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ABSTRACT

This paper proposes an alternative formulation for the Sen-Shorrocks-Thon (SST) index of poverty intensity that is appropriate for survey data with sampling weights. It also decomposes the SST index into the poverty rate, the average poverty gap ratio among the poor, and the overall Gini index of poverty gap ratios. To account for sampling variation in estimates of poverty intensity, this paper uses the bootstrap method to compute confidence intervals and presents international comparisons using Luxembourg Income Study (LIS) data from the 1970s to the 1990s. Cross-sectional and longitudinal analyses indicate that the percentage change in poverty intensity can be approximated by the sum of percentage changes in the poverty rate and average poverty gap ratio, since changes in the overall Gini index of poverty gap ratios are negligible. In the early 1970s poverty intensity in Canada and the United States was almost indistinguishable, but in the 1970s Canadian poverty intensity decreased. Large increases in poverty intensity occurred in the 1980s in the United States, the United Kingdom, and Sweden.

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I. Introduction

Analysts and policymakers often want to know if poverty has gotten "worse" or "better" and if poverty "here" is worse or better than poverty "elsewhere." Comparisons are, of course, only the first stage in asking such questions as whether better outcomes are possible, what causes poverty trends, and how possible policies might influence those trends. Atkinson (1999), however, has recently emphasized the importance of such comparisons and has argued for the adoption of formal targets for poverty alleviation, similar in spirit to the Maastricht Treaty objectives for inflation and government budget deficits. Such targets depend on the possibility of both year-to-year and jurisdiction-to-jurisdiction comparisons. He suggests that in the current hierarchy of policy, "macro-economic policy is determined first and then social policy is left to address the social consequences" (1999, p. 20). Because this separation of macroeconomic and social policy is inefficient in attaining either intermediate macroeconomic objectives or ultimate human welfare goals, Atkinson advocates the setting of a poverty target alongside targets for inflation and budget deficits.

This raises the issue of how best to summarize the extent of poverty and how best to compare poverty outcomes. Although poverty comparisons have become important in international debate, their statistical and conceptual significance is often open to question. The most commonly used measures are the poverty rate (the percentage of the population whose incomes lie below the poverty line) and the average poverty gap ratio (the average percentage shortfall of the poor individuals' incomes below the poverty line). However, the former does not reflect the amount by which the incomes of the poor fall below the poverty line, and the latter ignores the number of poor people. Neither measure can capture the degree of inequality among the poor. Furthermore, differences in poverty measures between countries may not be statistically significant. Since statistics on poverty measures are typically computed from data drawn from samples of the population, sampling variability implies that point estimates of poverty measures have an associated standard error.

The objective of this paper is, therefore, to present a set of international comparisons of poverty that have a stronger claim to being conceptually and statistically meaningful. More exactly, the purposes of this study are: 1. to propose a modified index of poverty intensity which is suitable for survey data with sampling weights, 2. to introduce a bootstrap-based statistical inference of this index and the Gini index of inequality, 3. to decompose the index of poverty intensity into three meaningful and familiar poverty measures, and 4. to apply the above measures to actual data to provide the first available international comparison of poverty intensity and contributing factors across major industrialized countries and over time.

The poverty index we use accounts jointly for the poverty rate, the average poverty gap, and inequality among the poor. It was initially advocated by Sen (1976), modified by Shorrocks (1995), and is identical to the limit of Thon's (1979, 1983) index. We therefore refer henceforth to the Sen-Shorrocks-Thon (SST) index of poverty intensity. The SST index is symmetric, replication invariant, monotonic, homogeneous of degree zero in incomes and the poverty line, and normalized to take values in the range [0,1]. All of these are important characteristics.[1] The SST index is a theoretical measure, however, premised on the assumption that all individual incomes are known. In reality, researchers do not know the incomes of the population. Instead, survey data with sampling weights are available. In this paper we therefore modify the SST index to accommodate sampling weights and develop a bootstrap method of statistical inference for the modified SST index.

It is often useful to know if increasing poverty is due to more people becoming poor, or increased deprivation of the poor, or some combination of the two. International comparisons are more meaningful if trends in poverty intensity can be decomposed into their underlying contributing factors. We therefore decompose the SST index of poverty intensity into three familiar poverty measures—the poverty rate, the average poverty gap ratio among the poor, and the overall Gini index of poverty gap ratios. We then trace changes in poverty intensity over time to their contributing factors.

This paper also provides the first available international comparisons of poverty intensity in the 20 countries of the Luxembourg Income Study (LIS) from the 1970s to the 1990s.[2] The remainder of the paper is organized as follows. Section IIA decomposes the SST index into three meaningful and familiar poverty measures. Section IIB suggests an alternative formulation of the SST index and a related bootstrap method for survey data with sampling weights. Section IIC briefly discusses data sources, the calculation of equivalent incomes, and the poverty line. Section IIIA compares the poverty intensity of major developed countries using the modified SST index and the bootstrap estimates of sampling variability. Because one component of poverty intensity is inequality among the poor, Section IIIB examines the empirical relationship between poverty intensity and aggregate inequality. Section IIIC decomposes the changes in poverty intensity in developed countries into their primary contributing factors—changes in the poverty rate and average poverty gap ratio. Concluding remarks are given in Section IV.

II. Research Methodology

A. The SST Index: Decomposition

Since Sen (1976) proposed a poverty index and a set of desirable axioms for evaluating a poverty index, research on poverty indices has received considerable atten-

1. The SST index encompasses the FGT(0) and FGT(1) indices proposed by Foster, Greer, and Thorbecke (1984) and is closely related to Jenkins and Lambert (1997), although Shorrocks (1995) and Jenkins and Lambert worked independently. The SST index is advantageous because 1. it is a theoretically desirable measure, 2. it allows a meaningful decomposition into three commonly used poverty measures (as shown in this paper), and 3. it has a clear and convenient geometrical/graphical representation (see Shorrocks 1995 and Jenkins and Lambert 1997).

2. Osberg and Xu (1999) use a similar methodology to analyze poverty intensity across Canadian provinces. Rodgers and Rodgers (1991) analyzed sources of poverty intensity using the FGT index (Foster, Greer, and Thorbecke 1984) across US states, and Jenkins and Lambert (1997) analyzed poverty in the UK but did not provide an international comparison. Blackburn (1994) studied poverty in 11 developed countries and de Vos and Zaidi (1997) analyzed poverty in the European Community. However, both studies focused only on the poverty rate and used only a one-year survey in the 1980s for each country studied.

tion.[3] As the Sen index is not replication invariant, not continuous in individual incomes, and fails to satisfy the strong transfer axiom, Shorrocks (1995) has proposed a modified Sen index for measuring the intensity of poverty, which corrects these deficiencies. This measure is identical to the limit of Thon's (1979) modified Sen index as the number of observations goes to infinity. Hence we refer to the SST index of poverty intensity.[4]

The SST index is proposed with the assumption that all the income data of a population are known and nonstochastic. Let ith-person's income of the population size N be Y_i such that $Y_1 < Y_2 < \cdots < Y_N$ and the poverty line be $z > 0$. Let Q ($<N$) be the number of individuals whose income is less than z. For the ith poor person, the poverty gap is $z - Y_i$, and the poverty gap ratio is $(z - Y_i)/z$. The SST index is defined as (see Shorrocks 1995):

$$(1)\quad P(Y; z) = \frac{1}{N^2}\sum_{i=1}^{Q}(2N - 2i + 1)\frac{z - Y_i}{z}.$$

It can be regarded as a weighted "average" of individual poverty gap ratios of the poor. The SST index is desirable because 1. it is symmetric, replication invariant, monotonic, homogeneous of degree zero in individual incomes and the corresponding poverty line, and normalized to take values in the range [0,1]; 2. it is continuous in individual incomes and consistent with the transfer axiom; and 3. it admits a geometric interpretation.[5] $P(Y; z)$ can be computed based on Equation 1 if the individual incomes of all members of the population are available.

The SST index of poverty intensity (Shorrocks 1995, p. 1228) can be decomposed as in Equation 2:

$$(2)\quad P(Y; z) = \mu(X)[1 + G(X)],$$

where $\mu(X)$ and $G(X)$ are the average poverty gap ratio and Gini coefficient of poverty gap ratios,

$$(3)\quad X_i = \frac{z - Y_i}{z}, \quad i = 1, 2, \ldots, N,$$

with the nonpoor population's X_i being set to zero.

Note that $\mu(X)$ and $G(X)$ must be differentiated respectively from the average income gap ratio among the poor and the more commonly used Gini index of income inequality among the poor. Both of these are components of Sen's original index.

3. See, among others, Atkinson (1987); Besley (1990); Blackorby and Donaldson (1980); Donaldson and Weymark (1986); Foster, Greer and Thorbecke (1984); Foster and Shorrocks (1988, 1991); and Takayama (1979). Kakwani (1980), Foster (1984), Hagenaars (1986, 1991), Seidl (1988), and Zheng (1997) have provided useful surveys of this literature. Methods of statistical inference of different poverty measures have been provided by Bishop, Chow, and Zheng (1995); Rongve (1997); Preston (1995); and Zheng, Cushing, and Chow (1995). Xu (1998) proposed a method of statistical inference for the SST index. However, he did not consider the sampling weights which are commonly used in large-scale social statistical surveys.

4. See Jenkins and Lambert (1997) and Zheng (1997) for further discussion about the limit of Thon's index.

5. See Shorrocks (1995) for details regarding the properties of the index.

(See Xu and Osberg 1999). Here, the population data set X for $\mu(X)$ and $G(X)$ refers to the poverty gap ratios calculated *for all members of the population.* The poverty gap ratios (X) are set to zero for the nonpoor subpopulation. To compute $G(X)$, the poverty gap ratios must be sorted in ascending order.

