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Schooling, Ability, Nonpecuniary Rewards, Socioeconomic Background, and the Lifetime Distribution of Earnings

I. INTRODUCTION

All individuals or families do not receive the same income or earnings. This inequality, the most indisputable fact about the distribution of income, has been found in capitalist and socialist economies, in democratic and dictatorial countries, and in biblical through modern times. There are other characteristics of the income distribution that are nearly as well documented for modern countries. For example, the distribution is not

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symmetrical but has a longer right-hand tail, and both average income and its variance generally increase with education and age.[1]

Economists have constructed various theories that purport to explain the income distribution. Some aspects of these theories have been tested against empirical observations.[2] This study will extend the range of such tests. In addition, we will generate some new facts that a complete theory should be able to explain.

The Personal Distribution of Earnings

Personal income is equal to the sum of labor earnings, returns to capital, and transfer payments. The distribution of transfer payments and of returns to financial capital will not be examined in this study. We shall focus primarily on earnings from work, to which the introductory statements on inequality also apply.

Most theoretical and related empirical work on the distribution of earnings falls into the "human capital" or "stochastic" theory categories, or constitutes some blend thereof. The human capital model assumes that people are paid a wage equal to their (real) marginal product. This wage varies over individuals because of differences in inherited or acquired skill levels. The stochastic theories assume that an individual's earnings over time depend on the cumulative history of random events.

Many of the models that economists have proposed to explain some or all of the features of the earnings distribution are presented in Section II. Some problems with these theories are also given in this section along with some testable hypotheses. Section III contains a description of how the NBER-TH sample was obtained and the major characteristics of the sample. The main regressions on which this study is based are given in Appendix A. In Section IV we discuss the effects of particular coefficients, grouped into categories, in the regressions for earnings reported on separate surveys conducted in 1955 and 1969. The categories in order of appearance are: education, mental ability, family background, work experience, compensating adjustments for nonpecuniary rewards, and finally, business assets.

In Section V we examine the extent to which the distribution of variables in each of these categories are the causes of variance, skewness and kurtosis. This section also examines the Lorenz curves for 1955 and 1969, and the stability of these curves. The stability of an individual's position in the overall distribution is examined in Section VI. This section also tests certain aspects of the human capital and stochastic theory models. Section VII contains conclusions.

II. SUPPLY AND DEMAND FOR LABOR

A traditional method of analyzing labor markets is via supply and demand curves. Suppose for the moment that all people are homogeneous with respect to skills that determine earnings. Assume that with a given quantity of capital and other factors of production, the marginal product of labor decreases as the number of employees increases. In a competitive labor market (with no on-the-job training), employers will hire that number of workers at which the marginal product is equal to the real wage rate, W/P (for convenience we shall set P at 1 and henceforth speak of wages only). The supply of labor will depend on the real wage rate and an equilibrium will be found where the supply and demand curves intersect.

In our example, an equilibrium wage rate of W_0 will clear the market and everyone who works the same hours will earn the same amount. This conclusion, which is not valid, depends crucially on the assumption that each person has the same skills. This study is based on the proposition that many different skills—inherited and acquired—help determine earnings. It is fairly easy, however, to incorporate many of the skills into the above analysis *if what is known as an "efficiency units" model is valid.* Suppose individual one, who has a particular complex of skills, is designated as the "standard" person. Let capacity be designated as C. As long as C_j/C_1 *always* equals b_j, we can state that the jth person is equivalent to b_j standard workers.

Since the employer would be indifferent to hiring person 1 at a wage of, say, W_0 or person j at a wage of b_jW_0, the demand curve can be redrawn in standard worker units. The supply curve can also be drawn in efficiency units as $\Sigma_j b_j Q_j$ where Q_j is the quantity of labor the jth person would offer at a particular standardized wage rate. In this efficiency model, a person who is 110 percent of standard capacity will always receive a wage 110 percent of the standard wage, but the equilibrium level of the standard wage will vary with the supply and demand curves.

An important set of questions that relate to this model are: What particular skills determine capacity? Are these skills inherited or acquired? Is the quantity of acquired skills consistent with the amount economists would define as optimum? Before considering these questions, however, we will examine briefly a model in which relative capacity, C_j/C_1, is not fixed but varies.

The world of work is subdivided into many different occupations, which are associated with different tasks and levels of responsibility. For example, the *Dictionary of Occupational Titles* differentiates thousands of occupations, some of which require physical strength; some, mental ability; and some, combinations of particular skills. A person's relative capacity may remain constant within an occupation but vary over occupations.[3] Thus, a person's observed relative capacity would depend on the occupation he worked in, which, in turn, would depend in part on the occupational wage structure. Though this model is complicated, in principle it is still possible to formulate and solve it as a general equilibrium model, in which individuals choose that occupation which yields them the highest income or utility.[4] One particularly important feature of this occupation-skill model is that some skills may not be at all useful in some occupations.[5]

Now let us return to the simpler efficiency units model. At the end of our previous discussion of this model we raised certain questions about what skills determine earnings or capacity. At a general level, we can classify those skills as cognitive, affective, physical, and psychological. Cognitive skills include learned facts and information, as well as recall and decision-making abilities. Affective skills include leadership and social behavior. Physical skills include strength, coordination, and dexterity, while psychological skills include extroversion, reaction to stress, and degree of neuroticism.

At this stage of our knowledge, we hardly know which particular skills determine earnings or capacity, since no sample contains reliable measures of all feasible skills and few samples contain direct measures of even a representative skill from each of the categories mentioned.[6] However, several studies have shown that certain aspects of intelligence and of leadership are valid. See Taubman-Wales (1974), Griliches and Mason (1972), Wise (1972), and Featherman (1971).

Suppose, however, that we have measurements on an exhaustive list of skills for each individual. We could then estimate an earnings equation such as

(1) $$Y = aX_1 + bX_2, \ldots, cX_m + u$$

where Y is earnings, $X_1, \ldots, X_m$ are the M measures of skill, and u is a random error representing "luck" or institutional phenomena.[7]

Each coefficient in the equation indicates the effect on earnings of increasing the associated X by one unit. It is worth noting that the coefficients may not be stable over time. For example, suppose there is a big increase in the supply of any X. In the efficiency units model, this will lead to shifts in the supply curve (in efficiency units) and a decrease in the standard wage rate, which, in turn, would decrease all coefficients proportionately. In more complex models, the effect on the coefficients of an increased supply in any one skill level depends on the individual supply and demand elasticities for each skill as well as on cross elasticities of demand. But in general the coefficients will not change proportionately.[8]

While estimation of equation 1 with many skills would represent a major achievement, our task would not be over, since we would then want to know what determines the level of each X or what policies could affect the distribution of earnings.

Inherited and Acquired Skills

The level of any skill or attribute a person possesses at any point in time is determined by his genetic endowments and by his environment.[9] As we are using the term environment, it includes all postconception events that influence the individual. Thus, it encompasses formal and informal training for all the skills discussed earlier, prenatal diet, expenditures on health which determine whether skills can be used, and random events. A huge literature has been devoted to assessing the relative importance of nature and nurture for particular skills and attributes.[10] As we come closer to estimating equation 1, this literature will become more important in economics, but at the current time it does not seem necessary to summarize it.

Since we have neither measured all the possible skills nor know their nature-nuture combination, we shall not estimate equation 1. We shall, however, make use of a modified procedure. Suppose each of the X_j's is represented as a function of genetics and environment. If, for example,

(2) $$X_{ji} = c_j G_i + d_j N_i$$

where G is genetic endowments, N is environment, and i is the individual, we can then rewrite equation 1 as

(3) $$Y_i = \Sigma_j a_j c_j G_i + \Sigma_j a_j d_j N_i = e_i G_i + f_i N_i$$

Equation 3 represents progress primarily because we do have measures of several aspects of environment.

Training

People learn or increase their skill levels in many ways, with some methods better for some skills than for others. However, some of the most important "training" institutions are the family, the peer group, the school, the military, and the job.

The family can affect the child's cognitive, affective, physiological, and psychological development by a variety of subtle and obvious means including: the behavior and attitudes of parents and siblings; material and nonmaterial goods and services provided to the child; love and affection; and degree of permissiveness in rearing. While it would be most useful and convincing if we could incorporate measures of parental behavior, love, material goods, and so on, in our equations, we do not have such information and are reduced to using proxies.

There are several difficulties in interpreting the coefficients of a proxy. A proxy, by definition, is assumed to be correlated with the true but unobserved variable. But the proxy may be insignificant, because it is too crude a measure, i.e., has too low a correlation with the true variable. Alternatively, the proxy may be correlated with several true variables whose separate effects we may be interested in. For example, father's education may be related to his earnings, his methods of child rearing and certain genetic (and thus partially inheritable) abilities.[11] Fortunately, if several proxies are used, it can be shown that each proxy will tend to reflect the underlying variable with which it is most highly correlated.[12]

We shall use proxy variables such as family income and wealth, religion, urban or rural residence, and parents' education and occupation, which are all often available and often made use of. We shall supplement this list with other proxies that we think are related to child-rearing techniques and family atmosphere.

The peer group can also affect the amount of schooling a person acquires and can directly affect all broad skill categories through its attitudes and reward structure, but the only available information which might be related to peer-group effects is a question on how the individual spent his time while growing up.

Both sociologists and economists have incorporated formal schooling into the earnings equation. It must be emphasized that schooling can affect cognitive, affective, physiological, and psychological skills though there is no reliable information on which of these changes determine earnings.[13] The most common though obviously very crude measure of education is years of schooling. However, following the lead of Solmon and Wachtel (1975), who used the same sample, we shall also incorporate certain measures of college quality.[14]

While all the people in our sample worked, the amount and type of work and of learning on the job has varied by individual and can affect earnings. Indeed, a major innovation in the earnings distribution literature is Mincer's theory of investment in on-the-job training, which is described below in more detail. For the most part, we measure this by years on civilian jobs, but we also examine the effects of military service and of time spent in one occupation on earnings in another.

Taste for Risk and Nonpecuniary Rewards

The models we have been examinining explain earnings by differences in skills. It is possible, however, to explain some features of the earnings distribution by differences in tastes toward work or nonpecuniary returns from work. Friedman (1957), for example, has suggested that skewness arises because while most persons are risk averse, some people are risk lovers.[15] Those in the latter group may initially choose an occupation in which there is a small chance of a very high income. Since success is not won overnight, eventually we observe some of these who succeed, and over time the average earnings of the winners grow more than those of persons who were risk averse.[16]

Friedman's model is closely aligned with that of von Neumann-Morgenstern, in which a person bases his decisions on the expected value of the utility of a set of outcomes, defined as $\Sigma P_i U(Aj)$, where P_i is the probability of the A_i event occurring and $U(Aj)$ is its utility. Suppose A_1 equals $\bar{B}$. Then it can be shown that if a person has diminishing marginal utility, he will attach more utility to, and choose, A. In other words, he is averse to risk. Alternatively, if his marginal utility exhibited increasing returns, he would be a risk lover and choose B in the above example.

While, in principle, it is possible to conduct controlled experiments in which people choose between various alternatives to determine an individual's utility function and degree of risk aversion, we do not have that option. Instead, we shall use questions dealing with preferences for employment versus self-employment and with the desire for job security to estimate crudely the amount of earnings people have been willing to forgo for safety.

The reduction in average earnings of the risk averse can be thought of as a nonpecuniary reward, called peace of mind, received by those who dislike risk. There can be many other positive and negative nonpecuniary rewards attached to jobs. Those rewards are important in our study of the determinants of the earnings distribution because nonpecuniary rewards can induce offsetting changes in monetary rewards.[17] The choice between pecuniary and nonpecuniary rewards can be treated in the general framework of utility maximization.[18]

There are also substantial problems in quantifying the tradeoffs between monetary and nonmonetary returns. The two major difficulties are determining which of all possible nonpecuniary returns are relevant and measuring differences in preferences. However, since the data set that we are using has measures of only a few possible nonpecuniary rewards, we have not had to choose. Our measures are crude and relate primarily to whether a particular reward was operative at a time of occupational choice. The many problems associated with these measures are discussed in Chapters 8 and 9 in Taubman (1975).

III. THE NBER SAMPLE

In this study, our empirical work will be based primarily on the 5,100 men in the NBER-TH sample.[19] The sample was drawn from a group of some 75,000 men who during 1943 volunteered to enter the Army Air Force's pilot, bombardier, and navigator training program. The people in this group obviously had to meet the health and physical requirements to be in the Army. Also, according to Thorndike and Hagen (TH), to enter this program, "a man first had to be single, be between the ages of 18 and 26, pass a fairly rigorous physical examination, and pass a screening aptitude test, the Aviation Cadet Qualifying Examination. This examination was primarily a scholastic aptitude test, though perhaps with a slightly technical and mechanical slant. The qualifying score on the screening test was set at a level that could be reached by approximately half the high school graduates, the country over."[20] The men who qualified and volunteered for the program were then given a battery of some seventeen tests which measure various types of mental and physical skills. These test scores as well as certain biographical information on hobbies and family background determined which of the men were accepted for the Air Cadet program.

Thorndike and Hagen (TH) decided in 1955 to draw a sample of 17,000 men who had taken a given battery of tests between July and December 1943. Beginning in late 1955 and throughout 1956, TH received responses from some 10,000 civilians and 2,000 men still in the military. The questionnaire that they used, which is to be found in *Sources of Inequality of Earnings*,[21] contains, among other things, an earnings occupation history from World War II to the date of the questionnaire.[22]

In 1968, Taubman and Wales (TW) contacted Thorndike and learned that he had retained a printout of the test scores, earnings, and a few other items for 9,700 people who were civilians in 1955, and also the completed questionnaires for about 8,600 of these men. With the concurrence of the Air Force, Thorndike kindly agreed to make available all of this information, as well as the address list as of 1956.

It was recognized almost immediately that it would be possible to update addresses via army serial numbers and the V.A.'s life insurance and claims file.[23] Thus, John Meyer and F. Thomas Juster of the

National Bureau of Economic Research (NBER) quickly agreed to conduct another interview using Bureau funds. This questionnaire, which is to be found in *Sources of Inequality*, was eventually answered in 1969 and early 1970 by some 5,100 out of about 7,500 people for whom correct addresses were available.[24] TW initially used the detailed information on education, ability, family background, and personal characteristics from the two surveys (for about 80 percent of the men) to examine the rate of return to education and the use of education as a screening (signaling) device.

The respondents had been promised summaries of the results of the questionnaire. When mailing these summaries in 1971, the NBER included a short questionnaire to try to resolve some of the puzzles raised by TW and others. Some 3,000 people responded to this one mailing. When funding was received from the National Science Foundation (NSF) for this project, another large questionnaire dealing with more aspects of family background and other matters was sent out and was returned by 4,474 people.[25] These last two questionnaires are also to be found in *Sources of Inequality*.

TH found little in the way of response bias in 1955. Taubman and Wales have shown that in 1969 the mentally more able and more educated were more likely to respond. However, TW also showed that there was no significant difference in the 1955 earnings equations between those who did and those who did not respond in 1969; thus, the data can be used for structural analysis.[26]

Sample Characteristics

The qualifications needed to be a potential member of this sample guarantee that the NBER-TH sample will not be representative of the U.S. male population of the same age. About one-quarter of the men fall into each of the categories of high school graduate, some college, bachelor's degree, and at least some graduate work.[27] Also, a person had to be in the top one-half of the I.Q. distribution to enter this program and the average ability level has been heightened by the aforementioned response bias.

The average age in 1943 was 21, with three-quarters of the men aged 19 to 22. At least in 1943, the program's qualifications assure us that its men were, on the average, in better mental and physical health than the U.S. male population aged 18 to 26. Given that these men volunteered to train for flight duty, it seems likely that they are less risk averse than the population as a whole, which may be a partial explanation of the high percentage of people who are self-employed in 1969.[28] We do not know how many nonwhites, if any, are in the sample, though the education and test aptitude qualifications suggest to us that whites probably make up 99 percent of the group.[29]

In her dissertation, Wolfe (1973) has compared this sample and the corresponding U.S. age cohort of white males for a number of characteristics. She finds a higher percentage of Jews and a smaller percentage of Catholics in this sample. The men in this sample have fathers with above-average education (and occupational status) and fathers-in-law with even higher educational attainment. Also, the people in this sample have above-average earnings in each year studied, even if the comparison is made with white males of the same education and age, with the differentials greater at a later age and at lower levels of education.

It is of some interest to compare the earnings inequality in this sample with that of the random sample of white males aged 45 to 59 (in 1966) studied by Kohen, Parnes and Shea (1975). They find, for example, that the share of total family income received in 1968 by the bottom 25, 50, 75, and 95 percent is 14, 35, 62, and 89 percent, respectively. In the NBER-TH's sample each of the corresponding figures is smaller by 5 to 6 percentage points. Thus, despite having a more restricted range in mental ability, education, and risk aversion, the NBER-TH sample has more inequality in family income than a nationwide cohort of about the same age. This result may be due to the heavier concentration of self-employed men in NBER-TH or to the heavier concentration of people in the NBER-TH in the right-hand tail of the earnings distribution.

Clearly the sample is not representative of the U.S. population, and in the case of education and I.Q., does not have any members representative of a large portion of the population. Moreover, some of the dimensions in which it is nonrandom will be shown to be related to earnings. The nonrepresentativeness and truncation of some variables will mean that the distribution of earnings should not correspond to that for the U.S. population. Still, the sample can be thought of as a random stratified sample in which the weights for various strata do not correspond to the population weights.[30] *It is well known that such unequal weighting will not cause the coefficients estimated from the data to be biased.* Thus, we can use this sample to study the effects of education, ability, and so on, on various aspects of inequality. We cannot, however, extrapolate the results to those levels of education and ability not included in our sample. And as noted above, measures of inequality such as variance should not be the same as in the population. However, such inequality measures calculated *within* education and ability groups or the changes in the measures over time may apply to the population.

IV. A SUMMARY OF THE DETERMINANTS OF EARNINGS AT VARIOUS POINTS OF TIME

In this section we shall summarize the results of the earnings equations for 1955 and 1969, presented in the appendix, by comparing the relative importance of coefficients of various variables. It is important to realize that we are discussing partial regression coefficients in which all other variables in the equations in the appendix have been held constant.

Several measures of importance can be used. In this section we shall be concerned primarily with those related to the range and to the variance in earnings. Later we will consider issues connected with skewness and kurtosis. An obvious measure of importance is the R^2 or the amount of the variance explained by the set of variables. Of course the R^2 in our sample may not generalize to the U.S. population because our sample is truncated in education and ability and is drawn more heavily from some strata than others. Since we do not know all respects in which this sample differs from the U.S. population nor how to extrapolate the results to the truncated portion of the population, we shall not try to calculate a weighted R^2. Many of these problems are less severe when we compare total or partial R^2's for the same people but in different years.

The variance explained by a set of independent variables combines two elements—the predicted value of the dependent variables, Y_i, as compared to the mean of Y, and the number of times each Y_i occurs. An alternative measure of importance is the difference in the average level of earnings, $Y_1 - Y_2$, caused by a set of variables. This range measure is related to the $Y_i - \bar{Y}$ portion of the variance but does not indicate how many people are at each Y_i.[31]

For ease of exposition, we shall discuss the 1955 and 1969 results for one variable at a time. Unless otherwise noted, these results are drawn from equations in which many other variables have been included. The variables which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife, information on self-employment and on teaching, a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards. While we have included many variables, we never explain more than 45 percent of the variance in earnings. The coefficients of any included variables will be biased if correlated with any omitted variable which determines earnings.[32]

Because of computer capacity limitations, we were forced to drop some variables which were consistently nonsignificant in preliminary runs. Table A-3 in Appendix A lists all of the variables that we tried but which were not significant in our earnings equation. In the equations presented, all the variables are either significant in one or more years or were significant in either the next to the last runs or in the Taubman-Wales equations from which this analysis commenced. When we cite coefficients for variables not in the last equation, the numbers are taken from the most complete versions of the final equations in which the variables appeared.

Formal Education

Formal schooling can affect physical, cognitive, psychological, and affective skills.[33] It would greatly increase our understanding of what schooling does if we could identify the particular skills that affect earnings and measure the change in all skills produced by schooling. However, since we do not have such measures or even know what the appropriate skills are, we shall have to be satisfied with crude measures of quantity and quality of schooling.

We represent quantity by level of education obtained. We use dummy variables for various responses. Earnings in 1969 generally increase with education.[34] However, despite our having included variables to hold constant nonpecuniary rewards, including those associated with precollege teaching, risk preference, and self-employment, those with just a bachelor's degree earn more than those with some graduate work. As shown in Table 1, the *increase* in earnings from education for the average high school graduate ranges from 8 percent for some college to 82 percent for non-self-employed M.D.'s, with bachelor's degree holders receiving 20 percent more.[35] (We have standardized by the average non-self-employed high school graduate's earnings of $10,300.)

In 1955, the same general pattern emerges, except that the effects of education are uniformly smaller and are not always statistically significant. For example, obtaining a bachelor's degree or some college would add 11 and 5 percent more to the $6,000 (1958 prices) received by the average non-self-employed high school graduate. *However, our self-employment variables are only measured in 1969. The resulting measurement error has probably caused us to overstate the relative returns to education of the not-self-employed in 1955.*[36]

The total effect of education may be understated if one of the mechanisms by which education alters earnings is measured after the completion of education and is also included in our equations. One such route would be the occupation the person was in. The variables on occupation we have used in these equations are teacher, self-employed businessman, professional, and business assets. The teacher variable is included because we felt that teachers receive more nonpecuniary

TABLE 1 The Increase in Earnings from Education in 1955 and 1969

	Percentage Increase from Education[a]			
Level of Schooling	1955, Average Age 33	1969, Average Age 47	Number of Observations as of 1955[b]	Number of Observations as of 1969[b]
Some college	5	8	1,145	1,162
Bachelor's	11	20	1,415	1,332
Some graduate	8	18	220	250
Master's	6	29	336	419
Ph.D.	13	43	238	298
LL.B.[c]	6	53	140	140
M.D.[c]	71	82	48	48

NOTE: The variables in the equation which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife; information on self-employment and on teaching; a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards.

[a]Calculated for the average high school graduate, not self-employed, who attended the quality of college of the average person with just some college.

[b]In the high school category, there were 1,246 observations in 1955 and 1,139 in 1969.

[c]In this equation this variable was also included in Ph.D. group. Moreover, these are salaried people only.

rewards as a substitute for earnings than are received in other occupations.[37] The various self-employment measures are designed to eliminate all of the return on financial capital included in the earnings estimate; rewards for bearing the extra risk of entrepreneurship; and perhaps unmeasured attributes that lead to being a successful businessman. However, it is possible that these measures have incorporated some of the influences of education. For example, education's affect on prior earnings could conceivably explain much of the difference in the accumulation in business assets; however, crude analysis suggests that such effects of education would be small. Moreover, if the self-employment variables were not included, the bachelor's, some college, and master's coefficients would all be *smaller* because the self-employed are more concentrated at the lower education levels.

It is also possible that a person's tastes for nonpecuniary rewards or risk bearing are partially formed by education. The inclusion of the so-called nonpecuniary variables caused the some college and bachelor's level coefficients to decrease and the graduate level coefficients to increase in both years.

