PROJECTIONS OF 1969 INCOME SIZE DISTRIBUTION FOR FAMILIES AND UNRELATED INDIVIDUALS COMBINED FOR STATES AND SELECTED SMSA's

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Introduction

The demand for information on levels and distribution of income of demographic units in "smaller" geographic areas, such as Standard Metropolitan Statistical Areas (SMSA) and counties, has increased significantly in the past few years. Although the 1970 Population Census will provide such data for income year 1969, there is still a need for current information each year after the census. The purpose of this paper is to outline an estimation procedure that can be used to develop projected income size distribution data for these areas for consumer units (families and unrelated individuals combined). Projections of 1969 income size distributions for states and selected SMSA's were computed by this estimation method. Also included are some 1967 data for analytical purposes.

The data presented herein are considered as experimental information and do not represent official estimates. We plan, at a later time, to compare these projected data against official estimates and to analyze the differences.

This document is divided into four parts. The first part outlines the simple projection procedure used to obtain data on income size distributions covering income year 1969 for states and selected SMSA's as shown in table 1. The second part analyzes these findings. The third part compares these estimates with aggregate income obtained from various sources. The last part briefly presents a summary and direction for further research.

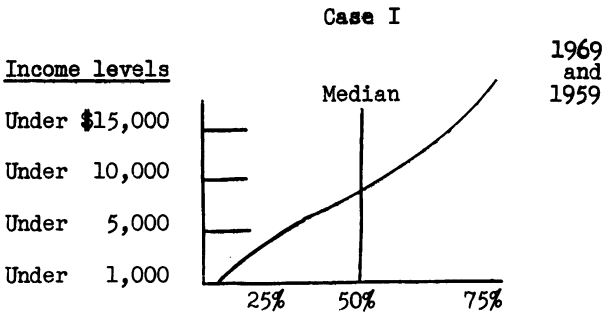
Derivation of Projected Income Size Distribution Data

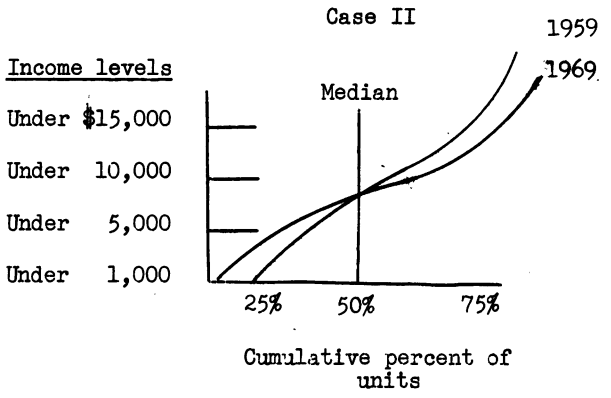
Table 1 presents projections of median income and income distribution for all states and a few selected SMSA's for 1969. These estimates were based upon a "naive" projection procedure, but it appears to give reasonable results. The key idea behind this procedure is that any cumulative income (lognormal) distribution can be described by two parameters, i.e., the median value (or the "positional" parameter) and the overall variance of the distribution (or the "shape of curve" parameter). 1/ Thus, any change in a distribution over two points in time can be classified under the following:

Case	Parameters "Position"	Parameters "Shape of curve"
1	Same	Same
2	Same	Change
3	Change	Same
4	Change	Change

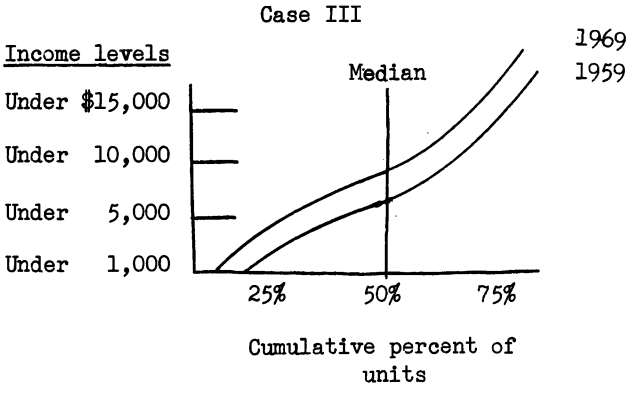
In turn, each of these parameters can be made a function of certain socioeconomic variables at the microeconomic level, e.g., the unemployment rate, occupational and educational mix of family heads, the propensity to work of wives and other family members, the age mix of employed family heads, etc. 2/ Also, for a given area, variables can be regrouped under the "internal" and "external" effects. 3/ These effects are still under study and are to be the subject of a future paper.