This paper extends Shorrocks (1995) based on the fact that $\mu(X)$ is simply the weighted average of the average poverty gap ratio among the poor and the poverty gap ratio among the nonpoor (namely, zero), with the weights being the population proportions (namely, the poverty rate and one minus the poverty rate, respectively). Let *RATE* be the poverty rate,

$$(4) \quad RATE = \frac{Q}{N},$$

and *GAP* the familiar average poverty gap ratio among the poor,[6]

$$(5) \quad GAP = \frac{1}{Q}\sum_{i=1}^{N} X_i.$$

It is easy to see that

$$(6) \quad \mu(X) = (RATE)(GAP) + (1 - RATE)(0),$$
$$= (RATE)(GAP).$$

Hence, combining Equations 2 and 6 the Sen-Shorrocks-Thon index can be further decomposed into:

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

Equation 7 can be further transformed into the following form:

$$(8) \quad \ln(P(Y; z)) = \ln(RATE) + \ln(GAP)\ \ln(1 + G(X)).$$

Taking the difference of Equation 8 gives Equation 9:

$$(9) \quad \Delta \ln P(Y; z) = \Delta \ln(RATE) + \Delta \ln(GAP)\ \Delta \ln(1 + G(X)).$$

Equation 9 shows that the overall percentage rate of change in poverty intensity can 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]

An index of poverty intensity is useful because it offers a defensible answer to the basic question of whether poverty is increasing or decreasing and how it compares across jurisdictions. Atkinson (1999, p. 24) and Nolan (1999) have noted that if reducing poverty is to become an explicit goal of policy, "it may be essential that there be a single headline number." Nevertheless, decomposability of such an overall index is also important because of the various possible origins of changes in poverty intensity. Poverty intensity may be increasing because more people are becoming poor, or because the average income shortfall below the poverty line is increasing,

6. Also known as Sen's income gap ratio.
7. The term $\ln(1 + G(X))$ is an approximate of $G(X)$ based on the first-order Taylor series expansion.

or because income shortfalls have become more unequal, or some combination of the above.

In trying to determine whether poverty has increased, analysts now often refer to trends in the poverty rate. However, as Myles and Picot (1999, p. 16) note: "Policy-makers are often frustrated by the fact that incremental reforms that genuinely improve the well-being of the very poor but fail to raise their incomes above a cut-off such as the LICO (Low Income Cut Off) remain statistically invisible. One temptation in this situation is to adopt a lower cut-off in the hope of making such policy changes statistically visible." Another temptation may be to dismiss as "failures" the policy initiatives that have statistically invisible effects on the poverty rate. It would seem preferable to use an index of poverty that is both defensible in itself as a single number, and easily decomposable into the underlying components of poverty trends.

Although important theoretical advances in poverty measurement have been made in the academic community, these have had relatively little impact on public debate—perhaps partly because of the limited mathematics background of much of the policy and advocacy community. Equations 7 and 9 provide a straightforward decomposition of the SST index of poverty intensity which can be readily interpreted by policy makers, social science researchers, and the general public.[8]

Figure 1 offers a geometric way of understanding our decomposition of the SST index. It graphs the poverty gap profile [sometimes called the deprivation profile, and also called the "Three 'I's of Poverty" (TIP) curve in Jenkins and Lambert (1997)]. The horizontal axis represents the percentiles (ordered by income) of the population and the vertical axis plots the cumulative sum of poverty gap ratios corresponding to each percentile of the population. As Shorrocks (1995) notes, the SST index has the graphical interpretation that it corresponds to twice the area beneath the poverty gap profile.

It is worth emphasizing, however that unless the poverty rate is very high, the poverty gap profile will be fairly closely approximated by the poverty rate and the average poverty gap ratio. Since the nonpoor have a poverty gap of zero, and typically comprise over 80 percent of a national population,[9] the poverty gap profile will be horizontal over most of its range, as in OBE in Figure 1. The curve in the poverty gap profile over the range OA, and its flatness over the range A1, simply represent the fact that the poverty rate can be represented as OA. The average poverty gap ratio is geometrically represented by the slope of the straight line OB. Therefore

8. Indeed, there is surprisingly little empirical application of existing measures of poverty intensity. Rodgers and Rodgers (1991) are an exception. They used the Foster-Greer-Thorbecke index across US states to focus on the contribution of subpopulations to overall poverty intensity rather than emphasizing the sources of poverty intensity (rate, gap, and inequality). Although subpopulations are not the focus of this paper, the SST index and its component decomposition can be used across subpopulations (see Xu and Osberg 1999).

9. Our Figure 1 differs from Figure 1 of Shorrocks (1995) because ours is plotted with actual data. We use microdata from Atlantic Canada (further details are available in Xu and Osberg 1998) because that region has the highest rate of poverty (0.185) and the highest average poverty gap ratio (0.259) among Canadian regions, and therefore the poverty gap profile has the greatest degree of curvature of any Canadian region. Nevertheless, our Figure 1 and that of Shorrocks (1995) make quite different visual impressions.

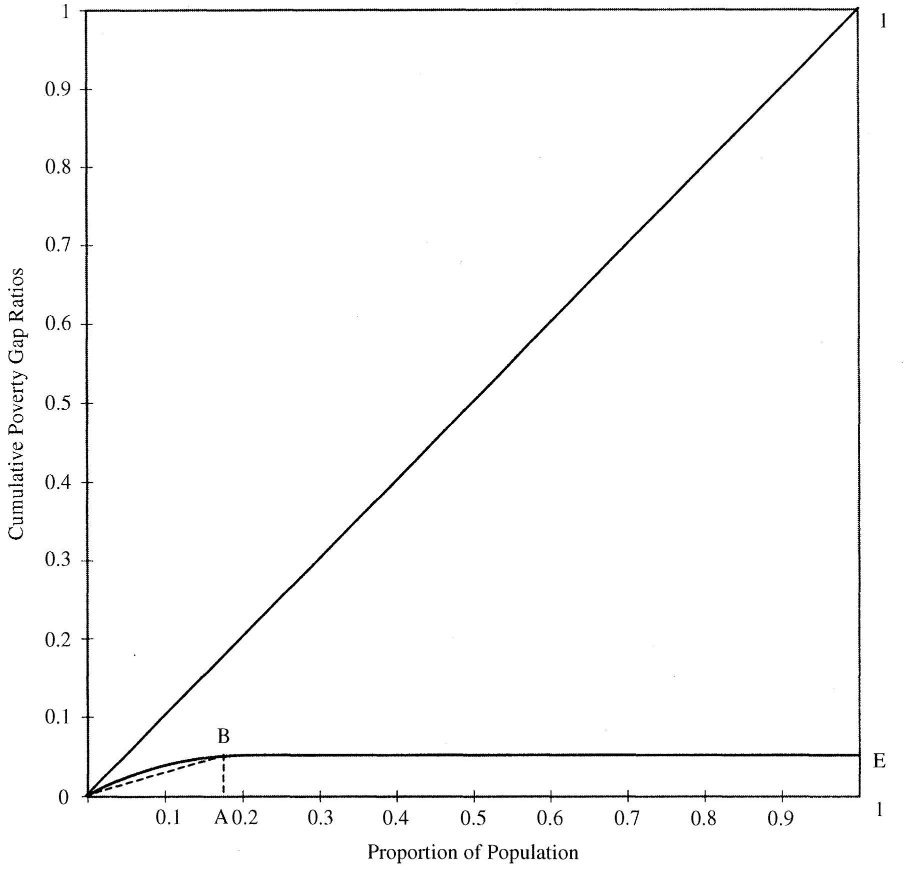

Figure 1
Poverty Gap Profiles, Atlantic Canada

most of the poverty gap profile[10] can be accounted for by the average poverty gap ratio and the poverty rate.[11]

As Section III will discuss, very little of the variation in the SST index of poverty intensity over time can be empirically explained by variation in $(1 + G(X))$, compared to the role of the poverty rate and the average poverty gap ratio. As Figure 1 indicates, this result is intuitively plausible, once the poverty gap profile is drawn to represent empirically plausible poverty rates. The "common sense" verbal expla-

10. The exception is the arc above the straight line OB. The area between this arc and OB is a small fraction of the entire area under the poverty gap profile OBE.

11. Using the FGT index of poverty intensity, Rodgers and Rodgers (1991, p. 338) also noted that "if primary income distribution data are not available, but the head count ratio and the mean poverty gap are known, a poverty intensity index based on the normalized deficit is a reasonable alternative."

nation for the unimportance of inequality among the poor in an aggregate measure of poverty intensity is that the differences in income among the poor are small compared to income differences among the nonpoor.[12]

B. Inference

Economists normally use data containing the sample incomes of households with sampling weights. Let m households in the sample be ordered by their equivalent incomes in ascending order and be indexed by i. Let the total number of households whose equivalent income is below the poverty line z be q ($<m$). Let the sample household equivalent income of household i, which is shared by all the members of that family, be y_i. Let the number of family members of the ith household be n_i, and the sampling weight[13] of the ith household w_i. Thus the total number of individuals is $\sum_{i=1}^{m} n_i w_i$. To accommodate complex survey data, we propose the following formulation for the SST index for survey data with sampling weights:

$$(10)\quad P(y;z) = \frac{1}{\left[\sum_{l=1}^{m} n_l w_l\right]^2} \sum_{i=1}^{q} \sum_{j=1}^{n_i w_i} \left[2\left(\sum_{l=1}^{m} n_l w_l\right) - 2\left(j + \sum_{k=1}^{i} n_{k-1} w_{k-1}\right) + 1 \right] \frac{z - y_i}{z},$$

where $n_0 = 0$, and $w_0 = 0$.

