LONG TERM CHANGE IN PERSONAL INCOME DISTRIBUTION: THEORETICAL APPROACHES, EVIDENCE AND EXPLANATIONS

T. Paul Schultz

January 1972

P-4767

LONG TERM CHANGE IN PERSONAL INCOME DISTRIBUTION: THEORETICAL APPROACHES, EVIDENCE AND EXPLANATIONS

T. Paul Schultz*
The Rand Corporation, Santa Monica, California

It is a commonly accepted fact that inequality in personal incomes in the United States diminished up to and during the Second World War, but that this long term trend was not sustained during the last 25 years. Given the unavoidable differences of opinion that attach to the meaning and measurement of income inequality, even this most generally observed fact is not free of controversy. The purpose of this paper is to bring discussion to a sharper focus on certain specific facts and their alternative interpretations. Advancement in the empirical study of the distribution of personal income awaits agreement on the most significant dimensions of the phenomenon. These attributes depend on the questions asked, and ultimately on the specification of models that promise to answer them.

In the first section, I present the logic for adopting one conceptual and statistical approach in measuring and analyzing income inequality.

---

*In the preparation of this paper I appreciate the programming assistance of Kenneth Maurer, the conscientious data coding of Dianna Pfeifer, and the helpful comments on an earlier draft by M. J. Bowman, J. S. DaVanzo, J. J. McCall, R. R. Nelson, J. P. Newhouse, J. Mincer, T. W. Schultz and C. Wolf, Jr. None are responsible, of course, for remaining errors or shortcomings.

A substantially shortened version of this paper was presented at the American Economics Association Meetings December 28, 1971, New Orleans, and will be published in the American Economics Review Papers and Proceedings, May 1972.

In the second section, I assemble empirical evidence on income inequality from 1939 to 1970. But to interpret the evidence and illuminate the forces responsible for secular trends will require a brief survey of recent contributions to the human capital literature. In traditional form, I conclude by stressing the need for new directions for research.

I. MEASUREMENT AND MEANING OF INCOME INEQUALITY

One traditional objective of studies of income distribution is to discover a single or modest number of parameters that efficiently summarize size distributions of personal income. This search has produced numerous papers over the years extolling the merits of particular functional forms as approximations for the frequency distribution of incomes. I think it is fair to say, nonetheless, that there has emerged no single "best fit," in large part because for alternative purposes data are arrayed by different recipient units and income is measured differently.

In the choice of a measure of income inequality, reliance on a normative or positive conceptual framework has greater attraction than simply curve-fitting. There are two reasons to be interested in income inequality: first, social welfare is thought to depend on both the level and personal distribution of income; second, economic analysis may usefully describe some of the systematic factors affecting income inequality. These two approaches to income inequality are concerned with different problems, attempting in the first instance to assign a social cost to disparities in personal income and in the second instance to attribute these disparities to various causes. Measurement of inequality as implied by one approach need not be suitable to the other, although overlap would prove convenient.

From a normative view, Dalton observed in 1930 that "the economist is primarily interested, not in the distribution of income as such, but in the effect of the distribution of income upon the distribution and total amount of economic welfare, which may be derived from

income" (p. 348). This linkage between income and welfare implies the specification of a social utility function and embodies obvious value judgments. In a recent paper Atkinson notes the parallel between the ranking of distributions of outcomes in decisionmaking under uncertainty and the ranking of income distributions by a generally prescribed social utility function. Thus, following Atkinson's formulation, the degree of "inequality-aversion" one professes alters one's preferred ordering of observed distributions of personal income. For a general class of social utility functions proposed by Atkinson, a single parameter, ϵ, reflects social sensitivity to income transfers at different relative income levels.[1] Most conventional measures of inequality do not imply, by this standard, a uniform degree of inequality aversion with the exception of the variance of the logarithms of income for which $\epsilon = 2$.[2] Since the log variance of income attaches equal importance to equal relative differences in income, it attributes greater weight to equal transfers to the poor than to the rich. Given the general concern expressed over conditions of the poor, the choice of $\epsilon = 2$ or perhaps more would not appear to misrepresent society's egalitarian preferences.[3]

The second and more attractive basis for arriving at a definition of income inequality is to adopt a measure that conforms to the requirements of an analytical model that promises to describe the distribution and identify the causes of income inequality. The most thoroughly elaborated approach to the economic determination of income inequality is that associated with the works of Becker, Mincer, and Chiswick.[4] Using the concept of human capital as the principal

systematic determinant of differences in labor earnings, a number of propositions are deduced about cohort age profiles and inequality of earnings by schooling and on-the-job experience. The measure of income inequality that is useful for the human capital approach is the variance of the logarithms of income.[5] Thus, the log variance has the convenient attraction as a single parameter of income inequality both because of the consistent and plausible nature of the social welfare function it implies and because it conforms to the dependent variable determined by the human-capital model of earnings inequality.

Concept of Income and Income Recipient Unit

Having indicated why I shall adopt a particular measure of income inequality, there still remains the task of defining the recipient unit and the concept of income consistent with normative and positive concepts of economics. It is difficult to interpret inequality of income among household units from a normative point of view because the composition of household units varies across social groups at one point in time and in a group over time, and this variation is not independent of the underlying distribution of resources among persons.

Schemes are often proposed to cope with these normative problems of non-comparability and horizontal equity -- for instance, a couple with five children and retired parents in the household has greater consumption needs than a childless couple.[6] But standardization of data neglects the margin of choice that is likely to influence the composition of household units. How individuals choose to arrange themselves into household units, how they divide their time among labor market, home production and leisure activities, and how many

children couples seek -- each of these decisions influences measured inequality of income among them. Each decision is also likely to be influenced by the economic endowments of individuals as well as to other social and economic conditions.[7]

Unfortunately these well-known problems cannot be resolved now except by avoiding altogether the household unit as a basis for inequality comparisons; subsequent analysis therefore concentrates on the distribution of income among individual persons. Numerous problems still exist in the study of income data for persons, but at least they are more manageable in principle, even if in practice they are severe for the study of secondary workers. Nonetheless, the study of household units requires the formulation of wholly new analytical concepts.

The time frame for comparisons of income inequality would logically be the individual's life cycle. Not only is the alleged link between equality and equity forged in terms of the distribution of lifetime (or even intergenerational) opportunities, the human capital framework also emphasizes the role of individual investment decisions as a determinant of different age-earnings profiles. Both approaches to the analysis of income inequality call for cohort time series information, but in lieu of these more appropriate data, empirical analysis has in fact almost always relied on contemporaneous cross-sectional data, interpreting differences among age groups, adjusted perhaps for neutral secular trends in productivity, as evidence on the behavior of income inequality over the life cycle. This jump from cross-sectional data to time series inferences deserves far more study than it has received.

Approaches to income inequality diverge, however, in defining a working concept of income. Nonhuman wealth is undoubtedly a most

important source of "inequitable" differences in personal lifetime opportunities, leading the normative analyst to prefer the broadest possible concept of labor and capital income including, if possible, capital gains and inheritances. From a positive point of view, human capital theory has implications primarily for the returns to labor as augmented by human capital, calling for a concept of "income" no broader than labor earnings of perhaps only wages and salaries. Another related class of problems is concealed from view by necessary reliance on measures of pretax money income, that neglect income taxes, income in kind[9] and nonpecuniary benefits associated with different investment, occupational, and migration choices made by individuals over their lifetime.

