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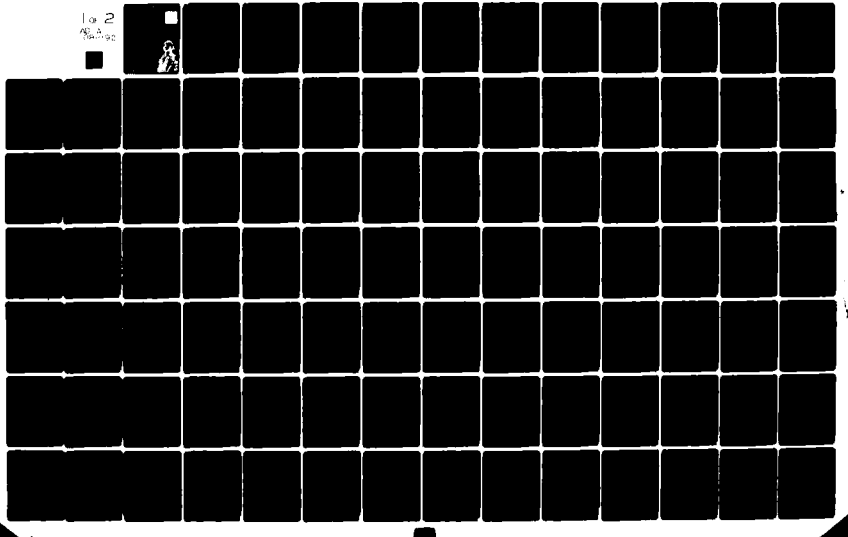

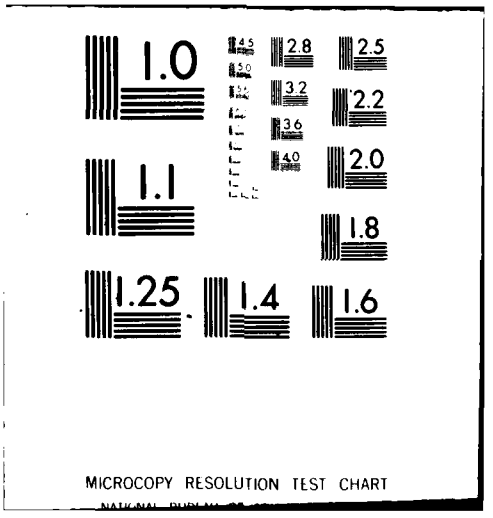
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THE SUPPLY OF YOUNG CRAFTSMEN TO AN INDUSTRY

by

Richard J. Claycombe

Serial T-421
12 June 1980

The George Washington University
School of Engineering and Applied Science
Institute for Management Science and Engineering

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THE SUPPLY OF YOUNG CRAFTSMEN TO AN INDUSTRY

by

Richard James Claycombe

B.A. (Cum Laude) 1974, DePauw University
Greencastle, Indiana

A Dissertation submitted to

The Faculty of

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Dissertation directed by

Sheldon Edward Haber
Professor of Economics

ABSTRACT

In this study, three models are developed for assessing the effects of economic and demographic factors on the supply of young craftsmen to an industry. Two of these models pertain to decisions that affect the inflow of young craftsmen to an industry, i.e., the decision whether or not to participate in craft vocational education and the decision whether or not to enter a craft occupation. The third decision pertains to the outflow of young craftsmen from an industry, i.e., the decision to stay in or leave their industry.

Complementing these three models are two sets of descriptive data presented at the beginning of the study. First, the career development patterns of young craftsmen are examined. These patterns are found to be consistent with findings based on the three analytical models. Second, data are presented which indicate how human capital variables affect the earnings of young craftsmen. While not analytical, the human capital and career development analyses provide insight into how young people become productive craftsmen.

Some findings in the study have policy implications while others are more academic in nature. An example of interest in both respects relates to the effect of prospective future wages on turnover. Economists have long been interested in the effect of earnings on turnover, expecting a negative relationship to exist. Empirical analysis has shown this relationship to hold between current earnings and turnover, but prior to this study the effect of future earnings has not been examined. From this study, they appear to be important factors influencing the turnover of young craftsmen. Beyond its academic interest, this finding has practical implications for employers. Some industries, shipbuilding for example, pay their young craftsmen well relative to

other industries, but pay their older craftsmen poorly relative to other industries. Consequently, there is high turnover among more experienced workers. By increasing older craftsmen's wages to the competitive level, their turnover could be reduced. The resultant increase in the wage bill could be offset by dampening the wages of younger craftsmen. While the depressed wages of young craftsmen might increase their turnover, this effect would be at least partially offset by their higher future earnings.

As might be expected, the influence of economic and demographic variables is not uniform over the three decision points examined in the study. For example, it appears that individuals with immediate income needs are less likely to enter crafts than individuals who are less constrained. This relationship does not hold, however, in obtaining craft vocational education. The difference is explained by the low private cost of craft vocational education and the high private cost of on-the-job training. Similarly, the availability of craft vocational education in public schools permits nonwhites to obtain this type of training. However, nonwhites are less likely than whites to enter craft occupations, perhaps because of racial discrimination or lack of information about the labor market.

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Finally, the writer wishes to express his deep gratitude to his wife, who provided unwavering support throughout his graduate study.

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CHAPTER I

INTRODUCTION

1. The Purpose and Scope of the Study

In this study, economic and demographic factors that influence the supply of young craftsmen available to an industry are analyzed. In part, the study is based on an earlier analysis of the shipbuilding labor market by John Martin.[1] His work suggests that the current age-earnings profile in the shipbuilding industry results in higher labor turnover than would otherwise be observed.[2] It appears from his study that further analysis is warranted concerning the effect of earnings and other factors on the supply of craftsmen, that is, more rigorous tests are needed to measure these effects.

The supply of craftsmen is particularly important in a number of industries. In shipbuilding, 50 percent of the employed males were craftsmen in 1970.[3] In recent years, labor's share of value added in shipbuilding has been about 77 percent.[4] In industries

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[1] John C. Martin, "The Labor Market of the United States Shipbuilding Industry: 1960-1970," (Technical Paper Serial T-383, Program in Logistics, The George Washington University, June 30, 1978).

[2] Specifically, Martin's findings indicate that older workers may be underpaid relative to what they could earn in other industries; this results in a high turnover rate among experienced craftsmen. Ibid., p. 117.

[3] U.S. Department of Commerce, Bureau of the Census, U.S. Census of the Population: 1970, Occupation by Industry, PC(2)-7C, (Washington, D.C.: U.S. Government Printing Office, 1972), Table 8.

[4] Martin, "Shipbuilding Labor Market", pp. 1 and 24.

where craft labor is this important, an inadequate supply can cause cost overruns and production delays. In the shipbuilding industry, for example, several crafts have often been in short supply.[5] This lack of craftsmen may be due to low wages or other factors. By analyzing factors that affect the supply of young craftsmen, more may be learned about how to increase the supply of craftsmen in an efficacious manner.

In industries where the supply of young craftsmen is important, there should be an interest in (1) factors that influence young men to enter crafts and (2) factors that influence previously hired young craftsmen to stay in the industry. It may be that the factors that influence craft entry are the same as those that influence retention of craftsmen. On the other hand, it would be of equal interest to know if the two sets of conditions are different.

Some supply issues should be of interest to academicians as well as policy makers. For example, in previous studies of turnover, only initial wages were measured and not the increase in wages expected in subsequent years. In this study, a new variable is introduced to measure the expected increase in future wages, i.e., a future wage variable. From the effects found for a future wage variable, academicians can judge the time horizon of young craftsmen. Policy makers should also have great interest in its influence. If young craftsmen are influenced by their prospective future wages, then industries where the age-earnings profile is flat, for example, shipbuilding, may be able to reduce turnover without increasing their wage bill (See Chapter V).

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[5] See Mark Battle Associates, Inc., "Shipbuilding Manpower Study, Executive Summary," (Report for the U.S. Maritime Administration, distributed by National Technical Information Service, U.S. Department of Commerce, March 1974), Chapter 6. According to Battle, high-skill crafts, e.g., electricians, machinists, pipefitters and welders have been in short supply in the shipbuilding industry. This may be due to the low wages particularly for more experienced workers. See Martin, "Shipbuilding Labor Market," pp. 93-101. In strict economics usage, a shortage only exists when the wage is below its equilibrium value. If wages are slow to rise in response to falling supply and/or rising demand, a shortage may be prolonged and disruptive to the production process.

Academicians and policy makers may also be interested in relationships that human capital/personal characteristic variables have with the supply of young craftsmen to an industry. Some demographic characteristics, for example, high school graduation or family size, may be related to young men's likelihood of entering a craft or staying in an industry. For example, young men who drop out of high school may do so because they have immediate income needs. These immediate income needs may later cause them to leave an industry that provides craft training but pays low wages. Presumably, they would go to an industry that pays higher wages but provides little training. Relationships such as this one may be of interest to academicians and potentially useful as screening devices to reduce turnover. Turnover might be reduced by using demographic characteristics as indicators of an individual's likelihood of staying in an industry; i.e., other things equal, young craftsmen could be selected according to their probable turnover. The use of these screening devices may be limited, however, due to legal and equity questions which may arise when screening by economic and demographic characteristics.

In addition to the above supply issues, the findings in this study are relevant to other areas of social concern. For example, it is useful to know if nonwhites are as likely to participate in craft vocational education as whites. Assuming this were the case, it may still be that access of nonwhites to crafts occupations is limited by racial discrimination or lack of information.

Another issue involving craft vocational education has to do with its benefits and costs. A large literature exists in this area with some studies finding that vocational education yields net benefits and others finding limited or no benefits. The benefits question is approached in a different way in this study. A variable not included in previous studies, an occupational aspirations control, is used in an occupational choice model. More specifically, the effect of craft vocational education on the likelihood of a young man entering crafts

is tested while controlling for his desire to enter crafts. If young men with craft vocational education are more likely to enter crafts, craft aspirations held constant, then it would appear that craft vocational education provides skills that make them more desirable new hires, that is, it must increase craft productivity.

The relationship between the demand for craftsmen and participation in craft vocational education may also be important. Planners of vocational education programs may attempt to match industry needs with programs, but for planning purposes, it is important to know if a young person's decision to participate is also responsive to industry demand.

