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## CHAPTER 7

# Time Period, Unit of Analysis, and Income Concept in the Analysis of Income Distribution

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The traditional focus of economic analysis has been more on the functional distribution of income than on the personal distribution of income, partly because the distribution between wages, rents, interest, and profits fits neatly into macromodels of the economy. In recent years, however, there has been a growing interest in the distribution of income among individuals or families, especially among those researchers concerned with evaluating and improving the personal distribution of welfare.

One dimension of welfare which has received little attention is the stability of income. This deficiency is partly due to the fact that microdata are usually available only for a single year. In order to study income stability, one needs data on income across several time periods. However, even when panel data are available, important questions remain. For example, what is an appropriate unit of analysis to examine? Given the importance of intrafamily transfers, individual income data are usually discarded in favor of family income data, yet the family may not be a stable unit over a lifetime, and the same income means different levels of well-being, depending on the size and structure of the family. The definition of income (before or after taxes and transfers, with or without nonmoney components) also affects the results. Finally, the

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instability or uncertainty of income and its temporal pattern are also important.

This paper focuses on the unit of analysis, the concept of income used, and the time period, leaving to another forum a discussion of instability as a dimension of welfare.<sup>1</sup> We focus on time periods ranging from three months to four years, not dealing with the lifetime-income problem directly.

## MEASURES OF INCOME INEQUALITY

The question of whether the length of the accounting period affects the distribution of income may be answered by adopting a summary measure of inequality and comparing the results for various accounting periods. The two most widely used measures of inequality are the Gini concentration coefficient and the variance of the logarithms of income. The former is the ratio of the area between the Lorenz curve and the 45° line of equal distribution to the area under the 45° line. It ranges between zero and one, with zero representing perfect income equality and one representing perfect inequality (i.e., one person has all the income). If the size distribution on income is in fact log-normal, the two measures provide the same ranking of the distributions, since the Gini concentration coefficient is monotonically related to the variance of the logarithms of income.<sup>2</sup> If income is not log-normally distributed, the two measures may yield conflicting results.<sup>3</sup> Since the income distributions of some subgroups may not be log-normal, and since we will examine inequality for selected subgroups, the Gini concentration coefficient appears to be the more appropriate measure for our analysis.

The usual method of estimating the Gini concentration coefficient

<sup>1</sup> Jacob Benus and James Morgan, "Income Instability as a Dimension of Welfare," *Proceedings of the American Statistical Association*, 1972, pp. 102-6.

<sup>2</sup> See J. Aitchison and J. A. C. Brown, *The Lognormal Distribution* (Cambridge, Mass.: Harvard University Press, 1957) pp. 111-15.

<sup>3</sup> An example of such discrepancies is found in a recent article by Schultz, where the Gini coefficient indicates lower inequality for white males, while the variance of logarithms of income indicates lower inequality for nonwhite males. See T. Paul Schultz, "Secular Trends and Cyclical Behavior of Income Distribution in the United States, 1944-1965," in L. Soltow, ed., *Six Papers on the Size Distribution of Wealth and Income* (New York: NBER, 1969). See especially the comment by Eleanor M. Snyder, pp. 101-6.

cient from data grouped by income intervals assumes that within each interval all incomes are equal. This assumption yields a lower bound for the Gini concentration coefficient.<sup>4</sup> However, since our main objective is to compare Gini coefficients for various accounting periods, the consistent underestimation due to grouping the data into deciles is unlikely to affect our results.

### SINGLE-YEAR VERSUS PANEL SURVEYS

Single-year survey data often contain persons whose incomes are temporarily high and others whose incomes are temporarily low. As a result, the measures of income inequality derived from these studies may exaggerate the real lifetime-income inequality. Two solutions to the problems caused by temporary fluctuations in income suggest themselves. First, one may eliminate those individuals who report recent short-run fluctuations in income. This leaves for analysis a subsample of individuals whose incomes remained relatively stable over a period of time. A second approach involves the lengthening of the accounting period for measuring income. The implicit assumption in this approach is that temporary income fluctuations average out over a period of years. Thus, with a longer accounting period, an individual's income level is less likely to reflect the effect of a temporary phenomenon.