Variation in Time Worked

A final difficulty for interpreting income inequality is the variation in the amount of time that individuals work in the labor market. This variation in hours worked can be attributed to both supply and demand factors, but integrated analysis has not clearly differentiated their respective roles: (1) individuals can invest time to enhance future productivity, given their abilities, cost of investable funds and time and risk preferences; (2) individuals allocate remaining time among market production, nonmarket and consumption (leisure) activities, given their preferences for market and nonmarket goods; and (3) individuals may not find employment for the wage they expect to receive and therefore go unemployed.[10]

Earnings are observed in the market gross of returns on past human capital investments and net of current time invested in further training.

Therefore, the profile of potential (full time) earnings and life cycle human capital investments cannot be derived uniquely for an individual from his observed age profile of earnings. The existence of depreciation and obsolescence of human capital complicates further the underdetermined character of the human capital model. Strong assumptions are required to constrain the life cycle investment process to draw inferences about its nature from available data. Ben-Porath [1968, 1969] and more generally Rosen [1970, 1971, 1972] derive life cycle investment behavior from attractive optimizing models, but the value of their models as a framework for empirical analysis is yet to be clearly demonstrated. Mincer's [1970a, 1971b] formulation of this problem, although arbitrary in assuming a linear or exponential rate of decline of time equivalent postschooling investment [see also T. Johnson], has, on the contrary, shown its ability to distinguish between important sources of earnings inequality. A novel implication of Mincer's formulation is the notion of an "overtaking period," seven to ten years after on-the-job training commences, when the log variance of cohort earnings can be interpreted as a measure of inequality in lifetime earnings opportunities. The lack of a satisfactory empirical approximation for postschooling investments for women and secondary workers currently limits the application of Mincer's model to supply considerations underlying earnings inequality among prime-age men. Promising approaches to preschool investments and ultimately childhood nutrition [Selowsky and Taylor] should also be accommodated within the evolving generalized household human capital framework.

The second source of variation in time worked in the labor force is the allocation of "uninvested" time between market and nonmarket activites. Empirical study of this behavioral process is as yet crude for want of satisfactory measures of nonmarket productivity. Since only a measure of the pecuniary product of time allocated to the labor market is observed, inequality of earnings opportunities can only be expressed per unit time worked. Although wage rate comparisons are one response to this problem, another is to restrict analysis to annual earnings of those fully employed, i.e., according to the current Census Bureau definition, persons working 35 or more hours per week for 50 to 52 weeks a year. To the extent that time worked is positively correlated among individuals with wage rates, earnings inequality among the fully employed will be less than wage inequality.

The third source of variation in overtime in the supply of labor to the market, unemployment, is generally attributed to demand factors. If our central concern is with secular change in income inequality, there is reason to limit our analysis to periods in the business cycle when labor markets are equally tight. But with data for 1939 and the postwar period, no comparisons are possible between 1939 and any postwar year, for postwar levels of unemployment have fortunately not reached 1939's 17.2 percent of the civilian labor force. The incidence and duration of unemployment may also differ by age, education and possibly experience classes, and thus a part of the association between annual earnings and education can be attributed to the partial correlation between hours worked and education and thus incorporated into the supply model [Becker, 1964; Oi; Bowman and Anderson; Mincer, 1971].[11]

From this review of the literature, it is clear the concept of income that both normative and positive analysts seek is a measure of inequality in lifetime income opportunities. The human capital model interprets differences in earnings among schooling groups as due to life cycle investment decisions modified by the correlation among preschooling, schooling and postschooling investments, capital market imperfections and time and risk preferences [Friedman, 1958]. Inequality within schooling groups is then viewed as an approximation of measurement error (i.e., unobserved variations in postschooling investment and quality of schooling) plus the underlying variance and covariance of individual ability and opportunity [Becker, 1967; Mincer, 1970b].

But this model by itself does not take account of the second and third sources of variation in the time worked by individuals. Except as human capital is linked to cyclical variation in education specific unemployment, unemployment does not yet fit comfortably within the human capital model of income distribution. Nor is this theory applicable to measured inequality among secondary workers whose life cycle attachment to the labor force is sporadic. This model is then most clearly applicable to earning inequality among fully employed male workers. Data for this group across age groups and over time are used in the next section to determine the extent of change in income inequality in the U.S.

II. SOME EMPIRICAL EVIDENCE: FACTS

Estimates of average income and the variance of the logarithms of income are reported in Tables 1 and 2 for all persons with income by sex and age. These annual estimates -- for the years 1947 through 1970 -- are based on published tabulations from the March Current Population Survey. The method of estimation used throughout this paper based on grouped data is described in the statistical appendix.

Overall Inequality

According to Table 2, income inequality, as measured by the log variance, has apparently increased substantially among both men and women since the Second World War. However, as I will show shortly, secular trends in labor force commitments of women and men confound in these data the underlying trends in inequality of wages or earnings opportunities. Among men 25 to 64 years of age, who are likely to have been full-time participants in the labor force throughout this period, income inequality has increased much less sharply. The variance of the logs of income among all males over 14 with income increased 78 percent over this 23 year period; inequality increased only 17 percent among men 25 and 64. Some of this increase, moreover, can be attributed to changes over time in the age composition.[12]

A large fraction of income inequality in a cross section is related to differences in the time persons work, as shown in Table 3 for 1939 and 1969. The log variance of wage and salary income in 1939 is four times as large among all men in the labor force as it is among those who worked a full 12 months. In 1969 all men with income exhibit

Table 1

ESTIMATES OF AVERAGE ANNUAL U.S. PERSONAL INCOMES BY SEX AND AGE: 1947-1970
(for persons 14 years and over with income in current dollars)

