
NS	84	0.084	0.148	0.297	1.911				
	89	0.061	0.139	0.229	1.923	-0.314*	-0.060	-0.261*	0.006
	94	0.077	0.147	0.272	1.915	0.223	0.055	0.172	-0.004
	95	0.082	0.155	0.278	1.908	0.067	0.051	0.021	-0.004
	96	0.078	0.148	0.276	1.915	-0.048	-0.048	-0.005	0.004
NB	84	0.108	0.194	0.297	1.880				
	89	0.074	0.133	0.290	1.916	-0.388*	-0.381*	-0.027	0.019
	94	0.073	0.137	0.280	1.917	-0.002	0.031	-0.034	0.000
	95	0.086	0.155	0.291	1.904	0.158	0.126	0.039	-0.007
	96	0.076	0.144	0.275	1.916	-0.122	-0.071	-0.058	0.006
QUE	84	0.068	0.141	0.251	1.920				
	89	0.053	0.109	0.252	1.933	-0.242*	-0.250*	0.002	0.007
	94	0.057	0.125	0.235	1.927	0.061	0.133	-0.068	-0.003
	95	0.067	0.128	0.271	1.924	0.165	0.027	0.140*	-0.001
	96	0.065	0.124	0.272	1.924	-0.027	-0.032	0.004#	0.000
ONT	84	0.060	0.093	0.332	1.946				
	89	0.033	0.064	0.267	1.965	-0.584*	-0.375*	-0.218*	0.009
	94	0.042	0.079	0.268	1.958	0.219	0.219	0.004	-0.003
	95	0.050	0.090	0.282	1.951	0.175	0.126	0.053	-0.004
	96	0.059	0.100	0.302	1.944	0.169#	0.107#	0.066	-0.004
MAN	84	0.087	0.131	0.346	1.922				
	89	0.063	0.126	0.256	1.929	-0.328	-0.032	-0.300*	0.004
	94	0.071	0.116	0.316	1.929	0.127	-0.084	0.211*	0.000
	95	0.056	0.118	0.245	1.934	-0.241	0.012	-0.256*	0.003
	96	0.067	0.127	0.275	1.923	0.186	0.078	0.114	-0.006
SAS	84	0.093	0.156	0.312	1.908				
	89	0.095	0.161	0.310	1.903	0.018	0.027	-0.006	-0.003
	94	0.082	0.136	0.316	1.913	-0.145	-0.168	0.018	0.006
	95	0.082	0.137	0.311	1.918	-0.003	0.011	-0.016	0.002
	96	0.077	0.137	0.294	1.919	-0.057	-0.001	-0.058	0.001
ALB	84	0.071	0.111	0.330	1.937				
	89	0.068	0.114	0.306	1.937	-0.041	0.034	-0.075	0.000
	94	0.060	0.113	0.272	1.934	-0.128	-0.009	-0.117	-0.002
	95	0.070	0.112	0.322	1.936	0.154	-0.015	0.167	0.001
	96	0.069	0.116	0.307	1.934	-0.011	0.037	-0.047	-0.001
BC	84	0.069	0.116	0.308	1.933				
	89	0.047	0.090	0.266	1.949	-0.394*	-0.258	-0.145	0.008
	94	0.058	0.104	0.288	1.938	0.218	0.144	0.079	-0.005
	95	0.060	0.103	0.301	1.942	0.037	-0.009	0.044	0.002
	96	0.065	0.095	0.350	1.944	0.070	-0.080	0.149	0.001

Notes: *Year-to-year change is significant at the 95 percent confidence level.
 #Change from 1994 to 1996 is significant at 95 percent confidence level.

inequality in poverty gaps. It can be decomposed (see Osberg and Xu 1997) as:

(1) $P(Y; z) = (RATE)\ (GAP)\ (1+G(X))$.

Here $P(Y; z)$ is the SST index for an *N*-person income vector *Y* and the poverty line *z*. The *poverty gap ratios* are given by

(2) $X_i = \dfrac{z - Y_i}{z}, \quad i = 1, 2, \dots, N,$

with the non-poor population's X_i being set to zero. *RATE* is the poverty rate,

(3) $RATE = \dfrac{Q}{N},$

where *Q* is the number of the poor. *GAP* is the familiar average poverty gap ratio among the poor.

(4) $GAP = \dfrac{1}{Q} \sum_{i=1}^{N} X_i.$

$G(X)$ is the Gini coefficient of poverty gap ratios,[3]

(5) $G(X) = 1 - \left(\dfrac{1}{N}\right) \sum_{i=1}^{N} \left(\dfrac{\sum_{j=1}^{i} X_j + \sum_{j=1}^{i-1} X_j}{\sum_{j=1}^{N} X_j} \right)$

It is useful to transform equation (1) into:

(6) $\ln(P(Y; z)) = \ln(RATE) + \ln(GAP) + \ln(1+G(X)),$

where the term $\ln(1+G(X))$ is an approximate of $G(X)$ based on the first-order Taylor series expansion.

The overall percentage rate of change in poverty intensity over time can therefore be expressed as the sum of the percentage changes in the poverty rate, average poverty gap ratio (among the poor), and Gini index of inequality in the poverty gap ratios (among all people).

(7) $\Delta \ln P(Y; z) = \Delta \ln(RATE) + \Delta \ln(GAP) + \Delta \ln(1+G(X)),$

where $\Delta \ln(1 + G(X))$ is an approximation of $\Delta G(X)$. Equation (7) is also useful for decomposing the percentage differences in poverty intensity between two populations (e.g., between two provinces) into percentage differences in poverty rate, poverty gap, and inequality of poverty.

In practice, as Osberg and Xu (1997) demonstrate using Luxemburg Income Study data, changes over time in the inequality measure $[1+G(X)]$ are empirically very small. Differences across countries in the inequality of poverty gaps $[1+G(X)]$ are also relatively small, compared to differences in the poverty rate and average poverty gap. Hence, for practical purposes the percentage change in poverty intensity can be approximated as the sum of the percentage changes of the poverty rate and the average poverty gap ratio.