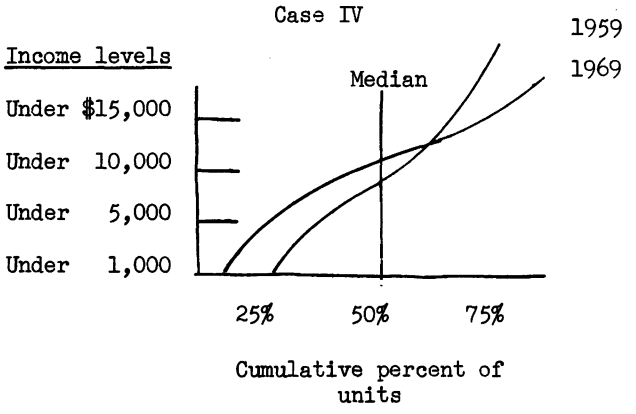
In Case I as shown below the median income level and the relative shapes of the income distribution curve are assumed to remain constant between the two points in time, e.g., 1959 and 1969. This type of stability can result from compensating positive and negative factors. In Case II, the medium income level remains constant but the distribution of income changes. In this example, the 1969 distribution is assumed to be more equal than the 1959 distribution. The decrease in the overall "slope" of the 1969 distribution compared with the 1959 distribution reflects a smaller variance of the 1969 distribution than the 1959 distribution. In Case III, the "shape" or variance of the distribution remains the same over the period but the median income level increases between the two points in time. (Case I may be considered a Case III with zero growth.) In Case IV, both the median income level and the overall "slope" had increased over the two points in time.





* The views expressed herein are not necessarily those of the U.S. Bureau of the Census. We wish to acknowledge suggestions by Dr. Murray S. Weitzman, Chief of the Economic Statistics Programs, Population Division, and staff members of the Consumer Income Statistics Branch.





Two basic sources of statistical data were used to analyze income distributions over time. These were (1) income tabulations obtained from the Current Population Survey conducted by the Bureau of the Census and (2) statistical tabulations of adjusted gross income data from the Internal Revenue Service.

Findings from these analyses show that for smaller population areas, e.g., counties, Case IV is the more typical one. For larger population areas, such as for states and for metropolitan areas not experiencing large population structural shifts, changes in income size distribution tend to follow Case III where the "shape" of the income distribution curve remains fairly constant but median income levels increase over time. This suggests that projections of income distributions for many areas can be made using one parameter (changes in median family income) instead of two. Under these conditions, the problem resolves itself in finding the most "efficient" carry-forward of median family income and assuming that the "shape" of the curve remained fairly constant over time.

If it is assumed that the "shape" of the income size distribution itself does not change, what is needed then is some rate of increase which is assumed to be constant over the entire distribution. One method of computing this rate of increase involves the following formula:

$$\text{Projection factor} = \frac{\frac{PI_{69}}{TR_{70}}}{\frac{PI_{59}}{TR_{60}}} \times 100$$

PI_t = OBE Personal Income for year t,

TR_t = Total Resident Population at time t.

The above rate can then be applied to income size class limits resulting in a projected distribution.4/ The conventional income size distribution classes can then be obtained by interpolation, assuming a linear distribution of units in each income class interval.

The assumptions involved in this simple projection procedure are: (1) The income level of all units change at the same rate, (2) neutrality of the internal and external effects on the shape of the distribution, and (3) the rate of change in income level of all units is equal to the rate of change in per capita personal income. This procedure was used to develop the data shown in table 1.