College Quality

As a crude measure of college quality, we have included for each person's undergraduate school the Gourman Index (of Academic Quality).[38] In 1969, we find that attendance at a school that ranked 100 points (the standard deviation) higher in the index is associated with a $450 increase in earnings. After our usual standardizing, the effect of the 100 point difference in college quality of 4½ percent is about half the size of the effect of obtaining some college. In 1955, a 100 point increase in undergraduate-school quality leads to a $140 increase in earnings or 2½ percent after standardization. Once again this is about half the size of the coefficient on the some college variable.[39]

The quality index used is obviously not the only one possible but we have not studied this problem in detail since it is the focus of the work of Wales (1973) and especially of Solmon (1973).

Mental Ability

In TW it was found that the seventeen tests taken by the people in 1943 contained at least four factors, but only the first factor, which was denoted mathematical ability but which probably correlates well with a standard I.Q. measure, was a significant determinant of earnings.[40]

In both 1969 and 1955 we tested for an interaction between mental ability and all other variables by computing separate equations within each ability fifth. Using analysis of covariance, we could not reject the hypothesis that the effects of all variables, including education, were independent of the level of ability in each year.

In both 1955 and 1969, as shown in Table 2, the coefficients on two of the top four fifths are significant. These coefficients are not sensitive to the inclusion of the self-employment-related variables.[41] The effects of each fifth increase in ability add a greater percentage to earnings in 1969 than in 1955, with the differences more pronounced in the top two ability fifths.

The numbers in Table 2 can be compared directly with those in Table 1. Thus the average difference in earnings between those in the top and bottom fifths of ability (14 percent and 19 percent in the two years) exceeds the effect of obtaining a bachelor's degree in 1955 and is nearly as large in 1969.

A person's test scores generally depend on his innate ability, the quality and quantity of pretest schooling, and differences in other aspects of "environment." Often we would like to know what portion of test scores (and associated earnings) are due to genetics and to environment. Suppose that the measures of religion, parents' and own educational attainment, occupation, income, and so forth, included in our earnings

TABLE 2 Increase in Earnings in 1955 and 1969 from Ability Differences

	Percentage Change in Earnings from Ability (Bottom Fifth to the Fifth Shown)[a]		
Ability Level	1955, Average Age 33	1969, Average Age 47	Number of Observations[b]
2nd fifth	5[c]	5[c]	848
3rd fifth	5[c]	7[c]	925
4th fifth	9	14	972
Top fifth	14	19	1,047

NOTE: The variables in the equation which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife; information on self-employment and on teaching; a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards.

[a]The dollar difference is divided by the not self-employed high school graduate's average earnings.

[b]In the bottom fifth there were 808 observations.

[c]Not significant at the 5 percent level.

are the only environmental differences that determine test scores. Ability coefficients in the earnings equations would then be net of the environmental influences.[42] Of course, if other aspects of environment affect test scores, the ability coefficient will still be a mixture. Taubman and Wales, who examined the genetic/environmental problem, conclude that in the *tests we are using* most of the variation in scores is due to genetic differences (or other nonmeasured dimensions of environment). This finding in no way tells us innate ability is more important than learned knowledge, since we have not examined the effects of various types of learned knowledge on earnings.

Since the sample includes only the top half of the I.Q. distribution, it seems safe to conclude that ability is a more important direct determinant of the range of earnings than education for those who are at least high school graduates. Even when self-employment information is not used, the same conclusions are reached, though the differences are smaller.

Family Background

An individual's "socioeconomic background" can determine earnings for a variety of reasons, including being a proxy for: genetic endowments;

TABLE 3 Increase in 1955 and 1969 Earnings Associated with Various Socioeconomic Measures

Socioeconomic Measures	Percentage Increase in Earnings from Differences in Various SES Characteristics[a]: 1955, Average Age 33	1969, Average Age 47	Number of Observations
Father's education			
Attended high school	6[b]	7[b]	1,409
Attended college	4[b]	5[b]	770
Father's occupation			
Business owner	2[b]	5[b]	1,699
Teacher	1[b]	−8[b]	360
Mother's education			
Attended high school	3[b]	3[b]	1,671
Attended college	2[b]	4[b]	685
Family never moved before high school graduation	−1[b]	−5[b]	1,452
Jewish	33	40	239
Protestant	−3[b]	−9	2,910
Religious school several times per week	−9	−11	236
Never went to religious school	−.1[b]	−3[b]	1,509
Biog[c] 2nd fifth and biog 3rd fifth	4	5	1,795
Biog 4th fifth and biog top fifth	11	8[b]	1,893
Father-in-law's education (per year)	1	1	[e]
Mother-in-law high school or college	−1[b]	6	2,294
Private elementary school	4[b]	27[b]	21
Private high school	25	29	99
Time spent on sports[d]	4[b]	10	[e]
Time spent on chores[d]	−3[b]	−10	[e]
Time spent on hobbies[d]	3[b]	−6[b]	[e]
Time spent on part-time job[d]	5	11	[e]

Notes to Table 3:

NOTE: The variables in this equation which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife; information on self-employment and on teaching; a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards.

The omitted categories can be found by subtracting the included ones from 4,600.

[a]The dollar difference is divided by earnings of the average, non-self-employed high school graduate.

[b]Not significant at the 5 percent level.

[c]Biog is a weighted average of information on activities, education, preferences, and family background which was formed by Thorndike and Hagen from data collected by the military in 1943.

[d]Difference between spent most time and hardly any time.

[e]Continuous variables.

differences in "training" which increase cognitive, affective or physical skills; nonmonetary tastes; and business contacts, pull, and nepotism.

The measures of family background we have analyzed include: father's education and occupation; mother's education and labor force participation; wife's education and her parents' education and occupation; various data related to family income, wealth, and city size while respondent was growing up; how the respondent spent his time while growing up, age at entering school, and religious preferences.[43] The results are given in Table 3.

In TW, the two measures of socioeconomic status (SES) used were father's education and the so-called biography variable. This biography variable is based on the respondent's family income and education, his hobbies, sports and interests, and his pretest education and grades as reported in 1943.[44]

It was, of course, a bit frustrating that a variable made up of so many disparate items with unknown contributions determined earnings. Thus, we are happy to report that inclusion of information collected in 1969 and 1972 similar to that collected in 1943 has substantially reduced the size of the biography coefficient, but the top two-fifths are still significant and the coefficients are monotonic. It is interesting to note that the big shift in the 1969 and 1955 coefficients occurred only after we included information on attitudes toward nonpecuniary rewards and a proxy for family wealth, implying that these are the components in the biography variable that influenced earnings. The differences between the top two-fifths and bottom fifth are 11 percent and 8 percent in 1955 and 1969. This is one of the few variables that has a smaller percentage effect in 1969.

In this study, father's education is insignificant both in 1969 and in 1955. Part of the reduction of significance of this variable occurs when the *father is an owner* variable is introduced. However, the reduction in size and significance of the coefficient is primarily associated with the introduction of the respondent's business assets variables. Since this variable is not often used in other studies, there is a suggestion that father's education is a proxy for family wealth and business ownership.[45]

There are other SES variables which are significant. Perhaps the most interesting of the new measures are the Jewish and Protestant variables.[46] Compared to Catholics (as well as to atheists, agnostics, and others, who all earn about the same amount in the various years), Jews received from 33 to 40 percent more earnings than the average high school graduate and Protestants from 3 to 9 percent less.[47] The reader is reminded that these differences are net of the influence of education (including M.D.), mental ability, self-employment, and various other personal attributes and family SES dimensions.[48]

At least for the generation being discussed, it seems likely that those who are Jewish had more of a taste for acquiring knowledge, and as shown in Taubman (1975) achieved more education and went to better schools, given ability and other SES measures.[49] Hence, for given levels of schooling and mental ability in 1943, Jews may have acquired more knowledge useful in earning a living. Given the evidence in Taubman (1975), I would suggest that religious upbringing affects motivation and other psychological skills. We cannot, however, rule out the possibility that some unmeasured, genetically determined characteristics are related to religion. Unfortunately, since we do not know what unmeasured attributes are important determinants of earnings, we cannot usefully examine the genetics literature to see what if any differences exist by religion.[50]

The idea that the extent of religious commitment or the differing environment in families of various religions can mold the individual receives some further support in the sample. That is, we find that those who remembered attending religious classes (not parochial school) several times a week earn 9 to 11 percent less than those who attended once or twice, whereas those who did not attend earn 1 to 4 percent less. Since the latter group would not have come from "typical" families of the 1920s and 1930s, it seems possible that the variable represents attitudes toward material success.

Another set of variables which reflect both the type of family and affective, physical, cognitive, and psychological attitudes that can be formed by the family and the peer group are contained in the question (asked in 1972): "Indicate how you spent your time while growing up."[51] The categories examined were sports, hobbies, chores, part-time job, reading, and other. The last two groups were never significant and will not be discussed here except to note that reading is related to the ability measure and educational attainment. The remaining categories were significant in 1969 but only part-time job was significant in 1955.

The difference in earnings of those who spent practically no time and those who spent the most time on part-time jobs is 5 percent and 11 percent in 1955 and 1969, with the working group earning more. It seems likely that the latter group came from poor families and needed money for themselves and/or valued financial success greatly. These men would be willing to work hard and apparently have succeeded, with success being cumulative over time.[52] In 1955 and 1969 those who spent much time on sports while growing up earn 4 percent and 10 percent more than those who spent practically no time on sports. Several explanations for this result are available. First, activity in sports may show up in later life as better physical fitness, and as shown below, healthiness is related to earnings. (In this explanation, 1955 has a smaller impact because of less health deterioration at that age.) Second, most sports involve both a competitive and cooperative structure which are also found in many work situations. That is, a boy's play is training for a man's work. Third, activity in sports may be indicative of energy and aggressiveness that pay off in the business world.[53] Finally, there is some indication in Thorndike and Hagen that in 1955 sports distinguishes company presidents and vice-presidents from treasurers. This suggests that sports in the 1920s and 1930s was an indicator of family wealth and availability of leisure time, or an indicator of attitudes such as risk taking.

The hobby variable has practically no effect in 1955 but in 1969 those who spent the most time on hobbies received 6 percent less, which is significant at the 10 percent level in the final equation. The most obvious explanation for this finding is that many, though not all, hobbies represented the opposite of sports and the effects should be reversed.

The last and perhaps most difficult of these to explain is the chore result. Those who spent much time on chores earn 3 percent and 10 percent less in 1955 and 1969 with the former not significant. Initially, we had expected chores to be a proxy for "willingness to take on responsibility" and to have a positive effect. Merton, however, argues that families who insist on their children doing chores are lower middle class and are very interested in conformity. He further argues that these families will produce "tame" individuals who make the ideal bureaucrat and who receive less earnings than people in riskier jobs (see below). We might add that Merton only refers to one piece of empirical evidence, which, he acknowledges, is not very compelling.

As might be expected, time spent on chores and on a part-time job are positively correlated ($R^2 = .13$) but the differences in emphasis of paid and family work apparently reflect different types of environment and different types of men.

Thus far, we have included SES measures which are strongly related to family upbringing and taste formation. Parental income or wealth can also influence a child's earnings by being used to purchase goods that produce marketable skills, by being a proxy for nepotism, or by being a proxy for genetically determined skills.

One possible proxy for family income is father's education, which, as we have already indicated, is not significant once business assets are included in the equation. Another possible proxy is father's occupation but this also does not explain directly much of the differences in earnings, with the other variables held constant.[54]

Two extremely important determinants of earnings are type of elementary school and type of high school attended. The coefficient on private elementary school is positive but not significant, probably because 22 of the 29 people who went to private elementary school went to private high school. Thus the elementary school coefficient only measures the extra earnings above private high school. Those who attended both private elementary and private high school in 1955 earn 29 percent more than those who always went to public schools. In 1969, those who went to private elementary and private high school earn 56 percent more than those who did not go to private school.

Our explanation for this result is that those who went to private elementary schools in the 1920s came from very wealthy families who provide a good home environment and/or genes, or who used pull to aid their sons. The pull argument seems to be the most likely, since the variable is primarily a proxy for large amounts of wealth.[55]

We are still left with the need to explain the change in the coefficient between 1955 and 1969. We would argue that a screening, sorting explanation is relevant, since even if nepotism is involved, one wants to see how good the person under consideration is before giving him an important job; of course, a person can probably become vice-president more quickly if his father owns the company.

Another interesting finding in our equations that suggests nepotism is that *father-in-law's education*, measured continuously in years, is a significant determinant of the respondent's *earnings* in both 1955 and 1969.[56] A primary explanation of these results is that business and social contacts provided by the father-in-law are important. But there can be other explanations. For example, daughters from good social backgrounds may have the necessary graces—not learned in school—which help to promote their husbands. Alternatively, women with successful fathers may be able to spot and marry men with those characteristics that made for their father's success or push their husbands into achieving success.

Interestingly, mother-in-law's education also is positively related to earnings in 1969, with the high school variable somewhat greater than the college variable, though the two are combined in the final equation. This finding makes it less likely that women are marrying men who are like their fathers and suggests nepotism.

Thus far, we have been concerned with the effects of individual aspects of SES on earnings. Except for religion, none of these has an impact as large as ability or education on the range of earnings in 1955 or 1969. However, it is possible for a person to fall into the top or the bottom category of all SES measures. Using the significant coefficients only, the average difference in earnings for such "extremists" would total about $14,000 or 140 percent of our average earnings in 1969, and $5,500 or 90 percent in 1955, and far exceed the direct effect of ability or education on earnings.[57]

The other dimensions of SES that we have tried but have found to be insignificant, perhaps because of their crudeness, include: whether the respondent was the youngest or oldest sibling, additional crude proxies for family wealth based on type of house; the labor force status of the respondent's mother when the respondent was less than 5 and less than 14 years old; being reared on a farm; size of city or town he grew up in; the region of the country in which raised; and age at time of entry into school.

To conclude this section, we should like to discuss several objections that have been raised concerning the SES variables and that might also apply to some of the taste and other variables still to be discussed. One set of objections is that the variables used have multiple interpretations and have not been validated as measures of the phenomena that we ascribe to them. Our defenses against this set of objections are: that when many proxies are used, each one tends to represent the one or several forces it correlates with most closely; that since we do not yet know what dimensions of SES affect earnings nor have a theory to guide us, it is important to use the empirical information at hand to suggest variables which should be validated; that a form of validation is replication, which has been performed successfully in the 1955 and 1969 equations and in Taubman (1975) for education, ability, and net worth variables.

Another set of objections is that, perhaps, because of the absence of a well-specified theory, we have tried many variables and may only be observing chance correlations. This argument suggests that 5 percent of the SES variables might be significant due to chance, but we have found more like 40 percent significant. More importantly, none of the variables not significant in 1969 are significant in 1955 and nearly all of the variables significant in 1969 are also significant in 1955.[58] The R^2 between earnings in the two years does not exceed .2; thus, the probability of finding coefficients significant at the 5 percent level in both years does not exceed one-third of 1 percent.

Maturation and Work Experience

A well-known and documented result is that (real) earnings increase with age till at least age 40. While we do not have data for all ages, the results for 1955 and 1969 in Table 4 certainly are in accord with this finding. The

TABLE 4 Age, Experience, and Hours Worked

Coefficients on:	1955	1969
Age	.08	−.11
Year of first full-time job	−.11	−.15
Hours worked, first job, 1969	−.01[a]	.07
Hours worked, second job, 1969	−.03	−.12
Weeks lost due to illness, 1969	−.03[a]	−.18

NOTE: The variables in this equation which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife; information on self-employment and on teaching; a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards.

[a]Not significant at the 5 percent level.

general explanations for the upward sloping age-earnings profiles are (1) as people age, mental and physical maturation increase those skills that determine earnings, (2) work experience and learning by doing increase earnings-related skills, (3) people are promoted on the basis of performance on the job and/or seniority, and (4) beyond a certain age senescence sets in or skills depreciate.[59]

Without distinguishing, for the moment, type of work experience, time on the job can be represented as $TJ = (\text{age} - \text{year of first job} - H)$, where H represents such things as time not working because of illness, unemployment, and departures from the normal period of time to complete a given level of schooling. If maturation is important, then age should have a separate effect from TJ.

Both age and year of first job (at the 6 percent level) are significant in 1969, but apparently senescence or depreciation has set in, since age in Table 4 is negative. In 1955, the separate age effect is nearly zero. The year-of-first-job coefficient can be treated as the negative of the experience coefficient. Thus, contrary to most findings, the absolute value of the experience coefficient is greater later in life, even though we have deflated by the Consumer Price Index. However, between 1955 and 1969, the effect of years experience has only risen about 50 percent, which is less than the percentage increase in average earnings of non-self-employed high school graduates or people with any other education level. That experience is more important than maturity in 1955 is not surprising given the evidence in Mincer (1974). It is somewhat surprising to find large senescence effects in 1969, since the discussion in Bloom (1964) suggests little changes in intelligence and certain other skills before age 50, and since weeks lost through illness have been held constant.[60] However, the results may also be due to discrimination on account of age for those who were fired in 1968 or 1969.

To try to refine the work-experience measure, we included information on military service after initial discharge, and type of work experience. We find that the additional military-experience data do not explain earnings, perhaps because military experience is a good substitute for civilian experience, or because, contrary to the above, experience on the job is not important. In Taubman (1975) we find that the earlier people enter into high-paying occupations, the more they earn in 1969 and that some 1955 jobs are better preparation than others, depending on one's 1969 occupation. These results suggest that some training is not general and that some people were in the wrong jobs in 1955 if they wanted to maximize their lifetime earnings.[61]

Earnings depend on hourly wage rates and hours worked. Unless there is a backward-bending supply curve of labor, higher wage rates will lead to greater hours worked and more earnings.[62] In 1969, each additional hour per week on the first job adds $70 to annual earnings.[63] If we use an average hourly wage rate per week of $350, we would estimate σ in the footnote as about -1.2. Each additional hour on the second job is associated with a $120 decrease in earnings, apparently because some of those people with low wage rates want higher material standards. Thus, both results, which rely on perhaps erroneous estimates of hours, suggest that the supply curve has some backward-bending sections.

Despite the fact that the hours data refer to 1969, we included them in 1955. The hours on second job are still significantly negative, while the hours on first job have become negative and insignificant. It appears that moonlighters work hard over long periods of time, since hours on second job is negatively related to recalled estimates of initial earnings and to the probability of the wife's working in 1968.

Weeks lost through illness in 1969 has a negative impact on 1969 and 1955 findings but only the 1969 coefficient is significant. The $180 a week lost would indicate a $9,000 a year job if the figures exclude paid sick leave, but we have no way of knowing if this is how the question was interpreted. Incidentally, this variable caused the self-assessed healthiness variable used by TW to become insignificant.

Nonpecuniary Rewards

There are monetary and nonmonetary rewards from a job. Since we expect people to base their job-choice decisions on the total of pecuniary and nonpecuniary rewards, those occupations which pay heavily in a nonpecuniary form should have a compensatory change in wage payments. We do not have available measures of the nonpecuniary aspects of various occupations, which we shall assume to be occupation specific, but equally accessible to all; however, we do have some crude information related to the preference of individuals on specific nonmonetary aspects of a job. For example, the respondents were asked, "Assuming that you thought that the financial possibilities were about the same, would you prefer to work for yourself or for somebody else or no preference?"[64] In 1955, those who preferred to be salaried earn 6 percent less than the

TABLE 5 Nonpecuniary Tradeoffs with Earnings, Relative to Salary of Average High School Graduate (Percentage of earnings for several variables[a])

	1955	1969	Number of Observations
Prefer to be salaried	−6	−10	962
Teacher	−10	−18	256
Reasons for taking 1972 occupation field when started:[b]			
Prospects of future financial success	−9	−17	1,200
Chance for independent work	5[c]	11	1,519
Person-to-person contact	−2[c]	1[c]	
Chance to help others	8	8	2,090
Represented a challenge	−13	−10	784
Job security	8	13	1,415
Free time	−1[c]	−2[c]	

NOTE: The variables in this equation which have been held constant include: education, mathematical ability, various measures of socioeconomic background of the respondent and of his wife; information on self-employment and on teaching; a crude measure of risk preference, age and work experience, health, hours worked, marital status, and attitudes toward nonpecuniary rewards.

[a]The dollar differences are divided by the earnings of the average non-self-employed high school graduate.

[b]Each coefficient refers to a "no" answer; hence, "yes" and the "no responses" are the omitted groups.

[c]Not significant at the 5 percent level.

average (non-self-employed) high school graduate (see Table 5). In 1969, the people who preferred to be salaried earn 11 percent less. It is important to realize that these results are from equations which hold constant being self-employed and amount of business assets.

We are interpreting the answer to the question as indicating risk preference, and that following the expected utility approach, risk averters give up some average earnings to reduce dispersion. Is this a reasonable interpretation? Taubman (1975) discusses in some detail how this variable could correspond to an economist's definition of risk aversion. We conclude there that in a formal sense, if respondents thought like economists, the question would distinguish between risk averters and risk lovers. In a less formal sense, people may simply be responding to their belief that a particular occupation is risky. This question was asked in 1969. It is possible that people who failed in their work now choose the salaried answer because of their failure. However, in Taubman (1975), Chapter 8, we show that this variable is not related to a (self-reported) measure of the difference between actual and expected financial success. However, an alternative explanation of the question might be that those who value being their own boss would earn less, especially since those who prefer independence in working do earn less (see below). While the results do not support the "being your own boss" explanation, this may mean that this explanation does not dominate the risk interpretation in this sample. While the results do not prove the risk interpretation result, there is, however, some evidence that bears on this issue which tends to corroborate it. As discussed in Taubman (1975) Chapters 8 and 9, this same variable determines schooling, the amount of business assets, and returns to capital in a manner consistent with risk preference. Finally, it is also worth reporting that the variable is significant and has the same sign in nearly all within-occupation equations. Moreover, in her dissertation, Wolfe has found that those who prefer to be salaried have less children for a given income, i.e., appear to be less willing to risk having children.[65]

Another set of questions asked in 1972 was, "As best as you can remember, what factors influenced your decision to enter the occupational field you are in at the present time? Check yes or no to each of the following and indicate factors that were of special importance."[66] In our equations, the dummy variable for each factor used was set at one if the respondent answered "no."

In 1969, the salary, person-to-person contact, and free-time variables were not significant in preliminary runs though salary nearly was. The other variables indicate that those who were not worried about future financial success receive 17 percent less than those who were worried (or didn't answer),[67] those not interested in independent work earn 10 percent more, those who wanted to help others earn 8 percent less, those who wanted to have a challenge earn 17 percent more, and those interested in job security receive 13 percent less earnings.[68] In 1955, when many of the people were in different jobs and even in different occupations, nearly all of the same variables are significant, and all the signs on the variables significant in 1969 are the same, though the magnitude is always less than in 1969.