This modified SST index maintains all the properties of the original SST index. In particular, it is symmetric and replication invariant. These two properties justify our treatment of the tied equivalent incomes of the individuals who come from the same household. According to Sen (1976) and Shorrocks (1995), the incomes used to compute either the Sen poverty index or the SST index are assumed to have no tied observations. In actual survey data, observed incomes of equal values are not rare. Theoretically, this problem can be circumvented by the property of replication invariance of the SST index, namely, if two identical income data sets are merged, the value of the SST index for the merged new data set does not differ from that for each individual data set. Hence the property of replication invariance allows the SST index to accommodate tied observations. Furthermore, the property of symmetry of the SST index suggests that identical equivalent incomes should be treated symmetrically.

12. The upper bound on the incomes of poor people is the poverty line. The lower bound, leaving aside measurement error, is subsistence. The dollar value of the difference is not large, particularly when compared to the dollar differences among the non-poor population.

13. According to the LIS, the variable of the household weight (''HWEIGHT'') contains the sample weight for each sample case in the data set for a particular country. This weight indicates essentially that this sample case represents that many units within the total population of units. The LIS data sets do not contain variables summarizing cluster and strata membership.

The sample counterpart of Equation 3 is:

$$(11)\quad x_i = \frac{z - y_i}{z}, \quad i = 1, 2, \ldots, \sum_{j=1}^{m} n_j w_j,$$

with the non-poor individual's x_i being set to zero. In order to compute sample counterparts of $\mu(X)$, $G(X)$, *RATE,* and *GAP,* one must sort sample records $\{x_i, w_i, n_i\}$ according to sample poverty gap ratios $\{x_i\}$ in ascending order. For the survey data with sampling weights, $\mu(x)$ is given by:

$$(12)\quad \mu(x) = \frac{\sum_{i=1}^{m} n_i w_i x_i}{\sum_{i=1}^{m} n_i w_i}$$

This can be decomposed further into $\hat{RATE}$ and $\hat{GAP}$ as

$$(13)\quad \mu(x) = \left(\frac{\sum_{i=m-q+1}^{m} n_i w_i}{\sum_{i=1}^{m} n_i w_i}\right)\left(\frac{\sum_{i=1}^{m} n_i w_i x_i}{\sum_{i=m-q+1}^{m} n_i w_i}\right) = (R\hat{A}TE)(G\hat{A}P).$$

$G(x)$ in this case should be defined as:

$$(14)\quad G(x) = 1 - \sum_{i=1}^{m}\left(\frac{w_i n_i}{\sum_{j=1}^{m} w_j n_j}\right)\left(\frac{\sum_{k=1}^{i} w_k n_k x_k + \sum_{k=1}^{i-1} w_k n_k x_k}{\sum_{j=1}^{m} w_j n_j x_j}\right).$$

The decomposition shown in Equations 7, 8 and 9 can be applied to the survey data with sampling weights when X is replaced by x, and *RATE* and *GAP* are replaced, respectively, by their sample estimates $R\hat{A}TE$ and $G\hat{A}P$ where "^" denotes an estimate of the population poverty measure computed from a sample.

We propose a bootstrap procedure to compute the standard error of the modified SST index estimator. According to Xu (1998), the linear combination of the poverty gap ratios can be viewed as a linear combination of order statistics following Stigler (1969, 1974) and Ghosh (1971). But the analytical variance (or standard error) of $P(y; z)$ is complex. One may want to rely on the computing-intensive bootstrap method to compute the bootstrap variance (or standard deviation) as proposed by Efron (1979, 1982) and Efron and Tibshirani (1986). To compute the bootstrap standard error of the modified SST index estimator, we resample randomly (with replacement) equivalent incomes and the sampling weights associated with them. We generate a random integer t, from a uniform distribution defined over the support from zero to the total number of the households m'. We then use this random integer to draw from the tth household the equivalent income, the number of members, and the sampling weight. The new sample of size m' is denoted by $\{y_i^*, w^*_i, n_i^*\}_{i=1}^{m'}$. The new sample can then be used to compute a new SST index denoted as $P(y^{*t}, z^{*t})$. Repeating this process T times (for example, $T = 200$) gives $P(y^{*1}, z^{*1})$, $P(y^{*2}, z^{*2})$, . . . , $P(y^{*T}, z^{*T})$. The bootstrap variance is computed as the sample variance of the large number of the standard SST index estimates from the new samples. We denote the sampling variance of $P(y; z)$ as $\sigma^2(P(y; z))$. (See Efron 1982, Chapter 8) for details. When ranking examined countries, we can approximate a 95 percent confidence interval by adding two bootstrap standard errors on each side of the SST index estimate.[14]

C. Data, Equivalent Income, and Poverty Line

We present estimates of poverty intensity over time for the following economies (see also Table A1): Australia (1981, 1985, and 1989), Austria (1987), Belgium (1985, 1988, and 1992), Canada (1971, 1975, 1981, 1987, 1991, and 1994), Denmark (1987 and 1992), Finland (1987 and 1991), France (1979, 1981, and 1984), Germany (1981, 1983, and 1984), Ireland (1987), Israel (1979, 1986, and 1992), Italy (1986 and 1991), Luxembourg (1985), the Netherlands (1983, 1987, and 1991), Norway (1979, 1986, and 1991), Spain (1980 and 1990), Sweden (1975, 1981, 1987, and 1992), Switzerland (1982), Taiwan (1986 and 1991), United Kingdom (1979, 1986, and 1991), and United States (1974, 1979, 1986, 1991, and 1994).[15]

We assume that income is shared within families. The focus of welfare comparisons, however, is the distribution of income among persons. We therefore use the LIS definition of total family money income after tax (disposable income)[16] as the basis for calculation of the equivalent income of all individuals within families. We therefore measure poverty intensity in terms of equivalent after—tax money income. In the literature, a number of equivalence scales have been used to account for the economies of scale of household consumption (Burkhauser, Smeeding, and Merz 1996 and Phipps and Garner 1994, among others, have examined some of the implications of alternative choices). The issues raised by different equivalence scales are important, but in order to keep this paper focused and to facilitate comparisons with

14. It should be noted that the SST index estimator is "nonpivotal" in the sense of Hall (1992, p. 14). In other words, its sampling distribution depends upon some unknown parameters(s). The bootstrap sampling distribution may differ from the true sampling distribution by an error. The error is in the order of 1/[*sample size*] if the statistic is pivotal; it is in the order of $1/\sqrt{[\textit{sample size}]}$ if the statistic is non-pivotal (see Hall 1992, pp. 83–85). Given that the sample sizes used here are very large, the bootstrap error becomes negligible.

15. Rose and McAllister (1996) argue convincingly that money income has been a poor measure of command over goods and services in Eastern Europe, and that its relative importance is changing rapidly in the economic transition process. For this reason, this paper does not present calculations for Hungary (1991), Poland (1986 and 1992) and Russia (1992 and 1995). Interested readers can however consult Appendix B in Osberg and Xu (1997).

16. Disposable income consists of the sum of gross wages and salaries, farm self-employment income, non-farm self-employment income, cash property income, sick pay, disability pay, social retirement benefits, child or family allowances, unemployment compensation, maternity pay, military/veteran/war benefits, other social insurance, means-tested cash benefits, near cash benefits, private pensions, public sector pensions, alimony or child support, other regular private income, and other cash benefits minus mandatory contributions for self employed, mandatory employee contribution, and income tax.

other research,[17] we use the OECD equivalence scale, which calculates the equivalent income of each household member as:

(15) $Y = Y_f/(1 + .7(N_a - 1) + .5N_c)$.

Here Y_f is total household income after tax,[18] N_a is the number of the adults in the household and N_c is the number of the children under age 18.

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. In developed countries, however, we take the view that social norms define a minimally adequate standard of living within each country, and that these norms differ across countries, 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 standard of half the median equivalent after-tax money income as the poverty line in each country, at each point in time.[19]

We note that some data sets contain individuals with negative incomes.[20] Such observations would dominate measures of inequality or poverty that emphasize mathematically the well being of the very poor (for example, the Atkinson family of inequality measures). Because there are very few such observations, and because negative incomes can only arise if individuals experience large capital losses in a particular year, which itself can only occur if initial wealth is substantial, we follow the common practice of deletion.

It is less clear, however, how to deal with individuals who record zero money income, which may be a valid measure of money income (for example, for members of monastic religious orders or residents of group homes for the disabled) but which may also be measurement error. Table A2 indicates that countries in the LIS database differ substantially in the percentage of the sample with zero recorded money income. This makes little difference to a measure of aggregate inequality such as the Gini Index, but it can make a difference to the SST index of poverty intensity. Table A2 also reveals that some countries, in some years, sanitize their data by removing zero income observations. To keep our data comparable across countries, we delete all observations with zero recorded money income. Appendix 1 discusses the extent to which excluding or including zeros may affect estimates of the SST index. For a fuller discussion of the LIS data set and its quality, consistency and comparability to other data sets, see Atkinson, Rainwater, and Smeeding (1995, especially Chapters 3 and 5).

17. See, for example, Buhmann et al. (1988); Coulter, Cowell, and Jenkins (1992); Burkhauser, Smeeding, and Merz (1996); and Figini (1998) for comparison of the 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."

18. "Disposable Personal Income" in the LIS data sets.

19. 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—see Section IIIB.