Sex/Age	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Male	2563	2692	2604	2894	3200	3356	3515	3539	3711	3975	4040	4177	4451	4627	4894	4956	5163	5378	5593	5709	6449	6925	7508	7956
14-19	706	660	569	607	699	724	744	679	604	640	607	579	635	628	609	635	646	753	867	919	1075	1097	1143	1225
20-24	1652	1911	1815	1972	2327	2311	2296	2290	2436	2657	2618	2647	2792	2809	2952	2967	2935	3150	3467	3729	3868	4020	4254	4497
25-34	2658	2868	2831	3059	3454	3681	3879	3767	3979	4395	4567	4663	4926	5127	5342	5357	5726	6062	6267	6889	7285	7840	8568	8917
35-44	3211	3357	3200	3604	3983	4093	4407	4406	4606	5107	5196	5411	5853	6179	6365	6644	6856	7218	7521	8168	8696	9387	10225	10792
45-54	3213	3204	3185	3539	3728	4072	4246	4377	4688	4925	5097	5211	5506	5903	6201	6394	6647	6903	7431	8000	8599	9094	10046	10776
55-64	2711	2858	2695	2993	3279	3442	3701	3732	3993	4149	4184	4495	4988	5011	5517	5571	5801	5867	6147	6789	7258	7978	8617	9153
65+	1695	1642	1751	1805	1869	2094	2092	2118	2238	2292	2210	2251	2512	2674	2899	2878	3003	3262	3107	3259	3614	3954	4271	4476
Female	1258	1266	1256	1300	1416	1493	1587	1581	1609	1631	1707	1735	1820	1847	1946	2008	2041	2183	2382	2414	2686	2831	3008	3230
14-19	637	654	609	591	650	808	619	716	614	660	645	603	573	598	574	699	579	592	892	765	971	905	927	940
20-24	1233	1346	1308	1370	1428	1541	1602	1662	1626	1719	1782	1779	1829	1944	1891	1906	2039	2169	2562	2386	2550	2708	2874	3038
25-34	1327	1445	1429	1472	1653	1712	1856	1794	1781	1853	1981	1932	2045	2120	2275	2171	2273	2404	2641	2750	3118	3237	3419	3747
35-44	1469	1483	1321	1513	1686	1786	1818	1837	1844	2035	2126	2136	2159	2292	2543	2442	2495	2687	2851	2959	3308	3439	3708	3999
45-54	1494	1554	1466	1532	1598	1815	1971	1903	2055	2076	2136	2224	2377	2403	2582	2656	2769	2857	3113	3212	3578	3739	4086	4315
55-64	1271	1202	1384	1333	1473	1659	1597	1712	1849	1852	1882	2003	2096	2048	2177	2460	2510	2583	2796	2888	3139	3384	3709	3837
65+	984	809	721	779	793	964	1027	1043	986	998	1049	1050	1172	1180	1210	1297	1331	1531	1504	1616	1749	1975	2123	2275
Both Sexes	2148	2225	2158	2350	2574	2696	2809	2823	2925	3082	3147	3198	3451	3526	3705	3769	3876	4047	4247	4518	4834	5103	5613	5849

Source: Derived from Current Population Reports, Consumer Income, Series P-60, Bureau of the Census.

Table 2

ESTIMATES OF THE VARIANCE OF THE LOGARITHMS OF U.S. PERSONAL INCOME BY SEX AND AGE: 1947-1970
(among persons 14 years and over with income)

Sex/Age	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970
Male	.6875	.6867	.7536	.7754	.7295	.7251	.8350	.8534	.8798	.9042	.9272	.9636	.9751	1.022	1.069	1.034	1.062	1.076	1.092	1.047	1.116	1.128	1.163	1.187
14-19	.8184	.7334	.9579	.6760	.9051	.7484	1.145	1.052	.9795	1.092	1.052	1.223	1.099	1.055	1.123	1.146	1.039	.8567	.9476	.8754	1.013	.9771	.9560	1.038
20-24	.4082	.3861	.4495	.5136	.4690	.4398	.5664	.5289	.5291	.5884	.6044	.6498	.6428	.6887	.7547	.7425	.8065	.7829	.7802	.7534	.8023	.7754	.7605	.8226
25-34	.3515	.3548	.3791	.3783	.3108	.3117	.3908	.4449	.4444	.3963	.4197	.4447	.4422	.4276	.4943	.4482	.4407	.4258	.4258	.3906	.3866	.3891	.4179	.4578
35-44	.4938	.4448	.5378	.4709	.4099	.4257	.4668	.5400	.4659	.4908	.5184	.4891	.4779	.5542	.5583	.5513	.4903	.4947	.5408	.4558	.4588	.4543	.4687	.4862
45-54	.5407	.5852	.6804	.6425	.5496	.5306	.6105	.7018	.6938	.6923	.6968	.7269	.6917	.7190	.7457	.6782	.6372	.6240	.6398	.5730	.5457	.5672	.5722	.5854
55-64	.6242	.7132	.8309	.7941	.7600	.6843	.7272	.8103	.8004	.8285	.7956	.8173	.8999	.8619	.8383	.8460	.8741	.8318	.8240	.7923	.7660	.7424	.7392	.7676
65+	.9647	.8398	.9568	.9961	.9427	.8392	.9762	.8964	.8450	.7881	.7252	.6896	.7328	.7109	.7642	.6488	.6509	.7270	.6318	.6568	.6872	.6598	.6687	.6408
Female	.6702	.6811	.7203	.7755	.7986	.8248	.8470	.8484	.9066	.9259	.9523	.9957	1.006	1.003	1.050	1.035	1.052	1.072	1.095	1.077	1.136	1.108	1.126	1.169
14-19	.8146	.8198	.8952	.6400	.6971	.8832	1.004	.7596	.6482	1.006	.8485	.8648	1.207	1.227	1.250	.9886	1.270	1.263	1.287	.8997	1.087	.9954	.9641	1.036
20-24	.4661	.5085	.5146	.5554	.5560	.6424	.6054	.6233	.6977	.7332	.6836	.8255	.8344	.8582	.9091	.8817	.8709	.8961	.9586	.9814	.9732	.9292	.8822	.9310
25-34	.5292	.5980	.6469	.6879	.6686	.7914	.7895	.7775	.8213	.9203	.9060	.9745	.9971	1.003	1.045	1.008	1.048	1.047	1.055	1.056	1.110	1.099	1.118	1.189
35-44	.6084	.6244	.6864	.7381	.7370	.7801	.7389	.7953	.8875	.9913	.9142	.9226	.9633	.9689	1.030	1.016	1.008	1.045	1.010	1.004	1.017	1.025	1.103	1.079
45-54	.7085	.6936	.7460	.4306	.7682	.7777	.8394	.8176	.8509	.9034	.8925	.9132	.9514	.9634	1.000	.9843	1.055	.9628	.9655	.9599	.9688	.9536	1.005	1.041
55-64	.7738	.7228	.7768	.8070	.8249	.8546	.7771	.8835	.9339	.9403	.9421	1.056	.9830	.9594	1.020	1.063	1.058	1.043	1.048	1.023	1.023	1.030	1.074	1.095
65+	.9857	.5198	.4901	.5556	.5590	.6254	.6597	.6429	.5516	.7506	.7709	.6775	.5342	.5246	.5078	.5137	.5211	.5935	.5163	.5672	.6288	.5988	.6002	.5772
Both Sexes	.7852	.8114	.8708	.9369	.9298	.9338	1.006	1.017	1.081	1.129	.1146	1.184	1.257	1.251	1.300	1.267	1.297	1.302	1.304	1.324	1.353	1.338	1.388	1.406

Source: Derived from Current Population Reports, Consumer Income, Series P-60, Bureau of the Census.

Table 3

LOG VARIANCE OF INCOMES BY TIME WORKED,
SEX AND RACE IN 1939 AND 1969

1939 Wages and Salaries	All Persons in Labor Force	Persons With Wages and Salaries[a]	Worked 12 Months in 1939[a]
Males	2.206	.7852	.4708
White	b	.7377	.4155
Non-White	b	.6221	.4383
Females	1.443	.7905	.4616
White	b	.7730	.3504
Non-White	b	.5970	.4062

1969 Earnings[c]	All Persons With Income	Worked Last Year	Work at Full-Time Job	Worked 50-52 Weeks at Full-Time Job
Males	1.282	1.265	.7566	.4205
Whites	1.271	1.253	.7338	.4118
Negros	1.144	1.137	.7377	.3386
Females	1.280	1.308	.8286	.3207
Whites	1.283	1.269	.8135	.3058
Negros	1.206	1.204	.8784	.3854

Notes:

[a]Excluding emergency workers.