One of the problems of the poverty literature is the wide gap between theoretically appropriate measures and the popular debate. Although new measures of poverty intensity, like the Foster-Greer-Thorbecke (1984) or the SST index, have desirable theoretical properties and although important theoretical advances in poverty measurement have been made in the academic community, these have had relatively little impact on public debate. However, equations (1) and (7) provide a straightforward decomposition of the SST index of poverty intensity which can be readily interpreted by policymakers, social science researchers, and the general public.

In this paper, we want to assess whether observed differences between provinces in poverty intensity are statistically meaningful. We therefore use a bootstrap procedure to compute the standard deviation of the SST index estimator.[4]

DATA AND METHODOLOGY

This paper uses data on the total after-tax income of economic families and assumes that income is shared within families. However, the focus of welfare comparisons is the distribution of income among persons. We therefore calculate the "equivalent income" of all individuals, and measure poverty intensity in terms of equivalent income. In the literature, a number of equivalence scales have been used to account for the economies of scale of household consumption (see Burkhauser, Smeeding and Merz 1996; Phipps and Garner 1994; and Figini 1998).

The issues raised by different equivalence scales are important, but to keep this paper focused, and to maintain comparability with much of the international literature, we simply use the "OECD" equivalence scale, which calculates the equivalent income of each family member, Y, as:

$$(8) \quad Y = Y_f / (1 + .7(N_a - 1) + .5N_c).$$

Here Y_f is total family disposable income, N_a is the number of adults in the family and N_c is the number of children under age 18.[5]

As Hagenaars (1991) and many others have noted, there has long been a debate on how best to conceptualize poverty. In very poor countries, where many people may be continually hungry, poverty can best be seen in absolute terms, but in developed countries we take the view that social norms within each country as to a minimally adequate standard of living differ across countries and change over time and are in fact heavily influenced by the prevailing average standard of living (see Osberg 1984, pp.61-73). We therefore adopt the commonly accepted international standard of half the median equivalent income as the poverty line, at each point in time for both international and interprovincial comparisons.[6] Since so much of the Canadian debate has used the Low Income Cut Offs (LICO) of Statistics Canada,

we also use the LICO as an estimate of the "poverty line" for interprovincial comparisons. For the international comparisons we use the Luxemburg Income Study (LIS) data (which is based, for Canada, on the Survey of Consumer Finance), but for the interprovincial comparisons we use the Survey of Consumer Finance microdata of 1984, 1989, and from 1991 to 1996 directly.

We assume that within all provinces, at all dates: (i) family (after-tax) income is equally shared among all family members, (ii) the OECD equivalence scale adequately accounts for economies of scale in family consumption, and (iii) the poverty line is represented by either (a) half the median equivalent income or (b) the LICO. Clearly, these are strong assumptions. For example, Sharif and Phipps (1994) have demonstrated the sensitivity of child poverty in Canada to alternative assumptions about the intra-family distribution of resources, and sharing norms within families may vary over time and across provinces. Pendakur (1998) has argued for consumption rather than income as a measure of adequacy, and has criticized the use of price insensitive equivalence scales. There is a considerable literature on intra-household allocation, equivalence scales, and poverty lines, but we make these assumptions in order to focus attention on issues which have, thus far, been neglected in the literature.

## THE INTERNATIONAL CONTEXT FOR CANADIAN POVERTY INTENSITY COMPARISONS

Differences in poverty intensity within Canada are important, but how do these levels compare internationally? Before proceeding to an examination of the differences between Canadian provinces in poverty intensity, we first set the context by discussing the much larger differences in poverty intensity that can be observed among selected developed countries and over time. Figure 1 presents LIS data from the 1990s,[7] to make the point that by the mid-1990s, poverty intensity in Canada was, overall, comparable to the high end of the European poverty

FIGURE 1

1990s – Country Rankings by SST Poverty Index – Poverty Line Based on Half the Median Equivalent Income
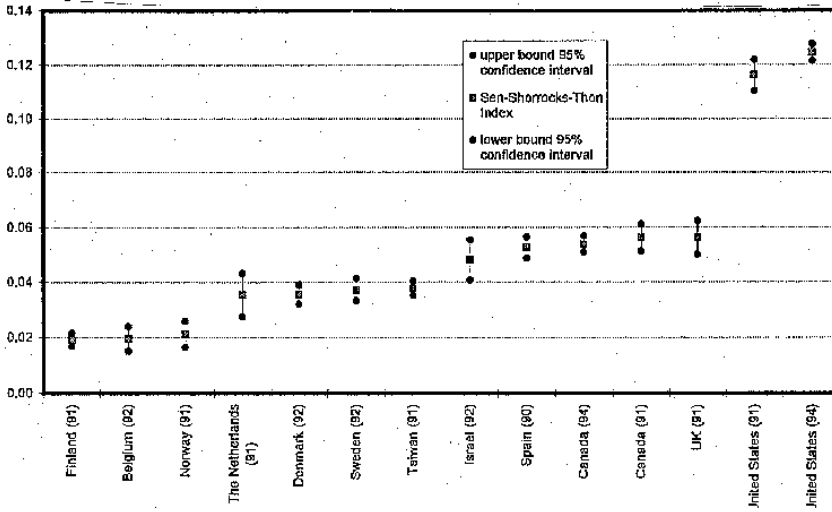
Note: [95% confidence interval = mean +/-2 standard deviations] of 300 bootstraps.
Source: Luxembourg Income Study, Osberg and Xu (1997).

