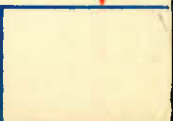
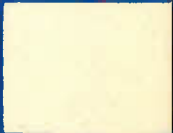
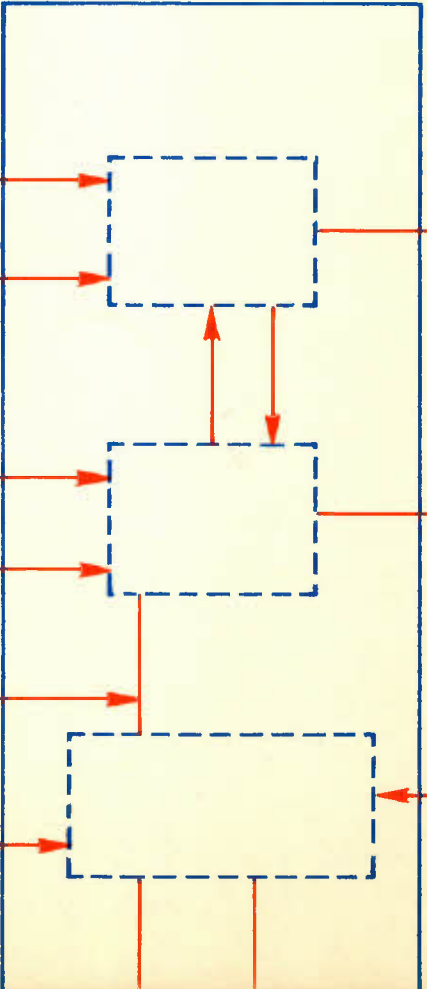
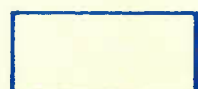
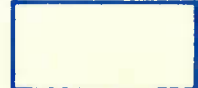
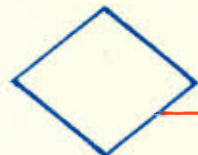
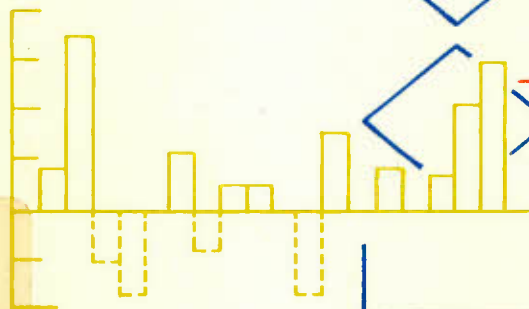




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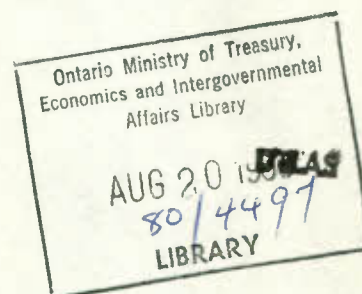
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DISCUSSION PAPER NO. 118

Structural Changes and the Distribution  
of Canadian Family Incomes, 1965-1975

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## RÉSUMÉ

Le présent document examine les effets qu'ont eu les modifications de certains facteurs socio-économiques et démographiques sur l'évolution des inégalités dans la répartition de l'ensemble des revenus au Canada, au cours de la période 1965-1975. La méthode consiste à normaliser, à partir d'une année de base, la répartition de la population des unités familiales suivant ces facteurs, tout en laissant inchangée la distribution des revenus selon leur taille dans chacune des sous-populations ainsi définies. Trois différents coefficients synthétiques sont utilisés pour mesurer les répartitions normalisées et non normalisées du revenu selon la taille.

La cohérence des résultats obtenus par ces trois mesures indique que chacune d'elles représente bien le profil d'évolution de l'inégalité des revenus. Les résultats montrent qu'après correction de certaines variations structurelles dans la population des unités familiales, le degré d'inégalité des revenus qui existe au Canada depuis 1965 a été généralement stable, sauf en 1971. Les principaux facteurs structurels qui ont influé sur les changements dans la répartition du revenu total depuis 1965 ont été, non pas l'âge et le degré d'instruction des chefs de famille, mais bien la taille des familles et le nombre de salariés dans la famille.\*

\* Les auteurs remercient M. Norman Leckie de l'aide qu'il leur a apportée dans l'utilisation de l'ordinateur, ainsi que Mlle Jocelyne Parisien qui a dactylographié ce document.

## ABSTRACT

This document examines the effects that changes in certain socio-economic and demographic factors have had on the evolution of the inequality of distribution of Canadian total incomes over the period 1965-1975. This is done by standardizing to a base year the distribution of the population of family units according to these factors, while leaving the size distribution of incomes within narrowly-defined sub-populations unchanged. Three different summary statistics are employed to measure the standardized and unstandardized size distributions of income.

The consistency of the results shown by the three summary statistics suggests that any one of them provides an adequate representation of the evolving pattern of income inequality. These results indicate that the level of income inequality experienced in Canada since 1965 has generally been stable, apart from 1971, once adjustments are made for certain structural changes in the population of family units. The principal structural factors affecting changes in the distribution of total income since 1965 have been family size and number of earners in family units, rather than the age and education of family heads.\*

\* The authors wish to thank Norman Leckie for his assistance on the computer, and Jocelyne Parisien for typing this document.

## Introduction

A persistent problem has affected all attempts to explore intertemporal changes in the size distributions of incomes. This problem is the instability of important socio-economic and demographic characteristics of the basic populations of recipient units. It arises whether these recipient populations are defined in terms of individuals or of families and, although its significance has been widely recognized for more than a quarter century, progress in the development of adequate methods for its alleviation has been slow. Thus interpretation of many of our existing summary statistics for changes in the size distributions of incomes remains difficult. Indeed our present concerns and techniques for use with incomes data do not seem to differ much from those cited by Dorothy Brady in 1951 during her presentation to the Conference on Research in Income and Wealth.<sup>1</sup>

The present techniques may be conveniently grouped into three broad types. For those of the first type, data are assigned to particular sub-populations identified by values of socio-economic and demographic characteristics such as family size, age of individuals or of family heads, education, number of male and female earners, sex, occupation, and experience of unemployment. Comparisons are then made of the differing experiences for members of the distinct sub-populations. An early example of this type of approach is provided by Janet Fisher (1952) who gives special attention to age categories for U.S. data. In a Canadian context, Jenny Podoluk (1968) uses 1961 Census information

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1 See especially Brady's comments on pages 9 to 12 inclusive.

to analyse the distribution of both earnings and incomes for many alternative classified sub-populations. More recently, Henderson and Rowley (1977, 1978) illustrate the feasibility and consequences of using sub-classes from the Canadian Surveys of Consumer Finances.

The second type of techniques attempt to convert recipient units to common equivalent bases, usually by scale adjustments determined from information concerning socio-economic or demographic characteristics. This type has been extensively discussed by William Vickrey (1947) and many subsequent contributors. Recent illustrations of scaling for family size disparities are provided by Barry Bressler (1974) and Simon Kuznets (1976, Section III). The choice of scales is often affected by the availability of secondary data. For example, expenditure patterns from consumption behaviour or from nutritional standards are commonly pooled with income data to obtain equivalents.

The final type, the one addressed in this paper, involves standardization of population frequency distributions for significant compositional changes that have occurred during the period spanned by available data. Complete standardization is an ideal but is generally infeasible due to our ignorance of many underlying adjustment processes as recipient units modify both their behaviour and composition in the light of changed economic circumstances. Computational complexities and costs are also important factors in the non-attainment of this ideal. A partial approach to standardization of incomes data is illustrated below.