[b]Not tabulated in 1940 Census Publications.

[c]Income data by time worked are available annually from the CPS after 1956. From 1956 to 1970 the log variance of income increased among all workers by 30 to 50 percent but evidenced no trend among the fully employed males and females.

income inequality three times as large as those with a full time job for 50 to 52 weeks.

For either positive or normative analyses of income inequality, it is clearly important to understand why persons in a cross section work different amounts of time in the labor force. Changes in the distribution of income or earnings opportunities over time may be obscured by changes in the time persons work, due to cyclical unemployment, extended schooling, women's participation and timing of retirement. Time series analysis, therefore, might better focus on incomes of persons by age, sex, and where possible race, who are fully employed in the labor force.[13] For at least men between the ages of 25 and 64, the difference between aggregate income inequality and income inequality among the fully employed can be attributed largely to the incidence of unemployment.

Inequality among the Fully Employed

Inequality by age in wage and salary income in 1939 is contrasted with inequality in earnings in 1967 in Table 4.[14] Over this 28-year period inequality among fully employed workers increased among men and women less than 25 years old, but was otherwise relatively constant for men and decreased among women in each older age group. If the differences in Census and CPS concepts can be neglected, these data support several major conclusions:

One, inequality among fully employed men 25 to 64 exhibited remarkable stability.

Two, most of the reduction in earnings inequality in the United States between 1939 and the present can be attributed to the postwar reduction in unemployment.

Three, changes in employment among women over the age of 25 with income

Table 4

EARNINGS OF FULL-TIME WORKERS: 1939 AND 1967
BY SEX AND AGE

Sex and Age:	1939 Wages and Salaries of Full-Year Workers		1967 Earnings of Civilians Working Year-Round Full-Time	
	Average	Log Variance	Average	Log Variance
Males	1,590	.4656	8,357	.4427
14-19	512	.4671	2,863	.9313
20-24	913	.3410	5,353	.4235
25-34	1,405	.3318	7,811	.2802
35-44	1,824	.3829	9,249	.3463
45-54	1,953	.4257	9,246	.3973
55-64	1,849	.5019	8,375	.5130
65+	1,639	.6677	7,332	.7753
Females	884	.4612	4,632	.4049
14-19	489	.4718	3,299	.7767
20-24	727	.3188	4,056	.3656
25-34	917	.3706	4,731	.3287
35-44	1,012	.4917	4,708	.3799
45-54	1,008	.5664	4,893	.3735
55-64	930	.6343	4,766	.4096
65+	797	.7894	4,721	.6975
Both Sexes	1,410	.5299	7,623	.4658

Source: Derived from 16th Census of The United States: 1940, Population, The Labor Force; Wage and Salary Income: in 1939, table 6a, p. 106; Current Population Reports, Consumer Income, Series P-60, No. 64 (October 6, 1969), table 19, p. 52.

account fully for the apparent postwar increase in income inequality for women shown in Table 2.

Four, the increase in inequality among young men and women less than age 25, noted in Table 2, is not caused solely by individual variation in time employed, but may be linked to increasing variation in postschooling investment behavior.

Although I have been unable to construct a time series on earnings of fully employed workers by schooling, age and sex, Tables 5A and 5B summarize evidence for 1967.[15] Several regularities in these cross-sectional data are of interest and may parallel cohort time series, were they available. Full-time earnings inequality does not monotonically increase with age within schooling groups as predicted by most simple stochastic models of income distribution; inequality among men is lowest in either the 35-44 or 25-34 age group, while there is no regular age pattern among women. Inequality does not increase systematically with levels of education. Income inequality among women within schooling groups appears to systematically decline with increased schooling.

The most frequently noted cross-sectional characteristics of income inequality by age and education are therefore primarily associated with variation in time worked by these groups, and are much less important in explaining inequality among full-time workers. These findings suggest to me that the more salient differences in earnings inequality may not have their origin in supply factors as is typically assumed by the human capital approach. Rather, variation in time worked, which may be largely demand determined, appears to be an important source of measured inequality.[16]

Women's average full-time earnings by age have changed in shape

Table 5A

EARNINGS OF MEN: WORKING YEAR-ROUND FULL-TIME

IN 1967 BY AGE AND SCHOOLING

Years of Schooling	25 and Over	25-34	35-44	45-54	55-64	65 and Over
			Average Earnings			
1-7	5,188	4,814	5,221	5,385	5,277	4,772
8	6,589	5,747	6,503	7,011	6,672	6,232
9-11	7,306	6,411	7,516	7,807	7,440	7,348
12	8,490	7,602	8,747	9,311	8,777	7,612
13-15	9,911	8,407	10,408	11,012	10,681	9,176
16+	13,342	10,445	14,228	15,233	15,366	13,642
All	8,656	7,811	9,249	9,246	8,376	7,332
			Variance of Log Earnings			
1-7	.4190	.3853	.3051	.4097	.4984	.5072
8	.3637	.2562	.3308	.3202	.3657	.7449
9-11	.3255	.3023	.2477	.2865	.4022	.8040
12	.2728	.1980	.2627	.2766	.4084	.6879
13-15	.2809	.1993	.1968	.3528	.4638	.7260
16+	.3625	.2452	.3420	.3814	.4638	.9727
All	.3974	.2802	.3463	.3973	.5130	.7753

Source: Current Population Reports, Consumer Income, Series P-60, N., 64 (October 4, 1969), table 20, pp. 53-56.

Table 5B

EARNINGS OF WOMEN: WORKING YEAR-ROUND FULL-TIME

IN 1967 BY AGE AND SCHOOLING

Years of Schooling	25 and Over	25-34	35-44	45-54	55-64	65 and Over
			Average Earnings			
1-7	3,073	2,951	2,871	2,865	3,069	4,094*
8	3,651	3,274	3,583	3,838	3,674	3,489
9-11	3,980	3,913	3,903	4,047	4,119	n.a.
12	4,698	4,558	4,624	4,850	4,785	4,988
13-15	5,614	5,234	5,683	5,888	5,594	n.a.
16+	7,303	6,316	7,384	7.953	7,654	n.a.
All	4,799	4,731	4,708	4,893	4,766	4,721
			Variance of Log Earnings			
1-7	.4826	.4554	.4575	.3825	.4354	.9188*
8	.3890	.4316	.3765	.3549	.3723	.5170
9-11	.3566	.3645	.3022	.3538	.3587	n.a.
12	.2783	.2370	.3171	.2632	.2992	.3631
13-15	.3271	.3380	.3184	.3127	.2442	n.a.
16+	.2868	.2551	.2793	.2672	.2852	n.a.
All	.3911	.3287	.3800	.3735	.4096	.6975

Note:

*Uncommon concentration of CPS sample in next to highest income bracket. Probably sampling variability.

Source: Current Population Reports, Consumer Income, Series P-60, N., 64 (October 4, 1969), table 20, pp. 53-56.

from 1939 to 1967, as shown in Table 4. In the earlier period they were similar to men's increasing sharply to age 35-44; in 1967 they are virtually flat from age 25 to 64. Even within schooling groups, as estimated in Table 5B, average earnings record only a modest increase with age for women with 12 or more years of schooling.