While both approaches theoretically require only a single interview survey, a panel study can provide greater accuracy in measuring the effect of lengthening the accounting period. A single interview can obtain, retrospectively, the respondent's income level over several accounting periods. Inequality measures for these accounting periods may then be compared to investigate the effect of lengthening the accounting period. The results, however, will reflect not only the effect of accounting period variation, but also the effect of diminishing recall for the more distant past. In a study of the reliability of income recall, Withey found that the greater the income change experienced, the greater the tendency to report a smaller amount of change (in the same direction).<sup>5</sup> The use of recall data in our analysis would, therefore,

<sup>4</sup> Joseph L. Gastwirth, "The Estimation of the Lorenz Curve and Gini Index," *Review of Economics and Statistics* 54 (August 1972): 306-16.

<sup>5</sup> Stephen B. Withey, "Reliability of Recall of Income," *Public Opinion Quarterly* 18 (Summer 1954):197-204.

lead to underestimation of the impact of lengthening the accounting period. The use of panel data, on the other hand, eliminates the difficulties caused by variable recall. What remains is the effect of lengthening the accounting period.

In the past few years the Survey Research Center (SRC) of the University of Michigan has conducted several panel surveys which may be useful in studying the effects of varying the accounting period. In 1964-65, the SRC conducted a four-wave panel to investigate the impact of the tax-cut provisions of the Revenue Act of 1964.<sup>6</sup> The panel members in this study (hereafter called the Tax Panel) were restricted to nonfarm families whose total family income before taxes was between \$3,000 and \$20,000 in 1963. Approximately 900 respondents remained in the panel through three interviews in 1964 and a fourth interview in 1965. Since these data were collected toward the end of the second, third, and fourth quarters in 1964, we have the opportunity to examine the effect of lengthening the accounting period by three-month intervals. In the final interview, conducted in May 1965, data were gathered on both the three-month period prior to the interview (i.e., March-May) and the entire calendar year 1964.

A second panel study, the Debt Panel, was conducted between early 1967 and early 1970 to investigate the factors that underlie the purchase of large household durables.<sup>7</sup> In this study, over 1,400 respondents completed four interviews approximately twelve months apart. Unlike the Tax Panel, this panel represents a national cross section of families with heads under 60 years old in 1967. As a result of the differences in the two samples, we would expect to find greater income inequality in the Debt Panel. Whether these differences will also lead to different responses to accounting period changes is open to question. We speculate, however, that the panel members of the Tax Study are more stable and, as a result, lengthening the accounting period will have less impact on income inequality.

The third, and perhaps the most useful panel for our analysis of income inequality, is the Office of Economic Opportunity (OEO)

<sup>6</sup> For details, see George Katona and Eva Mueller, *Consumer Response to Income Increases* (Washington, D.C.: The Brookings Institution, 1968).

<sup>7</sup> Details of this study will be found in Gary Hendricks and Kenwood C. Youmans, with Janet Keller, *Consumer Durables and Instalment Debt: A Study of American Households* (Ann Arbor: Survey Research Center, University of Michigan, 1973).

Panel.<sup>8</sup> In this panel, a national cross section of households have been interviewed annually since 1968, with the objective of studying family-income dynamics. The fifth wave of this study will be available before the end of 1972. The current availability of four waves of data, however, offers ample opportunity to analyze the impact of lengthening the accounting period by annual intervals. In addition, since the panel represents a national cross section, one may compare our results on inequality with the results of earlier single-year national cross-section studies.

#### UNIT OF ANALYSIS AND INCOME CONCEPT

While the organization of our data does not permit the analysis of inequality on an individual basis, we can examine income inequality for heads, wives, and families separately. As seen in Table 1, the addition of wife's labor income to that of the head's labor income reduces the inequality of labor income by approximately 2 percent. Similarly, the addition of taxable income of other family members to head and wife's taxable income further reduces the inequality by approximately the same amount. We conclude, therefore, that as the unit of analysis is broadened to include the earnings of all family members, the distribution of income becomes more equal.

A comparison of lines 2 and 3 of Table 1 also reveals another source of variation in income inequality. That is, altering the income concept from labor income to taxable income (i.e., labor

<sup>8</sup> Since the completion of this paper two more waves of data have been collected. For an analysis of the initial five years of data, see James Morgan et al., *Five Thousand American Families—Patterns of Economic Progress* (Ann Arbor: Survey Research Center, University of Michigan, 1974).