It is based on data linking incomes of Canadian families with many of their compositional characteristics for the years 1965, 1967, 1969, 1971, 1973 and 1975.<sup>2</sup> With 1973 as a basic reference year, the data for the years are amended to approximate the composition of Canadian family units in this base year.<sup>3</sup> This adjustment is fully described in Appendix A. It alters the distribution of the recipient population as determined by alternative sets of socio-economic and demographic criteria while leaving the size distribution of incomes within narrowly-defined sub-populations unchanged. The adjustment is thus incomplete. It only makes allowance for direct impacts of compositional shifts and it ignores the secondary impacts of these shifts, which may have important effects especially in labour markets. The primary advantages of the partial standardizations are their simplicity, relatively low cost, and ease of application to existing medium-sized bodies of repetitive data.

In the sections that follow, an account is provided of some of the structural shifts experienced by Canadian families in the decade after 1965, summary statistics for size distributions standardized for these shifts are presented, and some

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2 The nature and coverage of these data are given in Statistics Canada (1977a, b).

3 A family unit refers here to both economic families and unattached individuals, i.e., in the case of families, persons sharing a common dwelling unit and related by blood, marriage or adoption. We use the term "family" in this sense throughout this document. Our income concept is pre-tax money income from all sources going to the family unit.

conclusions are offered concerning the relative impacts of structural factors and other factors on the evolving distribution of income since 1965. Additional empirical information is collected in the remaining appendices.

### Structural Shifts in Family Composition

No standardization is required if the shifts in structure that have affected families are small in magnitude. Clearly the dimensions of structural changes should be determined before data are adjusted. It seems a reasonable preliminary to ask whether significant changes could occur within a decade. In Tables 1 to 4 inclusive, some relevant information is presented for family size, age of family heads, education of family heads and number of earners per family. Longer-term perspectives based on Canadian Census data are provided by Roderic Beaujot (1977) and by Keith Horner and Neil MacLeod (1975, Section VI).<sup>4</sup>

Table 1 records the distribution of family units by family size at two-year intervals since 1965. There occurred a very substantial growth in single-person families from 20.7 per cent of the units in 1965 to 29.0 per cent in 1975. Much of this growth is concentrated at the beginning and end of this period. Families with two persons also increased proportionately since 1965 though at a lesser rate. Substantial declines are apparent in the relative occurrence of large families so that the decade witnessed

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4 In Henderson and Rowley (1977, Appendix D), we present a more comprehensive account of changes to 1973. These tables have now been extended to include 1975 and are available from the authors.

a significant reduction in family size that may be expected to increase popular summary measures of income inequality (especially in view of the concomitant increase in the number of female headed families).

Table 1  
DISTRIBUTION OF FAMILY UNITS, BY SIZE OF FAMILY UNIT,  
CANADA, 1965-1975  
(Per cent)

Size	1965	1967	1969	1971	1973	1975
1	20.7	24.9	25.1	25.3	26.7	28.0
2	21.6	20.8	22.2	22.5	23.5	24.7
3	14.7	14.3	14.7	15.5	14.8	14.5
4	16.1	15.3	15.3	15.6	16.0	16.6
5	12.2	10.8	10.6	10.2	9.8	9.2
6 or more	14.8	13.8	12.1	10.9	9.1	6.9

Source: Surveys of Consumer Finances, Statistics Canada.

Smaller, but nonetheless significant, changes are revealed in Table 2, which records the distribution of family units by age of head since 1965. That these changes are smaller is to be expected since age adjustments have tended to be far slower than those associated with family size. The most noticeable changes with respect to age are the growth in the relative proportion of families with young heads (aged less than 35 years) and the decline of the proportion of families with heads aged between 35 and 54 years. The figures reported in this table suggest a steady "greening" of family heads which, when associated with received notions of life-cycle patterns of earnings, again may be associated with moderate increases in

summary measures of income inequality. Standardization for age, as for family size, would, therefore, be expected to separately reduce changes in these statistics, with age adjustments somewhat less pronounced than those for family size. Since changes in family size and age of family heads are clearly not independent, the joint effect of both shifts will not be the simple sum of separate effects although the direction of change in standardized data may be expected to be the same.

Table 2  
DISTRIBUTION OF FAMILY UNITS, BY AGE OF HEAD,  
CANADA, 1965-1975  
(Per cent)

Age	1965	1967	1969	1971	1973	1975
Less than 25	7.8	9.5	9.3	10.7	10.5	10.9
25-34	19.2	19.3	20.6	21.2	22.0	24.0
35-44	22.4	20.9	20.3	19.6	18.6	18.0
45-54	20.8	18.5	17.9	18.3	17.4	16.4
55-64	14.5	15.0	14.6	14.6	14.5	13.7
65 or more	15.3	16.9	17.3	15.7	16.9	17.0

Source: Surveys of Consumer Finances, Statistics Canada.

The remaining two tables only contain information concerning developments since 1967 as the samples associated with the Surveys of Consumer Finances, our primary source, do not provide appropriate consistent data for 1965. Table 3 reveals the distribution of family heads by the level of educational attainment of their heads. There occurred a substantial increase in the average level of attainment. By 1975, over 30 per cent of heads had at least some university or post-secondary education,

almost double the proportion for 1969 which, in turn, substantially exceeded the figure for 1967. The proportion of heads with only elementary education persistently fell throughout the period. The impact of these shifts is unclear since their magnitude has markedly affected the extent of differentials associated with education. There are a number of factors here. For an individual, a higher level of educational attainment is usually associated with a higher income. This educational income differential will, however, depend upon the number of other individuals who similarly raise their educational attainments, and upon the expansion of demand for workers with such attainments. Insufficient growth in demand or excessive growth in supply will reduce the direct income benefits of increased education for individuals. The overall impact of such developments on income inequality will also depend upon the extent to which education raises the average level of income rather than affecting income differences.

Table 3  
DISTRIBUTION OF FAMILY UNITS, BY EDUCATION OF HEAD,  
CANADA, 1967-1975  
(Per cent)

	1967	1969	1971	1973	1975
Elementary	41.3	37.4	34.6	32.6	30.8
Some Secondary	27.4	27.1	27.3	27.8	24.1
Complete Secondary	18.5	19.4	16.3	16.1	14.4
Some University or Post Secondary	5.9	7.2	14.0	15.7	20.1
University Degree	6.9	8.9	7.8	7.8	10.6

Source: Surveys of Consumer Finances, Statistics Canada.

Table 4 indicates the distribution of family units that have at least one earner working part of the year by the number of earners in the family. Its entries should be considered by reference to the changes in family size that were noted in Table 1. Thus the number of earners per family has risen markedly (essentially a relative shift from one-earner to two-earner families) while average family size has fallen. Hence the role of employment income in determining total family income has undergone substantial change. The table cannot reveal the full dimension of this change since the degree of inequality is also dependent upon characteristics not cited there. For example, inequality will depend upon the extent to which single-earner families have female heads and upon the extent to which additional earners have non-marginal contact with the labour market. There is an obvious case for standardization by reference to the number of male earners, the number of female earners and, also, to the number of earners working at least 20 weeks.<sup>5</sup> Unfortunately, our partial attempt at standardization cannot fully take account of the circular causal influences whereby not only does the number of earners affect the distribution of family incomes but also income inadequacies or insufficiencies lead to an enlarged labour force.