Income Disparities by Race and Sex

Aside from differences in earnings by age and schooling, for which numerous explanations have been offered, interest also attaches to differences in the level of earnings between the races and sexes as a reflection of current and past discrimination in education, training and job opportunities. Table 6 indicates that the ratio of nonwhite to white full-time earnings have increased for men from .43 in 1939 to .63 in 1969, and from .40 to .81 for women. The nonwhite woman has advanced not only with respect to her white counterpart, but also relative to the nonwhite man. The same cannot be said for the white woman; the relative gap between earnings of white women and men has not changed appreciably from 1939 to 1969.

The frequently noted tendency for the earnings status of the Negro male to deteriorate relative to the white male as his educational attainment increases is not as evident in the relative earnings status of women to men by schooling (Table 7). Only in the age group 55 to 64 does women's relative earnings status decline monotonically with increased schooling. The low level of earnings and the flatness of age-earnings profiles (in the cross section) of women is often explained in terms of their sporadic attachment to the labor force. Home production and childbearing interrupt a woman's accumulation of labor

Table 6

RATIO OF NON-WHITE TO WHITE AND FEMALE TO MALE INCOMES, 1939-1969

	Non-White/White		Women/Men	
1939 Wages and Salaries	Women	Men	Non-White	White
All Persons with Some Wages and Salaries	.40	.42	.56	.59
Worked 12 months	.40	.43	.54	.58
1969 Earnings				
With Some Earnings	.80	.58	.56	.40
Worked Full-Time 50-52 Weeks	.81	.63	.71	.55

Source: 16th Census of the United States: 1940, Population: The Labor Force; Wage and Salary Income in 1939, Tables 5-5a, pp. 75-88; Current Population Reports, Consumer Income, Series P-60, No. 75 (December 14, 1970) Table 54, pp. 124-125.

Table 7

RATIO OF WOMEN'S AVERAGE EARNINGS TO MEN'S: 1967, YEAR-ROUND FULL-TIME WORKERS BY AGE AND SCHOOLING

Years of Schooling	25 and Over	25-34	35-44	45-54	55-64	65 and Over
1-7	.592	.613	.550	.532	.582	.858
8	.554	.570	.551	.547	.551	.560
9-11	.545	.610	.519	.518	.554	n.a.
12	.553	.600	.529	.521	.545	.655
13-15	.566	.623	.546	.535	.524	n.a.
16+	.547	.605	.518	.522	.498	n.a.
All	.554	.606	.509	.529	.569	.644
1939 Wages and Salaries All Persons with Wages and Salaries (not on relief)	.561	.653	.555	.516	.503	.486

Source: Tables 4 and 5.

n.a. = not available.

force experience and may impose a higher rate of depreciation on her stock of market specific skills than is the case with men. This hypothesis could account for the difference in earnings age profiles of the sexes, but it also implies that women would earn relatively more (per unit time) than men at younger ages when men presumably forgo much of their potential earnings to purchase job options that transmit valuable experiences [Rosen 1971]. In fact, the relative earnings status of women is only 10 percent greater in the youngest age group than for all ages together (Table 7).[17] Until a much broader and better economic explanation of earnings differences by sex is proposed and found valid, the claims of substantial discrimination in employment opportunities ring true.[18]

The Tenuous Link between Cross Sections and Time Series

Finally, the relationship between cross sectional age average-income profiles and time series of birth cohort average-income profiles can be briefly examined. Time series and cross-sectional evidence implicit in Table 1 and 2 is summarized in Table 8. Cross-sectional income levels peak for men at age 35-44 and for women at age 45-54, whereas time series age profiles for both sexes increase to the retirement ages 55-64. Secular growth in labor productivity is usually assumed to account for this divergence between cross sectional and time series evidence, and this growth factor is conveniently assumed to benefit all ages (and schooling) groups by an equal percentage amount. Becker [1964, p. 74] assumed

Table 8

AVERAGE PERCENTAGE CHANGE IN MEAN REAL INCOME AND VARIANCE OF LOG INCOME: 1947-1970[a]

	Mean Real Income		Variance of Log Income	
	Men	Women	Men	Women
A. Between Age Groups (24) (Cross Section)[b]				
25-34/35-44	18.	6.2	21.	0.1
35-44/45-54	-2.5	5.4	30.	-1.9
45-54/55-64	-14.	-11.	25.	9.2
B. Within Birth Cohorts (14) (Time Series)[c]				
25-34/35-44	69.	34.	30.	31.
35-44/45-54	37.	38.	34.	22.
45-54/55-64	18.	16.	28.	32.
C. Within Age Groups (14) (Time Series of Cross Sections)[d]				
25-34	38.	22.	12.	35.
35-44	42.	28.	4.3	26.
45-54	41.	31.	1.4	25.
55-64	42.	35.	5.2	19.

Notes:

[a]All conceivable pairwise comparisons from Table 1 and 2 (the number of which is reported in parentheses) are expressed as a percentage change from the base year, and the arithmetic average of these values is reported here. Since the consumer price index increased approximately 25 percent per decade between 1947 and 1970, this amount was subtracted from time series calculations of change in mean incomes.

[b]Cross-sectional comparisons are between adjacent ten-year age groups in the same year; for instance, between the income of men 25 to 34 and men 35 to 44 in every possible year, 1947 through 1970.

[c]Time series comparisons are between a ten-year cohort's income in a base year and ten years later; for instance, between the income of men 25 to 34 in 1947, etc., and men 35 to 44 in 1957, etc., minus the 25 percent adjustment for inflation of income levels.

[d]Time series of cross-sections are comparisons between specific ten year age groups ten years apart; for instance, between the income of men 25 to 34 in 1947, etc., and men 25 to 34 in 1957, etc., minus the 25 percent adjustment for inflation of income levels.

a 1.25 percent annual secular growth in male earnings; estimates for the postwar period implied by Table 8 suggest a three to five percent annual growth in male productivity (i.e., subtract from birth cohort time series increase the age group cross sectional increase to obtain implicit adjustment factor per decade).[19] Since the difference between time series and cross sectional profiles is greater for younger men, the age-neutrality assumption may be questioned. For women there is no assurance that the birth cohort increase is unaffected by compositional changes but the evidence suggests a two to four percent secular growth in labor productivity, favoring women less than 50 years of age.

Income inequality or log variance of incomes increases for men between 20 and 35 percent per decade both in the cross-section and time series, although the time series changes are slightly larger. Within age groups, which was interpreted before as evidence on long-term trends, income inequality increased less than 5 percent per decade between the ages 35 and 64, but about 12 percent among the youngest age group.[20] Among women inequality changed relatively little by age in cross sections, but increased in time series at about the same rate as for men. Within age groups the large increase in measured inequality for women, as noted before, is due to changing participation patterns and is not an adequate reflection of long-term change in the inequality of earnings opportunities of women. In general, cross sectional evidence on income differences among men between and within age groups appears to be a relatively satisfactory basis for drawing

conclusions about income differences experienced by birth cohorts, but the same cannot be said for the study of income differences among women or between men and women.