20. For example, the 1992 Swedish microdata contain an income of −3,533, 937 Kroner [=Can.$641,000] and the 1987 Danish data contain an income of −656,959 Kroner [=Can.$143,000].

In summary, we assume that within all the sampled countries, at all dates: 1. household money income (after tax) is equally shared among all household members, 2. the OECD equivalence scale adequately accounts for economies of scale in family consumption, and 3. the poverty line is half the median equivalent income. Clearly, these are strong assumptions. Sharif and Phipps (1994) have, for example, demonstrated the sensitivity of child poverty in Canada to alternative assumptions about the intra-household distribution of resources, and one could plausibly argue that sharing norms within families vary over time and across countries. There is a considerable literature on intra-household allocation, equivalence scales, and poverty lines. We make these assumptions in order to focus attention on issues that have, thus far, been neglected in the literature.

A final caveat is that we do not disentangle the structural and cyclical components of poverty intensity. Clearly, the level of aggregate demand for labor is a crucial determinant of the job options and labor market earnings available to the poverty population. The LIS collects the international micro data sets that are available for each country, which sometimes correspond to different dates and different phases of the business cycle. In comparing nations it would be desirable to disentangle each nation's long-run structural level of poverty intensity and the deviations from that level due to the business cycle. However, decomposing the actual level of unemployment into its cyclical and structural components is a complex and controversial endeavor within each individual country,[21] and it is beyond the scope of this paper to attempt such a task for all the LIS countries simultaneously.

Table 1 presents the SST index and the Gini index, with their bootstrap standard errors, for 20 countries in the 1970s, 1980s, and 1990s. Column 1 indicates the raw number of records in each sample survey. Within countries, individual observations are often sampled with widely varying probability weights,[22] which implies that the inclusion or exclusion of a particular observation in the database can have widely varying impact. Estimates of population characteristics based on survey samples are in general subject to sampling variation, and the issue is potentially more important when sampling probabilities differ substantially. In the literature, it has been common to report point estimates of poverty and inequality measures without further elaboration. In this paper, all our calculations take the sampling weights into consideration.

As Column 2 indicates, the actual raw number of records for the poor families can be, in some countries, rather small. For example, the raw numbers are 67 in Luxemburg (1985) and 121 in the Netherlands (1987). In other instances, however, the number of the poor families is large. For example, the number is 10,762 in the United States (1994), which outnumbers the entire sample size in most other countries. To account for the impact of sampling variation on poverty comparisons (which

21. For example, using Canadian data, Setterfield, Gordon, and Osberg (1992, p. 119) conclude: "The range of prime age male NAIRU's (Non Accelerating Inflation Rate of Unemployment) generated by statistically satisfactory and economically reasonable estimating equations covers almost the entire range of Canadian post war prime age male unemployment experience. Estimates of the NAIRU depend heavily on the form of the estimating equation, the operational definition of key variables, and the data sample period."

22. Although LIS documentation indicates that the Belgian data is a simple random sample, other countries use a stratified random sampling design, with sampling weights varying by as much as a factor of 391 in Norway (1991) and 184 in Canada (1981).

is likely to differ widely in potential importance in LIS data), we report the point estimates of the SST index for each country survey (as it appears in LIS data) in Column 3 and the standard error based on 200 bootstrap iterations in Column 4.

Column 5 presents the point estimates of the Gini index of inequality and Column 6 reports the standard error based on 200 bootstrap iterations. The Gini index tends to be mid-range sensitive and is calculated for the entire (poor plus non-poor) sample, so it is not surprising that the bootstrap standard error of the Gini index is noticeably smaller, as a percentage than is the case with the SST index.

III. International Comparisons

A. Poverty Intensity Rankings

Figures 2 and 3 present the results of Table 1 graphically, in order to highlight simultaneously the ranking of countries and the range of statistical uncertainty surrounding such rankings. Figures 2 and 3 split the LIS data in 1984-85 because the macroeconomic context of inflation and high energy prices of the 1970s and early 1980s was arguably different from the policy settings of inflation control and deficit reduction more typical of the late 1980s and 1990s.[23]

It is noteworthy that the LIS data in Figure 2 for the 1970s and early 1980s show a number of North European countries clustered close together at the low end of the scale. Germany, the Netherlands, Norway and Sweden have the least poverty intensity, but there is too much statistical uncertainty to enable individual countries to be conclusively ranked. The United Kingdom (1979) is very close. At the high end of poverty intensity, in the early 1970s, Canada's point estimate of poverty intensity is higher than that of the United States, but the statistical uncertainty surrounding the estimates of Canada (1971) and the United States (1974) indicates that no clear judgment is possible.

Figure 3 is clear, however, in indicating that the United States in the 1990s is in a class by itself. The downward trend in Canadian poverty intensity moved that country into the high end of a continuum of ''European-style'' poverty intensity. Canadian poverty in 1994, for example, is statistically indistinguishable from that of Spain (1990) or the United Kingdom (1991).[24] Because data for Austria, Belgium, Denmark, Finland and Luxemburg become available Figure 3 presents a fuller picture of the low poverty intensity in North Europe than do the 1970s data. Notably, however, Sweden (1987 and 1992) is no longer a country particularly low in poverty intensity, and the difference between it and other North European countries is statistically meaningful. France, Italy, Israel, Spain, the United Kingdom, Australia and Canada clearly have higher poverty intensity than most of the North European coun-

23. Some evidence that the OECD perceives a change in macro-economic regime to have occurred in the mid-1980s can be found in its 1995 Jobs Study, which poses the provocative question: ''Does the present situation call for any change in the medium-term strategy of sound public finances, low inflation and structural reform which was agreed by OECD member countries in the first half of the 1980s?'' (p. 59).
24. Israel (the only Middle East country) and Taiwan (the only Asian economy) were similar in poverty intensity to the European countries.

Table 1
Poverty Intensity and Income Inequality in LIS Data

Country/Year (Ordered by SST Index)	Number of Records	Number of Records Below Poverty Line	SST Index of Poverty Intensity	Bootstrap Standard Error	Gini Index of Income Inequality	Bootstrap Standard Error
Austria (87)	11,147	718	0.0148	0.00111	0.210	0.00256
Luxembourg (85)	2,044	67	0.0158	0.00311	0.238	0.00448
Germany (83)	42,746	1,222	0.0170	0.00081	0.260	0.00168
Finland (91)	11,740	594	0.0190	0.00118	0.224	0.00183
Belgium (92)	3,779	148	0.0195	0.00220	0.221	0.00338
Finland (87)	11,856	498	0.0195	0.00126	0.220	0.00177
Belgium (85)	6,446	260	0.0206	0.00177	0.230	0.00268
Norway (86)	4,967	167	0.0207	0.00214	0.222	0.00291
Belgium (88)	3,751	148	0.0208	0.00237	0.235	0.00395
Norway (91)	8,059	249	0.0211	0.00231	0.222	0.00433
The Netherlands (83)	4,670	143	0.0235	0.00274	0.266	0.00687
Germany (84)	5,159	323	0.0240	0.00254	0.253	0.00475
Germany (81)	2,852	150	0.0247	0.00340	0.251	0.00466
Norway (79)	10,307	432	0.0249	0.00175	0.232	0.00236
Sweden (75)	10,268	672	0.0257	0.00180	0.214	0.00178
The Netherlands (87)	4,097	121	0.0259	0.00335	0.262	0.00419
Sweden (81)	9,564	1,196	0.0286	0.00216	0.194	0.00200
Taiwan (86)	16,434	1,267	0.0312	0.00116	0.318	0.00312
United Kingdom (79)	6,758	387	0.0324	0.00265	0.264	0.00298
Switzerland (82)	6,877	506	0.0349	0.00227	0.326	0.00727
The Netherlands (91)	4,326	202	0.0353	0.00390	0.272	0.00560
Denmark (92)	12,798	843	0.0355	0.00174	0.224	0.00253

Sweden (92)	12,435	782	0.0372	0.00198	0.222	0.00211
Taiwan (91)	16,434	1,598	0.0377	0.00126	0.309	0.00255
Denmark (87)	12,340	931	0.0382	0.00186	0.243	0.00248
Sweden (87)	9,476	944	0.0390	0.00165	0.211	0.00290
France (84)	12,579	834	0.0431	0.00221	0.298	0.00296
Ireland (87)	3,259	241	0.0465	0.00482	0.325	0.00595
United Kingdom (86)	7,091	408	0.0479	0.00348	0.293	0.00320
Israel (92)	5,212	474	0.0480	0.00369	0.325	0.00387
France (79)	10,989	638	0.0482	0.00266	0.304	0.00355
Spain (90)	21,110	1,796	0.0526	0.00195	0.307	0.00335
Canada (94)	38,938	4,176	0.0538	0.00145	0.287	0.00166
Israel (79)	22,717	191	0.0543	0.00553	0.332	0.00649
Canada (91)	21,566	2,478	0.0561	0.00248	0.285	0.00296
United Kingdom (91)	7,030	798	0.0562	0.00308	0.338	0.00538
Italy (86)	8,020	715	0.0562	0.00396	0.310	0.00465
Australia (85)	8,369	630	0.0586	0.00338	0.296	0.00293
Israel (86)	4,997	417	0.0593	0.00401	0.333	0.00405
Canada (87)	11,924	1,609	0.0595	0.00300	0.290	0.00351
France (81)	3,639	235	0.0597	0.00488	0.305	0.00507
Australia (81)	16,938	1,543	0.0620	0.00249	0.286	0.00191
Canada (81)	15,045	1,880	0.0634	0.00246	0.290	0.00212
Australia (89)	16,244	1,519	0.0648	0.00259	0.306	0.00223
Spain (80)	23,917	2,437	0.0690	0.00218	0.327	0.00419
Canada (75)	26,247	3,820	0.0757	0.00179	0.296	0.00153
United States (79)	15,773	2,421	0.0972	0.00291	0.311	0.00224
United States (74)	12,189	1,759	0.0990	0.00330	0.325	0.00278
United States (86)	12,477	2,051	0.1185	0.00344	0.343	0.00266
United States (94)	65,282	10,762	0.1246	0.00154	0.371	0.00137

