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RISK AND CAREER CHOICE

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RISK AND CAREER CHOICE

by

Hyman Sanders

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Abstract

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Adviser: Professor Michael Grossman

This dissertation seeks to determine what motivates individuals to select particular careers by testing how sensitive labor force entrants are to measures of monetary return and monetary risk characterizing these careers. Census data are analyzed for specific migration patterns between occupations, and several criteria are developed to permit related Census occupations to be aggregated into careers. Changes in the distribution of white male entrants into the labor force are then examined by aggregating data across these constructed careers from the 1960 Census of Population and the 1967 Survey of Economic Opportunity. Assuming the earnings distributions for the careers are normal, monetary risk can be depicted by measures of dispersion.

The regression results demonstrate that entrants prefer occupations with higher expected incomes, and shy away from those whose earnings streams are more volatile. Individuals assign much greater importance to the return than to the career risk, however. With respect to earnings variation, the evidence suggests that the risk relating to entrants' income is weighted more heavily than that applicable to prime age workers. Other factors hypothesized to influence individuals' preferences -- occupation growth, mean education levels, expected hours and weeks of employment, union coverage, and the probability of suffering work-related disability -- enter the analysis with the expected signs.

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CHAPTER I

LITERATURE REVIEW OF OCCUPATION CHOICE

1.1 INTRODUCTION

The career decision has often been dramatized as the most difficult choice confronting the individual over the lifetime. It has been so characterized primarily because current and future earnings are somehow linked to the selection of an occupation. The aim of this study is to investigate certain aspects of the initial choice of an occupation and attempt to formally define the relationship with market earnings.

What distinguishes career choice from most other economic decisions faced by the individual is the inability to fractionally adjust one's decision -- i.e., aside from multiple job holders, most people must treat market time as indivisible with respect to occupations. Workers specialize and operate within a limited scope of activities while in the labor market. There are significant reasons for this observed behavior: (1) Training may be subject to economies of scale. Equivalently, training costs borne by the worker, both in a monetary sense and in terms of foregone income, may be sufficiently high so as to cause diversification to be prohibitive.[1] [2] (2) Significant costs (e.g., fringes, specific training, etc.) may compel employers to regard less than a full-time commitment as inefficient from the firm's standpoint. Aside from satisfying particular short-term constraints, they may be unwilling to promote part-time employment.

A well-structured theory of the economic rationale for selecting a particular occupation is as yet incomplete. The purpose of this study will not be directed towards such a broad goal; indeed, the intentions of this work are only to highlight those options available to first-time entrants into the labor force and analyze their behavior from an economic standpoint. The focus of attention will rest upon two important attributes uniquely identifying each occupation: monetary returns and the "risk" associated with membership in the occupation. Proper definitions of these parameters follow below within a summary of previous developments in the field, beginning with the contributions of human capital theory.

1.2 OCCUPATIONAL CHOICE IN A HUMAN CAPITAL CONTEXT

Orthodox human capital analyses have, in the past, focused upon permanent characteristics of individuals, inherited and/or acquired, to account for economic behavior in a variety of circumstances.[3] Three components delegated by the theory the responsibility of accounting for earnings growth, income distributions, differential unemployment, and a host of related phenomena have been individual ability, formal schooling, and on-the-job training or labor force experience. The traditional model has posited an earnings function relating educational and post-school investment to a rate of return accruing to the labor input.[4]

This approach, however, has not offered explicit guidance in explaining career choice. In large part, this is due to the "human capitalist" view of the occupation as a transitory component, subject to frequent change, and not easily transformed into a perceived level of self-investment.[5] Its usefulness as a predictor of earnings growth and labor force behavior is thus severely hampered by theoretical considerations.

Economists have consequently adopted one of two competing strategies as a framework for understanding how career decisions are formulated. One methodology has involved the disection of the career into a series of job components, focusing attention upon the attributes of these jobs. The occupation, per se, does not play a role in this process, since an occupational title does not convey precise economic meaning. This approach, much as modern human capital theory, has evolved from earlier theoretical work.

1.2.1 The "Attributes" Approach

Adam Smith, in a review of motives related to job selection, enumerated factors which were thought to account for persistent wage differentials.[6] These encompassed both demand- and supply-side elements, including training opportunities afforded on the job, the nature of working conditions, steadiness of employment, and measures reflecting some uncertainty about success on the job.[7] Marshall incorporated an additional component to reflect worker efficiency or productivity.[8]

Adapting the above results to modern human capital has essentially involved refinement and expansion of the conclusions. Rosen has concentrated upon one aspect, the provision of on-the-job training, to provide a vehicle for characterising job switching. According to this perception, a continuum of joint opportunities to learn and to produce are afforded by the job market. Workers maximize some measure of lifetime incomes. By entering the labor force, individuals implicitly choose to modify the mix of training and production provided by schooling (i.e., only training) and, thereby, increase their incomes. The assumption of increasing marginal costs of learning and a declining period within which to recoup any investment result in switches to jobs which offer progressively less training and greater earnings.[9] [10]

Bartel, too, has sought to investigate the nature of the investments made in the job market by contrasting the impact upon earnings patterns of mobility and training capital.[11] She concludes that while returns to mobility, as measured by post-school income growth, are significantly lower than those to job-related investments, this appears to be somewhat less the case for individuals located in either tail of the schooling distribution. The most likely reason for observing such a result is the relatively smaller amount of specific training entailed in the jobs these groups are offered (hence, less likelihood of an individual incurring a loss in investment and earnings from a job switch).

Another variation of this approach has been taken by Lucas. Appending measures of job characteristics to workers' human capital attributes, he attempts to account for occupation decisions. His results suggest that, because wages are apparently a declining proportion of total pecuniary and non-pecuniary compensation for positions requiring greater human wealth, coefficients of personal characteristics representing rates of return will normally be downward biased.[12]

1.2.2 The Occupation Treated Exogenously

The greater proportion of investigators, however, have chosen not to ignore the occupation either as a decision to be explained or as a factor accounting for certain observed conditions. Such considerations admittedly have often been dictated by data limitations where "occupation" might serve as a proxy or may mask other economic forces at work in a given situation. Several researchers, in fact, have treated the occupational distribution as an independent force generating particular economic circumstances. Meanwhile, others have sought to understand the variation in occupational choice based upon certain theoretical considerations.

In the former subgroup, the conclusions normally drawn have emphasized significant wage income differences attributable to differences in the occupational composition of labor force subsets. King has asserted that earnings variation within educational groups exceeds variation among these groups and links occupational risk characteristics to several other measures in accounting for the residual earnings variation.[13] Fuchs has linked the sex wage differential to occupation differences[14] and, in the same vein, Chiswick, Fackler, O'Neill, and Polacheck have decomposed observed wage differentials among sex/race strata into occupation-related differences, wage rate differences, and intra-occupation wage variation.[15] [16] According to this technique, differences in occupational distributions can account for about 20 percent of the observed earnings differentials.

Some researchers have conjectured about what the above results represent. Rosen has noted that occupational composition might be a related outcome of the manner by which market forces handle ability variation and discrimination.[17] Bowles has suggested that persistent income inequality across demographic groups might be related to occupational preferences conditioned by family income.[18] Duncan, too, has viewed the occupation as the intervening variable in the translation of educational advantage into earnings dominance. Educational attainment qualifies the individual for participation in a particular career whose pursuit yields returns in the form of additional income.[19]

1.2.3 Career Choice Endogenously Determined

The last group of studies is directly concerned with career choice. Since the focus of my attention will concern the initial choice of an occupation, I summarize below recent efforts to deal with this issue.

Friedman and Kuznets are acknowledged to have pioneered empirical research of the occupational structure of the modern U.S. economy. They effectively circumvented defining the choice process, though, by arguing that their data reflected the "noncompeting" character of professional workers. After adjustments for training and the nonpecuniary aspects of a job, entry barriers in the forms of differential access to financial markets for purposes of self-investment and variation in ability endowments could account for the large earnings differences observed. Within professional group salary variation was attributed, among other factors, to differences in ability and in the elasticities of demand and supply for various categories of professionals. One other controversial proposition of Friedman and Kuznets suggested that individuals are drawn into fields which have relatively greater income dispersion in the cross-section. A portion of this variation, though, would be due to "chance" as measured by a "transitory" time component of income.[20]

Mincer advanced a rigorous human capital framework to analyze the occupation decision, based upon (what now serve as) some rudimentary assumptions,[21] and one further qualification -- namely, that occupations could be uniquely defined by the degree of training attained prior to labor force entry. Schooling levels were thus synonomous with occupation attainment and the resulting earnings equation relating two career incomes, one skilled and the other unskilled, would take the form:

$$\ln Y_{skilled} = \ln Y_{unskilled} + r\,S$$

where

Y = annual earnings

r = the market discount rate or internal rate of return

s = additional years of schooling attained by skilled workers

In this context, earnings differences across occupations due to differences in levels of investment could not result from noncompeting groups.[22]

Rahm has expanded upon this approach by generalizing to allow for post-school investment.[23] Occupations correspond to different stocks of human capital whose levels are determined by individual abilities to benefit from and to finance self-investment.[24] Consequently, rates of return would be expected to vary across occupations. Running regressions over different occupations of the form:

$$\ln Y = a + r\,S + b\,OJT + c\,OJT^2$$

where

(1) OJT = post-school experience,

(2) OJT^2 was included to capture the effects of depreciation upon the investment, and

(3) variables Y, S, and OJT represented occupation averages,[25]

Rahm has been able to explain 70 percent of the variation in occupational earnings for white males.

Several problems have arisen in the interpretation of these results which are worth mentioning because of their similarity to objections raised about other occupation studies. One criticism leveled has related to the cross-sectional nature of the data and the degree to which it could be successfully used to support life-cycle hypotheses. Individuals might in reality frequently move across occupations but the data techniques adopted impose the implied constraint that workers are permanently attached to one occupation. A further challenge to the theory has been that it addressed itself solely to white males, a relatively more homogeneous group than the general labor force. Could this framework accommodate the observed sex/race differences in the occupational distribution?

Another group of researchers has devoted its efforts exclusively to interpreting male-female occupational differences within a human capital context. These analyses have hinged upon the frequent entry-and-exit from the labor force exhibited by women of childbearing age and the notion that occupations differ with respect to the levels of human capital investment required. Polachek has argued that women choose careers where their investments are least likely to experience rapid depreciation in either an absolute sense or in terms of technological obsolescence.[26] Presenting the analogue to this hypothesis from the perspective of the firm, E. Landes has viewed female intermittent labor force behavior as a cause for the employer, who must bear a portion of the costs of specific training, to either offer a lower wage or discriminate in hiring practices for specific occupations.[27]

1.2.4 Endogenous Treatment Incorporating Uncertainty

A major refinement in human capital which allowed for a fuller explanation of career choice has been made possible by a reframing of the theory from an expected utility perspective. Weiss has introduced the element of uncertainty into the analysis in a model which considers schooling to be the sole form of investment. The inclusion of risk aversion in the individual's utility function produces two opposing effects: (1) greater stress is placed upon current incomes in evaluating career opportunities; and (2) because of restrictions on the utility function's form, self-investment presents itself as a means by which to reduce perceived risk. The net result upon occupational choice is dependent upon the sizes of the differentials in earnings and earnings variation among occupations.[28]

1.3 RELATED EFFORTS IN THE STUDY OF CAREER CHOICE

The research mainstream, while borrowing extensively from orthodox human capital theory, has incorporated other economic elements, too, in the empirical application of models of career choice. Boskin has presented a sophisticated econometric analysis of occupational selection by applying logit techniques.[29]

Galloway has formulated a model which overlooks traditional human capital parameters.[30] The individual's objective function is governed solely by the occupational wage. Given that significant cost differences in the selection of jobs will exist because of taste and ability variation, each occupation, in effect, reflects a distribution of shadow wages equal to the sum of a quantifiable market wage, and a set of variable and nonmeasurable costs and benefits (e.g., nonpecuniary returns, psychic costs, imperfect knowledge of related opportunities). As a byproduct of this approach, Galloway has recognized the likelihood of bidirectional gross mobility flows between occupations. In equilibrium, however, net flows should equal zero. Differential changes in the economic market structure would result in net flows whose size and direction should be positively correlated with the magnitude of income changes between occupations (assuming that nonpecuniary elements remain unchanged). Likewise, changes in nonwage aspects of jobs would serve to reallocate individuals, resulting in altered compensating differentials, in the course of arriving at a new equilibrium.[31]

Wilkinson has viewed the choice process and the acquisition of schooling as complementary activities engaged in by the individual.[32] He has justified his stratification of the labor force along occupational lines by arguing that occupations represent differences in on-the-job training (for given levels of education and ability). In addition, variation in unemployment rates among occupations indicates the existence of submarkets distinguished by unique demand and supply conditions. Further, imperfect knowledge of existing opportunities by entrants would impact more severely upon rates of return across these submarkets than within the individual strata.[33]

Wilkinson has erred somewhat in generalizing from his cross-sectional results to conclusions drawn about careers. While Mincer attempted to account for empirical differences in rates of return obtained upon comparing time-series and cross-section data, such contrasts are more difficult to perform within occupational groupings.[34] As discussed above, occupation switching in the forms of both older cohorts in-migrating and younger cohorts out-migrating may severely distort cross-sectional evidence applied to lifetime earnings profiles.[35]

Freeman has developed an elaborate set of models designed to explain and forecast occupational selection of recent college graduates.[36] He applies traditional price theory to draw conclusions concerning choice and then tests these empirically using aggregated time-series data. The bulk of variation in career choice is attributed to a pair of factors cited in earlier research above -- relative occupational earnings and relative employment opportunities. The effects of these variables are diluted, though, by several other elements which impede the supply-side adjustments. Foremost among these are: (1) human capital investments which tend to raise the foregone income costs attached to withdrawal from an occupation[37] [38] -- additional amounts of education and training limit the degree of substitutability among careers and, as a consequence, reduce the supply elasticity of many fields; and (2) demand-determined effects which alter the relative payoffs to various occupations. Such forces include the impact of technical change and differential sector growth.[39]

1.4 THE RISK ELEMENT

Nonhuman capital theorists have also investigated the impact of risk upon career decisions much along the same lines as Weiss. The general thrust of this research has been to focus upon the variability of earnings in a chosen career.[40] Other things being equal, people will treat earnings variation as a "bad" job characteristic. This should imply that mean earnings would have to be somewhat higher in occupations whose earnings display greater variance in order to compensate labor for its distaste for variability. Prior to reviewing these contributions, however, a thorough discussion of alternative definitions of risk is in order.[41]

1.4.1 "Private" and "Social" Risk

Nerlove has distinguished between two forms of risk. One type referred to as "private" risk focuses on the uncertainty of an individual's position within the occupational income distribution -- i.e., an entrant into an occupation is unsure of his ability to successfully compete in a market where his relative capabilities are unknown. This is the view of risk which predominates the empirical literature.[42] Nerlove has argued that the acquisition of human capital serves as a means by which such risks are mitigated.[43] To elaborate, the individual first embarking on a career is confronted with two possible risky outcomes -- either he will not possess the requisite skills to benefit from market opportunities or, alternatively, skills that have been acquired will not aid him in achieving greater earnings. Educational advancement, in particular, insures against the former outcome but increases the likelihood of the latter.[44] Further discussion of this issue follows below in the context of risk and human behavior.

The other form of risk -- "social" risk -- has developed from a more global perspective. Continually changing economic conditions signal shifts in the society's demand for outputs and, as a consequence, alter the requirements for specific skills necessary to produce these outputs. Hence, the present discounted value of earnings from different occupations will be subject to some fluctuation.[45] In the case of labor force entrants, this risk might appear to be compounded by the lack of knowledge concerning existing opportunities. Freeman, however, having analyzed this issue in great detail, has drawn the conclusion that students are sensitive to market conditions and will alter career decisions in light of structural changes in the labor market.[46]

1.4.2 Alternative Definitions

Implicit in the analyses of risk related to career choice are assumptions concerning attitudes of the participants towards risk. A standard set of definitions found elsewhere in the literature are reviewed at this time. The underlying premise is that individuals are risk averse -- i.e., prefer a sure thing to its actuarial equivalent composed of several uncertain outcomes. In algebraic terms:

$$U[V + E(Y)] > E\,U(V + Y)$$

where

V = unearned income,

Y = earnings,

E = the expectation operator, and

U = the utility derived from income.[47]

This requirement draws support from empirical evidence substantiating decreasing marginal utility of income. Further refining assumptions, also evolving from the observation of behavior towards risk, have been presented by Arrow, Pratt, and others in order to properly quantify risk aversion, since U" is dependent upon units of measurement.[48] These are analyzed in terms of the mechanics of their impact upon the risk premium or income differential required to make one indifferent between receiving an expected value of uncertain outcomes or its certainty equivalent. This premium will vary in accordance with the relevant amounts of earned and unearned income. Algebraically, this may be expressed as:

$$U\ V + E(Y) - \pi = E\ U(V + Y)$$

where

π = risk premium.

1. Absolute risk aversion: Given a particular distribution of earned incomes, this unit-free measure accounts for the impact of changes in the amount of earned income upon the size of the risk premium. Arrow and Pratt hypothesized that one purchases less insurance against a specified risk as wealth increases. This result, referred to in the literature as declining absolute risk aversion, hinges directly upon the original assumption of a declining marginal utility of income. Expressed as a formula, absolute risk aversion:[49]

$$A = \frac{-U''(V + Y)}{U'(V + Y)}$$

where

$$\frac{\partial A}{\partial (V + Y)} < 0$$

2. Relative risk aversion: The traditional unit-free measure, an elasticity, examines the relative effect upon the

risk premium of proportional changes in earned and unearned incomes. Arrow argued that one empirically observes elasticities exceeding one -- i.e., the fraction of wealth spent on insurance increases when both certain and uncertain events are increased in equal proportions. Hence, relative risk aversion is said to be increasing. The algebraic notation is written:

$$R = \frac{\frac{-U''(V + Y)}{U'(V + Y)}}{\frac{1}{(V + Y)}} = \frac{-(V + Y)U''(V + Y)}{U'(V + Y)}$$

and given that $\frac{dY}{Y} = \frac{dV}{V}$, then $\frac{dR}{dV} > 0$.

The implication of this assumption is that earned income is a normal good with a wealth elasticity bounded by 1, since proportional increases in wealth reduce the likelihood that the worker will undertake further investment in risky opportunities.

3. Partial risk aversion: Yet another definition of behavior under risk, flowing from the above assumptions,[50] analyzes the impact of a proportional increase in risk upon the relative change in the risk premium. Empirical results suggest that, for a given level of unearned income, a proportional increase in earnings will require a larger fraction of wealth devoted to risk insurance.[51] Expressed mathematically, P is defined by the above elasticity, i.e.:

$$P = \frac{-(V + Y)U''(V + Y)}{U'(V + Y)} \quad \text{and}$$

$$\left.\frac{\partial P}{\partial Y}\right|_V > 0.$$

In other words, the elasticity of the risk premium with respect to risky earnings will exceed 1.

1.4.3 The Risk Premium and Compensating Differential Compared

Weiss has demonstrated the similarity between the risk premium under uncertainty and the compensating differential employed in conventional analyses.[52] According to traditional economic theory, wealthier individuals are expected to choose occupations offering relatively more nonpecuniary benefits.[53] Operating with the previous mathematical notation, this result is shown below. An individual maximizes utility:

$$U = U(V + Y, N)$$

where

N = nonmonetary returns.

In equilibrium,

$$\frac{\partial U}{\partial N} = \frac{\partial U}{\partial (V + Y)}$$

For an increase in V,

$\frac{\partial U}{\partial (V + Y)}$ declines.

Therefore, an appropriate correction is to increase N, thereby lowering the marginal nonpecuniary benefit, in order to re-establish the equilibrium.[54] This conclusion would be reflected in the labor market by observation of wealthier individuals operating in more pleasant surroundings.[55]

Weiss considers the effect of an increase in human capital upon earnings.[56] If, as a result of self-investment, earnings potential in all occupations were to increase by some fixed amount, the outcome would be equivalent to an increase in unearned income. To demonstrate this result, assume

$$\frac{\partial U}{\partial W_A} > \frac{\partial U}{\partial W_B} \text{ and}$$

$$dW_A = dW_B = dw$$

where

A and B are occupations, and

$$W_A = W_B - \pi.$$

Then

$$dU = \frac{\partial U}{\partial W_A} dw > dU^* = \frac{\partial U}{\partial W_B} dw, \text{ but}$$

$$\frac{\partial^2 U}{\partial W_A \, w} < 0$$

which implies that the differential must increase if workers are to remain in A.[57] The increase in all wages also signals a change in the relative proportions of earned and unearned incomes. Assuming that earned income is a normal good, the fraction of wealth composed of earnings increases. This conclusion, though, represents a partial equilibrium analysis, since it does not explicitly consider among other elements the human capital effect upon work effort and the consequences of secular change in human capital on rates of return.

Alternatively, were the increase in human capital to be interpreted as a proportional increase in earned income, price and income effects would move in opposite directions -- i.e., initially a larger wage differential would induce selection of the higher paying career but the resulting higher income would prompt movement towards nonpecuniary benefits. Assuming the income effect is the larger, the results are identical to those above. In this instance:

$$\frac{dW_A}{W_A} = \frac{dW_B}{W_B}$$

$$dU = \frac{\partial U}{\partial W_A} \frac{dW_A}{W_A} W_A$$

$$U^* = \frac{\partial U}{\partial W_B} \frac{dW_B}{W_B} W_B$$

In comparing dU and dU^*, the outcome is ambiguous since[58]

$$\frac{\partial U}{\partial W_A} > \frac{\partial U}{\partial W_B} \quad \text{and}$$

$$W_B > W_A.$$

Thus the consequences of real economic growth can be summarized as follows. Workers demand greater premiums to remain in less pleasant occupations, thereby driving up equilibrium differentials and, in the process, marginal groups shift to more comfortable occupations.

Reviewing these conclusions and introducing the element of uncertainty into the analysis, Weiss derives the following results. Assuming two occupations are equally pleasant but the earnings flow from A is considerably more variable -- i.e., riskier -- a rise in nonearned income, V, increases the likelihood of selecting occupation A. To show why this is to be expected, assume decreasing absolute risk aversion holds. The result follows immediately by definition. Note, too, that because of the risk premium attached to A, wealthier individuals will be empirically observed to choose higher paying and riskier (in the monetary sense) occupations -- i.e., for equivalent levels of human capital, workers with greater (non-earned income) resources will appear to obtain higher rates of return on their investment.[59]

This outcome contrasts sharply with the income effect obtained earlier and provides a glimpse of the problems associated with a partial analysis. The overall direction of the wealth effect will serve as an indicator of the relative magnitudes of each cause. Should better paying occupations also provide more pleasant working conditions, both partial effects would operate in a similar fashion to induce wealthier individuals to enter these careers.[60]

The direct impact of an increase in self-investment is analyzed somewhat differently, with results similar to those obtained under certainty conditions. A constant increase in income caused by self-investment can be treated as a parallel shift in all earnings distributions. Since variability measures would not change, by invoking decreasing absolute risk aversion it can be shown that riskier occupations would be selected.[61] This result is analogous to that obtained from a rise in unearned income.