Selected Analysis of Findings

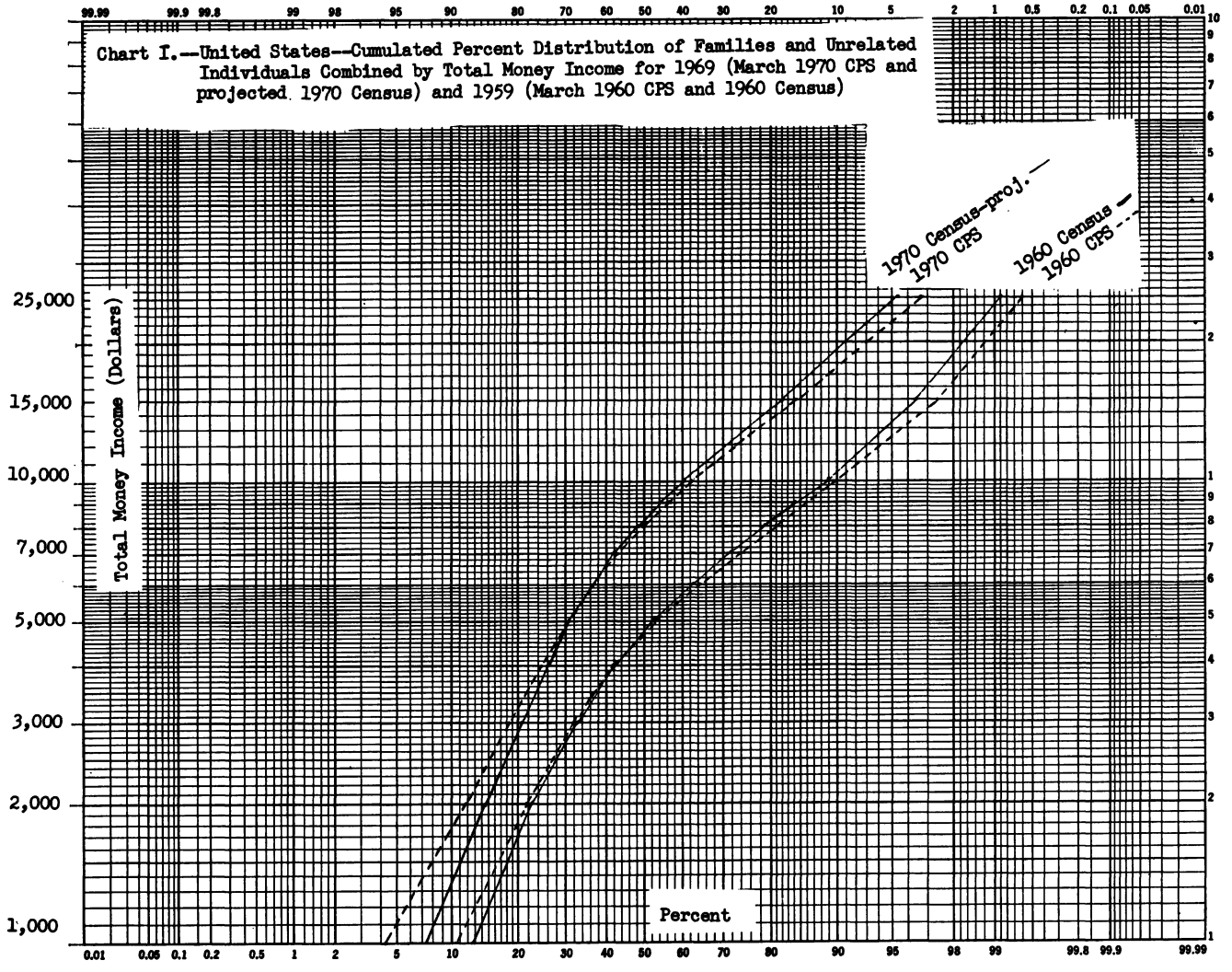
In this second part, we attempt to evaluate the projections presented in table 1 by comparing them against national and regional data obtained from the Current Population Survey (CPS). Shown on Chart I are income distributions of consumer units (families and unrelated individuals) obtained from the 1960 census, 1960 CPS (both covering income year 1959), the March 1970 CPS, and the projected 1970 census income distribution for the United States (both covering income year 1969).