Another social issue has to do with the ability of craftsmen to aid their sons in entering crafts. Craftsmen may be able to aid their sons in entering high paying craft occupations by providing special information or contacts. If this were so, economic efficiency and equity might be promoted through policy that gives this information to all young people. If special advantages like this do not appear to exist, then equalization programs may not appear warranted.

To limit the complexity of the study only young craftsmen are examined. They are of particular interest because many of them are still developing craft skills on the job; the cost of this training influences occupational choice and is also an important component of turnover cost. Also, in this study, selected crafts are examined rather than crafts in general. While the set of selected crafts is not exactly the same over the entire study, it is always comprised of occupations which are important in shipbuilding and related industries, for example, carpenters, electricians, painters, pipefitters and welders. Care is taken to define the particular set of occupations used in each portion of the paper. In addition, only male craft workers are considered. In 1960 and 1970, crafts important in shipbuilding were almost exclusively male, for example 98.7 percent of carpenters

and 98.9 percent of pipefitters were male in 1970.[6] Nearly 100 percent of these occupations were male in 1960. This situation is slowly changing but since so few craft workers were female in the 1960's, only males are included in this study.

2. The Methodology and Data

In the chapters that follow, factors that affect the supply of young craftsmen to an industry are analyzed by examining their influence on the occupational and industrial choice of young men. Recent literature concerning these decisions makes use of data sets comprised of individuals. Earlier studies used aggregated industry data that limited the precision with which relationships could be tested. For example, industry turnover studies by Pencavel examined the influence of many factors on labor turnover but the measures used were only industry averages.[7] The effect of race on industry turnover could only be controlled by observing the percent black by industry. Observation of the effects of other variables was similarly limited, for example, education, age, and sex. More recent studies using individual data are able to observe individual behavior and characteristics.[8] With individual data, personal characteristics can be directly associated with behavior.

A model of individual choice, like the decision to stay in or leave an industry, uses a dichotomous dependent variable to indicate the choice made. The use of a dichotomous dependent variable creates

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[6]For the composition of craft occupations by sex see, C. B. Dicesare, "Changes in the Occupation Structure of U.S. Jobs," Monthly Labor Review 98 (March 1975): 28-9 and Dixie Somers, "Occupational Rankings for Men and Women by Earnings," Monthly Labor Review 97 (August 1974): 38-9.

[7]John Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, (Princeton: Industrial Relations Section, Princeton University, 1970).

[8]For example, Morely Gunderson, "Determinants of Success in On-the-Job Training," Journal of Human Resources 8 (Fall 1973): 472-84.

several econometric problems in ordinary least squares, the most important of which is inherent heteroscedasticity. Maximum likelihood estimation does not have this problem and is employed in this study. Another problem with having a dichotomous dependent variable is the desirability of constraining the prediction of the model to the value of a probability, i.e., to the zero-one range. This is often done using a probit or logit transformation; the probit method is employed in this study.

Two primary data bases are used in this study. One is the National Longitudinal Study of Young Men (NLS), which was collected by the Center for Human Resource Research of The Ohio State University. These data include longitudinal information from 1966 to 1973 for young men aged 14 to 24 years in 1966. These data were used in the analysis of occupational choice and participation in craft vocational education. The NLS includes a wide array of economic and demographic variables for these analyses, but some variables had to be derived from the second primary data source.

The second source is the Bureau of the Census 1970 Public Use Sample (PUS). These data provide a one percent sample of the population. The sample of young craftsmen used in the industry turnover analysis was taken from the PUS, and this data source was used to derive many measures needed for the study. For example, craft earnings by industry were derived from the PUS and then assigned to individuals in the NLS.

3. A General Description of the Analysis

In Chapter II, some general, descriptive material is presented that complements the central focus of the study, occupational and industrial choice. One area of inquiry concerns the prior occupations and training of young craftsmen. Another area of inquiry concerns the subsequent occupations of this group. While the results of this work are not surprising, they are consistent with more interesting findings in later chapters, which have to do with the influence of the cost of on-the-job training and other factors on the supply of young craftsmen to an industry.

Another aspect of the supply of young craftsmen is their productivity. However, since this is a study of occupational and industrial choice, productivity analysis is limited to a descriptive examination of the effects of formal and vocational education on the earnings of young craftsmen. Findings from this work provide some insights into craft productivity and suggest areas where further research might be conducted.

Young men make several decisions that determine their occupation and industry. In this study, particular attention is devoted to three of these. First, a young man may or may not choose to participate in craft vocational education. Second, he may or may not become a craftsman. Third, given that the person is a craftsman, he may or may not change industry.

These three decisions are all important in the supply of young craftsmen to an industry. (1) When young people take craft vocational education, the pool of young people with preparation to enter craft occupations is enlarged. (2) The occupational choice decision determines, in part, the flow of young craftsmen into an industry. This flow is also dependent on an industrial choice decision, but only the decision to enter an occupation is analyzed in this study. A young person looking for his first job is more likely to be concerned with occupational choice than industrial choice; he may enter the first industry in which he finds a job in the occupation to which he aspires. (3) After having settled on an occupation, for example, crafts, the individual may wish to change industry. The decision of a young craftsman to stay in, or conversely, to leave his industry is the third area of analysis.

In discussing these choices, the occupational choice decision is examined before the craft vocational education decision. The reason for this reverse sequence is that an interest in entering a craft is likely to be a major force behind the decision to participate in craft vocational education. But factors that influence interest in entering a craft are central in the occupational choice chapter, and are

discussed more easily in that context. Rather than discuss these matters twice, they are initially discussed in the occupational choice chapter, Chapter III, and later reviewed in the craft vocational education chapter, Chapter IV. No such expositional problem exists for the chapter on the decision to stay in or leave an industry; it follows in its natural order, Chapter V.

Some of the economic and demographic variables that are expected to influence these decisions are as follows. Beginning with the occupational choice decision, influential factors may include craft earnings, training costs, the discount rate, education, race, and the demand for craftsmen. These factors might also influence the decision to train for a craft occupation, that is, to participate in craft vocational education. As noted in Chapter IV, a special feature of craft vocational education is its public funding. Public funding and the time that generally elapses between participation in vocational education and craft entry may diminish the importance of the factors mentioned above. In the industry mobility decision some of the factors that may be important include the previously mentioned future wage and initial earnings. Other important factors may include race, training cost, and the demand for craftsmen.

The three primary areas of analysis in this study all are directly related to the supply of young craftsmen to an industry. Participation in craft vocational education directly influences the number of young men with preparation to enter crafts. Even more directly, young men's decisions whether or not to become craftsmen determine the flow of young men into craft occupations. And, having become craftsmen, young men's decisions whether or not to change industries influence industry turnover rates and costs.

4. General Findings and Policy Implications

In Chapter II it is shown that while a substantial percentage of young craftsmen have craft vocational education, it is neither a necessary or sufficient preparation to become a craftsman. A requirement

to become a craftsman does appear to be experience in a less skilled blue-collar occupation. Analysis of the subsequent occupations of young craftsmen who left crafts suggests that separations are both voluntary and involuntary in nature. Voluntary separations appear to be prompted by opportunities in managerial occupations; moves to lower-skill blue-collar occupations, on the other hand, are common and likely to be involuntary in nature.

Analysis in Chapter II also suggests craft vocational education and a high school diploma increase the earnings of young craftsmen. Education beyond high school appears to increase craft productivity, although its effect on craft earnings is diminished by craft work experience lost while attaining the additional education. Similarly, noncraft vocational education appears to increase craft productivity, but its effect on craft earnings is more than offset by lost craft work experience: an explanation is that noncraft vocational education participants characteristically lose craft work experience by pursuing noncraft occupations. Additionally, in the lower-skill blue-collar occupations where less training is required, the above human capital variables generally appear to have weaker effects on earnings.

The findings in Chapters III, IV, and V suggest that many economic and demographic factors influence the supply of young craftsmen to an industry. In the decision to enter a craft, initial earnings, the demand for craftsmen, craft vocational education, and race appear to play important roles. Training costs and the discount rate also appear influential in craft entry, but they are not found to be as important in the decision to participate in craft vocational education. Public funding, wide availability, and the time that separates craft vocational education from craft employment, explain these weaker effects. Factors that appear to influence the craft vocational education decision include the demand for craftsmen, aspirations to enter crafts and the availability or quality of craft vocational education programs. Factors that influence the decision of a young craftsman to stay in his industry include initial earnings, future earnings, and demand for craftsmen in his industry. It also appears that interindustry mobility of young craftsmen is influenced by the individual's race, work experience, and immediate income needs.

Several policy implications follow from these findings. An important one for industrial policy makers has to do with the future earnings of young craftsmen. As noted above, it appears that industry turnover of young craftsmen is influenced not only by their current earnings, but by their expected future earnings as well. This means that if older craftsmen receive low wages, young craftsmen will observe this and be less inclined to stay in their industry. Hence, it appears that industries that pay low wages to experienced workers can expect higher turnover of not only those experienced workers, but of younger workers as well. This finding may be of particular importance in the shipbuilding industry and others where craftsmen have flat age-earnings profiles. By restructuring the wage system to increase the earnings of experienced craftsmen, turnover in this group could be reduced. To hold labor costs constant, wages of less experienced craftsmen could be held down; the inclination to leave caused by their depressed initial earnings would be at least partially offset by their improved future earnings.[9]

Other findings of the industry mobility analysis indicate that personal characteristics may be predictive of turnover. It is not clear, however, how this information can be used by employers, as legal and equity considerations may make screening by demographic characteristics an unacceptable method of reducing turnover. For example, findings suggest that high school graduates are more likely to remain in their industry, but it may be considered illegal or unfair to give preference to high school graduates simply on this basis.[10]

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[9] A self-selection process may also exist that would diminish turnover in industries where initial earnings are low but future ones are high. With such an earnings structure, the industry may attract craftsmen who intend to stay; craftsmen looking for temporary jobs may be inclined to take work where the initial wage is high but the future wage does not rise by much. See Joan Salop and Steven Salop, "Self-Selection and Turnover in the Labor Market," Quarterly Journal of Economics 90 (November 1976): 619-27.

[10] This may occur where race is correlated with education, thereby leaving the employer open to charges of racial discrimination.

Findings concerning some demographic variables may have broader social policy implications. Results in the industry mobility analysis and the craft entry analysis suggest that nonwhites are less likely to enter crafts and, if they do manage to enter, are less mobile between industries. It appears that these relationships are due to racial discrimination or to nonwhites' lack of information about the labor market. While these relationships are widely known, the findings mentioned above provide additional evidence that social policy to either increase information or reduce discrimination may be appropriate.