Intuitively, all of these results seem quite plausible, and each one is internally consistent with the others. However, there is still the question of whether these variables are related to nonpecuniary preferences. This issue is discussed in detail in Taubman (1975), where it is concluded that the variables are probably related to preferences. This conclusion is in part based on the findings in Chapters 8 and 9 that the variables have effects consistent with the above interpretation in other equations. Moreover, the introduction of these variables has a big impact primarily on the various graduate education variables, which seems quite reasonable, since we often think that Ph.D.'s and other graduate students choose nonpecuniary rewards, such as independence in work or helping others.[69]

The basic threads running through these findings are that people who are willing to work hard on difficult or risky projects will end up with substantially more earnings, while those who are more interested in the intrinsic rewards of the job will receive less. While this is hardly a startling conclusion, we know of no other study which has been able to obtain significant impacts after holding constant such things as education and ability. Moreover, the consistency of findings between 1955 and 1969 suggests that the 1972 survey responses are not ex post rationalizations, and this is confirmed by the finding in Chapter 8 that responses to these variables are not a function of ex ante/ex post differences in monetary success.

The tradeoffs of earnings with nonpecuniary returns is quite large. Excluding the teacher dummy, which is discussed below, but including all the other significant coefficients in Table 5, we find that the difference in earnings due to various nonpecuniary preferences could be as high as 55 percent or $5,500 in 1969, and 40 percent or $2,500 in 1955, which are greater than all education effects except that for M.D.

The last nonpecuniary-related variable that we have used is that of being a precollege teacher. We find that such people earn 10 percent and 18 percent less in 1955 and 1969. The premium paid to be a teacher is even larger before the nonpecuniary variables are introduced, which seems reasonable. We cannot, however, rule out the possibility that teachers earn less because they are less able.

Business Assets

The respondents were asked for their "earnings," without definition of the concept. However, we would expect the self-employed to report their net income from their business, since most people would find it difficult to separate earnings derived from labor from those derived from capital. To try to hold constant the returns from capital, we have included a dummy variable for self-employed businessman, another dummy for self-employed professional, and most importantly, a continuous variable on amount of business assets.[70] All of these variables were measured only in 1969. The extra measurement error involved in using these variables in 1955 undoubtedly affects the comparability of our answers and our R^2, though comparison of 1955 and 1969 equations, which only use data available in both years, indicates that general conclusions on R^2 are not affected. We shall interpret the coefficients on the business-asset variable as the rate of return on financial capital invested in business.[71]

In 1969, the coefficient on the business-asset variable, which is an estimate of the before-tax rate of return, is .12. Such a figure is not unlike the .7 to .10 estimates usually found in studies such as Kravis (1962).[72] The dummy variable for self-employed businessman is still significant, though assets and hours worked are included in the 1969 equations, and equals 10 percent of the standardized base. The self-employed professionals, who may not have much in the way of financial investments, receive 31 percent more than the non-self-employed professionals (though the denominator is too low, since, for comparability, we have divided by the average earnings of high school graduates).

In 1955, the coefficient on 1969 business assets is still highly significant (a t of 11) at .03 even though the growth of assets must not have been uniform during the period, and some people must have changed their self-employment/salaried status. Probably because of the increased measurement error involved in using the 1969 asset and hours variables in 1955, the 1969 self-employment businessman dummy is as important in 1955 as in 1969. On the other hand, the 1969 self-employed professional dummy is not significant, presumably because many of these people were salaried in 1955 and had not had a chance to display their true worth to their employers.

Conclusion

The many and varied comparisons made in this section lead to several important conclusions. First, the effects of nearly all variables change during a person's life cycle and, in general, display a profile that increases with age. Second, the profiles are steeper for the education variables than for most other variables, though as shown in more detail below, the steepest profile is for those who attended private elementary school. Third, even after holding constant a wide variety of variables, we still find that education leads to large and statistically significant differences in earnings. These differences, however, are relatively small in comparison with those arising from the conglomeration of family background, attitudes, and nonpecuniary preferences and are no larger than the differences which are the result of ability. While we shall return to the topic below, it is also important to realize that a large portion of the differences in annual earnings is due to unmeasured variables and random events.

V. INEQUALITY: EXTENT AND CAUSES

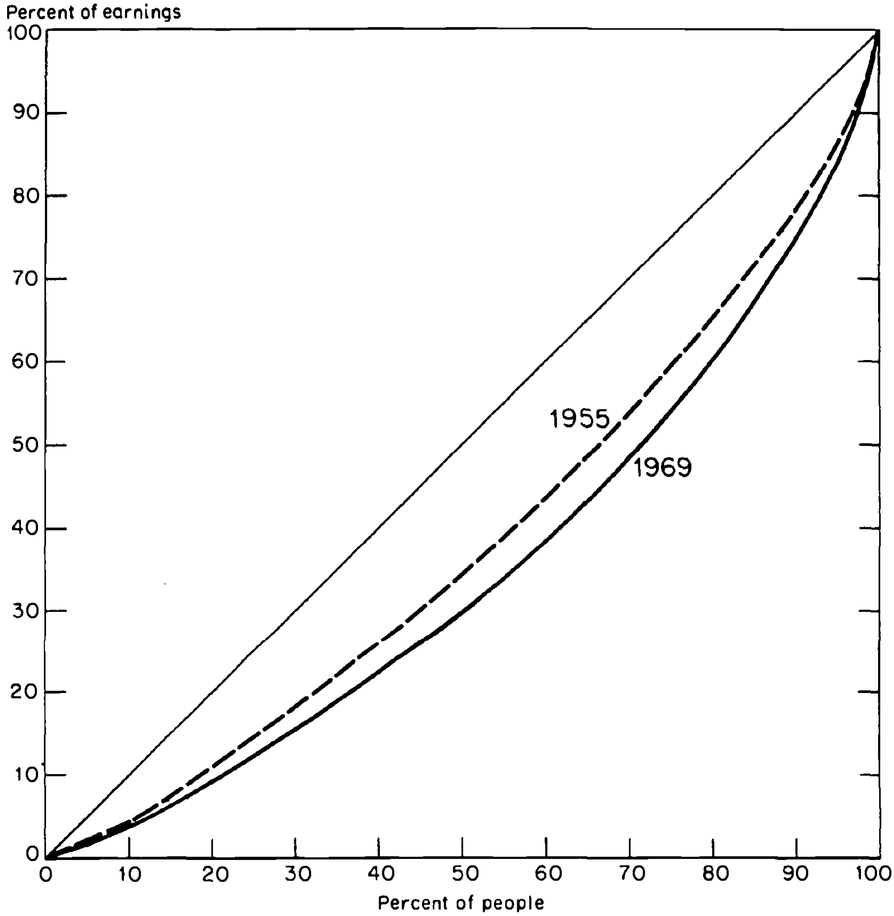
In this, as in most samples, the distribution of earnings is skewed to the right.[73] Since most people *assume* that something called "ability" or capacity is normally distributed, much attention has been paid to the question of why earnings exhibit a skewed distribution.[74] Becker (1964) and Mincer (1970) have demonstrated that such distributions can be generated by "acquired" human capital models. Mandelbrot (1962) explains skewness solely in terms of many different inherited skills. Champernowe (1953), Aitchison and Brown (1957), and others have shown that stochastic processes that operate continuously can generate skewed distributions.[75] In Friedman's model (1953), skewness arises from behavior toward risk rather than from differences in abilities.

Inequality in Earnings

The inequality in earnings can be measured in several ways.[76] One important measure is the Lorenz curve, which indicates the percent of total earnings received by the top X percent. The Lorenz curves for 1955 and 1969 are presented in Figure 1. Also drawn in that figure is a diagonal which is the Lorenz curve that would be observed if each person had the same earnings. In all years studied, earnings are not distributed equally and are below the diagonal.

All summary measures of relative inequality of two Lorenz curves will yield the same ranking *provided* the two curves do not intersect.[77] Conversely, if the curves intersect, there are always some measures that would disagree on whether curve 1 or 2 is more unequal. Since earnings do not follow any well known distribution, we have used the nonparametric Kolmogorov-Smirnov test (KS) to determine if the difference in the

FIGURE 1 Cumulative Earnings Distributions, 1955 and 1969, Percentage of Total Earnings Held by the Bottom X Percent



Lorenz curves is statistically significant. Results of the KS test indicate that the 1969 curve is statistically different from (more unequal than) the 1955 curve.

We also have examined the Lorenz curves for various education and mental ability groups.[78] In either 1955 or 1969, the Lorenz curves for any two mutually exclusive groups, such as high school and some college, were never significantly different at the 5 percent level though many were at the 10 percent level. For any particular group, the 1969 curve was always beneath the corresponding 1955 curve and the maximum differences which range from 6 to 10 percentage points were always significant at the 5 percent level. Thus, there is little difference in inequality in earnings between various education and ability groups in any year but in each case there is more inequality in 1969 than in 1955.

From Variance to Kurtosis

Thus far we have indicated that earnings inequality has varied from year to year. For many purposes, however, it is necessary to ask how particular features of the distribution have changed over time and to what extent these features and their change are the consequence of the distribution of education, mental ability, and so on. A quantifiable and at times decomposable description of a distribution can be obtained from various "moments" of the distribution.[79] The first four moments measure the mean, variance, skewness, and kurtosis of the distribution.

In 1969, in Table 6, our standard deviation, σ, is \$9.4.[80] In some types of labor markets, we would expect σ to increase when average earnings did. For these cases a standardized measure is provided by the coefficient of variation, σ/mean, which is about two-thirds in 1969.

Several measures of symmetry have been proposed in the literature. To avoid reranking the observations as we hold constant education and other sets of variables, we shall use the third moment standardized by the second to eliminate scale effects. A distribution is skewed to the right when this measure is positive, as is our 1969 estimate of 3.0. At the 5 percent level, we can reject the null hypothesis that the population is normally distributed, which is symmetric, using a test developed by Fisher.

Kurtosis measures the frequency of observations in the tail or near the mean of the distribution. We use the fourth moment divided (standardized) by the second. From this ratio we subtract 3 which is the expected value of the kurtosis in a normal distribution. Larger values such as our 12 indicate that there are too many observations in the tails or too few near the mean as compared with the normal curve.

In 1955, the mean earnings are \$7,300 (in 1958 dollars). The standard deviation is \$3.8 thousand and the coefficient of variation is about 1/2. Our skewness and kurtosis estimates are 5.4 and 62.0 respectively, neither of which would be in accord with the null hypothesis that the distribution is normal. Thus in both 1955 and 1969, the distribution of earnings is skewed to the right and has larger numbers of people in the tails.

Given the differences between our sample and the U.S. population, the results on the various inequality measures in any one year have restricted interest until we control for education, ability, and so forth. But the changes during the 14 years are of substantial interest—especially since such data are not generally available over such a time span and so late in the life cycle.

TABLE 6 Sources of Inequality in 1969 and 1955

	Standard Error	Skewness	Kurtosis
1969			
Y	9.42	3.05	13.90
$Y-Y_1$	7.75	2.76	14.75
$Y-Y_2$	9.11	3.22	15.27
$Y-Y_3$	9.33	3.11	14.31
$Y-Y_4$	8.63	2.82	13.39
$Y-Y_5$	9.20	3.12	14.61
$Y-Y_6$	9.33	3.05	13.91
$Y-Y_7$	9.06	3.11	14.78
$Y-Y_8$	9.37	3.01	13.71
1955			
Y	3.81	5.35	61.99
$Y-Y_1$	3.41	5.56	78.24
$Y-Y_2$	3.74	5.47	65.09
$Y-Y_3$	3.78	5.41	62.88
$Y-Y_4$	3.65	5.40	68.50
$Y-Y_5$	3.74	5.46	64.29
$Y-Y_6$	3.80	5.32	62.34
$Y-Y_7$	3.69	5.42	65.12
$Y-Y_8$	3.80	5.33	61.99

NOTE: The Y_1 through Y_8 series are based on equations in Table A-1 in Appendix A.

Y_1 = all variables.
Y_2 = education coefficients, including M.D. and LL.B., and the Gourman rating.
Y_3 = mental ability variables.
Y_4 = business assets, and the self-employed businessmen and professional dummies.
Y_5 = prefer to be salaried and the 4 other nonpecuniary variables.
Y_6 = age, year of first job, hours worked, hours on second job.
Y_7 = time spent, private schools, in-law, biography, religion, size of current town, never-move variables.
Y_8 = teacher, no response in 1972, weeks lost from illness, age entered school, religious school attendance, and weight variables.

Between 1955 and 1969, the mean earnings in constant dollars grew by about 100 percent. Since the standard deviation increased by a greater amount than the mean, the coefficients of variation increased by 27 percent.[81] The changes in the skewness and kurtosis measures are both negative. Thus, contrary to the usual interpretation of stochastic theories, the distribution is becoming *less* asymmetric and less deviant from a normal curve as the people age (though the 1969 curve is far from a normal curve).[82]

Sources of Variance, Skewness and Inequality

Our sample is, of course, better educated, mentally more able, probably less risk averse, and more limited in age than the population. Since all these characteristics affect earnings and have a distribution different from that in the population, there is no reason to expect to find that the distribution of earnings is the same as that in the population. Despite this, we can still use the sample to study some problems of interest. For example, suppose the true equation *in the population* is

(1) $$Y_i = X_i a + u_i$$

where X_i is a vector of (measured) independent variables, a is the associated vector of coefficients and u_i are errors arising from random events and unmeasured variables. Because our distribution of the X's differs from the population, we have an unequally weighted stratified sample.[83] As long as the u's are distributed the same as in the population, we can study the distribution of $Y - Xa = u$ to determine what the population distribution would be if everyone has the same education and ability, and if wage rates did not change.

In examining the sources of various aspects of inequality, several things must be noted. First, since the equation's coefficients are selected so as to minimize the variance of the residuals with no attention given to the skewness or kurtosis, the results (on sources) are less reliable for these latter two measures than for the variance.[84] Second, despite this caveat, the effects of the X's on skewness and kurtosis might be larger than those on variance.[85]

Table 6 contains estimates for 1969 of the standard error, skewness, and kurtosis with the latter two standardized by the standard error raised to the appropriate power.[86] This standardization is appropriate, since we are primarily interested in the question of whether the distribution would be normal or would be much less skewed if ability, and so forth, were the same for everyone. But variables which reduce the residuals will also reduce u^3 or u^4; thus, the resulting series could be as skewed though $\Sigma(Y_i - \bar{Y})^3$ would be smaller.

We present the estimates for earnings (Y) and residual earnings, ($Y - X^*a$), where X^*a refers to a subset or all of the variables used in the equations in Table A-1. If we had estimated an equation with just X^*, generally we would have obtained different estimates of these coefficients. But since such coefficients would be biased estimates of the true parameters, it was felt that it was better to use the estimates from the comprehensive equation.[87]

Using the most comprehensive equation available, the standard error of the residual earnings is reduced by about 18 percent to \$7.8 in row 2 of

Table 6. The remaining rows in the table, identified at the bottom, indicate the effects of various sets of variables. For purposes of reference, Y_2 will be called education, Y_3 mental ability, Y_4 self-employment, Y_5 nonpecuniary tradeoffs, Y_6 work-related experiences, Y_7 socioeconomic standing, and Y_8 miscellany. The reduction in the standard errors indicates the partial R's—ignoring sign—of these variables but because reductions in variance depend upon the covariance of the independent variable, the effects of the individual rows are not additive.[88]

The self-employment data reduces the standard error, σ, by 8 percent, with business assets being the most important single variable. The SES variables reduce σ by 5 percent. The quantity and quality of education variables (including M.D. and LL.B.) reduce σ by less than 4 percent and all other sets of variables have even smaller impacts on σ.

In the sample, the standardized skewness measure is 3.05. As shown in the $Y-Y_1$ row, the full set of variables reduces the skewness by 10 percent to 2.76.[89] Thus, even if education, ability, SES, business assets, and so on, were equal for all individuals, the earnings distribution would be about 90 percent, as skewed as originally, once we adjust for the reduction in variance from holding each of these items constant.

Interestingly, when education, ability, and the nonpecuniary tradeoffs are individually held constant, the *standardized* skewness measure *increases* between 1 and 5 percent. On the other hand, the self-employment variables *reduce* the relative skewness by 7 percent and the miscellaneous variables in Y_8 reduce skewness by 1 percent.

Thus, we can conclude that if everyone in the sample had the same education or ability or nonpecuniary preferences, the earnings distribution would have slightly more skewness.[90] We can also conclude that differences in self-employment (size of business assets and being self-employed) have contributed greatly to the existing skewness in the distribution in this sample.

Now let us examine kurtosis. In the sample the standardized kurtosis measure had a value of 13.9 which is far from, and significantly different from, the zero expected in the normal distribution.[91] The standardized kurtosis measure based on the residuals from equation 2 is increased by 6 percent. Looking at the other rows, we find that only holding constant self-employment and the miscellany in Y_8 has led to a reduction in relative kurtosis. Even with self-employment held constant, the distribution of earnings would exhibit kurtosis. On the other hand, the elimination of education differences leads to a big increase in kurtosis. This suggests that education pushes more people away from the mean and makes for a smoother transition to the tails, whose existence is not related to education.

1955

Our analysis of the source of inequality in 1955 earnings distributions is handicapped by the fact that several of our most important variables—including the self-employment ones—are measured only in 1969 and must have changed between 1955 and 1969. Nevertheless, let us examine the same statistics on inequality. As shown in Table 6, the standard error of earnings in 1955 is $3.8 (thousands of 1958 dollars). Since the 1955 equation has a smaller R^2, the standard error of $Y - Y_1$ has only been reduced by 10 percent. The standard error of earnings is reduced by about 1½ to 3 percent by each of education, ability, risk preference, and nonpecuniary variables, work experience, SES and the miscellany in Y_8, but the self-employment variables reduce the standard deviation by 4 percent.

The 1955 skewness measure is 5.3, which is much greater than in 1969. Examining the various rows, we find that holding constant any subset (except work experience and the miscellany) of the whole set of the characteristics in equation 2 *increases* relative skewness.[92]

Much the same pattern appears on kurtosis. The residuals from the full or any partial set of variables (except the miscellany) have greater standardized kurtosis than in the original earnings data and this kurtosis is greater in 1955 than in 1969.

Pattern by Education Level

Since we have eliminated the average difference in earnings for people with different amounts of education and ability, the above analysis essentially analyzes the *between cell* contribution of education and ability, to inequality. For several purposes it is important to study inequality *within* various education and ability cells. As shown in Table 7, in 1955 the standard error is lowest for those with only a high school education, at the peak for those who started or completed college, and intermediate for those with more formal education than a bachelor's degree.[93] The relative skewness and kurtosis measures increase sharply from high school through a bachelor's degree, then fall to their lowest level for those with at least some graduate work. In each education group, neither earnings nor the log of earnings are distributed normally.

In 1969, it is still true that the earnings distribution is neither normal nor log-normal. In other respects, the pattern is much different from 1955. While high school graduates still have the lowest standard error, graduate students (including M.D.'s and LL.B.'s) have the highest. The

TABLE 7 Effects of Various Sets of Variables on Inequality by Four Levels of Education, in 1955 and 1969

	1955			1969		
	Standard Error	Skewness	Kurtosis	Standard Error	Skewness	Kurtosis
High school						
Y	2.81	2.87	13.68	7.12	3.59	21.36
$Y-Y_1$	2.50	1.97	9.79	5.74	2.68	17.50
$Y-Y_2$	2.82	2.84	13.50	7.12	3.61	21.50
$Y-Y_3$	2.80	2.89	13.97	7.07	3.61	21.62
$Y-Y_4$[a]	2.64	2.34	10.74	6.28	3.18	19.41
$Y-Y_5$	2.73	2.79	13.26	6.84	3.56	21.64
$Y-Y_6$	2.80	2.79	13.10	7.07	3.60	21.68
$Y-Y_7$	2.75	2.82	14.04	6.84	3.47	20.39
$Y-Y_8$	2.82	2.80	13.48	7.13	3.52	21.37
Some college						
Y	4.30	5.37	51.00	9.79	3.29	15.20
$Y-Y_1$	3.87	5.25	53.81	8.32	2.87	15.45
$Y-Y_2$	4.29	5.30	51.17	9.72	3.30	15.32
$Y-Y_3$	4.30	5.38	50.98	9.75	3.29	15.30
$Y-Y_4$	4.14	5.33	52.67	9.02	3.09	15.58
$Y-Y_5$	4.25	5.45	52.48	9.58	3.36	15.96
$Y-Y_6$	4.29	5.39	51.45	9.72	3.28	15.12
$Y-Y_7$	4.13	5.30	51.18	9.37	3.23	15.36
$Y-Y_8$	4.30	5.30	50.21	9.76	3.23	14.84
Bachelor's degree						
Y	4.25	6.30	77.92	9.64	2.81	11.50
$Y-Y_1$	3.93	6.94	99.70	8.38	2.57	11.35
$Y-Y_2$	4.23	6.36	79.06	9.58	2.85	11.80
$Y-Y_3$	4.22	6.34	78.52	9.60	2.85	11.76
$Y-Y_4$	4.13	6.41	85.69	9.02	2.48	9.69
$Y-Y_5$	4.19	6.40	79.79	9.50	2.85	11.85
$Y-Y_6$	4.22	6.40	80.63	9.50	2.84	12.76
$Y-Y_7$	4.15	6.53	83.65	9.35	2.90	12.60
$Y-Y_8$	4.26	6.32	78.25	9.58	2.78	11.28
Graduate work						
Y	3.33	2.53	10.29	10.02	2.96	12.73
$Y-Y_1$	2.89	1.56	8.08	8.19	2.65	13.63
$Y-Y_2$	3.12	2.21	9.35	9.55	3.16	14.54
$Y-Y_3$	3.29	2.60	10.84	9.93	3.00	13.02
$Y-Y_4$	3.14	2.33	9.55	9.08	2.79	12.74
$Y-Y_5$	3.27	2.62	11.03	9.79	3.05	13.53
$Y-Y_6$	3.32	2.53	10.30	9.85	2.97	12.85
$Y-Y_7$	3.32	2.50	10.77	9.80	3.01	13.49
$Y-Y_8$	3.27	2.47	10.01	9.83	2.97	13.04

NOTE: For definitions, see Table 6.
[a]While this row should repeat the row for Y, there is a small recorded change since a few people whom we treat as not having attended college went for less than a semester and have a Gorman rating.

skewness and kurtosis measures are greatest for high school graduates and then decrease through the bachelor's level, followed by a slight increase at the graduate level. The major change in the high school category between 1955 and 1969 requires comment. We suggest that the above average growth in the standard error and the large absolute and comparative increase in the skewness and kurtosis measures occur because even the talented or lucky individual among high school graduates finds that it takes longer to get to the top. Thus, in 1955, these people would not be so far out in the right-hand tail as they are in 1969. Perhaps because of a different distribution of talent among the more educated, because of credentialism based on education, or because of nepotism, this same phenomenon does not occur in other education classes.

More light can be shed on these and other issues by examining the distribution of the residuals in each education class. Since we are not able to find significant differences in the coefficients by ability or education level, we can use the same sets of coefficients that we employed previously in making these calculations.

Consider first the 1955 results in Table 7. At each education level, the standard error declines by about 10 per cent, with the self-employment variables ($Y - Y_4$) generally responsible for the largest reduction in the standard error and the SES($Y - Y_7$) and nonpecuniary tradeoffs ($Y - Y_5$) variables nearly as important.