If the incremental returns to human capital are, in fact, proportional to existing wage levels, the appropriate vehicle for analysis is the increasing partial risk aversion assumption. If occupations do not differ in nonpecuniary benefits, the individual will attempt to reduce his risk by selecting the certainty equivalent. The implicit assertion is that human capital raises earnings, the risky component of income. Since the risk elasticity is greater than one, the spector of greater earnings variability induces the individual to choose the less risky occupation. In this sense, too, the certainty effect and nonpecuniary effect operate in like fashion with regard to changes in human capital.

CHAPTER I
FOOTNOTES

[1]Semi-skilled or unskilled workers who realize lower costs could, therefore, be expected to engage in more part-time work.

[2]For similar reasons, occupation switches should be infrequent where training costs cannot be recouped. Only in those situations where skills are generalized and/or transferable should migration be evident. In the latter case where a high degree of agreement in the skill requirements for two occupations exists, one avenue investigated below is to treat these jointly as one career.

[3]For extensive bibliographies see T.W. Schultz, Human Resources, NBER Fiftieth Anniversary Colloquium Series, Volume VI (NBER, New York: 1972), and J. Mincer, "The Distribution of Labor Incomes: A Survey," Journal of Economic Literature, March 1970, pp. 1-26.

[4]Ability has entered into the process in a somewhat different fashion, operating as an efficiency parameter, translating units of investment into increased levels of return.

[5]Bartel and Borjas have noted that frequent job turnover is the norm. The typical male worker will switch jobs six times over the course of his attachment to the labor force. See A. Bartel, "Job Mobility and Earnings Growth," NBER Working Paper #117, November 1975.

[6]A. Smith, Wealth of Nations (Modern Library, 1937), p. 99.

[7]See Section 1.4.2 for alternative definitions of risk.

[8]A. Marshall, Principles of Economics, 8th edition (McMillan, 1956), pp. 546-49.

[9]Rosen's objective function contains two elements: one term representing perceived benefits from a job move -- the maximum net present value of income obtained across all possible choices net of search/mobility costs and specific capital costs incurred on the new job and previously made at the present job -- and the other term equal to the present discounted value of the returns accruing from the current occupation. See S. Rosen, "Learning and Experience in the Labor Market," Journal of Human Resources, Summer 1972, pp. 326-42.

[10]For a detailed exposition of these assumptions, see Y. Ben-Porath, "The Production of Human Capital and the Life-Cycle of Earnings," Journal of Political Economy, August 1967, pp. 352-65.

[11]See A. Bartel, op cit.

[12]R. Lucas, "Hedonic Wage Equations and Psychic Wages in the Returns to Schooling," American Economic Review, September 1977, pp. 549-58.

[13]A. King, "Occupational Choice, Risk Aversion, and Wealth," Industrial and Labor Relations Review, July 1974, pp. 586-96.

[14]V. Fuchs, "Differences in Hourly Earnings Between Men and Women," Monthly Labor Review, May 1971, pp. 9-15.

[15]Chiswick, Fackler, O'Neill, and Polacheck, "The Effect of Occupation on Race and Sex Differences in Hourly Earnings," Review of Public Data Use, April 1975, pp. 2-9.

[16]A somewhat similar effort is also produced by P. Schmidt and R. Strauss. They present a multiple logit model of occupation choice with entry into occupations serving as dependent variables. Controlling for the effects of human capital, they examine the degree to which race and sex contribute independently in the selection process (either because of individual preferences or discrimination). By utilizing cross-sectional data at two points in time, 1960 and 1970, they are also able to monitor changes in the coefficients of the demographic variables. See "The Prediction of Occupation Using Multiple Logit Models," International Economic Review, June 1975, pp. 471-86.

[17]Rosen, op cit.

[18]S. Bowles, "Schooling and Inequality from Generation to Generation," Journal of Political Economy, May 1972, pp. S219-S251.

[19]O. Duncan, "Occupational Components of Educational Differences in Income," Journal of the American Statistical Association, December 1961, pp. 783-92.

[20]Friedman and Kuznets, Income from Independent Professional Practice, National Bureau of Economic Research (New York: 1945).

[21]Three assumptions were stated: (1) working lifespans, including schooling, are fixed and equal for all individuals; (2) investment occurs only in the form of formal schooling -- thus earnings flows are constant upon entry into the labor force; and (3) opportunity costs constitute the sole training costs borne by the individual.

[22]J. Mincer, "Investment in Human Capital and Personal Income Distribution," Journal of Political Economy, August 1958, pp. 281-302.

[23]C. Rahm, Investment in Training and the Occupational Structure of the United States, Ph.D. dissertation, Columbia University, 1971.

[24]G. Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, National Bureau of Economic Research (New York: 1964).

[25]As a consequence, the values of the parameters are weighted averages of each occupation's corresponding parameters.

[26]J. Mincer and S.W. Polacheck, "Family Investments in Human Capital: Earnings of Women," Journal of Political Economy, March 1974, pp. S76-S108, presents an overview of some subsequent unpublished work by Polacheck.

[27]E. Landes, Male-Female Differences in Wages and Employment: A Specific Human Capital Model, Ph.D. dissertation, Columbia University, 1974.

[28]Y. Weiss, "The Risk Element in Occupational and Educational Choices," Journal of Political Economy, November 1972, pp. 1203-13.

[29]M. Boskin, "A Conditional Logit Model of Occupational Choice," Journal of Political Economy, March 1974, pp. 389-98.

[30]Since much of Galloway's work predates the general acceptance of human capital theory in the labor literature, I've modified his approach to a degree without affecting his general conclusions.

[31]See L. Galloway, Manpower Economics, Irwin (Homewood, Illinois: 1971), Chapter 5.

[32]See Y. Weiss, "The Risk Element in Occupational and Educational Choices," for a variation in this framework.

[33]B. Wilkinson, "Present Values of Lifetime Earnings for Different Occupations," Journal of Political Economy, December 1966, pp. 556-72.

[34]See J. Mincer, Schooling, Experience, and Earnings, National Bureau of Economic Research (New York: 1974), pp. 76-8.

[35]There are instances, though, where the assumption of negligible migration may be justified. This would be particularly true where either ability limitations or government-sanctioned or other market imperfections impose effective barriers to entry. Calculated rates of return to professional athletes, physicians, and union members serve as adequate illustrations. See, for example, F. Sloan, "Life-

time Earnings and Physicians' Choice of Speciality," Industrial and Labor Relations Review, October 1970, pp. 47-56.

[36] R. Freeman, The Market for College Trained Manpower: A Study in the Economics of Career Choice (Harvard University Press, Cambridge: 1971), Chapter 10.

[37] The "investment" effect is dampened somewhat by the improved information normally sought by individuals intending to make extensive self-investments in a particular profession, reducing the likelihood of a career change.

[38] See Bartel, op cit, for some empirical evidence in this regard. While occupation switches may decline, such conclusions should not necessarily be drawn for job mobility.

[39] See below for a further discussion regarding the probable effects of technological progress upon choice.

[40] Note that human capital theorists have preferred to treat income variation as a related outcome of schooling and on-the-job investment decisions. Refinements to this general approach include an allowance for quality variation in schooling and an assumption of the existance of differences in rates of return to post-school investments -- i.e., risk. Mincer has argued that variation within schooling groups will be increasing over time beyond the "overtaking" age due to returns to experience, and such dispersion in earnings should not be attributed to risk. See Mincer, Schooling, Experience, and Earnings, Part I, Chapter 2.

[41] Knight differentiated between the two terms "risk" and "uncertainty" by treating the former as an insurable event -- i.e., defined by a statistically known distribution of outcomes -- while treating the latter as uninsurable. Most of the literature summarized here does not adhere to this fine distinction. See F. Knight, Risk, Uncertainty, and Profit, University of Chicago Press, 1921, Part II.

[42] See Friedman and Kuznets, A. King, "Occupation Choice, Risk Aversion, and Wealth," Industrial and Labor Relations Review, July 1974, pp. 586-96, and Weiss.

[43] M. Nerlove, "On Tuition and the Costs of Higher Education: Prolegomena to a Conceptual Framework," Journal of Political Economy, May 1972, pp. 178-218.

[44] Nerlove has attributed the absence of perfect certainty in human capital decisions partially to certain market imperfections (e.g., the inability to untie the owner from the acquired capital). This feature accounts for an additional premium by which the rates of return to risk on human capital exceed those on other assets.

[45] Systematic unemployment -- cyclical or seasonal -- as in the agricultural sector or teaching professions is meant to be precluded from this category. Such events are already incorporated into the equilibrium wage structure of an occupation. In comparing a "normal" occupation with one experiencing systematic unemployment, for the latter, let

P_i = the probability of employment during period i

Y_i = earned income in period i

W = end-of-period wealth

and assume

(1) P_i is fixed over time

(2) $E(P_i\ P_j) = P_i\ P_j$ (i.e., independence of events)

Then

$$W = \sum_{t=1}^{T} Y_t \sum_{i=1}^{t} P^i (1 - P)^{t-i}$$

Where the second term represents the sequence of employment during the period, a binomial expansion whose mean is equal to P. Therefore,

$$W = \sum_{t=1}^{T} PY_t$$

The resulting differential at a given moment in time between the two occupations is then dictated by P -- i.e., if the two occupations are to appear equally attractive, end-of-period wealth should be the same, and income in the normal profession

Y_t^N will equal $E(PY_t)$.

Thus

$$W^N = \sum_{t=1}^{T} Y_t^N = W = \sum_{t=1}^{T} PY_t$$

$$Y_t^N = E(PY_t) = PY_t$$

and

$$\frac{Y_t}{Y_t^N} = \frac{1}{p} > 1$$

[46]Freeman, op cit.

[47]This is normally presented in a more compact version as

$$U(E(Y)) > E(U(Y)).$$

Both formulations require $U'' < 0$.

[48]See Y. Weiss, "The Wealth Effect on Occupational Choice," International Economic Review, June 1976, pp. 292-307 for a brief review of the existing literature.

[49]
$$\frac{\partial A}{\partial (V + Y)} < 0$$

implies that quadratic functional forms are technically incorrect specifications of utility. To show this, consider the function

$$U = aY^2 + bY + C$$

where all income is earned. In the relevant range, $U' > 0$ where

$$U' = 2aY + b > 0 \quad \text{and}$$

$$U'' = 2a$$

Now

$$a = \frac{-U''}{U'} = \frac{-2a}{2aY + b}$$

and

$$\frac{dA}{dY} = -(-2a)(2aY + b)^{-2} \cdot 2a = \frac{4a^2}{(2aY + b)^2} > 0.$$

This result contradicts the basic assumption of declining risk aversion. Thus, although analysis based upon the mean and variance of a probability distribution proves convenient, the assumption should rule out its application. King, among others, avoids discussion of this issue.

[50]See C. Menezes and D. Hanson, "On the Theory of Risk Aversion," International Economic Review, October 1970, pp. 481-87.

[51]Ibid.

[52]Y. Weiss, "The Wealth Effect in Occupational Choice."

[53]See Freeman for a similar exposition.

[54]Freeman has noted that, in the selection among alternative careers, the initial choice (say, (Y_o, N_o)) and subsequent readjustments may be more accurately represented by the discrete analogue where occupations are uniquely described by Y - N vectors.

[55]Weiss has identified research elsewhere in the literature which support this hypothesis. Of course, since skills vary as well in the marketplace, rigorous empirical support concerning job preferences is difficult to uncover.

[56]An attempt is not made to distinguish between wage increases due to increased productivity and those caused by "credential" effects that impose additional human capital requirements unrelated to productivity upon more recent vintages of the labor force.

[57]See G. Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, Chapter 3.

[58]Galloway's empirical analysis follows from this "inconclusive" result. Depending upon the marginal utility of income, the size of the differential and of the group on the margin, gross mobility flows into both occupations might be observed.

[59]See King for confirmation of this hypothesis. He observes that riskier occupations offer higher expected incomes and that wealthier individuals tend to select in greater relative numbers such careers.

[60]The traditional argument made, however, suggests that the rich tend to choose positions in philanthropy, academia, or politics which offer lower salaries for comparable positions than private industry.

[61]For an application of this result to the analysis of migration, see P. David, "Fortune, Risk, and the Microeconomics of Migration," Nations and Households in Economic Growth, P. David and M. Reder, eds. (Academic Press, New York: 1974), pp. 21-88. David offers an extensive theoretical discussion supporting the hypothesis that risk aversion increases with age while declining with higher levels of educational attainment. David's work has been criticized, however, by A. Schwartz, who shows that human capital theory alone can account for the empirical finding that migration rates decline more quickly across age groups as education

levels rise. See A. Schwartz, "Migration, Age, and Education," <u>Journal of Political Economy</u>, August 1976, pp. 701-19.

CHAPTER II

EMPIRICAL MEASURES OF RISK

2.1 TWO ALTERNATIVE APPROACHES TO MEASUREMENT

The incorporation of risk into empirical research, an undertaking pursued to a larger degree in the sphere of investment portfolio theory, has produced a pair of competing approaches designed to measure risk.[62] The original methodology involves the comparison of moments of probability distributions of alternative choices being considered, and traces its beginnings to pioneering works by Markowitz and Tobin in the application of portfolio theory to security analysis.[63] The other set of techniques, recently developed, offers a more theoretically correct approach to determining preferences under the assumption of risk aversion, but suffers from difficulties in empirical implementation. I proceed with a discussion of these latter criteria and then comment briefly upon the earlier methodology and several of its shortcomings.

2.2 STOCHASTIC DOMINANCE

In one of a limited number of empirical studies devoted to occupational choice under uncertainty, King has adopted several of the tools utilized in security analysis and has compared results with those obtained by ranking careers based solely upon expected present values of income streams. He has argued that such a criterion is both insufficient and inappropriate since, in most instances, the individual's relative income status in an occupation is variable, and lifetime career selection opportunities are too infrequent to permit the expectations technique to adequately reflect a true ranking.[64] [65] He has proposed instead to view the problem in terms of expected utility maximization and has applied the criteria of "stochastic dominance" which allow for generalized utility functions, free of functional form constraints, to predict choices among occupations.[66]

2.2.1 A General Criterion

The most general criterion chosen asserts that choice F "dominates" choice G -- i.e., the expected utility derived from F exceeds G for all choices of utility functions, if and only if the following relationships hold true:

$F(X) \leqslant G(X)$ and

$F(X_o) < G(X_o)$ for some X_o

where F,G represent cumulative distribution functions of the prospects and it is assumed that the marginal utility of income is positive throughout the relevant range.[67]

A graphical exposition is presented in Figure 2.1. Note that the F and G cumulative distributions do not intersect. The concentration of the distribution probabilities in the higher payoffs distinguishes the preferred outcome from its dominated alternative. Thus the value of the chosen prospect's cumulative distribution at any particular income will never exceed that of an inferior one -- i.e., for any X, the probability of receiving an income of x dollars or less cannot be larger with F than with G.

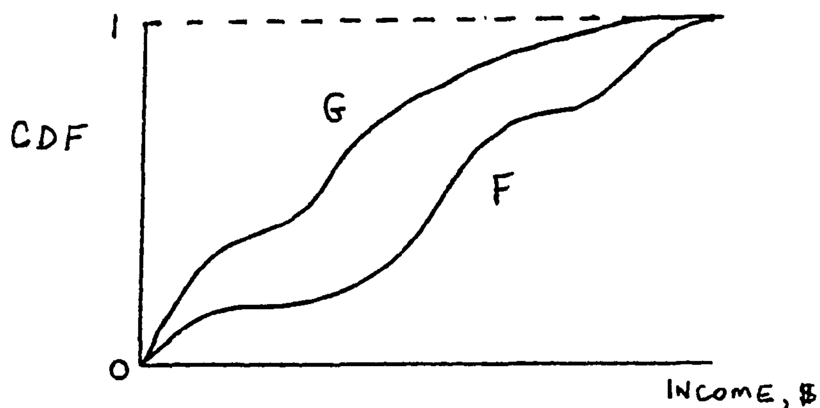

FIGURE 2.1
STOCHASTIC DOMINANCE UNDER THE GENERAL CRITERION

Application of the principle to a large number of choices, though, is particularly time-consuming and difficult. While the decision rule is transitive with respect to dominance -- e.g., if F dominates G and G dominates H, then F dominates H -- it is intransitive with respect to indifference -- e.g., if F is indifferent to G and G to H, F need not be indifferent to H (see Figure 2.2) -- and can, therefore, only be applied on a pairwise basis.

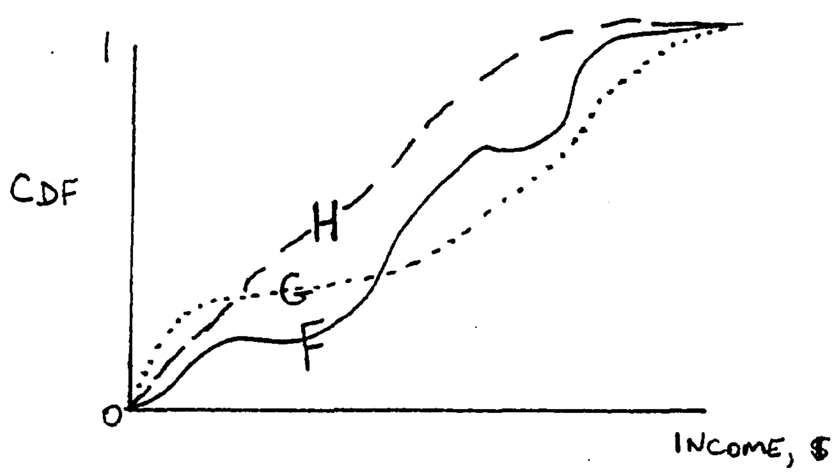

FIGURE 2.2
STOCHASTIC INDIFFERENCE UNDER THE GENERAL CRITERION

It can also be shown that all moments about zero of the dominant choice exceed the corresponding levels of other prospects.[68] Note that this result need not extend to measures of variance, though, of interest in the discussion below. Consider, for example, the following two prospects, F and G in Table 2.1. While F dominates G, the variance attributable to F is smaller. The lack of any presumption about attitudes towards risk in the general criterion readily accounts for this result.

TABLE 2.1
THE RELATIONSHIP OF PROSPECT VARIANCES TO DOMINANCE UNDER THE GENERAL CRITERION

Prospect	Probability	Income	E(X)	MSS(X)	S(X)
F	0 1	0 $25,000	$25,000	625,000,000	0
G	1/2 1/2	$ 5,000 $15,000	$10,000	125,000,000	$25,000

In practice, even if such dominant career choices are observed, they are unlikely to persist because the increased supply of labor to these professions must eventually drive each of these careers' probability distributions to the left as relative incomes fall. Once occupational distributions intersect, the general criterion can no longer provide solutions since choices are then functionally related to the particular utility distribution employed. By adopting a somewhat more restrictive (but realistic) assumption about the nature of the utility function, a new decision rule incorporating risk aversion can be developed.

2.2.2 A Risk Aversion Criterion

Assume marginal utilities are nonincreasing over the relevant range of incomes -- i.e., the utility function is treated as either linear or concave. Mathematically, a new dominance relationship can be described by F dominating G if and only if:

$$\sum_{i=1}^{r} G(x)\Delta X_i \geq \sum_{i=1}^{r} F(x)\Delta X_i \qquad \text{for all } r < n$$

where

X_n is the largest value of X, and

$\Sigma G(X)\Delta X > \Sigma F(X)\Delta X$ for some interval.[69]

The graphical equivalent requires that, while distributions may intersect, the area under the dominant curve must always be less than for other choices, at any value other than the maximum along the horizontal axis (see Figure 2.3). To recognize how this decision rule treats risk averse behavior, notice that the sum of negative differences in area (where F exceeds G) to the left of any value X_o must always remain smaller in absolute value terms than the sum of the positive differences (where F falls below G). Thus:

$$\sum_{i=1}^{r} G(X)\Delta X_i$$

will be greater than the equivalent combination of "F" distribution terms, and any linear utility transformation will retain this ordering. Since a concave utility function weighs high incomes to a lesser degree than low incomes, negative areas to the right of any positive area will translate into relatively smaller increments in utility, and thus the criterion satisfies risk aversion.[70]

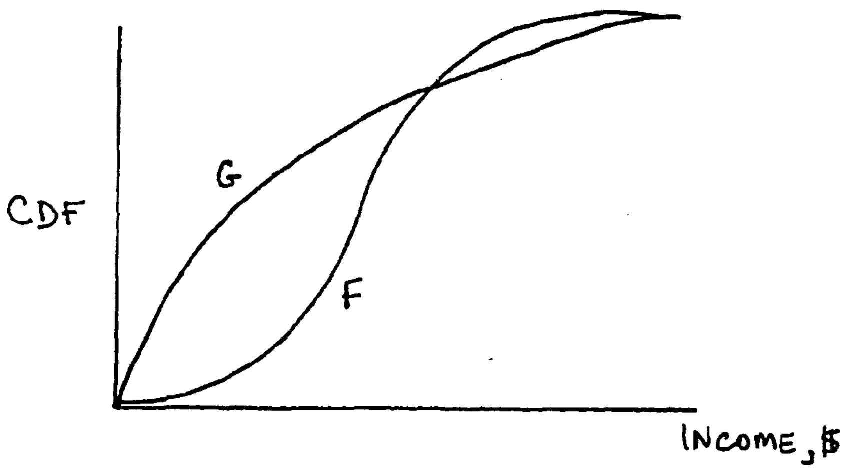

FIGURE 2.3
STOCHASTIC DOMINANCE UNDER THE RISK AVERSION CRITERION

While the mean of F must exceed that of G as in the earlier more general dominance criterion, the same need not apply for other moments of the probability distribution. Likewise, a systematic relationship between the variances of F and G cannot be established in all instances. Consider the following two cases.

TABLE 2.2
TWO PROSPECTS WITH DIFFERING PROBABILITY DISTRIBUTIONS WHICH ARE INDIFFERENT UNDER A MEAN-VARIANCE RULE

Prospect	Probability	Income	E(X)	S(X)
F	1/2 1/2	\$ 7,500 \$17,500	\$12,500	\$25,000
G	1/3 1/3 1/3	\$ 5,000 \$10,000 \$15,000	\$10,000	\$16,667

Note that while $E_F(X) > E_G(X)$, $Var_F(X) > Var_G(X)$.

F dominates G by our risk aversion criterion as shown below. (Since X = $2,500 is constant throughout, it is not included in the calculations.)