FIGURE 2

Canada-United States Comparison – The SST Index from 1971 to 1994 – Poverty Line Based on Half the Median Equivalent Income
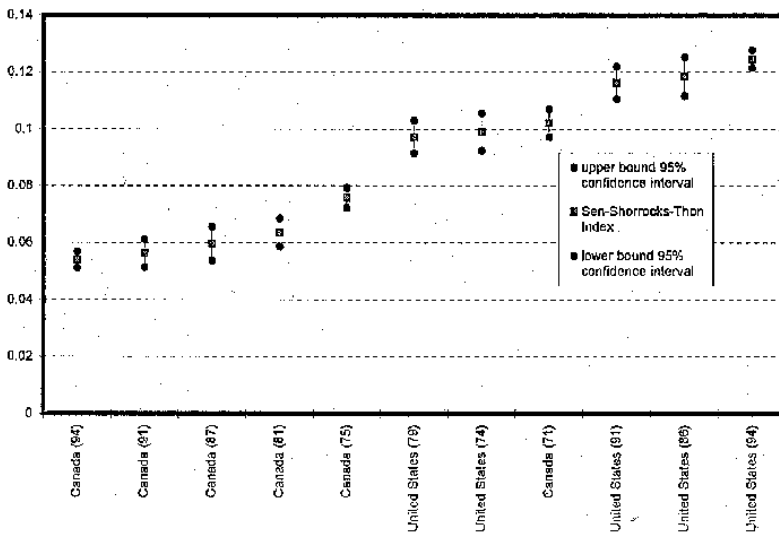
Note: [95% confidence interval = mean +/-2 standard deviations] of 300 bootstraps.
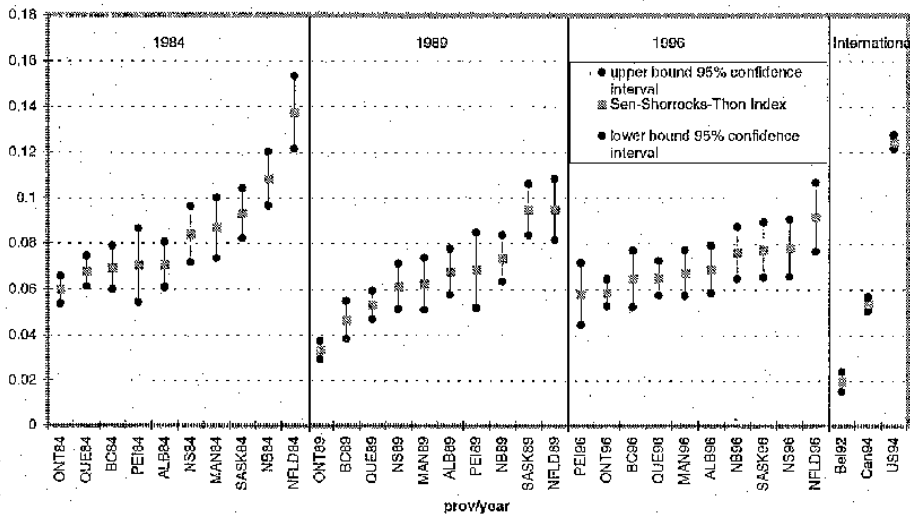Source: Luxembourg Income Study, Osberg and Xu (1997).

intensity spectrum — and quite different from that observed in the United States.

Figure 2 is presented to make the point that the difference in poverty intensity between the United States and Canada was not always there, and has only emerged within the last 25 years. Canada and the US were statistically indistinguishable in poverty intensity in the early 1970s (indeed Canada's point estimate of poverty intensity in 1971 exceeds the US 1974 point estimate). But over the period 1971 to 1994, Canadian social policy diverged from that in the US (see Card and Freeman 1993), and Canadian and American poverty intensity moved in different directions. By the mid-1990s Canadian poverty intensity was clearly less than in the US. However, differences in poverty that emerge in a decade can, presumably, disappear just as quickly. Given the many cutbacks to Canadian social programs of the last few years, the extent to which Canada will continue to differ from the US remains to be seen.

## POVERTY INTENSITY COMPARISONS AMONG CANADIAN PROVINCES

Although Figures 1 and 2 present national data, Canada is a federal state, and much of social policy is set at the provincial level. How do Canadian provinces differ in poverty intensity? By constructing bootstrap estimates of the confidence intervals around point estimates of poverty intensity we are able to distinguish between those differentials in poverty intensity that are significant and those that are not. Figures 3 and 4 present estimates of provincial poverty intensity using alternative poverty lines, and the associated 95 percent statistical confidence intervals. It is apparent from either figure that some differences between provinces in point estimates are not statistically meaningful. For example, point estimates of poverty intensity in Nova Scotia and New Brunswick may change in relative ranking from one year to the next, or under alternative definitions of the poverty line, but such

FIGURE 3
Sen-Shorrocks-Thon Index of Poverty Intensity – 1/2 Median After-Tax Income, 1984, 1989, 1996

Note: [95% confidence interval = mean +/-2 standard deviations] of 300 bootstraps.
Source: Authors' calculations, Survey of Consumer Finances, various years. Luxembourg Income Study, Osberg and Xu (1997).

Sen-Shorrocks-Thon Index Using After-Tax LICO, 1984, 1989, 1996
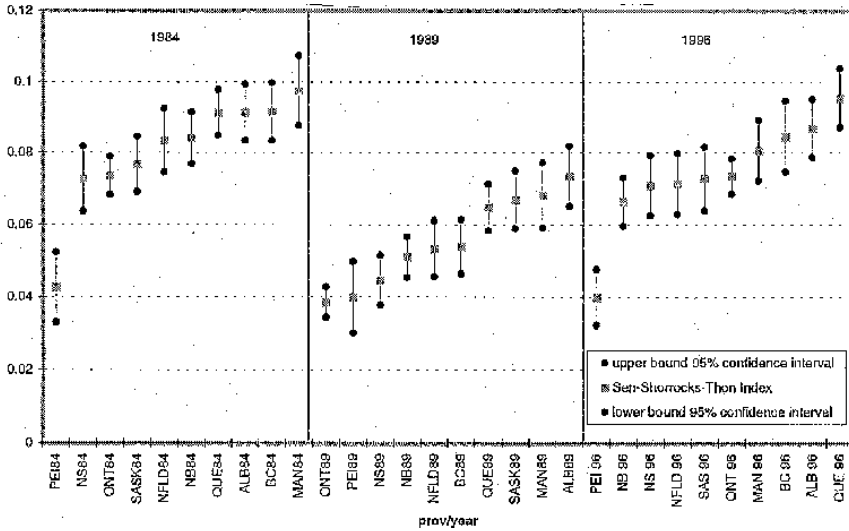
Note: [95% confidence interval = mean +/-2 standard deviations] of 300 bootstraps.
Source: Authors' calculations, Survey of Consumer Finances, various years.

changes in rankings do not really deserve much emphasis, since there is substantial overlap in the confidence interval surrounding these estimates. Indeed, in all years and by both criteria of the poverty line, there is a good deal of overlap among provinces in poverty intensity.