In all but the bachelor's group, holding the self-employment variable constant causes a reduction in the relative skewness measure. The opposite is true in Table 6 for the total sample. It seems likely that this difference is due to the use of a separate standardization factor in each education level or, in other words, the total sample combines within education distributions which have different parameters. In the high school and graduate level, kurtosis decreases when self-employment is held constant, while the opposite is true at the other two education levels. No other set of characteristics has a large impact on skewness or kurtosis in 1955 at more than one education level.

In 1969, the picture is more varied. The standard error of $Y - Y_1$ is nearly identical for all but the high school category, which remains the lowest, and much of the difference in skewness and, to a lesser extent, kurtosis, disappears. At each education level, holding constant the self-employment variable substantially reduces the standard error and the relative skewness and the estimates of relative kurtosis of the high school and bachelor's degree categories. Once again SES and nonpecuniary variables play an important secondary role in determining the standard error but have little effect on skewness and kurtosis.

Mental Ability

Since very little information has ever been presented about the distribution of earnings by mental ability, it is appropriate to repeat the above analysis by the five ability levels. Table 8 contains the distribution statistics for earnings for each ability fifth. In 1955, the standard error is lowest for the bottom fifth and highest for the top. The middle fifth, however, has a lower standard error and coefficient of variation than the group on either side. (Since the standard error of the log of earnings does not vary with ability, the above results may be due to a few extreme observations—as is also suggested by the skewness and kurtosis measure.) Both skewness and kurtosis follow the same pattern, with highest values in the top fifth; however, none of the earnings distributions within an ability cell are normal or log-normal.

In 1969, the standard deviation follows the same pattern as in 1955 (though the top fifth has the lowest coefficient of variation). Skewness and kurtosis are substantially lower in the top two-fifths than in the lowest three-fifths; however, none of the distributions are normal or log-normal.

TABLE 8 Effects of Various Sets of Variables on Inequality by Five Ability Levels, in 1955 and 1969

	1955			1969		
Ability Fifth	Standard Error	Skewness	Kurtosis	Standard Error	Skewness	Kurtosis
Bottom fifth						
Y	2.91	2.92	14.79	7.81	3.39	17.89
$Y-Y_1$	2.67	1.90	9.54	6.71	2.98	20.23
$Y-Y_2$	2.88	2.89	14.96	7.60	3.55	19.83
$Y-Y_4$	2.83	2.45	12.36	7.24	3.29	20.36
$Y-Y_5$	2.85	2.94	15.27	7.61	3.45	18.49
$Y-Y_6$	2.91	2.81	13.84	7.76	3.40	17.96
$Y-Y_7$	2.83	2.64	12.60	7.68	3.25	17.48
$Y-Y_8$	2.91	2.86	14.67	7.75	3.26	17.02
2nd fifth						
Y	3.90	5.39	49.39	9.14	3.50	17.95
$Y-Y_1$	3.53	5.41	56.95	7.52	2.98	17.57
$Y-Y_2$	3.86	5.41	50.26	8.89	3.55	18.28
$Y-Y_4$	3.78	5.37	52.09	8.38	3.16	17.11
$Y-Y_5$	3.83	5.47	50.96	8.89	3.55	18.66
$Y-Y_6$	3.88	5.44	50.47	9.07	3.47	17.83
$Y-Y_7$	3.76	5.31	49.88	8.86	3.56	19.15
$Y-Y_8$	3.89	5.36	49.29	9.04	3.44	17.61

TABLE 8 (concluded)

	1955			1969		
Ability Fifth	Standard Error	Skewness	Kurtosis	Standard Error	Skewness	Kurtosis
3rd fifth						
Y	3.32	3.02	13.73	9.06	3.36	16.44
$Y-Y_1$	2.86	2.20	9.98	7.52	2.95	16.64
$Y-Y_2$	3.22	2.89	13.11	8.81	3.50	17.87
$Y-Y_4$	3.07	2.67	11.89	8.16	3.05	15.37
$Y-Y_5$	3.25	3.07	14.28	8.84	3.44	17.32
$Y-Y_6$	3.32	2.94	13.32	8.97	3.37	16.65
$Y-Y_7$	3.27	2.99	13.93	8.79	3.44	17.48
$Y-Y_8$	3.30	2.98	13.46	9.05	3.31	16.16
4th fifth						
Y	3.82	3.80	23.84	9.66	2.77	11.42
$Y-Y_1$	3.40	3.66	25.99	7.76	2.66	13.56
$Y-Y_2$	3.75	3.89	25.00	9.39	2.95	12.73
$Y-Y_4$	3.63	3.65	23.43	8.75	2.66	11.86
$Y-Y_5$	3.74	3.87	24.71	9.42	2.81	11.93
$Y-Y_6$	3.81	3.76	23.74	9.53	2.77	11.61
$Y-Y_7$	3.70	3.87	25.24	9.19	2.84	12.18
$Y-Y_8$	3.83	3.78	23.83	9.59	2.71	11.12
5th fifth						
Y	4.50	7.27	95.12	10.26	2.77	11.29
$Y-Y_1$	4.17	7.77	114.43	8.81	2.45	10.41
$Y-Y_2$	4.47	7.33	96.74	10.00	2.89	12.16
$Y-Y_4$	4.36	7.51	104.38	9.55	2.49	9.69
$Y-Y_5$	4.45	7.33	96.34	10.12	2.83	11.85
$Y-Y_6$	4.48	7.31	96.70	10.15	2.75	11.15
$Y-Y_7$	4.39	7.41	99.69	9.85	2.82	11.93
$Y-Y_8$	4.49	7.26	95.45	10.21	2.78	11.46

NOTE: See Table 6 for definitions. $Y-Y_3$ is omitted since Y_3 contains only the ability variables.

Table 8 also presents the inequality pattern by ability level once other variables have been held constant. As we have consistently found in dealing with 1955, the self-employment variables cause the biggest reduction in the standard error in most ability fifths, with the SES and nonpecuniary tradeoffs contributions almost as large. In the 1969 data, holding self-employment constant substantially reduces the standard error and skewness.

At first glance, the inequality pattern seems confusing. For example, when comparing the education results, we find high school to be (about) the lowest on skewness and kurtosis in 1955 but the highest in 1969. A similar reversal occurs in the ability results.

A sorting uncertainty model can be used to explain these reversals and other results contained in Tables 6 and 7. The basis of this model is that it is difficult to measure in advance a person's capacity to perform in various jobs. Firms also do not use piece pay rates perhaps because of difficulty in measuring one person's productivity and of interdependencies within production lines or hierarchical structures. Firms, therefore, initially assign people to particular jobs on the basis of certain "objective" criteria, such as education, marital status, and military record, and certain "subjective" criteria such as performance at an interview.[94] In addition, appointment may be based on discrimination, as evidenced by race, gender, or parental pull.

Since firms know that the above criteria or signals are fallible, they continuously monitor performance on the job to base decisions on which to fire, to retain, and to promote. Average initial earnings may be fairly uniform when studied by objective criteria, because of morale problems associated with different pay for the same position and because at low-level jobs a person has little chance to use initiative or display productivity outside of a narrow range.[95] People with more potential capacity perform better, are promoted faster, and have a higher growth rate in earnings. However, promotions occur somewhat randomly, because the particular vacancies a person is qualified for occur irregularly, because a person's talent may not be recognized at once if he "blooms" late, and because family connections or nepotism results in faster promotions for equally qualified persons.[96]

Now, how does this model, with some other considerations, explain the previous findings? First, high school graduates have less objective credentials and probably less parental pull than the more educated, and they start at lower rungs in the career ladder. By 1955, the high school graduates have made some progress, but they have not yet made it to those positions, such as manager or successful business owner, where salaries are very high.[97] Thus in 1955, high school graduates have a smaller standard error, skewness, and kurtosis than those with some college and a bachelor's degree, because some in the latter two groups have received promotions to very responsible positions. By 1969, when the men are about forty-seven years old, firms have sorted out people by capacity; thus the talented high school graduate has received his promotions and is at or near his potential capacity at age forty-seven. However, the distribution of talent in the high school group is different from that in the other groups, with relatively few such talented people among the less educated. This difference arises for several reasons. For example, the more talented partly inherit their capacity from successful parents, who encourage them to get more education. Second, some sources of their capacity (such as drive and creativity) may lead to academic leanings and scholarships. Third, for most people, education may be a necessary ingredient in the formation of capacity.

Now, how do we explain the ability results? A plausible argument can be made that the mental ability measure we use is correlated with other types of cognitive and, to a lesser extent, noncognitive skills. Following the lines of the above argument, we would expect skewness and kurtosis for the less able to be relatively low in 1955 and high in 1969. Comparing the bottom and top fifths, we find this to be the case. However, Table 8 also indicates very large values of skewness and kurtosis in the second fifth in 1955 and an extremely large increase for the top fifth.

While we can construct a plausible explanation of the changes in inequality measure on the basis of a sorting uncertainty model, other theories are also consistent with the results. For example, Mincer (1970) has shown that in his theory

$$\frac{\sigma^2(YP)}{\sigma^2(Yj)} - 1 = \frac{r^2\sigma^2(C_T)}{\sigma^2(E_S)} + \frac{2r\rho\sigma(C_T)}{\sigma(E_S)}$$

where

$\sigma^2(YP)$ is the variance in peak earnings;
$\sigma^2(Yj)$ is the variance in earnings in the overtaking year;
r is the rate of return on postschool investment;
$\sigma^2(C_T)$ is the variance in the sum of postschool investment;
$\sigma^2(E_S)$ is the variance in initial postschool earnings capacity; and
ρ is the correlation between dollar investments in schooling and postschool investment.

We shall discuss the issue in more detail later, but it is approximately true that 1955 corresponds to the overtaking year (in any event, $\sigma^2(Yt)$ will increase with t if ρ is positive). Thus Mincer's interpretation of the faster growth in σ between 1955 and 1969 for high school graduates is that either ρ or $\sigma(C_T)/\sigma(E_S)$ is greater for these people.

Skewness in Mincer's model arises primarily from the correlations between the means and variances of earnings (within education cells). However, under the same assumptions as above we can express the nonstandardized skewness as

$$\frac{\sigma^3(YP)}{\sigma^3(Yj)} - 1 = 3\rho_1 r\frac{\sigma(C_T)}{\sigma(E_S)} + 3\rho_2 r^2\frac{\sigma^2(C_T)}{\sigma^2(E_S)} + \frac{r^3\sigma^3(C_T)}{\sigma^3(E_S)}$$

where ρ_1 and ρ_2 are the correlations between E_S^2 and C_T and E_S and C_T^2 respectively. Generally speaking, ρ_1 and ρ_2 will have the same sign as ρ; hence, $\sigma^3(YP)$ would certainly exceed $\sigma^3(Yj)$ if $\sigma^3(C_T)$ and $\sigma^3(E_S)$ have the same sign. The theory would also suggest that the faster the growth in variance within educational levels, the faster the growth in skewness, provided the last term is about the same at all education levels. This is borne out in our sample. The findings are not inconsistent with Mincer's model and indeed can not be made so since $\sigma^3(C_T)$ can vary by education level.

VI. INDIVIDUAL STABILITY IN THE EARNINGS DISTRIBUTION

While many of our findings are based on variables not previously used in studies of earnings, in principle the same phenomena could be examined for different cohorts in Census-type samples. The longitudinal data in our sample also permit us to extend our understanding of the dynamic evolution of the earnings distribution and to analyze the relationship of annual to lifetime earnings by examining the stability of an individual's position in the earnings distribution over time.

The empirical facts on stability and change over a long time span are very valuable in themselves, since the distribution of lifetime earnings is more important for many purposes than that of any one year's earnings. But equally important, these facts allow us to test, and thus have a chance to reject, certain earnings' distribution theories, as described below.

Individual Stability and Change in the Earnings Distribution

To examine individual stability in the distribution, we have calculated the "transition probability matrix" for the people who reported earnings in both 1955 and 1969. Table 9 indicates the percentage of people who ended up in any tenth of the 1969 earnings distribution from any given tenth in the 1955 distribution.[98] For example, of the people with the lowest 10 percent of the earnings in 1955, in 1969, 39 percent were still at the bottom, an additional 30 percent could be found between the 10 percent and 30 percent percentiles, and less than 9 percent have moved up into the top 30 percent of the distribution. As a simple (ordinal) measure of stability we can use the average percentile position, which has risen from 5 percent to 26 percent by 1969.

TABLE 9 Distribution of Earnings in 1969 for 1955 Earnings Percentile—Percent of People

Percentile in 1955	Number in 1955	Percentile in 1969 (Percent of Row Sum): Bottom 10%	10 < 20	20 < 30	30 < 40
Bottom 10%	412	38.7	19.1	10.6	6.5
10 < 20	484	15.2	21.7	16.5	11.4
20 < 30	368	16.4	20.4	14.4	10.6
30 < 40	358	8.9	12.6	16.2	18.1
40 < 50	516	5.4	13.0	13.2	14.8
50 < 60	586	4.9	10.0	7.3	13.9
60 < 70	353	3.1	7.1	3.7	6.8
70 < 80	565	3.0	2.5	3.5	6.1
80 < 90	500	1.2	3.2	2.8	4.0
Top 10%	462	1.7	1.5	0.8	1.3
Number, 1969	4,607	451	492	397	428

For contrast, consider the people in the top 10 percent in 1955. In 1969 44 percent were still in the top 10 percent, an additional 35 percent were in the next 20 percent of the distribution, and only 4 percent had fallen below the thirtieth percentile. The average percentile position had fallen from 95 percent to 80 percent in 1969.

In the other tenths in 1955, people tend to be close to their starting position with, for example, from 39 percent to 64 percent of the people falling within the same or neighboring tenths of the distribution. Not more than 30 percent of the people in the row lie above the seventieth percentile in 1969 until we reach the 60–70 percent interval in 1955, while at least 30 percent of the row fall below the thirtieth percentile in 1969 until we reach the 50–60 percent interval in 1955. The average percentile standing in 1969 for each tenth in 1955 rises continuously; but, on the average, people who were in the bottom 40 percent in 1955 have a higher percentile standing in 1969, while the reverse is true for those in the top 60 percent in 1955.[99]

As shown in Table 10, between 1955 and 1969 about 1 percent of the people suffered a decline in nominal earnings; and 15 percent had a growth of less than 75 percent.[100] For almost 50 percent of the sample, earnings grew between 75 percent and 175 percent while for 3 percent of the sample, earnings grew in excess of 500 percent. Using individual

Percentile in 1969 (Percent of Row Sum)						Average Percentile in 1969
40 < 50	50 < 60	60 < 70	70 < 80	80 < 90	90 < 100	
5.6	6.5	3.9	2.7	3.4	2.6	25.7
10.8	8.9	4.1	2.3	2.0	1.6	29.2
10.0	9.3	7.1	4.8	4.5	1.9	34.6
15.6	11.1	6.7	6.4	2.5	1.7	38.7
16.5	15.2	9.9	7.8	3.1	1.4	42.8
14.6	13.9	11.9	11.1	7.5	4.2	46.9
14.8	16.7	15.3	17.3	11.8	3.3	57.0
11.1	14.0	17.2	17.7	16.1	8.9	62.8
3.8	11.2	9.8	19.0	26.0	19.0	71.3
3.9	6.9	4.5	10.0	25.5	43.7	80.1
491	520	428	470	501	416	

NOTE: The cutoff points by tenths for 1955 are: $4,068, $4,788, $5,028, $5,388, $6,000, $6,468, $7,188, $8,028, $8,798. The cutoff points by tenths for 1969 are: $8,899, $10,000, $12,000, $15,000, $16,510, $19,000, $23,000, $30,000.

observations, the average percentage change is 175 percent and the average annual compound growth rate between 1955 and 1969 is 4.7 percent which, over 14 years, is equivalent to an increase of about 90 percent. (There is no reason to prefer one measure to the other.)

Of the people who were in the second tenth of earnings in 1955, 1 percent had a decrease in (nominal) earnings. Nearly 16 percent (the mode) had a gain between 125 percent and 150 percent, while 8.5 percent had a growth in excess of 300 percent. The average growth rate in earnings in this tenth is 176 percent.

Of the people in the eightieth to ninetieth percentile in 1955, nearly 5 percent had a decrease in their nominal earnings. The mode is in the 75 percent to 100 percent interval, and 14.5 percent had a growth rate in excess of 300 percent. The mean growth rate in the next to bottom and the next to top rows are identical; but there are more people in both tails of the distribution in the eightieth to ninetieth percentile, and the two distributions are significantly different at the 5 percent level (KS test).

In all but the two extreme rows, the mean growth in earnings only ranges from 151 percent to 176 percent and the compound rates range from .045 to .051. However, those whose earnings placed them in the top

TABLE 10 Distribution of Growth Rate in Earnings 1955 to 1969 by Earnings Percentile in 1955: Whole Sample*

1955 Percentile	Growth Rate (= 1969 Income Less 1955 Income/1955 Income) <0	0 < .25	.25 < .50	.50 < .75	.75 < 1.00	1.00 < 1.25	1.25 < 1.50	1.50 < 1.75
0 < 10	.000	.007	.010	.046	.077	.116	.082	.100
10 < 20	.002	.010	.006	.056	.126	.152	.157	.118
20 < 30	.000	.005	.035	.070	.138	.177	.087	.130
30 < 40	.000	.000	.039	.064	.128	.131	.193	.103
40 < 50	.002	.006	.043	.094	.090	.173	.093	.125
50 < 60	.000	.000	.026	.099	.141	.178	.152	.105
60 < 70	.006	.020	.059	.057	.105	.150	.142	.096
70 < 80	.004	.030	.044	.087	.119	.143	.103	.127
80 < 90	.010	.048	.062	.068	.118	.114	.098	.092
90 < 100	.086	.043	.110	.087	.089	.087	.089	.100
Total	.011	.018	.045	.076	.110	.145	.115	.113

70 percent to 90 percent in 1955 have distributions which are significantly different (KS test, 5 percent level) with more people in both tails than those in the bottom 10 percent to 50 percent. In the bottom tenth, the mean change is 267 percent with a heavy concentration in the right-hand tail. In the top tenth, the mean change is only 143 percent; and there is a heavy concentration in the left-hand tail.

Distribution of Growth Rates by Education Level

Tables 11 through 14 show the growth rate distributions for each of four education levels. Since, in these tables, cutoff points for the tenths are those for the entire sample, we may compare the corresponding rows. In the tenth to twentieth percentile, about 68 percent, 57 percent, 45 percent, and 36 percent of people with high school, some college, a bachelor's degree, and at least some graduate training had earnings increases no greater than 150 percent. The average growth in earnings increases with education for people with the same earnings in 1955. Despite the relatively small sample sizes within each of these 1955 percentiles, the KS test rejects the hypothesis that the cumulative

Growth Rate (= 1969 Income Less 1955 Income/1955 Income)								
1.75< 2.00	2.00 < 2.25	2.25 < 2.50	2.50 < 2.75	2.75 < 3.00	3.00 < 5.00	>5.00	Mean Growth Rate	Mean Compound Annual Growth Rate
.107	.070	.075	.043	.036	.135	.092	.2675	.68
.101	.076	.037	.050	.023	.064	.021	.1759	.51
.065	.082	.030	.026	.041	.081	.030	.1806	.46
.123	.050	.039	.031	.036	.042	.017	.1671	.48
.075	.063	.053	.025	.020	.057	.019	.1550	.46
.089	.068	.037	.031	.010	.037	.026	.1715	.45
.105	.102	.023	.031	.031	.059	.018	.1610	.46
.087	.051	.053	.021	.028	.071	.032	.1702	.45
.082	.062	.032	.052	.024	.106	.030	.1760	.47
.065	.041	.039	.030	.024	.089	.022	.1425	.36
.089	.066	.044	.034	.027	.076	.030	.1757	.47

[a]Those with zero earnings in either year are excluded.

distribution of, say, the second and ninth rows are the same in each education level.

For any one educational level, the results are similar to those given for the whole sample in Table 2. That is, except for the top and bottom row, the mean percentage change is independent of the earnings percentile in 1955.[101] The people at the bottom in 1955 have the highest growth rate, while those at the top in 1955 have the lowest growth rate (except for the high school category). Within each education level, those with high earnings in 1955 tend to have distributions with a greater percentage of people in both tails than people with low incomes. Despite the relatively few observations within these tables, the differences in the distribution by row are significant. Thus, we can conclude that results in Table 10 do not occur because high school graduates are more concentrated in the lower percentiles in 1955.

In the appendix, we present several equations in which the dependent variable is $(Y69 - Y55)/Y55$. (The reader who wishes to examine the determinants of $Y69 - Y55$ can do so by subtracting the 1955 regression from the 1969 one.) The first equation contains all the variables used in the final equation for 1955 and 1969, while the second adds $Y55$.

TABLE 11 Growth Rate in Earnings 1955 to 1969 by Earnings Percentile in 1955: High School Graduates

1955 Percentile	Growth Rate (= 1969 Income Less 1955 Income/1955 Income)							
	<0	0 < .25	.25 < .50	.50 < .75	.75 < 1.00	1.00 < 1.25	1.25 < 1.50	1.50 < 1.75
0 < 10	.000	.006	.012	.093	.086	.154	.105	.117
10 < 20	.000	.012	.012	.093	.216	.234	.191	.100
20 < 30	.000	.000	.091	.091	.190	.223	.074	.140
30 < 40	.000	.000	.086	.140	.194	.172	.151	.065
40 < 50	.000	.005	.116	.152	.152	.223	.076	.112
50 < 60	.000	.000	.024	.167	.190	.286	.095	.143
60 < 70	.000	.016	.078	.109	.172	.234	.109	.016
70 < 80	.012	.049	.074	.210	.222	.136	.049	.049
80 < 90	.032	.063	.168	.131	.116	.074	.063	.074
90 < 100	.120	.040	.173	.067	.080	.067	.080	.120
Total	.012	.016	.080	.122	.159	.184	.103	.098

TABLE 12 Growth Rate in Earnings 1955 to 1969 by Earnings Percentile in 1955: Some College

1955 Percentile	Growth Rate (= 1969 Income Less 1955 Income/1955 Income)							
	<0	0 < .25	.25 < .50	.50 < .75	.75 < 1.00	1.00 < 1.25	1.25 < 1.50	1.50 < 1.75
0 < 10	.000	.000	.010	.040	.102	.163	.061	.112
10 < 20	.008	.000	.008	.076	.114	.152	.167	.106
20 < 30	.000	.009	.009	.072	.153	.198	.090	.108
30 < 40	.000	.000	.042	.073	.125	.188	.208	.104
40 < 50	.000	.009	.050	.161	.120	.190	.046	.143
50 < 60	.000	.000	.040	.140	.180	.100	.160	.100
60 < 70	.000	.045	.112	.067	.123	.202	.135	.045
70 < 80	.007	.067	.081	.101	.135	.121	.128	.095
80 < 90	.000	.066	.041	.082	.131	.139	.106	.082
90 < 100	.081	.060	.081	.126	.104	.096	.067	.067
Total	.011	.022	.049	.099	.126	.158	.108	.101

Growth Rate (= 1969 Income Less 1955 Income/1955 Income)								
1.75< 2.00	2.00 < 2.25	2.25 < 2.50	2.50 < 2.75	2.75 < 3.00	3.00 < 5.00	>5.00	Mean Growth Rate	Mean Compound Annual Growth Rate
.130	.043	.062	.049	.025	.067	.049	1.875	.056
.068	.031	.006	.012	.019	.006	.000	1.246	.037
.033	.033	.017	.000	.025	.066	.017	1.559	.037
.075	.032	.011	.032	.043	.000	.000	1.234	.041
.049	.031	.031	.013	.005	.022	.013	1.260	.036
.000	.024	.024	.024	.024	.000	.000	1.238	.034
.078	.047	.031	.000	.031	.078	.000	1.377	.038
.062	.037	.012	.012	.000	.037	.037	1.354	.034
.032	.053	.000	.074	.021	.095	.000	1.307	.029
.053	.040	.067	.013	.027	.027	.027	1.199	.033
.063	.037	.027	.023	.020	.039	.016	1.386	.034

NOTE: Items in this table are fractions of row sum except the last two columns.