**TABLE 1** Gini Concentration Coefficients for Various Units of Analysis, Office of Economic Opportunity Panel<sup>a</sup>

	1967	1968	1969	1970
Head's labor income	.45	.46	.46	.48
Head and wife's labor income	.44	.45	.45	.47
Head and wife's taxable income	.43	.44	.44	.45
Family taxable income	.42	.43	.43	.44

<sup>a</sup> Based on entire sample of 4,840 households in 1971.

income plus income from assets) leads to a reduction in inequality. This result, therefore, suggests that differences in income concept also affect the results on income inequality.

An examination of Table 2 confirms that differences in income concept have substantial impact on the Gini coefficients. The addition of transfer payments to family taxable income, for example, reduces the income inequality by raising the income level of those families in the low end of the income distribution while leaving others essentially unaffected. The distributional impact of the inclusion of transfer income is substantial, reducing income inequality by approximately 15 percent (i.e., from an average of .430 to an average of .365). The impact of taxes on the distribution of income is weaker, reducing the Gini coefficient by approximately 5 percent.<sup>9</sup> The relatively weaker impact of the tax adjustment in reducing income inequality reflects, perhaps, the fact that income taxes are less progressive than transfer payments. That is, the wealthy and the not-so-wealthy pay income taxes, while mostly the poor receive transfer payments.

<sup>9</sup> Other studies have estimated the effect of taxation to be slightly higher, with estimates of about 7 to 8 percent. Peter Vandome, "Aspects of the Dynamics of Consumer Behavior," *Bulletin of the Oxford University Institute of Statistics* 20 (February 1958):87. James N. Morgan, Martin H. David, Wilbur J. Cohen, and Harvey E. Brazer, *Income and Welfare in the United States* (New York: McGraw-Hill, 1962) p. 315.

**TABLE 2** Gini Concentration Coefficient for Various Income Measures, Office of Economic Opportunity Panel<sup>a</sup>

	1967	1968	1969	1970
Family taxable income	.42	.43	.43	.44
Plus: transfer income =				
Family money income	.36	.36	.37	.37
Less: federal income taxes =				
Family disposable income	.34	.34	.35	.35
Less: cost of child care				
Less: union dues				
Plus: nonmoney income (including free food, housing, etc.) =				
Family net real income	.33	.33	.34	.34

<sup>a</sup> Based on entire sample of 4,840 households in 1971.

Finally, adjusting disposable money income by adding non-money incomes and deducting the cost of earning income (union dues and child-care cost) reduces the inequality still further, but only slightly. We may, therefore, conclude that the results on income inequality depend significantly on the choice of unit of analysis and income concept. Our analysis of the impact of accounting period variation on income inequality may also be affected by the choice of unit of analysis and income concept.

### ACCOUNTING PERIOD VARIATION

In an early study, Hanna measured the impact of lengthening the accounting period by comparing the weighted average of annual distributions with distributions for two- and three-year accounting periods.<sup>10</sup> Since individual relative income positions shift from year to year, the Lorenz curve for several years taken as a single accounting period will lie between the "average" Lorenz curve and the line of equal distribution. Thus, the "average" Lorenz curve serves as an inequality limit against which the effect of lengthening the accounting period may be measured.

In the analysis that follows, we use the initial-year distribution rather than the average annual distribution as our benchmark. The results of Tables 1 and 2 indicate less income inequality in the initial year than in subsequent years of the panel. Thus, the use of the initial year as a benchmark probably underestimates the impact of lengthening the accounting period.

Since the initial-year distribution does not serve as an inequality limit for the longer accounting period distributions, lengthening the accounting period may, in principle, lead to increased inequality. In practice, however, the inequality of the initial year does establish a limit for the lengthened accounting period. This result is largely due to the fact that data from any single period contain incomes that are influenced by temporary events. Lengthening the accounting period reduces the influence of these vagaries, raising the income level of those with unusually low incomes in a single period and vice versa.

Since income for a short accounting period is more likely to be

<sup>10</sup> See Frank A. Hanna, "The Accounting Period and the Distribution of Income," Part III in Frank A. Hanna, Joseph A. Pechman, and Sidney M. Lerner, *Analysis of Wisconsin Income*, Vol. 9, Conference on Research in Income and Wealth (New York: NBER, 1948), pp. 204-12.



influenced by temporary events or institutional arrangements (i.e., quarterly dividend, semiannual interest payment) than long accounting periods, lengthening short accounting periods should exhibit a greater impact on the distribution of income. As a result, we expect to observe a greater reduction in inequality for the Tax Panel than for either the Debt or OEO panels. However, as seen in Table 3, the impact of lengthening the accounting period is lower for the Tax Panel than for the Debt Panel. This unexpected result may partly reflect the unusual composition of the Tax Panel (i.e., the sample is restricted to nonfarm families with a total income between \$3,000 and \$20,000 in 1963).<sup>11</sup> However, as we discover later, greater homogeneity of the sample is expected to increase rather than decrease the impact of accounting period variation. Thus, we are left without an explanation for this result.