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5 The detailed results of such standardizations are presented in Appendix B.

Table 4

DISTRIBUTION OF FAMILY UNITS WITH AT LEAST ONE EARNER  
WORKING PART OF THE YEAR, BY NUMBER OF EARNERS,  
CANADA, 1967-1975  
(Per cent)

Earners	1967	1969	1971	1973	1975
1	60.4	57.3	56.6	54.1	53.1
2	29.4	31.7	32.4	33.3	35.3
3	7.3	7.5	7.5	8.5	7.8
4 or more	2.9	3.6	3.5	4.1	3.9

Source: Surveys of Consumer Finances, Statistics  
Canada.

#### Standardization for Structural Change

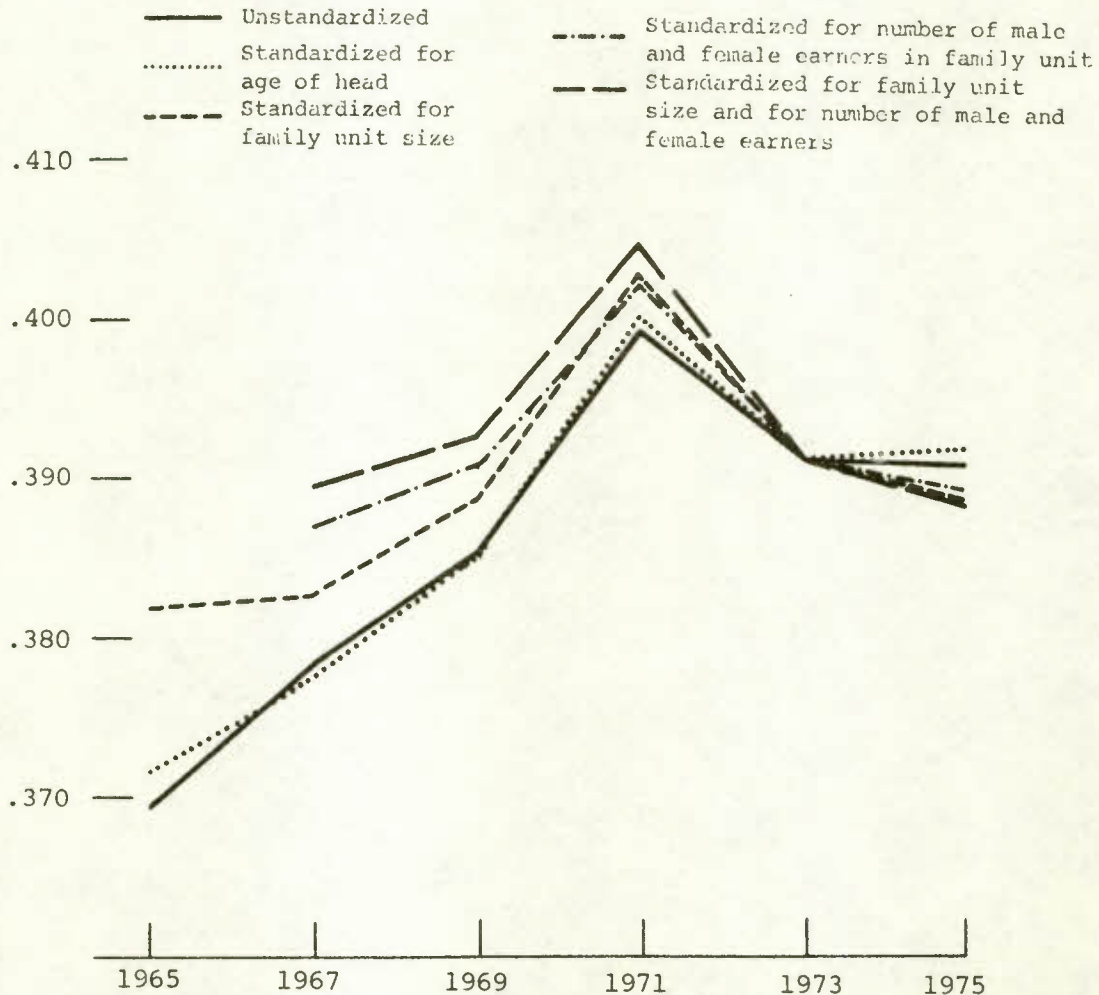
The size distribution of incomes is usually summarized by one of a number of popular statistics. The Gini coefficient is perhaps the most common of these but some researchers have chosen to cite alternatives such as the Theil-Bernoulli index or the coefficient of variation. All three statistics are measures of income spread or inequality. Values for the Gini index of Canadian incomes, based on unadjusted data, rise from .3696 in 1965 to .3994 in 1971 before declining to .3909 in 1975. These values indicate a substantial increase in income inequality between 1965 and 1971 followed by a moderate decrease thereafter with inequality remaining markedly higher in 1975 than in 1965, 1967 (.3784), and 1969 (.3853). A similar pattern of development is also indicated by values of the two alternative statistics.<sup>6</sup> Clearly, an important issue for public policy in this area is the relative magnitude of changes in income distribution due to structural factors (such as those cited above) and those due to other factors over which governments might have greater control.

<sup>6</sup> See Appendix C.

Recalculation of the summary statistics using data standardized for changes in structural factors may help to clarify such magnitudes even though the process of standardization is necessarily incomplete.

Chart 1

GINI COEFFICIENTS -- UNSTANDARDIZED AND  
STANDARDIZED TO 1973 FOR CERTAIN STRUCTURAL  
CHANGES IN THE CANADIAN POPULATION,  
1965-1975