Growth Rate (= 1969 Income Less 1955 Income/1955 Income)								
1.75 < 2.00	2.00 < 2.25	2.25 < 2.50	2.50 < 2.75	2.75 < 3.00	3.00 < 5.00	>5.00	Mean Growth Rate	Mean Compound Annual Growth Rate
.092	.071	.061	.030	.051	.133	.082	2.675	.069
.083	.076	.030	.045	.023	.076	.038	1.759	.051
.063	.108	.036	.036	.027	.072	.018	1.800	.049
.146	.031	.042	.010	.010	.000	.010	1.671	.045
.074	.065	.032	.037	.018	.051	.005	1.550	.042
.080	.060	.020	.000	.020	.080	.020	1.715	.040
.067	.067	.011	.022	.034	.034	.034	1.617	.043
.054	.034	.067	.014	.034	.054	.007	1.702	.037
.090	.032	.024	.041	.041	.090	.033	1.700	.041
.074	.059	.037	.022	.022	.089	.015	1.495	.031
.081	.061	.032	.029	.028	.067	.024	1.611	.043

NOTE: Items in this table are fractions of row sum except the last two columns.

TABLE 13 Growth Rate in Earnings 1955 to 1969 by Earnings Percentile in 1955: Bachelor's Degree

1955 Percentile	Growth Rate (= 1969 Income Less 1955 Income/1955 Income) <0	0 < .25	.25 < .50	.50 < .75	.75 < 1.00	1.00 < 1.25	1.25 < 1.50	1.50 < 1.75
0 < 10	.000	.015	.015	.015	.105	.045	.060	.075
10 < 20	.000	.011	.000	.011	.066	.120	.099	.120
20 < 30	.000	.016	.000	.078	.094	.125	.063	.172
30 < 40	.000	.000	.000	.032	.138	.053	.213	.138
40 < 50	.004	.011	.011	.044	.063	.170	.159	.144
50 < 60	.000	.000	.016	.063	.143	.222	.111	.079
60 < 70	.008	.008	.031	.039	.086	.094	.180	.117
70 < 80	.000	.010	.019	.058	.082	.159	.087	.192
80 < 90	.011	.040	.038	.048	.136	.115	.107	.079
90 < 100	.072	.039	.112	.086	.065	.112	.112	.119
Total	.012	.017	.029	.050	.091	.126	.125	.130

TABLE 14 Growth Rate in Earnings 1955 to 1969 by Earnings Percentile in 1955: Graduate Training

1955 Percentile	Growth Rate (= 1969 Income Less 1955 Income/1955 Income) <0	0 < .25	.25 < .50	.50 < .75	.75 < 1.00	1.00 < 1.25	1.25 < 1.50	1.50 < 1.75
0 < 10	.000	.012	.000	.000	.012	.047	.082	.071
10 < 20	.000	.020	.000	.010	.051	.051	.141	.162
20 < 30	.000	.000	.014	.028	.069	.111	.125	.111
30 < 40	.000	.000	.027	.000	.040	.107	.200	.107
40 < 50	.005	.000	.010	.055	.050	.155	.100	.130
50 < 60	.000	.000	.028	.028	.028	.083	.278	.111
60 < 70	.014	.014	.028	.028	.056	.111	.111	.194
70 < 80	.000	.008	.023	.039	.094	.148	.133	.109
80 < 90	.000	.028	.019	.009	.075	.123	.104	.142
90 < 100	.080	.030	.100	.050	.110	.080	.090	.100
Total	.010	.011	.024	.029	.061	.110	.123	.124

Growth Rate (= 1969 Income Less 1955 Income/1955 Income)								
1.75< 2.00	2.00< 2.25	2.25< 2.50	2.50< 2.75	2.75< 3.00	3.00< 5.00	>5.00	Mean Growth Rate	Mean Compound Annual Growth Rate
.119	.105	.105	.015	.045	.164	.120	3.087	.075
.176	.099	.088	.066	.000	.179	.015	2.044	.059
.094	.063	.047	.047	.063	.109	.030	1.938	.057
.106	.096	.043	.043	.043	.074	.021	1.934	.053
.096	.077	.074	.022	.019	.067	.037	1.754	.053
.143	.079	.048	.048	.000	.016	.032	1.926	.050
.141	.164	.016	.023	.008	.078	.008	1.718	.048
.101	.043	.067	.029	.019	.082	.053	1.923	.053
.085	.073	.068	.040	.011	.102	.034	1.794	.049
.066	.033	.033	.026	.026	.105	.007	1.413	.037
.106	.078	.059	.033	.021	.089	.034	1.877	.050

NOTE: Items in this table are fractions of row sums except the last two columns.

Growth Rate (= 1969 Income Less 1955 Income/1955 Income)								
1.75 < 2.00	2.00 < 2.25	2.25 < 2.50	2.50 < 2.75	2.75< 3.00	3.00 < 5.00	>5.00	Mean Growth Rate	Mean Compound Annual Growth Rate
.071	.094	.094	.071	.035	.247	.165	2.147	.095
.111	.131	.051	.101	.051	.080	.040	2.176	.063
.097	.139	.028	.042	.069	.097	.069	2.275	.053
.173	.040	.067	.040	.053	.120	.027	2.085	.060
.100	.095	.085	.035	.050	.110	.020	1.766	.057
.111	.111	.056	.056	.000	.056	.056	2.214	.055
.111	.083	.042	.083	.070	.042	.014	1.827	.054
.117	.094	.039	.023	.055	.094	.023	1.879	.050
.113	.094	.009	.066	.028	.142	.047	2.173	.055
.060	.030	.030	.060	.020	.110	.050	1.702	.044
.105	.090	.052	.054	.045	.113	.046	2.191	.057

NOTE: Items in this table are fractions of row sums except the last two columns.

We shall concentrate first on the second equation, which contains $Y55$ and which has an R^2 of .20. The inclusion of $Y55$ in our equation means that we have held constant all the other systematic determinants of Y and its percentage change, including luck and $K55 - I55$ where $K55$ is the stock of investment in on-the-job training and $I55$ is the investment in that year.[102] But the coefficients on the other variables in this equation represent the effect of each variable on the growth rate, net of the effects passed on through $Y55$.[103]

The higher a person's 1955 earnings are, the slower his growth rate rate will be. The coefficient of −.09 is highly significant with a t value of 19. As just explained, the coefficient on the earnings variable represents the effect of all the unmeasured variables. Results presented later suggest that one of the important unmeasured variables is luck. The on-the-job training variable, $K55 - I55$, may also be important though tests of the theory presented below tend to conflict with Mincer's theory.

Previous research based on cross-section data has shown that age earnings profiles tend to be steeper for the more educated. Using the same people at different points of time, we also find that the average growth rate increases continuously with education (except for some graduate), with most of the difference from high school graduates being statistically significant. The coefficients on the education variables are larger than most of the other coefficients although attending private elementary school is the single largest coefficient.

While the average growth rate increases monotonically with ability, none of these coefficients are significant at the 5 percent level. There are, however, several interesting variables which have significant and large effects. For example, those who are Jewish have a growth rate 21 percentage points above that of Catholics. Those who attended private elementary school have a growth rate 80 percent higher than those who did not. Also, mother-in-law's and father-in-law's education are both significant and positive.

Of the time spent on youth variables, sports and part-time jobs have significant positive effects, while chores have a significant negative effect. The nonpecuniary variables are significant with the exception of helping others and job security, which is significant at the 6 percent level. Those not interested in future financial prospects, nor in challenging work, have a slower growth rate, which is also true for those interested in independence in their work. The people who prefer to be salaried have a 10 percentage point slower growth rate.

The age variable has a negative coefficient implying a concave earnings function. The positive sign on the year of the first job also implies concavity but this coefficient is only significant at the 7 percent level.

Those who were self-employed in 1969 have a faster growth in earnings. Increased hours on the first job in 1969 also lead to a faster growth rate, but the opposite is true for hours on the second job.[104] Those who moved interregionally after 1955 have a faster growth rate, as do those who lived in bigger cities in 1969. Good health in 1969, as reflected in weeks lost from illness and weight, are associated with higher growth rates.

We have reestimated the equations, dropping the variables that pertain exclusively to 1969. The general results are unchanged.

The equations clearly indicate that there are important systematic elements in the distribution of growth rates from 1955 to 1969. Is there an underlying structure that explains which of the determinants of earnings in 1955 and 1969 are also significant in the growth-rate equations? In Mincer's theory, differential growth rates reflect differential investments in on-the-job training (OJT). Thus, the more educated, those whose in-laws have high education, those who attended private elementary school, those who do not want to be self-employed, those who do not want to be independent, those not interested in future financial success, and those who are Jewish, all invest more than the omitted categories. Mincer may be right, but one still wonders why these groups are different.

An alternative explanation is that because of uncertainty, people have to demonstrate their competence on the job, which determines how quickly they ascend their career ladders. There are different career ladders with different characteristics. Some careers are relatively safe, but as a consequence have both a relatively low ceiling on earnings and a narrow distribution of outcomes. Other careers have higher earnings ceilings but more risk. Because people are relatively risk averse, the latter careers have higher average earnings. The difference in earnings between ladders is greater for older persons because the sorting process takes place *sequentially* over time, and people only gradually reach the upper parts of the hierarchy.

This explanation, which can be applied easily to the risk-preference and other nonpecuniary variables, can also explain why the other variables are significant. For example, the in-law and private school variables can be interpreted as proxies for nepotism. In an uncertain world, a nepotistic system can function by a person's being given a secure job and then, only if he has the ability, being promoted (though his promotions may come faster for equal ability). Since there are pay scales within a firm, even the owner's son will only receive very high earnings if he holds an important job. We have argued earlier that the religious variable is associated with drive and hard work, but such effort may only pay off cumulatively. Finally, the education findings reflect the types of career ladders chosen by the more educated. Very few of our college graduates worked at any job but owner/manager, salesman, or professional. Their choice may have been based on opportunities or preferences, but in any event, these can be the careers within which sorting is important and ceiling earnings are high.[105]

Test of Predictions of Some Earnings Distribution Theories

We begin the discussion with the stochastic theories.[106] In these models initial earnings depend on an individual's capacity, but the change in earnings depends on luck. Let the earnings of the ith individual in year t be represented by Y_{it} and the random event by e_{it} which is assumed to be independent of Y_{it-1}. The stochastic theories can be written as

$$(1) \qquad Y_{it} = Y_{it-1} + e_{it} = Y_{io} + \sum_{i=0}^{N} e_{it-i}$$

$$(1a) \qquad \ln Y_{it} = \ln Y_{it-1} + e_{it} = \ln Y_{io} + \sum_{i=0}^{N} e_{it-i}$$

The variance of Y_t can be expressed as

$$(2) \qquad \sigma^2_{Y_t} = \sigma^2_{Y_o} + \sum \sigma^2_{e_{t-i}} + 2\sum \sigma_{Y_o e_{t-i}} + 2\sum_{j>k} \sigma_{e_{t-j}e_{t-k}}$$

There is a similar expression for $\sigma^2_{\ln Y}$.

An important case arises if the e's are serially independent. Then after a long enough passage of time, the distribution of Y_t will depend solely on the distribution of e_t, the last two terms in (2) will be zero, and σ^2_{YT} will increase each year by the addition of σ^2_{et}. Thus, this version of the stochastic theory predicts that the variance of earnings will increase continuously with age. Since the theories assume that e_t is distributed independently of Y_{it-1} and its systematic determinants, σ^2_e should be homoscedastic over the different education levels and other X's.

Some stochastic models assume that Y_{io} is determined by education, and so on, and then luck determines ΔY. Here the correlations of education, and so on, with Y should decline over time, since the variance of Y_t increases while that of Y_o is constant.[107] Moreover, a hypothesis of stochastic models is that e_{it} should be distributed independently of Y_{it-1} or Y_{io}.

How do these predictions compare with our findings? As shown in Tables 6, 7, and 8 the standard error of earnings and its log increased between 1955 and 1969 in the whole sample and in each of the education and ability groups. However, contrary to predictions of the model, the errors display heteroscedasticity in both years with respect to both education and mental ability.

The stochastic theories require that the difference or the percentage change in earnings be independent of *Y*55. But Table 10 indicates that the mean growth in earnings is different at the highest and lowest level of 1955 earnings.[108] The difference in mean growth rates might be attributable to transitory effects that do not become impounded into a person's earnings base, but such an explanation is not in accord with the model's Markovian assumptions. As is evident from the pattern of the percentage changes, and as has been confirmed by direct calculations, the *average difference* in earnings increases with the level of *Y*55.

Education, ability, family background, nonpecuniary preferences, and other characteristics yield an R^2 about 4 points higher in 1969 than in 1955, even when we exclude the information such as business assets which pertain directly to 1969. This is contrary to the model's prediction.

All in all, the particular version of the stochastic model that we are testing does not seem to fit the data well. Of course, other versions that make different assumptions about either the pattern of serial correlations or the relationship of the *e*'s and the determinants of Y_o could be in accord with the facts. See, for example, Kalecki (1945). However, I have yet to see a version of the stochastic theory that can be made consistent with all the findings presented above, unless the sorting model described below is thought of as a stochastic model.

Investment in On-the-Job Training Models

Next, let us consider the investment in on-the-job training theory as presented by Mincer (1970). His model can be thought of in the following terms. Suppose skills learned on the job increase a person's marginal productivity to many employers. If an employee who receives general on-the-job training is legally free to accept any job offer at any time, after finishing his training he will be paid a wage equal to his new, higher marginal product (in a competitive market). Next, suppose occupation A gives no general training and will pay a person the same wage rate throughout his lifetime, but occupation B involves general training and has a rising age/earnings profile for an individual. A rational person would choose the occupation whose earnings stream has the larger present discounted value. But Mincer argues that with free entry into both occupations, the present value of the two earnings streams will be equalized. Since a person will receive a real wage equal to his marginal product after training, he must be paid less than his marginal product while being trained.

Mincer expresses his theory as

(3) $$Y_{it} = Y_i^* + r \sum_{j=0}^{t} [\lambda_{ij} Y_j] - \lambda_{it} Y_t$$

where Y^* (which depends on schooling, ability, and so forth) is the constant earnings of a person who never invests on the job, λ is the fraction of earnings invested or k_t / Y_t, r is the rate of return on investments in on-the-job training, and Y is observed earnings. Mincer assumes that investments are a monotonically decreasing function of age. The change in earnings, $Y_{t+1} - Y_t$, can be written as $rk_{t+1} - (k_{t+1} - k_t)$ which certainly will be positive if k decreases with age.

Mincer introduces several concepts to help analyze the path of earnings in 3. One concept is that there is some peak level of earnings, Y_p, at which $\lambda_{it} = 0$. Another important concept is the overtaking point, which is designated as the year in which $r \sum \lambda_{it} Y_t$ equals $\lambda_t Y_t$ or when $Y_t = Y^*$. Let us write $\sum \lambda_{it} Y_t$ as K_t and $\lambda_t Y_t$ as I_t.

At the peak earnings period, the variance in earnings will be

(4) $$\sigma^2_{Y_p} = \sigma^2_{Y^*} + r^2 \sigma^2_{K_t} + 2r\rho_{Y^* K_p} \sigma_{Y^*} \sigma K_p$$

where ρ_{YK} is the correlation between Y and K. While at the overtaking point, which we designated as j

(5) $$\sigma^2_{Y_j} = \sigma^2_{Y^*}$$

In equation 4, the variance over individuals in observed earnings depends on the variance of Y^*, the variance of investments in OJT and the correlation between Y^* and K. At the overtaking point, $rK_t - I_t$ and the variance in observed earnings equals the variance in Y^*. If r and ρ are nonnegative, Mincer's model indicates that the variance in earnings should increase from the overtaking to the peak year. Also, since individual variation in investment in OJT is not measured, the contribution of the measured variables to observed earnings should be greater in the overtaking year.[109]

The above conclusions are conditional on the sign of ρ. We can also derive other tests which also depend on the sign of ρ, or in which ρ does not enter. Suppose we rank individuals by earnings in the overtaking period (1955) and calculate mean earnings in both 1955 and 1969 for people within the bottom tenth, second tenth, . . . , top tenth *in 1955*. Then, using equation 3, we can calculate that the mean change in a cell is

(6) $$\bar{Y}_p - \bar{Y}_j = r\bar{K}_p$$

(if r is the same for all).

Now, if $\bar{K}_p$ and $\bar{Y}^*$ are not correlated, the expected value of $r\bar{K}$ should be the same for each cell. If, however, $\bar{K}_p$ is positively correlated with Y^*, the $r\bar{K}$ will increase with $\bar{Y}_j$. But the correlation of Y^* and $\bar{K}_p$ is the "between cell" estimate of ρ. The model, of course, could be expressed in terms of ln Y in which case (5) can be approximated by $(\bar{Y}_p - \bar{Y}_j)/\bar{Y}_j$.

It may be helpful to view this problem in another way. If the distribution of K_p is independent of Y^*, then, when examined at the overtaking point, Mincer's theory yields the same testable hypothesis on growth rates as the stochastic theory, expressed in equation 1a. Mincer's model, however, yields different predictions when growth rates are calculated from a year that is not the overtaking point. We can see this best if we specify the on-the-job training investment function. Mincer in his analysis often assumes that the individual's investment paths are exponential as in equation 7

$$\lambda_{it} = A_i e^{-b_i t},\ 0 < A_i < 1,\ b_i > 0 \qquad (7)$$

The implications of this investment equation, which are derived in Taubman (1975), will be summarized here. Mincer usually restricts b_i to be the same for all individuals while letting A_i vary. In this case, the length of the overtaking period is the same for all A_i although the actual overtaking year will vary for people of the same age because of differences in time spent in school and, perhaps, in military service. Mincer's model, therefore, predicts that those with the higher A_i will always have higher growth rates in earnings.

If we knew A_i for each person, we could test the theory directly. We can, of course, calculate the average earnings that a person with a given set of measurable skills would receive. But the difference between an individual's actual earnings and this average would also include the effects of other unmeasured skills, and so on.

Suppose, however, in a year prior to the overtaking period, we were to order people by observed earnings and then calculate average earnings within each of successive tenths in the distribution. For each individual $Y_i - \bar{Y}$ would be equal to $(rK_t - I_t) + Y^*$, where these last terms are calculated about their mean values. A person can fall into the lowest tenth of the distribution for a variety of reasons.[110] If one thinks of drawings from distributions of $(rK - I)$ and of Y^*, the average value of each of these variables must be negative in the lowest decile of observed earnings. Similar analysis indicates that the average of $rK - I$ will increase monotonically with average earnings. Note that no mention was made of any correlation between $(rK - I)$ and Y^*. Positive or negative correlation would affect the average levels of $(rK - I)$ and Y^* in each tenth, but would not affect the statements about the qualitative pattern of the change in the average as earnings increase.

Since grouping by average earnings separates people by average level of $(rK - I)$, it is possible to determine whether those who have been investing more in preovertaking years and for whom $(rK - I)$ is smaller, are the ones with the greater increase in earnings. Similarly, if b varies in equation 6, those who invest more will have a higher growth rate in earnings.

According to Mincer, the overtaking point occurs in no more than $1/r$ years of work experience or probably less than a decade. In 1955, in the NBER-TH sample, the length of time in the civilian post-World War II labor market is 8 to 10 years for most high school graduates, 7 to 9 years for most of those with some graduate work, and 5 to 8 years for those with one or more degrees.[111] As a first approximation, let us assume that everyone was at the overtaking point in 1955. It also appears that 1969 corresponds to the peak earnings period. (This conclusion is based on the age distribution of 45 to 52 and on comparisons between the 1969 and recalled 1968 earnings data.)

Earlier, we observed that Mincer's model predicts an increase in the variance in observed earnings from overtaking to peak period, for positive (and for small negative) values of ρ. The variance does increase in the whole sample and in every education and ability group for Y and for $\ln Y$. The model also predicts that the R^2 explained by the measured variable should decrease with age, which is contrary to our results, even excluding several important variables measured only in 1969.

Our results also provide additional information on ρ. In Mincer's theory, coefficients on all skills other than those produced by OJT would remain constant if OJT did not change, and the change in coefficients occurs only because of differentials in average investment in OJT. The $Y69 - Y55$ coefficients can be obtained by subtracting the two comparable equations.[112] Nearly every variable that has a positive effect on $Y69$ or $Y55$ has a positive effect on the change in earnings; i.e., ρ would be positive for all of these variables. Similarly, the growth rate equations reveal a number of variables which have positive and significant effects on earnings, and which are positively related to the level of earnings.

The material on the distribution of growth rates reveals a different picture. The average growth rate in the whole sample or in the education subgroups indicates that ρ is zero over much of the range but negative if the highest and lowest values of $Y55$ are included. Negative values of ρ can be consistent with growth in the variance, but such a finding seems strange, given the above discussion of ρ from regression results, and, especially, since those tables do not hold constant the variables with a positive ρ.

Until now we have assumed that everyone was at the overtaking point in 1955. However, because the more educated have worked fewer years and because individuals follow different investment paths, this assumption is unlikely to hold for *all* individuals. Mincer often specifies in his investment function that *bi* is equal to $\bar{b}$ for all persons. For this investment function, the overtaking period is the same for people with the *same education* (who begin work in the same year). But the distribution of growth rates within education groups, Tables 11 through 14, exhibits the same pattern of results as above, even if we standardize for differences in age and time on the job. Thus, if on the average, we are at, or before, the overtaking point within each education group, ρ in the ln form would be negative or zero.

There is another possibility to consider. Suppose that contrary to Mincer, the *b*'s differ; but on the average, people in all educational levels were at the overtaking point in 1955. At every education level, there will be a dispersion of *b*'s about $\bar{b}$. Since earnings increase with education, on the average, people with high education but low earnings in 1955 must be investing more than people with less education and the same earnings. But those people with less education and high earnings in 1955 must be investing less than the more educated. Thus, at each level of 1955 earnings, the mean growth rate should increase with education as is found in Tables 11 through 14. But the same argument would suggest that *within an education class*, those with smaller earnings in 1955 must on the average have been investing more than those with larger earnings, and that the mean growth rates should be inversely related to *Y*55.[113] Yet in Tables 11 through 14 the mean growth rates are constant, except for the very top and bottom tenths, again suggesting negative or zero correlations.