While lengthening the accounting period by constant intervals is expected to reduce inequality monotonically, the rate of inequality reduction is expected to decline. That is, since additional periods represent declining proportions of the total period, their impact in reducing inequality diminishes. This expectation is supported by the results of Table 3: In fact, lengthening the accounting period beyond three periods has almost no impact on the distribution of income. This result suggests that a limit may have been reached with the extension of the accounting period to three periods. Whether the periods are quarters or years seems insignificant, since similar results are obtained for all three panels. Only the number of periods combined appears to be important.

The overall conclusion that may be drawn from Table 3 is that lengthening the accounting period has only a slight effect on the distribution of income. The impact ranges from no reduction in inequality for head's labor income (OEO Panel) to a reduction of approximately 9 percent for family money income (Debt Panel).<sup>12</sup> Within each of the studies, the impact of lengthening the accounting period appears to be approximately the same for all the income concepts. Differences, however, appear between the

<sup>11</sup> This composition of the sample also accounts for the relatively low inequality level for the Tax Panel when compared to the OEO and Debt panels.

<sup>12</sup> Vandome estimated that the inequality of gross income declined by 4 percent (over the average for yearly distributions) when the years were taken as a single accounting period. "Dynamics of Consumer Behavior," p. 88.

TABLE 3 Gini Concentration Coefficients for Various Accounting Periods

		(same heads) <sup>a</sup>											
		Tax Panel (N = 844)				Debt Panel (N = 1,335)				OEO Panel (N = 3,743)			
Type of Income		Jan.-Dec. 1964 +		Jan.-Dec. March-May 1965		1966		1966-67		1966-68		1967	
		Jan.-June 1964	Jan.-Sept. 1964	Jan.-Dec. 1964	March-May 1965	1966	1966-67	1966-68	1966-69	1967	1967-68	1967-69	1967-70
Head's labor income	.33	.32	.32	.32	.32	.41	.40	.39	.39	.45	.45	.45	.45
Family money income	.22	.21	.21	.21	.21	.33	.31	.31	.30	.36	.35	.35	.35
Family disposable income	—	—	—	—	—	.30	.29	.28	.28	.34	.33	.33	.33

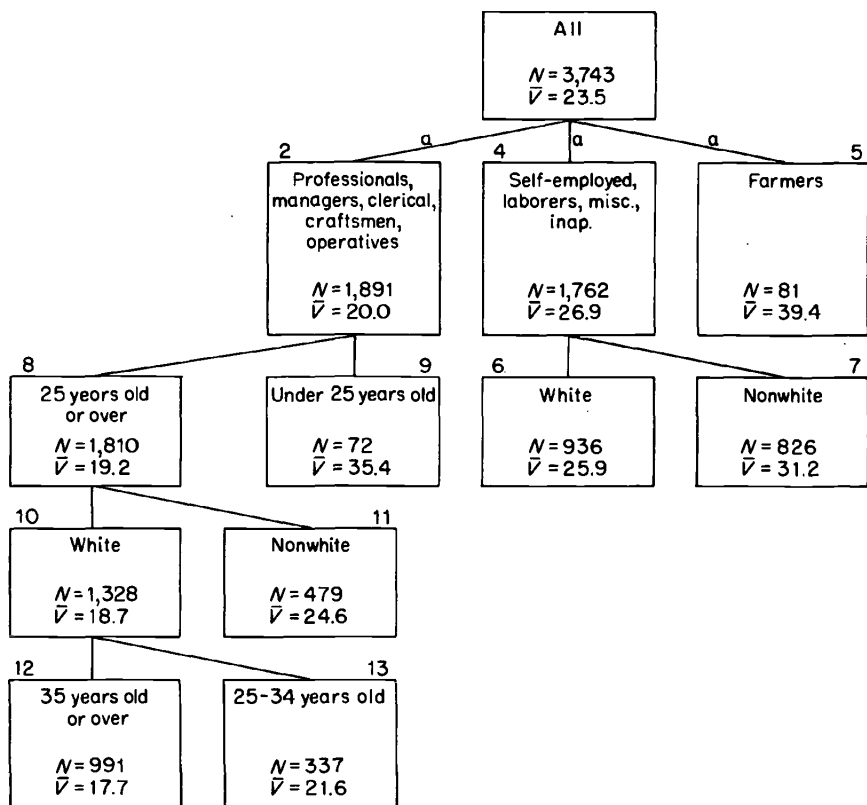
<sup>a</sup> In this analysis only those families with unchanged heads are included.

studies, with the Debt Panel exhibiting the largest impact of accounting period variation.