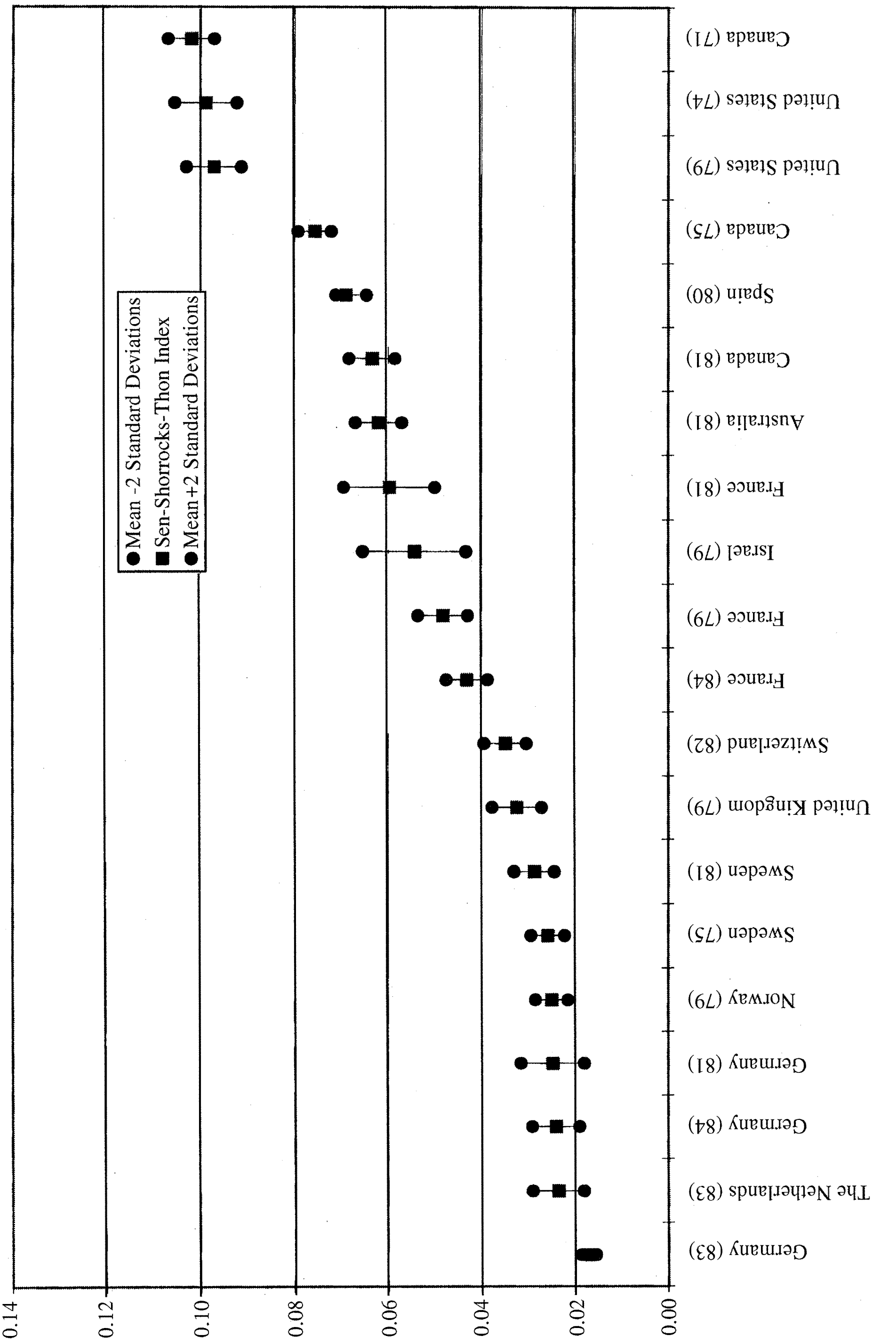

Figure 2
1971–1984 Country Rankings by Sen-Shorrocks-Thon Poverty Index

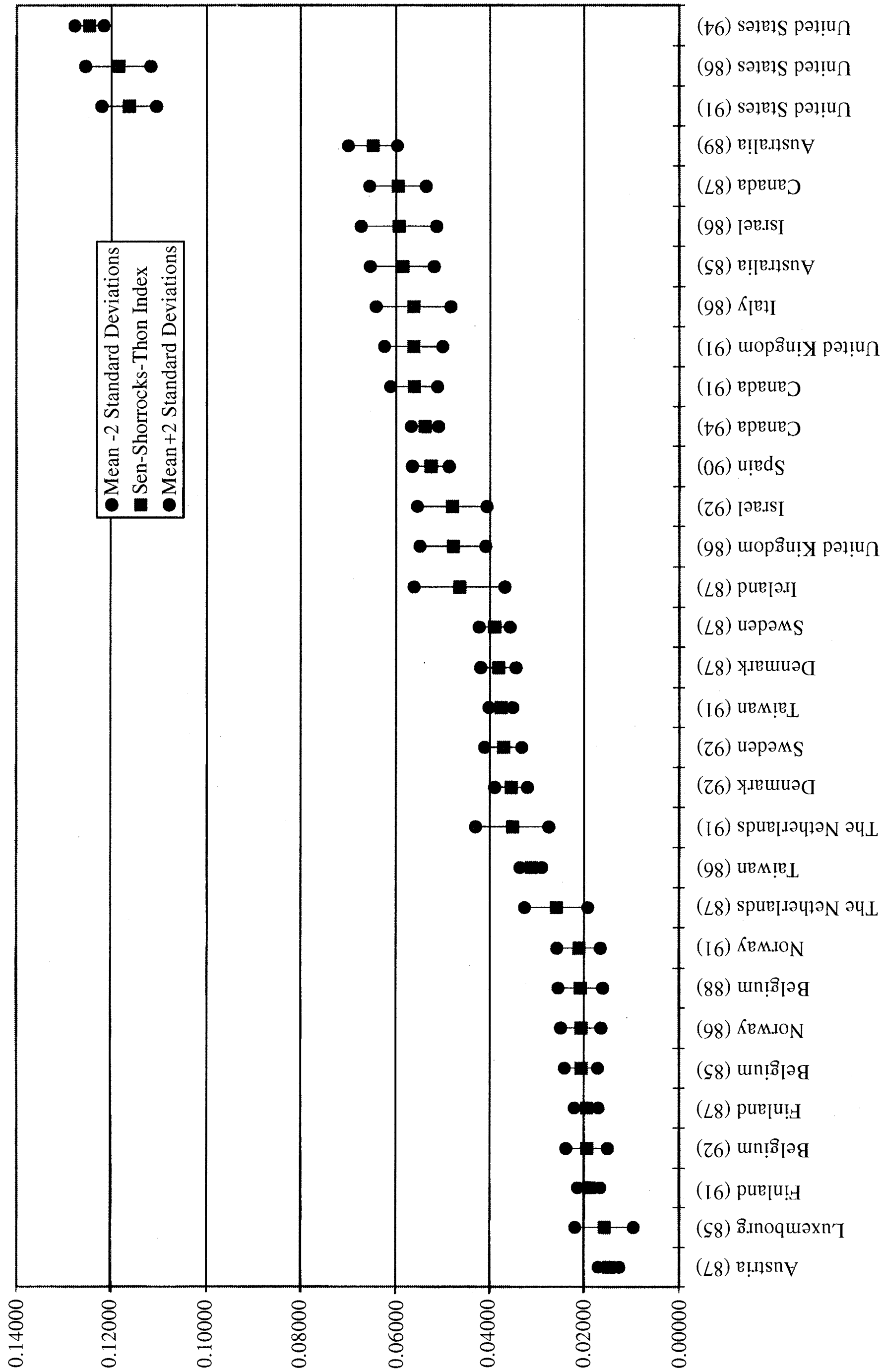

Figure 3
1985–1994 Country Rankings by Sen-Shorrocks-Thon Poverty Index

tries, but there is enough statistical uncertainty to warn against presenting more exact country rankings.

Because Canada and the United States are very similar in economic organization, income levels, statistical data collection methods, and so on, the Canada/United States comparison may be particularly interesting. As Card and Freeman (1993) have documented, Canadian and American social policy diverged in the 1970s and 1980s. Starting from a position of statistical indistinguishability in poverty intensity in the early 1970s, Canadian data up to 1994 show a clear trend to reduced poverty intensity, while the United States data show an equally clear trend to increased poverty intensity.

B. Poverty Intensity and Aggregate Inequality

Are international comparisons of poverty intensity effectively equivalent to international comparisons of inequality? As Equation 7 indicates, one term in the analytic decomposition of the SST index of poverty intensity is $(1 + G(X)$—where $G(X)$ is the Gini index of inequality of poverty gap ratios. Shorrocks (1995, p. 1229) has argued that poverty gap profiles, from which the SST index can be derived, "fulfill a role similar to that of Lorenz curves and generalized Lorenz curves in the evaluation of inequality and welfare." Furthermore, the measure of poverty intensity used in this paper is based on a poverty line drawn at half the median equivalent income, and such measures are sometimes criticized on the grounds that relative poverty is "merely" another aspect of income inequality.