It is possible that high school graduates are beyond the overtaking point, whereas those with one or more degrees have not yet reached the overtaking point. For those people not yet at the overtaking point, those investing more in 1955 should have the higher growth rate. Thus, the correlation between mean growth rates and 1955 earnings level should be positive for high school graduates and negative for college graduates. But once the top and bottom fifths are eliminated, there is no correlation at any education level in the average growth rates and a slight negative correlation at any education level in the compound growth rates.

The classification by observed percentiles in 1955 may be affecting the test of Mincer's theory since his formulation does not deny that an individual's earnings in a year may be affected by random events. Suppose such events are transitory so that, ignoring the job investments, $Y_t = \bar{Y} + e_t$. Then as in Friedman (1957), we would expect the top and bottom tenth of 1955 earnings to include a larger proportion of those with large positive and negative e's. But with transitory events uncorrelated over fourteen years, we would also expect those at the top in 1955, because of large positive e's, to have low growth rates, and so on. Replacing the observed fraction of people in the top tenth in the left-hand cell with the overall sample percentage, the average growth rate becomes about 1.8, while a comparable adjustment for the right-hand cell for the bottom tenth reduces its average growth rate to about 2.2. This implies a U-shaped pattern of average growth rates. However, if transitory events are found in varying amounts throughout the distribution, Friedman's analysis would suggest that the estimates of ρ would be biased towards zero or that the true ρ would be more negative.

The essence of Mincer's argument is that labor markets function well. There are several reasons why our data might cause us to reject the investment hypothesis, though Mincer's theory might be a partial explanation of earnings and the labor market. By 1955, the market might have adjusted for *expected* wage changes that were *not* realized. However, if forecasts are generally incorrect, it is difficult to consider how investment models can ever be verified with either cross-section or time-series samples; or more importantly, how such samples can be analyzed within the context of equilibrium investment models.

Second, Mincer's formulation only applies to general on-the-job training. We presented some evidence earlier that suggests that nongeneral training is important. No one has yet analyzed the implications of firm-specific training on earnings profiles although some arrangements must lead to rising profiles. However, we suspect that there is too much uncertainty and lack of information, and too many barriers to competition to permit markets to function well.

Sorting Uncertainty and Hierarchy Models

Suppose that employers are uncertain about a person's productivity, because performance depends on many skills, some of which are difficult to test for in advance. The firm could let a person fill any job and use a piecework system to pay him. But on most jobs, a piecework system is not used because of the difficulty in measuring an individual's output and because of the possibility of negative outputs associated with bad decisions. An alternative procedure is to learn by observing. In this model, firms initially place an individual in a job which is an entry position for one or more career paths. Then, firms make successive decisions to fire, retain, or promote, on the basis of both the observed and required competency in the particular position held.

Ross has recently analyzed such a model, in which firms, who use an expected discounted profit criteria, acquire information by sampling on initial and subsequent assignments. In his model, he assumes that an individual's skill level remains constant. But the solution of this model indicates that on the average, earnings will rise with time on the job, even though skills are not being created on the job.[114]

Without more information, it does not appear possible to specify the optimal assignment path. Instead, we shall postulate a partial adjustment model that is built up of several elements. The peak earnings a person can earn can be represented as

(8) $$Y^* = f(x)$$

where x is a vector of inherited and acquired skills. Progress along a career path can be represented as

(9) $$Y_T^N = Y^* \frac{b}{T-t} \text{ for } t < T, 0 > b$$

Actual earnings in any year depend on random events and on performance versus normal performance

(10) $$Y_t = \alpha Y_T^N + (1-\alpha) Y_{t-1} + u_t, \; 0 < \alpha < 1$$

If b is the same along all ladders, then the coefficients of the X's should change proportionately over time. However, there is every reason to believe that some career ladders are steeper than others or that b varies. Similarly, α can also vary by occupation.

While this model has certain similarities with the previous two, it yields some different predictions. Consider first the R^2 between Y and X. As in the stochastic models, if u_t are distributed independently, the variance of u will increase with t. To determine the change in R^2 as people age, we must examine the variance of the independent variables times their coefficient in comparison with the growth of the variance of

$$\sum_{i=0}^{t} \alpha^i u_{t-i}$$

Since in our empirical work, we generally do not include Y_{t-1}, the estimated coefficients on the X's will be those implied by equation 9. This equation can be written as Xd_t. In our equations the variance of the X's is a constant as the people age, but the coefficients, and thus their contribution to the variance of Xd_t, alter. It is possible, therefore, for the R^2 to increase or decrease as people age. As just noted, when the u's are independent, this model postulates a growth in the residual variance in Y. The model also indicates that σ_y^2 will grow as people age, as long as the d's have the same sign and increase with time.

Next let us consider the change in earnings as people age. From equation 10 we see that

$$(11) \quad dY_t/dt = \alpha b Y^*[1/(T-t)]^2 + (1-\alpha)dY_{t-1}/dt$$

which for most purposes we can treat as $b[Y^*/(T-t)]$. As noted earlier, b probably varies by career ladder or occupation. In general, we would expect people who work in jobs such as manager and professionals to have the highest b. Because the x's help determine the occupation a person is in, we would expect that those x's which determine Y^* would influence b in the same direction.

Over a fourteen-year period $(1-\alpha)^i dY_{t-1}$ can be treated as close to zero except for large dY_{t-1}.[115] Thus, ignoring the last term in (9), dYt should be positively related to Y^* and Y^N in 1955. It can be shown that the percentage change in Y should be independent of the 1955 value of Y. However, the larger dY_{t-1} terms, which cannot be ignored, will be more concentrated among those with the highest and lowest 1955 earnings. Since the model indicates that Y_t will grow faster the more Y^N exceeds Y_{t-1}, those with very low earnings would grow fastest over a fourteen-year period.

Alternatively, the model could be expressed in terms of ln Y in place of Y. The only major difference in the above analysis is that the percentage change of earnings from the equivalent of (9) would be dependent on b and could vary by education, and other factors.

None of these predictions are contradicted by the results given in previous chapters and used in the tests of the other theories. But since the theory is not tightly specified, especially in comparison with Mincer's, these tests are relatively weak. A more definitive test of this theory and Mincer's could be made if more years of earnings were available, since the dynamic implications vary for those. But such tests await more and better data.

VII. CONCLUSIONS AND QUESTIONS

Empirical Results

In our regressions, we have found a number of significant variables, many of which have never been examined before. Nearly all of these variables have the same sign in equations explaining earnings in widely separate years and also have what we consider to be consistent signs in equations explaining educational attainment, test scores, and assets.

In the earnings equations, we find that educational quantity and quality, mental ability, business assets, certain aspects of family background (discussed below), preferences towards risk and towards nonmonetary aspects of a job, locational information, hours of work, health, and work experience and age are significant determinants of earnings. Among this list of items are several, which, to my knowledge, have never been found significant in earnings equations, partly because they have never been studied. But the empirical results are in accord with economic and social science theory. For example, economists and others have long recognized that people can trade off earnings for nonpecuniary rewards; but previously information on what nonpecuniary rewards are traded off with earnings and the importance of such rewards were not available.

Our family background variables are much different from those in most other studies. For example, parents', or especially fathers', education and occupation are often used as the major index of SES. Although we started off using these variables, we found that they became insignificant, especially when business assets were held constant. This suggests to us that education and occupation act primarily as proxies for financial and business inheritance, perhaps tinged with nepotism, and not for home training. (Since parental education is associated with the educational attainment and test scores of respondents, we are only speaking of direct effects on earnings.)

While the traditional SES variables are not significant, we have found others that seem to be related to the types of family life and child-rearing processes that people have in mind when they talk of training and taste formation. For example, we find that Jews earn significantly more than, and Protestants significantly less than, Catholics (and the few atheists and agnostics). Other studies have found that Jews of this and surrounding generations have more drive and motivation for financial success. Others, in small samples, have found that some Catholic groups—such as German or French—do better than the average Protestant. Given the education cutoff, in our sample and the cohort involved, it seems likely that we have drawn Catholics from the above-average earnings group.

Another aspect of religious upbringing that affects earnings is frequency of attendance at religious (not parochial) school, with those attending most often earning the least, and those never attending earning the most. The ones who attended more than twice a week are probably certain subgroups of Catholics and more Orthodox Jews. This variable may help to distinguish those less interested in the material aspects of life.

The nonattendees are more difficult to explain although nonattendance in the 1920s or early 1930s may represent a very atypical family.

We also find that those who attend private elementary school and high school earn about $5,000 a year more in 1969. While there are a number of explanations for this result, the one that appeals to us is that these people come from very wealthy families who use pull to advance their sons.

We also find that those who spent their time differently on various activities while growing up earn different amounts. The explanations for these findings include indication of respondents' tastes and attitudes as well as certain types of family rearing. For example, we argued that respondents who remembered spending time on chores came from families that are interested in conformity and produce people who enter into bureaucracies and safe jobs.

The more educated earn more although the graduate coefficients are not always higher than the bachelor's coefficients.[116] The effects of education increase with age, and the age/earnings profiles are steeper for education than for most other variables. However, in this sample, which is stratified differently from the population and which has a truncated distribution of education and ability, the (average) range in earnings arising from education are dwarfed by the range arising from the combination of SES variables, or of tradeoffs for nonpecuniary rewards, and are only of the same magnitude as the range associated with mental ability.

Mental ability has a continuous direct effect on earnings (as well as indirect effects through educational attainment). The age/earnings profile slope upward with only a tendency for the more able to have significantly steeper profiles.

Risk premiums and nonpecuniary tradeoffs are also a greater percentage of earnings as people age. Given the crudeness of measures (zero, one dummies), it is not surprising that variables such as job security and a preference to be salaried, both of which are related to risk avoidance, have separate effects. Combining these different variables and others such as chores and SES proxies into categories, the impression conveyed is that those who take safe, unchallenging, and conventional jobs fall progressively further behind in earnings. That is, the high-paying jobs are at the top of certain career ladders and cannot be reached by people on other ladders.

Time on the job is important especially early in a person's career, but experience in some types of work is more transferable than in other types. However, people generally do best when they do not switch occupations. It also appears that hours worked is an important determinant of earnings (though the data are only available for 1969). However, there are a large group of men who moonlight because their earnings are low.

Business assets, as measured in 1969, are one of the most important variables in our equation, by itself explaining 10 percent of the variance in earnings. The coefficient is .12 in 1969, which is not extremely high on a before-tax basis.

We have also calculated the same equations within various occupations. Since many of the above variables are related to occupational choice, coefficients tend to be smaller and are significant less often. But we do find clear evidence that some skills and attributes are more important in some occupations than others. For example, intelligence is more important for the self-employed. Moreover, the self-employed, who have more control over their work environment, have larger coefficients on the various nonpecuniary measures.

We can explain more of the variance in earnings in 1969 than in 1955, even when we restrict our attention to variables equally accurate in both years (i.e., when we ignore business assets, and so on). Second, the truncated education variable has a partial R^2 of about .05, though some of the effects of education may be impounded in the nonpecuniary and other variables. The biggest partial R^2 in each year is attached to the 1969 business-asset variable. This result probably does not generalize to the population, since we have a high proportion of self-employed, and several with large amounts of business assets. The SES variables (including all the time-spent variables) and the nonpecuniary variables (including a preference to be salaried) each explain about 3 percent of the variance in the two years.

Most of the variables have little or no effect on our relative skewness and kurtosis measures. However, business assets, attending private elementary and high school, the nonpecuniary variables, and the time spent all reduce skewness and kurtosis sharply in 1969.

Methodology

Perhaps the simplest way to describe the methodological advances we have made is that many phenomena, skills, and attitudes that economists, sociologists, biographers, and others have hypothesized as being related to earnings, can be represented or captured by simple questions that can be included in mail surveys. It seems likely that more systematic efforts would allow us to incorporate many other skills, attitudes, and preferences, or to refine existing measures.

Relationship of Theory to Empirical Work

At the beginning of this paper, there was a discussion of various theories, hypotheses, and ideas that have been advanced to explain various features of the distribution of earnings. Our empirical results do shed some light on the validity and importance of many of these. For example, Friedman suggested that skewness arose because of differences in risk preferences. The variables which are related to risk preferences include the preference to be salaried item, the entered occupation because of job-security item, and the time spent on chores item.[117] In each year, we find that those wanting to avoid risk earn significantly less, and that the differential grows with age and is a greater percentage of average earnings (of high school graduates) as people age.

Avoidance of risk can be considered one type of nonpecuniary reward. We find that tastes toward other types of nonmonetary returns also show up as a reduction in earnings—presumably through the type of occupation in which a person chooses to work. We find that those who want interesting work, or to help others, or who are not interested in future financial success earn less, and that these differentials increase with age. But these variables do not contribute to skewness and kurtosis.

We also find evidence that those who are willing to work hard or have drive or concern for financial success receive greater earnings. These conclusions are based on the effects of religion, part-time job while growing up, and entrance in occupation because it (work) was challenging. These variables have larger effects over time.

These last several sets of results also suggest that models which emphasize that training and taste formation (on earnings-related aspects) occur in the family, religious institutions, and within peer groups have a large grain of truth to them. However, the lack of significance of parental education and occupation suggest that education is too crude an indicator of the differences in upbringing.

Many people have argued that a good portion of earnings differentials arise because of family pull. While we have no variable which is an unambiguous measure of nepotism, we have several which lend themselves to that interpretation. This, for example, is the simplest explanation of the in-laws education results, and of why the inclusion of business assets wipes out the father's education coefficients. Nepotism and/or inheritance of controlling interest in a business seem to be likely explanations of why the 22 people who went to private elementary and high school earn on average up to 50 percent more than people who went to public or parochial school.

Some theories such as the one that goes under the general title of human capital are more general in nature. To the extent that the human capital model means that people can improve their earnings capacity by expending time and resources on schooling or informal training, we find strong support in our analyses. The education coefficients are significant and large. Certain types of family environment and childhood activities are also significant. But the human capital model often is presented as one in which people invest rationally, i.e., invest to the point where the rate of return on the last dollar equals the cost of capital. This proposition is very difficult to test, because many of the returns to education are of a nonmonetary variety, have not been examined in this study, and are not easy to convert into monetary equivalents.

Mincer, in a brilliant series of pieces, has demonstrated that if all on-the-job training is general, if all returns to such training are in monetary terms, and if the market functions as a competitive market would, then the human capital model would predict at what age earnings profiles would rise with age for investors; and that the more investment, the steeper the profile. His model also predicts that the labor market adjusts occupational wages so that the present discounted value of lifetime earnings would be the same (to marginal choosers) in relevant occupations. In its most general form, this theory is a tautology with, for example, the amount invested in a year adjusting to make equations into identities. But with restrictions the theory can be tested. We have performed certain tests. We find evidence that is at variance with the Mincer model unless certain correlations are postulated. We also find some evidence that skills learned in one occupation may not be as transferable to another occupation as homegrown skills. This suggests that all training is not general.

We have also examined stochastic models. Since these can be represented as difference equations or Markov chains, it is also true that these models can be used to explain any age profile of variance of earnings as well as generating skewed models. But the most common stochastic models assume that errors are uncorrelated. We find several pieces of evidence at variance with this view. For example, the percentage change in earnings from 1955 to 1969 is not independent of 1955 earnings level, and the R^2 of the systematic elements increases over time although the stochastic model implies a decrease.

The sorting-uncertainty model, which we believe in, receives some support from these findings. In part, this support is in the growth in importance of the effects of education and ability, since these determine potential earnings. Additional support comes from the growth in the differentials associated with drive, risk aversion, willingness to work hard, and so forth, as summarized above. That is, these subjective measures are best displayed on the job. The differential of 1955 experience on 1969 earnings would be consistent with this model.

Problems and Extensions

Several different types of problem remain. First, our interpretation of many of the new variables that we have used may be wrong. It would be very useful for someone else, perhaps a psychologist or sociologist, to test, validate, and improve our measures of risk aversion, eleemosynary behavior, and so on. Second, we have spent very little time examining interactions which may be very important and whose omission may be biasing some of our results. Third, we have not related our various cross-section periods to macro time-series development. Fourth, the results are only generated within an atypical sample of a cohort, which in turn may be atypical because of war experience and because of the Depression, and because the economy and society are much altered now. Thus, many of our findings must be subject to replication in other groups before being accepted as not false. Finally, we have not made much progress on the nature/nurture or genetic/environment explanations of the distribution. Hopefully, progress on this issue will be forthcoming soon.

APPENDIX: REGRESSIONS

TABLE A-1 Earnings Equations for 1955 and 1969

Independent Variables	1955 Earnings Coefficient	1955 Earnings *t*-value	1969 Earnings Coefficient	1969 Earnings *t*-value
Education				
Some college	−.21	1.0*	−1.10	2.0
Bachelor's	.13	.6*	.16	.3*
Some graduate work	−.05	.2*	−.01	.0*
Master's	−.15	.5*	1.15	1.6*
Ph.D. + LL.B. + M.D.	.22	.5*	2.52	2.6
LL.B.	−.38	.8*	1.12	1.1
M.D.	3.49	5.3	4.13	2.9
Ability				
2nd fifth	.28	1.6	.54	1.4*
3rd fifth	.31	1.9*	.71	1.9*
4th fifth	.56	3.3	1.40	3.7
5th fifth (top)	.82	4.8	1.98	5.1
Biography				
2nd fifth / 3rd fifth	.21	1.5*	.56	1.7*

TABLE A-1 (continued)

Independent Variables	—1955 Earnings—		—1969 Earnings—	
	Coefficient	*t*-value	Coefficient	*t*-value
4th fifth } 5th fifth }	.66	4.5	.80	2.4
Father H.S.				
Father college				
Religion				
Jewish	2.00	7.7	4.13	7.0
Protestant	−.15	1.3*	−.93	3.6
Attended religious school often	−.51	2.0	−1.14	2.0
Attended religious school never	−.01	.1*	−.33	1.2*
Father-in-law H.S.+	.05	3.0	.10	2.7
Mother-in-law H.S.+	−.01	.1*	.57	2.1
Time spent on sports	.06	1.7*	.26	2.9
Time spent on chores	−.05	1.3*	−.27	2.8
Time spent on hobbies	.04	1.0*	−.15	1.7*
Time spent on part-time job	.07	2.1	.29	3.8
Never moved before H.S.	−.06	.5*	−.43	1.7*
Attended private high school	1.49	3.9	2.80	3.3
Attended private elementary school	.23	.3*	2.98	1.6*
Factors which influenced entering occupation				
Future financial prospects (No = 1)	−.54	4.2	−1.77	6.0
Independence (No = 1)	.27	2.1	1.19	4.1
Challenging work (No = 1)	−.76	5.0	−1.70	4.9
Help others (No = 1)	.48	3.8	.86	3.0
Job security (No = 1)	.48	4.0	1.41	5.2
Prefers to be salaried	−.37	2.9	−1.00	3.4
Other assets (own business, real estate), 1969	.03	11.5	.12	20.4
Self-employed businessman, 1969	.72	4.4	1.09	2.9
Self-employed professional, 1969	.45	1.7*	3.30	5.5
Teacher, pre-college	−.61	2.4	−1.86	3.1
Hours on main job, 1969			.07	4.7
Hours on second job, 1969	−.03	3.3	−.12	5.2

TABLE A-1 (concluded)

Independent Variables	—1955 Earnings—		—1969 Earnings—	
	Coefficient	*t*-value	Coefficient	*t*-value
Weeks lost from illness, 1969	–.03	1.6*	–.18	3.8
Mobile 1955 to 1969	.08	2.7	.33	5.1
Age	.08	3.3	–.11	1.9*
Year of first job	–.11	5.1	–.15	3.1
Current residence in town of 50,000 to 1,000,000	.46	3.6	1.09	3.7
Current residence in city in excess of 1,000,000	.92	5.1	2.89	7.0
College quality (Gourman rating)	.0014	3.5	.0044	4.3
Weight, 1969 (100's of lbs.)	6.68	2.7	24.73	4.4
Weight-squared, 1969	–1.69	2.5	–6.45	4.2
Dummy for nonresponse in 1972	1.23	3.9	2.54	3.6
Constant	–.97	.3*	–7.74	1.2*
R^2	.19		.32	
Standard error	3.43		7.80	
Degrees of freedom	4,548		4,547	

*Not significant at the 5 percent level.

TABLE A-2 Earnings Equations ($(Y69 - Y55)/Y55$)

Independent Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	Coefficient	*t*-value	Coefficient	*t*-value	Coefficient	*t*-value	Coefficient	*t*-value
Education								
Some college	.040	.8*	.070	1.5*	.082	1.7*	.116	2.4
Bachelor's	.143	2.8	.214	4.4	.187	3.6	.245	4.8
Some graduate work	.122	1.5*	.173	2.2	.142	1.7*	.180	2.2
Master's	.362	4.8	.393	5.4	.332	4.6	.338	4.8
Ph.D. + LL.B. + M.D.	.487	4.0	.543	4.6	.491	4.1	.511	4.4
LL.B.	.191	1.3*	.176	1.2*	.464	3.1	.493	3.4
M.D.	.793	3.9	1.114	5.6	1.357	6.8	1.676	8.5
Ability								
2nd fifth	–.009	.2*	.016	.3*	.013	.2*	.038	.7*
3rd fifth	–.006	.1*	.024	.5*	–.003	.1*	.021	.4*
4th fifth	.013	.2*	.063	1.2*	.020	.4*	.061	1.1*
5th fifth (top)	.018	.3*	.098	1.8*	.036	.6*	.098	1.8*
Biography								
2nd fifth, 3rd fifth	.008	.2*	.039	.8*	.016	.3*	.039	.8*
4th fifth, 5th fifth	–.080	1.6*	–.035	.7*	–.063	1.3*	–.028	.6*
Religion								
Jewish	.037	.4*	.215	2.7	.203	2.4	.376	4.5*
Protestant	–.036	1.0*	–.049	1.4*	–.023	.6*	–.031	.8*
Attended religious school often	–.009	.1*	–.056	.7*	–.032	.4*	–.071	.9*
Attended religious school never	–.037	1.0*	–.042	1.2*	–.035	.9*	–.037	1.0*
Father-in-law H.S.+								
Mother-in-law H.S.+	.075	2.0	.077	2.1	.106	2.7	.113	2.9
Time spent on sports	.014	1.1*	.020	1.6*	.006	.5*	.009	.7*

TABLE A-2 (concluded)

Independent Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	Coefficient	*t*-value	Coefficient	*t*-value	Coefficient	*t*-value	Coefficient	*t*-value
Time spent on chores	−.030	2.1	−.032	2.4	−.024	1.7*	−.027	2.0
Time spent on hobbies	−.010	.8*	−.006	.6*	−.016	1.3*	−.014	1.1*
Time spent on part-time job	.017	1.6*	.024	2.3	.016	1.5*	.021	1.9*
Never moved before H.S.	−.012	.3*	−.018	.5*	−.009	.2*	−.013	.4*
Attended private high school	.005	1.5*	−.001	.4*	.114	.9*	.629	2.4
Attended private elementary school	.720	2.9	.790	3.3	.622	2.3	.236	1.9*
Factors which influenced entering occupation								
Future financial prospects (No = 1)	−.137	3.3	−.188	4.7	−.203	4.8	−.261	6.3
Independence (No = 1)	.065	1.6*	.078	2.0	−.039	.9	−.049	1.2*
Challenging work (No = 1)	−.060	1.5*	−.084	2.1	−.052	1.2*	−.069	1.7*
Help others (No = 1)	.019	.5*	.052	1.4*	−.049	1.2*	.083	2.1
Job security (No = 1)	.021	.6*	.069	1.9*	.091	2.3	.139	3.6
Prefers to be salaried	−.066	1.6*	−.102	2.5	−.167	3.9	−.215	5.2
Other assets (own business, real estate), 1969	.005	1.5*	.013	4.4				
Self-employed businessman, 1969	.405	4.7	.443	5.4				
Self-employed professional, 1969	.080	1.5*	.146	2.8				
Teacher, pre-college, 1969	−.080	.9*	−.126	1.5*				
Hours on main job, 1969	.011	5.5	.010	5.2				
Hours on second job, 1969	−.007	2.0	−.010	3.1				
Weeks lost from illness, 1969	−.017	2.6	−.020	3.1	−.018	2.7	−.020	3.1
Mobile 1955 to 1969	.028	3.1	.036	4.1	.022	2.4	.026	2.9
Age	−.029	3.7	−.022	2.9	−.027	3.3	−.021	2.7
Year of first job	.021	3.0	.012	1.8*	.016	2.3	.009	1.3*

Current residence in town of 50,000 to 1,000,000	.060	1.4	.105	2.6				
Current residence in city in excess of 1,000,000	.211	3.6	.297	5.2				
College quality (Gourman rating)								
Weight, 1969 (100's of lbs.)	1.114	1.4*	1.684	2.2	1.083	1.3*	1.509	1.9*
Weight-squared, 1969	−.288	1.3*	−.430	2.0	−.271	1.2*	.376	1.7*
Dummy for nonresponse in 1972	.040	.4*	.156	1.6	−.055	.6*	−.009	.1*
Entered school age 7+	−.074	.8*	−.116	1.3*	−.077	.8*	−.108	1.2*
*Y*55			−.089	19.1			−.067	14.4
Constant	−.424	.5*	−.494	.6*	.344	.4*	.332	.4*
R^2	.135		.200		.084		.124	
Standard error	1.109		1.067		1.142		1.117	
Degrees of freedom	4,547		4,546		4,555		4,554	

*Not significant at the 5 percent level.