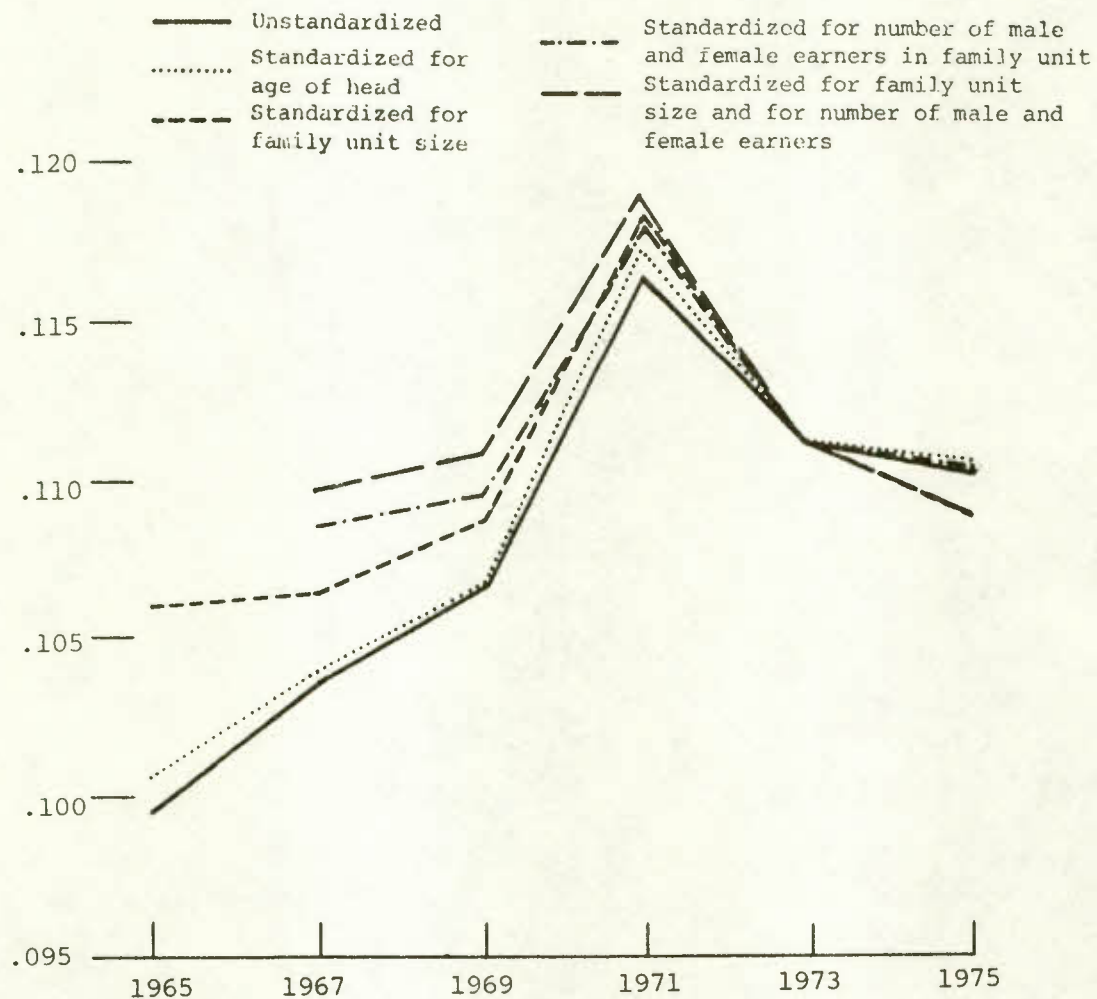


Source: Surveys of Consumer Finances, Statistics Canada, and estimates by the authors.

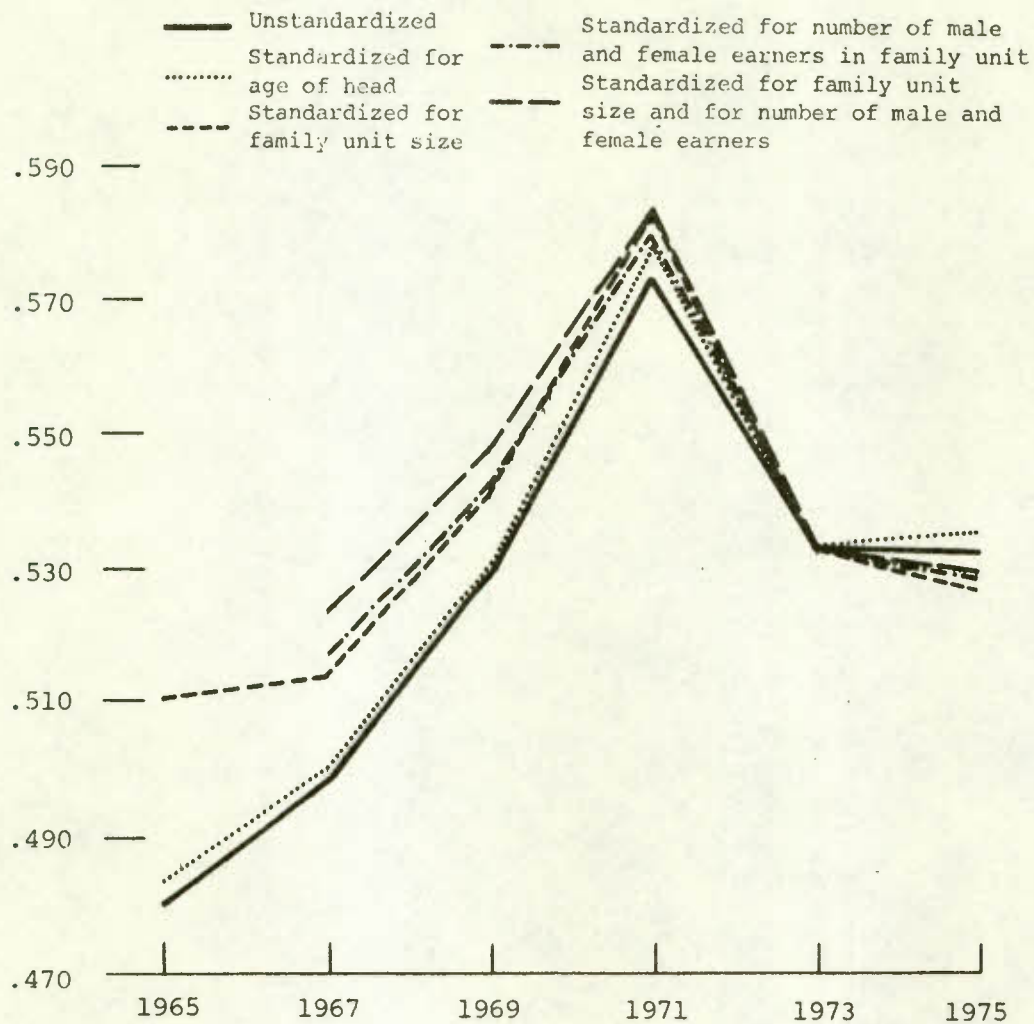
Chart 2

ALTERNATIVE COEFFICIENTS -- UNSTANDARDIZED AND  
STANDARDIZED TO 1973 FOR CERTAIN STRUCTURAL  
CHANGES IN THE CANADIAN POPULATION  
1965-1975

(A) Theil-Bernoulli Index



(B) Coefficient of Variation



Source: Surveys of Consumer Finances, Statistics Canada, and estimates by the authors.

Chart 1 reveals the evolution of the Gini coefficients that are associated with four particular standardizations of the basic data -- these data being provided by the Surveys of Consumer Finances. An adjustment for age apparently has little impact on the Gini coefficient. The standardization for age only reduces the drift to greater inequality between 1965 and 1971 by about 2 per cent.

More substantial amendments to Gini coefficients occur with standardizations for family size and for number of earners in family units. With respect to family size, the 1965-1971 drift toward inequality is reduced by about a third when only changes in family size are considered and by about a quarter when both these changes and those in age of head are acknowledged.<sup>7</sup> Relative to the standardization for family size, even more of this drift is eliminated when data are standardized for changes in the number of male earners and in the number of female earners. The sharp increase in income inequality revealed by unadjusted data for 1971 persists but, after these standardizations, the size distribution of incomes is relatively stable across other years.

Graphs for the evolution of the Theil-Bernoulli index and of the coefficient of variation are presented in the two sections of Chart 2. When standardized data are used, these alternative statistics provide similar results to those indicated for the Gini coefficient. More complete evidence is collected in Appendices B and C. Gini coefficients and deciles for many sets

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<sup>7</sup> See Appendix B for the results of the standardization for both family size and age of head.

of standardized data are given in Appendix B. Criteria used to determine the standardizations include family size, age of head, sex of head, number of male earners, number of female earners and education of head. Appendix C tabulates the values of the alternative statistics for which graphs are given in Chart 2.