On the other hand, measures of aggregate inequality are dominated by income distribution among the non-poor, who comprise the vast majority of the population, regardless of whether the poverty line is drawn in absolute or relative terms. The institutional detail of transfer programs and the mode of operation of low-wage labor markets differ tremendously among countries, with major impacts on the poverty rate and poverty gap. However, these issues have little relevance for the nonpoor. Hence, country rankings in aggregate inequality can differ considerably from country rankings in poverty intensity. In comparisons of the inequality of equivalent income (as measured by the Gini index), one observes much more of a continuum in the international data than in poverty intensity.

Although there is a positive correlation between income inequality and poverty intensity, the relationship is far from perfect. To illustrate this, we provide the first empirical evidence on the relationship between measures of poverty intensity and inequality in international data. Figure 4 presents a plot of the relationship between the SST index of poverty intensity and the Gini index of inequality. Note, for example, that although Switzerland has a comparable Gini index of income inequality to that of the United States, it has markedly lower level of poverty intensity. One can also note that although Sweden (1981) and Switzerland (1982) are quite similar in poverty intensity, they are quite different in Gini index of inequality.

C. Decomposing Trends in Poverty Intensity

Table 2 decomposes the level of the SST index as per Equation 7 and the changes observed in poverty intensity as per Equation 9. Table 2, Column 2, presents the

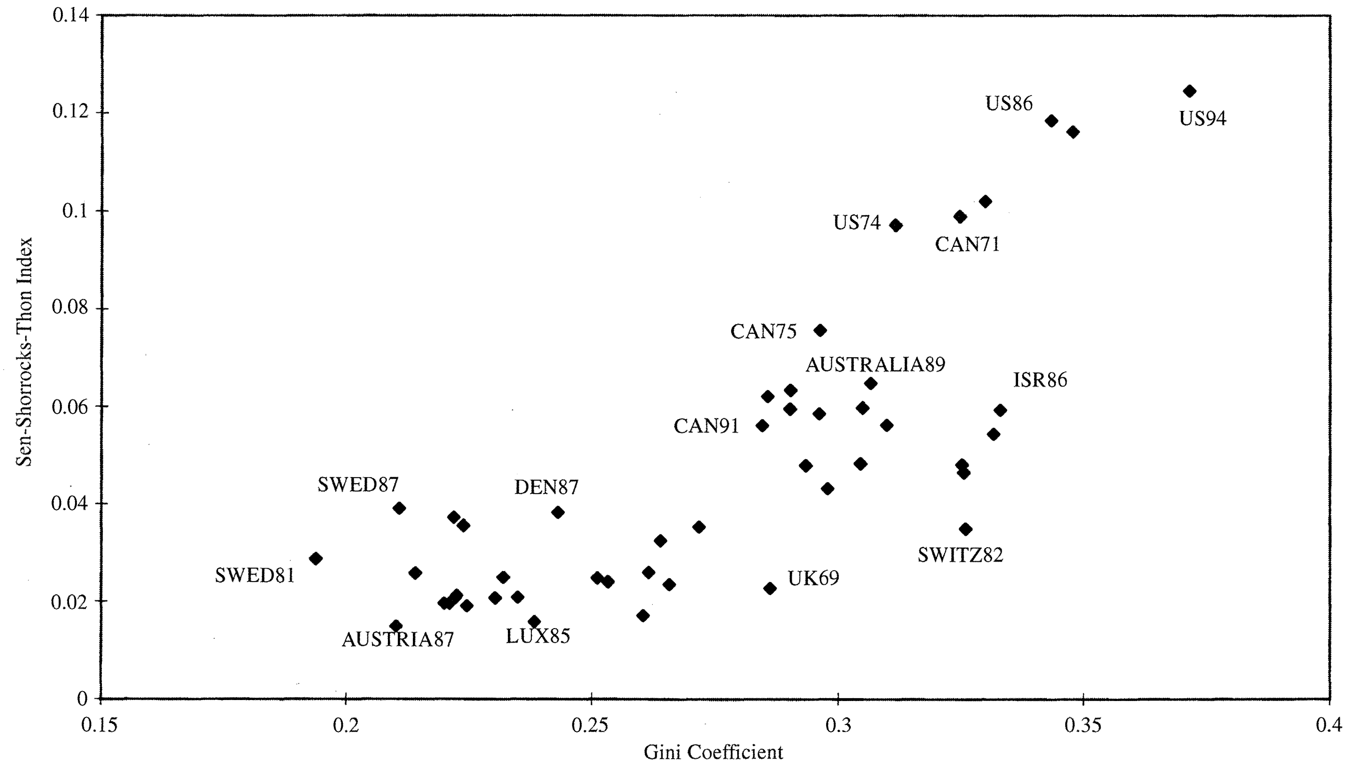

Figure 4
Poverty Intensity vs Income Inequality

Table 2
Decomposition of the Sen-Shorrocks-Thon Index

		SST	Decomposition of Level				Decomposition of Change		
Country	Year	Index (P)	Rate	Gap	$(1 + G(x))$	$\Delta\ln(P)$	$\Delta\ln$ (Rate)	$\Delta\ln$ (Gap)	$\Delta\ln$ $(1 + G(x))$
Australia	1981	0.062	0.100	0.319	1.947				
	1985	0.059	0.091	0.329	1.951	−0.057	−0.089	0.030	0.002
	1989	0.065	0.102	0.329	1.943	0.101	0.106	−0.001	−0.004
Austria	1987	0.015	0.010	0.185	1.979				
Belgium	1985	0.021	0.044	0.237	1.979				
	1988	0.021	0.047	0.224	1.977	0.008	0.067	−0.058	−0.001
	1992	0.019	0.045	0.221	1.978	−0.066	−0.051	−0.015	0.001
Canada	1971	0.102	0.149	0.359	1.914				
	1975	0.076	0.123	0.318	1.929	−0.299*	−0.186	−0.120	0.008
	1981	0.063	0.113	0.290	1.935	−0.177*	−0.089	−0.091	0.003
	1987	0.060	0.109	0.281	1.937	−0.063	−0.031	−0.033	0.001
	1991	0.056	0.107	0.271	1.938	−0.059	−0.022	−0.037	0.000
	1994	0.054	0.105	0.265	1.940	−0.042	−0.021	−0.022	0.001
Denmark	1987	0.038	0.064	0.302	1.969				
	1992	0.036	0.053	0.340	1.972	−0.074	−0.194	0.119	0.001
Finland	1987	0.020	0.041	0.243	1.978				
	1991	0.019	0.041	0.234	1.979	−0.026	0.010	−0.036	0.001
France	1979	0.048	0.081	0.305	1.954				
	1981	0.060	0.096	0.318	1.948	0.214*	0.176	0.041	−0.003
	1984	0.043	0.080	0.276	1.957	−0.326*	−0.190	−0.140	0.005
Ireland	1987	0.046	0.098	0.242	1.955				

Israel	1979	0.054	0.138	0.205	1.919				
	1986	0.060	0.130	0.238	1.921	0.092	−0.060	0.151	0.001
	1992	0.048	0.117	0.212	1.931	−0.215*	−0.106	−0.115	0.005
Italy	1986	0.056	0.109	0.266	1.938				
Luxembourg	1985	0.016	0.043	0.184	1.981				
The Netherlands	1983	0.023	0.040	0.299	1.978				
	1987	0.026	0.048	0.271	1.976	0.098	0.200	−0.101	−0.001
	1991	0.035	0.047	0.380	1.975	0.309*	−0.030	0.339	0.000
Norway	1979	0.025	0.041	0.307	1.978				
	1986	0.021	0.037	0.285	1.980	−0.185*	−0.112	−0.074	0.001
	1991	0.021	0.035	0.303	1.982	0.020	−0.043	0.063	0.001
Spain	1980	0.069	0.119	0.300	1.929				
	1990	0.053	0.096	0.281	1.947	−0.272*	−0.214	−0.067	0.009
Sweden	1975	0.026	0.043	0.303	1.977				
	1981	0.029	0.047	0.309	1.972	0.107	0.089	0.021	−0.003
	1987	0.039	0.058	0.344	1.966	0.309*	0.205	0.107	−0.003
	1992	0.037	0.052	0.363	1.969	−0.048	−0.104	0.054	0.002
Switzerland	1982	0.035	0.070	0.253	1.965				
Taiwan	1986	0.031	0.086	0.186	1.953				
	1991	0.038	0.096	0.201	1.943	0.187*	0.115	0.078	−0.005
United Kingdom	1979	0.032	0.067	0.245	1.966				
	1986	0.048	0.081	0.300	1.960	0.390*	0.190	0.204	−0.003
	1991	0.056	0.127	0.229	1.934	0.160*	0.442	−0.269	−0.013
United States	1974	0.099	0.146	0.355	1.913				
	1979	0.097	0.155	0.328	1.909	−0.018	0.065	−0.081	−0.002
	1986	0.118	0.180	0.349	1.888	0.198*	0.145	0.063	−0.011
	1991	0.116	0.177	0.346	1.892	−0.020	−0.013	−0.009	0.002
	1994	0.125	0.183	0.360	1.889	0.070	0.031	0.040	−0.001

* Change in the SST Index is significant at the 95 percent confidence level.

level of poverty intensity for the LIS countries, both those with multiple observations over time and those with single observations. This is the *product* of Column 3 (the poverty rate), Column 4 (the average poverty gap ratio among the poor) and Column 5 (the inequality in poverty gap ratios among all people). Column 6 presents the proportionate *change* in poverty intensity in a given year of a country's data, compared to the immediately preceding observation of that country. This is the *sum* of Column 7 (the proportionate change in the poverty rate), Column 8 (the proportionate change in the average poverty gap ratio of the poor) and Column 9 (the proportionate change in inequality of the poverty gap ratio among all people).