The finding that nonwhites are less likely to enter crafts, other factors held constant, has importance beyond questions of equity. This finding suggests that work force productivity could be improved if entry barriers to nonwhites were lessened. The exclusion of qualified nonwhites requires the use of some whites whose productivity is lower. Hence, reduction of barriers to nonwhites could raise average work force productivity.

Another policy implication regarding the flow of young men into crafts involves craft vocational education; it appears that this training aids young men in entering crafts by increasing their productivity in craft work. Promoters of vocational education should find this pleasing. Employers of craftsmen should too; one can infer that a larger pool of young men with craft vocational training will lower the training costs of employers and/or the wages they must pay young craftsmen Another finding suggests that participation in craft vocational education is responsive to the demand for craftsmen. Industries that are expanding their craft work force might be able to increase future supply via participation in craft vocational education by disseminating information concerning craft openings to high schools.

Comparison of the findings in the craft entry and craft vocational training chapters suggests that the public funding of craft vocational education increases participation in it. Also, its wide availability and low cost also appear to be factors in the participation of nonwhites; in contrast to craft entry, participation in craft vocational education does not appear to be related to race.

CHAPTER II

CAREER DEVELOPMENT OF YOUNG CRAFTSMEN AND FACTORS WHICH AFFECT THEIR EARNINGS

1. Introduction

This chapter is descriptive in nature, its purpose being twofold. In the first half of the chapter, discussion centers on the previous training and occupations of young men who become craftsmen and the subsequent occupations of young workers who leave crafts. While the results of this analysis are not surprising it is useful to document this career development. In subsequent chapters, factors that influence this career development are examined, that is, analysis is presented of factors that influence participation in training for craft occupations, participation in craft occupations themselves, and mobility of young craftsmen between industries.

In the second half of the chapter, questions are considered where the relationships are more difficult to anticipate. The focus shifts to the effects of various types of training on the earnings of young craftsmen. This portion of the chapter bears on important issues in craft productivity and supply but it differs widely from the craft participation and mobility issues, which are the core of this study. For this reason, the human capital analysis is descriptive rather than analytical; the intent is to obtain some insights that may lead to more rigorous analysis.

Findings in the first part of the chapter suggest that (1) while a substantial portion of young craftsmen have craft vocational education, it cannot be considered a prerequisite to entering a craft occupation, (2) experience in a less skilled blue-collar job is the most important way young people become craftsmen and (3) young

craftsmen who leave crafts tend to either voluntarily enter managerial occupations or involuntarily enter less skilled blue-collar ones.

In the second half of the chapter, some of the findings are that earnings of young craftsmen are increased by 1) a high school degree, 2) craft vocational education, and 3) some combinations of formal education with craft and noncraft vocational education. It also appears that a high school degree may be substituted for craft vocational education to obtain comparable craft earnings.

In the next section the prerequisite training and occupations to enter a craft occupation are considered. In the following sections the subsequent occupations of young craftsmen who leave crafts are examined and a comparison of the prior and subsequent occupations of young craftsmen is made. In the second portion of the chapter, the analysis is divided into two sections. The first deals with craft earnings as related to the education, vocational training, and work experience of young craftsmen. The second introduces similar information for other young blue-collar workers. This analysis helps to resolve uncertainties remaining from the previous section and provides some useful descriptive data as well. The last section is a chapter summary.

2. Prerequisite Training to Enter Selected Craft Occupations

One would expect that to enter a craft occupation, an individual would have to have some prior training. While craft vocational education might satisfy this requirement, it is not an exclusive or necessarily adequate means of doing so. In 1970, 25 percent of young craftsmen had craft vocational education (see Table II.1). This proportion is markedly higher than that found in the other blue-collar occupations shown in Table II.1, i.e., laborer and operative occupations. These generally require less training than craft occupations and are less likely to require or make use of craft vocational training. Still, as 75 percent of young craftsmen did not have craft vocational education, it can hardly be considered a prerequisite to craft entry.

Table II.1

PERCENTAGES OF YOUNG BLUE-COLLAR WORKERS
WITH CRAFT VOCATIONAL EDUCATION
BY OCCUPATIONAL GROUP

Occupational Group	Percentage with Craft Vocational Education
Craftsmen	25.8
Operatives	11.6
Laborers	8.9

Source: Bureau of the Census, 1970 Public Use Sample

Note: The occupational groups include all the Census occupations listed under the respective group names, e.g., "craftsmen" include all Census craft and kindred occupations. The data are for males aged 18 to 24 years.

What appears to be a prerequisite is work experience in a less skilled blue-collar occupation, for example, an operative or laborer one. In these occupations an individual can acquire general and specific skills that prepare him to perform craft work. These skills may be acquired through either full-time or part-time employment.

Table II.2 shows the types of occupations in which young craftsmen are employed prior to entering a selected craft occupation. The selected craft occupations include ones which are important in shipbuilding, e.g., carpenters, electricians, painters, pipefitters and welders. (See Appendix II.1 for a complete list.) Craft occupations that are not selected are referred to as "other" crafts, some of which are automobile mechanics, brick masons, bulldozer operators, plasterers, and roofers. The basic skills necessary to enter the selected crafts may be acquired in these other crafts.

The data in Table II.2 were compiled in the following way from the National Longitudinal Study of Young Men (NLS, also see Appendix II.1). Each individual's record was scanned to find the first year, if any, in which he was a full-time employee in one of the selected craft occupations. Upon finding such an individual, his occupation and full- or part-time attachment to the labor force in the prior year was recorded in a broad occupational class, for example, operative occupations.[1] The distribution of individuals according to occupational class in the year prior to craft entry is shown in Table II.2.

The proposition that prior blue-collar experience is a major path for entering a craft occupation is supported by Table II.2. In the NLS, 73.4 percent (2.8 + 26.9 + 8.5 + 15.8 + 0.6 + 9.7 + 9.1) of the full-time selected young craftsmen had other blue-collar work

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[1]Full-time work was defined as 40 or more weeks in a year and 30 or more hours per week; both the identification of full-time selected craftsmen and the classification of their previous employment use this criteria.

Table II.2

PERCENT DISTRIBUTION OF YOUNG CRAFTSMEN IN SELECTED CRAFT OCCUPATIONS BY PRIOR OCCUPATION

Occupations		
Full-Time Employment in Prior Occupation		
Professional and Technical	3.4	
Managerial	2.9	
Clerical	4.8	
Other Craft	2.8	
Operative	26.9	
Service	3.3	
Labor	8.5	
Other	1.8	
Subtotal		54.5
Part-Time Employment in Prior Occupation		
Clerical	2.7	
Selected Craft	15.8	
Other Craft	0.6	
Operative	9.7	
Labor	9.1	
Other	5.3	
Subtotal		43.2
Not Employed	2.3	2.3
Total Percentage	100.0	100.0
Number of Observations	785	785

Source: Center for Human Resource Research, National Longitudinal Study of Young Men, (Columbus: Ohio State University).

Note: The table is derived from data covering the period 1966-73 and includes individuals aged 14 to 24 years in 1966 (see Appendix II.1).

experience in the year prior to full-time selected craft employment. A large percentage of them, 37.6 percent, were employed as full-time or part-time operatives in the year previous to entering crafts; another 17.6 percent were in full-time or part-time laborer occupations in the year prior to craft entry. These occupations prepare young workers for crafts because they call for lower order skills often closely related to crafts, e.g., construction workers' helpers who are classified as laborers. The 3.4 percent employed full-time or part-time in one of the "other crafts" may seem small. It is not small, however, in a relative sense; only 2.4 percent of all the young men in the NLS sample were employed in these "other crafts."

A substantial portion, 15.8 percent, of the full-time selected young craftsmen were employed part-time in a selected craft in the year prior to full-time selected craft employment. These individuals may have been employed part-time for a number of reasons, the most likely being school attendance and layoffs due to low seniority. Alternatively, they may have reported themselves as a craftsman while their real status was that of a less skilled blue-collar worker; unfortunately, this cannot be determined from the NLS.

While Table II.2 shows 73.4 percent of selected young craftsmen as having prior blue-collar experience this still leaves 26.6 percent with no apparent previous experience. There are several possible explanations for this. First, many of these individuals may have been employed in blue-collar occupations in earlier years. For example, an individual may have been employed as a selected craftsman in 1968, as a service worker in 1967 and as an operative in 1966. In addition, some of these individuals may have been employed as full-time craftsmen before 1966. Such individuals were reentering crafts after having tried an intervening occupation. This is not an uncommon phenomenon. Of the young craftsmen who left the selected crafts in the 1966-1973 period, 32 percent reentered by 1973.

The young craftsmen who had nonblue-collar occupations in the year prior to full-time employment in the selected crafts might be explained in other ways. It is possible that craft vocational education can be substituted for blue-collar work experience. If young craftsmen are able to substitute craft vocational education for blue-collar work experience, one would expect young craftsmen with no prior blue-collar experience to have craft vocational education in higher proportion than those with prior blue-collar experience. The NLS data do not suggest this; 14.9 percent of the selected young craftsmen with prior blue-collar experience had craft vocational education while 14.8 percent of the selected young craftsmen without prior blue-collar experience had it. It is also possible that some young males were hired as craftsmen without previous experience because of nepotism or high demand. It is not necessary, however, to rely on this explanation. It is plausible that most of 26.6 percent of the young craftsmen who were not in a blue-collar occupation in the year before entering a selected craft may have acquired that experience in earlier years. Unfortunately, it is not possible to check this hypothesis using the NLS.

3. Subsequent Employment of Young Craftsmen Who Leave Selected Craft Occupations

Analysis of the subsequent employment of young craftsmen who left the selected craft occupations suggests some causes of those separations. Involuntary separations from crafts may occur due to declining demand or incompetence. Many young craftsmen discharged in this manner may take jobs in less skilled blue-collar occupations. Voluntary separations may occur due to lack of motivation to do craft work or because of changes in occupational aspirations and opportunities. Occupations that may be both attractive and open to young craftsmen might include managerial ones, both craft and noncraft oriented, e.g., union officials and administrators in construction and manufacturing and managers in retail gasoline stations, business repair stores, restaurants, and bars.