### Concluding Comments

At least four conclusions may be derived from these uses of standardized data for assessing the size distribution of incomes. First, the consistency revealed by the graphs for the three summary statistics suggests that any one of them provides an adequate representation of the evolving pattern of income inequality. Second, the level of income inequality experienced in Canada since 1965 has generally been stable, apart from 1971, once adjustments are made for structural changes in the population of recipient units. Third, the principal structural factors affecting changes in the distribution of total income since 1965 have been family size and number of earners in family units rather than the age and education of family heads.<sup>8</sup> Finally, there is an urgent need to explore non-structural sources of the additional inequality that was experienced in 1971. Standardization for changes in the socio-economic and demographic characteristics of the Canadian population reduces the measured shift to inequality during the period 1967-1971 by about 30 per

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8 See Appendix B for a verification of the conclusion with respect to the standardization for the education of family heads.

cent but the measured level of inequality experienced in 1971 after this standardization remains markedly above the levels found in other years during the decade.

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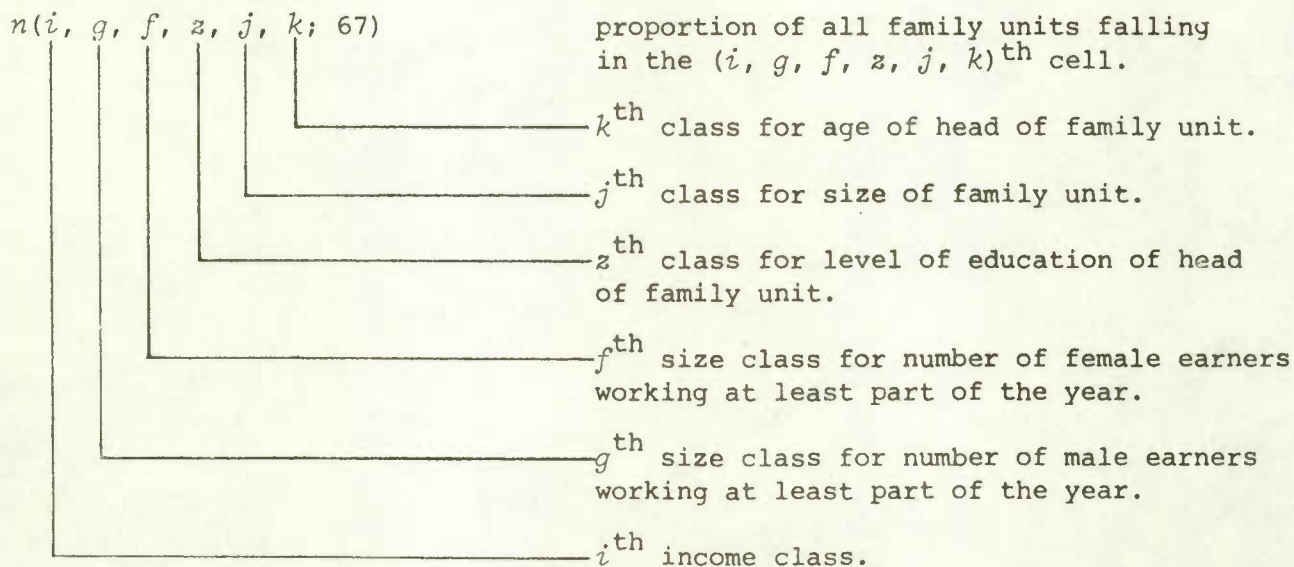
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# APPENDIX A

## EXAMPLE OF THE PROCEDURE EMPLOYED IN THE STANDARDIZATION OF INCOME DISTRIBUTION FOR CHANGES IN SOCIO-DEMOGRAPHIC STRUCTURE

### Notation

The data for each year under study are arranged and classified according to the number of individuals in economic family units (identifying index  $j = 1, 2, \dots, 6$ ), ages of the heads of these units (index  $k = 1, 2, \dots, 6$ ), the total income class to which these units belong (index  $i = 0, 1, 2, \dots, 36$ ), the number of male earners in the family unit who work part of the year or more (index  $g = 0, 1, 2, 3$ ), the number of female earners in the family unit who work part of the year or more (index  $f = 0, 1, 2, 3$ ), and the educational level of the head of the family unit (index  $z = 1, 2, 3, 4, 5$ ). The following notation can be used for the data for 1967 (clearly a similar notation for the years 1965, 1969, 1971, 1973, and 1975 can be employed:



$N(i, g, f, z, j, k; 67)$

number of family units falling in the  $(i, g, f, z, j, k)^{th}$  cell.

$Y(i, g, f, z, j, k; 67)$

total combined income of those family units falling in the  $(i, g, f, z, j, k)^{th}$  cell.

$y(i, g, f, z, j, k; 67)$

total combined income of those family units falling in the  $(i, g, f, z, j, k)^{th}$  cell as a proportion of the total combined income for all family units.

The following are the specifications for the identifying indexes:

(a) Number of individuals in the family units ( $j$ )

<u>Identifying index</u>	<u>Number of individuals in family units</u>
1	1
2	2
3	3
4	4
5	5
6	6 or more

(b) Age of head of family units ( $k$ )

<u>Identifying index</u>	<u>Age of head of family units</u>
1	<25
2	25-34
3	35-44
4	45-54
5	55-64
6	≥65

(c) Income class ( $i$ )<sup>1</sup>

<u>Identifying index</u>	<u>Income class (\$)</u>	<u>Identifying index</u>	<u>Income class (\$)</u>	<u>Identifying index</u>	<u>Income class (\$)</u>
0	<0	13	6000-6499	25	14000-14999
1	0-499	14	6500-6999	26	15000-15999
2	500-999	15	7000-7499	27	16000-16999
3	1000-1499	16	7500-7999	28	17000-17999
4	1500-1999	17	8000-8499	29	18000-18999
5	2000-2499	18	8500-8999	30	19000-19999
6	2500-2999	19	9000-9499	31	20000-20999
7	3000-3499	20	9500-9999	32	21000-21999
8	3500-3999	21	10000-10999	33	22000-22999
9	4000-4499	22	11000-11999	34	23000-23999
10	4500-4999	23	12000-12999	35	24000-24999
11	5000-5499	24	13000-13999	36	≥25000
12	5500-5999				

1 For 1975, it was necessary to break the 36<sup>th</sup> category into a total of six income classes in order to avoid too much "bunching" of families in the highest income category: 25000-26999, 27000-30999, 31000-32999, 33000-34999, and ≥ 35000.

(d) Number of male earners in family unit (g)

<u>Identifying index</u>	<u>Number of male earners in family unit</u>
0	0
1	1
2	2
3	3 or more

(e) Number of female earners in family unit (f)

<u>Identifying index</u>	<u>Number of female earners in family unit</u>
0	0
1	1
2	2
3	3 or more

(f) Education level of head of family unit (z)

<u>Identifying index</u>	<u>Educational level of head</u>
1	Elementary schooling or less
2	Some secondary school
3	Secondary school completed
4	Some university or postsecondary non-university training
5	University degree

An asterisk is used to denote summation over all the categories of an identification index. For example,

$$n(*, g, f, z, j, k; 67) = \sum_{i=0}^{36} n(i, g, f, z, j, k; 67),$$

$$n(i, g, f, z, *, k; 67) = \sum_{j=1}^6 n(i, g, f, z, j, k; 67),$$

$$n(i, *, *, *, *, *, 67) = \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 n(i, g, f, z, j, k; 67),$$

$$N(*, *, *, *, *, *, 67) = \sum_{i=0}^{36} \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 N(i, g, f, z, j, k; 67)$$

= N(67), where N(67) is the total number of family units in 1967,

$$\text{and } Y(*, *, *, *, *, *, 67) = \sum_{i=0}^{36} \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 Y(i, g, f, z, j, k; 67)$$

=  $Y(67)$ , where  $Y(67)$  is the total combined income of all family units in 1967.