However, some differences in poverty intensity *are* statistically significant. Although, compared to other provinces, Ontario had a relatively low rate of poverty intensity in 1984, it was not significantly different from Quebec or BC. In 1989, the situation was different, Ontario's poverty intensity was clearly lower than that of all other provinces and the difference was statistically (and practically) significant. Despite the intense impact of the recession of the early 1990s on Ontario, until 1994 Ontario continued to do a clearly better job than most other provinces in mitigating the intensity of poverty. Dooley and Stewart (1998) noted that the period 1983 to 1991 saw very substantial increases in the real value of social assistance benefit levels in Ontario. (Social

assistance benefits remained roughly constant from 1992 to 1994 but were cut by 21 percent in October 1995.)

Overall, the visual impression of Figures 3 and 4 is that there was a shift down in poverty intensity in several provinces between 1984 and 1989 (more pronounced for the LICO-based measures of poverty intensity). Table 1 presents the percentage change in poverty intensity by province, and its decomposition into the underlying changes in poverty rate and the average poverty gap.[8] Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario, and British Columbia recorded statistically significant declines in poverty intensity from 1984 to 1989.

To place these estimates of poverty intensity in some context, the right panel of Figure 3 compares overall poverty intensity in Canada, Belgium, and the United States, as calculated using Luxembourg Income Study data (see Osberg and Xu 1997).[9] In 1994, using the internationally comparable "one-half

the median equivalent income" concept of poverty, the LIS data indicate that the SST index of poverty intensity in the US was 0.1246, over twice the Canadian level of 0.0538. In the early 1990s, poverty intensity in some Canadian provinces (see Table 1) was roughly comparable to that in some European countries (see Osberg and Xu 1997). For example, Ontario's poverty intensity level in 1994 (0.0416) was higher than that in Sweden in 1992 (0.0372), but since the 95 percent confidence interval for Sweden spans the range 0.0332 to 0.0412, it could be argued that the difference between Ontario and Sweden in poverty intensity in the early 1990s was at the edge of statistical significance. Prince Edward Island, with a point estimate of 0.0427 in 1994, but a wider range of statistical uncertainty (spanning 0.0281 to 0.0574) was also comparable with Sweden. However, since the other provinces had, in 1994, clearly higher levels of poverty intensity (e.g., Quebec at 0.0567 in 1994, British Columbia at 0.0581 in 1994), their poverty intensity was more comparable to that of the UK in 1991 (0.0562).[10]

Since demography or industrial structure may imply a structural tendency to greater poverty in some provinces, it can be argued that the trend of poverty within provinces is especially meaningful. Figures 5a, 5b, and 5c therefore present the estimate of poverty intensity, and the confidence interval surrounding each estimate, within each province for 1984, 1989, and from 1991 to 1996.

Figures 5a-5c focus on Canadian provinces, with a comparison to aggregate Canadian poverty intensity and to LIS data on Canada, the US and a pair of examples of European poverty intensity (Belgium and Sweden). As Figure 2 has already indicated, although poverty intensity in Canada was slightly greater than that in the US in the early 1970s, poverty intensity since then has risen significantly in the US, and fallen significantly in Canada. The choices of social policy matter a good deal for the well-being of the poor — and the end result of 20 years of such choices is a very different intensity of poverty in the US than in Europe, or in Canada.

FIGURE 5a

Atlantic Provinces – Trends in Poverty Intensity – Poverty Line Based on Half the Median Equivalent Income
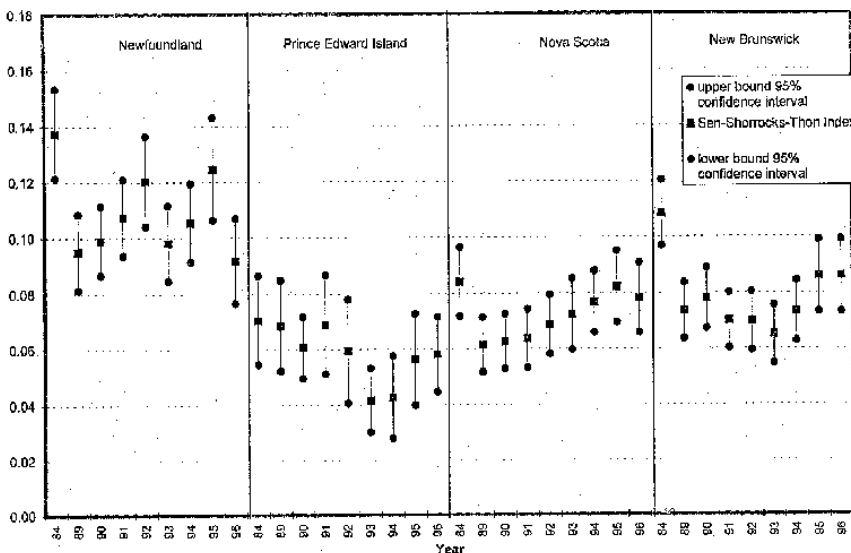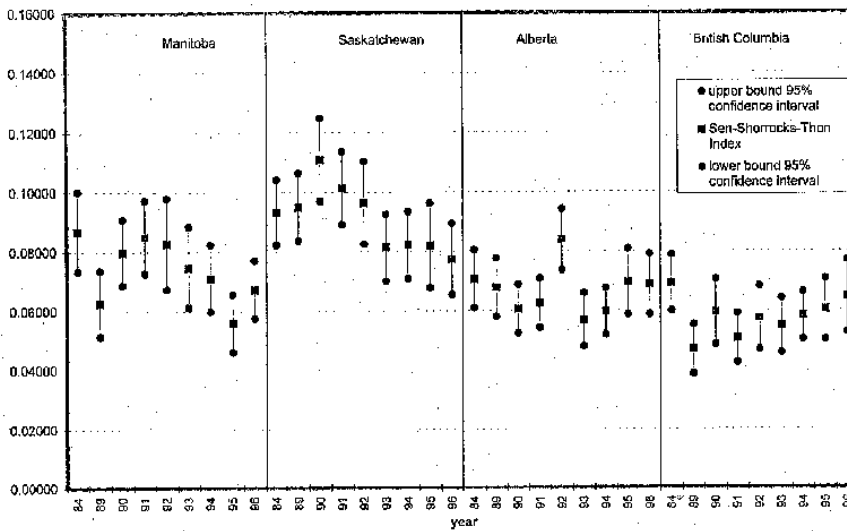

Source: Authors' calculations, Survey of Consumer Finances, various years.