TABLE 2.3
DOMINANCE UNDER THE RISK AVERSION CRITERION OF PROSPECTS INDIFFERENT UNDER A MEAN-VARIANCE RULE

X	F(X)	G(X)	$\Sigma G(X)\Delta X - \Sigma F(X)\Delta X$
$ 2,500	0.00	0.00	0.00
$ 5,000	0.00	0.33	0.33
$ 7,500	0.50	0.33	0.16
$10,000	0.50	0.67	0.33
$12,500	0.50	0.67	0.50
$15,000	0.50	1.00	1.00
$17,500	1.00	1.00	1.00

Here $E_F(X) > E_G(X)$ and, while it can again be demonstrated that distribution F dominates G, the variance of F is smaller than that of G.

TABLE 2.4
DOMINANCE UNDER THE RISK AVERSION CRITERION OF PROSPECTS SATISFYING A MEAN-VARIANCE RULE

Prospect	Probability	Income	E(X)	S(X)
F	1/2 1/2	$ 8,000 $16,000	$12,000	$16,000
G	1/3 1/3 1/3	$ 5,000 $10,000 $15,000	$10,000	$16,667

The above examples are not meant to suggest, though, that a ranking of occupations based solely upon the present value of expected earnings can produce an equivalent ordering. Consider the following illustration.

TABLE 2.5
INDIFFERENCE UNDER THE RISK AVERSION CRITERION OF PROSPECTS SATISFYING AN EXPECTED VALUE RULE

Prospect	Probability	Income	E(X)
F	1/2 1/2	$ 5,000 $15,000	$10,000
G	1	$ 7,500	$ 7,500

Note that, although $E_F(X) > E_G(X)$, F is indifferent to G since, for any interval below $10,000, the area under F exceeds G. The example highlights another aspect of the modified decision rule. As a general proposition, prospect F may technically never dominate prospect G if its minimum value falls below that of G, irrespective of the difference in mean values.[71]

Again, though, it is readily evident that the application of these criteria to a large number of prospects can be cumbersome with results that are subject to qualification.[72] Simpler computational methods which also rely upon dominance relationships would be preferred in empirical work. Implementation, however, requires that one resort to techniques based upon the moments of the career probability distributions of incomes. It should be noted that such rules, while capable of generating an ordering of prospects, are restricted by much tighter conditions governing their applicability.

2.3 THE "MOMENTS" APPROACH

Tobin and Markowitz are acknowledged to have been the initiators responsible for development of the moments approach.[73] They argued that a utility function might always be fully described in terms of a polynomial based upon its moments. Constraining the set of functions to those reflecting risk aversion, members of this subset could be expanded about a mean $\bar{Y}$ into a Taylor series of the form:

$$U(Y) = U(\bar{Y}) + U'(\bar{Y})(Y - \bar{Y}) + \frac{U''(Y)}{2!}(Y - \bar{Y})^2 + \frac{U'''(Y)}{3!}(Y - \bar{Y})^3 + \dots$$

By assuming that this series converges so that most higher order terms can be neglected, expected utility could be determined from the first few moments of the function.[74] Pivotal to the formulation of this technique was the assumption that, given risk aversion, preferences among alternative prospects are not determined by the expected return alone but by other properties of the probability distribution of returns which, for purposes of computational ease, might be summarized with little loss of information into a single measure referred to as risk. The most common statistical measures adopted were the variance and standard deviation, primarily because (1) on theoretical grounds a substantial portion of risk may be traced to the degree of dispersion of the distribution, and (2) as a matter of convenience, calculating the second moment about the mean is a trivial operation to perform. Simply stated, then, the decision rule, often referred to as the mean-variance criterion, holds that prospect X dominates Y if and only if:

$$E(X) \geqslant E(Y)$$

$$Var(X) \leqslant Var(Y)$$

where at least one of the two conditions represents a strong inequality.

Certain costs of generality and efficiency are attached to this decision to limit the representation of risk to but one dimension of the probability distribution. While both sets of general criteria discussed above require that E(X) exceed E(Y) to assure dominance, the additional constraint regarding variances embodied in this rule is not specified elsewhere. To ensure that the standard deviation (variance) serves its role as a risk indicator adequately, further research has demonstrated that either the distribution of returns must be restricted so that other moment values do not confound choices based solely upon the second moment, or, alternatively, the translation of the probability distribution into expected utility must somehow weight only the first two moments heavily in its calculation.[75] Below are examined in greater detail the limited number of options which have evolved to provide a theoretical justification for proceeding under the mean-variance criterion.

2.3.1 The Quadratic Utility Function[76]

The unique property of this function lies in its dependence solely upon the first two moments of the returns distribution. It may, therefore, be easily related to the mean-variance rule in the following manner. Let:

$$U(Y) = aY^2 + bY + C$$

Then

$$EU(Y) = \sum_i P_i \; U(Y_i) = \sum_i P_i \; (aY_i^2 + bY_i + C)$$

$$= aE(Y^2) + bE(Y) + C$$

$$= a(\sigma^2 + E(Y)^2) + bE(Y) + C$$

where

σ^2 represents the variance.

Accordingly, if

$$E(Y_F) > E(Y_G)$$

then in order that the function satisfy the criterion

$$\frac{\partial EU(Y)}{\partial E(Y)} = 2aE(Y) + b \geqslant 0.$$

Similarly, if

$$\sigma^2(Y_F) < \sigma^2(Y_G),$$

$$\frac{\partial EU(Y)}{\partial \sigma^2} = a < 0$$

Hence, $a < 0$ and $b > 0$, defining the proper quadratic form.

As noted earlier, the function's choice is subject to serious objections on theoretical grounds -- violation of observed decreasing absolute risk aversion, and inadmissability of half of the relevant range of the function exhibiting declining marginal utility of income. While this latter problem may be resolved by extending the range, this solution poses further difficulty. Recall that:

$$U(Y) = aY^2 + bY + C,$$

$$U' = 2aY + b \geqslant 0, \text{ and}$$

$U'' = 2a < 0.$

$U' = 0$ when $Y = \frac{-b}{2a}$.

By requiring this fraction to take on larger values, the acceptable range where marginal utility is positive is increased (see Figure 2.4). Unfortunately, as $\frac{-b}{2a}$ grows larger, U(Y) approaches a linear form and in the limit $U' = b$ and $U'' = 0$, implying risk neutrality.

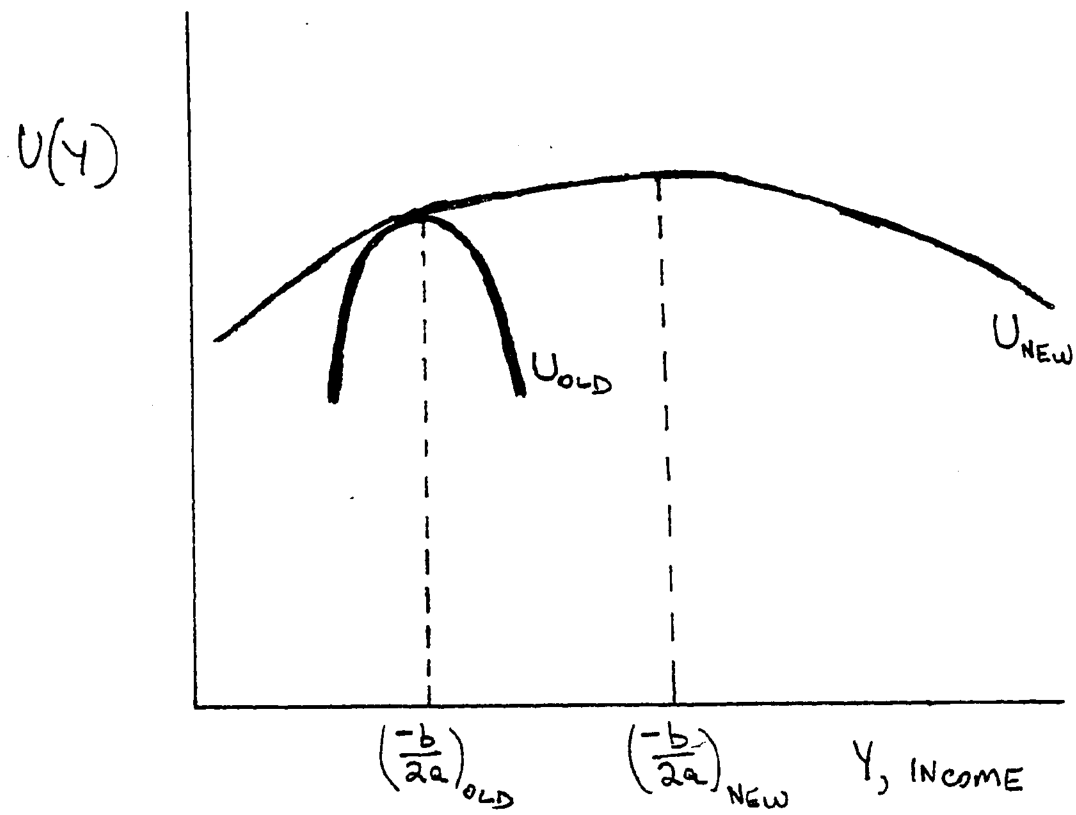

FIGURE 2.4
THE EFFECT OF MODIFYING THE QUADRATIC UTILITY FUNCTION
TO SATISFY ASSUMPTIONS ABOUT RISK AVERSION

In addition, even were these cautionary remarks to be dismissed in the application to empirical analysis, further opposition could be expected to the choice of a quadratic utility function based upon an efficiency argument. Consider the following situation in which the criterion is unable to provide an ordering of prospects.

Let there exist two choices, X and Y, such that:

$E(X) \geqslant E(Y)$,

$EU(X) = a(\sigma_X^2 + E(X)^2) + bE(X) + C$, and

$EU(Y) = a(\sigma_Y^2 + E(Y)^2) + bE(Y) + C$.

To first demonstrate how the mean-variance criterion assures dominance, calculate:

$EU(X) - EU(Y)$.

If positive (negative), then X dominates (is dominated by) Y and, if equal to zero, an individual is considered indifferent between the two alternatives. Operating under the assumption that the result is positive,

$$EU(X) - EU(Y) = a(\sigma_X^2 - \sigma_Y^2) + a(E(X)^2 - E(Y)^2) + b(E(X) - E(Y)) > 0$$

or

$$-(\sigma_X^2 - \sigma_Y^2) - (E(X)^2 - E(Y)^2) - \frac{b}{a}(E(X) - E(Y)) > 0$$

where $a < 0$.

Define $K \equiv \frac{-b}{2a}$ at which point $U' = 0$.

Then

$$-(\sigma_X^2 - \sigma_Y^2) - ((E(X) - E(Y))(E(X) + E(Y)) + 2K(E(X) - E(Y)) > 0$$

or

$$2(E(X) - E(Y))\ (K - \frac{E(X) + E(Y)}{2}) - (\sigma_X^2 - \sigma_Y^2) > 0$$

Since K assumes the maximum permissible value for the utility function, it exceeds (or is equal to) all values of X and Y and is necessarily greater than E(X) or E(Y). Hence, the term

$$(K - \frac{E(X) + E(Y)}{2})$$

is positive, as is the entire first expression. Thus, by one form of the mean-variance criterion, if

$E(X) > E(Y)$ and

$\sigma_X^2 \leq \sigma_Y^2$

the above expression will be positive and dominance is assured.

Note, though, that even if the expression containing variance terms is positive, prospect X may still be preferred. While sufficient, then, the criterion is not a necessary condition to guarantee dominance. In other words, according to the rule, if

$E(X) > E(Y)$ and

$\sigma_X^2 > \sigma_Y^2$

then the individual is said to be indifferent between the two sets of outcomes, but as just observed, this need not hold true -- an indication of the inadequacy of the criterion.

A proposed modification to the expected utility formulation which removes this flaw from the mean-variance rule also complicates the measure to be tested, thereby eliminating any advantage obtained from the assumption of quadratic utility. To ensure that the first expression remains positive, K is replaced by the highest mean value of any prospect. We obtain:

$$2(E(X) - E(Y))\left(\frac{2E(X)}{2} - \frac{E(X) + E(Y)}{2}\right) - (\sigma_X^2 - \sigma_Y^2) > 0,$$

or

$$(E(X) - E(Y))^2 - (\sigma_X^2 - \sigma_Y^2) > 0.$$

Thus, X is preferred to Y if

$$E(X) \geqslant E(Y) \quad \text{and}$$

$$\sigma_Y^2 > \sigma_X^2 - (E(X) - E(Y))^2.$$

While no new information is required to evaluate alternatives according to this altered criterion, it is capable of generating an ordering in those instances in which the mean-variance rule implies indifference and conforms to the original rule's results in all other instances. It can also be shown that transitivity relationships hold under the modified decision rule. Let X dominate Y, and Y dominate Z. Then:

$$E_X \geqslant E_Z \quad \text{and}$$

$$\sigma_Z^2 > \sigma_Y^2 - (E_Y - E_Z)^2$$

$$\sigma_X^2 - (E_X - E_Y)^2 - (E_Y - E_Z)^2$$

$$\sigma_X^2 - ((E_X)^2 - 2E_XE_Y + (E_Y)^2 + (E_Y)^2 -$$

$$2E_YE_Z + (E_Z)^2)$$

$$\sigma_X^2 - ((E_X)^2 + (E_Z)^2 + 2E_Y(E_Y - E_X - E_Z))$$

Since $E_Y \geqslant E_Z$ we may substitute in the above inequality. Then:

$$\sigma_Z^2 > \sigma_X^2 - ((E_X)^2 + (E_Z)^2 + 2E_Z(E_Z - E_X - E_Z))$$

$$> \sigma_X^2 - (E_X - E_Z)^2.$$

Even weaker rules may be devised for distributions which provide additional information incorporated into the criterion -- e.g., symmetry or known degrees of skewness.[77] Each is in turn a more efficient tool in ordering given subsets of distributions.

2.3.2 Concave Utility Functions and Restricted Returns Distributions[78]

The utility function's form guarantees declining marginal utility of income and risk aversion. If prospects under consideration are then constrained to those

a. belonging to the same family of distributions which,

b. contain only two parameters,

c. each of which is an independent function of the mean and variance, and

d. provided that the cumulative probability distributions intersect

then the mean-variance decision rule will produce an efficient ordering of alternatives. A proof of this claim by Hanoch and Levy demonstrates how the specified conditions resemble those stipulated under the general "risk aversion" criterion. Without the requirement that distributions intersect, however, the mean-variance rule satisfies only sufficiency conditions since dominance under the most general criterion, which assumes nonintersecting distributions, is unrelated to orderings by variance size.[79] As discussed earlier, however, there is only a slight chance that one will observe such conditions involving career income distributions on an extended basis. It appears far more probable that the mean-variance rule can, in fact, provide meaningful results when applied to the U.S. labor market.

Of critical importance is the selection of the distributional form governing the prospects under consideration. The two most common candidates for this assignment are the normal and uniform density functions, and brief illustrations are provided below of how the criterion may operate given these alternative assumptions. The uniform distribution postulates that, with proper constraints upon the universe being considered, the likelihood of earning a particular level of career income among a range of possibilities is constant at all levels.

$$f(Y) = \begin{cases} \frac{1}{b-a} & a \leq Y \leq b \\ 0 & \text{otherwise} \end{cases}$$

where a and b represent minimum and maximum occupational income levels, respectively.

$$E(Y) = \frac{a + b}{2}$$

$$Var(Y) = \frac{(a - b)^2}{12}$$ [80]

It may be verified both algebraically and graphically that mean-variance dominance is both necessary and sufficient. Consider two prospects where one is preferred according to this rule. We wish to demonstrate that this choice would also be selected under the more general risk criterion.

TABLE 2.6
DOMINANCE UNDER THE MEAN-VARIANCE CRITERION WITH TWO UNIFORMLY DISTRIBUTED PROSPECTS

Prospect	E(Y)	Var(Y)
F	$\frac{a_F + b_F}{2}$	$\frac{(a_F - b_F)^2}{12}$
G	$\frac{a_G + b_G}{2}$	$\frac{(a_G - b_G)^2}{12}$

where

$$E(Y_F) > E(Y_G) \text{ or } b_F - b_G > a_G - a_F, \text{ and}$$

$$Var(Y_F) < Var(Y_G) \text{ or } b_F - b_G < a_F - a_G$$

Hence,

$$a_F - a_G > b_F - b_G > a_G - a_F$$

We utilize this information in Figure 2.5. Prospects 1 and 2 intersect at the point (x,f*). To assure dominance, the shaded area A must exceed the upper area B. Performing the necessary computations, we indirectly calculate the areas of the two triangles:

$$\text{Area A} = 1/2\ f^*(a_F - a_G)$$

$$\text{Area B} = 1/2(1 - f^*)(b_G - b_F)$$

$$= 1/2\ f^*(b_F - b_G) - 1/2(b_F - b_G).$$

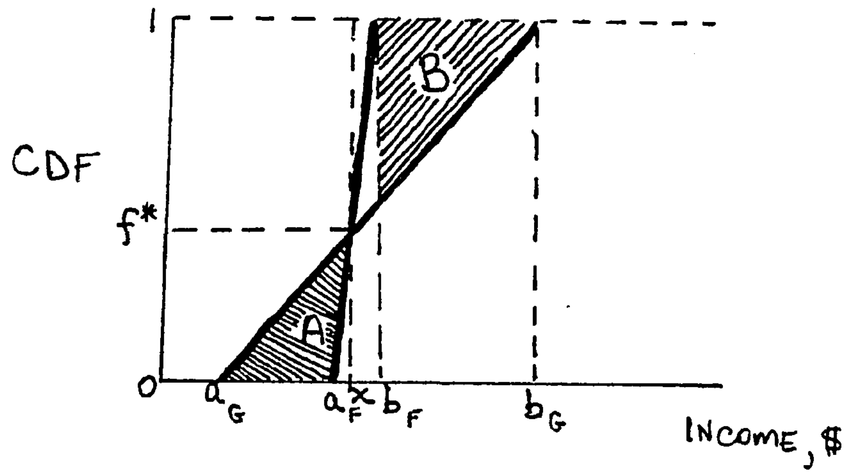

FIGURE 2.5
STOCHASTIC DOMINANCE WITH UNIFORM DENSITY FUNCTIONS

Since both prospects follow a uniform distribution,

$$1/2\ f^*(a_F - a_G) > 1/2\ f^*(b_F - b_G)$$

but

$$1/2\ f^*(b_F - b_G) > 1/2\ f^*(b_F - b_G) - 1/2(b_F - b_G)$$

so choice F must be preferred.

To show sufficiency, assume $E(Y_F) > E(Y_G)$ but $Var(Y_F) > Var(Y_G)$. Proceeding as before, the resulting inequality $b_F - b_G > |a_F - a_G|$ does not allow us to determine the relative magnitudes of the two areas. In order to establish dominance, we are left with the result:

$$(b_F - b_G) - f^*((b_F - b_G) - (a_F - a_G)) > 0$$

Since both bracketed expressions are positive and the value of f* is indeterminate, indifference can be assumed.

The normal distribution's two moments are also independent functions fully described by two parameters:[81]

$$f(X) = \frac{1}{\sigma\sqrt{2\pi}} e^{-1/2\left(\frac{X-\mu}{\sigma}\right)^2}$$

$$E(X) = \mu$$

$$Var(X) = \sigma^2$$

Assumption of the normal density places a set of more restrictive conditions upon the likelihood of an event occurring outside of the "neighborhood" of the mean outcome. The first two examples below are presented to show that necessary and sufficiency conditions are met.

TABLE 2.7
TWO PROSPECTS WITH DIFFERING
NORMAL PROBABILITY DISTRIBUTIONS

Prospect	μ	σ^2
F	\$ 9,000	\$25,000
G	\$12,000	\$ 4,000

To evaluate graphically, select several points on the cumulative distribution curve (see Figure 2.6). For example, if the values for X = \$6,000, \$14,000, and \$19,000 are chosen, the normalized values can be calculated for each prospect at these points, as shown in Table 2.8.[82]

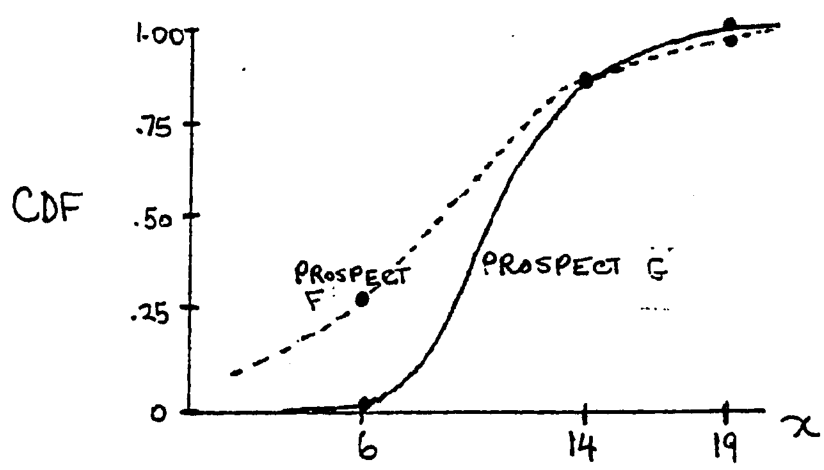

FIGURE 2.6
STOCHASTIC DOMINANCE WITH NORMALLY DISTRIBUTED PROSPECTS

TABLE 2.8
DOMINANCE UNDER THE MEAN-VARIANCE CRITERION
WITH TWO NORMALLY DISTRIBUTED PROSPECTS

	Area Under Curve		
Prospect	(X = $6,000)	(X = $14,000)	(X = $19,000)
F	0.274	0.841	0.977
G	0.002	0.841	1.000

Clearly, prospect G is preferred. Similarly, normalized values based upon X = $2,000, $4,000, and $10,000 appear in Table 2.9.

TABLE 2.9
INDIFFERENCE UNDER THE MEAN-VARIANCE CRITERION
WITH TWO NORMALLY DISTRIBUTED PROSPECTS

			Area Under Curve		
Prospect	μ	σ^2	(X = $2,000)	(X = $4,000)	(X = $10,000)
F	$9,000	$25,000	0.115	0.159	0.579
G	$5,000	$ 1,000	0.002	0.159	0.877

By the risk aversion criterion, prospect G may never dominate F because of the lower values assumed by choice F. Without resorting to a rather complex set of integrations, accept the visual proof that at the point X = $10,000 the area under prospect G exceeds F, thus assuring indifference between the pair of choices (see Figure 2.7). Sufficiency of the criterion is thus demonstrated.