Forty-eight percent of the selected young craftsmen in the NLS left the selected crafts between 1966 and 1973. But, as previously mentioned, thirty-two percent of these reentered in that same period. The high separation rate may be due in part, to the lengthy observation period (1966-1973). Most likely, it is due to the tendency of young people to change jobs in search of a career. It is also possible that some of the observed changes are due to inconsistent self classification. An individual might report himself as a craftsman one year and an operative the next, even though he may not have changed his occupation.

The data in Table II.3 show the types of occupations to which young craftsmen transferred subsequent to employment in the selected crafts. These data are derived in a manner directly analogous to that described for Table II.2. The subsequent occupation (if any) of each selected young craftsmen was recorded by broad occupational group, taking care to distinguish between full-time and part-time work. There is no category for part-time work in a selected craft as there is in Table II.2. A young craftsman was not counted as having left the selected crafts if his selected craft employment changed to part-time.

The data in Table II.3 are consistent with the discussion of voluntary and involuntary separation from crafts. Many young craftsmen who left the selected crafts, 53.6 percent, went to less skilled full- or part-time blue-collar occupations and presumably earned less (see Section 5); these moves are likely to have been involuntary. The flow of young craftsmen to managerial positions is noteworthy. Twelve percent of the young craftsmen who left crafts became managers. This is consistent with voluntary separation from crafts.

The remaining subsequent occupations of the young males who left the selected crafts display no particular pattern. It is of interest, however, to compare the distribution of individuals by previous and subsequent occupations. This is done in the next section where the occupational distribution of all young males is also included.

Table II.3

PERCENT DISTRIBUTION OF YOUNG CRAFTSMEN IN SELECTED CRAFT OCCUPATIONS BY SUBSEQUENT OCCUPATION

Occupation		
Full-Time Employment in Subsequent Occupations		
Professional and Technical	5.9	
Managerial	12.0	
Clerical	3.8	
Sales	4.7	
Other Craft	6.1	
Operative	32.6	
Service	5.2	
Labor	14.7	
Other	0.7	
Subtotal		85.7
Part-Time Employment in Subsequent Occupations		
Other Craft	0.4	
Operative	3.6	
Labor	2.7	
Other	2.8	
Subtotal		9.5
Not Employed	4.8	4.8
Total Percentage	100.0	100.0
Number of Observations	558	558

Source: Center for Human Resource Research, National Longitudinal Study of Young Men, (Columbus: Ohio State University).

Note: The table is derived from data covering the period 1966-73 and includes individuals aged 14 to 24 years in 1966 (see Appendix II.1).

4. Prior and Subsequent Employment of Selected Young Craftsmen Relative to Employment of All Young Males

In this section, occupational distributions of prior and subsequent full-time selected craft employment are compared with each other and with the occupational distribution of all young males. To this end, the discussion of previous and subsequent occupations needs to be developed a little further. The semi-skilled operative occupations are likely to provide basic training applicable in crafts occupations. The similarity of the skills used in operative occupations and crafts should also make them likely alternative occupations for laid-off or otherwise separated young craftsmen. Further, since an individual advances when moving from operative to craft occupations, and regresses when moving back, one might expect a higher proportion of young men to transfer from operative to craft occupations than vice versa. The same relationships may exist between craft and laborer occupations but these are less likely to be strong. Laborer occupations require less skill than operative ones and include many occupations that have little in common with crafts. Thus, young craftsmen should be less likely to drop to low-skill laborer occupations. Also, a disproportionate share of young craftsmen may transfer to managerial occupations, where there are good possibilities for higher earnings and social status. Conversely, one would not expect a large proportion of young craftsmen to transfer to professional occupations. While these occupations have high earnings and social status, they are usually entered through educational and not blue-collar channels.

The data in Table II.4 conform to these expectations concerning the prior and subsequent occupations of young craftsmen. The proportion of young males employed as operatives prior to entering crafts is greater than the proportion employed as operatives subsequent to leaving crafts (49.3 percent versus 38.1 percent). The proportion of all young males employed as operatives is lower still (30.1 percent). This suggests the similarity of craft and operative occupations, as young craftsmen appear to flow to and from operative occupations in greater proportion than young men in general flow to them. In contrast, the

Table II.4

Previous Occupations of Craft Entrants and
Subsequent Occupations of Craft Leavers

Versus

Occupations of All Young Males

Full-Time Occupations	Young Males Who Were Employed Full-Time In a Selected Craft		All Young Males
	Previous	Subsequent	
	%	%	%
Professional and Technical	6.3	6.9	15.3
Managerial	5.4	14.0	9.2
Clerical	8.9	4.4	10.2
Sales	2.6	5.4	5.5
Other Craft	5.1	7.1	5.6
Operatives	49.3	38.1	30.1
Service	6.1	6.1	7.0
Labor	15.6	17.2	15.4
Other	0.7	0.8	1.6
Total Percentage	100.0	100.0	100.0
Number of Observations	428	478	12286

Source: Center for Human Resource Research, National Longitudinal Study of Young Men, (Columbus: Ohio State University).

Note: The table is derived from data covering the period 1966-1973 and includes individuals aged 14 to 24 years in 1966 (see Appendix II.1).

proportion of young males employed as laborers prior to entering crafts is roughly the same as the proportion employed as laborers subsequent to leaving crafts (15.6 percent versus 17.2 percent). The proportion of all young males employed as laborers is also similar (15.4 percent). The similarity of these figures is consistent with the weak relationship of craft and laborer occupations. Young craftsmen do not appear to flow to and from laborer occupations in much greater proportion than young men in general flow to them.

The data in Table II.4 is also consistent with expectations about the flow of young craftsmen to managerial and professional positions. A higher proportion of young males who left crafts were in managerial occupations than was the case for all young males (14.0 percent versus 9.2 percent). A lower proportion of young males who left crafts were in professional occupations than was the case for all young males (6.9 percent versus 15.3 percent).

The findings in these sections are consistent with the development of craft skills through on-the-job training. These data also suggest that many individuals who leave crafts do so involuntarily. But, some individuals voluntarily leave crafts to take managerial positions. In the next section, the focus shifts to the effect of various kinds of human capital on craft earnings.

5. Earnings, Education, Vocational Training, and Work Experience of Young Craftsmen

Crafts require more skill than other blue-collar occupations. They often require the ability to work with figures and to read blueprints and other types of written procedures. They require more training either in formal training programs or on the job. Individuals who obtain craft training or formal education before becoming craftsmen should be more productive. For this reason formal education, craft vocational training, and, perhaps, some forms of noncraft vocational training should increase the productivity and presumably the earnings of young craftsmen.

While the role of human capital in raising productivity and earnings is well known there still remain questions pertaining to particular occupations, such as the craft occupations. Some of these more narrowly defined questions are: (1) How much education is useful in craft work? (2) Does craft vocational education increase the earnings of young craftsmen? (3) Can young craftsmen substitute formal education for craft vocational education and achieve comparable earnings? (4) Are formal education and vocational education complementary forms of craft preparation, that is, do young craftsmen who have both vocational education and higher levels of education have higher earnings than young craftsmen who have only one form of preparation?

Underlying many of these questions is the relationship between on-the-job training and formal education. A young person must postpone on-the-job training in order to attain higher levels of formal education. For this reason, one would expect the effect of formal education on craft earnings of young people to be less than it would be if formal education and on-the-job training were obtained simultaneously. For formal education to yield a positive return, it must raise productivity to an extent that more than makes up for the loss in productivity due to lost work experience.

An individual may not have to sacrifice work experience to obtain vocational training since it often can be obtained as part of his general education. (See Chapter IV.) One might expect, however, individuals with noncraft vocational education to spend time in noncraft occupations before entering crafts. This would lower their craft work experience and earnings.

From this discussion it appears that the effects of different types of human capital on craft earnings will vary. As indicated above, the following analysis is descriptive rather than analytical. In addition, it is plagued by the possible effects of uncontrollable factors that burden even the most advanced analyses; specifically, it is possible that young craftsmen who obtain vocational training

or a high level of education have more ambition and/or natural ability than young craftsmen who do not. It may be that these factors are the cause of all or part of the observed effect of education and vocational training on craft earnings.[2]

It should also be noted that the earnings differentials observed for young craftsmen may not be representative of those of older craftsmen. The value of craft vocational training may not be great among older craftsmen. The high levels of on-the-job training that older craftsmen have may overshadow the initial value of craft vocational education. On the other hand, the value of higher education may be greatest among older craftsmen. These craftsmen are more likely to have the experience to be eligible for supervisory positions. A similar relationship may exist for noncraft vocational education. Business, drafting, or engineering skills may aid craftsmen with experience in advancing to supervisory positions. The analysis of the earnings of older craftsmen is, however, beyond the focus of this study.

In Table II.5 the earnings of young craftsmen are displayed by level of education and by type of vocational education. For the purpose of this analysis craftsmen are broadly defined as the full range of Census craft occupations. These data suggest that:

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[2]Evidence of these effects is found in Orley Ashenfelter, "Estimating the Effect of Training Programs on Earnings," Review of Economics and Statistics 60 (February 1978): 47-57. A method of controlling for these effects is used in Nicholas Kiefer, "Federally Subsidized Occupational Training and the Employment and Earnings of Male Trainees," Journal of Econometrics 8 (August 1978): 111-125. Kiefer finds no effect of manpower training on employment and a negative effect on earnings.

1. When controlling for types of vocational education, young craftsmen who complete high school have higher earnings than those who do not.

2. At all levels of education, young craftsmen who have craft vocational education have higher earnings than those who have noncraft or no vocational education.

3. Young craftsmen can receive similar earnings by substituting craft vocational education for a high school degree.

4. The combination of education beyond high school and craft or noncraft vocational training yields higher earnings.

5. Education beyond high school without vocational education does not compensate for the work experience lost in obtaining it.

6. Young craftsmen with noncraft vocational education and a high school degree or less have lower current craft earnings than other young craftsmen with comparable education.

The last two points warrant additional explanation. Education beyond high school without vocational education may cause higher earnings for older craftsmen. But for young craftsmen, high educational attainment without vocational education does not appear to increase productivity enough to compensate for the work experience missed while in school.