While the impact of lengthening the accounting period may not have a powerful effect on the income distribution of the entire sample, it may affect significantly the income distribution of selected subgroups. The groups most likely to be affected by accounting period variation are those groups with the highest income instability over the period of the panel. To search out these subgroups, we employ an Automatic Interaction Detection Program (AID) analysis on individual coefficients of variation,  $^{13} V_i = 100 (\sigma_i/\bar{Y}_i)$ . $^{14}$  The results, presented in Chart 1, indicate that

$^{13}$  For a description of this procedure, see John A. Sonquist, Elizabeth Lau Baker, and James N. Morgan, *Searching for Structure* (Ann Arbor: Survey Research Center, University of Michigan, 1971. Revised, 1973.).

$^{14}$  The coefficient of variation may be thought of as a measure of relative



**CHART 1:** Coefficient of Variation on Family Money Income for Families With Same Head, 1968-71, OEO Panel

the most important determinant of income instability is occupation. Farmers, by far, have the highest instability; white collar and skilled occupations are at the other end of the spectrum; the self-employed, laborers, and so forth, are somewhere in between. Another important determinant of income instability is age, exhibiting an inverse relationship. The third important determinant is race, with nonwhite incomes exhibiting greater instability than that of whites. Demographic characteristics which proved to be less important determinants of income instability include sex, education, region, size of city, and family size.

To examine the differential impact of accounting period variation for groups of various instability levels, we present in Table 4 the seven final subgroups of the AID tree. As expected, accounting period variation tends to have greater impact on subgroups with relatively high income instability. For example, groups 5, 7, and 9 have both high instability levels and relatively large declines in inequality as a result of lengthening the accounting period from one to four years. The relation between instability and reduction in inequality, however, is not monotonic. Group 13 (25- to 34-year-old whites who were professionals, managers, clerks, craftsmen, or operatives), for example, has a relatively low instability level but the second highest decline in inequality. We may, therefore, conclude that there is a differential impact of accounting period variation for selected subgroups. The tendency is for groups with high instability levels to exhibit a greater impact of accounting period variation. The relationship, however, is not strong.

Intuitively, one would expect that the less homogeneous a group's income trajectories (or trends), the greater the reduction in inequality that results from lengthening the accounting period.<sup>15</sup> That is, differences in income trends within a group are

variance. Each individual's standard deviation is divided by his own average income level. If the standard deviation were one quarter the size of income, for example,  $V_i = 25.0$ .

<sup>15</sup> We define income trajectory or trend as the slope of a regression of income on "time." The equation for the slope reduces to:

$$b = \frac{\sum_{t=1}^4 Y_t T_t}{\sum_{t=1}^4 T_t^2} = \frac{1.5Y_4 + .5Y_3 - .5Y_2 - 1.5Y_1}{5},$$

where  $T = -1.5, -.5, .5, 1.5$ .

TABLE 4 Impact of Accounting Period Variation for Selected Subgroups, Office of Economic Opportunity Panel<sup>a</sup>

<i>Group Number</i>	<i>Description</i>	<i>N</i>	<i><math>\bar{V}</math></i>	<i>One-Year Gini Coefficients</i>	<i>Four-Year Gini Coefficients</i>	<i>Relative Decline in Inequality, 1968-71</i>
5	A. Farmers	83	39.4	.35	.32	8.6
	B. Self-employed, laborers, misc.					
6	1. White <sup>b</sup>	937	25.9	.43	.41	4.7
7	2. Nonwhite <sup>c</sup>	828	31.2	.41	.36	12.2
	C. Professionals, managers, craftsmen					
9	1. Under 25 years old	75	35.4	.33	.23	30.3
	2. 25 years old or over					
11	a. Nonwhite <sup>c</sup>	485	24.6	.29	.28	3.4
	b. White <sup>b</sup>					
13	(1) 25-34 years old	339	21.6	.25	.21	16.0
12	(2) 35 years old or over	992	17.7	.27	.26	3.7
1	All	3,739	23.5	.36	.35	2.8

<sup>a</sup> An examination of the nine extreme cases revealed that in four cases errors had been made in recording one year's income level. The remaining cases represented exceptional but legitimate income fluctuation. The latter cases are included in this analysis.