TABLE A-3 Variables Insignificant in 1969 and 1955 Earnings Equations

Mother's education
Father's education
Single, marital status
Father owner-manager
Father professional
Mother's work status
Had own room as child
High school health
Rank in military
Raised by grandparents
Raised on farm
Number of moves within neighborhood when growing up
Type of house grew up in
Time spent reading
Why entered present job:
Salary or pay offered
Personal contacts
Provided a lot of free time
Retirement information
Military service after World War II
Length of service in military
Being the youngest and oldest child
Present health condition
Voting habits: frequency of participation in local, state, and national elections
Political self-concept: degree of conservativeness or liberalness
Opinion on extent of freedom of youth
Opinion on people's concern with financial security
Opinion on rate of racial integration in last 10 years
For the items listed below, how does your total work experience to date compare with what you expected when you first started?
Requirement for independent judgment
Responsibility
Prospects for advancement
To what degree does success in your work depend on
Your own performance
Having the right connections
Being able to get along with people
Being lucky or unlucky
Having a college diploma
Working hard
Do you enjoy your work?
Based on your own personal experience, what do you think high schools and colleges should concentrate on?
Basic skills

TABLE A-3 (concluded)

General knowledge
Career preparation
Activities
Social awareness

NOTES

1. For international comparisons see Lydall (1968). For the U.S., see Miller (1966).
2. See, for example, Mincer (1970).
3. Even this need not be true. For example, different types of skills may be more or less important depending on the types of machinery used.
4. Tinbergen (1959) has formulated this type of model and Reder has examined some features of such a model though he uses somewhat different terminology. Indeed, the usual general equilibrium models state that each individual is a separate factor of production because he has his own bundle of skills.
5. Suppose, for example, the only two occupations are manager and manual worker and that intelligence received such a high wage in managerial work that all people with an I.Q. above 110 are managers. Assume also that physical strength is of no importance as a manager, but that among manual workers strength increases capacity while I.Q. does not. Finally, assume that all those with I.Q.'s greater than 110 have above average strength (though the correlation is not perfect). Then, for people with I.Q.'s above 110, variations in strength would not affect earnings, while for those with lower I.Q.'s and less strength, only variations in strength would affect earnings. Thus, in this example, each skill is redundant in one occupation and only a portion of the distribution of each skill determines earnings. This analysis, of course, suggests that it may be necessary to examine earnings functions within occupations and that in the whole sample the effect of a skill may have upper and lower limits.
6. Indeed, for some possible skills, appropriate measures have not yet been designed. Perhaps the Terman sample (1959) contains the most information, but it is small and limited to people with I.Q.'s (as children) of 140 and over. The Project Talent (1964) and to a lesser extent the Little-Sewell (1958) samples have more skill information for the period when their respondents were in elementary and high school, but currently little in the way of earnings data, since the people graduated from high school no earlier than 1958.
7. As equation 1 is written, all skills have an independent, linear effect. This representation was chosen for simplicity. Interactions between skills should be not assumed away in empirical work, especially because Roy (1950) has demonstrated that if skills affect earnings multiplicatively, symmetric skill distributions yield asymmetric earnings distributions—an important feature of the observed distribution. See also Mandelbrot (1962).
8. There is one other special case to note. It is possible that only skill differences relative to the average matter, e.g., the brightest lawyer may receive twice as much per case as the average lawyer. If all lawyers received more training and increased their legal

skills X percent, none might receive more earnings. However, the effect on earnings of legal brightness between lawyers should be given by the coefficients in (1).

9. The genetic effect can be both direct and indirect. For example, a person's knowledge level can depend on innate ability and on educational attainment, which is partly determined by innate ability.
10. See for example Jinks and Fulker (1970), Burt (1971), Cavelli-Sforza (1971), or Mittler (1971).
11. See Kagan (1971) for the last. Some of the former are discussed in Sewell and Shah (1967).
12. See Crockett (1960).
13. For evidence on some noncognitive effects as well as the mechanism by which education causes these changes see Simon and Ellison (1973).
14. A problem with many of these measures is that they seem more related to cognitive development than to the other skills. However, certain information on type and size of college may be related to noncognitive changes.
15. Alternatively, he has also suggested that people are risk averse to small changes but are willing to gamble to achieve major gains.
16. There is no corresponding group of people with large losses because, as Lebergett (1959) points out, the inept (risk lover) generally cannot raise as much financial capital as the successful risk lover. Lebergett, in fact, presents some evidence that for the non-self-employed the earnings distribution is nearly symmetric—though, of course, this need not follow from the above model, since there are some risky salaried occupations such as that of stockbroker.
17. For example, reasoning from personal introspection, some economists have thus explained the low earnings (and rate of return on educational investment) for Ph.D.'s and theologians.
18. It is possible, however, that tastes or the parameters of the utility function are partly determined by family background or by education, in which case the extra earnings attributed to, say, education are inadequate as a measure of the total returns to education if tastes are also included in the equation. See, for example, McConnell in Clark et al. (1972).
19. Much of the descriptive material is drawn from Taubman and Wales (1974), Chapter 4; and from B. Wolfe's dissertation (1973).
20. Thorndike and Hagen (1959), pp. 8 and 9.
21. Taubman (1975).
22. It is important to note that because of their vocational emphasis, much care and attention was paid to assigning occupation codes. See their description on pp. 90–107.
23. The V.A. graciously provided new addresses at no charge. Additional updates were obtained by checking phone books of the city of the last known address.
24. Initially, we had felt that 2,500 responses would have qualified this survey as a success.
25. The NSF funds also enabled the NBER to extract more information from the TH questionnaire, including the details on the job and earnings history.
26. For the post-1969 questionnaires we have adopted the practice of including a "no response" dummy variable. Since this tends to be significant over time the more successful are continuing to respond more.
27. This is a much better level of education than among World War II veterans—even if we restrict ourselves to high school graduates. See Miller (1960).
28. The high percentage may also be due to the availability of V.A.-guaranteed loans, better financial position of parents and in-laws, or business competence.

29. However, several of the highest ranking black Air Force generals in 1972 were in the Air Cadet program in World War II.
30. The reader is reminded that TW rejected the hypothesis of a success bias over and above the response bias by education and ability level.
31. However, the range and variance only indicate the direct effect of a variable. There can also be indirect effects; for example, parental income can determine educational attainment.
32. Formally, if the true equation is $Y = X\alpha + Z\delta + u$, where u is a random variable, the expected value of the ordinary least-squares estimate of δ obtained when Z is omitted is: $E(a) = \delta + E(X^1X)^{-1}XZ\delta = \alpha + \beta\delta$. β is equal to the coefficient in $Z = X\beta$. The bias is $\beta\delta$ which is zero only if β or δ is zero.
33. See, e.g., Simon and Ellison (1973) or McConnell in Clark et al. (1972) for some evidence on the noncognitive developments.
34. These calculations assume that all post-high-school graduates attend a college of the average quality of people who had only had some college. The quantity effects are slightly larger when quality is omitted, but never by more than $200.
35. If self-employment variables were not included, the increases would be: 14 percent for some college; 28 percent for bachelor's; 80 percent for LL.B.; and 110 percent for M.D. These increases are less than those given in TW, primarily because of the introduction of self-employment variables, though the graduate level coefficients were much smaller before we introduced some variables related to nonpecuniary returns. Essentially, the same percentage increases are obtained from equations using the log of earnings. If we adopt Mincer's 1973 model, these percentage changes divided by the associated number of years of education beyond high school are an estimate of the rate of return from education which is less than 6 percent at all education levels.
36. When the self-employment information is omitted, the 1955 differentials are: some college 11 percent; bachelor's degree 14 percent; LL.B. 14 percent and M.D. 82 percent, which are very close to those given in TW.
37. However, the variable could mean that on some unmeasured aspect of ability, teachers are less able.
38. This is described in more detail in Chapter 4 in Taubman (1975). Because the index is scaled arbitrarily, we initially included it and its square in the equations. Since these two terms together are never significant and do not explain more of the variance of earnings than the linear term, we use only the linear term.
39. The introduction of the quality variable causes a 5 percent to 10 percent reduction in the coefficients of the Jewish, year of first job, attendance at private high school, and attendance at private elementary school variables, as well as a 10 percent increase in the precollege-teacher dummy in 1969 and smaller changes in 1955. The quality index may still be acting as a proxy for unmeasured attributes but we would hope that it in part measures the extra value added imparted by better schools.
40. No attempt was made here to reinvestigate the usefulness of the other factors. Since we convert the test score data into dummy variables for the different fifths of the factor score distribution, we are assuming that post-test-taking events (not otherwise measured) do not change the fifths of the ability distribution a person would belong to in each of the particular years studied.
41. Since people had to be in the top half of the Air Cadet General Test (ACGT) to be able to volunteer for the program, these fifths are more like tenths.
42. If this is true, equation is $Y = a$ (innate ability) $+ bX$, but we estimate $Y = a^*$ (innate ability $+ cX$) $+ b^*X$, then our least-squares estimate of a^* and b^* are identical for those for a and $b - ac$.

43. The weights of this index are based on how well the items predicted success in pilot and navigator school. This is a wider list than that used in most previous studies, and some of the variables require justification as SES measures. Almost all of these variables are significant in both 1969 and 1955. Several of the variables have been used at one time or another by others; see, for example, Blau and Duncan (1967) and Sewell and Shah (1967).
44. The original items, which were collected by the military, are not extant though much information has been re-collected in 1969 and 1972.
45. This also suggests that the business asset variable reflects inheritances or nepotism rather than the cumulative effect of education, arising out of extra earnings.
46. In 1969 the respondents were asked to indicate their religious preference by checking one of Protestant, Catholic, Jewish, None, Other. It is possible that different answers would have been obtained if "the religion you were raised in" was asked. Compared to the U.S. white population, the NBER-TH had 1.7 percent more of both Jews and Others and 5 percent fewer Catholics. However, the differences from white males in the particular cohorts who were at least high school graduates would probably be smaller.
47. If self-employment and M.D. are not held constant, Jews earn even more. The asset variable is measured imperfectly, but it is difficult to attribute a difference of $4,000 a year to this.
48. In a study of college graduates of the first half of the century, Hunt (1963) also found similar qualitative results. Also using the same basic data source, Haveman and West (1952) found that being Jewish was the most important determinant of earnings of people who graduated from college in the first half of this century. Featherman (1971) also found Jews to earn more and some Catholics, such as French, to earn more than the average Protestants. Both the Hunt and Featherman studies hold constant education and mental ability as well as other variables.
49. For example, Eckland (1965) finds that for given test scores and social class, Jews go to higher quality institutions of learning. This would indicate either higher tastes for education, more motivation and drive, or lower costs relative to returns. He also finds that certain ethnic groups of Catholics do better than the average Protestants. Given the education cutoff in the Air Force program, it seems likely that our Catholics come largely from these successful ethnic groups.
50. We also cannot rule out the possibility that the Jews and other non-Protestants are a more select group of their respective populations. However, given the nature of the Air Force work they volunteered for, it might be argued that those who volunteered could include more people who wanted to gain revenge on Germany or quickly inflict destruction in large doses. However, the revenge motive would seem to suggest that Jews and, to a lesser extent, Catholics would be a more random (less select) group of their religious compatriots with respect to the characteristics that determine earnings.
51. 1 is for practically no time spent and 5 is for the most time spent.
52. If we are right about the type of families that these men came from, we would expect them to have a high rate of time preference, and less access to capital early in their lives; thus, we would find it hard to interpret the growth in earning over time as an investment theory, as in Mincer.
53. Related to this last viewpoint is the idea that people who play sports may be more able to make decisions quickly. If intellectualism is taken as evidence of the opposite personality, it is interesting that the Phi Beta Kappa's among top management earn substantially less than other people. See the Taubman-Wales (1974) appendix using the Lewellen data.

54. There are, however, several caveats that must be attached to this conclusion. First, father's occupation (and resulting income) has an indirect effect on earnings through the amount of schooling the respondent receives. Second, and more importantly, father being an owner is significant when the self-employment variables are not included. Third, in 1968 the father's occupation and education have a much greater impact on the range in family *income* than on earnings of the *head*. This suggests that income inequality is perpetuated through generations directly through financial inheritance (including business assets) and indirectly through educational attainment. The biography variable also includes some parental wealth indicators, though it is not clear what aspects of the variable determine earnings.
55. Indeed, when we include a crude measure of net worth in our equations, the private school variables become insignificant and much smaller. Since private schooling is both different from public schooling and more costly to the respondent's parents, it might be argued that these results are due to quality differentials. But if this argument is accepted, it is difficult to explain why in Taubman (1975) neither type of private school is significantly related to our ability measure, which contains some learned knowledge.
56. Dummy variables for father-in-law's occupation and spouse's education are not significant.
57. This only includes items in Table 3. Business assets and some other variables may be partly determined by SES.
58. The ones not significant had small coefficients in both years (though smaller in 1955), but we explain more of the earnings variance in 1969. Since $(X'X)$ is nearly the same in the two years, the variance of the coefficients relative to the size of the coefficients is smaller in 1969. Presumably, similar reasoning explains why some of the education coefficients are not significant in 1955.
59. It is also possible that age is a proxy for particular cohorts. While most people in the survey are within 7 years of one another, the youngest people did not begin work till after serving in the military, whereas many of the older people began work before World War II.
60. Also, we have not included those with zero earnings, which would include those (if any) retired or unemployed for mental or physical health reasons.
61. The ranking of occupations is about the same in all years; hence, if you are going to be a manager in 1969, you should choose to be one earlier if you have the option.
62. Earnings $= WH$. ∂Earnings$/\partial W = H(1+\sigma)$ where $\sigma = W\,\partial H/H\,\partial W$. While this is the usual way of viewing the problem, our equations relate Earnings to H. ∂Earnings$/\partial H = W(1+1/\sigma)$. With backward-bending supply curves, σ might be negative.
63. Part of this earnings increase represents the substitution of material goods for leisure. Unfortunately, the hours data, which were only collected in 1969, do not mesh perfectly with the earnings data, since the earnings in 1969 are those on main job only, while we have separate estimates for hours on first and second job. However, the 1968 earnings data, which include second job, give similar results, so that this caveat need not be important.
64. An additional question was asked in which "about the same" was replaced with "slightly favorable if you worked for yourself." This second question was never significant given the first, but the first question always yielded significant coefficients in the earnings equations of various years.
65. These examples all assume that risk preference is a trait which is exhibited in all activities. This assumption may be wrong. For example, some college professors may be risk lovers in the field of ideas but risk averters in other matters.

66. The factors examined were: salary offered, prospects of eventual financial success, chance to do interesting work, chance for independent work, chance for a lot of person-to-person contact, chance to help others, represented a challenge, job security, and provided a lot of free time. We did not examine type of training in school, type of training in military, personal contacts, or always liked that kind of work.
67. The denominator, as usual, is the earnings of the average non-self-employed high school graduate. If the current salary variable answer is included, the coefficient is 10 percent.
68. For those who want to try to replicate these findings in other studies, it is important to note that several of the variables, e.g., independence, and helping others, were not significant by themselves but became significant after the financial prospects variable was added to the equation.
69. For a few of these variables, the answers may represent an individual's recognition of his own limitations. For example, those who like to help others may not have the aggressiveness to be successful managers. In such a case, the variable represents skills that determine earnings.
70. It also includes nonresidential real estate and other nonspecified items. The variable is crude, since people were only asked to check one of eight categories including "don't have" and "over $80,000."
71. This interpretation, however, may be wrong for several reasons. Consider the results obtained from regressing a person's earnings which equal wage income plus returns from capital (assuming that education, etc., is held constant by sample design). That is, we regress $W + rk = cK$. The expected value of c would be equal to $E\Sigma(w + rK)(K)/\Sigma K^2 = r + \Sigma(wK/K^2)$. If wage income and business assets are not correlated (linearly) the coefficient on K will be an unbiased estimate of the returns from capital, but if people with more capital also have higher wage rates (education, etc., constant) then c is biased upwards as an estimate of r.
72. Also, the asset variable must be measured with error, since people only checked categories into which their assets fell, and because the data were taken from an item in which real estate holdings could be included with the business assets. Christensen (1970) has argued that because unincorporated businesses do not have to pay the corporate income tax, a 7 percent to 10 percent return is consistent with the 15 percent before-tax return made by corporations.
73. See Lydall (1968) or Kravis (1962) for surveys of other samples. Lebergett (1959) suggests that among males working full time who are not self-employed, the earnings distribution in 1959 approaches normality. For some purposes, however, the self-employed and unemployed should be included in the earnings distribution.
74. There is little direct evidence on the distribution of capacity. I.Q. scores, for example, are generally *scored* so as to be normally distributed.
75. For an excellent summary of all these models, see Mincer (1970).
76. See Atkinson (1970), Mincer (1970), Kravis (1962).
77. See Atkinson (1970).
78. The education and ability groups are those defined above.
79. We shall assume that the expected values of the first four moments can be estimated from the actual value. This need not be true. For example, if the distribution were Pareto, the expected value of the variance would be infinite though a number could be obtained from the data.
80. To insure comparability with the regression results, and to save on costs, the 1955 and 1969 statistics are based on the approximately 4,600 people who reported earnings in both years.

81. One skewed distribution that has been used to describe the earnings distribution is the log-normal. The skewness and kurtosis results for the log of earnings in Table 6 are not consistent with the null hypothesis that earnings in 1955 and 1969 are distributed in log-normal fashion. Given our earlier results on (nonintersecting) Lorenz curves and Atkinson's theorems, the coefficients of variation and the standard error, which are measures of inequality, must increase.
82. Careful analysis of nationwide random samples has generally resulted in the conclusion that the earnings do not follow the log-normal distribution for high levels of income, but probably because of the restricted distribution of education, mental ability, and age in our sample, the deviations from the log-normal case (on a chart not shown) are greater and occur over a wider range of earnings in this sample.
83. It is well known that such samples yield unbiased estimates of the a's. Thus we can use the equations we have developed to examine the effect of the various X's on earnings for the range of each X in the sample.
84. Since most of our variables are "zero, one" dummies, our coefficients are estimates of the mean in various cells. Provided our model specifications—including interaction and homoscedasticity—are correct, the residuals represent the distribution within various cells and can be used to study skewness and kurtosis.
85. For example, suppose that the variable being considered is a "zero, one" dummy variable, Z. The "ones" in the Z variable could all be located just so that eliminating the effect of Z would eliminate completely any (nonnormal) kurtosis in the earnings distribution. Since most of our variables have been transformed into dummy variables, the effects of, say, schooling depend on the distribution of people by education level and their coefficients.
86. See Kendall and Stuart (1961).
87. However, part of the effects of, say, education may be appearing in other coefficients whose variables are partially determined by education.
88. All the moments in Table 3 are calculated about the mean that applies to each row.
89. The reduction in $\Sigma(u_i^3)$ is about 50 percent.
90. This increase is partly due to the distribution of people in each category, e.g., nearly rectangular over the education groups and in the ability and SES instances, and partly to the pattern of the coefficients.
91. We have already subtracted 3 which is the value if the distribution is normal. The unstandardized measure of kurtosis, Σu_i^4, would decline substantially, but even with the initial variance, the distribution would not be normal.
92. The major difference between the 1969 and 1955 results for the self-employment variables may well be due to the measurement problem, i.e., some in the right-hand tail in 1955 are no longer self-employed in 1969, while some with large business holdings in 1969 were not yet self-employed.
93. There are from 950 to 1,330 people in each cell.
94. The criteria used may vary depending on supply of the "best" groups relative to total demand.
95. There can still be a wide variance within, say, education groups, because initial position obtained may depend on nepotism, being at the right place at the right time, or because of the importance of subjective criteria.
96. Wise (1972) has examined the effects of such a system on the variance of earnings, using a Markov model.
97. Pay does not increase linearly with position. See Lydall (1968). For some specific evidence on corporate executives see Taubman-Wales (1974), Chapter 8, Appendix L.

98. There are not exactly 10 percent of the sample in each row or column for two reasons. First the dividing points were found for all respondents with nonzero earnings in the sample, while some individuals were not included in this table, primarily because they did not report earnings in both years. Secondly, in a few instances, a large number of people reported earnings equal to the dividing point. While we could randomly allocate people to each adjoining class to fill it, it was simpler and not misleading to place people in only one class.

99. Some of this difference may reflect attenuation, since those in the bottom tenth cannot fall but can rise in 1969, etc. In all but one comparison, the Kolmogorov-Smirnov (KS) test would reject the hypothesis that each row is distributed the same as its adjacent rows.

100. In this section we use nominal earnings rather than the constant dollar ones used earlier. This change is made because the determination of the cutoff points was done, early on, in current dollars. Deflation would not change the pattern or conclusions.

101. There is, however, a tendency in each of the tables for the average compound growth rate to decrease with 1955 earnings, partly because of the wider variance in growth rates at the higher 1955 percentiles.

102. We have expressed the on-the-job training variable in this way to be in accord with Mincer's model, as explained below.