In table A below, the March 1970 CPS shows a smaller percent of families and unrelated individuals with income under $3,000 and shows a greater percent between $3,000 - $15,000 than the projected 1970 census data. Data indicate that the projected data tend to overstate, somewhat, the percentage of units at the extremes.

In summary, the projections appear to be reasonable as compared with CPS data for the United States. Also, projected data are found to be consistent with regional CPS income size distribution data. We consider the income data obtained from the CPS to be a good approximation of what the actual census will show.

Table A.--UNITED STATES--FAMILIES AND UNRELATED INDIVIDUALS COMBINED BY TOTAL MONEY INCOME FOR 1969 (MARCH 1970 CPS AND PROJECTED 1970 CENSUS) AND 1959 (MARCH 1960 CPS AND 1960 CENSUS)

Income class	1969			1959		
	March 1970 CPS	Projected 1970 Census	Difference (CPS-Census)	March 1960 CPS	1960 Census	Difference (CPS-Census)
Total.....	100.0	100.0		100.0	100.0	
Under $3,000.....	18.3	20.4	-2.1	31.5	32.5	-1.0
$3,000 - $4,999.....	12.2	10.9	1.3	21.1	19.7	1.4
$5,000 - $6,999.....	12.4	10.9	1.5	21.1	19.6	1.5
$7,000 - $9,999.....	19.2	18.1	1.1	16.0	16.2	-.2
$10,000 - $14,999.....	22.0	21.9	0.1	7.6	8.4	-.8
$15,000 and over.....	15.6	17.9	-2.3	2.6	3.7	-1.1
Median.....	$8,170	$8,317	-$147	$4,759	$4,791	-$32



Reconciliation of Aggregate Income Obtained From Income Distribution Data

In the third part, we compare aggregate total money income computed from the 1960 census and projected 1967 and 1969 data with two independent sources of aggregate income: Adjusted gross income (AGI) and personal income. 5/ If the projected income size distributions for each state are reasonable approximations of the actual distribution, then the 1969 ratio of census aggregate total money income to the independent aggregate income source should be close to the 1959 ratio. This type of analysis can be used to identify areas for which the simple projection procedure used in this paper would not be appropriate and alternate projection methods would be necessary.

Table B below shows differences in the ratios of aggregate total money income to adjusted gross income (AGI). For 46 of the states, the absolute value of the difference is less than .10.

Table B.--DISTRIBUTION OF THE DIFFERENCES IN THE RATIOS OF AGGREGATE TOTAL MONEY INCOME TO AGGREGATE TOTAL ADJUSTED GROSS INCOME FROM 1959 TO 1967 AND 1969 INCOME FOR THE 50 STATES AND THE DISTRICT OF COLUMBIA 1/

Difference in ratios	1959 to 1967		1959 to 1969	
	Number	Percent	Number	Percent
Total.....	51	100.0	51	100.0
Less than .02.....	16	31.4	16	31.4
.02 to .05.....	23	45.0	19	37.3
.05 to .10.....	7	13.7	7	13.7
.10 and over.....	5	9.8	9	17.6

1/ The 1969 adjusted gross income data were estimated by increasing the 1968 AGI by the average annual increase from 1959 to 1968.
Source: Unpublished tabulation.

The difference in the ratios of aggregate total money income to personal income between 1959 and 1969 are presented below in table C. Overall, data show that the 1969 ratio of census money income to total personal income remains fairly similar to the 1959 ratio.

Table C.--DISTRIBUTION OF THE DIFFERENCES IN THE RATIOS OF AGGREGATE TOTAL MONEY INCOME TO PERSONAL INCOME BETWEEN 1959 AND 1969 FOR THE 50 STATES AND THE DISTRICT OF COLUMBIA

Difference in ratios	Number	Percent
Total.....	51	100.0
Less than .01.....	16	31.4
.01 to .02.....	12	23.5
.02 to .03.....	10	19.6
.03 to .05.....	8	15.7
.05 and over.....	5	9.8

Source: Unpublished tabulation.