### Standardization Procedure

The extent to which the distribution of total income across all family units was affected over time by certain socio-demographic shifts in the structure of the population was taken into account by employing the following "standardization" procedure. In the example of this procedure described below (two equivalent alternative procedures are also noted) the effects of structural shifts in five particular characteristics of family units were considered; the characteristics considered were the size of the family unit, the age of the head of the family unit, the number of male earners in the family unit working at least part of the year, the number of female earners in the family unit working at least part of the year, and the level of education of the head of the family unit. In the process of standardization, a base year is selected (1973 in the example described below), and the population in each of the other years is modified so that it is proportionately identical to that of the base year with respect to the characteristics under consideration. From the revised distributions of the proportion of family units and the proportion of total income by income class, new "standardized" Gini coefficients are calculated for non-base years. In more detail, the procedure is as follows:

- (i) The expression  $n(i, g, f, z, j, k; 67) \cdot \frac{n(*, g, f, z, j, k; 73)}{n(*, g, f, z, j, k; 67)}$  is calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $n_{gfzjk}(i, g, f, z, j, k; 67:73)$ . It can be shown that  $n_{gfzjk}(*, g, f, z, j, k; 67:73) = n(*, g, f, z, j, k; 73)$ .

- (ii) The expression  $Y(i, g, f, z, j, k; 67) \cdot \frac{n(*, g, f, z, j, k; 73)}{n(*, g, f, z, j, k; 67)}$  is calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $Y_{gfzjk}(i, g, f, z, j, k; 67:73)$ .
- (iii) The expression  $y_{gfzjk}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}(i, g, f, z, j, k; 67:73) / Y_{gfzjk}(67:73)$  is then calculated for all  $i, g, f, z, j, k$ , where  $Y_{gfzjk}(67:73) = \sum_{i=0}^{36} \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 Y_{gfzjk}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}(*, *, *, *, *, *, 67:73)$ .
- (iv) The values of the expressions  $n_{gfzjk}(i, *, *, *, *, *, 67:73)$  and  $y_{gfzjk}(i, *, *, *, *, *, 67:73)$  are determined and used to calculate an adjusted Gini coefficient for 1967. The four steps (i), (ii), (iii) and (iv) are then repeated using the data for 1969, 1971, and 1975 in place of those for 1967.<sup>1</sup>

Two alternative procedures to the one noted above, each of which gives identical results, are noted below.

#### Alternative A

- (i) The expression  $N(i, g, f, z, j, k; 67) \cdot \frac{N(*, g, f, z, j, k; 73)}{N(*, g, f, z, j, k; 67)}$  is calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $N_{gfzjk}(i, g, f, z, j, k; 67:73)$ . It can be shown that  $N_{gfzjk}(*, g, f, z, j, k; 67:73) = N(*, g, f, z, j, k; 73)$ .
- (ii) The expression  $n_{gfzjk}(i, g, f, z, j, k; 67:73) = N_{gfzjk}(i, g, f, z, j, k; 67:73) / N(73)$  is calculated for all  $i, g, f, z, j, k$ .
- (iii) The expression  $Y(i, g, f, z, j, k; 67) \cdot \frac{n(*, g, f, z, j, k; 73)}{n(*, g, f, z, j, k; 67)}$  is then calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $Y_{gfzjk}(i, g, f, z, j, k; 67:73)$ .

<sup>1</sup> In this standardization and the following alternatives, 37 income classes are employed (0 to 36) for all the years except 1975. For 1975, 42 income classes are employed (0 to 41).

- (iv) The expression  $y_{gfzjk}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}(i, g, f, z, j, k; 67:73) / Y_{gfzjk}(67:73)$  is then calculated for all  $i, g, f, z, j, k$ , where  $Y_{gfzjk}(67:73) = \sum_{i=0}^{36} \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 Y_{gfzjk}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}(*, *, *, *, *, *, 67:73)$ .
- (v) The values of the expressions  $n_{gfzjk}(i, *, *, *, *, *, 67:73)$  and  $y_{gfzjk}(i, *, *, *, *, *, 67:73)$  are determined and used to calculate an adjusted Gini coefficient for 1967. The five steps (i), (ii), (iii), (iv) and (v) are then repeated using the data for 1969, 1971, and 1975 in place of those for 1967.

#### Alternative B

- (i) The expression  $N(i, g, f, z, j, k; 67) \cdot \frac{N(*, g, f, z, j, k; 73)}{N(*, g, f, z, j, k; 67)}$  is calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $N_{gfzjk}(i, g, f, z, j, k; 67:73)$ . It can be shown that  $N_{gfzjk}(*, g, f, z, j, k; 67:73) = N(*, g, f, z, j, k; 73)$ .
- (ii) The expression  $n_{gfzjk}(i, g, f, z, j, k; 67:73) = N_{gfzjk}(i, g, f, z, j, k; 67:73) / N(73)$  is calculated for all  $i, g, f, z, j, k$ .
- (iii) The expression  $Y(i, g, f, z, j, k; 67) \cdot \frac{N(*, g, f, z, j, k; 73)}{N(*, g, f, z, j, k; 67)}$  is then calculated for all  $i, g, f, z, j, k$ . The outcomes of these calculations are denoted by  $Y_{gfzjk}^{\alpha}(i, g, f, z, j, k; 67:73)$ .
- (iv) The expression  $y_{gfzjk}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}^{\alpha}(i, g, f, z, j, k; 67:73) / Y_{gfzjk}^{\alpha}(67:73)$  is then calculated for all  $i, g, f, z, j, k$ , where  $Y_{gfzjk}^{\alpha}(67:73) = \sum_{i=0}^{36} \sum_{g=0}^3 \sum_{f=0}^3 \sum_{z=1}^5 \sum_{j=1}^6 \sum_{k=1}^6 Y_{gfzjk}^{\alpha}(i, g, f, z, j, k; 67:73) = Y_{gfzjk}^{\alpha}(*, *, *, *, *, *, 67:73)$ . It can be shown that  $Y_{gfzjk}^{\alpha}(i, g, f, z, j, k; 67:73) = N(67) = Y_{gfzjk}(i, g, f, z, j, k; 67:73) \cdot N(73)$ , and  $Y_{gfzjk}^{\alpha}(67:73) \cdot N(67) = Y_{gfzjk}(67:73) \cdot N(73)$ .

- (v) The values of the expressions  $n_{gfzjk}(i, *, *, *, *, *, *; 67:73)$  and  $y_{gfzjk}(i, *, *, *, *, *, *; 67:73)$  are determined and used to calculate an adjusted Gini coefficient for 1967. The five steps (i), (ii), (iii), (iv) and (v) are then repeated using the data for 1969, 1971, and 1975 in place of those for 1967.