A further illustration of the power of the decision rule under the normal density assumption is of interest. Notice in Table 2.10 that, although one condition of mean-variance domi-

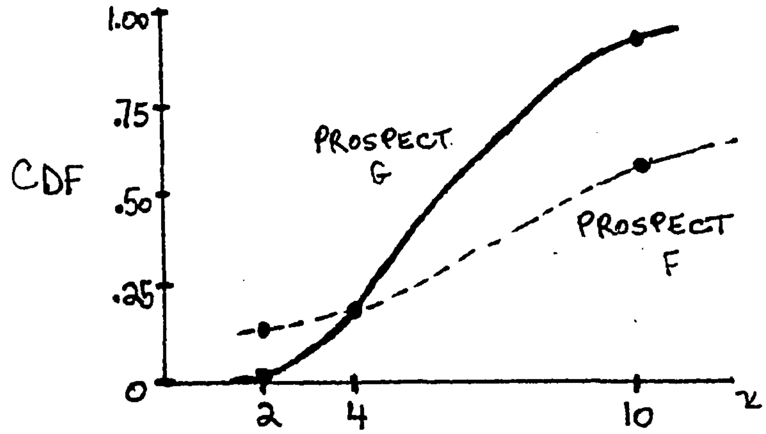

FIGURE 2.7
STOCHASTIC INDIFFERENCE WITH NORMALLY DISTRIBUTED PROSPECTS

nance has not been satisfied, namely intersection of the two curves, the criterion still holds by the more general criterion which allows no reference to risk at all (see Figure 2.8). This attribute of the normal distribution strengthens the generality of the mean-variance approach and is, therefore, to be favored when distributions may be shown to resemble this form.

TABLE 2.10
EQUIVALENCE OF MEAN-VARIANCE AND GENERAL CRITERIA FOR SPECIFIC CASES OF NORMALLY DISTRIBUTED PROSPECTS

			Area Under Curve		
Prospect	μ	σ^2	(X = $6,000)	(X = $10,000)	(X = $14,000)
F	$9,000	$25,000	0.274	0.579	0.841
G	$7,000	$25,000	0.421	0.726	0.885

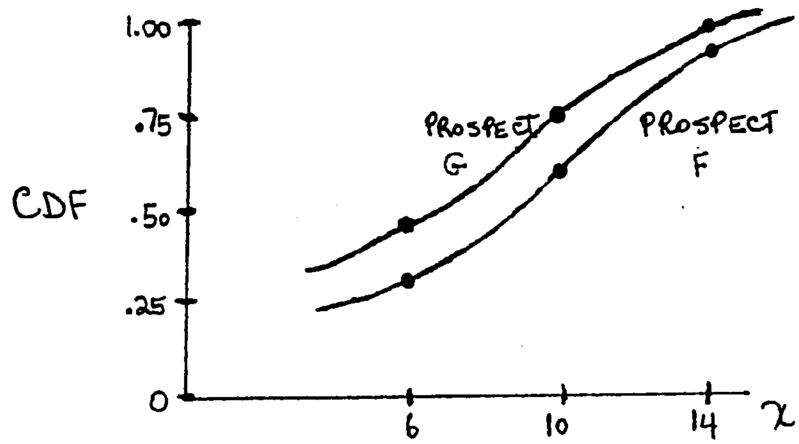

FIGURE 2.8
STOCHASTIC DOMINANCE UNDER THE GENERAL CRITERION
OF NORMALLY DISTRIBUTED PROSPECTS

This is not to suggest, however, either that (1) transformations which preserve ordering and generate normal densities for functions with non-normal properties, or (2) bell-shaped symmetrical distributions in general will meet the conditions of the criterion. Specifically, Feldstein provides a proof of the invalidity of the log-normal distribution. Summarizing his argument, he shows that for the log-normal distribution:

$$E(X) = e^{\mu+\frac{\sigma^2}{2}} \quad \text{and}$$

$$Var(X) = e^{2\mu+\sigma^2}(e^{\sigma^2} - 1) = (E(X))^2 (e^{\sigma^2} - 1)$$

That is to say, two independent parameters which are functions of the mean and variance do not exist. Hence, the mean-variance criterion's conditions are not met even though the log of the dependent variable is normally distributed.[83]

Likewise, the presence of symmetry alone is not an assurance of the applicability of the criterion. Hanoch and

Levy present examples to verify this assertion that can be generalized to obtain necessary and sufficiency conditions.[84] First, distributions which satisfy the criterion's specifications for dominance are compared in Table 2.11, and it is then determined whether the more general risk aversion criterion supports this conclusion.

TABLE 2.11
TWO PROSPECTS WITH DIFFERING SYMMETRIC DISTRIBUTIONS

Prospect	Probability	Income	E(X)	Var(X)
	p	$u - k$		
F	$1 - 2p$	u	u	$2k^2p$
	p	$u + k$		
	p	$u' - k'$		
G	$1 - 2p$	u'	u'	$2k'^2p$
	p	$u' + k'$		

where $u' > u$ and $k' < k$

Then, were the criterion applied, prospect G would be preferred. As seen from Figure 2.9, this statement appears true, but to be more rigorously defended, it must be shown that areas I and II will always exceed III.[85] Computing the relevant measures, area III equals $p((u + k) - (u' - k'))$ while I and II equal $p((u' - k') - (u - k))$ and $(1 - 2p)(u' - u)$, respectively.

$$p(k - k') - p(u' - u) \overset{?}{<} p(u' - u) + p(k - k') + (u' - u) - 2p(u' - u)$$

$$\overset{?}{<} p(k - k - p(u' - u) + (u' - u)$$

or

$$0 < u' - u$$

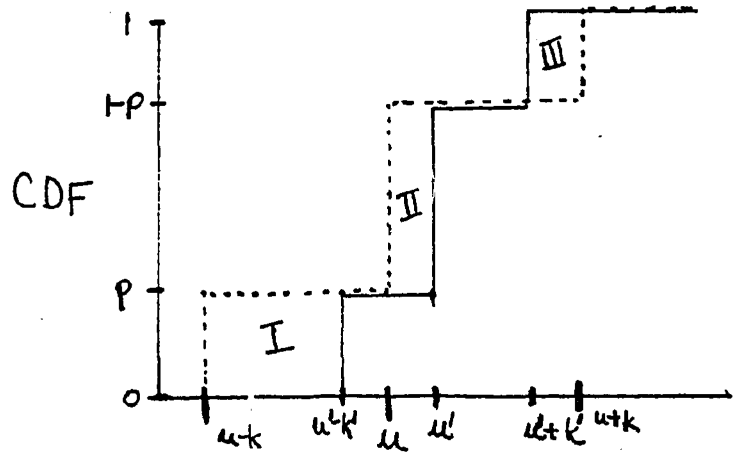

FIGURE 2.9
STOCHASTIC DOMINANCE UNDER THE RISK AVERSION CRITERION
OF SYMMETRICALLY DISTRIBUTED PROSPECTS

Thus sufficiency conditions rely upon the relative sizes of the means to guarantee dominance. If the means are equal, however, the mean-variance rule would incorrectly indicate a preference based upon the magnitudes of the variances. Thus sufficiency conditions cannot be satisfied. Likewise, necessary conditions cannot be met, as is demonstrated below. The table values from above are retained, but one critical assumption is altered -- namely, $k' > k$. Then the decision rule suggests indifference between the two choices. Figure 2.10 reveals, however, that this result hinges critically upon the relative values of the lower bounds of the distributions in question. If $(u' - k')$ falls below $(u - k)$, the mean-variance approach corresponds to the risk aversion criterion. However, if the lower bound of prospect G is greater, prospect G is dominant. Thus, necessary conditions are then not satisfied either.

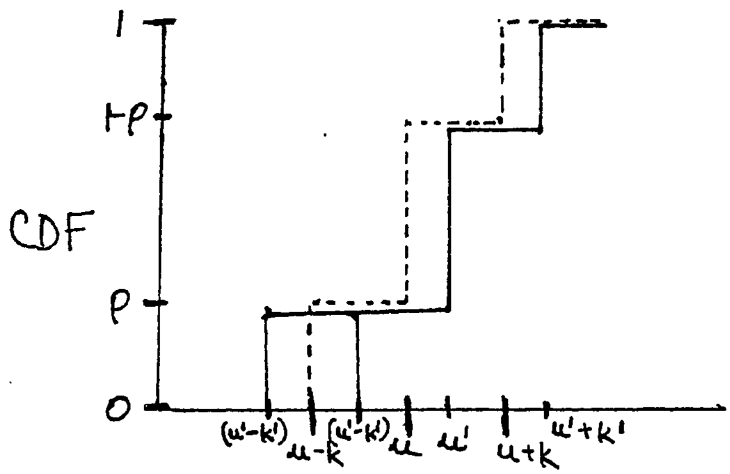

FIGURE 2.10
STOCHASTIC INDIFFERENCE OF
SYMMETRICALLY DISTRIBUTED PROSPECTS

CHAPTER II
FOOTNOTES

[62]Some analyses have chosen to integrate the schooling and training decisions into this overall process, treating the human capital assets as but another dimension of feasible investment alternatives. See D. Mayers, "Portfolio Theory, Job Choice, and the Equilibrium Structure of Expected Wages," Journal of Financial Economics, 1974, pp. 23-42.

[63]J. Tobin, "The Theory of Portfolio Selection," The Theory of Interest Rates, F. Hahn and F. Brechling, eds. (MacMillan, London: 1965), pp. 3-51, and H. Markowitz, Portfolio Selection: Efficient Diversification of Investments (Yale University Press, New Haven: 1959).

[64]A. Carol and S. Parry present an analysis based upon the expected value criterion alone. See "The Economic Rationale of Occupational Choice," Industrial and Labor Relations Review, January 1968, pp. 183-96.

[65]A. King, "Stochastic Dominance and 'The Economic Rationale of Occupational Choice,'" Industrial and Labor Relations Review, April 1973, pp. 996-1000.

[66]Utilizing our former notation, it is straightforward to demonstrate the link between risk aversion and King's approach. Assume

$$EU(V + Y)_A \geqslant EU(V + Y)_B$$

for choices A and B where $V = V_A = V_B$ and $E(Y_A) = E(Y_B)$. Then, under risk averse behavior,

$$U(V + E(Y_A) - \pi_A) \geqslant U(V + E(Y_B) - \pi_B)$$

and $\pi_A \leqslant \pi_B$ because marginal utility is assumed to be non-negative. These premiums are reflected in inequalities among career incomes which are measurable.

[67]See J. Hadar and W. Russell, "Rules for Ordering Uncertain Prospects," American Economic Review, March 1969, pp. 25-34 for proofs of statements relating to the various criteria discussed in the text.

[68]See ibid.

[69]Ibid.

[70]While also true for the more general criterion, the result is irrelevant in this instance, since intersecting curves are ruled out immediately.

[71] G. Hanoch and H. Levy, "The Efficiency Analysis of Choices Involving Risk, Review of Economic Studies, July 1969, pp. 335-45.

[72] King (op cit) offers just such an empirical framework.

[73] See S.C. Tsiang, "The Rationale of the Mean-Standard Deviation Analysis, Skewness Preference, and the Demand for Money," American Economic Review, June 1972, pp. 354-71 for a summary of much of this literature and a general critique of its approach.

[74] See ibid. Also see K. Borch, "A Note on Uncertainty and Indifference Curves," Review of Economic Studies, January 1969, pp. 1-4 and M. Feldstein, "Mean-Variance Analysis in the Theory of Liquidity Preference and Portfolio Selection," Review of Economic Studies, January 1969, pp. 5-12 for objections to this method.

[75] See Tsiang, Borch, and Feldstein, op cit.

[76] The discussion in this section summarizes G. Hanoch and H. Levy, "Efficient Portfolio Selection with Quadratic and Cubic Utility," Journal of Business, April 1970, pp. 181-89, which contain proofs for decision rules developed below.

[77] Hanoch and Levy, "Efficient Portfolio Selection with Quadratic and Cubic Utility."

[78] Much of the analysis in this section extends the effort of Hanoch and Levy, "The Efficiency Analysis of Choices under Risk."

[79] For an example, see Table 2.2.

[80] See J. Freund, Mathematical Statistics (Prentice-Hall, Englewood Cliffs, New Jersey: 1962), p. 146 for a derivation.

[81] See ibid.

[82] The procedure followed standardizes x values to create Z scores defined by

$$Z = \frac{X - \mu}{\sigma} \sim N(0,1)$$

A table is then utilized to determine the cumulative area under the curve at a particular Z.

[83] See Feldstein, op cit.

[84] Hanoch and Levy, "The Efficiency Analysis of Choices under Risk."

[85] The case where $u + k < u' + k'$ is not considered since then prospect 2 would be preferred by the most general criterion.

CHAPTER III

DESIGNING AN EMPIRICAL FRAMEWORK

3.1 INTRODUCTION

This study intends to capture empirically the effects of selected forces upon occupation choice, as reflected by recent U.S. labor force experience. With this goal in mind, this treatment identifies and incorporates a host of factors which contribute to the individual's decision process. Positing an objective function which maximizes expected utility and is appropriately concave, the thrust of the analysis will be to demonstrate that, other things being equal, career choice will be a positive function of monetary returns accruing to membership in the profession, and will be inversely related to job riskiness. There are many other important dimensions entering into the individual's calculus of job choice and their respective contributions to the selection process must be incorporated as well in order to correctly determine the direction and magnitude of the key elements in the analysis. Income maximization and risk averse behavior are thus to be viewed as two of several components which at any given moment influence the individual to either remain at the present job or "migrate" elsewhere.

3.2 FACTORS ENTERING THE CHOICE DECISION

Expressed algebraically, the choice function might be of the following form:

$$O_{ij} = f\left\{W_{ij},\ R_{ij},\ (W_{kj},\ R_{kj})\forall_{k\neq i},\ X_{ij}\right\}$$

where

O_{ij} represents the selection of occupation j by individual i

W = occupation-specific wage

R = occupation-specific measure of risk

X = relevant socioeconomic and demographic information (e.g., ability, stocks of human capital, age, sex, race, labor force participation status), some of which may be occupation-specific

Among the other factors to be included are past stocks of human capital and future investment opportunities (for which existing stock may act as a prerequisite) which may constrain the feasible set of job alternatives. In the context of a life-cycle model, any assessment of opportunities, performed iteratively, must include both the costs -- in terms of foregone income from specific training undergone at the present position as well as the potential for future investment, conditional on the current human capital stock -- and benefits -- discounted returns from training obtained in a new profession -- related to a switch. Also implicit in the analysis is the consideration that the absence of certain skill levels effectively inhibits entry into particular fields. In each period, then, expected-utility maximizers re-evaluate their current situation, subject to the quantity and type of previous self-investment, in determining whether to continue in their present career.

Nonpecuniary returns and psychic costs represent additional factors which may mitigate the impact of income maximization and risk averse behavior upon career choice. To the extent that these influences are reflected in compensating differentials among positions, they too must enter into the empirical analysis. Workers may willingly trade additional income for greater comfort or job amenities; such actions must be carefully monitored regardless of whether riskiness and job satisfaction are complementary with respect to their effects on earnings and job choice or tend to operate in opposite directions.

To a lesser degree, cultural forces, tradition, and regional differences each play a role in occupational choice and may also motivate an individual to plan a career within well-defined bounds, thereby limiting the wide band of opportunities which may be technically available to the worker. While such factors have been downplayed by economic researchers, it is clear that these causes cannot be totally discounted in any attempt to understand sex-related differences in occupational distributions, for example.

3.3 DEFINING A UNIT OF OBSERVATION

To accommodate these elements, the empirical framework must be designed to effectively control for their contemporaneous effects which may complicate analysis of the impact of earnings and risk and dilute the statistical results to be obtained. To successfully do so, however, requires that the choice of an appropriate unit of observation in this analysis be resolved initially. The relevant issues regarding this matter fall into two categories -- those items dealing with the definition of a career and those relating to the proper level of aggregation of the sample data. More explicitly, it is argued that (1) there exists a basis for viewing a modified census definition of an occupation as an adequate proxy for a career variable and (2) a valid approach to the measurement of the effects of risk and return upon career choice will involve working with occupational aggregates.

3.3.1 The Census Definition of "Occupation"

As discussed above, several human capital studies have focused upon the individual job as the proper empirical unit.[86] Notable among these efforts has been Bartel and Borjas' work determining the returns to job "switchers'" and "stayers'" human capital stock. They have recognized, though, the connection between job and occupation, reporting that three of four job changes are accompanied by an occupation switch, too.[87] [88] It seems legitimate then to argue that, in most instances, the occupation serves as an adequate proxy for the individual job, involving a somewhat higher degree of statistical "noise." The lack of another convenient scale by which to categorize the returns and riskiness of various positions also dictates that the occupation be adopted as our unit of measurement.

3.3.2 Mitigating Factors in the Empirical Analysis

Tracing movements across occupations requires that explicit accounting be taken of several forces which jointly impact upon career decisions. Previous self-investment, of course, appears to be the most important obstacle in determining how migration might otherwise occur in a vacuum. A number of other factors, though, are also of concern. Definitions of occupation often fail to take into account the natural process whereby one occupation serves as training or preparation for another. As part of the normal flow of events, individuals in occupation A, with the acquisition of a defined amount of labor force experience, will find themselves operating in occupation B. In an analysis of career choice, it would be appropriate, therefore, to treat such occupations as a single composite opportunity.[89] A further complication to direct observation of individual migration patterns is the difficulty encountered in formulating a number of career decisions empirically. Specifically, the decision to remain in or switch occupations must be framed as one dependent upon a series of variables, including the incomes and associated risk measures of the opportunities set. For individuals who choose to migrate, a multivariate approach would require that the relevant observed quantities for both occupations be included in the estimating equation. To ascribe a set of options for stayers, however, proves to be a nontrivial exercise. (It is infinitely more complicated in a model attempting to explain job migration.) In general, data containing historical labor force behavior will not record nonquantifiable information which might aid in identifying the correct choice. In the limited number of instances where such data might appear, the information is often thought to be a questionable utility because of the likelihood of response bias.

3.3.3 Testing with a Subsample of Initial Entrants

The approach outlined below is adopted as a consequence and serves as an attempt to address most of these concerns. What can be regarded as one segment of the marketplace is chosen as the basis for empirically verifying the income and risk hypotheses. The data sample to be analyzed is restricted to initial entrants to the labor force whose human capital stocks are most easily quantified. The danger of biasing the coefficients of the relevant variables is thereby eliminated.[90] I choose to also further limit the data base to white, male, nonfarm, full time members of the labor force to obtain a sample of entrants which is relatively homogenous with respect to a host of demographic criteria. In so doing, the probability of extraneous factors, many of which may have independent effects upon occupational choice, affecting the analytic results is minimized.[91]

There are implicit risks in focusing exclusively upon young labor force cohorts, too. While periodic job migration is a permanent feature of labor force tenure, such movement occurs with far greater frequency than can be readily accounted for during the initial stages of membership in the labor force.[92] A common explanation for such behavior relies upon the entrants' lack of information about available job opportunities.[93] Such "mistakes" may either assume the form of overqualification for an occupation or may occur as a mismatch of skills. In the former case, the individual's skills are underutilized, preventing him from maximizing income -- even though occupational income may be maximized -- while in the latter instance the more likely result is a low income profile or unemployment because of the limited contribution the worker can offer.

Another reason why younger cohorts may be expected to migrate more often has been noted previously. With time in the labor force, individuals acquire increasing amounts of specific training which tend to substantially raise the perceived costs of any move. The accumulation of specific capital over the initial period of attachment to the labor force may thus account for the rapid decline in inter-occupational migration with increased labor force experience. Finally, it is possible that younger individuals, who are generally viewed as facing less binding constraints on their overall behavior within the society, may possess a greater degree of risk preference and may, therefore, be more willing to "experiment" with different situations in their initial stages of labor force participation. Such an explanation, of course, lacks an economic motivation that can be readily controlled for in a statistical analysis; to the degree to which it acts as an important influence, it is likely that the residual or random component in the empirical work will be larger.

While recognizing all of the above concerns in the empirical application to this subpopulation of the labor force, the benefits of this approach (or costs associated with competing options) appear to outweigh the potential costs of generalizing the results to be obtained from this sample of entrants. It seems preferable to operate with constraints on the generality of results that will at least offer the opportunity to derive unbiased estimates of the effects of income and risk. Moreover, the distortions caused by the factors discussed above are unlikely to significantly affect the size and direction of the observed coefficients. They can be expected instead to result in greater measured statistical variation or "white noise."

Operating with such a restricted sample, however, will only partially resolve the difficulties of capital accumulation, job or occupation definitions, and wage and risk imputation mentioned above.

3.3.4 Aggregating by Occupation

Tracing entrants through their initial period of attachment to the labor force, for example, would again raise the issue of how to abstract from the effects of on-the-job training. Furthermore, the appropriate measure of shadow values for occupation stayers and the proper construction of careers from occupational definitions remain to be addressed. To remove these distorting effects requires that the problem be analyzed from an entirely different perspective. Instead of following individuals, I choose to study economic behavior from changes observed in occupation aggregates over time -- how these quantities may adjust on account of changing opportunities. In addition, a technique for determining and then combining related occupations is developed to overcome the definitional problems of migration. These adjustments taken together should allow an accurate, albeit incomplete, representation of the effects of risk on occupational choice.

By analyzing the changes in the distribution of entrants among potential occupations in the aggregate at two distinct points in time, two of the difficulties -- those related to human capital acquisitions and to the measurement of unobserved behavior (of stayers) -- are conveniently discarded. The potential biases caused by specific training are circumvented by limiting the empirical focus exclusively to new entrants in each time frame. The need to compute return and risk information is also obviated by no longer directing attention to specific individuals' behavior. Instead, each set of grouped observations will contain socioeconomic information about the population characteristics of new entrants in order to control for occupation-related differences.

3.3.5 Occupational Mergers: Theory

To account for the phenomenon of "natural" migration from one occupation to another with the accumulation of human capital, a method for recombining occupations is constructed and applied to the 1970 Census of Population. Unlike many earlier comprehensive population surveys, the 1970 census collected additional information that allows researchers to view stocks of labor force participants as they were distributed across occupations at two distinct points in time -- 1965 and 1970.[94] From these data it is possible to generate transition probabilities measuring movement beween occupations. To the degree to which such movement exceeds statistical expectations, it is argued that the relevant occupations be merged. Such unions may occur either when the observed migration is uni-directional, from A to B, or when the flows between occupations are relatively large.[95]

Of course, not all such transfers will be related to a natural career flow. Some movement may follow as a by-product of economic shocks experienced in the labor market (such as a war or inflation), or may be due to newly erected barriers to entry or to the effects of growth and technological change, all of which may alter individual choices from what they might otherwise have been. Individuals may depart from occupations that appear "crowded" and offer little opportunity for advancement and may, likewise, be induced to stay away from such occupations. It is implicitly assumed, though, that these effects have only a minor and neutral impact on the selection of a career.