Summary and Direction for Future Study

Empirical projections of income size distribution for small areas involve analysis of the complex interaction of many institutional changes. In trying to probe for an empirical model by which these projections can be made, we classified changes in the form of income size distributions into four basic types. These models cover changes essentially in two parameters: (1) The median income level (the positional parameter) and (2) the "shape" of the curve (the variance parameter). Empirical evidence, however, shows that among the four models, only two are typically found. Thus, empirical data for large areas show that, as a rule only the positional parameter tends to change while the "shape of the curve" parameter remains fairly constant. Using this finding, projections of income distribution were developed and tested against independent sources. This comparison showed that, overall, the projections appear reasonable. However, the ultimate test is to compare them against actual census results. This will be done at a later date. Also, more work is planned to determine what changes in socioeconomic variables are associated with changes in the two parameters noted above.

FOOTNOTES

1/ A theoretical model can be shown simply as follows:

Income distribution = f(M,V)
Where M = Median income
V = Variance

2/ For example, see "State Differentials in Income Concentration" by Ahmad Al-Samarrie and Herman P. Miller in The American Economic Review, March 1967.

3/ The "internal" effect relates to changes in the income distribution resulting from the income upgrading or downgrading of the population within an area, assuming no changes in income distribution due to migrants. The "external" effect relates to changes in income distribution due to migrants only. These two effects interact with each other in generating different types of income size distribution curves for small areas at different points in time.

4/ Other ways of projecting median family income are:

a. Imputing the growth rate of median income of a region to its subareas.
b. Imputing a growth rate of median income based upon the average growth rate over some past period.

See technical appendix for the projection procedure used. For a graphic projection technique, see "A Graphic Technique for Projecting Family Income Size Distribution" by Mitsuo Ono, Proceedings of Social Statistics Section, American Statistical Association, 1969.

5/ The comparison of the aggregate total money income with personal income is not strictly independent for this particular set of projections because we used per capita personal income to derive the projection factor for these projections.