One should not infer from Point 6 that there is something about noncraft vocational education, itself, that lowers craft earnings. An alternative explanation of the data is that young craftsmen with noncraft vocational education tend to spend time in noncraft employment before they enter crafts. This would cause them to have less craft work experience than young craftsmen with no vocational education and with less craft work experience their earnings would be lower. Hence, one need not infer that

Table II.5

Earnings of Young Craftsmen - Age 18-24
By Level of Education and Type of Vocational Training

Level of Education	Type of Vocational Training			
	Craft	Noncraft	None	All Types
Less Than High School	6041 (383)	5126 (178)	5231 (1943)	5348 (2504)
High School	6405 (1596)	5728 (576)	5925 (2901)	6054 (5073)
Greater Than High School	6804 (306)	5836 (215)	5700 (739)	5991 (1260)
All Levels	6397 (2285)	5641 (969)	5654 (5583)	5845 (8837)

Source: Bureau of the Census, 1970 Public Use Sample.

Note: All earnings are in 1969 dollars. The number of observations for each cell are in parentheses.

noncraft vocational education, itself, lowers craft productivity, but rather that young craftsmen who have noncraft vocational education lose craft work experience by spending time in noncraft occupations. If the difference in craft work experience is the correct explanation of these low earnings then noncraft vocational education may yield a return for more experienced, older craftsmen. While this question might be addressed in future studies, some insight into this possibility may be obtained by inspecting parallel tables for young operatives and laborers included in the next section.

6. Education, Vocational Training and Earnings of Young Craftsmen, Operatives, and Laborers

This section has two general purposes. The primary one is to analyze the effects of noncraft vocational education on blue-collar earnings. As a by-product some descriptive data is presented comparing the effects of other factors on the earnings of young craftsmen with their effects on the earnings of young operatives and laborers.

Operative and laborer occupations generally require less training than craft occupations. For this reason, factors such as formal education and vocational training should not be as useful in operative and laborer occupations as they are in craft occupations. In the lower skill occupations, where they are less useful, these factors should have a smaller effect on earnings.

From Table II.6 one can infer that less education and training are required in operative and particularly laborer occupations. Young craftsmen have more education, more craft vocational training, and higher earnings than young operatives and laborers. The differences between young operatives and young laborers are not nearly as striking, except in earnings. Young operatives earn 18.8 percent more than young laborers, which suggests that they are more productive. It can also be seen in Table II.6 that all the groups have nearly the same amount of noncraft vocational education; it is the effect of noncraft vocational education on earnings that is of primary interest in this section.

Table II.6

Education, Vocational Training and Earnings, Young Craftsmen, Operatives, and Laborers

	Young Craftsmen	Young Operatives	Young Laborers
Level of Education (in percentages)			
Less Than High School	28.3	37.2	41.7
High School	57.4	52.5	47.0
Greater Than High School	14.3	10.3	11.3
	100.0	100.0	100.0
Type of Vocational Training (in percentages)			
Craft	25.8	11.6	8.9
Noncraft	11.0	11.1	12.3
None	63.2	77.3	78.8
	100.0	100.0	100.0
Average Earnings (in dollars)	5815	5222	4397
Average Age (in years)	21.97	21.70	21.26

Source: Bureau of the Census, 1970 Public Use Sample.

The effects of formal education, and craft and noncraft vocational education on the earnings of young operatives and laborers can be seen in Tables II.7 and II.8, respectively, In general, the effects are weaker than in the case of young craftsmen (although this generality does not hold in some cells where the number of observations are small). The data suggest that:

1. When controlling for types of vocational education, young operatives and laborers who finish high school have higher earnings than those who do not.

2. At all levels of education, young operatives and laborers who have craft vocational education have higher earnings than those who have noncraft or no vocational education.

3. Young operatives and laborers cannot attain comparable earnings by substituting craft vocational education for a high school degree.

4. When controlling for types of vocational education, young operatives and young laborers who have education beyond high school have lower earnings than those who terminate their education at the completion of high school.

5. At all levels of education, young operatives and laborers who have noncraft vocational education have lower earnings than those who have craft or no vocational education. This relationship is similar to the one found among young craftsmen.

There are similarities and differences between these findings and the parallel ones for young craftsmen. On balance, it appears that formal education and vocational education are less useful in the lower skill blue-collar occupations. Comparing Table II.5 with Tables II.7 and II.8 it appears that:

1. A high school degree increases the earnings of all young blue-collar workers by approximately the same amount. (This amount varies by vocational education group.)

2. While craft vocational education increases the earnings of all young blue-collar workers, its effect is largest for young craftsmen.

Table II.7

Earnings of Young Operatives - Age 18-24
By Level of Education and Type of Vocational Training

Level of Education	Type of Vocational Training			
	Craft	Noncraft	None	All Types
Less Than High School	5091 (236)	4358 (232)	4934 (2887)	4905 (3355)
High School	5760 (727)	4876 (570)	5500 (3426)	5465 (4723)
Greater Than High School	5231 (78)	4718 (199)	5244 (654)	5131 (931)
All Levels	5569 (1041)	4725 (1001)	5244 (6967)	5222 (9009)

Source: Bureau of the Census, 1970 Public Use Sample.

Note: All earnings are in 1969 dollars. The number of observations for each cell are in parentheses.

Table II.8

Earnings of Young Laborers - Age 18-24
By Level of Education and Type of Vocational Training

Level of Education	Type of Vocational Training			
	Craft	Noncraft	None	All Types
Less Than High School	4530 (82)	3122 (100)	4003 (1195)	3971 (1377)
High School	4926 (184)	4037 (222)	4912 (1148)	4789 (1554)
Greater Than High School	4385 (27)	3307 (85)	4667 (260)	4336 (372)
All Levels	4766 (293)	3660 (407)	4470 (2603)	4397 (3303)

Source: Bureau of the Census, 1970 Public Use Sample.

Note: All earnings are in 1969 dollars. The number of observations for each cell are in parentheses.

3. Young craftsmen can obtain comparable earnings by substituting craft vocational education for a high school degree, but young operatives and laborers cannot.

4. Education beyond high school yields young craftsmen higher earnings when combined with vocational education but it does not yield young operatives and laborers higher earnings regardless of vocational education.

5. While noncraft vocational education is associated with lower earnings for most young blue-collar workers, the negative relationship is the smallest for young craftsmen and the largest for young laborers. As the data analyzed below suggest, the negative relationship is more apparent than real and may be explained by the fact that young men with noncraft vocational education are likely to have less blue-collar work experience than young men with no vocational education.

The above similarities and comparisons may be generalized. Points 1 and 4 suggest that education up through high school graduation has broad applicability to blue-collar occupations. For education beyond the high school level only the group that requires the most training, young craftsmen, show any return. Similarly, Points 2 and 3 suggest that young craftsmen, requiring more training, derive the largest return from craft vocational education. In addition, since young operatives and laborers do not benefit as much from craft vocational education, they cannot substitute it for a high school degree and receive comparable earnings.

Point 5 bears on the finding of primary interest in this section. Human capital theory suggest that training and work experience have a positive effect on productivity; this should also hold for noncraft vocational education, in spite of the fact that its positive effect on craft productivity appears to more than offset by reduced craft work experience.

In lower skill blue-collar occupations where less training is required, noncraft vocational education may increase productivity very little. Hence, its positive effect on earnings may be far

outweighed by the lost blue-collar work experience effect. In contrast, in craft occupations where the most training is required, noncraft vocational education may increase productivity enough to offset most or all of the lost blue-collar work experience effect. If noncraft vocational education were not useful in craft work, then the negative earnings differential caused by lost blue-collar work experience would be similar to that found for the lower skill blue-collar occupations. As stated above, it appears that the value of noncraft vocational education offsets the negative work experience effect most for young craftsmen and least for young laborers. These effects are highlighted in Table II.9.

In Table II.9, the earnings differential associated with noncraft vocational education is given by level of formal education for young craftsmen, operatives, and laborers. Each cell in the table is the difference between the earnings of workers with noncraft and no vocational education. For example, from Table II.5, young craftsmen with less than a high school degree and noncraft vocational training have mean earnings of $5,126, while those with the same education and no vocational education have mean earnings of $5,231. The difference between these figures is the earnings differential of noncraft vocational education given in Table II.9 ($5,126 - 5,231 = -$105).

In Table II.9, all but one of the earnings differentials is negative. The largest negative values are found in the laborer occupations where the least training is required. In contrast, young craftsmen, the group with the highest training requirements, have the smallest negative earnings differential. This relationship appears to hold for all levels of education, with young craftsmen actually showing a small return to noncraft vocational education when they also had education beyond high school.

These data are consistent with the offsetting effects outlined above, that is, in craft occupations where the most training is required, noncraft vocational education has the largest effect on productivity. But even in crafts where noncraft vocational education

Table II.9

The Effect of Noncraft Vocational Education on Blue-collar Earnings

Earnings of Young Workers Who Have Noncraft Vocational Education
Minus Earnings of Young Workers Who Have No Vocational Education

Level of Education	Young Craftsmen	Young Operatives	Young Laborers
Less Than High School	-105 (178)	-576 (232)	-881 (100)
High School	-197 (576)	-624 (570)	-875 (222)
Greater Than High School	+136 (215)	-526 (199)	-1360 (85)
All Levels	-13 (969)	-519 (1001)	-810 (407)

Source: Bureau of the Census 1970 Public Use Sample.

Note: All earnings are in 1969 dollars. Also, each "observations" figure (in parentheses) in the table is the number of observations for the earnings of young craftsmen who have noncraft vocational education. The number of observations of young craftsmen who have no vocational education is much larger.

is most productive, its effect on earnings is wholly, or nearly, offset by lost blue-collar work experience.

If data were available to control for blue-collar work experience, one might find noncraft vocational education to show a positive relationship with the earnings of young blue-collar workers. It may also be that older craftsmen with noncraft vocational education have sufficient craft work experience to make their late start in crafts unimportant. With this negative work experience effect reduced, older craftsmen may earn a return on their noncraft vocational education.

7. Summary

In the beginning of the chapter the work experience of young craftsmen both prior and subsequent to employment in selected crafts is examined. The NLS data suggest that previous blue-collar work experience is a prerequisite to becoming a craftsman. While many young craftsmen have craft vocational education, none of the findings suggest that it is necessary or sufficient preparation for a craft occupation. (Findings in the latter part of the chapter indicate, however, that it increases the earnings of young craftsmen.) Analysis of the subsequent work experience of young craftsmen who left the selected crafts shows that many of them return to other blue-collar occupations, i.e., operative and laborer ones. Many of these moves may be involuntary as these occupations have lower earnings. In support of this proposition, the data show that a large number of these individuals subsequently return to the selected craft occupations. Other selected young craftsmen transfer to managerial positions. These moves are likely to be voluntary and may be to craft- or noncraft-related positions.