Several techniques of varying degrees of sophistication are available to uncover career ladders from the census data. One procedure, for example, would manipulate earnings variation within and among occupations so as to construct distinct occupation classes whose mean values reflected statistically significant earnings differences. Another alternative might focus upon the attributes of the occupation members and attempt to minimize geometric "distances" between values of the occupation attributes.[96] The technique chosen in this study attempts to benefit from the 1970 Census information detailing each respondent's occupational status in 1965 and 1970. The structure of the method employed is rather elementary. Define f_{ij} to be the gross number of migrants from occupation i in 1965 to occupation j in 1970. A number of basic elements, then, which can be used to form a number of different frequency distributions, may be readily computed.[97] Four of these are reviewed below, although a considerably greater number may exist. Let

M^1 = migrants flowing from occupation i to occupation j as a proportion of migrants leaving occupation i, or

$$m^1_{ij} = \frac{f_{ij}}{\sum_{\substack{l \\ l \neq i}} f_{il}} \quad \forall i,j$$

M^2 = migrants flowing from i to j as a proportion of all members of i in 1965 who remain in the labor force through 1970, or

$$m^2_{ij} = \frac{f_{ij}}{\sum_{l} f_{il}} \quad \forall i,j$$

M^3 = migrants flowing from i to j as a proportion of all migrants entering j, or

$$m^3_{ij} = \frac{f_{ij}}{\sum_{\substack{l \\ l \neq j}} f_{lj}} \quad \forall i,j$$

M^4 = migrants flowing from i to j as a proportion of all members of j in 1970 who were members of the labor force in 1965, or

$$m^4_{ij} = \frac{f_{ij}}{\sum_{l} f_{lj}} \quad \forall i,j$$ [98]

All four formulations satisfy the basic properties of a probability distribution. Namely,

$$0 \leq m^k_{ij} \leq 1, \text{ and}$$

$$\sum_{i \text{ or } j} m^k_{ij} = 1 \quad \text{for } \forall_{i,j} \text{ and } k = 1, 2, 3, 4$$

M^1 and M^3 measure flows in relation to total migration at different points along the flows, while M^2 and M^4 also attempt to account for the magnitude of these flows relative to the base populations.[99]

Were we concerned with the general issue of transferability among occupations, only two probability distributions would be required to measure mobility. One such measure would be constructed to capture the job ladder concept -- unidirectional movement from one occupation to another. For this purpose, M^1 would be selected.[100] Another measure to be developed would observe gross flows between occupations which, if sufficiently great, might imply that such occupations may be indistinguishable in the marketplace. Let

M^5 = migrants flowing from occupation i to occupation j or from j to i, as a proportion of all members leaving either i or j, or

$$m^5_{ij} = \frac{(f_{ij} + f_{ji})}{(\sum\limits_{\substack{l \\ l \neq i}} f_{il} + \sum\limits_{\substack{l \\ l \neq j}} f_{jl})} \quad \forall_{i,j}$$

where

M^5 also satisfies the requirements of a probability distribution.

Since our interest is focused primarily on establishing career paths of occupational entrants, however, it is less critical that this latter measure be computed.

As a further precaution, though, against obtaining incorrect occupational mergers, a separate test is devised to screen out initially potential combinations where total flows constitute a minor fraction of the base populations -- something distributions M^2 and M^4 were improperly designed to achieve. Define M* to be the proportion of the total occupation population consisting of movers, or

$$m_i^* = \frac{\sum_{j \neq i} f_{ij}}{\sum_j f_{ij}}$$

Assuming that M* and M^1 are normally distributed,[101] the appropriate statistical test to perform will be a one-tail Z-test. Because M*, if applied at the standard levels of significance, will severely restrict the number of possible mergers,[102] a rather generous assumption is adopted that would permit the flows falling within the upper 20 percent of the distribution ($Z_{\alpha=.2} = +0.8416$) to be considered. Figure 3.1 presents this methodology graphically. If $\bar{m}$ is specified as the grand average proportion of movers in the 1965 population remaining in the labor force in 1970 and $s_{\bar{m}}$ as the relevant standard error, then

$$\bar{m} = \frac{\sum_i \text{movers leaving occupation } i}{\sum_i (\text{stayers and movers})} \quad \text{and}$$

$$s_{\bar{m}} = \frac{\bar{m}\ (1 - \bar{m})}{n}$$

where

$$n = \text{minimum sample size} = \min \{n_i\}$$ [103]

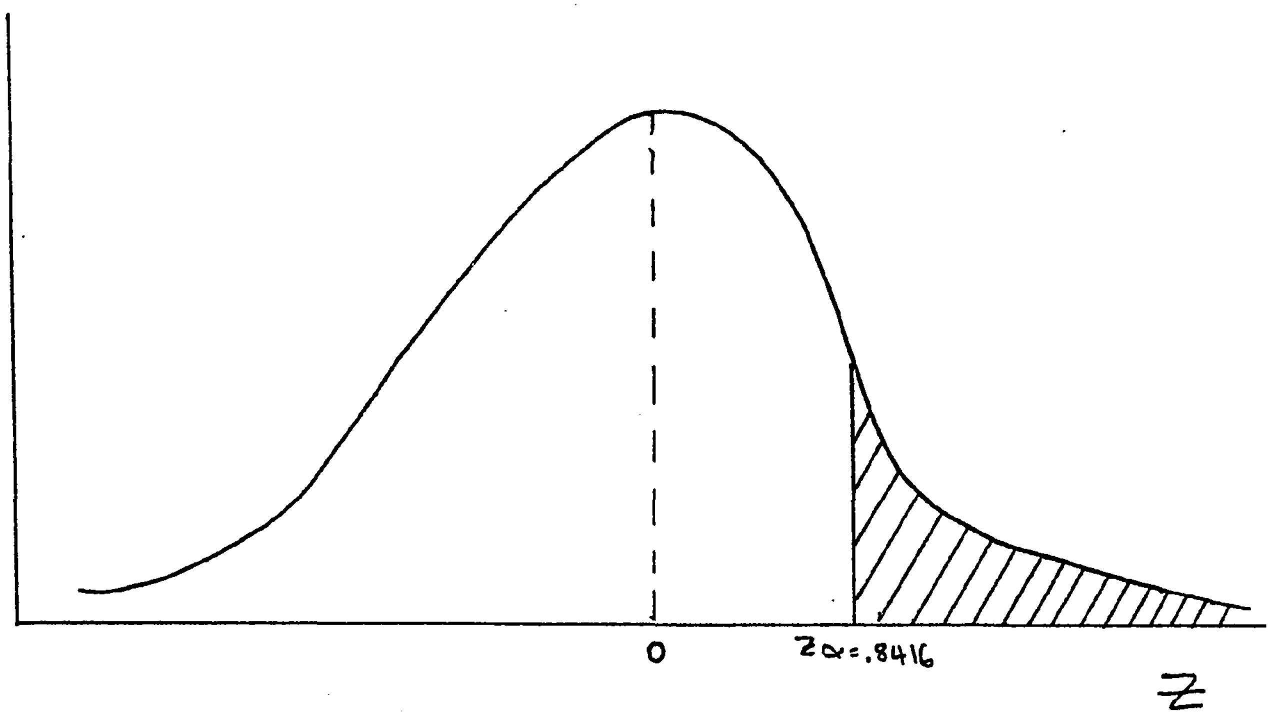

FIGURE 3.1
CONSTRAINING OCCUPATION MERGERS TO OCCUPATIONS WITH THE 20 PERCENT HIGHEST MIGRATION RATES

We accept those occupations for whom

$$\frac{m_i^* - \bar{m}}{s_{\bar{m}}} > Z_{\alpha=0.2} = 0.8416$$

3.3.6 Occupational Mergers: Empirical Implementation

The data to be applied consist of all males in the labor force in 1965 and 1970 who were engaged in nonfarm activity.[104] This proves to be a slightly larger universe than is intended by our area of focus, but it is assumed that measurement differences caused by the shift between these two populations are negligible.[105] Table 3.1 presents a list of 98 occupations from which mobility flows will be further analyzed.[106] The Z-scores associated with these choices are based upon a mean proportion of transfers of 0.3621 and a standard error of 0.0877.[107] For the most part, this group consists of occupations that do not require huge schooling investments. A large number of the individuals who migrated from these occupations were most probably employed in positions that may be classified as marginal. Employers in such occupations typically provide little in the way of on-the-job training, and may, therefore, anticipate higher turnover in their work force. In another group of occupations, though, including most notably those positions experiencing the highest migration rates -- apprenticeships, the training received in lieu of income can easily be shown to translate into higher paying trades and crafts occupations.

It may be difficult to distinguish between these two sets of workers and occupations, given the limited amount of information supplied about the migrants' socioeconomic characteristics. Such distinctions may be important because the primary purpose of this exercise is to join together the occupational links that form the second group's career ladders. It is expected, though, that the untrained workers will be unable to demonstrate a clear pattern of movement between occupations, and will thus fail to satisfy the second set of criteria imposed to establish the need for an occupational merger.

TABLE 3.1
OCCUPATIONS SATISFYING M* CRITERION

Occupation	Census Code	Migration Rate
DYERS	(620)	0.4376
TELEPHONE OPERATORS	(385)	0.4402
PACKERS, EXC MEAT	(643)	0.4418
ENG SCIENCE TECH,NEC	(162)	0.4444
ENGRAVERS	(435)	0.4444
ATHLETES AND KINDRED	(180)	0.4473
GRADERS AND SORTERS	(624)	0.4481
ADULT EDU TEACHERS	(141)	0.4525
BOATMEN,CANALMEN	(701)	0.4545
HOUSEKEEPER-EX PRIV	(950)	0.4553
SEWERS, STITCHERS	(663)	0.4576
ASSEMBLERS	(602)	0.4616
INDUSTY ENGNER TECHN	(154)	0.4626
CAR WASHER-EQIP CLEN	(764)	0.4641
STOCK CLERKS	(381)	0.4652
ANIMAL CARETAKERS	(740)	0.4664
WRITER,ARTIST,NEC	(194)	0.4684
COMPUTER SPECIAL,NEC	(005)	0.4685
RECREATION WORKERS	(101)	0.4688
RIVETER,FASTENER	(660)	0.4723
FILE CLERKS	(325)	0.4730
COMPUTER OPERATORS	(343)	0.4737
MISC CLERICAL WORKER	(394)	0.4782
ACTORS	(175)	0.4792
TYPISTS	(391)	0.4832
PARKING ATTENDANTS	(711)	0.4880
BILLING CLERKS	(303)	0.4896
MISC OPERATIVES	(694)	0.4901
CHILD CARE-EX PRIV	(942)	0.4924
LUMERMEN,RAFTSMEN	(761)	0.4935
MINE OPERATIVES	(640)	0.4942
SPINNER,TWISTER OPR	(672)	0.4957
RECEPTIONISTS	(364)	0.4976
KEY-PUNCH OPERATORS	(345)	0.5000
OFFICE MACH OPER,NEC	(355)	0.5000
BOARDING	(940)	0.5000
UNSPEC MACHINE OPR	(692)	0.5002
KNITTERS,LOOPER OPR	(671)	0.5030
TECHNICIANS,NEC	(173)	0.5044
HEALTH AIDES-EX NURS	(922)	0.5069
TEXTILE OPER,NEC	(674)	0.5103
RELIGIOUS WORK,NEC	(090)	0.5142
MAIL HANDLERS	(332)	0.5156
SAILOR, DECKHAND	(661)	0.5199
FURRIERS	(444)	0.5222
MESSENGERS	(333)	0.5244
TOOL PROGRAMMERS	(172)	0.5283
EMBALMERS	(165)	0.5308
UNSPEC RESEARCH WRK	(195)	0.5312
HUCKSTER AND PEDDLER	(264)	0.5313
SHOEMAKING MACH OPR	(664)	0.5333
COUNTER CLERKS	(314)	0.5379
ATTENDNT,RECREATION	(932)	0.5486
MILLERS,GRAIN,FLOUR	(501)	0.5535
PRODUCE GRADER,PACKR	(625)	0.5639
CONSTRUCTION LABORER	(751)	0.5660
MEAT WRAPPERS,RETAIL	(634)	0.5667
INTERVIEWERS	(320)	0.5699
NEWSBOYS	(266)	0.5709
COLLECTORS	(313)	0.5770
CHAINMEN,RODMEN,AXMN	(605)	0.5789
CARPENTERS' HELPERS	(750)	0.5806
CASHIERS	(310)	0.5859
WAREHOUSEMEN	(770)	0.5884
ELEMENTARY TEACHERS	(142)	0.5966
BILL-MACH OPERATORS	(341)	0.6063
TELEGRAPH MESSENGERS	(383)	0.6122
FOOD COUNTER,FOUNTAN	(914)	0.6291
TEAMSTERS	(763)	0.6330
BANK TELLERS	(301)	0.6360
DISHWASHERS	(913)	0.6402
FOOD SERVICE-EX PRIV	(916)	0.6403
UNSPEC TEACHER-UNIV	(140)	0.6420
MECHANICS-UNSPECIFID	(495)	0.6567
LIBRARY ATTENDANTS	(330)	0.6640
GARAGE WORKERS	(623)	0.6650
STOCKHANDLERS	(762)	0.6716
UNSPEC LABORERS	(785)	0.6872
WELFARE SERVICE AID	(954)	0.6981
CHAMBERMAID-EXC PRVT	(901)	0.7184
UNSPEC OPERATIVES	(695)	0.7197
UNSPEC CLERICAL WRK	(395)	0.7322
BRICKMASONS APPRENTS	(411)	0.7531
TEACHER AIDES	(382)	0.7684
PRESSMEN-APPRENTICES	(531)	0.7778
BUSBOYS	(911)	0.7836
ELECTRICIANS APPRENT	(431)	0.7914
TAB-MACH OPERATORS	(350)	0.7958
USHERS,AMUSEMENT	(953)	0.8065
PLUMBER-APPRENTICES	(523)	0.8105
SHEETMETAL,APPRENTIS	(536)	0.8246
SPEC CRAFT-APPRENTIS	(571)	0.8291
PRINTING APPRENTICES	(423)	0.8318
MECHANICS-APPRENTICS	(491)	0.8421
TOOL,DIE-APPRENTICES	(562)	0.8561
CARPENTERS APPRENTI	(416)	0.8710
MACHINIST-APPRENTICS	(462)	0.8761
UNSPEC-APPRENTICES	(572)	0.9500

In the construction of M^1, only the flows from these 98 sources are considered. These occupations may be combined, though, with any of the nearly 300 remaining. In these instances, the null hypothesis about distribution M^1 is expressed in terms of raw numbers of transfers. Let

$$\bar{f}_i^1 = \frac{\sum_j \text{movers leaving occupation } i}{n_i} = \frac{\sum_{j \neq i} f_{ij}}{n_i}$$

$$S^1_{\bar{f}_i} = \frac{\sum_j (\text{movers})^2}{n_i} - (\bar{f}_i^1)^2 = \frac{\sum_{j \neq i} (f_{ij})^2}{n_i} - (\bar{f}_i^1)^2$$

where

n_i = the number of possible destination occupations, i.e., destination occupations with nonzero entries

Then if

$$\frac{f_{ij} - \bar{f}_i^1}{S^1_{\bar{f}_i}} > Z_{\alpha=0.01} = 2.33$$

a merger will occur.

Implementing this test, however, fails to distinguish between preferred and "randomly chosen" destinations, probably because the distributions being considered only approach normality in the limit.[108] This criterion must, therefore, be augmented by a set of additional constraints that permit mergers to occur only between one source and one destination.[109] These additional criteria used to select a destination occupation include:

a. a sample size restriction -- limiting mergers to occupations receiving 16 or more transfers from the source occupation;

b. a "specificity" rule -- census-defined occupations that represent combinations of occupations are deleted (these are identified by modifiers like "miscellaneous," "not elsewhere classified," "allocated," etc.); and

c. a "career path" requirement -- the median age of workers in the destination must exceed that in the source.[110] This ensures that in the subsequent analysis of entrants' labor force behavior the empirical content of careers corresponds to the information entrants are likely to utilize in determining their choices.

Even with these restrictions, 34 of the original 98 source occupations are deleted because two or more occupations qualify as destinations. Of the remaining 64 occupations, 38 do not have any destinations that satisfy the above criteria.[111] Table 3.2 contains the 26 mergers that result under the above criteria. Although only nine of these are explicitly defined as apprenticeships, the bulk of these mergers contain similar relationships signifying career growth. The socioeconomic characteristics of these mergers supersede the original occupational data in the subsequent analysis of labor force entrants' choice of careers.

TABLE 3.2
OCCUPATION MERGERS BASED ON 1970 CENSUS DATA

Occupation	Census Code	Merged Occupation	Census Code
RELIGIOUS WORK,NEC	(090)	CLERGYMEN	(086)
RECREATION WORKERS	(101)	SECONDARY TEACHERS	(144)
INDUSTY ENGNER TECHN	(154)	ENGNER-INDUSTRIAL	(013)
EMBALMERS	(165)	FUNERAL DIRECTORS	(211)
ATHLETES AND KINDRED	(180)	SALE-CLK,RETAIL	(283)
COUNTER CLERKS	(314)	SALE-REP,WHOLESALE	(282)
KEY-PUNCH OPERATORS	(345)	COMPUTER PROGRAMMERS	(003)
BRICKMASONS APPRENTS	(411)	BRICKMASONS	(410)
CARPENTERS APPRENTI	(416)	CARPENTERS	(415)
PRINTING APPRENTICES	(423)	COMPOSITORS,TYPESETR	(422)
ELECTRICIANS APPRENT	(431)	ELECTRICIANS	(430)
ENGRAVERS	(435)	EXCAVATING MACH OPR	(436)
MACHINIST-APPRENTICS	(462)	MACHINISTS	(461)
MILLERS,GRAIN,FLOUR	(501)	MILLWRIGHTS	(502)
PLUMBER-APPRENTICES	(523)	PLUMBER,PIPE FITTERS	(522)
PRESSMEN-APPRENTICES	(531)	PRESSMEN,PLATE PRINT	(530)
SHEETMETAL,APPRENTIS	(536)	SHEETMETAL,TINSMITHS	(535)
TOOL,DIE-APPRENTICES	(562)	TOOL & DIE MAKERS	(561)
SAILOR, DECKHAND	(661)	OFFICER,PILOT-SHIP	(221)
SEWERS, STITCHERS	(663)	TAILORS	(551)
KNITTERS,LOOPER OPR	(671)	MECHANICS-HEAVY EQIP	(481)
TEAMSTERS	(763)	TRUCK DRIVERS	(715)
CHAMBERMAID-EXC PRVT	(901)	CLEANER & CHARWOMEN	(902)
FOOD COUNTER,FOUNTAN	(914)	MANAGER-RESTAURANT	(230)
ATTENDNT,RECREATION	(932)	JANITORS & SEXTONS	(903)
HOUSEKEEPER-EX PRIV	(950)	MANAGER-RESTAURANT	(230)

CHAPTER III
FOOTNOTES

[86]See Section 1.2.1.

[87]See especially A. Bartel, "Job Mobility and Earnings Growth," NBER Working Paper #117, November 1975.

[88]The remainder of the job moves most likely entail an enduring change within the occupation. It is arguable whether such shifts represent career changes. In a simple test for variation by industry in the mean occupation earnings of all employed males during 1969 (excluding those classified as farmers), the hypothesis that such income streams may differ is barely significant at 95 percent level. Were the effects of race and the extent of labor force participation included, the variation accounted for by industry would most likely then be statistically insignificant.

[89]There may also be instances in which the opposite conclusion may be drawn. Namely, an occupation can provide a number of distinct opportunities which differ in terms of training and earnings. This study will not be concerned with such possibilities.

[90]Human capital elements not accounted for in the empirical work which tended to impede movement across occupations would be reflected in over- (under-) estimates of the effects of risk and earnings, depending upon whether these variables were positively or negatively correlated. See J. Kmenta, <u>Elements of Econometrics</u> (MacMillan, New York: 1971), pp. 392-95.

[91]The main source of concern is that, for a number of factors, the quantifying of their influences may not be possible and their empirical effects not easily determined. Assuming that such forces are correlated to some degree with other measures excluded from the study, the likelihood that the risk and income coefficients may be distorted is reduced.

[92]As computed from 1970 sample data, well over half of all recorded switches occur below the age of 40. In terms of labor force experience, migration probabilities decline by more than half over the course of a lifetime, as shown in the following table.

Labor Force Experience in 1970 (by age)	Percent of Cohort That Switched Occupations During Previous Five Years
1-8	59
9-16	43
17-24	34
25-32	30
33+	27

SOURCE: 1970 Census of Population

[93]See, e.g., A. Schwartz, "Interpreting the Effect of Distance on Migration," Journal of Political Economy, September 1973, pp. 1153-69. Schwartz's measure is one of physical distance, although his argument may be readily applied to occupational migration as well.

[94]For a description of the data elements appearing in the 1970 census and a copy of the detailed questionnaire used in the survey, see U.S. Bureau of the Census, Public Use Samples of Basic Records from the 1970 Census: Description and Technical Documentation (Washington, D.C.: 1972).

[95]Differing age distributions among occupations would also be indicative of the acquisition of minimum levels of human capital by movers.

[96]The statistical approach required to properly analyze such data is known as cluster analysis. For a description of its proper use, see M. Anderberg, Cluster Analysis for Applications (Academic Press, New York: 1973).

[97]Much of this analysis is derived from some earlier work performed by L. Schroeder. See "An Information-Theoretic Analysis of Occupational Mobility Paths," Quarterly Review of Economics and Business, Winter 1975, pp. 15-24.

[98]Another possible set of distributions, where

$$M_{ij} = \frac{f_{ij}}{\sum_i \sum_j f_{ij}} ,$$

is rejected because the null hypothesis in this instance implicitly assumes that occupational mobility is essentially a constant phenomenon across all occupations. That is to say, f_{ij} should not significantly differ from f_{ji} or f_{kl}.

[99] M^2 and M^4 actually include only those individuals who remain in the labor force between 1965 and 1970 -- stayers. Those who left the labor force -- retirees, deaths, some secondary workers -- would be excluded.

[100] Since M^1 and M^3 measure similar flows, one about the point of source and the other around the destination of movers, it is felt that the calculation of both would prove to be redundant. M^2 and M^4 are not chosen either, because it remains unclear how one might incorporate information that includes stayers in developing null hypotheses about movers (see below).

[101] Each distribution consists of elements representing net outcomes obtained under either binomial or multinomial experiments (the decision to migrate or to remain; the choice among occupations A, B, or C, etc., conditional on the decision to migrate). The mean outcomes or proportions of these distributions, though, are distributed approximately normally.

[102] Since there are slightly more than 400 occupations, a 5 percent criterion, it is assumed, would allow about 20 combinations and a 10 percent rejection level, about twice that number.