Quebec, Ontario, Canada and International – Trends in Poverty Intensity – Poverty Line Based on Half the Median Equivalent Income
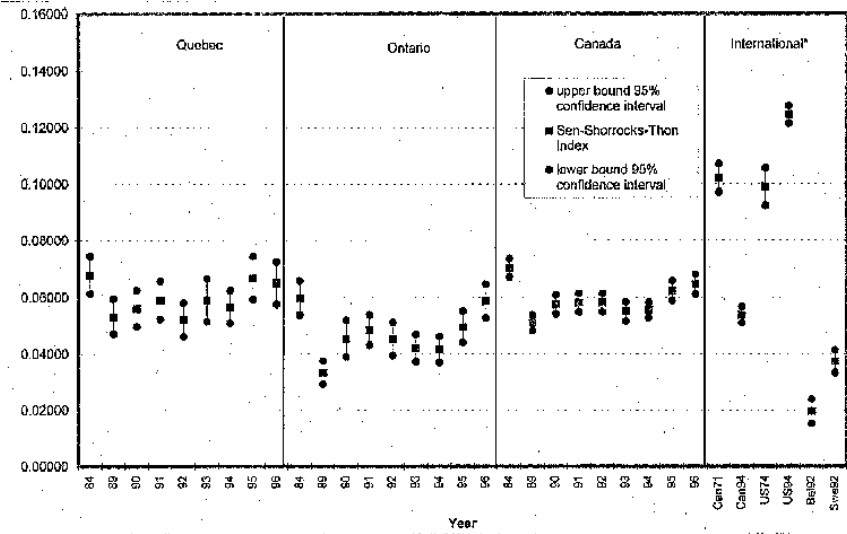
Note: *The international data uses household income from the Luxembourg Income Study (Osberg and Xu 1997).
Source: Authors' calculations, Survey of Consumer Finances, various years.

Western Provinces – Trends in Poverty Intensity – Poverty Line Based on Half the Median Equivalent Income

Source: Authors' calculations, Survey of Consumer Finances, various years.

Table 1 indicates that the statistically significant changes in poverty intensity from 1984 to 1989 were mostly driven by declines in the poverty rate, but in Nova Scotia and Ontario the average poverty gap also declined 26 percent and 22 percent, respectively. From 1989 to 1996, changes in overall poverty intensity within provinces generally came from large increases in the poverty rate, and small changes in the average poverty gap ratio.

By contrast, there was little change over time, and there is little difference across provinces, in inequality among the poor (see column 4 of Table 1, headed $(1 +G)$).[11] It is changes in the poverty rate, and/or the average poverty gap ratio, which explain changes in poverty intensity almost entirely.

It may be asking a lot of participants in the poverty debate, when new data become available each year, to expect them to perform 300 bootstrap estimates before making any statement about whether a measured change in poverty, or a point estimate of the differential between provinces, is statistically significant. Currently, depending on the sample size available for the computation of a particular statistic, Statistics Canada usually follows the practice of reporting either a number or an asterisk — which effectively means that the statistical uncertainty that inevitably surrounds generalization from a sample of the population is dichotomized into "totally reliable" and "totally unreliable" estimates.

Statistics Canada could follow the practice of reporting both the point estimate, and the standard error of that estimate, for all computed statistics (like the poverty rate). However, until this is available, Appendix Table A2 may be a useful set of "rules of thumb." Since the standard deviation of poverty intensity estimates varies by province (being significantly larger in smaller provinces) and by concepts of poverty, the appropriate confidence interval varies accordingly. Table A2 can therefore be read as establishing the approximate width, plus or minus, of a 95 percent confidence interval. If one, for example, is interested in knowing whether, at a 95

percent level of confidence, another province has a lower/higher poverty gap than Nova Scotia's, one needs a differential of more than 0.0279 in the poverty gap (according to the LICO) and more than 0.026 (by the half median income concept).

For many people, the "new information" of Figures 3 and 4 may be how well Prince Edward Island has done in mitigating the impact of poverty. Even when the poverty line standard is set at half the median equivalent income of all Canadians, Prince Edward Island does nearly as well in 1996 in reducing poverty as Ontario (a much richer province). By the LICO criterion, which builds in some recognition of rural/urban differentials in costs of living, Figure 4 indicates that PEI was very clearly superior to all other provinces in 1996 in poverty intensity. Although the smaller sample size of PEI data does imply a larger confidence interval surrounding PEI estimates, these differentials in poverty intensity *are* statistically significant.

Why does PEI do so well in reducing poverty intensity? Although there are some differences in poverty rate, the outstanding difference is in the level of the average poverty gap. There may be a straightforward explanation — social assistance benefits in PEI have not been as miserly as in other provinces. In 1994, for example, a couple with two children on social assistance in PEI would have received 38 percent of the estimated average income of such family types in PEI, which compared well to 24 percent in New Brunswick, 34 percent in Ontario and 27 percent in British Columbia. For all family types for which comparisons were possible, social assistance benefits in PEI were the highest, of any province, as a percentage of the average income of comparable households in that province (see National Council of Welfare 1995, p. 30, Table 4).

On the other hand, although the decline in poverty intensity in Ontario from 1984 to 1989 does reflect the substantial increase in social assistance benefit levels of that period, the 1995 poverty intensity data for Ontario did not fully reflect the

impact of the 21 percent reduction in Social Assistance support levels instituted by the current government, as these only came into effect in October 1995. To see the full impact of these cuts on Ontario poverty we had to await the 1996 data, which contained a full year's impact of reduced generosity of social assistance. As Figure 5*b* indicates, there is a clear, statistically significant increase in poverty intensity in Ontario between 1994 and 1996 and (since Ontario is the largest province) there is a noticeable increase from 1994 to 1996 in overall national poverty intensity. Presumably, nobody will be greatly surprised by the direction of Ontario's trends, but there remains the crucial issue of the ultimate size of the impact on Canadian poverty intensity of a trend to reduced generosity of transfer payments.