The findings in the latter part of the chapter suggest that formal education and vocational training have a positive effect on craft earnings. The strongest effects appear to be yielded by craft vocational education and completion of high school. They have a positive effect on earnings, both separately and combined and one can

be substituted for the other to obtain comparable earnings. Education beyond high school yields higher craft earnings when combined with craft or noncraft vocational education. When obtained without vocational education, education beyond high school yields lower craft earnings. The negative work experience effect is dominant in this instance due to extra years spent in school. Similarly, the data suggest that young craftsmen who have noncraft vocational education have lower craft earnings.

When observing the negative earnings differential of noncraft vocational education for less skilled blue-collar workers, i.e., operatives and laborers, it appears that this negative differential is much greater for these groups than for young craftsmen. Thus, one can infer that noncraft vocational education has a weak effect on productivity among operatives and laborers. On the other hand, noncraft vocational training appears to nearly compensate for lost craft work experience among young craftsmen; their negative craft earnings differential is small.

Other findings of interest concern the comparative effects of formal education and craft vocational education between young craftsmen, operatives, and laborers. Formal education up through high school graduation appears to be equally productive for all young blue-collar workers. Education beyond hign school and craft vocation education appear, however, to yield higher returns to young craftsmen; young operatives, and laborers have less need for this training in their work and consequently it has a smaller effect on their earnings.

The relationships suggested above between education, vocational training work experience, and blue-collar earnings are consistent with human capital theory. One can infer that the effects of various levels of education and types of vocational training on blue-collar earnings depend on underlying effects on productivity. The effect of work experience on earnings is evident where it must be sacrificed to attain higher levels of education. Similarly, work experience differentials appear to be important in explaining the lower earnings of blue-collar workers with noncraft vocational education.

Appendix II.1

Description of the Derivation of Previous and Subsequent Work Experience of Selected Young Craftsmen

The NLS sample of young men gives the occupation and the number of weeks and hours worked for the years 1966 through 1973. This information was used to identify full-time young craftsmen in the sample.

Only selected occupations are included in the craftsmen group. Other occupations ordinarily classified as crafts are referred to as "other" crafts. The selected crafts are listed in Table II.10; they were chosen because they are important in shipbuilding.

Table II.10

Selected Crafts

Blacksmiths	Mill Wrights
Boilermakers	Molders - Metal
Carpenters	Painters
Cranemen	Pipefitters
Electricians	Rollers - Metal
Foremen	Structual Metal Workers
Heat Treaters	Tinsmiths
Job Setters - Metal	Toolmakers
Machinists	Welders
Mechanics - Nonauto	

To identify full-time selected young craftsmen, the occupational history of each young man was scanned from 1966 to 1973. If he became a full-time selected craftsman, his occupation and full- or part-time attachment to the labor force in the year prior to entering crafts was recorded in a broad occupational class, e.g., operatives.[3]

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[3] Full-time work was defined as 40 or more weeks in a year and 30 or more hours per week. (A change from full-time to part-time selected craft work was not counted as leaving the selected crafts.)

If he left the selected crafts during the 1966-73 period then the occupation to which he transferred and his attachment to the labor force was recorded.

While the NLS contains the detailed information necessary to conduct this analysis, it contains only 5225 observations. Only 1136 of these were full-time selected craftsmen in some year between 1966 and 1973 (the time period over which the NLS data was collected); furthermore, 351 of these were employed full time in a selected craft in 1966 making their prior occupation unavailable. This leaves 785 (1136-351) observations of prior occupations. Of the 1136 selected young craftsmen, 558 left crafts by 1973 and 50, 4.4 percent, were in a selected craft in every year from 1966 through 1973; no prior or subsequent occupation was available for them making them absent from both Table II.2 and Table II.3.

Due to the small sample sizes of 785 and 558, it was not possible to control for age to the extent desired. The individuals in the NLS were 14 to 24 years of age in 1966. By 1973, the oldest members of the sample were 31 years of age, making it possible for entry or exit from the selected crafts to be observed at ages as low as 14 or as high as 31. The range of age might be reduced by using, for example, only individuals who were 18 years of age in 1966. This would, however, reduce the sample size by approximately 90 percent. Alternatively, the age at the time of entry or exit could be monitored, but this would further complicate software that has already grown to a cumbersome form. Fortunately, it seems unlikely that many individuals would enter or exit the selected crafts at ages near 14. To a lesser extent, the same seems true of individuals near the age of 31. These considerations, taken together with the technical difficulties mentioned above, lead to the use of the entire NLS sample, ages 14 through 31.

CHAPTER III

FACTORS THAT INFLUENCE YOUNG MALES TO ENTER CRAFTS

1. Introduction

The flow of young men into the craft occupations of an industry is affected by factors that influence both industrial and occupational choice. In this chapter the focus is on the factors that influence occupational choice, since in early job search it is likely that young men place the most emphasis on this aspect of career development. Particular attention is given to human capital considerations as the craft occupations can require lengthy training. Foremost among the factors examined are earnings and prior craft vocational education. In addition, the effects of other variables are considered, for example, race and father's occupation.

In the next chapter, factors that influence young people to participate in craft vocational education are analyzed. The decision to take craft vocational education is similar to the decision to enter crafts. Knowledge of the factors that influence the decision to take craft vocation education may suggest ways to increase the supply of craft workers. In addition, comparison of the craft vocational education findings with the occupational choice findings may add to understanding of the factors that influence both of these decisions.

The occupational choice literature may be classified into two categories. In one the focus is on earning's effect on

occupational choice.[1] In the other the focus is on factors other than earnings, some of which are non-economic in nature.[2]

Of the studies that focus on earnings, only two provide empirical tests of the model presented. Using a conditional logit model, Michael Boskin explains occupational choice in terms of the present discounted value of lifetime earnings, occupational investment costs, and the loss of income due to unemployment.[3] Boskin generates a vector of expected values of these variables for each individual classified by major occupational group. He then compares the expected values for a person's actual occupation against its value in other occupations. The results show a significant positive tendency for people to choose the occupation in which present discounted value is the greatest. This relationship is found to hold for females as well as males and for blacks as well as whites. Of interest, Boskin's findings suggest that in choosing an occupation, training costs and layoffs are not an important concern to white males. But they are important to females and black males. While not self-evident, this finding is in accord with intuition, i.e., that white males, being the dominant work group, feel more secure in their prospects of holding a job and earning a return on their training cost, and, hence, give less weight to training costs and potential unemployment in choosing an occupation.

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[1]See Michael J. Boskin, "A Conditional Logit Model of Occupational Choice," Journal of Political Economy 82 (March-April 1974): 389-98; similar studies are listed in the bibliography under occupational choice.

[2]See, for example, Peter Schmidt and Robert P. Straus, "The Prediction of Occupation Using Multiple Logit Models," International Economic Review 16 (June 1975): 471-86. Other studies are listed in the bibliography under occupational choice.

[3]Boskin, "Occupational Choice," pp. 389-98.

The effect of earnings on occupational choice is also examined in an extensive analysis of forest workers by Philip Cottell.[4] Unfortunately, his sample includes only 75 people. This study, which employs multivariate probit analysis, also indicates that earnings play a significant role in occupational choice. Cottell also finds that social, personal, and family related factors are important.

The premise that non-economic factors influence occupational choice is supported by a number of studies. For example, in a study of youths living in rural areas of Pennsylvania, Thomas Iwand and Judith Stoyle indicate that the parental occupation is the dominant factor influencing choice of occupation among children.[5] In another study, Peter Schmidt and Robert Strauss use a multiple logit model to test the effect of education, work experience, race, and sex on occupational choice. Not surprisingly, they find that blacks and women are more likely to be in blue-collar, service, and clerical occupations than in other occupations.[6] Their data also suggest a significant positive relationship between educational attainment and the likelihood of being in a white-collar occupation.[7]

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[4]Philip L. Cottell, Occupational Choice and Employment Stability Among Forest Workers, (New Haven: Yale University 1974), esp. pp. 108-113,122-3.

[5]Thomas Iwand and Judith Stoyle, "Social Rigidity: Income and Occupational Choice in Rural Pennsylvania," Economic and Business Bulletin 22 (Spring-Summer 1970): 26.

[6]Schmidt and Strauss, "Prediction of Occupation," pp. 471-86.

[7]Other studies suggesting similar relationships are documented in the bibliography under occupational choice.

2. A Model of the Decision to Enter a Craft

Whether or not a young man enters a craft is influenced by economic and demographic factors that, for analytical convenience, can be classified into two categories. Included in the first category are factors that affect the utility that an individual may derive from being a craftsman. Included in the second category are factors which limit an individual's opportunities to enter a craft.

The utility of entering a craft depends, in part, on current and future earnings in the craft, the rate at which an individual discounts earnings, and the time horizon over which the earnings are discounted. Empirical measures of these variables, while not easy to derive, can be formulated. For example, a variable that may serve to identify individuals who have low discount rates and long time horizons is marital status. Nonmonetary factors may also determine the utility that a young man derives from entering a craft occupation; he may prefer craft work because it is often performed outdoors or because it may afford more leisure than other occupations. A preference for craft work may be indicated by a direct statement of preference or by less direct indicators, for example, by educational attainment, the presence or absence of craft vocational education, and father's occupation. In addition to reflecting aspirations to enter crafts, these factors may also aid, or constrain, a person

in finding craft employment. Other constraints include the demand for craftsmen and the immediate income needs of an individual. For example, young men from poor families may be deterred from craft occupations because of the relatively large cost of training that may be required.

A. The Utility Function - In deciding whether or not to enter a craft, a young person is likely to emphasize the occupation-oriented variables in his utility function.

His utility function can be written as

$$U = U(PDV_E, \text{Job Satisfaction})$$

where $PDV_E = PDV_E$ (Current earnings, Expected future earnings, Discount rate, Time horizon)

and

Job Satisfaction = J.S. (Type of occupation, Nature of industry, Amount of leisure associated with job, etc.)

Economic theory suggests that the present discounted value of earnings is a significant factor in determining occupational choice. A young man may be influenced by the current earnings and the future earnings of an occupation. High future earnings may attract young men with low discount rates and long time horizons. As noted above, married persons may be more likely to exhibit such characteristics than unmarried ones.