[103] Since sample size will vary by occupation, information is "thrown away" by redefining n in this fashion. Of the 424 census occupations, 29 fail to meet this criterion. Only 422 sample individuals, though, are lost by this technique.

[104] I am grateful to Dixie Sommers at the Bureau of Labor Statistics, U.S. Department of Labor, for granting me access to these data which are derived from the 1970 Census Public Use Samples. For a further description of the file, see D. Sommers and A. Eck, "Occupational Mobility in the American Labor Force," Monthly Labor Review, January 1977, pp. 3-26.

[105] Other measurement problems cannot be adjusted for, however. Because the data review only two discrete points in time, our migration estimates will tend to be downward biased. Individuals, for example, who migrated more than once during this period will be weighted equally with those who moved only one time. Since our concern is primarily with the type of mergers to be performed and is less directly related to the magnitude of the migration probabilities, the estimation errors are regarded as minor in nature.

[106] Note that categories designated "allocated" in the Census are not included in these computations.

[107] The figure 0.3621 represents a five-year cumulative rate. Assuming a steady migration rate between 1965 and 1970, this

figure may be translated into an annual rate of about 8.6 percent. The annual cutoff point would then be approximately 10.8 percent. Again, it should be recalled that these numbers fail to take into account intermediate transfers between 1965 and 1970, and assume the absence of entry or exit from the labor force during this period.

[108]The distribution of migrants may alternatively be defined as consisting of a large number of zero entries -- those occupations to which none of the migrants transfer, a lesser number of occupations to which a few persons migrate, and an even smaller group to which large numbers of individuals transfer. This distribution of migrants would tend to resemble an exponential probability distribution.

[109]While it is certainly possible for the group of migrants from a given occupation to select more than one destination, such a possibility is ruled out because of empirical difficulties in implementation.

[110]This information appears in U.S. Bureau of the Census, 1970 Census of Population, Subject Report: Occupational Characteristics PC(2-7), Table 1.

[111]The rules from which these results obtain are, of course, arbitrary. There appears to be a tradeoff, however, between the specification of sample size and the establishment of unique distinations. For example, were the acceptable sample size dropped to 10, the number of sources with multiple destinations would climb to 45 and thus result in precisely the same number of mergers -- 26. These 26 mergers, though, would differ slightly from those appearing in Table 3.2.

CHAPTER IV

EMPIRICAL TESTS OF THE IMPACT OF RISK ON CAREER CHOICE

4.1 CRITERIA IN THE SELECTION OF A DATA BASE

Examining shifts in exogenous variables that may influence entrants' decisions as to their choice of occupation, and concurrent changes in the occupational structure is possible using a wide variety of data sources. There are two important factors, tending to counteract each other, which influence the choice among these data sets. On the one hand, the longer the time elapsed between the two points of measurement, the greater the probable amount of variation among the aggregated occupation variables. Offsetting this desirable effect, however, is the greater likelihood that the surveys might contain noncomparable information, as even occurs in the 1970 Census data (see below). An additional concern is that the sample population be fairly extensive in its coverage since the focus is upon occupation entrants who, depending on the definition, may form between 1 and 10 percent of the population. Since it is necessary to stratify these entrants among a very large number of occupations, the number of entrants initially selected must be great enough to provide statistically reliable results.

4.1.1 Construction of the Data from the 1960 Census and 1967 SEO

While the 1970 Census has been relied on for much of the earlier analysis, determining an entrant's sensitivity to "riskiness" from its data is severely limited by the lack of detail contained in its 1965 data about income and labor force status, and about other socio-demographic information. Thus it would be difficult to explain income growth and variation over the five-year period since most of the variables that might account for changes in the occupations' characteristics and in the selection of occupations are unmeasured. Conceivably, such information could be imputed for occupations as a whole by inserting existing aggregates from other population survey data for 1965. Unfortunately, a change in occupation definitions implemented by the Census Bureau in 1970 and first reflected in the 1970 Census precludes the adoption of such a procedure.[112] To minimize the measurement error resulting from variable definitions, it is preferable to operate with data sets that employ similar definitions of occupations over the course of the survey period.

This concern about statistical variability attributable solely to definition changes, and the ready availability of only a limited number of data sources led to the choice of the 1960 1/1000 Census of Population and the 1967 Survey of Economic Opportunity (SEO) as the pair of data sets to be employed for this study.[113] Sponsored by the Office of Economic Opportunity, the SEO was designed to gather detailed information about work histories, incomes by source, and assets of the general population with a special emphasis on data collection relating to nonwhites. SEO surveys were conducted during 1966 and 1967, although only the 1967 data were available for the analysis. To properly analyze changes in occupations that may have occurred between 1960 and 1967, only one part of the SEO -- the self-weighting portion comprising roughly 60 percent of the total sample -- was used. A subsample that oversampled nonwhites was dropped. The remaining portion of the SEO prior to screening amounted to 18,000 households, or 74,835 observations -- about 40 percent the size of the 1960 1/1000 Census (179,567 observations), or half the size of the annual Current Population Survey (CPS) at the time. In most respects, this subsample also conformed in its design and definitions to the 1960 Census (as well as to the CPS), thus simplifying the task of analyzing occupation changes.

The human capital literature abounds with references to the different economic forces that motivate various demographic groups within the general population (e.g., black-white and male-famale differences). A proper test of any hypothesis, though, requires some degree of homogeneity among the data being analyzed to limit the possibility that extraneous forces dominate the results. For this reason, both the Census and SEO samples were further screened in order to exclude females, nonwhites, nonmembers of the civilian labor force, the self- employed, rural area inhabitants, and those below 17 and above 64 years of age.[114] These criteria reduced the sizes of the two data sets being employed considerably, so that only 19,606 observations remained from the Census (11 percent of the original sample) and 6,228 in 1967 (8 percent).[115]

The remaining data were then stratified by occupation and aggregated to form observations composed of occupational averages for a set of variables. Where possible, use was made of the information assembled earlier on career paths in Chapter III; because of noncomparability with the 1970 Census definitions, however, only 18 of the 26 mergers shown in Table 3.2 could be performed on the remaining 1960 Census and SEO data. These are displayed in Table 4.1, the figures in parentheses referring to the codes used in the 1960 and 1967 surveys. Thus, of the 296 occupations appearing in both the 1960 Census and the SEO, 278 remained following mergers, of which only 247 contained any observations in the screened 1967 data set. When an additional criterion for being considered in the analysis of imposing a minimum of 10 observations per occupation was added,[116] the number of occupations was further reduced to 106. These occupations comprised 91 percent of the observations in the screened SEO, however, and 90 percent of the screened 1960 Census.

4.2 KEY FACTORS AFFECTING THE CHOICE OF AN OCCUPATION

The Rate of Return

As alluded to in Chapters II and III, certain variables are assumed critical to an individual's implicit occupational choice function.[117] In particular, it has been argued that the earnings streams of different career paths and the variability associated with them, their risks, capture the essence of the selection process. According to the analysis concluding Chapter II, it is assumed that risk can be mathemati-

TABLE 4.1
OCCUPATION MERGERS BASED ON 1960-1967 DATA

Occupation	Census Code	Merged Occupation	Census Code
Religious Work, NEC	(170)	Clergymen	(023)
Recreation Workers	(165)	Secondary Teachers	(183)
Athletes and Kindred	(015)	Sale-Clk, Retail	(394)
Brickmasons Apprents	(602)	Brickmasons	(405)
Carpenters Apprentice	(603)	Carpenters	(411)
Printing Apprentices	(615)	Compositors, Typesetr	(414)
Electricians Apprent	(604)	Electricians	(421)
Engravers	(424)	Excavating Mach Opr	(425)
Machinist-Apprentices	(605)	Machinists	(465)
Millers, Grain, Flour	(490)	Millwrights	(491)
Plumber-Apprentices	(612)	Plumber, Pipe Fitters	(510)
Tool, Die-Apprentices	(614)	Tool & Die Makers	(530)
Sailor, Deckhand	(703)	Officer, Pilot-Ship	(265)
Sewers, Stitchers	(705)	Tailors	(524)
Knitters, Looper Opr	(673)	Mechanics-Heavy Equip	(480)
Teamsters	(971)	Truck Drivers	(715)
Chambermaid-Exc Prvt	(823)	Cleaner & Charwomen	(824)
Attendant, Recreation	(813)	Janitors & Sextons	(834)

cally expressed as the variance or standard deviation of the earnings variable.[118]

Mathematically, the earnings variable itself can be expressed as a stream

$$\ldots \frac{Y_t}{(1+d)^t}, \frac{Y_{t+1}}{(1+d)^{t+1}} \ldots \frac{Y_T}{(1+d)^T}$$

where

Y_i = earnings earned in working life year i, i=1,...t,...T

d = a rate of discount[119]

and can be implemented empirically according to a number of alternative specifications including: (1) the discounted value of the career path; (2) the mean earnings of new entrants; and (3) the mean earnings of prime age members of an occupation. Although the first of these measures may be preferable from a theoretical standpoint, empirical implementation is difficult for several reasons. First, data on career path incomes is relatively scarce and would not appear in cross-sectional data sets such as the Census, although time-series income data generally might be reasonably approximated from the cross-section.[120] In addition, to compare occupations according to mean-variance criteria would require that income streams be discounted at some appropriate rate. Since the present discounted values of various occupations are sensitive to the rate used, it is likely that results about preferences will differ depending on the size of the discount rate.

Employing the earnings of new entrants alone as an alternative specification is insufficient since, according to human capital theory, initial wage differentials are more likely to be the result of different investment patterns in on-the-job training. When taken together with the income measure for prime age workers mentioned above, though, the statistical significance of entrants' earnings, if present, may serve as an indication of the discount rates entrants implicitly use in selecting among occupations.

The third proposed income measure, earnings of prime age males, is the specification believed to best represent the "return" concept of a career. To the degree that working life prior to the overtaking age forms only a small portion of total working life, and earnings peak during prime age, the relative ranking of occupation income streams by comparing prime age earnings may serve as a reasonable proxy.

The Riskiness

Ideally, to guage an occupation's riskiness, one could make reference to the stochastic dominance concept covered in Chapter II. Using any of the measures discussed earlier, a preference ordering could be established for the entire set of careers.[121] Such a ranking, however, would not resolve the empirical issue of risk's effect on career selection. (One could make inferences from a particular ordering, though, about risk's relative impact.) To answer this question requires that summary statistics of risk be explicitly incorporated into a multivariate analysis. Two alternative sets of risk measures are proposed, both of which employ the change over time in the standard deviation of the income variable (see Table 4.2). The first group focuses on the earnings variation faced by the two types of prime age populations defined below. A second set of measures is intended to capture the risk individuals are immediately confronted with upon entry into the labor force.[122]

The latter set, corresponding to the entrant definitions below, presents a number of statistical difficulties, however, because a sizable portion of the occupations in the 1967 sample contain too few observations of new workers to form reliable measures of risk. Generating replacement values for the missing data was not attempted.

4.2.1 Defining Entrants and Prime Age Workers

Because neither the Census nor SEO contains information that specifically identifies new members of the labor force, a procedure commonly found in human capital literature developed by Hanoch to approximate years of labor force experience is used to designate entrants.[123] Technically, to qualify as an entrant, an individual should have labor force tenure of less than one year. Various restrictions on the sample discussed above, however, would severely limit the number of workers identified as entrants according to this definition. Therefore, two alternative specifications are also proposed which relax the above definition to include all workers with less than three years and less than five years labor force experience, respectively. The latter two definitions may also be more appropriate if individuals do not immediately begin lifetime careers upon entry into the labor force.

Prime age in human capital literature has normally referred to the peak earnings period in the life cycle, corresponding to the 35-44 age bracket for males. Again because of previous restrictions placed on the sample, one alternative specification is proposed for prime age -- ages 30-50 -- in order to expand the number of prime age observations per occupation used to form occupation means.

Table 4.2 highlights some of the critical differences among the measures used to define entrants and prime age workers, and in the two key independent variables. Six alternative specifications of the dependent variable were initally constructed, although only three appear in the first panel. The three measures which are shown (PCT_CHANGE1, PCT_CHANGE2, PCT_CHANGE3) adjust for secular growth in the labor force that occurred between 1960 and 1967 by examining the change in the fraction of entrants who selected a particular occupation.[124] During this period, rapid economic growth generated new job opportunities and the initial cohort of the post-war baby boom greatly expanded the potential stock of new job holders. Three companion measures (ENT_CHANGE1, ENT_CHANGE2, ENT_CHANGE3) which correspond to what might be best termed first differences in numbers of entrants by occupation as reflected in the Census and SEO data were discarded because the smaller SEO sample size caused most differences to be negative (contrary to actual experience).

Most of the table entries in the second panel contain two sets of earnings figures -- one unadjusted for missing data and the other including adjustments for missing information. The constraints placed on the 1967 sample necessitate the development of an algorithm to replace missing values. For missing data for the most narrow definition of a specific variable, the value obtained from the next less narrow definition is substituted. If the two most narrow entrant earnings are missing, the measure for the broadest entry definition replaces both missing values. If all three values are absent for a particular occupation, i.e., the number of entrants in

TABLE 4.2
ALTERNATIVE MEASURES OF CHANGES IN THE OCCUPATIONAL DISTRIBUTION OF ENTRANTS AND OF CHANGES IN MEASURES OF RETURN AND RISK

PANEL A -- DEPENDENT VARIABLES[a]

Variable Name	Description	Mean	Standard Deviation
PCT_CHANGE1	Change between 1960 and 1967 in entrants with less than one year experience into occupation, as a percent of all entrants	0.0[b]	.006
PCT_CHANGE2	Change between 1960 and 1967 in entrants with less than three years experience into occupation, as a percent of all entrants	0.0[b]	.004
PCT_CHANGE3	Change between 1960 and 1967 in entrants with less than five years experience into occupation, as a percent of all entrants	0.0[b]	.004

[a]N=106 unless otherwise specified.

[b]PCT_CHANGE1, PCT_CHANGE2, PCT_CHANGE4 must have mean values of 0.0 by definition, since

$$P_{ji} = \frac{E_{ji_{67}}}{\sum_i E_{ji_{67}}} - \frac{E_{ji_{60}}}{\sum_i E_{ji_{60}}} \qquad i=1,106 \qquad j=1,3$$

where P = PCT_CHANGE

and E_{ji} = change in number of entrants with less than $\forall j=1\ldots1$, $\forall j=2\ldots3$, $\forall j=3\ldots5$ years experience into occupation i between 1960 and 1967 (i.e., 1967#-1960#)

and $$\sum_i P_{ji} = \frac{\sum_i E_{ji_{67}}}{\sum_i E_{ji_{67}}} - \frac{\sum_i E_{ji_{60}}}{\sum_i E_{ji_{60}}} = 1 - 1 = 0$$

TABLE 4.2 (continued)

PANEL B -- KEY INDEPENDENT VARIABLES

Definition	Variable Name	Mean of Changes in Average Occupation Earnings 1960-1967 (1967 constant dollars)	Coefficient of Variation	Variable Name	Mean of Changes in Standard Deviation of Occupation Earnings 1960-1967 (1967 constant dollars)
Earnings of entrants with less than one year labor force experience	M_ENT_WAGE1	805.70 (N=71) 1039.45	2.17 2.05	S_ENT_WAGE1	68.40 (N=50)
Earnings of entrants with less than three years labor force experience	M_ENT_WAGE2	1045.71 (N=84) 1070.22	1.58 1.84	S_ENT_WAGE2	89.69 (N=59)
Earnings of entrants with less than five years labor force experience	M_ENT_WAGE3	1039.57 (N=93) 968.69	1.46 1.72	S_ENT_WAGE3	13.86 (N=77)
Earnings of prime age workers between ages 35-44	M_PRIME_Y1	1252.73 (N=104) 1252.91	1.95 1.93	S_PRIME_Y1	279.31 (N=97) 225.00
Earnings of prime age workers between ages 30-50	M_PRIME_Y2	1150.22	1.64	S_PRIME_Y2	150.26 (N=105) 157.22
Earnings of all members of occupation	M_WAGES	1149.70	1.08	S_WAGES	170.36

either 1960 or 1967 equals zero, measures of the mean values (across all occupations) for each definition of entrant are substituted in order to preserve population grand means.[125]

Tests of significance indicate that, although the values obtained from the replacement algorithm at times appear to differ substantially from the unadjusted means, these differences are statistically insignificant. The two alternative sets of data are therefore used interchangeably in the subsequent regression analyses.

All income figures have also been adjusted so as to be measured in a constant dollar framework. This is done by increasing 1960 income data by a factor of 1.145, the cumulative rate of increase in the CPI during the period.[126]

Table 4.3 examines the degree of similarity between the alternative measures proposed in Table 4.2 by analyzing simple coefficients of correlation. The lower portion of the Panel A matrix displays the relationships between the three proportional dependent variables. The data indicate that, while not perfectly substitutable for one another, the proportional measures are significantly correlated; even the smallest correlation is statistically different from 0.[127] The results suggest that regression results might vary substantially depending on the dependent variable which is selected.

Panels B and C of Table 4.3 display relationships between the various measures of return and of risk, respectively. Again, as expected, the results demonstrate that alternative definitions of entrant-specific return (upper portion of

TABLE 4.3
CORRELATIONS BETWEEN ALTERNATIVE DEFINITIONS OF
THE DEPENDENT VARIABLE AND TWO KEY INDEPENDENT VARIABLES

PANEL A -- DEPENDENT VARIABLES

	PCT_CHANGE1	PCT_CHANGE2	PCT_CHANGE3
PCT_CHANGE1	1.00		
PCT_CHANGE2	.84	1.00	
PCT_CHANGE3	.58	.83	1.00

PANEL B -- MEASURES OF RETURN

	M_ENT_WAGE1	M_ENT_WAGE2	M_ENT_WAGE3	
M_PRIME_Y1	.10	.92	.82	M_ENT_WAGE1
M_PRIME_Y2	.94	.14	.85	M_ENT_WAGE2
M_WAGES	.79	.84	.27	M_ENT_WAGE3
	M_PRIME_Y1	M_PRIME_Y2	M_WAGES	

PANEL C -- MEASURES OF RISK

	S_ENT_WAGE1	S_ENT_WAGE2	S_ENT_WAGE3	
S_PRIME_Y1	.22	.77	.58	S_ENT_WAGE1
S_PRIME_Y2	.95	.06	.73	S_ENT_WAGE2
S_WAGES	.73	.78	.18	S_ENT_WAGE3
	S_PRIME_Y1	S_PRIME_Y2	S_WAGES	

Panel B) and risk (upper portion of C) measures correlate highly with each other as do broader occupational indicators of return (lower portion of Panel B) and risk (lower portion of C). Of particular interest, though, are the fairly weak relationships appearing along the diagonals of Panels B and C, suggestive of the different influences affecting new entrants and seasoned workers. Unless individuals are myopic, however, the latter group's economic position should dominate the choice among careers.

How significantly related are the measures of risk and return just considered? Table 4.4 displays key correlations between these two sets. Of particular interest are the high positive coefficients -- contrary to what has been hypothesized -- relating experienced workers' return and respective risk (measured along the diagonal). These results are discussed further below.

TABLE 4.4
CORRELATIONS BETWEEN THE TWO KEY INDEPENDENT VARIABLES--
MONETARY RETURN AND RISK

	S_ENT_WAGE1	S_ENT_WAGE2	S_ENT_WAGE3	S_PRIME_Y1	S_PRIME_Y2	S_PRIME_Y3
M_ENT_WAGE1	.10			-.03	.04	-.01
M_ENT_WAGE2		.14		-0.1	.02	-.01
M_ENT_WAGE3			.00	.01	.05	-.01
M_PRIME_Y1	-.04	-.15	.10	.62		
M_PRIME_Y2	-.03	-.10	.07		.59	
M_PRIME_Y3	.03	-.09	.18			.51

Somewhat less surprising are the coefficients (also measured along the diagonal) relating entrants' return and risk. Their lack of significance may serve as an indication of more complex relationships which can only be explored within a multivariate framework, or alternatively may point to the importance of a life cycle framework in analyzing such issues. Also suggestive of the minimal weight given entrant earnings and their riskiness are the correlations describing the relationship between entrant riskiness and experienced workers' wages (below the diagonal) and between entrant earnings and experienced workers' risk (above the diagonal). In neither framework do the entrants' experiences appear to serve as an important factor in determining future wages or their variation.

4.3 OTHER INDEPENDENT FACTORS

A number of other variables are likely to influence decisions about career choice. A variety of formulations were analyzed that included these factors. Some factors, which were highly correlated with others, though proved to be statistically insignificant in the regressions that were run. After dropping the insignificant variables in subsequent work, the remaining ones also served as proxies for those that were omitted.[128] The analysis that follows in this section reviews both sets of factors, since all were assumed to be important in the entrants' selection of an occupation. Some sample statistics for these variables are displayed in Tables 4.6 and 4.7 (see below).

4.3.1 Growth in the Relative Size of an Occupation

Prospective entrants to an occupation are attracted by the balance of return (income) and risk the occupation offers. In the aggregate, if the occupation is unable to attract enough new workers, market forces will alter the composition and magnitudes of the occupation's return and risk. Similarly, an abundance of candidates will be reflected in a relative decline in the compensation package offered. In a stationary economy, such adjustments would be a one-time occurrence. New entrants to the labor force (or to a particular occupation) would just equal the attrition rate. Economic growth and technical change, however, induce differential growth rates in each sector of the economy, so the optimal occupation mix is subject to continual change. Expansion of demand for a specific output, for example, causes increased demand for certain labor inputs by firms in that sector attempting to increase their stocks of skilled manpower whose aggregate supply is less than infinitely elastic.

In this respect, it is worth contrasting the economic climate immediately preceding 1960 and 1967, the two cross-sectional data points. Between 1960 and 1967 occurred the most recent period of sustained economic growth. Table 4.5 highlights several of the more significant variables pertaining to labor market conditions then. In 1959, as the economy recovered from the 1957-1958 recession, unemployment continued to decline. The civilian labor force expanded by roughly 1 percent and the unemployment rate dropped by 1.3 percent to 5.5 percent. Average gross hourly earnings also rose at a sizable 6.2 percent rate. Subsequently, economic conditions deteriorated somewhat in 1961 with another period marked by slow growth.

TABLE 4.5
ECONOMIC CONDITIONS IN THE LABOR MARKET
1959 AND 1966

	1959	1966
Unemployment Rate (percent)	5.5	3.9
Change from Previous Year	-1.3	-0.7
Civilian Labor Force (millions)	69.4	77.3
Change from Previous Year (percent)	1.2	2.0
Average Increase in Gross Hourly Earnings (percent)	6.2	4.1

SOURCE: Economic Report of the President, various issues.