APPENDIX B

Table B-1

GINI COEFFICIENTS -- STANDARDIZED TO 1975 FOR  
CERTAIN STRUCTURAL CHANGES IN THE CANADIAN POPULATION,  
1965-1975 -- AND THE CORRESPONDING PROPORTIONS FOR  
TOTAL INCOME GOING TO EACH DECILE OF FAMILY UNITS<sup>1</sup>

Year	Gini Coefficient	Percentage of total income by decile									
		Lowest	2nd	3rd	4th	5th	6th	7th	8th	9th	Highest
1. <u>Unstandardized</u>											
1965	.3696	1.21	3.23	5.08	6.69	8.27	9.68	11.23	13.26	15.99	25.36
1967	.3784	1.12	3.07	4.88	6.57	8.16	9.66	11.32	13.32	16.24	25.66
1969	.3853	1.28	3.00	4.66	6.34	7.98	9.60	11.26	13.29	16.24	26.34
1971	.3994	0.95	2.70	4.38	6.22	7.98	9.66	11.40	13.43	16.34	26.92
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3909	1.16	2.81	4.44	6.17	7.95	9.66	11.49	13.65	16.58	26.07
2. <u>Standardized for family unit size</u>											
1965	.3821	1.13	2.94	4.79	6.45	8.12	9.68	11.32	13.41	16.35	25.81
1967	.3829	1.15	2.93	4.75	6.48	8.08	9.65	11.34	13.39	16.33	25.89
1969	.3887	1.26	2.94	4.56	6.27	7.93	9.58	11.28	13.37	16.32	26.49
1971	.4026	0.94	2.64	4.30	6.15	7.92	9.66	11.44	13.49	16.43	27.04
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3887	1.16	2.85	4.50	6.24	7.98	9.67	11.47	13.61	16.51	26.01
3. <u>Standardized for age of head</u>											
1965	.3718	1.19	3.16	5.01	6.63	8.25	9.71	11.29	13.30	16.11	25.36
1967	.3780	1.11	3.07	4.88	6.58	8.16	9.67	11.33	13.33	16.22	25.67
1969	.3851	1.27	3.01	4.65	6.35	7.98	9.60	11.26	13.31	16.22	26.35
1971	.4009	0.96	2.67	4.33	6.17	7.94	9.66	11.43	13.46	16.38	26.99
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3918	1.15	2.80	4.43	6.16	7.94	9.65	11.48	13.66	16.60	26.14
4. <u>Standardized for family unit size and age of head</u>											
1965	.3800	1.13	2.96	4.83	6.49	8.16	9.70	11.34	13.43	16.32	25.63
1967	.3792	1.10	3.00	4.82	6.55	8.16	9.70	11.38	13.40	16.29	25.59
1969	.3865	1.26	2.96	4.62	6.32	7.97	9.61	11.29	13.36	16.28	26.34
1971	.4029	0.95	2.62	4.28	6.13	7.93	9.67	11.46	13.50	16.43	27.03
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3907	1.16	2.83	4.47	6.20	7.95	9.64	11.45	13.61	16.55	26.15
5. <u>Standardized for family unit size, age of head, and sex of head</u>											
1965	.3825	1.11	2.91	4.78	6.44	8.12	9.70	11.38	13.45	16.38	25.71
1967	.3816	1.08	2.98	4.78	6.49	8.12	9.68	11.37	13.42	16.35	25.72
1969	.3892	1.25	2.93	4.56	6.25	7.92	9.59	11.30	13.38	16.33	26.49
1971	.4049	0.94	2.59	4.24	6.09	7.89	9.66	11.47	13.53	16.48	27.12
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3904	1.16	2.83	4.47	6.20	7.95	9.64	11.45	13.61	16.55	26.13

Table B-1 (cont'd)

Year	Gini Coefficient	Percentage of total income by decile									
		Lowest	2nd	3rd	4th	5th	6th	7th	8th	9th	Highest
6. <u>Standardized for number of male earners<sup>2/3</sup></u>											
1967	.3888	1.59	2.88	4.64	6.36	8.03	9.62	11.35	13.44	16.47	25.64
1969	.3918	1.24	2.90	4.50	6.21	7.89	9.56	11.27	13.37	16.36	26.68
1971	.4046	0.92	2.61	4.27	6.11	7.90	9.64	11.43	13.49	16.46	27.17
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3880	1.17	2.85	4.51	6.25	8.00	9.68	11.47	13.61	16.52	25.94
7. <u>Standardized for number of female earners<sup>2</sup></u>											
1967	.3739	1.14	3.13	4.95	6.63	8.19	9.69	11.34	13.34	16.19	25.39
1969	.3827	1.29	3.04	4.70	6.39	8.01	9.61	11.26	13.29	16.19	26.21
1971	.3966	0.97	2.73	4.44	6.26	8.01	9.68	11.42	13.45	16.32	26.71
1973	.3911	1.02	2.82	4.48	6.23	8.01	9.68	11.49	13.66	16.61	26.04
1975	.3932	1.15	2.78	4.40	6.13	7.92	9.64	11.48	13.67	16.63	26.20
8. <u>Standardized for number of male and number of female earners<sup>2</sup></u>											
1967	.3871	1.04	2.84	4.61	6.38	8.08	9.70	11.45	13.55	16.51	25.83
1969	.3904	1.23	2.89	4.51	6.23	7.93	9.61	11.33	13.42	16.38	26.47
1971	.4022	0.93	2.64	4.31	6.15	7.94	9.66	11.45	13.49	16.44	26.99
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3888	1.17	2.86	4.51	6.23	7.97	9.64	11.44	13.59	16.53	26.05
9. <u>Standardized for family unit size and number of male earners<sup>2</sup></u>											
1967	.3889	1.06	2.88	4.62	6.34	8.02	9.61	11.35	13.46	16.50	26.15
1969	.3928	1.23	2.87	4.48	6.19	7.88	9.56	11.46	13.52	16.42	26.40
1971	.4051	0.92	2.59	4.24	6.09	7.89	9.65	11.45	13.52	16.50	27.15
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3883	1.16	2.85	4.51	6.26	8.00	9.68	11.47	13.60	16.49	26.00
10. <u>Standardized for family unit size and number of female earners<sup>2</sup></u>											
1967	.3814	1.09	2.96	4.75	6.49	8.13	9.69	11.41	13.47	16.39	25.63
1969	.3876	1.26	2.94	4.58	6.29	7.95	9.60	11.30	13.39	16.34	26.35
1971	.4012	0.94	2.64	4.32	6.17	7.96	9.68	11.46	13.50	16.43	26.90
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3899	1.17	2.86	4.48	6.20	7.95	9.64	11.44	13.60	16.53	26.13
11. <u>Standardized for family unit size and number of male and number of female earners<sup>2</sup></u>											
1967	.3895	1.04	2.80	4.56	6.32	8.04	9.67	11.45	13.58	16.59	25.93
1969	.3928	1.21	2.83	4.46	6.19	7.89	9.59	11.34	13.47	16.48	26.53
1971	.4040	0.92	2.58	4.26	6.12	7.92	9.67	11.47	13.52	16.50	27.03
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3886	1.17	2.87	4.52	6.25	7.97	9.64	11.43	13.57	16.49	26.09

Table B-1 (cont'd)