In addition to the present discounted value term, the utility function includes a job satisfaction term. It represents factors other than earnings that may characterize an occupation. At some point in time a young man begins to develop career aspirations. These aspirations may be due, in part, to expected earnings in the occupation, but they may also be due to the type of work associated with the

occupation or the amount of leisure associated with it. These tastes may be discovered through direct inquiry or the personal characteristics of the individual may reveal this information in a less direct manner.

Occupational aspirations may be revealed by the level of education that a young man achieves. A young man who is well educated is likely to aspire to an occupation that requires that preparation. Crafts do not require advanced education so that young men who have advanced education probably do not wish to enter crafts.

It might be presumed that the relationship between entry into crafts and intelligence is the same as the relationship between entry into crafts and education. When education is controlled for, however, a positive relation may exist between IQ and craft entry. Among young men with low or moderate levels of education, those with higher intelligence may aspire to enter crafts. The opposite relationship may exist at high levels of education, but as well-educated persons are unlikely to enter crafts for other reasons, variation in IQ among this group may be unrelated to craft entry.

While young men with education may have a predisposition for white-collar work, it is likely that individuals who enroll in craft vocational education are interested in entering a craft occupation. Likewise, a young man may be more likely to enter a craft occupation if his father is a craftsman. In this case, the father may provide the model that his son attempts to emulate.

B. Constraints and Aids to Craft Entry - The opportunity for a young man to enter an occupation is constrained in three ways. First, the demand for labor in an occupation limits the number of workers who can enter it. Second, an individual's occupational opportunities may be limited by his personal characteristics, e.g., education, craft vocational training, race, etc. Third, the immediate income needs of an individual may limit his choice of occupation.

A young man is more likely to find employment in a craft if the demand for craftsmen is high. Conversely, the opportunities to enter a craft are lower when demand is low. A model of the decision to enter crafts should control for variation in demand.

A young man's personal characteristics may also influence his opportunities to enter a craft. A minimal amount of education may be necessary to work with figures and to read blueprints or other instructions that are used in varying degrees throughout all crafts. Young males with little education may be deficient in these skills and may experience difficulty in finding craft employment. The preceding occupational aspirations discussion suggests, however, that individuals with advanced education may not aspire to enter a craft. Furthermore, the more education an individual has, the better certified he is to enter occupations such as sales, managerial, and the technical and professional occupations. Higher levels of education remove constraints that inhibit entry into these occupations. The absence of these constraints decreases the likelihood of a young man entering crafts. In summation, the relationship between education and craft entry may be positive at low levels of education and negative at high levels of education.

One level of education may have a greater impact on craft entry than other levels. Completion of high school increases opportunities to enter occupations which use a high school degree as a screening device.[8] A young man who completes high school may have access to many occupations in addition to crafts and may be less likely to enter crafts. For this reason, the impact of completing high school may be greater than the general impact of additonal education.

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[8]The use of educational degrees as screening devices is discussed in Fred Hirsh, Social Limits to Growth, (Cambridge: Harvard Press, 1976), pp. 41-52, and Paul Taubman and Terence Wales, Higher Education and Earnings, (New York: McGraw Hill, 1974), Chapter IX.

Crafts require a number of different skills, some of which may be gained by participating in craft vocational education. If craft vocational education does not develop useful skills in young people, then such education should not aid them to enter crafts. An extensive literature is concerned with the usefulness of vocational education.[9] The impact of craft vocational education on craft entry can be viewed as another measure of effectiveness of this kind of education.

In examining the relationship between craft vocational education and entry into the crafts, it should be recognized that a positive relationship is likely to exist between them whether or not the former is effective. This is true simply because young men who take craft vocational education are also likely to want to become craftsmen. This is the aspirations effect noted in the discussion of the utility function. To measure the effect of craft vocational education in facilitating craft entry, control should be provided for the aspirations effect.

It might also be argued that even if craft vocational education increases the likelihood of craft entry, this may be due to still another factor besides aspirations. It may be that participants in craft vocational education are more likely to enter crafts because these programs also provide placement services.[10] If, however, the young people placed by these programs are no more qualified to enter crafts than other young people, employers would have little incentive to give them preference when hiring.

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[9]A recent survey of this literature is provided by Leonard Lecht, Evaluating Vocational Education - Policies and Plans for the 1970s, (New York: Praeger, 1974), pp. 80-4. These and other studies are listed in the bibliography under vocational education.

[10]Approximately 25 percent of HEW vocational education funds are spent on guidance and counseling. U. S. Department of Health, Education and Welfare Office of Education, Bureau of Occupational and Adult Education, Vocational and Technical Education, Selected Statistical Tables, Fiscal Year 1974, (Washington, D.C., 1974) p. 20.

Another aid to craft entry involves parental occupation. A young male whose father is a craftsman may have an advantage in craft entry. His father may be able to help him enter a craft through nepotism or simply by providing information about how to apply for entry.

Opportunities to enter crafts may be influenced by race; for example, nonwhites may encounter hiring discrimination.[11] If the discrimination exists, it reduces the demand for nonwhite labor and increases the demand for white labor. Nonwhites may be less likely to enter crafts for another reason. They may have less information about the labor market in general, and about how to enter craft occupations in particular.

Unions are pervasive in craft occupations. It may be that craft entry is more difficult in labor markets where unions are stronger than average. This may be particularly true for nonwhites, as discrimination may be more prevalent in union shops.

The occupational choice of young men may also be constrained by immediate income needs. If a young man has pressing income needs, say, because he is a member of a large family, he may be deterred from occupations that provide general training; to acquire general training on the job, an individual must work for a wage that is less than his marginal value product.[12] A young person with pressing immediate income needs may choose a job which pays a higher current wage, but which provides little training, craft or otherwise.

Having noted this immediate "income needs" effect, it is important to recognize that this influence may also be reflected by completion of high school. A young person may drop out of high school if his family is

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[11] This is particularly true of the construction crafts. See Orley Ashenfelter, "Discrimination and Trade Unionism" in Orley Ashenfelter and Altert Rees, eds., Discrimination in Labor Markets, (Princeton: Princeton University Press, 1973), pp. 88-112.

[12] Gary S. Becker, Human Capital, 2nd ed., (New York: National Bureau of Economic Research, 1975), pp. 37-38.

poor or simply because he lacks the perseverence to finish.[13] These reasons may also cause him to take a job that pays high initial wages, but which provides little craft training. This effect counteracts the screening effect associated with completion of high school. If neither effect dominates the other, it will not be a useful indicator of craft entry.

It might be thought that marriage would affect craft entry through its impact on immediate income needs. Some married young men may have to support their wives and have immediate income needs. But other married young men's wives may earn income and contribute to the support of their husband. These situations may offset each other.

3. The Decision to Enter a Craft
Variables in the Empirical Equation

The discussion in the previous section suggests that craft entry can be modeled by the equation shown below. All variables are entered linearly since no specific relationships are suggested by theory. The model of this study has the following form:

$$Cft = \alpha + B_1 Earn + B_2 Asp + B_3 Ed + B_4 HS + B_5 Voc + B_6 FOc + B_7 MR + B_8 Ue + B_9 Grth + B_{10} IQ + B_{11} R + B_{12} FS + \varepsilon$$

where

- Cft: Craft dummy, = 1 for young males employed full time in any of the selected crafts between 1966 and 1973; = 0 otherwise
- Earn: Mean earnings of all census craft workers in 1969 in the young male's industry
- Asp: Craft aspirations dummy, = 1 for young males who aspired to any of the selected crafts

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[13] Completion of high school is shown to be an indicator of perseverence in Sheldon Haber, "Factors Influencing Attrition in the Marine Corps," (Technical Paper Serial T-306, Program in Logistics, The George Washington University, March 4, 1975), pp. 34-6.

Ed: Highest level of education completed by 1973

HS: High school dummy, = 1 for young males who completed high school by 1973

Voc: Vocational education dummy, = 1 for young males who participated in craft vocational education by 1973

FOc: Father's occupation in crafts dummy, = 1 for young males with fathers employed in any of the selected crafts between 1966 and 1973

Mr: Marital status dummy, = 1 for young males married in 1966

Ue: Unemployment rate in the region of residence

Grth: Percentage change in employment of all census craft workers between 1965 and 1970 by industry

IQ: Intelligence quotient

R: Race dummy, = 1 for nonwhite young males

FS: Number of people in family

The variables in this equation are derived from two data bases. The primary data base is the National Longitudinal Study of Young Men (NLS). It contains measures of all the variables except the earnings variable and growth rate of employment variable. These are derived from the 1970 Public Use Sample (PUS). The use of these sources and the exact meaning of each of the variables is described in this section.

The dependent variable is the craft entry dummy. Craft entry is defined as full-time employment in any craft in a selected group of crafts in any year between 1966 and 1973. The selected group includes crafts that are important in shipbuilding, e.g.,

welders, pipefitters, electricians, etc. (See Appendix II.1 for a complete list.)

Discussion of the utility function suggests that earnings and occupational preference variables should be included in a model of occupational choice. An ideal earnings variable would measure the earnings that an individual could earn in crafts relative to other occupational opportunities. One approximation of this ideal would be the earnings of craftsmen relative to the earnings of other workers in the local labor market where the individual resides. Unfortunately, such data are not available. As an alternative, earnings opportunities are defined on an industry basis.

The earnings variable is derived from the PUS and assigned to the individuals in the NLS in the following manner. First, mean earnings are derived by industry for all craft and kindred workers in the PUS. All crafts are used instead of the selected crafts to increase the number of observations. If an individual entered any of the selected crafts, his earnings variable is assigned the value of the mean craft earnings of the industry that he entered. If an individual did not enter a selected craft occupation at any time in the 1966-1973 period, his first industry of employment is used to assign to him the mean earnings of craftsmen in that industry. It should be noted that the industry earnings derived from the PUS reflect only 1969 earnings. It is assumed that the structure of earnings among industries during the 1966-1973 period was similar to its structure in 1969.

In adopting this approach, the relationship between earnings and occupational choice can be viewed as follows. If craft earnings in an industry, for example shipbuilding, are below the competitive level, young men will be less inclined to enter a selected craft occupation in that industry. On the average, one

would expect individuals who enter the selected crafts to do so in industries where craft earnings are higher, i.e., higher than in the industries entered by individuals who did not choose one of the selected crafts. Individuals who did not enter crafts might enter any industry, but on average, the mean craft earnings in these industries should be lower. If earnings do not influence the occupational choice decision, one would expect the mean craft earnings in the industries of selected young craftsmen to be no higher than in the industries of other young workers.