Beginning in 1963, however, sharp increases in real income and output were realized for several years in succession. In all likelihood, the period immediately following 1966 served as a high-water mark for an economy reflecting high real growth with negligible inflation. By 1966, the unemployment rate had fallen to 3.9 percent, a figure usually taken to roughly represent full employment. The labor force had expanded by 2 percent in that year alone. Hourly earnings, though, rose by a smaller amount than in earlier comparable periods, probably because newly hired workers in 1966 were more marginal to production than were previously unemployed workers rehired during the economic recovery in 1959.

When observing the labor market in 1960 and 1967, it is necessary to control for the equilibration that may have already occurred over the period, as reflected by growth in the relative size of the occupation. If, for example, increased demand for particular kinds of output caused changes in an occupation's return and risk in the early portion of the period, it is conceivable that by 1967 compensating changes in the occupation's work force matched the rise in the derived demand for labor, and thus resulted in insignificant changes in overall compensation for the occupation's workers. Alternatively, continuing increases in the demand for certain careers may have resulted in only a partial adjustment in the labor market; such shifts might require a longer term for the market to accommodate them. By incorporating the relative changes that have taken place in the size of the occupation-specific labor market (using the variable OCC_GROWTH, defined as one plus the percentage change in occupation size between 1960 and 1967), coefficients for the risk and return terms are likely to more accurately reflect entrants' sensitivities.

The first entry in Table 4.6, OCC_GROWTH, depicts mean growth across occupations. The value is below 1 because the variable approximates the sizes of the 1960 and 1967 data sets.[129] The more interesting statistics, however, are measures of the variation in the mean value -- the standard deviation and coefficient of variation ($S/\overline{X}$) -- since these more likely indicate the degree to which economic changes may have accounted for shifts among entrants. The low coefficient of variation suggests that massive changes in the labor market structure can be observed only over fairly long periods of time because of the huge investment losses in human capital and the transaction costs that would be involved.

Table 4.7 seeks to highlight statistically significant relationships between the key return/risk variables and other independent variables, those where collinearity may interfere with the proper interpretation of economic effects in the subsequent regression analyses. As can be seen in the first row of entries in the table, OCC_GROWTH, the coefficients are for the most part insignificant.[130] According to these measures, only one important relationship emerges -- the positive correlation between overall occupation income increases and occupational growth. What is surprising is the absence of any

TABLE 4.6
POPULATION STATISTICS FOR INDEPENDENT VARIABLES INCLUDED IN REGRESSION ANALYSES

Variable Name	Mean	Standard Deviation	Coefficient of Variation
OCC_GROWTH	.368	.161	.44
EDUCATION	.368	.697	1.89
ED_GROWTH	1.033	.062	.06
ED_ENT1	-.035	1.764	50.00
ED_ENT1_GROWTH	1.006	.144	.14
ED_ENT2	-.009	1.656	180.16
ED_ENT2_GROWTH	1.008	.138	.14
ED_ENT3	-.030	1.492	49.62
ED_ENT3_GROWTH	1.004	.125	.12
HOURS_WKD	.120	4.085	34.07
WEEKS_WKD	.766	2.496	3.26
AGE	1.154	3.304	2.86
AGE-GROWTH	1.030	.085	.08
EXPERIENCE	.688	3.493	5.08
EXP_GROWTH	1.050	.214	.20
UNION-SHARE[a]	.306	.276	.90
SMSA_SHARE	.038	.088	2.30
SOUTH_SHARE	-.025	.109	4.34
UNEMPLOYED_SHARE	.003	.059	19.15
S_HOURS	2.531	5.212	2.06
S_WEEKS	-1.311	3.899	2.97
FEDERAL_SHARE	.008	.085	10.43
DISABLED_SHARE[a]	.098	.076	.77
FAM_INCOME	2836.62	1645.51	.58

[a]Measure existed only for 1967 cross-section.

TABLE 4.7
SIMPLE CORRELATIONS OF MONETARY RATE OF RETURN AND
VARIATION IN MONETARY RETURN WITH OTHER INDEPENDENT VARIABLES

	M_ENT_WAGE1	M_ENT_WAGE2	M_ENT_WAGE3	M_PRIME_Y1	M_PRIME_Y2	M_WAGES
OCC_GROWTH	.10	.09	-.01	.12	.08	.22
EDUCATION	-.05	-.02	-.01	.23	.25	.23
ED_GROWTH	-.04	-.03	-.03	.13	.14	.12
ED_ENT1	-.05	-.04	.02	.05	.06	.10
ED_ENT1_GROWTH	-.03	-.02	.04	.01	.01	.06
ED_ENT2	-.06	-.04	.05	.02	.04	.08
ED_ENT2_GROWTH	-.05	-.02	.06	.00	.01	.05
ED_ENT3	.04	.05	.18	.02	.06	.14
ED_ENT3_GROWTH	.04	.06	.17	-.01	.02	.10
HOURS_WKD	.09	.20	.18	.15	.14	.19
WEEKS_WKD	.19	.19	.26	.30	.29	.35
AGE	-.05	-.08	-.04	.06	.08	.22
AGE_GROWTH	-.04	-.08	-.04	.05	.07	.20
EXPERIENCE	-.04	-.08	-.04	.03	.04	.19
EXP_GROWTH	-.07	-.13	-.08	.05	.06	.17
UNION_SHARE	.08	.03	.10	-.09	-.10	-.11
SMSA_SHARE	-.20	-.27	-.22	.03	.03	-.06
SOUTH_SHARE	.05	.09	.04	.05	-.02	.00
FAM_INCOME	-.04	-.01	.05	.63	.64	.71

TABLE 4.7 (continued)

	S_PRIME_Y1	S_PRIME_Y2	S_WAGES
EDUCATION	.23	.24	.25
ED_GROWTH	.17	.18	.20
AGE	.11	.13	.11
AGE_GROWTH	.10	.12	.10
EXPERIENCE	.07	.08	.06
EXP_GROWTH	.07	.07	.08
UNEMPLOYED_SHARE	.06	.07	.04
S_HOURS	.18	.20	.17
S_WEEKS	.07	.01	.00
FEDERAL_SHARE	.07	.02	.06
DISABLED_SHARE	.10	.01	.04
FAM_INCOME	.29	.35	.35

correlation between income increases to entrants and growth; apparently, all wage gains are captured by longer-term members of the occupations.

4.3.2 Education

Changes on education levels by occupation between 1960 and 1967 may have occurred for a number of different reasons, all of which may somehow have related to entrants' career selection. First, the increased demand for more skilled types of labor by certain sectors of the economy may have raised the relative return to schooling and lowered its risk, thereby encouraging further investment in education. Freeman found college students in the 1960s were aware for the most part of changes in labor market conditions and adjusted their marginal human capital investments accordingly.[131]

In addition, as part of a national policy to promote greater investment in higher education, a variety of programs were enacted during the 1960s to subsidize the costs of a college education. These programs often served either to lower the pecuniary costs students' families might otherwise have faced through direct grants to the institutions, or to reduce the shadow costs of remaining in school by providing some students with scholarships.[132]

Credentialism, the acquisition of additional education for purposes other than the enhancement of individual productivity, may also account for ties between schooling and careers.[133] In this instance, though, the causality discussed above would be reversed; higher minimum job requirements may have been responsible for any observed increases in schooling among entrants. Thus, education would have operated as a screening device to distinguish either better qualified applicants or prospective entrants of a particular subclass from a larger pool of entrants. Changes in the occupation distribution may still have occurred but they would not have resulted at all from changes in schooling levels.

Education may also be responsible to a degree for changes in the terms measuring earnings variation. In the cross-section, earnings dispersion has been related to ability differences -- either acquired or innate.[134] Thus, changes in the educational composition of the labor force would probably be reflected in the components of the variance in earnings due to human capital rather than to risk per se.

Two alternative sets of education variables are employed in the analysis to depict the occupation-specific changes in schooling that took place between 1960 and 1967 -- changes in overall education levels and changes that applied in particular to new entrants. The second set of entries in Table 4.6 contains the mean and dispersion measures for the education variables. EDUCATION and ED_GROWTH represent changes in the occupation overall; the others show changes for each of the three entrant definitions described above. Those variables with the suffix "GROWTH" measure the percentage change between 1960 and 1967; the others reflect first differences.

All eight variables tell a consistent story. Although the three first-difference entrant measures are mildly negative, they are insignificantly different from zero, as are the three percentage-difference entrant definitions. Thus, one can conclude that levels of education for entrants did not significantly increase between 1960 and 1967. Overall education levels, on the other hand, did climb on average by about one-third of a year, or roughly 3 percent.[135] The unchanged entrant schooling levels, together with the higher overall educational attainment, probably resulted from the mix of old workers and new relatively more educated entrants shifting further in favor of new workers. Although education levels for entrants in 1967 appeared to be no greater than for the 1960 cohort, they were significantly greater than for prime-age workers already in the occupation. The standard deviations for the two overall measures indicate a fairly high degree of dispersion, which is suggestive of differential occupational growth -- some occupations experienced a large influx of entrants who raised occupation schooling levels while other occupations showed little growth between 1960 and 1967.

Overall, changes in education levels do not correlate well with the key earnings measures. According to Table 4.7, only one variant of the educational attainment measures, EDUCATION, is significantly related to the overall occupational earnings terms. This positive correlation would be in keeping with well-known human capital findings concerning positive rates of return to schooling. The entrant-specific education measures, however, are poorly related to entrant measures, probably because, as previously noted, increases in educational attainment by entrants over the period were limited. In addition, entrant earnings are unadjusted for differences in on-the-job training; some careers may provide new workers with additional training, which would be reflected in lower renumeration.

As shown in the second panel of Table 4.7, EDUCATION and ED_GROWTH are positively correlated with the three measures of occupational earnings variation (S_PRIME_Y1, S_PRIME_Y2, and S_WAGES). The significant coefficients support the notion that at least a portion of the observed variation in earnings is ability-related. Without controlling for differences in education among workers, coefficients measuring the risk-related dispersion in earnings will be overestimated.

Table 4.8 displays correlations among the variables within each set of additional explanatory terms being considered. High correlations between most of the various education measures are evident in the first panel. Only those entries relating occupation-wide education levels and entrant schooling attainment are barely significant, confirming the weak relationship uncovered above between the occupation-wide measures and those specific to entrants.

4.3.3 Labor Force Participation

This element might serve as a short-hand for a number of overlapping factors. Careers obviously serve as the vehicle by which individuals arrange their labor-leisure decisions --

TABLE 4.8
SIMPLE CORRELATIONS BETWEEN THE OTHER INDEPENDENT VARIABLES

	ED_GROWTH	ED_ENT1	ED_ENT1_GROWTH	ED_ENT2	ED_ENT2_GROWTH	ED_ENT3	ED_ENT3_GROWTH	
	.97	.24	.21	.18	.15	.19	.16	EDUCATION
		.24	.23	.17	.16	.18	.17	ED_GROWTH
WEEKS_WKD	.41		.97	.92	.90	.82	.82	ED_ENT1
AGE	-.04	.00		.90	.93	.81	.86	ED_ENT1_GROWTH
AGE_GROWTH	-.04	-.02	1.00		.97	.89	.87	ED_ENT2
EXPERIENCE	-.07	.02	.98	.97		.87	.91	EDENT2_GROWTH
EXP_GROWTH	-.05	-.02	.91	.93	.93		.97	ED_ENT3
	HOURS_WKD	WEEKS_WKD	AGE	AGE_GROWTH	EXPERIENCE			

r(SOUTH_SHARE, SMSA_SHARE) = -.20

	S_HOURS	S_WEEKS	FEDERAL_SHARE
UNEMPLOYED_SHARE	.53	.31	-.02
S_HOURS		.22	-.12
S_WEEKS			.02

some careers afford more labor force attachment while others result in less time spent in the labor market over the life cycle. Rates of return to an occupation (gross of fringe benefits and net of taxes) therefore should be measured with one unit of labor supply (e.g., one hour) as a numeraire. Fringe benefit data and tax data were unavailable, however. Wage and salary data per manhour were also not recorded and construction of such a measure with the information available at hand would likely produce biased coefficients.[136] Instead, HOURS_WKD (hours worked per week on the job) and WEEKS_WKD (annual weeks worked) are included directly as variables on the right hand side.

Ideally, a measure of years worked in the occupation might also have been included. Instead, labor force experience terms as measured by mean age of worker (AGE, AGE_GROWTH) or by the synthetically created experience term (EXPERIENCE, EXP_GROWTH) described earlier are included.[137] To the degree that some occupations in the same period had not yet "matured" but were still undergoing expansion, this effect would also be captured by the age and experience terms.

The third set of variables in Table 4.6 contains the six alternative measures of labor force participation. What is immediately evident when examining the data is the relatively high degree of dispersion reflected by most of the measures. Between 1960 and 1967, for example, hours worked and weeks worked increased overall, confirming the tight labor market conditions exhibited in Table 4.3. If it is assumed for the moment that both measures are distributed normally, however, applying a 95 percent confidence interval would suggest that the change in hours worked may have varied between an eight-hour decline in some occupations and an eight-hour increase in others. Similarly, weeks worked may have shrunk by about four weeks in some sectors and risen by nearly six weeks in others.

The age and experience terms also increased during the period, results which were somewhat surprising at first glance. By 1967, one might have expected the initial cohort of the baby boom to have entered the labor force, tending to bring down the working age. Moreover, a general trend toward a lower retirement age was already underway as the qualifying age for reduced Social Security benefits dropped in 1961 from 65 years of age to 62.[138] Counteracting these effects, however, were the tight labor market conditions of 1967 and the expanding manpower requirements of the war effort as American troops were first sent to Vietnam in large numbers. The armed forces siphoned off most potential labor force entrants, in turn exaccerbating existing labor shortages and leading employers to provide even greater benefits to workers who may have otherwise opted for retirement. In addition, to further supplement labor stocks, secondary workers were probably induced into the labor market in record numbers.[139]

The third panel of Table 4.7 displays how well the labor market variables correlate with the key income/return variables. The WEEKS_WKD and HOURS_WKD terms are significantly related a good portion of the time, suggesting that these factors are already accounted for in the key variables. Including WEEKS_WKD and HOURS_WKD in the regression then will partition the variation otherwise accounted for by the key income/return variables into variation in labor force participation and in rates of return among occupations. The danger, of course, by including the labor force factors is that multicollinearity may render all related terms statistically insignificant.

Table 4.7 also shows that age and experience variables are insignificantly related to all but one of the income specifications (WAGES). Mean wages grew faster in careers whose lifetime labor force tenure extended more rapidly. Conceivably, this is a result of the aging process of occupations; new occupations are likely to attract younger workers at first. As these occupations "mature," older members approach prime age, the peak of individual earnings paths.

The remaining income terms in Table 4.7 are age specific and, thus, would not be expected to correlate well with the age and experience terms which describe lifetime career opportunities.

As with education, experience may also explain a portion of income dispersion which is not risk-related. For this reason, simple correlations of the experience and the monetary risk terms are displayed in the second panel of Table 4.7. Likewise, correlations with the age variables are shown, since chronological age may serve as a proxy for experience. Unlike with education, however, the coefficients for both sets of data indicate the absence of a strong tie (although this may be masked by the presence of other intervening relationships).

The lower triangle in the first panel of Table 4.8 depicts the correlations among the labor force participation variables. As can be seen, HOURS_WKD and WEEKS_WKD exhibit a high correlation, as do the age and experience terms. The former is probably an outgrowth of the sample specification. As constructed, the data consist of individuals, most of whom are primary workers with jobs providing limited opportunities to trade off intensive (HOURS_WKD) versus extensive (WEEKS_WKD) margins. The strong positive relationship between the two margins is governed by the inclusion in the sample of unemployed individuals (more likely to be found in stagnant occupations) for whom HOURS_WKD is set equal to zero and WEEKS_WKD below 52 weeks.

The age and experience terms are highly correlated because any extension of the chronological age of workers must also necessarily increase experience or labor force tenure, unless schooling raises the average age of entrants. As noted above, overall educational attainment increased somewhat between 1960 and 1967, but apparently not so rapidly as to undo the positive relationship between chronological age and labor force age.

4.3.4 Labor Market Imperfections

Incorporating the above variables alone into the analysis, though, would be insufficient to measure labor force participation associated with different occupations correctly. This is because the labor force variables included thus far describe observed labor force participation, the outcomes of both derived market demand for specific kinds of labor and labor supply response. Individuals may prefer to work longer weekly hours and/or more weeks per year but may be unable to do so because of institutional constraints -- e.g., union contracts, pension and retirement age restrictions, etc. -- that limit their labor supply. Employers may face similar restrictions on their demand for certain types of labor because of minimum wage laws, overtime provisions, labor immobility, etc.

To take account of the degree to which market imperfections may have played a role in variation in labor force participation among occupations, a series of factors serving as proxies for these effects were entered into the regression equations. As suggested by the analysis, the degree of unionization in an occupation during the period 1960-1967 would be influential in determining observed labor supply.[140] Union membership data was available only in the 1967 SEO. Thus, it appears in its static form in the regressions (UNION_SHARE) and could be interpreted to imply that, ceteris paribus, occupations with large union membership will exhibit less sensitivity to labor market conditions.

To model employer responses to such constraints, two measures of locational shifts are included -- employer-sponsored moves to larger regional labor markets (SMSA_SHARE, the change in the proportion of the occupation members within

SMSAs) and from high-wage areas to the South (SOUTH_SHARE, the change in the fraction of occupation members residing in the South). Over time, the locus of available jobs shift to where larger pools of manpower are concentrated, within SMSAs, and to where wages historically have been lower, in the Southern United States.[141]

The fourth set of entries in Table 4.6 describe the means and measures of dispersion for the above variables. On average, in 1967, unionized members comprised about 31 percent of each occupation. This estimate might appear somewhat inflated until it is recalled that the data measure labor force status for white males only. Union membership for 1958 shows that in the United States roughly 18.3 million workers belonged to unions, and about 3.3 million were women.[142] Since the total civilian labor force at the time amounted to 68.6 million, of which about 30 percent were women, the proportion of unionized male workers would be about the same as contained in Table 4.6.

The SMSA variable mean reflects the gradual concentration of economic activity in urbanized regions, and its limited variation indicates that few occupations were differentially impacted by this movement. The SOUTH variable, however, appears with other than the hypothesized sign, suggesting a different interpretation for the term from that supplied above. While employers are motivated to minimize labor costs (other things being equal) by shifting their locus of operation to the South, individuals seeking to maximize labor income have an equal incentive to leave the South and pursue employment in the North or Mid-West. Determining which flow was greater during the 1960-1967 period is an empirical question. In all likelihood, given the declining role of unemployment then, employers might have experienced greater risk by undertaking a geographical move than would have individual workers. Another plausible explanation for the incorrect sign on the variable mean might again be related to the sample design -- its limitation to white nonfarm males. Conceivably, a less restrictive grouping might have produced a reversal in the sign, particularly since its present sample mean is insignificantly different from zero.

Tables 4.7 and 4.8 contain correlations between the UNION_SHARE, SMSA_SHARE, and SOUTH_SHARE variables and the key income/return variables, and between the SOUTH_SHARE and SMSA_SHARE variables. (The UNION_SHARE variable is not included in Table 4.8 because both its purpose in the analysis and its structure differ from the other two factors in this set.) Most of these correlations are insignificant, with the exception of SMSA_SHARE and the mean entrant wage terms, and the SMSA_SHARE and SOUTH_SHARE variables. The UNION term probably showed no well-defined relationship because as constructed it would only affect income levels across occupations but not rates of change. As could also be anticipated from the earlier discussion, increased movement into large labor markets goes hand-in-hand with the departure of younger workers from the South. Entrant wages rose significantly more slowly in labor markets, which grew more rapidly during this period, though, suggesting either that incoming workers overestimated the available opportunities awaiting them in larger metropolitan areas and suffered lower incomes as a result, or alternatively, that migration of entrants to SMSAs exaccerbated shortages in nonmetropolitan areas, particularly during the late 1960s when many younger men were drafted.

4.3.5 Labor Market Riskiness

The labor market variables discussed above do not capture the nonmonetary aspects of risk associated with different occupations. Changes in the demand for final products may require fewer (or an increased amount of) labor inputs, for example, particularly if wages are sticky in the downward direction. In the short run, as the labor market adjusts, this is likely to be reflected in increased unemployment or in a greater variability in hours worked or weeks worked. The occupation-specific unemployment rate (UNEMPLOYED_SHARE), and the variation in weeks worked (S_WEEKS) and in hours worked (S_HOURS), therefore, appear as independent variables to capture any riskiness not directly measured by the wage variance term.

Employees in the public sector are generally exempt from these effects. Civil Service regulations typically prohibit officials from dismissing government employees "without cause." Thus, some of the aforementioned aspects of risk can be offset. To capture the unique status granted public workers, the change in the proportion of workers in each occupation employed by the federal government, FEDERAL_SHARE, was entered in the regressions.

Another dimension of risk that influences career choices is the degree of physical risk encountered on the job. To measure its effect, the proportion of workers with a disability in an occupation, DISABLED_SHARE, as contained in the SEO is included in the analysis.[143] This variable is likely to underestimate risk, however, to the extent that workers injured while engaged in one career must subsequently undertake other kinds of work. About 10 percent of the work force in the 1967 sample, according to Table 4.6, suffered from some health-related disability.

The fifth set of terms displayed in Table 4.6 refer to the supplementary risk measures covered above. The unemployment rate for white males showed no change over the period, reinforcing a common belief that other segments of the labor force alone (e.g., secondary workers) are impacted differentially by changes in unemployment conditions. The S_HOURS and S_WEEKS terms taken together give evidence to the labor shortages that were probably experienced in some sectors by 1967. Since most of the workers in the sample were probably employed full-time to begin with, the standard deviation in annual weeks worked could only have been reduced as those not working 52 weeks per year at the start of the decade began doing so. In contrast, larger variation in weekly hours could also be expected by the end of the period as a greater number of workers were employed over time.

The fraction of the labor force on the civilian federal payroll, as measured by the data, barely changed between 1960 and 1967. In some sense, this result is surprising since the enactment of many new social programs after 1964 would appear to have required an expansion in civilian federal personnel.[144] Several explanations for the absence of a change, though, seem reasonable. First of all, the lack of a change does not imply that no hiring at all took place, only that the federal share of the labor force did not grow. The federal government may have placed a higher priority in satisfying its military manpower needs and, therefore, may have limited federal civilian hiring requests at the time. Also, the result shown in Table 4.6 applies to white males only; the federal government may have consciously promoted the employment of nonwhites and women during this period.[145] One other possibility is that some white males were bid away from the traditionally low-paying federal sector by private employers paying higher wages, offsetting any gains in federal employment which might otherwise have occurred.