Year	Gini Coefficient	Percentage of total income by decile									
		Lowest	2nd	3rd	4th	5th	6th	7th	8th	9th	Highest
12. <u>Standardized for number of male earners working 20 weeks or more<sup>2</sup></u>											
1967	.3890	1.05	2.88	4.63	6.35	8.02	9.61	11.34	13.44	16.47	26.20
1969	.3916	1.24	2.91	4.50	6.21	7.89	9.56	11.28	13.38	16.38	26.64
1971	.4037	0.93	2.63	4.29	6.12	7.91	9.64	11.43	13.49	16.46	27.11
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3865	1.18	2.87	4.54	6.28	8.02	9.69	11.47	13.59	16.47	25.88
13. <u>Standardized for number of female earners working 20 weeks or more<sup>2</sup></u>											
1967	.3746	1.14	3.12	4.93	6.62	8.18	9.68	11.35	13.34	16.20	25.44
1969	.3824	1.30	3.05	4.70	6.39	8.00	9.60	11.26	13.30	16.21	26.19
1971	.3960	0.97	2.73	4.45	6.27	8.02	9.69	11.43	13.44	16.33	26.67
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3935	1.14	2.78	4.40	6.12	7.92	9.64	11.48	13.66	16.62	26.23
14. <u>Standardized for number of male and number of female earners working 20 weeks or more<sup>2</sup></u>											
1967	.3883	1.04	2.83	4.58	6.34	8.06	9.69	11.46	13.57	16.54	25.88
1969	.3916	1.22	2.87	4.47	6.21	7.91	9.60	11.34	13.45	16.44	26.49
1971	.4010	0.94	2.65	4.32	6.17	7.95	9.67	11.46	13.50	16.46	26.88
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3870	1.18	2.89	4.55	6.28	8.00	9.65	11.43	13.55	16.46	26.00
15. <u>Standardized for family unit size and number of male earners working 20 weeks or more<sup>2</sup></u>											
1967	.3884	1.07	2.89	4.63	6.35	8.03	9.62	11.36	13.46	16.48	26.13
1969	.3918	1.50	2.87	4.49	6.20	7.89	9.58	11.32	13.44	16.44	26.29
1971	.4042	0.93	2.60	4.26	6.11	7.90	9.65	11.45	13.52	16.49	27.08
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3872	1.16	2.85	4.53	6.29	8.02	9.69	11.47	13.59	16.46	25.93
16. <u>Standardized for family unit size and number of female earners working 20 weeks or more<sup>2</sup></u>											
1967	.3813	1.10	2.96	4.75	6.49	8.13	9.69	11.41	13.47	16.38	25.62
1969	.3878	1.26	2.93	4.57	6.29	7.95	9.60	11.31	13.40	16.37	26.34
1971	.4006	0.94	2.64	4.32	6.18	7.97	9.69	11.48	13.52	16.45	26.82
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3893	1.17	2.87	4.50	6.22	7.97	9.64	11.44	13.58	16.49	26.13
17. <u>Standardized for family unit size and number of male and number of female earners working 20 weeks or more<sup>2</sup></u>											
1967	.3890	1.04	2.81	4.56	6.33	8.05	9.68	11.46	13.58	16.59	25.90
1969	.3927	1.21	2.82	4.44	6.19	7.90	9.61	11.37	13.51	16.48	26.48
1971	.4022	0.93	2.60	4.36	6.15	7.95	9.69	11.48	13.53	16.50	26.81
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3872	1.18	2.89	4.55	6.29	8.01	9.66	11.42	13.54	16.43	26.04

Table B-1 (cont'd)

Year	Gini Coefficient	Percentage of total income by decile									
		Lowest	2nd	3rd	4th	5th	6th	7th	8th	9th	Highest
18. <u>Standardized for education of head<sup>2</sup></u>											
1967	.3767	1.09	3.10	4.94	6.62	8.18	6.97	11.30	13.28	16.17	25.66
1969	.3822	1.27	3.05	4.71	6.43	8.04	9.61	11.26	13.27	16.16	26.20
1971	.3980	0.95	2.71	4.42	6.25	8.00	9.67	11.42	13.42	16.31	26.85
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3897	1.19	2.82	4.44	6.16	7.96	9.69	11.52	13.69	16.63	25.89
19. <u>Standardized for family unit size and education of head<sup>2</sup></u>											
1967	.3785	1.09	3.05	4.86	6.57	8.16	9.68	11.34	13.34	16.24	25.67
1969	.3872	1.25	2.96	4.60	6.33	7.97	9.59	11.27	13.33	16.26	26.44
1971	.4020	0.93	2.64	4.32	6.17	7.94	9.67	11.44	13.48	16.40	27.01
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3885	1.18	2.85	4.48	6.20	7.98	9.68	11.49	13.65	16.57	25.91
20. <u>Standardized for family unit size, number of male and number of female earners, and age and education of head</u>											
1967	.3862	0.99	2.81	4.61	6.41	8.13	9.76	11.53	13.62	16.58	25.57
1969	.3937	1.15	2.79	4.47	6.25	7.93	9.63	11.35	13.44	16.37	26.63
1971	.4006	0.96	2.60	4.26	6.15	7.95	9.70	11.50	13.55	16.48	26.86
1973	.3911	1.02	2.82	4.48	6.23	7.97	9.68	11.49	13.66	16.61	26.04
1975	.3866	1.17	2.89	4.55	6.28	8.02	9.69	11.47	13.61	16.52	25.84

1 These deciles are created from all family units ranked in order of total income.

2 In these cases, it was not possible to derive standardized figures for 1965 since not all family units in the sample for 1965 responded to the questions concerning the level of education of the head of the family unit and the number of earners in the family unit.

3 Earners, unless otherwise specified, are defined as those working for at least some period during the year.

Source: Surveys of Consumer Finances, Statistics Canada, and estimates by the authors.

APPENDIX C

ALTERNATIVE COEFFICIENTS -- UNSTANDARDIZED AND STANDARDIZED TO  
1973 FOR CERTAIN STRUCTURAL CHANGES IN THE CANADIAN POPULATION,  
1965-1975

(A) Theil-Bernoulli Index

	1965	1967	1969	1971	1973	1975
Unstandardized	.0995	.1039	.1069	.1167	.1114	.1101
Standardized for family unit size	.1061	.1065	.1089	.1185	.1114	.1090
Standardized for age of head	.1006	.1041	.1070	.1175	.1114	.1106
Standardized for number of male and number of female earners		.1087	.1098	.1183	.1114	.1104
Standardized for family unit size and for number of male and number of female earners		.1099	.1110	.1192	.1114	.1090
Standardized for family unit size, age and education of head, and number of male and number of female earners		.1083	.1122	.1170	.1114	.1080

The formulation of Theil's measure employed is as follows:

$$T = \sum_{j=1}^k s_j \log_{10}(ks_j)$$

where  $s_j$  is the proportion of total income going to the  $j^{\text{th}}$  of  $k$  groups of family units; the  $k$  groups ( $k = 20$  in this case) are obtained by ordering the family units by total income and dividing them into  $k$  groups, each with and equal number of family units.

(B) The Coefficient of Variation

	1965	1967	1969	1971	1973	1975
Unstandardized	.4802	.4988	.5296	.5731	.5325	.5317
Standardized for family unit size	.5108	.5129	.5402	.5815	.5324	.5265
Standardized for age of head	.4836	.4997	.5307	.5776	.5324	.5349
Standardized for number of male and number of female earners		.5168	.5423	.5792	.5324	.5276
Standardized for family unit size and for number of male and number of female earners		.5232	.5473	.5829	.5324	.5288
Standardized for family unit size, age and education of head, and number of male and number of female earners		.5078	.5542	.5681	.5324	.5205

The coefficient of variation (CV) has the following form:

$$CV = \frac{1}{N} \sum_{i=1}^N p_i (y_i / p_i - 1)^2$$

where  $y_i$  is the proportion of total income going to the  $i^{th}$  of  $N$  income classes, and  $p_i$  is the proportion of the total population in the  $i^{th}$  income class. To obtain the values cited in this table, it is necessary to rank family units according to the level of total income, to divide them into 20 groups, each containing the same number of family units, and to determine the proportion of total income associated with each group.

Source: Surveys of Consumer Finances, Statistics Canada, and estimates by the authors.

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