CONCLUSIONS

This paper has presented estimates of the level of poverty intensity in Canada, and within each Canadian province, for the years 1984, 1989, and 1991-96 and has compared poverty intensity over time, across provinces and in relation to other countries and to long-run trends in the US. Bootstrap methods have been used to establish the statistical confidence interval surrounding those estimates. It is clear that in most provinces, the 1980s were a period of declining poverty intensity, and these gains have not yet been entirely erased in the 1990s.

One conclusion to be drawn is methodological — some measured changes in poverty intensity are not statistically meaningful. To distinguish those changes that are meaningful, it would be desirable for the debate on poverty to include, routinely, consideration of the level of statistical uncertainty surrounding estimates of poverty measures, or the ranking of jurisdictions in terms of poverty intensity. This consideration of the inevitable uncertainty that is inherent in sample data would be assisted if statistical agencies were to publish routinely both the point estimates, and the standard errors, of the poverty rate and the poverty gap. In the absence of such a

change in statistical procedure, researchers can use bootstrap methods to estimate the confidence interval (if they have access to microdata) or the approximations of Table A2 (if they do not have microdata access).

Measurement of trends is only the first stage in causal analysis. The prevalence and depth of poverty is influenced by secular trends in household composition and formation, structural trends in low-wage labour markets, the ups and downs of aggregate demand and the design and funding of transfer payments. In this paper, we have concentrated on measurement of the aggregate outcomes that need to be explained, and have not presented direct tests of alternative hypotheses. Nevertheless, the coincidence between more generous social assistance benefits levels and lessened intensity of poverty surely points to the potential importance of social policy.

More substantively, this paper has noted that comparing the early 1970s and 1994, poverty intensity in Canada diminished, with particularly large changes in the late 1970s for Canada as a whole and a downward trend in Ontario (which heavily influences the national figures) in the late 1980s and early 1990s. These trends in Canada contrasted with those in the US, so that Canada moved from being statistically indistinguishable from the US to being clearly different. By the early 1990s, poverty intensity in Canada, and particularly in Ontario and Prince Edward Island, was statistically indistinguishable from that in several European countries.

A general lesson of the international literature, however, is the vulnerability of the poor.[12] The poor do not have much in the first place, and a few dollars more or less can make a big difference in each of their lives. Since 1994 there have been major cutbacks to transfer payments, both federally and in Ontario. Poverty intensity in Canada increased significantly between 1994 and 1996, but it remains to be seen whether this marks the beginning of a long-run trend to American levels of poverty intensity, or not.

NOTES

[1]The federal government's replacement of the Canada Assistance Plan (CAP) by the Canadian Health and Social Transfer (CHST) is one example, since CAP was a cost-sharing program with some national standards (in that need was the only basis for social assistance and that an appeal mechanism had to be provided) while CHST is block-funded, and requires only that provinces not impose a residency requirement. The devolution of responsibility for social housing and for training to the provinces are other examples.

[2]See, among others, Atkinson (1987), Besley (1990), Blackorby and Donaldson (1980), Donaldson and Weymark (1986), Foster, Greer and Thorbecke (1984), Foster and Shorrocks (1988, and 1991), Takayama (1979), and Thon (1979, 1983). In addition, Kakwani (1980), Foster (1984), Hagenaars (1986), Seidl (1988), and Zheng (1997) have provided useful surveys of this literature. Statistical inferences of different poverty measures have been provided by Bishop, Chow and Zheng (1995), Davidson and Duclos (1998), Osberg and Xu (1997), Rongve (1997), Preston (1995), Xu (1998), and Zheng, Cushing and Chow (1995).

[3]Note that in equation (5), individual poverty gap ratios are ordered from smallest to largest.

[4]To compute the bootstrap standard deviation of the modified SST index estimator, we re-sample randomly both equivalent incomes and corresponding sampling weights. The new sample is used to compute a new SST index estimate. Repeating this process T times (e.g., $T=300$) gives T SST index estimates. The bootstrap variance is computed as the sample variance of the T SST index estimates from the re-sampling. Under the assumption of normality, one can approximate a 95 percent confidence interval by adding two bootstrap standard deviations on each side of the SST index estimate when ranking provinces. Alternatively, a distribution-free estimate of the 95 percent confidence interval is given by ordering all 300 bootstrap estimates by size, and selecting the 8th and 293rd largest. Both methodologies give highly similar results (see Osberg and Xu 1997, and the references therein).

[5]See Burkhauser *et al.* (1996) for comparison OECD and other equivalence scales. Figini (1998, p. 2) notes that "OECD" and other two-parameter equivalence scales empirically used show a similarity of results (in measurement of inequality) to one parameter equivalence scales with elasticity around 0.5.

[6]We note that this does *not* imply either that poverty cannot be eliminated or that poverty and inequality are identical issues, since the fraction of a population below half the median is a characteristic of only the lower tail of the distribution of income. Statistics Canada refers to this concept of poverty as the "Low Income Measure" or LIM.

[7]See Osberg and Xu (1997) for details.

[8]Table 1 presents decomposition of the SST index using the "one-half median income" conception of the poverty line while Appendix Table A1 presents a comparable table, using the LICO.

[9]Since Luxembourg Income Study data is organized to present household income data, while the Canadian debate on poverty has traditionally been framed in terms of the poverty of economic families, LIS-based estimates of poverty intensity will be slightly lower than economic family-based estimates. Note that this implies that the gap between actual poverty in Canadian provinces and European countries is slightly less than a comparison of LIS household data and SCF economic family data would indicate.

[10]It should be noted that poverty intensity in the UK increased rapidly in the 1980s — from 0.032 in 1979, to 0.048 in 1986 to 0.0562 in 1991. Poverty intensity in Sweden was 0.026 in 1975, before increasing to 0.029 in 1981 and 0.039 in 1987 (see Osberg and Xu 1997).