It is noteworthy that in Table 2 the percentage changes in $\ln(1 + G(x))$ are always an order of magnitude smaller than percentage changes in the poverty rate and the average poverty gap ratio.[25] Since inequality in the poverty gap ratios among all people (that is, $1 + G(x)$) does not change much, changes in poverty intensity are dominated by changes in the poverty rate and the average poverty gap ratio. Hence, to a first approximation, the percentage change in poverty intensity is the sum of the percentage change in the poverty rate and the percentage change in the average poverty gap ratio of the poor.

It is also clear from Table 2, however, that neither the poverty rate nor the poverty gap by itself tells the whole story about poverty intensity—a high level of poverty intensity may be caused by a high poverty rate, or a high poverty gap, or both. For example, France in 1981, Israel in 1986 and Canada in 1987, had the same value for the SST index (0.060). But France in 1981 the lowest poverty rate (0.096) in the three countries while Israel in 1986 had the highest poverty rate (0.130). On the other hand, France in 1981 had the highest poverty gap (0.318) while Israel in 1986 had the lowest poverty gap (0.238).

Given our earlier discussion of the importance of sampling variability, we would not want to ascribe unwarranted importance to small changes in poverty intensity. We therefore use our estimates of the bootstrap variance reported in Table 1 to indicate (with an asterisk) the changes in poverty intensity within countries that are statistically significant at a 95 percent level of confidence (that is, those that differ by more than two standard errors from the prior year's estimate). Only thirteen of 30 observed changes in poverty intensity pass this stringent test.

One major implication of Table 2 is that there is no clear trend to greater poverty intensity—no ''immutable natural law'' of greater immiserization—to be observed in the LIS data. If one simply counts the number of times one observes a decrease in poverty intensity in Table 2 (16) and the number of times an increase in poverty intensity is observed (14), the result is pretty much a draw. The number of statistically significant declines (6) and increases (7) are also nearly matched. Even in an increasingly globalized international economy, one can observe different social choices and different social outcomes.

A second implication of Table 2 is the potentially precarious economic position

25. Since $(1 + G(x))$ measures inequality in the poverty gap ratios among all people, most of whom are nonpoor (namely, their poverty gap ratios are set to zero), this number is always large, but nearly constant within countries. It does differ somewhat *across* countries, but by far less than the across-country difference in poverty rate or average poverty gap ratio. The coefficient of variation of poverty rates (Column 3 of Table 2) is 0.493, while the coefficient of variation of average poverty gap ratios (Column 4) is 0.185. However, the coefficient of variation of $(1 + G(x))$ (Column 5) is only .014.

of the poor. In a number of countries, there have been quite significant increases in poverty intensity, albeit with differing underlying causes. For example, the 31 percent increase in Dutch poverty intensity between 1987 and 1991 was driven entirely by an increase in the average poverty gap ratio among the poor. Sweden experienced a similar increase in poverty intensity between 1981 and 1987, but two-thirds of Sweden's increase in poverty intensity was due to an increase in the poverty rate. The 39 percent increase in poverty intensity in the United Kingdom between 1979 and 1986 was almost equally due to an increase in the poverty rate and an increase in the average poverty gap ratio among the poverty. The 1986 to 1991 period saw a further 16 percent increase in poverty intensity in the United Kingdom, driven entirely by a substantial increase in the poverty rate.

On the other hand, significant improvements in the well being of the poor can also occur fairly quickly. Countries experiencing significant declines in poverty intensity include Canada (between 1971 and 1975 and between 1975 and 1981), France (between 1981 and 1984), Israel (between 1986 and 1992), Norway (between 1979 and 1986), and Spain (between 1980 and 1990).

Table 2 is also interesting for the light it sheds on the diverging trends in poverty intensity in Canada and the United States. The largest changes in the intensity of poverty in Canada came in the 1970s, particularly between 1971 and 1975. This was period of strong economic growth which saw the introduction of the Canada Pension Plan and Guaranteed Income Supplement for senior citizens and the Canada Assistance Plan, plus the liberalization of unemployment insurance. Reductions in Canada's poverty intensity in the 1980s and 1990s were much more modest and not statistically significant at a 95 percent level of confidence. In both the 1970s and the 1980s, declines in Canadian poverty intensity were split fairly evenly between declines in the poverty rate and decreases in the average poverty gap ratio among the poor. Unfortunately, the trend to lower poverty intensity in Canada ended in the early 1990s.[26]

The U.S. data on poverty intensity indicates that a large change—an increase of 20 percent in poverty intensity—occurred between 1979 and 1986. About seven-tenths of that increase in poverty intensity can be attributed to an increase in the poverty rate, with the remainder being due to an increase in the average poverty gap ratio among the poor. There is no return to lower poverty intensity in the data up to 1994.

IV. Conclusion

If poverty targets are to become explicit objectives of government, such targets should be conceptually defensible, publicly communicable, and meaningfully measured. We hope that we have contributed to demonstrating the possibility of that objective by presenting a conceptually defensible measure, by demonstrating how it can be decomposed into familiar and easily understandable components, and by assessing the statistical reliability of international comparisons.

26. Osberg and Xu (1999) use Survey of Consumer Finance data (which is not exactly the same as that mounted at LIS) to examine trends in poverty intensity in aggregate, and within Canadian provinces, from 1984 to 1996.

We have demonstrated that aggregate poverty intensity, as measured by the Sen-Shorrocks-Thon index, can be decomposed into the product of the poverty rate, average poverty gap ratio, and overall Gini index of poverty gap ratios. We also show, however, that the changes in inequality among the poor are empirically unimportant in explaining changes in poverty intensity. For practical purposes, the percentage change in poverty intensity in international data can be approximated by the sum of percentage changes in the poverty rate and average poverty gap.

This paper has also presented the first international comparisons of poverty intensity using the Sen-Shorrocks-Thon index. Since international comparisons of poverty are based on sample data, the number of people observed to be poor depends on the sample size drawn and the prevalence of poverty in each country. There is substantial variation in both sample size and poverty prevalence, which gives rise to a degree of uncertainty in international comparisons of poverty intensity, due to the potential for sampling variation in estimation. This paper has therefore used bootstrap methods to assess the potential importance of sampling variation.

The Scandinavian countries, especially Sweden, have long been renowned for the generosity of their social programs and high degree of economic equality. Our analysis with explicit confidence intervals for poverty intensity, however, shows that a cluster of North European countries were statistically indistinguishable from Norway and Finland in poverty intensity up to the early 1990s. Indeed, because of the rise in poverty intensity in Sweden in the mid–1980s, Sweden in 1987 and 1992 was no longer particularly exemplary among European nations. If broad generalizations are to be drawn, it may therefore be more appropriate to speak of a ''North European,'' than a ''Scandinavian'' model.

Statistical analysis with explicit confidence intervals is useful to ensure that changes in measured poverty intensity within countries correspond to real changes. The international data indicate that there is no general tendency to immiserization of the poor—the number of countries where poverty intensity increased is almost exactly matched by the number of decreases. Nevertheless, since the poor do not have much to begin with, it does not take much money to make a major difference in their lives. Large proportionate changes in poverty intensity were observed in several countries—a fact that underscores the precariousness of poverty incomes.

In the international data, the clear divergence between the United States and Europe in poverty intensity is noteworthy. Decomposition of the Sen-Shorrocks-Thon index of poverty intensity indicates that most of this change occurred in the early 1980s, largely due to an increase in the poverty rate. Canada has followed a different path from the United States, with large declines in poverty intensity in the 1970s. By the early 1990s, Canada sat at the high end of a ''European'' continuum of poverty intensity. The reasons for these trends and, more importantly, what to do about them, remain important issues for future research.

Appendix 1

Table A1 presents graphically the value of the SST index when zero incomes are included and when such incomes are excluded. The same values appear in column 5 and 6 of Table A2. Two instances stand out (Netherlands 1983, Belgium 1992)