<sup>b</sup> Included in the white category are 32 cases coded "other" on race (i.e., Orientals, Filipinos).

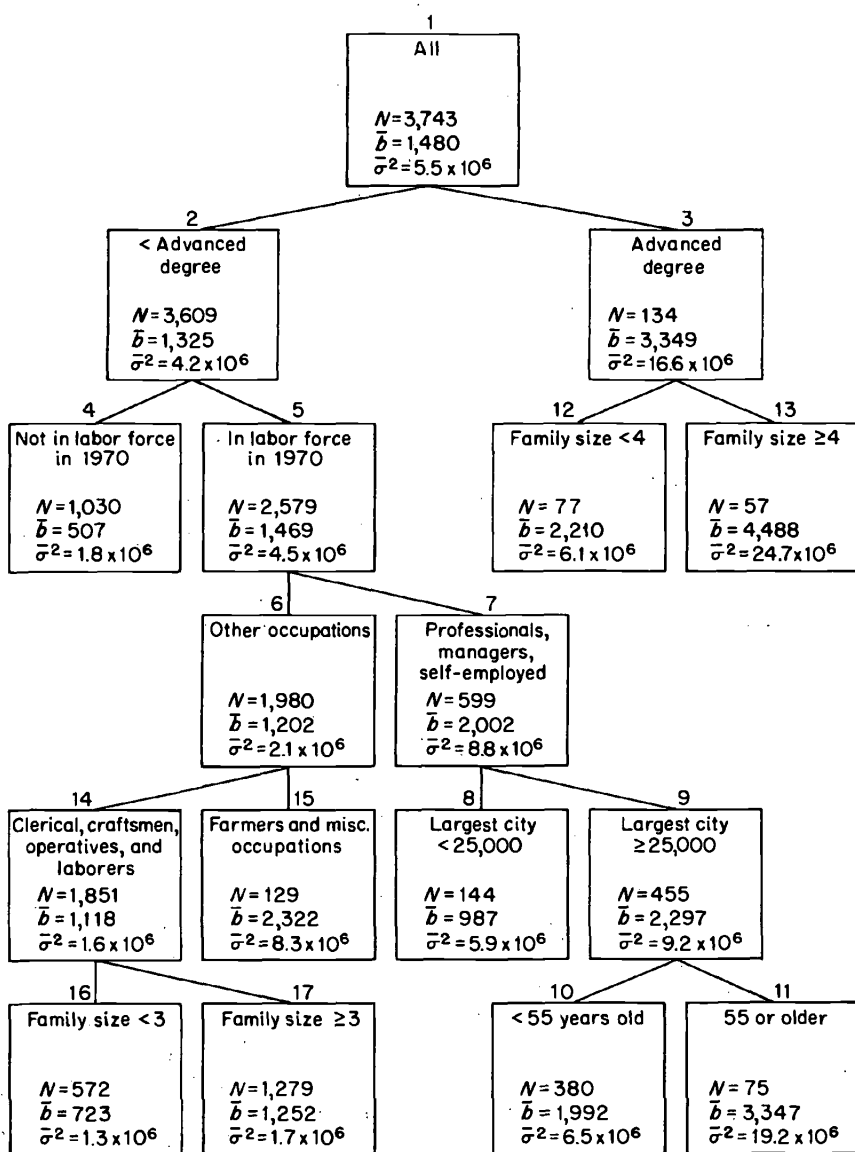
<sup>c</sup> Included in the nonwhite category are 87 cases coded Spanish American, Puerto Rican, Mexican, or Cuban.

expected to reduce inequality. The results of Table 5, however, indicate that the opposite is true. Groups with relatively large trend variation (i.e., groups 6, 11, and 12) have the lowest relative decline in inequality. On the other hand, groups with more homogeneous trends (i.e., groups 7, 9, and 13) have the highest relative declines in inequality. These results partly reflect the fact that, within any group, those with high income levels tend to have the steepest trends, and those with low incomes the flattest trends. As a result of this positive correlation between trend and level, inequality may actually increase, rather than decrease, over time. At the same time, however, there is a tendency for incomes to regress from unusual initial income levels, thereby leading to reduced inequality over time. These two forces, operating in opposite directions, determine the extent of inequality reduction that results from lengthening the accounting period. Thus, for those subgroups with large variation in trends, trend differences are expected to dominate the regression effect. On the other hand, for subgroups with relatively homogeneous trends, the regression effect is expected to be the dominant force. We, therefore, expect to observe greater reduction in inequality for subgroups with relatively homogeneous trends.