[11]The coefficient of variation of column 4 of Table 1 is an indicator of the variability among provinces and over time in inequality *among* the poor. Its value is 0.011,

which is far below the coefficient of variation of the average poverty gap ratio in Column 3 (0.106) and that of the poverty rate in column 1 (0.248).

[12]See Osberg and Xu (1997) for documentation of the large changes in poverty observed in several OECD countries in the 1975-95 period.

REFERENCES

Atkinson, A.B. (1987), "On the Measurement of Poverty," *Econometrica* 55:749-64.

Besley, T. (1990), "Means Testing versus Universal Provision in Poverty Alleviation Programmes," *Economica* 57:119-29.

Bishop, J.A., K.V. Chow and B. Zheng (1995), "Statistical Inference and Decomposable Poverty Measures," *Bulletin of Economic Research* 47:329-40.

Blackorby, C. and D. Donaldson (1980), "Ethical Indices for the Measurement of Poverty," *Econometrica* 48:1053-60.

Burkhauser, R.V., M. Smeeding and J. Merz (1996), "Relative Inequality and Poverty in Germany and the United States Using Alternative Equivalence Scales," *The Review of Income and Wealth* 42:381-400.

Card, D. and R. Freeman, eds. (1993), *Small Differences that Matter: Labour Markets and Income Maintenance in Canada and the United States* (Chicago: University of Chicago Press).

Davidson, R., and J. Y. Duclos (1998), "Statistical Inference for Stochastic Dominance and for the Measurement of Poverty and Inequality," mimeo (Kingston and Sainte-Foy: Queen's University and Université Laval).

Donaldson, D. and J.A. Weymark (1986), "Properties of Fixed Population Poverty Indices," *International Economic Review* 27:667-88.

Dooley, M. and J. Stewart (1998), "The Duration of Welfare Spells and Off-Welfare Spells Among Lone Mothers in Ontario," mimeo (Hamilton: McMaster University).

Figini, P (1998), "Inequality Measures, Equivalent Scales and Adjustment for Household Size and Composition," paper presented at the 50th General Conference of the International Association for Research in Income and Wealth, Cambridge, August 1998.

Foster, J.E. (1984), "On Economic Poverty: A Survey of Aggregate Measures," *Advances in Econometrics* 3:215-51.

Foster, J.E., J. Greer and E. Thorbecke (1984), "A Class of Decomposable Poverty Indices," *Econometrica* 52:761-66.

Foster, J.E. and A.F. Shorrocks (1988), "Poverty Orderings," *Econometrica* 56:173-78.

____ (1991), "Subgroup Consistent Poverty Indices," *Econometrica* 59:687-709.

Hagenaars, A.J.M. (1986), *The Perception of Poverty* (Amsterdam: North-Holland).

____ (1991), "The Definition and Measurement of Poverty," in *Economic Inequality and Poverty: International Perspectives*, ed. L. Osberg (Armonk, NY: M.E. Sharpe Inc.), pp. 134-56.

Kakwani, N. (1980), *Income Inequality and Poverty: Methods of Estimation and Policy Applications* (New York: Oxford University Press).

National Council of Welfare (1997), *Welfare Incomes 1995* (Ottawa: Supply and Services Canada).

____ (1995), *Welfare Incomes 1994* (Ottawa: Supply and Services Canada).

Osberg, L. (1984), *Economic Inequality in the United States* (Armonk, NY: M.E. Sharpe Inc.).

Osberg, L. and K. Xu (1997), "International Comparisons of Poverty Intensity: Index Decomposition and Bootstrap Inference," Working Paper No. 97-03 (Halifax: Department of Economics, Dalhousie University).

Pendakur, K. (1998), "Trends in Consumption Distribution in Canada: Sensitivity to Equivalence Scales," mimeo, Simon Fraser University. Paper presented at Conference on the State of Living Standards, Centre for the Study of Living Standards, Ottawa, 31 October 1998.

Phipps, S. and T.I. Garner (1994), "Are Equivalence Scales the Same for the United States and Canada?" *Review of Income and Wealth* 40:1-18.

Preston, I. (1995), "Sampling Distribution of Relative Poverty Statistics," *Applied Statistics* 44:91-99.

Rongve, I. (1997), "Statistical Inference for Poverty Indices with Fixed Poverty Lines," *Applied Economics* 29:387-92.

Sen, A.K. (1976), "Poverty: An Ordinal Approach to Measurement," *Econometrica* 44:219-31.

Sharif, N. and S. Phipps (1994), "The Challenge of Child Poverty: Which Policies Might Help?" *Canadian Business Economics* 2(3):17-30.

Seidl, C. (1988), "Poverty Measurement: A Survey," in *Welfare and Efficiency in Public Economics*, ed. D. Bos, M. Rose and C. Seidl (Berlin: Springer-Verlag).

Shorrocks, A.F. (1995), "Revisiting the Sen Poverty Index,' *Econometrica* 63:1225-30.

Takayama, N. (1979), "Poverty, Income Inequality, and their Measures: Professor Sen's Axiomatic Approach Reconsidered," *Econometrica* 47:747-59.

Thon, D. (1979), "On Measuring Poverty," *Review of Income and Wealth* 25:429-40.

____ (1983), "A Poverty Measure," *The Indian Economic Journal* 30:55-70.

Wolfson, M. (1986), "Stasis Amid Change — Income Inequality in Canada 1965-1983," *Review of Income and Wealth*, 32:337-369.

Xu, K. (1998), "Statistical Inference for the Sen-Shorrocks-Thon Index of Poverty Intensity," *Journal of Income Distribution* 8(1):143-52.

Zheng, B. (1997), "Aggregate Poverty Measures," *Journal of Economic Surveys* 11(2):123-61.

Zheng, B., B.J. Cushing and K.V. Chow (1995), "Statistical Tests of Changes in U.S. Poverty, 1975 to 1990," *Southern Economic Journal* 62:334-47.