Table 1.--PROJECTED[1] 1969 INCOME SIZE DISTRIBUTION FOR FAMILIES AND UNRELATED INDIVIDUALS

Region, State (including D.C.), and SMSA	Base[2] (000)	Total	Under $3,000	$3,000 to $4,999	$5,000 to $6,999	$7,000 to $9,999	$10,000 to $14,999	$15,000 and over	Median[3] (dollars)	Mean[4] (dollars)
United States	65,431	100.0	20.4	10.9	10.9	18.1	21.9	17.9	8,317	10,072
Northeast	16,198	100.0	16.5	9.4	10.9	19.8	23.9	19.6	9,062	10,753
North Central	18,209	100.0	19.0	9.9	10.1	18.6	23.6	18.6	8,823	10,285
South	19,314	100.0	25.5	13.2	12.0	16.1	18.5	14.8	6,878	9,198
West	11,821	100.0	18.8	10.4	10.9	18.7	23.0	18.3	8,625	10,115
Northeast										
Maine	323	100.0	21.9	13.5	14.7	20.6	19.3	9.8	6,962	8,150
New Hampshire	245	100.0	19.2	10.7	13.1	21.7	22.5	12.8	7,963	9,066
Vermont	145	100.0	22.5	11.6	12.4	18.9	21.2	13.5	7,557	9,207
Massachusetts	1,880	100.0	16.7	9.4	10.7	19.8	24.7	18.8	9,068	10,579
Rhode Island	317	100.0	19.9	11.0	12.2	20.2	22.6	14.2	8,059	9,415
Connecticut	985	100.0	13.3	7.3	9.0	19.1	26.9	24.4	10,254	12,113
New York	6,217	100.0	16.2	9.4	10.8	18.9	23.4	21.1	9,181	11,152
New Jersey	2,318	100.0	14.1	8.0	9.8	19.3	25.9	22.8	9,822	11,471
Pennsylvania	3,768	100.0	17.7	9.8	11.6	21.5	23.1	16.3	8,542	9,927
North Central										
Ohio	3,371	100.0	17.3	8.7	9.7	19.8	25.6	19.0	9,241	10,474
Indiana	1,658	100.0	18.3	9.4	10.4	19.3	24.3	18.3	8,902	10,266
Illinois	3,688	100.0	17.2	8.7	9.6	17.9	24.5	22.2	9,480	11,133
Michigan	2,734	100.0	16.6	8.4	8.3	18.5	25.9	22.4	9,756	11,299
Wisconsin	1,391	100.0	18.7	10.1	10.7	20.3	24.4	15.7	8,610	9,682
Minnesota	1,208	100.0	20.3	11.0	10.9	18.0	22.9	16.8	8,313	9,914
Iowa	925	100.0	22.3	12.0	11.6	18.1	21.3	14.9	7,704	9,441
Missouri	1,594	100.0	25.4	12.7	11.7	18.3	19.1	12.9	7,029	8,583
North Dakota	188	100.0	21.2	12.7	12.2	18.0	20.2	15.6	7,613	9,575
South Dakota	210	100.0	24.0	12.8	11.4	15.9	20.0	15.9	7,320	9,440
Nebraska	491	100.0	21.0	13.0	12.8	18.3	20.3	14.5	7,479	9,377
Kansas	751	100.0	21.1	11.6	11.5	18.7	21.4	15.9	7,965	9,731
South										
Delaware	177	100.0	19.9	11.1	12.7	20.4	20.4	15.5	7,902	9,888
Maryland	1,225	100.0	16.4	8.8	9.8	17.4	23.6	24.0	9,605	11,734
District of Columbia	306	100.0	19.3	10.9	12.5	19.1	18.2	19.9	8,059	10,947
Virginia	1,444	100.0	22.3	12.1	11.3	15.9	19.2	19.1	7,772	10,349
West Virginia	513	100.0	26.5	12.4	11.3	18.0	19.6	12.0	6,941	8,373
North Carolina	1,480	100.0	25.3	13.4	12.4	16.4	18.2	14.5	6,837	8,988