III. LONG TERM TRENDS AND THEIR EXPLANATION

Although cyclical behavior of income inequality has been plausibly linked to aggregate indices of demand, such as growth in real output, inflation and unemployment [Schultz, 1968, 1969, Metcalf; McCall], economic explanations of secular change in income inequality are less satisfactory [Kuznets, 1963; Soltow, 1965, 1968; Weisskoff]. The lack of sufficiently long, appropriately defined time series may account in part for this unsatisfactory state, but the absence of a theory of the size distribution of personal incomes has been the main source of analytical difficulty.

To my way of thinking, the most promising theoretical start is the human capital earnings distribution model, but its current shortcomings are nonetheless still very severe. In a recent paper, Chiswick and Mincer have applied this model to predict and extrapolate U.S. time series for male income inequality. Although the predictions of their model are statistically significantly associated with the observed series for the log variance of annual incomes of men, much of their "success," so it seems to me, is a function of their inclusion of a variable for the "variance of annual weeks worked." One may want to include in a reduced-form type model this sensitive indicator of unemployment and slack in aggregate demand, but the predictive power of the resulting model cannot then be interpreted as confirmation of the human capital framework which is formulated mainly in terms of labor supply variables. The theoretically designated variables in the Chiswick-Mincer model -- the level and dispersion of schooling, the level and dispersion of age

(a proxy for labor force experience), and intercorrelation terms -- tend to cancel each other out over longer periods, such as between 1939 and 1970. The earlier cited evidence that age-specific earnings inequality among fully employed men did not change substantially during this period may be viewed as tenuous support for their model.[21]

Alternatively, one may entertain the null hypothesis, that widely noted and explained patterns of income inequality, such as the tendency for inequality to increase with age, education and the passage of time (during the postwar period), do not persist when the analysis focuses only on fully employed persons. Although it seems reasonable to presume that much of the variation in time worked by persons over their life cycle is a function of human capital investment decisions and evolving personal comparative advantage within the family in market and nonmarket production, the much simplified human capital model does not as yet cope adequately with the complexity of the process underlying observed time allocation and annual income inequality. The large differences across groups and over time within groups in the allocation of time to market activities should be accounted for largely within the human capital model and not observed as an ad hoc explanatory variable. This is obviously true across age, sex and marital status groups, and over time the additional importance of demand factors must be taken into account. Until this broader set of decisions is treated as jointly determined and the role of exogenous demand variables are firmly identified, models of earnings distribution based on schooling and age still remain seriously incomplete.

After decades of confidence in the egalitarian redistributive

influence of the U.S. economy [Burns], a reappraisal of our progress toward equalizing economic opportunities may be warranted. Apparently most, if not all, of the reduction since 1939 in the inequality of annual earnings among men and women in the United States can be attributed to the reduction in postwar unemployment and the improved management of aggregate demand. Of course, changes in the share and personal distribution of unearned income may also have played an equalizing role over the long run [Kuznets, 1953; Lampman], but the magnitude of this development cannot be directly assessed from the data available to me. Variation in annual earnings inequality arises from the interaction of supply and demand factors that affect both the personal allocation of time to market activity and wage rates as influenced by life cycle human capital investments. An integrated explanation of this process does not now exist, but the conceptual and econometric framework for such an explanation is beginning to emerge.

DATA APPENDIX

Published data from the annual Current Population Surveys (CPS) and the 1940 Census 5 percent sample are used in the paper. To estimate average income levels and inequality (variance of the logarithms of income) from the frequency distribution of incomes by size classes, one must make some assumption as to the distribution of incomes within size classes. This problem is most obvious with regard to highest income size class that has no upper bound. Distributions of earnings are often approximated by the log-normal distribution, $\Lambda(\mu, \sigma^2)$, where μ and σ^2 are the mean and variance of the logarithms of income. The density function for income y may then be defined as

$$d\Lambda(y \mid \mu, \sigma^2) = 0, \quad y \leq 0$$

$$d\Lambda(y \mid \mu, \sigma^2) = \frac{1}{y\sigma\sqrt{2\pi}} \operatorname{Exp}\left[-\frac{(\log (y) - \mu)^2}{2\sigma^2}\right] dy, \quad y > 0 .$$

Maximum likelihood estimates of μ and σ^2 were calculated by minimizing the negative log-likelihood function,

$$\Phi(\mu, \sigma^2) = - \sum_{i=1}^{M} m_i \log \left[N\left(\frac{u_i - \mu}{\sigma}\right) - N\left(\frac{\ell_i - \mu}{\sigma}\right)\right]$$

with respect to μ and σ, where M is the number of income size classes, m_i the frequency of observations in each class, N $(\cdot)$ standard normal distribution functions, and u_i and ℓ_i the logs of the upper and lower limits respectively of each income size class.[22]

The method of Davidon as modified by Fletcher and Powell and Stewart was used to perform the nonlinear minimization of the negative log-likelihood function. The mean and variance of incomes within income size classes were then calculated on the basis of the log-normal distribution implied by the maximum likelihood estimates of μ and σ^2 using the moment generating function,

$$E\,(y^k \mid \mu, \sigma^2, \ell_i < y \leq u_i) = \lambda_k \,[\Lambda(u_i \mid \mu + k\sigma^2, \sigma^2) - \Lambda(\ell_i \mid \mu + k\sigma^2, \sigma^2)] \Big/ [\Lambda(u_i \mid \mu, \sigma^2) - \Lambda(\ell_i \mid \mu, \sigma^2)] \quad ,$$

where

$$\lambda_k = \int_0^\infty y^k d\Lambda(y \mid \mu, \sigma^2)$$

$$= \text{Exp}\,(k\mu + \frac{k^2\sigma^2}{2}) \quad .$$

The mean of the entire frequency distribution was then calculated, using the above estimates of the mean and variance of the income-size classes weighted by the actual class frequency distribution. The variance of the logarithms of income was then reestimated assuming, for lack of a better method, that incomes within each size class were concentrated at the estimated class mean.

REFERENCES

Anthony B. Atkinson, "On the Measurement of Inequality," J. Econ. Theory, Sep. 1970, 2:3, 244-263

J. Aitchison, and J. A. C. Brown, The Lognormal Distribution, Cambridge, 1963

Gary S. Becker, Human Capital: A Theoretical and Empirical Analysis, Nat. Bur. Econ. Res., New York 1964.

_____, "A Theory of the Allocation of Time," Econ. J., 75, Sep. 1965.

_____, Human Capital and the Personal Distribution of Income: An Anlytical Approach, Ann Arbor, 1967.

Gary S. Becker, and Barry R. Chiswick, "Education and the Distribution of Earnings," Am. Econ. Rev., May 1966, 56:2, 358-368.

Yoram Ben-Porath, "The Production of Human Capital and the Life Cycle of Earnings," J. of Polit. Econ., Aug. 1967, 75:4, 352-365.

_____, "The Production of Human Capital Over Time," in W. L. Hansen, ed., Education, Income and Human Capital, Nat. Bur. Econ. Res., New York 1969.

Mary Jean Bowman, and C. A. Anderson, "Distributional Effects of Educational Programs," in Income Distribution Analysis, Agricultural Policy Institute, N.C. State University, Raleigh, N.C., 1966.