The last major panels of Tables 4.7 and 4.8 show how well these measures of risk correlate with the key monetary risk terms and with each other. Surprisingly, only one of the five factors considered here, S_HOURS, is significantly correlated with the income/risk variables. The limited variation of the other nonpecuniary risk terms noted above (in Table 4.6) probably accounts for the absence of any other relationship. Most of these variables, however, are strongly related to each other. (DISABLED_SHARE is not considered in Table 4.8 because of its static formulation.) As depicted in Table 4.8, the signs on the statistically significant coefficients are fairly strightforward to explain. Occupations experiencing wider unemployment show greater variation in hours and weeks of work by members because the unemployment spells are factored into the computation of the variances.

4.3.6 Family Resources

Family wealth or its proxy family income (FAM_INCOME) may dictate to some extent the amount of human capital an individual purchases, and thus the career pursued. Becker hypothesized that more well-to-do students would face fewer constraints in an imperfect financial market and would, therefore, more often pursue careers requiring greater self-investment.[146] Wealthier persons, though, will also tend to prefer riskier careers (in the monetary sense), if they are subject to decreasing absolute risk aversion.[147] On balance, it is unclear towards what path larger family incomes are likely to direct individuals.

Data from Tables 4.6 and 4.7 offer mixed support for these hypotheses. The mean increase in FAM_INCOME registered in Table 4.6 is large, but when measured against the sizable sample variation, it may be insufficient to provide more than weak evidence. Table 4.7 contains correlations of FAM_INCOME with the key return and key risk variables (see last row entry in each section). In both instances, family income is highly correlated with occupation-wide measures of wages and wage dispersion. The correlation between family income and wages is probably not too informative, however, since wages form the larger portion of family income. Higher wages, thus, would necessarily lead to higher family income. Similarly, higher wages, in and of themselves, increase wage dispersion; hence, a positive coefficient could also be attributable to a statistical artifact.[148]

FAM_INCOME is poorly correlated with the entrant-specific income terms. The absence of any relationship would also suggest that the data do not support the hypothesis that the more well-to-do tend toward greater self-investment. It is conceivable, however, that the on-the-job training received by some entrants and not by others may mask the presence of a significant relationship.

4.4 REGRESSION ANALYSES

Modelling occupation choice given the constraints of the data selected is a difficult task. A properly defined model would examine the derived demand for particular kinds of occupations and the potential supply of workers to the same occupations. The data, however, which are based upon household survey information, omit any detail which would be useful in directly determining how employers select their labor skill-mix. Thus, the regressions which were run primarily reflect the decision-making of workers given employer choices and, to the degree that these relationships are simultaneous, could be viewed as reduced-form outcomes.

Table 4.9 presents regressions analyzing the effects of return and risk on career choice. While not particularly robust, the findings are suggestive of the hypothesized trade-offs between rates of return and riskiness, the focus of this study.[149] In all four formulations, though, the hypothesized return and risk relationships developed in the earlier analysis are confirmed. The distinguishing factors among them are the choice of the variables included to designate monetary returns and risk. In two instances, the focus is on entrant wages, in the others on prime age earnings (intended to represent occupation career incomes). Appearing in each of four columns are ordinary least-squares (OLS) coefficients, respective standard errors, number of observations contained in the specific subsample used to estimate the regression equation, and an R^2 adjusted for degrees of freedom.[150] Coefficients significant at the 95th percentile are denoted with an asterisk, those significant at the 99 percent level with two asterisks.[151]

When measured for overall fit by using the adjusted R^2 criterion, none of the regressions appear to be markedly different from the others. All four account for only a fraction of the overall variation in the dependent variables. For this reason, instead of analyzing each regression in turn, the discussion of results below focuses instead on the direction of the coefficients of particular variables across all four specifications.

TABLE 4.9
REGRESSION EQUATIONS

Independent Variables: \ Dependent Variable:	PCT_CHANGE1	PCT_CHANGE1	PCT_CHANGE3	PCT_CHANGE3
Return				
M_ENT_WAGE1		1.3 E-6 (0.9 E-6)		
M_PRIME_Y1	1.1 E-6 (0.7 E-6)			
M_PRIME_Y2			4.0 E-7 (3.7 E-7)	2.5 E-7 (2.5 E-7)
OCC_GROWTH	0.0188 ** (0.0077)	0.0240 * (0.0104)	0.0031 (0.0019)	0.0081 ** (0.0025)
ED_GROWTH		0.0233 (0.0127)		0.0079 * (0.0034)
HOURS_WKD		-4.7 E-4 (3.9 E-4)		-1.4 E-4 (0.9 E-4)
WEEKS_WKD		0.0022 (0.0012)	-4.4 E-4 (2.6 E-4)	
AGE	-0.0033 (0.0019)		-0.0017 (0.0009)	
AGE_GROWTH		-0.0283* (0.0140)		-0.0117** (0.0032)
EXPERIENCE	0.0021 (0.0018)		0.0012 (0.0009)	
UNION_SHARE			0.0024 (0.0021)	0.0020 (0.0014)
SMSA_SHARE	0.0197 (0.0163)			
FAM_INCOME	-2.0 E-6 (1.1 E-6)	-1.2 E-6 (0.8 E-6)		
Risk				
S_ENT_WAGE1	-9.2 E-7 (7.6 E-7)	-1.4 E-6 (0.8 E-6)		
S_ENT_WAGE3			-5.3 E-7 (4.4 E-7)	
S_PRIME_Y1		8.2 E-7 (6.9 E-7)		
S_PRIME_Y2				-2.3 E-7 (2.1 E-7)
S_WEEKS	5.4 E-4 (3.8 E-4)	0.0017 * (0.0008)		
DISABLED_SHARE			-0.0076 (0.0069)	
N	(49)	(49)	(77)	(106)
R^2_{ADJ}	.14	.10	.11	.15

4.4.1 Dependent Variables

Two of the six alternative dependent variables are displayed in Table 4.9. Columns 1 and 2 contain formulations attempting to explain variation in the change of the fraction of entrants with less than one year experience to an occupation. Columns 3 and 4 do similarly for a broader scope of entrants (with less than five years experience). Both measures suffer from certain shortcomings alluded to above which may in part account for the low overall explanatory power of the regressions. Entrants with less than one year experience, as a group, may include new workers who have erred in their career selection and thus may exhibit inappropriate labor force behavior (for purposes of modelling the return and risk relationships). Workers with nearly five years experience, on the other hand, may already have significant investments in particular careers and may be less swayed by changes in returns or riskiness because of sunk costs.

4.4.2 Return and Risk

In assessing the effects of monetary return and risk on occupation choice, only occupation-wide measures and entrant-specific measures consistent with the definition of the dependent variable were considered. Thus, in columns 1 and 2, return and risk terms apply to the narrower one-year entrant definition, while the risk term in column 3 refers to the broader measure. Interestingly, none of the return and risk variables displayed are significant at the 95 percent level. This may be due to multicollinearity with other return and risk factors (see Table 4.7). The direction of the coefficients, though, supports the hypothesis that entrants prefer less risk. Entrants tend to flock to better paying occupations and shy away from careers whose income streams are likely to fluctuate. It is informative to compare the strengths of the two effects. Estimated at their respective means, the return effect outweighs the risk effect significantly, by a factor of 8 in some instances and by a multiple of 66 in another.

The regression in column 2 is included to introduce the possibility that entrants may react differently to short-run and long-term pecuniary risks. There are a variety of plausible explanations for the positive coefficient on the occupation-wide risk term. Individuals may have complex utility functions which make them behave like risk averters when engaging in small monetary transactions but like risk preferers when presented with situations involving greater odds.[152] The analogue in this instance is that when confronted with risk early on in the career, entrants are anxious to avoid or reduce such uncertainty; when reacting to long-term uncertainty, however, entrants either heavily discount the risk (in which case, the regression coefficient should approach 0) or view it as a beneficial attribute because they believe they will benefit from additional income fluctuations. They may regard themselves as sufficiently more capable than other occupation members and, therefore, more likely to have incomes higher than the occupation average.

4.4.3 Other "Return" Variables

OCC_GROWTH, as expected, dominates the empirical analysis. In two of the four regressions, its coefficient is significant at the 99 percent level, and in another at the 95 percent level. Entrants are sensitive to market changes and migrate to occupations experiencing the largest growth.

The strength of OCC_GROWTH probably also accounts for the absence of highly significant wage coefficients. To the extent that the supply of labor is less than infinitely elastic, outward shifts in demand that were above average could also have been reflected by greater than average wage increases in those occupations.

Of the education variables constructed above, only the overall education variables entered into the regressions. Although the coefficients took on positive signs, as had been anticipated, the empirical framework is unable to distinguish among the competing causes of this relationship -- a greater demand by firms for certain types of human capital, a lower cost of attaining specific levels of higher education, or credentialism.

The labor force participation variables, HOURS_WKD and WEEKS_WKD, have coefficients bordering on significance, as do the age (but not the experience) terms. The high correlations between HOURS_WKD and WEEKS_WKD and between the age and experience variables probably account for their low t-values. The HOURS_WKD and WEEKS_WKD terms have negative coefficients indicating that, ceteris paribus, individuals prefer more leisure and less time spent in the labor market. The age variables may confirm the leisure preference as most commonly expressed by retirement at earlier ages or may reflect the fact that an increase in the number of entrants must cause a decline in the average age. It might also be noted that a reduction in labor supply, holding wages fixed, is equivalent to an increase in the return to a unit of labor. Finally, the formulation in column 2 suggests that, given the choice between cutting back on hours per week or a reduction in weeks per year, the market solution calls for fewer hours and a greater number of weeks of employment.

The experience terms contain signs contrary to what was hypothesized. The most likely explanation for this relates to the war-induced reduction during the late 1960s in the number of young male entrants. Thus, the relationship depicted in the equation is less a causal one than the product of a tight labor market inducing older workers to postpone retirement, and of a reduction of entrants as well.

Of the terms describing labor market imperfections, only SMSA_SHARE and UNION_SHARE enter into any of the regressions. The SMSA term is positive, indicating that continued development of regional labor markets probably accompanied the growth of certain occupations during the 1960s. The UNION_SHARE coefficient is positive, confirming a preference by entrants for careers heavily represented by unions.

4.4.4 Other "Risk" Variables

Only a number of the risk terms described earlier -- S_WEEKS and DISABLED_SHARE -- appear in Table 4.9. The latter two terms appear with negative signs, indicating as expected that entrants sought to avoid belonging to occupations with such characteristics. The coefficients of S_WEEKS proved to be surprising. It is conceivable, however (although unlikely, given the labor market conditions typifying the late 1960s), that S_WEEKS does not denote risk in the Table 4.9 equations, but represents instead the greater opportunities offered by some occupations to vary weeks of employment.

4.4.5 Family Income

FAM_INCOME enters the regressions twice with a negative coefficient. Recalling that, in most instances, the largest component of FAM_INCOME will be the worker's wage and salary income (see Tables 4.2 and 4.6), the negative sign on the coefficients may imply that additional income would induce workers to select an occupation other than that yielding the highest return. This may be simply a matter of tastes or alternatively may be related to risk aversion. Individuals with greater family resources may be subject to declining risk aversion.

Between 1960 and 1967, however, entrants tended to choose occupations entailing less risk, as evidenced by the negative coefficients on the monetary risk terms S_ENTWAGE1, S_ENTWAGE3, etc. Thus, increases in family income may normally induce the acceptance of greater risk, but the reduction in risky job opportunities during this period overwhelms this relationship.

4.5 SUMMARY AND IMPLICATIONS

It is an accepted fact that individual behavior under uncertainty may differ from what is normally posited by standard economic theory. This study has attempted to determine how individuals incorporate return and risk in selecting among alternative lifetime careers with limited success. The empirical framework utilized in the analysis is unlike those found in somewhat more traditional human capital studies of rates of return and may to some degree account for the weaker results presented here. In large measure, though, the choice of techniques has been dictated less by the inclusion of the risk element than by the nature of the central element under consideration -- the career.

In more standard analyses, it is hypothesized that individuals make decisions about amounts of education and training to be acquired for use in the "labor market," a construct consisting of what would appear to be a continuous spectrum of opportunities. In the real world, however, this "black box" does not exist; instead, people are observed to purchase only from among narrowly defined sets of schooling and training. Firms in the labor market exercise a demand for only certain bundles of human capital assets. Skills in excess of what are required receive a zero marginal return. Individuals, thus, have an incentive to accommodate firms' skill specifications.

These bundles of schooling and training form the basis of what are more commonly referred to as careers. Unfortunately, it is unusual to find socioeconomic survey data containing information about careers, partly because careers normally encompass many kinds of related jobs involving similar skills at different points in the life cycle. Usually one job in a career path will serve as a prerequisite to qualifying for another along the same path. Thus, it is more sensible to categorize workers at a given moment in time on the basis of current position or occupation.

Such a classification, however, makes little sense from an economic research perspective since occupations serve only as vehicles to achieve certain lifetime employment and income goals. Broad decisions about the scope of work activities are principally made at the time of entry into the labor force. Given certain innate and acquired skills, prospective entrants evaluate alternative paths on the basis of existing information about initial incomes, prospective future incomes, the probabilities of achieving these levels, and assorted other preferences. Upon selection of one path, entrants begin employment in one occupation and, with experience, either advance within the occupation (depending on how broadly defined it may be) or migrate to another.

To empirically test the sensitivity of individuals' choice of careers to rates of return and riskiness, then, first required a technique for converting observed occupation data into the more useful career information. This analysis developed such a method for linking together related occupations by utilizing migration flows between occupations. To determine the nature of the tradeoffs confronting workers, a fairly unique approach was devised which examined first differences for the variables included in the hypothesized relationship. This technique, however, because it analyzed only recorded changes from data samples several years apart, may have been subject to considerable distortion from omitted macro variables (to the extent these were not captured by the occupational growth catch-all term included in the regressions). The effect of grouped data, which generally act to reduce within occupation variation, may also have served as a drawback by magnifying the importance of the remaining unincluded sources of variation.

It is questionnable whether other empirical methods might have produced more robust results given the available data on hand at the time this study began. One technique, ultimately rejected because of limited accessibility, would have examined career choice by first calculating shadow wage rates of competing substitutes for each individual. Then, within a multinominal logistic framework, career choice would have been predicted. The cross-sectional data, though, are probably too weak to have supported an estimation techique of this sort unless occupations were merged into a handful of groupings. More precise calibrations probably await the availability of detailed longitudinal population survey data.

CHAPTER IV
FOOTNOTES

[112]The 1970 Census, in its description of an individual's occupation, increased the number of occupational categories from 297 for the 1965 occupation variable to 443 for 1970, and at the same time altered its definition of the occupation categories existing both before and after 1970, so as to make any comparisons over time extremely difficult.

[113]For a detailed description of the 1960 data, see U.S. Census of Population and Housing: 1960 One-in-a-Thousand Sample Description and Technical Documentation, U.S. Department of Commerce, 1964. The 1967 data are detailed in The 1967 Survey of Economic Opportunity Codebook, U.S. Office of Economic Opportunity.

[114]In addition, the construction industry was incorrectly coded in the SEO and its members mistakenly dropped. For the sake of comparability, the 1960 Census was also purged of construction workers, thus reducing its sample from 21,352 to 19,606 -- a loss of about 8 percent.

[115]The SEO data shows a somewhat greater decline because 40 percent of its observations formed a supplementary subsample of nonwhites which also was eliminated.

[116]A sample size of 10 was felt to be the minimum level necessary to ensure that the occupational averages considered in the analysis later on were reasonable.

[117]An individual is normally thought to maximize utility over the life cycle by maximizing both income and leisure. Implicit in these decisions is the choice of a career -- the vehicle adopted to generate income in the labor market.

[118]To technically satisfy the conditions set in Chapter II would require that each occupation's income stream be distributed normal. One way of testing for this property would be to use the Kolmogorov-Smirnov statistic which measures deviations of the sample cumulative distribution from a hypothetical cumulative normal distribution.

[119]The analysis necessarily assumes statistical independence of wage and nonwage components of income, that is to say, career choice does not affect levels of unearned income although it is conceivable that causality may be at work in the opposite direction (as discussed earlier) -- namely, workers with greater amounts of wealth may be willing to tolerate a greater or lesser degree of risk in selecting an occupation.

[120] This is demonstrated in J. Mincer, Schooling, Experience, and Earnings (New York: National Bureau of Economic Research), 1974, Part II. Defining career paths from cross-section data requires greater fine-tuning, as discovered from the empirical work in Chapter III above.

[121] See B. Eden, "Stochastic Dominance in Human Capital," Journal of Political Economy, February 1980, pp. 135-45, who outlines such a procedure.

[122] In addition, as discussed below, variables that may capture other dimensions of risk, like an occupation-specific unemployment rate, were considered in the analysis.

[123] G. Hanoch in "An Economic Analysis of Earnings and Schooling," Journal of Human Resources (Summer 1967), pp. 310-29, posits for males the following relationship between chronological age, education level, and labor force experience:

Experience = Age - Number of Years Required to Attain a Particular Level of Education

The accompanying table indicates the age at which a given number of years of schooling is assumed to be completed.

AGE	14	14	16	18	20	23	25	28
EDUCATION	0 - 4	5 - 7	8	9 - 11	12	13 - 15	16	17+

[124] Algebraically, this expression would be represented by

$$\frac{E_{i,67}}{\sum_j E_{j,67}} - \frac{E_{i,60}}{\sum_j E_{j,60}}$$

where

E_{kt} = number of entrants in occupation k in year t

[125] An alternative method would have been to regress in turn each of the specific variables on a number of known occupation aggregates and use the resulting equation to predict in those occupations missing such detailed data.

[126] Economic Report of the President (January 1978), Table B-50.

[127] Applying a t-test,

$$t = \frac{r \times \sqrt{N-2}}{\sqrt{1-r^2}} = \frac{.58 \times \sqrt{104}}{\sqrt{.6636}} = 7.26 > t_{104,.99} = 2.4$$

[128]See Kmenta, Elements of Econometrics (McMillan: New York, 1971), pp. 392-95.

[129]This is likely to be so even though, in theory,

$$\frac{\sum_i n_{i_{67}}}{\sum_i n_{i_{60}}} = \frac{N_{67}}{N_{60}} \neq \sum_i \frac{n_{i_{67}}}{n_{i_{60}}}$$

where

n_{i_j} = number of occupational members in year j

N_j = the year j work force

[130]If a 5 percent critical region is assumed ($\alpha = .05$), only coefficients exceeding /.19/ would indicate significance.

[131]R. Freeman, The Market for College-Trained Manpower (Cambridge: Harvard University Press, 1971), Chapter 11, pp. 202-26.

[132]The Higher Education Act of 1965 established several student assistance programs, including Education Opportunity Grants, College Work Study, and Guaranteed Student Loans. Major efforts in behalf of institutions included the Construction, Reconstruction, and Renovation of Academic Facilities Program, enacted as part of the Higher Education Facilities Act of 1963.

[133]A detailed discussion of credentialism appears in Rawlins and Ulman, "The Utilization of College-Trained Manpower in the United States," Higher Education and the Labor Market, ed. M. Gordon (Berkeley, California: Carnegie Commission on Higher Education, 1974), pp. 195-235.

[134]See, for example, J. Hause, "Ability and Schooling as Determinants of Lifetime Earnings, or If You're So Smart, Why Aren't You Rich?" American Economic Review (May 1971), pp. 289-98.

[135]Solving the relationship to obtain the mean education level in 1960, average schooling was 11.2 years.

[136]See J. Johnston, Econometric Methods, 2nd ed. (New York: McGraw-Hill, 1972), pp. 281-83.

[137]Experience = Chronological Age - Entry Age into the Labor Force Conditional on Years of Schooling

See Footnote 123.

[138] Social Security Bulletin, Annual Statistical Supplement, 1977-1979, U.S. Department of Health and Human Services (1980), p. 19.

[139] Between 1960 and 1967, the female civilian labor force rose by over 5 million. Moreover, as a proportion of the total civilian labor force, the female share climbed from 33 percent to 37 percent. Historical Statistics of the United States, Colonial Times to 1970, U.S. Department of Commerce (1975), Table D 11-25.

[140] Rosen, for example, suggests that a unionization measure may proxy for short-run labor supply inelasticities. See "On the Interindustry Wage and Hours Structure," Journal of Political Economy, vol. 77, no. 2 (April 1969), pp. 249-73.

[141] The traditional explanation for the geographic wage-differential has been rooted in differences in labor productivity. Galloway, for example, argues that marginal productivities of labor vary because capital-labor ratios were lower in the South than elsewhere. See "The North-South Wage Differential," Review of Economics and Statistics, vol. 45, no. 3 (August 1963), pp. 265-72.

[142] See A. Rees, The Economics of Trade Unions (University of Chicago, 1965), pp. 21-24.

[143] Thaler and Rosen, using the SEO, estimate wage differentials for broad occupation groupings due to the avoidance of risk of death. Their measure of risk, however, is derived from insurance company mortality data which is matched to the SEO. See "The Value of Saving a Life: Evidence from the Labor Market," Household Production and Consumption, Nestor Terleckyj, ed. (New York: National Bureau of Economic Research, 1975), pp. 265-98.

[144] In fact, federal civilian employment grew by roughly 300,000 during the period. This figure, though, amounts to less than one-half percent of the total labor force.

[145] Employment data by sex are available only from 1964 on. Between 1964 and 1969, federal civilian employment grew by 16 percent overall. Female federal civilian employment, however, grew considerably faster, registering a cumulative 27 percent gain. See Employment and Earnings, Bureau of Labor Statistics, related years.

[146] Becker, "Human Capital and the Personal Distribution of Income," W.S. Woytinsky Lecture No. 1, University of Michigan, 1967.

[147] See King, "Occupational Choice, Risk Aversion, and Wealth," Industrial and Labor Relations Review, vol. 27, no. 4 (July 1974), pp. 586-96.

[148] For $\{x\}$ distributed with mean μ and standard deviation σ, and $K \neq 0$, $\{Kx\}$ will be distributed with mean $K\mu$ and standard deviation $K\sigma$.

[149] Numerous regressions were modelled, most of which unfortunately did not substantiate the hypothesized relationship. These included regressions in which the dependent variables were regressed on only the key monetary return and risk variables. In these instances, both F- and t-statistics were insignificant. In part, this may have occurred because of difficulties in properly expressing the tradeoffs individuals may face when selecting among careers. The estimation procedure adopted in this study examined changes in grouped data over time, a technique that probably exacerbates any misspecification of the different factors affecting career choice.

[150] Differences in the sample size resulted from the inclusion of the standard deviations of entrant wages as explanatory variables. The regression program automatically dropped observations when such a term was undefined either in the 1960 Census, the 1967 SEO, or both.

[151] All terms contained in Table 4.8 have coefficients with t-values equal to or exceeding 1. In specifications where some explanatory variables had t-values below 1, the variables were dropped and the coefficients on the other terms reestimated.

[152] Friedman is among the first to account for this phenomenon in modelling the role of uncertainty in individual utility functions. See Price Theory: A Provisional Text, revised edition (Chicago: Aldine, 1968), Chapter 4.

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