South Carolina	725	100.0	27.9	12.9	11.7	15.1	17.9	14.5	6,557	8,718
Georgia	1,350	100.0	24.3	13.6	12.1	15.7	18.2	16.2	7,000	9,501
Florida	2,334	100.0	23.8	14.8	13.9	17.2	17.4	12.9	6,631	8,763
Kentucky	974	100.0	28.3	13.6	11.6	15.8	17.7	13.0	6,371	8,546
Tennessee	1,176	100.0	27.4	13.7	12.3	15.7	17.7	13.3	6,429	8,655
Alabama	984	100.0	28.5	13.8	11.9	15.7	17.4	12.6	6,283	8,350
Mississippi	621	100.0	36.6	15.3	11.3	13.0	13.5	10.3	4,722	7,179
Arkansas	591	100.0	32.4	16.3	12.8	14.5	14.0	10.0	5,179	7,417
Louisiana	1,061	100.0	27.8	14.5	12.1	15.5	17.2	13.0	6,257	8,485
Oklahoma	853	100.0	26.5	13.6	12.0	17.0	18.0	12.8	6,644	8,601
Texas	3,500	100.0	24.3	12.8	12.0	16.8	19.2	14.9	7,153	9,195
West										
Montana	228	100.0	22.5	13.0	14.0	21.1	18.9	10.4	7,059	8,259
Idaho	217	100.0	20.5	13.0	14.3	22.0	19.8	10.6	7,297	8,437
Wyoming	107	100.0	18.0	11.6	13.2	21.9	22.1	13.1	7,984	9,231
Colorado	732	100.0	20.4	12.1	12.6	19.9	21.0	13.9	7,733	9,105
New Mexico	292	100.0	23.0	12.6	13.0	18.9	19.2	13.3	7,212	8,750
Arizona	551	100.0	21.1	11.3	11.3	18.7	21.3	16.3	8,008	9,668
Utah	308	100.0	18.2	9.6	12.1	23.6	23.1	13.4	8,325	9,302
Nevada	176	100.0	17.7	10.7	12.1	19.7	22.8	17.1	8,453	10,054
Washington	1,157	100.0	18.5	10.1	9.8	19.1	24.4	18.0	8,891	10,107
Oregon	704	100.0	19.7	10.5	11.3	21.2	23.2	14.2	8,248	9,372
California	7,002	100.0	18.2	10.1	10.4	17.9	23.5	19.9	8,926	10,511
Alaska	112	100.0	22.1	12.6	8.9	13.1	17.9	25.4	8,466	11,149
Hawaii	235	100.0	16.0	11.2	11.2	15.9	19.8	25.9	9,157	12,911
SMSA's										
New York - SCA 5/	5,520	100.0	14.5	8.9	10.7	18.9	24.6	22.5	9,558	11,161
Chicago - SCA 6/	1,752	100.0	14.7	7.8	9.3	17.8	26.7	23.7	10,007	10,439
Los Angeles - Long Beach	2,402	100.0	15.8	9.1	9.7	17.3	24.8	23.1	9,662	11,191
Boston, Massachusetts	933	100.0	16.3	8.8	9.5	17.7	25.1	22.8	9,662	11,157
Baltimore, Maryland	620	100.0	16.8	9.1	10.8	19.6	24.6	19.1	9,071	10,340
Washington, D.C.	945	100.0	14.8	8.6	10.4	17.1	22.6	26.6	9,845	11,966
Detroit, Michigan	1,267	100.0	13.4	7.2	6.8	15.2	28.5	28.8	11,283	12,619
Omaha, Nebraska - Iowa	179	100.0	17.5	10.4	11.8	21.6	23.4	15.2	8,445	9,500
Columbia, South Carolina	98	100.0	31.3	13.6	12.5	14.9	15.8	11.8	5,800	7,604
Knoxville, Tennessee	121	100.0	23.0	12.4	12.4	18.3	20.9	12.9	7,345	8,545
Nashville, Tennessee	152	100.0	23.1	12.0	11.9	16.6	20.6	15.8	7,540	9,081
Houston, Texas	542	100.0	17.7	10.8	12.4	19.6	22.8	16.7	8,384	10,675
Denver, Colorado	422	100.0	19.2	10.6	12.2	20.5	22.9	14.6	8,178	9,897