D. S. Brady, Age and Income Distribution, Social Security Admin., Research Report No. 8, Washington, D. C. 1965.

Arthur F. Burns, The Frontiers of Economic Knowledge, Nat. Bur. Econ. Res., New York 1954.

Barry R. Chiswick, "The Average Level of Schooling and the Intra-Regional Inequality of Income: A Clarification," Am. Econ. Rev., June 1968, 58:3, 495-500.

_____, "Earnings Inequality and Economic Development," Quart. J. Econ., Feb. 1971, 85:1.

Barry R. Chiswick and Jacob Mincer, "Time Series Changes in Personal Income Inequality in the U.S. from 1939, with Projections to 1985," J. Polit. Econ., (forthcoming) May/June supplement 1972.

Hugh Dalton, "The Measurement of the Inequality of Incomes," Quart. J. Econ., Sep. 1930, 30, 348-361.

W. Davidon, "Variable Metric Method for Minimization," AEC Res. Dev. Rept. ANL-5990 (Ref.), 1959.

R. Fletcher, and M. Powell, "A Rapidly Convergent Descent Method for Minimization," Computer J., 1963, 6, 163-168.

Milton Friedman, "A Method of Comparing Incomes of Families Differing in Composition," Nat. Bur. Econ. Res., Studies in Income and Wealth, 1952, 15, New York.

_____, "Choice, Chance and the Personal Distribution of Income," J. of Polit. Econ., 61:4, August, 1958

Selma F. Goldsmith, "Size Distribution of Personal Income," Survey of Current Business, April 1958.

David H. Greenberg and Marvin Kosters, Income Guarantees and the Working Poor: The Effects of Income Maintenance Programs on the Hours of Work of Male Family Heads, The Rand Corp., R-579, December 1970, Santa Monica.

Harry G. Johnson, "The Alternatives before Us," J. of Polit. Econ., (forthcoming) May/June Supplement.

Thomas Johnson, "Returns from Investment in Human Capital," Am. Econ. Rev., Sep. 1970, 60:4, 546-560.

Marvin Kosters and Finis Welch, The Effects of Minimum Wages on the Distribution of Changes in Aggregate Employment, The Rand Corp., RM-6273, Santa Monica, Sep. 1970.

Simon Kuznets, Shares of Upper Income Groups in Income and Savings, Nat. Bur. Econ. Res., New York 1953.

_____, "Income Distribution and Changes in Consumption," in H. S. Simpson, ed., The Changing American Population, rpt. Arden House Conf., Institute of Life Insurance, New York 1962.

_____, "Quantitative Aspects of the Economic Growth of Nations: VIII, Distribution of Income by Size," Econ. Dev. and Cul. Change, Jan. 1963, 11:2, part II.

Robert J. Lampman, The Share of Top Wealth Holders on National Wealth, 1922-1956, Nat. Bur. Econ. Res., Princeton, 1962.

Harold Lydall, The Structure of Earnings, Oxford 1968.

John J. McCall, "Miscellaneous Measures of Income Distribution," mimeo., October 1971.

Charles E. Metcalf, "The Size Distribution of Personal Income During the Business Cycle," Am. Econ. Rev., Sep. 1969, 59:4, Part 1, 657-668.

Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," J. Polit. Econ. Aug. 1958, 66:4.

_____, "On the Job Training: Costs, Returns and Some Implications," J. Polit. Econ., Oct. 1962, 70:5, Part 2.

_____, "The Distribution of Labor Incomes: A Survey," J. of Econ. Lit., Mar. 1970a, 8:1, 1-26.

_____, Schooling, Age, and Earnings, Nat. Bur. Econ. Res. (preliminary manuscript), Sep. 1970b, New York.

_____, "Education, Experience and the Distribution of Earnings and of Employment," mimeo, March 1971.

W. Y. Oi, "Labor as a Quasi Fixed Factor," J. of Polit. Econ., Dec. 1962, 70:6, 538-555.

Sherwin Rosen, "Knowledge, Obsolescence and Income," mimeo, Nat. Bur. Econ. Res., Nov. 1970.

_____, "Learning and Experience in the Labor Market," mimeo, July 1971.

_____, "Learning by Experience as Joint Production," Quart. J. Econ. (forthcoming) 1972.

T. Paul Schultz, "Secular Equalization and Cyclical Behavior of Income Distribution," Rev. Econ. Stat., May 1968, 50:2, 259-267.

_____, "Secular Trends and Cyclical Behavior of Income Districution in the United States, 1944-1965," in L. Soltow, ed., Six Papers on the Size Distribution of Wealth and Income, Nat. Bur. Econ. Res., New York 1969.

Marcelo Selowsky, and Lance Taylor, "The Economics of Malnourished Children: A Study of Disinvestment in Human Capital," (mimeo) 1971.

Joseph P. Seneca, and Michael K. Taussig, "Family Equivalence Scales and Personal Income Tax Exemptions for Children," Rev. Econ. Stat., Aug. 1971, 53:3, pp. 253-262.

Lee Soltow, Toward Income Equality in Norway, Madison, 1965.

_____, "Long Run Changes in British Income Inequality," Econ. Hist. Rev., April 1968, 21:1, 17-29.

G. Stewart, III, "A Modification of Davidon's Minimization Method to Accept Difference Approximations of Derivatives," J. Assn. Computing Machinery, Jan. 1967, 14:1, 72-83.

Henri Theil, Economics and Information Theory, New York 1967.

U.S. Bureau of the Census, Current Population Reports, Consumer Income Series P-60, No. 4-80, Washington, D. C.

_____, 16th Census of the United States: 1940, Population, The Labor Force, Wage and Salary Income in 1939, Washington, D. C. 1943.

Richard Weisskoff, "Income Distribution and Economic Growth in Puerto Rico, Argentina and Mexico," Rev. of Inc. and Wealth, December 1970, 16:4.

Finis Welch, "Labor-Market Discrimination: An Interpretation of Income Differences in the Rural South," J. of Polit. Econ., June 1967, 75:3, 225-240.

_____, "Education in Production," J. of Polit. Econ., Jan./Feb. 1970, 78:1, 35-39.

_____, "The NBER Approach to Human Resource Problems," mimeo, Nat. Bur. Econ. Res., New York, March 1971.

Albert Wohlstetter, and S. B. Coleman, Race Differences in Income, R-578 The Rand Corp., Santa Monica, 1970.

FOOTNOTES

1. Assuming that the measure of social welfare derived from the personal distribution of income is invariant to proportionate changes in all incomes (the real value of mean income also enters social welfare), Atkinson proposes a class of social utility functions defined as

$$U(y) = A + B \frac{y^{1-\epsilon}}{1-\epsilon}, \quad \epsilon \neq 1$$

and

$$U(y) = \log_e (y), \quad \epsilon = 1$$

where y is individual income, U(y) is the social utility produced by this income, A and B are shift and scale parameters, and ϵ a measure of inequality aversion. In discrete form this function is shown by Atkinson to imply an index of inequality, I, which is useful for ranking distributions:

$$I = 1 - \left\{ \sum_i \left(\frac{y_i}{\mu}\right)^{1-\epsilon} f'(y_i) \right\}^{1/(1-\epsilon)},$$

where μ is the mean income and $\epsilon \geq 0$ to insure concavity. For $\epsilon = 0$, income are simply summed, with no regard to how they are distributed, whereas for $\epsilon = 1$, transfers from the rich to middle class are weighted equally with those from middle class to poor. Most conventional measures of inequality, such as the Gini coefficient or coefficient of variation, rank distributions approximately as though $\epsilon = 1$. The index of inequality has the attractive property of being the share of income that would be required to yield the current level of social welfare if income were distributed equally.