APPENDIX

TABLE A1

Decompostion of SST Index – Poverty Line = After-Tax LICO

		SST Index	Decomposition of Level				Decomposition of Change		
		(P)	RATE	GAP	(1+G)	Δ ln(P)	Δ ln(RATE)	Δ ln(GAP)	Δ ln(1+G)
NFLD	84	0.083	0.177	0.251	1.900				
	89	0.053	0.111	0.248	1.938	-0.450*	-0.462*	-0.011	0.020
	94	0.070	0.132	0.276	1.921	0.272	0.173	0.108	-0.009
	95	0.094	0.153	0.323	1.903	0.300*	0.147	0.155	-0.009
	96	0.071	0.131	0.283	1.914	-0.279*	-0.155	-0.130	0.006
PEI	84	0.043	0.081	0.270	1.961				
	89	0.039	0.073	0.278	1.963	-0.067	-0.097	0.029	0.001
	94	0.029	0.066	0.227	1.965	-0.316	-0.112	-0.202	0.001
	95	0.040	0.070	0.285	1.963	0.304	0.071	0.228	-0.001
	96	0.040	0.076	0.267	1.961	0.010	0.076	-0.065	-0.001
NS	84	0.073	0.127	0.301	1.924				
	89	0.044	0.096	0.241	1.945	-0.491*	-0.279*	-0.223*	0.011*
	94	0.068	0.124	0.284	1.929	0.420	0.259	0.167	-0.008
	95	0.073	0.134	0.283	1.921	0.077	0.079	-0.004	-0.004
	96	0.071	0.125	0.293	1.927	-0.031	-0.070	0.035	0.003
NB	84	0.084	0.155	0.288	1.909				
	89	0.051	0.096	0.274	1.941	-0.503*	-0.475*	-0.048	0.017
	94	0.061	0.115	0.278	1.932	0.182	0.176	0.012	-0.005
	95	0.067	0.120	0.291	1.923	0.095	0.044	0.046	-0.004
	96	0.066	0.118	0.292	1.929	-0.012	-0.018	0.003	0.003

TABLE A1 (CONT'D.)

		SST Index	Decomposition of Level				Decomposition of Change		
		(P)	RATE	GAP	(1+G)	Δ ln(P)	Δ ln(RATE)	Δ ln(GAP)	Δ ln(1+G)
QUE	84	0.091	0.165	0.294	1.901				
	89	0.065	0.125	0.271	1.923	-0.345*	-0.277*	-0.080	0.012
	94	0.081	0.152	0.281	1.907	0.221	0.192	0.037	-0.009
	95	0.091	0.155	0.308	1.905	0.121	0.021	0.092	-0.001
	96	0.095	0.166	0.303	1.897	0.048#	0.069	-0.017	-0.004
ONT	84	0.073	0.114	0.334	1.934				
	89	0.038	0.073	0.268	1.960	-0.648*	-0.444*	-0.221*	0.014
	94	0.054	0.098	0.285	1.945	0.346	0.295*	0.061	-0.008
	95	0.064	0.116	0.284	1.935	0.161*	0.163*	-0.004	-0.005
	96	0.073	0.121	0.313	1.930	0.141#	0.046#	0.098	-0.002
MAN	84	0.097	0.147	0.350	1.910				
	89	0.068	0.125	0.285	1.925	-0.360*	-0.158	-0.208*	0.008
	94	0.082	0.138	0.312	1.920	0.185	0.096	0.093	-0.003
	95	0.073	0.134	0.284	1.918	-0.115	-0.029	-0.095	-0.001
	96	0.081	0.146	0.289	1.915	0.100	0.087	0.016	-0.002
SAS	84	0.077	0.137	0.292	1.926				
	89	0.067	0.107	0.322	1.937	-0.138	-0.243*	0.097	0.006
	94	0.070	0.119	0.306	1.926	0.043	0.101	-0.050	-0.006
	95	0.070	0.119	0.305	1.932	0.003	-0.003	-0.003	0.003
	96	0.073	0.124	0.304	1.928	0.039	0.047	-0.006	-0.002
ALB	84	0.091	0.140	0.343	1.917				
	89	0.073	0.114	0.334	1.935	-0.219*	-0.201*	-0.027	0.009
	94	0.074	0.127	0.307	1.923	0.014	0.104	-0.083	-0.006
	95	0.085	0.137	0.324	1.922	0.136	0.077	0.053	-0.001
	96	0.087	0.136	0.333	1.919	0.020	-0.007	0.026	-0.002
BC	84	0.091	0.151	0.319	1.910				
	89	0.054	0.098	0.283	1.943	-0.533*	-0.431*	-0.121	0.018
	94	0.077	0.132	0.305	1.921	0.358	0.297	0.074	-0.011
	95	0.075	0.128	0.305	1.927	-0.020	-0.032	0.001	0.001
	96	0.085	0.128	0.342	1.926	0.116	0.003	0.114	0.001

Notes: *Year-to-year change is significant at the 95 percent confidence level.

#Change from 1994 to 1996 is significant at 95 percent confidence level.

T<small>ABLE</small> A2

Statistically Significant Differences in Poverty Measures – Average Value of Two Standard Deviations of Bootstrap Estimates

Province	RATE		GAP		SST Index	
	LICO	½ Median	LICO	½ Median	LICO	½ Median
Newfoundland	0.0113	0.0216	0.0290	0.0260	0.0089	0.0147
Prince Edward Island	0.0101	0.0236	0.0530	0.0440	0.0086	0.0151
Nova Scotia	0.0103	0.0179	0.0279	0.0260	0.0078	0.0113
New Brunswick	0.0083	0.0167	0.0244	0.0242	0.0064	0.0110
Quebec	0.0099	0.0108	0.0171	0.0174	0.0068	0.0066
Ontario	0.0067	0.0081	0.0203	0.0231	0.0052	0.0054
Manitoba	0.0128	0.0175	0.0278	0.0303	0.0097	0.0120
Saskatchewan	0.0102	0.0175	0.0293	0.0276	0.0083	0.0124
Alberta	0.0095	0.0137	0.0250	0.0280	0.0077	0.0094
British Columbia	0.0105	0.0131	0.0287	0.0337	0.0088	0.0098
Simple Average	0.0099	0.0161	0.0283	0.0280	0.0078	0.0108
Population Weighted Average	0.0088	0.0115	0.0223	0.0242	0.0068	0.0077
Canada-wide Estimates	0.0041	0.0047	0.0092	0.0097	0.0030	0.0031