1/ The projection procedure was to multiply the income class limits by a projection factor to obtain a projected income distribution. The traditional income class limits were then obtained by interpolation assuming a linear distribution of units in the projected income class.

2/ The 1970 number of families and unrelated individuals was estimated by assuming a proportional increase with total resident population from 1960 to 1970.

3/ Computed on the basis of $1,000 intervals under $10,000.

4/ Computed by assuming midpoint to be the mean for each income class below $15,000; the mean of the $15,000 and over income interval was estimated assuming a Pareto relationship.

5/ New York - Northeastern New Jersey Standard Consolidated Area.

6/ Chicago - Northwestern Indiana Standard Consolidated Area.

APPENDIX

General Procedure for Projecting an Income Size Distribution for 1959 to 1969 1/

Step 1.--Obtain a benchmark income size distribution for geographic area. Table a gives the income size distribution for families and unrelated individuals by total money income for Maine in 1959.

Step 2.--Accumulate the distribution. Table b shows the accumulated distribution for Maine.

Step 3. Obtain a projection factor by one of the methods discussed in the paper. The projection factor used in the paper for Maine from 1959 to 1969 is 1.731.

Step 4.--Multiply the income class limits by the projection factor.

The projected distribution (table c) is obtained by multiplying the class limit in table b by the projection factor. For example:

$1,000 x 1.731 = $1,731
$2,000 x 1.731 = $3,462
:
$15,000 x 1,731 = $25,965
$25,000 x 1,731 = $43,275

Step 5.--Obtain the "conventional" income class limits ($1,000, $2,000, ... $8,000, etc.) by assuming the units are linearly distributed within the projected income class.

$$\text{Under } 1{,}000: \quad 0 + \frac{1{,}000-0}{1{,}731-0} \times (41{,}872-0) = 24{,}189$$

$$\text{Under } 2{,}000: \quad 41{,}872 + \frac{2{,}000-1{,}731}{3{,}462-1{,}731} \times (80{,}094-41{,}872) = 47{,}812$$

$$\vdots$$

$$\text{Under } 25{,}000: \quad 299{,}233 + \frac{25{,}000-17{,}310}{25{,}965-17{,}310} \times (313{,}148-299{,}233) = 311{,}596$$

Step 6.--Disaccumulate the projected income size distribution either as an absolute or a percent. Table e gives the projected 1969 income size distribution for families and unrelated individuals for Maine.

1/ The computer program can be obtained by writing to Joseph Knott, Population Division, U.S. Bureau of the Census, Washington, D.C. 20233

Table a.--FAMILIES AND UNRELATED INDIVIDUALS IN MAINE FOR 1959

Income	Number
Total.....	318,316
Under $1,000.....	41,872
1,000 - 1,999.....	38,222
2,000 - 2,999.....	37,131
3,000 - 3,999.....	41,100
4,000 - 4,999.....	39,420
5,000 - 5,999.....	35,947
6,000 - 6,999.....	26,749
7,000 - 7,999.....	18,366
8,000 - 8,999.....	12,552
9,000 - 9,999.....	7,874
10,000-14,999.....	13,915
15,000-24,999.....	3,823
25,000 and over.....	1,345

Table b.--ACCUMULATED

Income	Number
Under $1,000.....	41,872
Under 2,000.....	80,094
Under 3,000.....	117,225
Under 4,000.....	158,325
Under 5,000.....	197,745
Under 6,000.....	233,692
Under 7,000.....	260,441
Under 8,000.....	278,807
Under 9,000.....	291,359
Under 10,000.....	299,233
Under 15,000.....	313,148
Under 25,000.....	316,971
Total.....	318,316

Table c.--PROJECTED 1969 ACCUMULATED INCOME SIZE DISTRIBUTION

Income	Number
Under $1,731.....	41,872
Under 3,462.....	80,094
Under 5,193.....	117,225
Under 6,924.....	158,325
Under 8,655.....	197,745
Under 10,386.....	233,692
Under 12,117.....	260,441
Under 13,848.....	278,807
Under 15,579.....	291,359
Under 17,310.....	299,233
Under 25,965.....	313,148
Under 43,275.....	316,971
Total.....	318,316

Table d.--1969 INCOME SIZE DISTRIBUTION (CONVENTIONAL CLASS LIMITS)

Income	Number	Percent
Under $1,000....	24,189	7.6
Under 2,000....	47,812	15.0
Under 3,000....	69,893	22.0
Under 4,000....	91,634	28.8
Under 5,000....	113,085	35.5
Under 6,000....	136,386	42.8
Under 7,000....	160,056	50.3
Under 8,000....	182,829	57.4
Under 9,000....	204,909	64.4
Under 10,000....	225,676	70.9
Under 15,000....	287,160	90.2
Under 25,000....	311,597	97.9
Total.....	318,316	100.0

Table e,--PROJECTED PERCENTAGE INCOME SIZE DISTRIBUTION FOR 1969

Income	Percent
Total.....	100.0
Under $1,000.....	7.6
1,000 - 1,999.....	7.4
2,000 - 2,999.....	7.0
3,000 - 3,999.....	6.8
4,000 - 4,999.....	6.7
5,000 - 5,999.....	7.3
6,000 - 6,999.....	7.5
7,000 - 7,999.....	7.1
8,000 - 8,999.....	7.0
9,000 - 9,999.....	6.5
10,000-14,999.....	19.3
15,000-24,999.....	7.7
25,000 and over.....	2.1