2. Theil uses a measure of inequality which is similar if the distribution is log normal, $T = \sigma^2/2$ where σ^2 is the variable of the logarithms of the variate, e.g., income.

3. If some sources of inequality are required as incentives to sustain an efficient allocation of resources, society must arrive at a trade-off between (growth in) income level and inequality to obtain a static (dynamic) optimum (see H. Johnson). Thus, perfect equality is an infrequent social goal, because it probably implies socially undesired levels and patterns of resource accumulation and allocation, respectively.

4. See Becker [1964, 1967]; Becker and Chiswick; Chiswick [1968, 1971]; Chiswick and Mincer; and Mincer [1958, 1962, 1970a, 1970b, 1971].

5. If labor earnings for the i^{th} individual, Y_i, are equal to man's innate earnings potential, Y_o, and a return, r_i, on the cost of his training, C_i, then

$$Y_i = Y_o + r_i C_i \quad ,$$

and where training is measured in time-equivalents (years) as S_i, the earnings function becomes

$$Y_i = Y_o (1 + r_i)^{S_i} \quad .$$

Taking logarithms of both sides gives the approximation where r_i is small of

$$\log y_i \tilde{=} \log Y_o + r_i S_i \quad .$$

If Y_o, S_i and r_i are uncorrelated, the log variance of earning is expressed as

$$\sigma^2_{\log Y_i} = \sigma^2_{\log Y_o} + \bar{r}\,\sigma^2_{S_i} + \bar{S}\,\sigma^2_{r_i} + \sigma^2_{S_i}\,\sigma^2_{r_i} \quad .$$

The log variance of earnings is expected to be positively related to the variance in training and returns on training, to the level of training and the rate of return, and the covariance of the two. Intercorrelations between the rate of return on human capital (ability) and the amount of training (opportunity) modify the model's predictions as to how the level of training (schooling) will influence the log variance of earnings [Becker, 1967]. See also Mincer [1970a, 1970b] for elaboration of framework to include postschooling investments in training.

6. See Friedman [1952] for original approach to problem and for a recent elaboration of this scheme see Seneca and Taussig.

7. The classic example of this problem is noted by Goldsmith, Kuznets and Brady, among others, in comparing inequality before and after the Second World War. The "undoubling" of composite families after the war created the impression of relatively increased inequality among families, because the newly "visible" old and young household units were disproportionately at a relatively low income level.

8. Inequality, as measured by the log variance, is often of similar magnitude when based on these different current concepts of income. In 1969, for instance, among all men with some of the specified income, the log variance of total income was 1.163, and wages

and salaries 1.205; Average incomes are also nearly identical in this year. But, of course, this does not imply that the same explanation of inequality should hold for different concepts of income.

9. Income in kind referred in the past largely to home produced food and fuel and such barter arrangements as employers saw fit to use, whereas today probably the bulk of these transfers occur under the postwar incentives of tax shelter such as business expense accounts, and employee fringe benefits and options. Their magnitude and distribution are unknown, but I hazard to guess that their personal distribution is positively correlated with money income, and hence increase real income inequality.

10. Minimum wage legislation [Kosters and Welch] and income maintenance programs [Greenberg and Kosters] may permanently preclude some wage offers and increase some wage expectations, respectively, adding to the persisting level of frictional unemployment.

11. Mincer [1970b] has estimated this partial correlation between weeks worked and education from the 1960 Census 1/1000 Sample.

12. Holding age weights (number of individuals with income in a particular ten year age group) constant, and allowing only the relative size distribution of incomes in each group to vary, the increase in inequality with 1947 population weights is 15 percent from 1947 to 1970 for males 25 to 64.

13. The tautness of the labor market influences not only the proportion of the civilian labor force fully employed, it is also likely to affect the inequality (structure) of earnings among those fully employed [Schultz, 1968, 1969]. Thus changes in income inequality

among the fully employed from 1939 to 1967 may tend to overstate secular trends between two years of equal unemployment. In 1967 unemployment was less than one-fourth the level recorded in 1939: 3.8 versus 17.2 percent of the civilian labor force.

14. 1967 income data are also available and are consistent with all relationships noted for earnings (Table 4).

15. The small size of the cells in three-way tabulations of the Current Population Survey from which my estimates were derived imply that sampling variability is a serious shortcoming of these estimates.

16. Demand determined factors include both those operating through market employment opportunities and, particularly for secondary workers, those factors that influence nonmarket productivities. Mincer [1970b] is justified in maintaining that the higher incidence and greater cyclical variability of unemployment among less schooled groups is another incentive, and hence return, to obtain more schooling. Also, the more schooled person may have a stronger pecuniary incentive to avoid unemployment (and postpone retirement, etc.) because of the greater opportunity cost it entails for him relative to the less schooled. These may be viewed as supply factors influencing the time persons work, but their importance apart from demand factors is moot.

17. It is also more difficult to invoke the "quality" of schooling argument used to account for part of racial earnings differences [Welch, 1967; Wohlstetter and Coleman] when analyzing sex earnings differences. The quality or cost of schooling is probably quite similar for men and women, but their different courses of study may have quite different pecuniary value to the market activities they

later engage in. Hence, the consumption and investment components of education may differ by sex.

18. Differences in the occupational mix of men and women would certainly "account" for a significant share of the earnings differences shown in Table 7. But this fact doesn't explain why more women than men tend to be found in lower paying occupations. Are women inclined to choose jobs where earnings are low and training limited (i.e., supply determined) or are employers inclined to choose women for such jobs (i.e., demand determined)? I have not seen any adequate analysis to answer this important question.

19. Becker's [1964, p. 76] calculated rate of return on native white male college education was 14.5 percent for 1949 assuming that the secular rate of growth in earnings was 1.25 percent. A growth factor of at least 4 percent, as implied here for men of all schooling groups, would have increased by one-fifth his estimated rate of return.

20. This growth in inequality among the younger age groups is undoubtedly due in part to the increase in the variance of schooling and postschooling investments within this age group. With reference to Table 4, the sharp increase in inequality among men 20-24 between 1939 and 1967 must be largely a function of the increase in the proportion of this group attending school from 7 to 32 percent, respectively.

21. Chiswick and Mincer include in their regression equation the predicted inequality (based on supply and demand factors) and also a time trend in linear and quadratic form. The statistical significance of the two trends in time suggests that systematic

changes in inequality have occurred over the postwar period and should be accounted for by theoretically more appropriate variables than time and time squared.

22. See Aitchison and Brown (pp. 7-13, 51-52, 87-88, 107-115) for development of the relationships used here and a description of additional properties of the log-normal distribution.