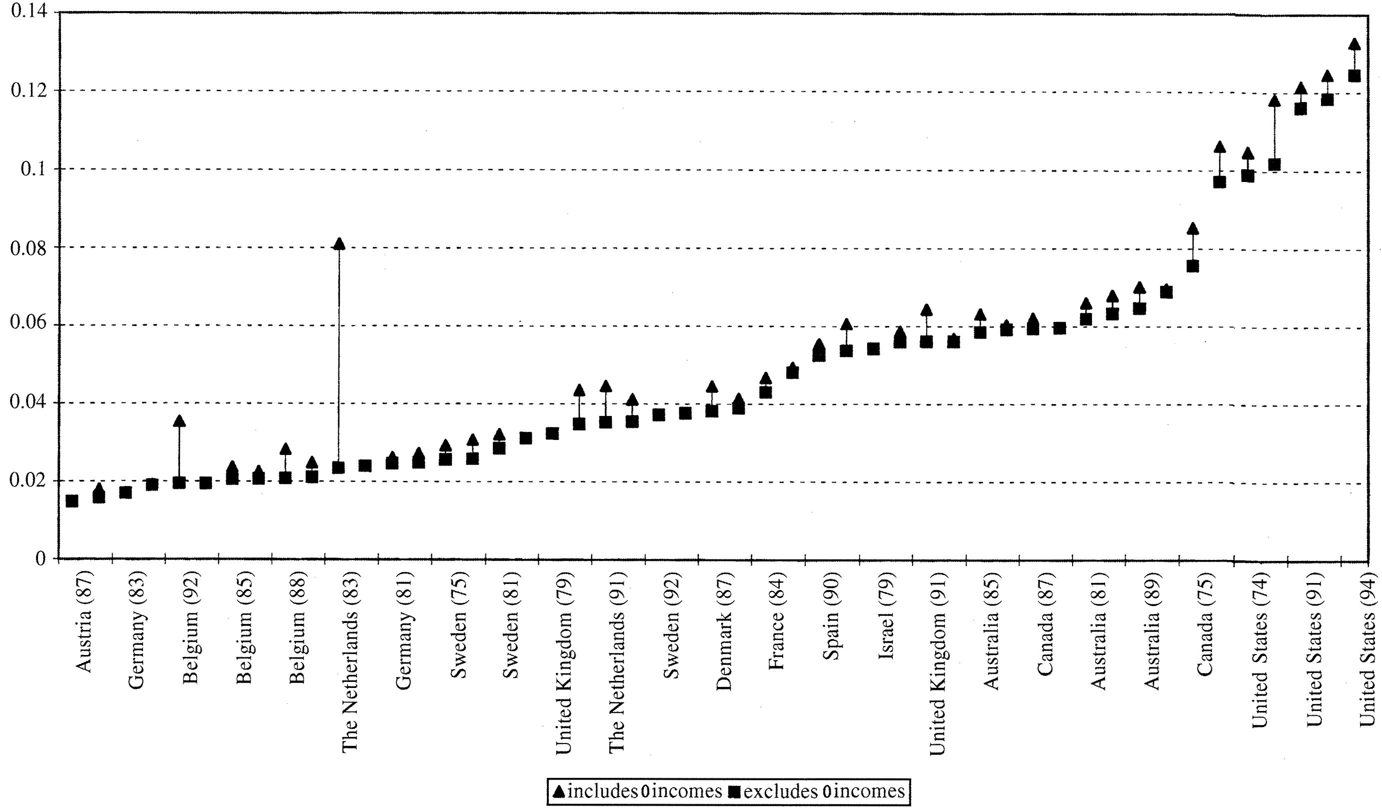

Figure A1
Poverty Intensity
SST Index Excluding and Including Zero Incomes

Source: Luxenbourg Income Study, authors' calculations.

Table A1
LIS Data Sets Analyzed in the Study

Year	Country/Survey
1971	Canada
1974	U.S.A.
1975	Canada, Sweden
1979	France, Israel, Norway, U.K., U.S.A.
1980	Spain
1981	Australia, Canada, France, Germany, Sweden
1982	Switzerland
1983	Germany, Netherlands
1984	France, Germany
1985	Australia, Belgium, Luxemburg
1986	Israel, Italy, Norway, Taiwan, U.K., U.S.A.
1987	Austria, Canada, Denmark, Finland, Ireland, Netherlands, Sweden
1988	Belgium
1989	Australia
1990	Spain
1991	Canada, Finland, Italy, Netherlands, Taiwan, U.K., U.S.A.
1992	Belgium, Denmark, Israel, Sweden
1994	Canada, U.S.A.

where the inclusion or exclusion of zero incomes makes a significant difference in country ranking. For the most part, however, the fraction of respondents with zero income is well below 1 percent (see Table A2, Column 1). Thus, the differences between countries in SST index (reading down columns 5 or 6 of Table A.2) are much larger than the measurement differences created by inclusion/exclusion of zero incomes (reading across columns).

Overall, the Pearson rank correlation of the SST index with/without zero incomes is 0.96. Dropping people with zero incomes will always reduce the measured poverty rate, poverty gap ratio, and inequality among the poor, and the percentage of respondents with zero income is a statistically significant determinant of the SST index—but the effect is not large, particularly if one controls for the two cases noted above. Using OLS regression, we find that 99.6 percent of the dispersion in the SST index calculated without zero incomes can be explained by (coefficient in parentheses, all significant at .0001) the SST index with zero incomes (0.979), a dummy for Netherlands 1983 (−0.0438), a dummy for Belgium 1992 (−0.0083) and the percentage of the population with zero incomes (−0.00579). (Similar results are obtained with the reverse regression.)

In summary, statistical decisions on the treatment of zero incomes in the calculation of the SST index are potentially important in specific cases, but not actually important in most cases. The major utility of an appendix like this is the detection of rogue surveys, and a resultant extra level of caution in discussion of results for the Netherlands (1983) or Belgium (1992).

Table A2
Sensitivity Analysis

Country	Percent of Sample with Zero Incomes	Gini Index			Sen-Shorrocks-Thon Index		
		Include Zero Incomes	Exclude Zero Incomes	Percent Difference	Include Zero Incomes	Exclude Zero Incomes	Percent Difference
Austria (87)	0.000	0.210	0.210	0.000	0.0148	0.0148	0.000
Luxembourg (85)	0.244	0.239	0.238	0.372	0.0180	0.0158	12.542
Germany (83)	0.002	0.260	0.260	0.012	0.0171	0.0170	0.491
Finland (91)	0.009	0.224	0.224	0.013	0.0191	0.0190	0.277
Belgium (92)	1.099	0.227	0.221	2.845	0.0354	0.0195	45.058
Finland (87)	0.000	0.220	0.220	0.000	0.0195	0.0195	0.000
Belgium (85)	0.371	0.232	0.230	0.544	0.0237	0.0206	12.874
Norway (86)	0.121	0.223	0.222	0.314	0.0225	0.0207	7.794
Belgium (88)	0.741	0.238	0.235	1.270	0.0283	0.0208	26.674
Norway (91)	0.173	0.224	0.222	0.683	0.0249	0.0211	15.297
The Netherlands (83)	1.994	0.288	0.266	7.750	0.0810	0.0235	71.040
Germany (84)	0.000	0.253	0.253	0.000	0.0240	0.0240	0.000
Germany (81)	0.210	0.252	0.251	0.219	0.0262	0.0247	5.454
Norway (79)	0.194	0.233	0.232	0.408	0.0273	0.0249	8.809
Sweden (75)	0.088	0.215	0.214	0.687	0.0293	0.0257	12.294
The Netherlands (87)	0.510	0.264	0.262	0.736	0.0308	0.0259	15.984
Sweden (81)	0.344	0.195	0.194	0.758	0.0322	0.0286	10.997
Taiwan (86)	0.000	0.318	0.318	0.000	0.0312	0.0312	0.000
United Kingdom (79)	0.015	0.264	0.264	0.015	0.0325	0.0324	0.326
Switzerland (82)	2.149	0.329	0.326	0.951	0.0436	0.0349	19.963
The Netherlands (91)	0.689	0.275	0.272	1.300	0.0446	0.0353	20.894
Denmark (92)	0.513	0.226	0.224	1.031	0.0412	0.0355	13.775
Sweden (92)	0.008	0.222	0.222	0.050	0.0374	0.0372	0.693

Table A2 (*continued*)

Country	Percent of Sample with Zero Incomes	Gini Index			Sen-Shorrocks-Thon Index		
		Include Zero Incomes	Exclude Zero Incomes	Percent Difference	Include Zero Incomes	Exclude Zero Incomes	Percent Difference
Taiwan (91)	0.000	0.309	0.309	0.000	0.0377	0.0377	0.000
Denmark (87)	0.644	0.246	0.243	1.038	0.0446	0.0382	14.275
Sweden (87)	0.148	0.212	0.211	0.463	0.0414	0.0390	5.687
France (84)	0.293	0.299	0.298	0.465	0.0468	0.0431	7.838
France (79)	0.109	0.305	0.304	0.154	0.0494	0.0482	2.415
Spain (90)	0.251	0.308	0.307	0.364	0.0555	0.0526	5.282
Canada (94)	0.259	0.289	0.287	0.851	0.0607	0.0538	11.289
Israel (79)	0.000	0.332	0.332	0.000	0.0543	0.0543	0.000
Canada (91)	0.231	0.286	0.285	0.385	0.0588	0.0561	4.653
United Kingdom (91)	0.368	0.340	0.338	0.861	0.0644	0.0562	12.718
Italy (86)	0.025	0.310	0.310	0.077	0.0569	0.0562	1.160
Australia (85)	0.452	0.298	0.296	0.604	0.0632	0.0586	7.328
Israel (86)	0.060	0.333	0.333	0.093	0.0604	0.0593	1.922
Canada (87)	0.193	0.291	0.290	0.357	0.622	0.0595	4.291
France (81)	0.000	0.305	0.305	0.000	0.0597	0.0597	0.000
Australia (81)	0.482	0.287	0.286	0.561	0.0661	0.0620	6.160
Canada (81)	0.430	0.292	0.290	0.633	0.0680	0.0634	6.729
Australia (89)	0.533	0.309	0.306	0.684	0.0702	0.0648	7.675
Spain (80)	0.229	0.327	0.326	0.244	0.0696	0.0690	0.947
Canada (75)	1.041	0.300	0.296	1.277	0.0853	0.0757	11.212
United States (79)	0.755	0.315	0.311	1.171	0.1062	0.0972	8.495
United States (74)	0.684	0.327	0.325	0.719	0.1048	0.0990	5.547
Canada (71)	2.153	0.336	0.330	1.942	0.1183	0.1020	13.728
United States (91)	0.693	0.350	0.348	0.643	0.1215	0.1162	4.360
United States (86)	0.677	0.346	0.343	0.717	0.1246	0.1185	4.941
United States (94)	0.936	0.375	0.371	0.860	0.1328	0.1246	6.169

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