103. It can be demonstrated that if we compare the estimates of $Y = Xd + Ze$ and $Y = Xf + (Z + Xb)g$ that our estimates of g and e would be identical, while the estimate of f would equal that of $d - bg$.

104. This may be because the 1969 earnings are only for the main job, while the 1955 earnings may include all jobs. However, this variable seems to represent those people with low wage rates who work hard. Thus it may represent some of the same forces in 1955.

105. Even if this alternative explanation is accepted, Mincer's theory may be correct in a formal sense. Lifetime earnings within career ladders can be adjusted so that they are the same net of risk premiums and nonpecuniary rewards. But even here, the increase in earnings need not be due to on-the-job training but could solely reflect the firm's learning by observation, although a combination of the two learning mechanisms seems more likely.

106. See Mincer (1970) for an interesting survey and analysis of these theories. The original work in this area is due to Aitchison and Brown (1957), Champernowe (1953), Rutherford (1955), and Mandelbrot (1962). Various assumptions about the distribution of the e's and about the validity of equations (1) or (1a) can lead to a normal, log-normal, Pareto, or other distributions.

107. The stochastic-processes theories also provide no explanation of why age earnings profiles slope upward or why the steepness of the profiles varies with education.

108. Those with high earnings in 1955 also have distributions with fatter tails for which the theory offers no explanation.

109. Unless the individual variation in OJT is perfectly correlated with some measured variables.

110. Y^* may be very negative and $(rK_t - I_t)$ not a large enough positive number to offset Y^*. Second, both terms may be moderately negative; and third, $rK_t - I_t$ may be a large negative and Y^* not large enough positive to offset it.

111. About half of the high school graduates and one-third of the some-college group began work before 1942.

112. However, since 10 percent of the people received more education after 1955, the education variables are a bit different.

113. This tends to happen in the compound growth rates but the differences are not significant.

114. Of course, a person may exercise only certain skills when he reaches particular rungs on the ladder. But in this model the person always had the skill, and it was not created on the job.
115. For example, if $\alpha = .1$, $(1 - \alpha)^{14}$ is less than .2.
116. The inclusion of various nonpecuniary and attitude variables generally raises the coefficients on graduate education.
117. Our argument is that the people came from homes that bred conformity.

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12 COMMENTS

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In an era of burgeoning interest in microeconomic data and analysis, and an exploding supply of data, the NBER-Thorndike data set clearly has an important place. It starts, of course, with a selected group who: (a) applied during 1943 for an Army Air Force pilot, bombardier, and navigator training program, (b) passed a screening test, (c) took a battery of tests after preliminary acceptance, and replied to a mail questionnaire in 1955.[1] And the 1969 follow-up further selected those: (a) with good addresses, and who (b) were willing to return a much more comprehensive questionnaire (5,100 of them). Still smaller subsets provided further information in 1971 and 1972 (3,000, 4,474). If we described them as brighter, physically tougher, risk taking, probably more successful than average, and still alive and cooperative, we should not be far off.

Second, we need to keep in mind that things are measured at different points in time. Taubman carefully points this out during the paper, but one must always worry about the extent to which reports in 1972 about why one chose an occupation twenty years earlier may be affected by how successful one was in that occupation.

The analysis is really four analyses, one of earnings levels in 1955 and 1969, one of the distribution (inequality, variance, skewness, and kurtosis), one of the trends between 1955 and 1969 in individual incomes, and one of the possibility of testing of certain theories about reasons for inequality. It is not easy to summarize all this.

EARNINGS LEVELS

First, earnings levels: With such a rich body of data, and with no single theory to serve as guide (no theory in some areas, and competing theories in others), the author is justified in doing some ransacking. He does it by a sequence of regressions, eliminating things that do not seem to matter, even in multiple regression analyses simultaneously with the obvious other variables, as, for example, education.

What mattered? Education of course, and in a nonmonotonic way—as we have usually found in out analyses. *Finishing* something like high school or college is what matters. (Perhaps credential effects are more important than we admit?)

Occupation matters, and reduces the apparent importance of education when it is introduced. The quality of the college matters. And a mental ability test matters, even in the regression with education, and without any apparent interaction with educaton. Family background matters, but it seems to be more a matter of wealth than father's education. The Jews, and to a lesser degree Catholics, do better, even controlling for education (including a dummy variable for M.D. degrees). And some reports on how time was spent when growing up seem to matter, part-time jobs and sports positively, hobbies and chores negatively. Going to a private high school pays off, as do the education of father-in-law and mother-in-law, a result interpreted as nepotism. (I have another interpretation.) Among the things that did not matter were birth order, growing up on a farm, region, and so on.

Business assets have a powerful effect on the respondents "earnings," but may only reflect the difficulty in separating labor earnings from a return on capital in one's own business. A larger proportion than average of these people were self-employed.

And of course, age and work hours affect earnings.

Interesting comparisons and reassuring confirmations come from doing this analysis for both 1955 and 1969, even though some of the variables were only measured in 1969, and a few only later in 1972 (reasons for occupational selection). Such confirmation is at least a partial substitute for searching half the data and assessing a final model on the other half.

Finally, some attitudes toward risk and nonmonetary aspects of a job, (measured in 1972 by asking about reasons for choosing an occupation much earlier) were related to earnings.

The results are presented in the form of percentage differences from some "standard" group, with t tests.

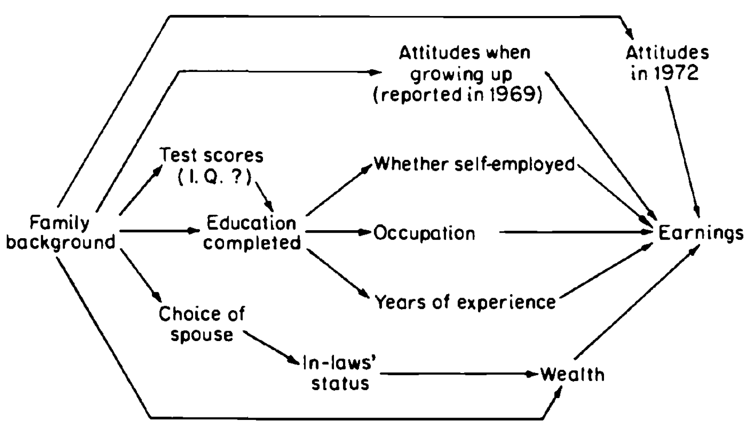
COMMENTS ON THE ANALYSIS OF EARNINGS

I have no objections to ransacking, and do a lot of it myself. I am concerned, however, with the use of a single-stage linear model in this situation. It seems likely, and some theories even call for it, that the factors affecting earnings are not additive. (The dummy variable regressions take care of the nonlinearity of the relationships but not of interaction effects.) Some interaction checks were made, mostly for levels of ability, and by rerunning regressions for some occupation groups.

More important, we do not have here a single-stage causal path, but something calling for a more systematic attention to the possible causal paths.[2] The inclusion of occupation and education and I.Q. in the same regression (which we all tend to do) can be taken as a simple example. If education is an essential prior requirement for some occupations, and there is little later formal education, then our analysis should not assess their influence simultaneously, but attempt to answer one of two questions: Is there anything about occupational choice that explains earnings over and above its role as the channel through which education works? (For this, we need the partial correlation of occupation with earnings.) Is there anything about education that affects earnings over and above what could be explained by occupation? (For this, we need the partial correlation of education with earnings.) And since both have nonlinear effects and/or no neat metric, assessing marginal contributions really requires rerunning whole sets of dummy variable regressions.

The sociologists have recently leapfrogged over most economists in the development of more sophisticated procedures for analyzing data, borrowing from Sewall Wright, a geneticist, and his "path analysis."[3] If we were to analyze the present problem in their terms, we might have a diagram like Figure 1. Not only does such a diagram reveal problems like the dangers of simultaneous use of sequential explanatory forces, but it also alerts us to such other possible difficulties as: (a) the possibility that the attitudes (reasons for occupational selection) reported in 1972 might have been the result of success rather than its

FIGURE 1 Paths of Influence Leading to Earnings



NOTE: Exogenous forces affect each of the variables, and are customarily indicated by arrows coming to them from empty space. I have left them off for simplicity. The system is recursive—no feedback arrows, though some could be justified.

cause or may work *through* other things; (b) the possibility that what appears to be an effect of well-educated in-laws may reflect mate selection and the individual's own background and ambition, rather than nepotism.

Even path analysis makes restrictive assumptions, the most powerful, of course, being that of recursivity—no feedback loops to demand structural equation models. And most path analysis has to assume measurability and linearity, or at least some uniform arbitrary scaling of categorical variables. It is not the statistics but the attention to modeling the world that is important.

The additivity assumption is, however, also a problem. And spelling out the possible effects of combined extremes on whole sets of predictors is probably an exaggeration. Indeed, it is testably so. One should look at the cases which combine such extremes and examine their residuals. I submit that they would prove nonadditivity—by being mostly less extreme than the additive model predicts.

I am particularly concerned with the use and interpretation of 1972 reports on reasons for occupational selection to explain 1955 and 1969 incomes. It is quite possible that attitudes are far more the result of economic experience than a cause of it. We're looking at our own panel data now to check this.

Finally, while there are various caveats about the meaning of both occupation and education, let me reinforce them. What does an occupational title represent? It can represent salary, responsibility, education required, training, supervision of others, whether supervised and by how many levels, skills, clean or dirty work (white collar), size of organization, type of industry (farmer), prestige, whether you serve others personally, whether on annual salary, amount and kind of capital equipment used, entrepreneurial activities, work for a government, and in the words of Eliot Jacques, how often you are evaluated by others.

If it shrewdly incorporates many of these, it should, of course, relate well to earnings. We find it difficult to keep coders from looking at earnings when they categorize occupations! Sociologists' occupation scales are *based on* correlations with earnings and education, so if we use those codes we are likely to reproduce their methods, just as analysis of quarterly time series may rediscover the seasonal adjustment.

And education has problems of spurious correlation with things other than investment in human capital. It can represent self-selection by perseverance, willingness to hew to the line, ambition, or selection by others by obedience, memory, adulation, intelligence, or acquired knowledge, or even acquired skills (physical, cognitive, psychological, or affective). It can represent simple correlation with parental background, inheritance, standards, or actual help, or the friends met in school and later help from them. It can even mean credentials which are substantively meaningless but open a lot of doors. In other words, attributing earnings to education is probably always a somewhat fruitless and dangerous undertaking. We have no adequate natural experiments, only spurious correlations.

Finally, I must urge that we have results presented in forms closer to the original data. Coefficients representing percent difference (logs) from some excluded group are affected by the earnings of that excluded group, as are the t-tests. What we want are departures from *average* and the significance of those. There is no reason why dummy variable regressions cannot be presented in that form. What the reader really needs is the unadjusted subgroup means for each dummy variable subclass, such as religious group, the adjusted coefficients or means, the subgroup frequencies, and some measure of the importance of the whole set of subclasses. For the unadjusted, gross effect, the correlation ratio, beta-squared, is clearly the appropriate measure of importance. We have been using an analogue for the adjusted coefficients, which is also analogous to the partial beta coefficient (the normalized regression coefficient if one thinks of the coefficients as a new scale, scaling a variable called religion). If the adjusted coefficients are in the form of deviations from the grand mean (have a weighted sum of zero instead of having one coefficient constrained to zero) then it is easy to assess their individual significance, since it is largely affected by the number of cases in that subgroup and the overall standard deviation (reduced if the multiple R-squared is large). But t-tests of individual coefficients expressed as deviations from an excluded class are difficult to interpret. It is useful to see both the gross and net effects, to see what the adjustment for intercorrelation by the regression actually does. Sometimes, the effect of a predictor is *greater* after the adjustments, indicating a spurious lack of association in the crude data.[4]

When we compare R-squares from regressions explaining the log of earnings, what are we doing? True, extreme cases may affect things, but models which seem best with logs can differ from those which explain the actual earnings best.

Which brings me, because it is related, to an even more difficult statistical problem, that of weighting. Logs are a kind of weighting, emphasizing the importance of differences at the lower end of the scale. Several times the author argues that weights for differential sampling or response rates are not required because unequal weighting will not affect the unbiasedness of coefficients estimated from the data. This is true *only if the model is correctly specified*, and our models are never correctly specified. We have rather good evidence that failure to use weights makes appreciable differences in coefficient estimates even in generally accepted models.

DISTRIBUTION OF EARNINGS

A second strand of analysis deals with variance, skewness, and kurtosis, finding the distributions not log-normal, but with skewness, and stretched-out-tails (platykurtic). Between 1955 and 1969, variance increased more than the mean; skewness and kurtosis got smaller. If one looks at residuals from various regressions, all three, of course, get a little smaller, but not much. The failure of the regressions to reduce skewness reraises the possibility of nonaddivities. One difficulty in comparing skewness and kurtosis between years, and between original data and residuals, is that most of us have no intuitive sense for the size of sampling errors or third and fourth moments. I have the uneasy feeling that most of the differences are random and do not call for much sophisticated explanation. The apparent finding that what the author calls the "self-employment variables" reduce variance and skewness most when their effect is removed, may well be the removal of the effects of business assets in a few extreme cases, where there is a conceptual problem to boot, that "earnings" are partly a return to capital.

Some of Taubman's speculation about late recognition of talent is potentially testable by seeing whether the relative importance of ability compared with education is greater in 1969 than in 1955. Such a comparison is made difficult by the absence of any way of looking at the importance of sets of dummy variables, as distinct from the range of their coefficients. I recommend to users of such regression the partial beta analogue we use, or else the actual calculation of the partial R-square for each crucial set of predictors, by rerunning the regression without that set and then looking at (R-square full − R-square without)/(1 − R-square without), which estimates the partial R-square.

However, in our experience, the analogue to the partial beta coefficient (normalized regression coefficient) is close enough and can easily be calculated from the dummy variable regression material.

TRENDS IN EARNINGS

The third section deals with trends in earnings for individuals from 1955 to 1969, taking maximal advantage of the panel data. Starting with transition matrices, and with such matrices separately for different levels of education, several regressions are presented where the dependent variable is the percent increase in income ($Y69 - Y55)/Y55$. The initial income is used as one of the explanatory variables in some regressions, representing "the effects of all the unmeasured variables." Our interpretation would be different—namely, that we are really looking at regression, in the old-fashioned sense of that term, and of two types: real and statistically spurious, resulting from errors in measurement.

In general, and this has been our experience, too, it proves to be difficult to explain changes in earnings. Change is mildly associated with ability, and with education (at these upper levels of education), and with a number of the same variables that explained level. The R-squares are deceptively large, of course, because of the lagged dependent variable format—$Y - 1$ as a "predictor"; we need a more modest estimate of how much of the *change* we have explained!

The author then goes on to examine whether some of the results can be simplified and interpreted as reflecting a single effect, such as investment in on-the-job training.

Change is found to be related to education, having gone to a private elementary school, minority religion (though there is a disturbing inconsistency in the "Jewish" effect depending on which equation was used), engaging in sports or work as a youth, not doing chores (farm background?), and self-employment.

The data do not seem to be easily interpretable as differences in on-the-job training (Mincer), and the author suggests they may represent choices of careers with more risk and more payoff, and a sorting over time for those who take the risks.[5]

COMMENTS ON CHANGE

Studying change separately from level is always a difficult task. Attempts to assess experimental programs have recently made this even more clear. Change and level are intimately related in fact, and in statistical artifact. Let us take statistical artifact first. The term regression arose because of a discovered tendency for things subject only to random shocks to appear to regress toward the mean. In other words, any individual whose initial measure was unusually high (low) tended to move down (up) subsequently. If the initial departure was a measurement error, then the regression was a spurious result of measurement problems. If the departure was real (the result of some shock), then a real regression phenomenon was occurring, but neither of these reflect long-term real differences in trends. The problem is exacerbated, of course, by taking increases as a percent of the initial year. If two people whose normal income is $10,000 have initial incomes, from random shock or measurement error, of $5,000 and $15,000, respectively, one has a 100 percent increase and the other, a 33 percent decrease. And if on the average there are increases, those with initial low levels will have larger percentage increases.

Using the initial level as one of the predictors is Taubman's solution. It is equivalent to using both the level and the square of the initial level to explain the change, and all other variables shift that *relation* by a fraction of the initial level. In some of our work, we take the change as a percent of the middle years, or as a percent of the average (beginning and end) years. Even better, perhaps, would be to find the relationship of change to average level, and explain the deviations from that, since even our measure tends to have some remaining (usually positive) relation to level.

Take the interpretation of education: People whose education was high relative to their 1955 earnings had a larger increase in earnings. Is this anything more than "regression to the mean" again? And is this why age seems to have an effect?

Finally, why do the results vary so much across the four equations?

TESTING THEORIES OF INCOME DISTRIBUTION

The final section of Taubman's paper asks whether some of the simpler theories of income-distribution dynamics fit the data. It is a valiant attempt, since as the author points out, most theories are not easily refuted, being so general that with some adjustments they can fit almost any set of data—like the "permanent income hypothesis." They are a way of looking at data rather than a testable proposition. But by imposing some additional reasonable assumptions, it can be shown that the data do *not* fit a stochastic theory of independent random changes in earning levels (the R-squared increases from 1955 to 1969, and there *is* a correlation of change with level).

The on-the-job training theory, or a variant which simply talks about willingness to trade a low start for a promise of more rapid increases in earnings later, is examined by assuming that 1955 may represent the "overtaking point," and that

1969 may represent the peak earnings year. In this case the R-square should be largest in 1955, when the "investments in job training" are least distorting. (It is assumed that anyone who earns less than expected is investing the difference in job training, something which surely must take some prize for special interpretation of data.) Since R-square does go up rather than down, the data do not fit this theory better, either. The author concludes that markets may not function that well, even for this special upper-level population.

Finally there are sorting-uncertainty models, even more difficult to test. In general, the author concludes, we may need a collection of theories and explanations to fit the complex world in which we live. I agree.

FOR ALL FOUR PARTS

I have some strong feelings about presentation of data. We need better estimates of the explanatory power not of individual subgroups of explanatory characteristics—such as one occupational class—but of each characteristic as a whole. We want to know how much education matters, for instance.

And we all need to cast a wider net when we search for the reasons why our measured variables make a difference. A significant relationship can have a variety of explanations. Ultimately the proof of any one explanation must consist of discrediting all the alternative explanations of the same relationship. There had not been time today to engage in that exercise extensively, but the kind of data we have here surely invite it.

In summary, I really think that the analysis of earnings levels needs a model that pays more attention to levels of causation, to explanatory variables that can affect other explanatory variables but that cannot be affected by them, in other words, directional relationships. And the analysis of changes in earnings needs to face up, in addition, to the problems of separating level from trend. This is a discouraging road, of course, since we can explain level a lot better than changes. I am not convinced that studies of the higher moments of distributions are useful, except as indicators that our additive models are not working (or that some better transformation of the dependent variable is called for). And finally, we must all come to terms with the strategy of research. Are we actually testing models or engaging in what Ed Leamer calls "Post Data Model Construction"? And if we are doing the latter, with any ingenuity whatever, even the most sophisticated methods of penalizing ourselves for looking at the data are not likely to suffice.

I suggest that we develop some protocols about research reporting which require that the author clearly state whether he is constructing models (has run more than one regression), or is testing some particular model or set of models. If the latter is the case, Taubman's exercise in asking what in the data could possibly refute a particular model is a good example. But it is also revealing, in that most theories and models are not testable without imposing additional assumptions.

Given the rich bodies of microdata becoming available, and the ransacking capacity that some of us have been developing on computers, I predict an explosion of "findings" and a rediscovery of what other social sciences have long since found, that the "aha" factor can lead to many "significant," but contradictory, findings. We can reduce the confusion if we all make clear what we are doing, but we really should ransack only part of the data, and use the other part to fit and test the preferred model that resulted from the searching process.

NOTES

1. That was the base for Thorndike's original study: R. L. Thorndike and E. Hagen, *Ten Thousand Careers* (New York: Wiley, 1959).
2. Z. Griliches and W. Mason have shown that it is possible to assess more complex models in "Education, Income, and Ability," *Journal of Political Economics* 80 (May-June supplement 1972): S74–S103.
   See also Paul Wachtel, "The Effect of School Quality on Achievement, Attainment Levels, and Lifetime Earnings," *Explorations in Economic Research* 2 (Fall 1975), pp. 502–536.
3. Sewall Wright, "The Method of Path Coefficients," *Annals of Mathematical Statistics* 5 (1934): 161–215.
   P. R. Heise, "Problems in Path Analysis and Causal Inference," in E. F. Borgatta, ed., *Sociological Methodology (San Francisco:* Jossey-Bass, 1969); Arthur Goldberger and O. D. Duncan, eds., *Structural Equation Models in the Social Sciences* (New York: Seminar Press, 1973).
4. For documentation of a computer program that does all these things, see Frank Andrews, John Sonquist, James Morgan, and Laura Klem, *Multiple Classification Analysis* (*Ann Arbor, Mich.*: Institute for Social Research, 1973).
5. See Duncan's paper in this volume.

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This is a partial comment on Taubman's paper in response to the section entitled "Investment in On-the-Job Training Models" (in Section VI), which purports to test a job-training theory ascribed to me. I will not elaborate on a number of perhaps unavoidable shortcomings in Taubman's brief summary of this model, as my actual detailed specification and analysis are now available to the reader in the monograph *Schooling, Experience, and Earnings*, published by the NBER in 1974, just after this Conference. It will suffice to stress several points which are relevant to the purported tests:

1. There is no prediction in my analysis to the effect that persons who invest more in their early work experience will later earn more than persons who invest less. This would be true only when the postschool earnings capacity Y_i^* is the same for each individual i. Holding years of schooling

fixed is not sufficient. In my work I found that 40 percent of the variance is due to variation in Y^* among men with the same schooling who, moreover, worked the same number of weeks per year.

2. The coefficient ρ in Taubman's expression (4) refers to the correlation between dollar investments and dollar earning capacity Y^*. This should be positive, and the implications for dollar growth and for growth of dollar variances are consistent with the findings. However, in the analysis of relative (percent) growth of earnings and of variances of logarithms of earnings, ρ is a correlation between time-equivalents of investment with levels of earning capacity ($\ln Y^*$). The latter ρ can be zero or negative, when the former is positive.
3. The fact that a near-zero value of ρ can give rise to a structure which is *in part* similar to the predictions of stochastic theories does not warrant a rejection of the investment (job-training) theory. Indeed, other parts of the structure are shown to be inconsistent with "random shock" theories in my monograph (Chapter 7), and the stochastic theory rejected in favor of the investment theory which is consistent with the observed structure.
4. Some approximations are better than others, but it is particularly far-fetched in the Thorndike sample to assume that persons in it had the same number of years of work experience in a given calendar year (1955), even if the persons had the same education. In this sample, there is a large variation among individuals in the chronology of their schooling, military service, and job experience. Taubman's tests are of doubtful value in view of this variation.
5. Taubman's brief sketch of human capital analysis suggests a flavor of monomania to it. This is a misunderstanding of the concept of human capital and of the function of parsimonious models. Apart from this objection I do accept the proposition that labor markets function well enough for the purposes of my analysis, as the predicted tendencies in the wage structure do appear in the observations. I am not aware of a better definition of "functioning well."