In order to isolate subgroups with various levels of trend variation we run an AID analysis on income trend level. Since average trend is positively correlated with the variance of the trends within a group, the AID analysis, in effect, isolates

**TABLE 5** Initial Income, Trend, Trend Variance, and Relative Change in Inequality for Selected Subgroups

<i>Group Number</i>	<i>1967 Family Income (Dollars)</i>	<i>Family Income Trend (Dollars)</i>	<i>Trend Variance (10<sup>6</sup>)</i>	<i>Relative Change in Inequality</i>
5	6,670	764	5.1	-8.6
6	6,498	400	2.9	-4.7
7	4,517	337	1.4	-2.2
9	5,039	1,164	2.3	-30.3
11	7,720	1,204	2.6	-3.4
13	8,841	1,039	1.9	-16.0
12	11,667	1,042	2.9	-3.7
Total	8,612	779	2.8	-2.8



**CHART 2: AID on Family Money Income Trend: Families With Same Head, 1968-71**

Group Number	Description	N	Trend Variance (10 <sup>6</sup> )	One-Year Gini Coefficient	Four-Year Gini Coefficient	Relative Change in Inequality
12	A. Advanced degree					
13	1. Family size < 4	77	6.1	.31	.29	-6.5
	2. Family size ≥ 4	57	24.7	.25	.25	0.0
4	B. No advanced degree					
	1. Not in labor force (1970)	507	1.8	.42	.39	-7.1
	2. In labor force (1970)					
15	a. Farmers and miscellaneous occupations	129	8.3	.33	.29	-12.1
	b. Professionals, managers, self-employed					
8	(1) Largest city < 25,000	144	5.9	.31	.27	-12.9
10	(2) Largest city ≥ 25,000					
11	(a) Under 55 years old	380	6.5	.28	.24	-14.3
	(b) 55 years old or older	75	19.2	.30	.31	3.3
	c. Clerical, craftsmen, operatives and laborers					
16	(1) Family size < 3	575	1.3	.33	.30	-9.1
17	(2) Family size ≥ 3	1,279	1.7	.25	.23	-8.0
1	All	3,743	5.5	.36	.35	-2.8



subgroups with different levels of variance in the trends. The results, presented in Chart 2, indicate that the group that has the highest trend level, as well as the highest trend variance, is composed of families with four or more members in which the family head has an advanced degree. The group with the lowest trend variance, but not the lowest trend level, is composed of one- or two-member families in which the head has less than an advanced degree and is employed in the clerical, craftsman, operative, or laborer classification.

In Table 6 we present the nine final subgroups and the impact of changing the accounting period from one year to four years. The results indicate that accounting period variation has less of an impact on subgroups with substantial variation in income trends than on subgroups with relatively homogeneous income trends. For example, groups 11 and 13, the groups with the highest trend variances, show either no reduction or a slight increase in inequality as the accounting period is lengthened from one to four years. The remaining subgroups exhibit reductions in inequality that range from 6.5 percent to 14.3 percent.

Thus, we may conclude that there are indeed two forces in operation: one that leads to increased inequality due to the permanent spreading of individual incomes, and another that leads to diminished inequality due to the regression of individual incomes toward a permanent level.

## CONCLUSION

What we have been examining is still a far cry from an assessment of the distribution of well-being in a society. We said at the start that well-being depends on lifetime income level and its pattern (instability), but we have been dealing with distributions of income over shorter periods. We do not have the data to study income distributions over longer periods, but that is only the first problem. Families do not stay intact over lifetimes, price levels change, and levels of real income also change. Consequently, we must be careful in making evaluative judgments on the basis of the data presented. What we can say is that for the population as a whole, the unit of analysis and the measure of income seem to have more effect on measures of inequality than the length of the accounting period. For some subgroups, however, the impact of accounting period variation is substantial.