Another way to interpret the industry craft earnings variable is as a proxy for the craft earnings opportunities in an individual's local labor market. Individuals enter industries that are, by definition, in their local labor market. The mean craft earnings in these industries can be used as proxies for craft earnings opportunities there. For example, an individual in Detroit who enters a selected craft in the automobile industry is assigned that industry's mean craft earnings. Individuals who did not enter one of the selected crafts may have been influenced by low craft earnings in their local labor markets. On average the mean craft earnings in industries where craftsmen found employment should be higher.

A marital status variable is included in the model because married young people may have longer time horizons and may be more likely to recognize the higher future earnings of craftsmen. This variable indicates whether or not an individual was married in 1966.[14]

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[14] A direct measure of future earnings is not included in the model for several reasons. First, most young men who are interested in crafts have only moderate levels of education and, hence, may not be able to perform sophisticated calculations when estimating the present value of future earnings. Second, and perhaps more importantly, it may be that young men, prior to entry into an occupation, have limited information about future earnings in alternative blue-collar occupations. Third, the rate of increase of earnings with age is similar in these occupations. The ratio of the earnings of all workers to the earnings of young workers is approximately 1.4 for craftsmen, operatives, and laborers. Bureau of the Census, 1970 Public Use Sample.

Several variables are included that may reflect aspirations to enter crafts. The main purpose of these variables is to control for the aspirations effect of the craft vocational education variable. A good control for craft aspirations is available in the NLS, where individuals were directly questioned about their career aspirations. Based on this information a dummy variable is included in the model to indicate whether or not the individual expressed a desire for a career in crafts. Less direct controls are also included, e.g., educational attainment and the intelligence quotient. With these controls, the craft vocational education variable can be interpreted as an indicator of the effectiveness of craft vocational education in training young craftsmen. The degree to which the aspirations effect of craft vocational education is controlled, however, cannot be known.

There are two variables in the model which may reflect either occupational preference or assistance in entering crafts. One of these is the previously mentioned craft vocational education dummy. This variable indicates whether or not an individual participated in craft vocational education at any time between 1966 and 1973. Such participation is, however, almost certain to have occurred before entering crafts full time. A young craftsman has little use for craft vocational education after having entered crafts; craft vocational education is general in nature and useful in learning the basics of craft work, but it can add little to actual on-the-job training. Another occupational preference or aid-to-entry variable is a dummy variable that indicates whether or not the father of an individual is a craftsman. The father of an individual is designated as a craftsman if he was employed in a selected craft occupation between 1966-1973.

Measures of the various constraining factors are also included in the model. To control for the demand for young craftsmen, the percentage change in employment in crafts between 1965 and 1970 is used. The procedure used to derive this percentage is analogous to the one utilized for the earnings variable. First, percentage changes by industry were derived from the PUS for all craft and kindred workers. Then, individuals who entered a selected craft were assigned the percentage change in craft employment of their entry industry; individuals who never entered a selected craft were assigned the percentage change in craft employment of their first industry of employment. With this variable in the model, the earnings effect can be distinguished from the demand effect. The separation of these effects is important because without the control for demand, it could easily be argued that the earnings variable merely reflects greater opportunity for craft employment.

While this procedure is a reasonable way to measure demand for workers who aspire to enter a craft, there is a problem in using it for workers who do not aspire to enter a selected craft. In those industries entered by individuals who did not aspire to have a career in crafts, craft employment declined in many instances by as much as 84 percent. One explanation for such large decreases is the greater use of contract services in noncraft-oriented industries. Rather than having an in-house plumber or painter, a professional or retail establishment may contract for these services. The high negative percentage changes in employment industries entered by non-aspirants creates a spuriously high positive correlation between individuals who do not enter crafts and the growth variable. This spurious correlation can be avoided by measuring only variation in the growth rates associated with individuals who aspired to enter a craft. This is achieved by entering the growth variable in the model as the product of itself and the craft aspirations dummy

variable. Multiplying by the craft aspirations dummy sets the growth rate to zero for individuals who do not aspire to enter a craft.[15] The remaining variation in the variable reflects differences in demand in the industries of individuals who aspire to crafts.

The growth rate of employment of craftsmen measures changes in demand for craftsmen. The regional unemployment rate is used to help control for the initial level of demand for craftsmen. The unemployment rate of the region of residence in 1965 is the best measure available for this purpose. As better proxy for the demand for craftsmen would be the unemployment rate of craftsmen. These data, however, are not readily available on a regional basis or more local basis. This may not be a large problem since the general rate of unemployment reflects demand for labor in all occupations.

Other variables are included to capture the effect of other constraints. A dummy variable is used to control for the discrimination or information effects of race. The number of family members is included to test for the effect of immediate income needs on craft entry.

Discussion in the preceding section suggests that education should be specified quadratically to fit a positive relationship at low levels of education and a negative relationship at high levels of education. Experimentation with a quadratic specification of education does not, however, suggest that a positive relationship exists at low levels of education.[16]

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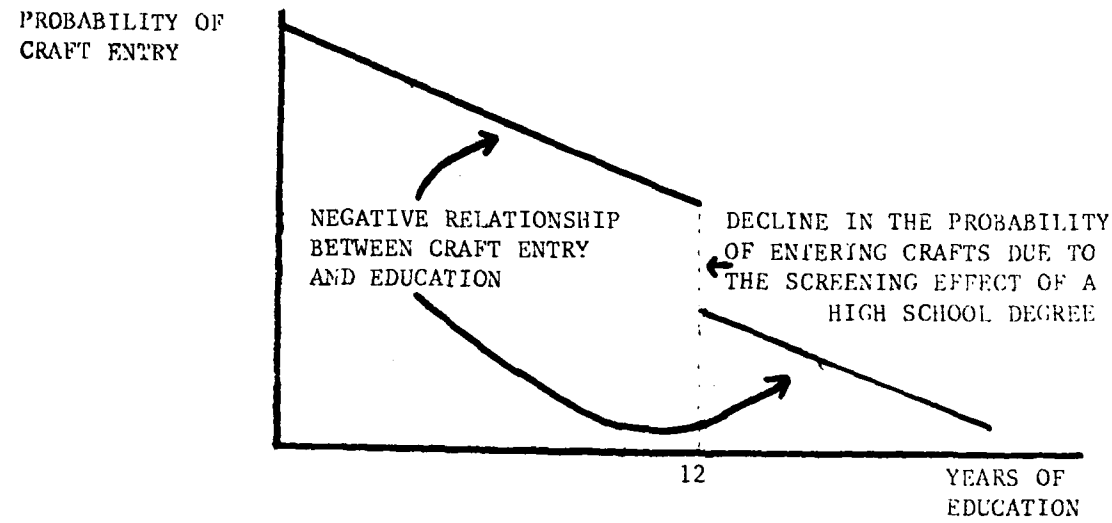
[15] Instead of setting these growth rates to zero they can be changed to any other constant. Such a change does not affect the estimates of any variables other than the constant and the craft aspirations dummy. This is due to the perfect correlation between the craft aspirations dummy and the zeroes in the growth variable.

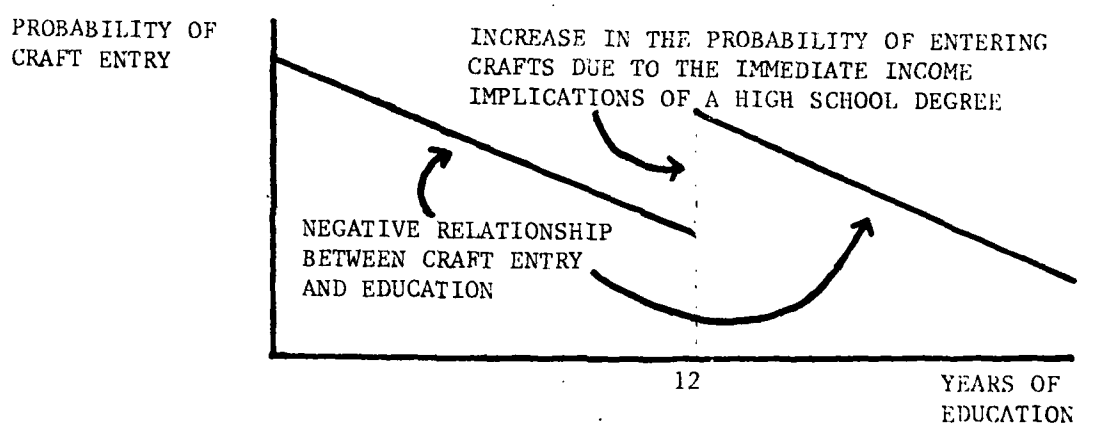
[16] This finding may be due to the small number of individuals with low levels of education in the craft entry sample. In the National Longitudinal Study of Young Men (NLS), individuals who did not attend high school often have missing data and are not included in the craft entry data set. Those excluded individuals may change the form of the education control from quadratic to linear, but there is no reason to believe that any bias has been introduced.

While the education specification is not quadratic, neither is it a simple linear one. This is due to the inclusion of a dummy variable that indicates whether or not the young person finished high school. It is included to test for dominance of either a high school degree's screening effect or of its immediate income implications. As previously mentioned, a high school degree may increase an individual's access to occupations other than crafts if the degree is used as a screening device in them. Offsetting this effect, possession of a high school degree suggests that an individual did not quit school due to immediate income needs; lack of this pressure makes it easier for an individual to take a craft job which requires an investment in general training. If either effect is dominant, the high school dummy will cause a positive or negative discontinuity in the relationship between education and craft entry (see Figure III.1).

The strength of craft unions in a young man's labor market may influence his ability to enter crafts, but there are several problems in incorporating this factor into the model. One problem is that a measure of unionization in craft occupations in each industry is needed, rather than a measure of unionization in an entire industry. The degree of unionization among industries may vary widely due to differences in occupational mix, while the degree of unionization in crafts may be relatively constant. Another problem is that the unionization measure is needed on a local basis. For these reasons, a measure of unionization could not be included in the model. This may not be a large problem, since, to some extent, the effect of unions on craft entry may be reflected by the race variable. As previously noted, nonwhites may find crafts especially difficult to enter where unions are strong.

No direct measure of an individual's ability to do craft work or of the leisure that he associates with crafts is available. These factors, however, may be controlled, in part, by the variables already included in the model. Individuals with high ability in craft skills





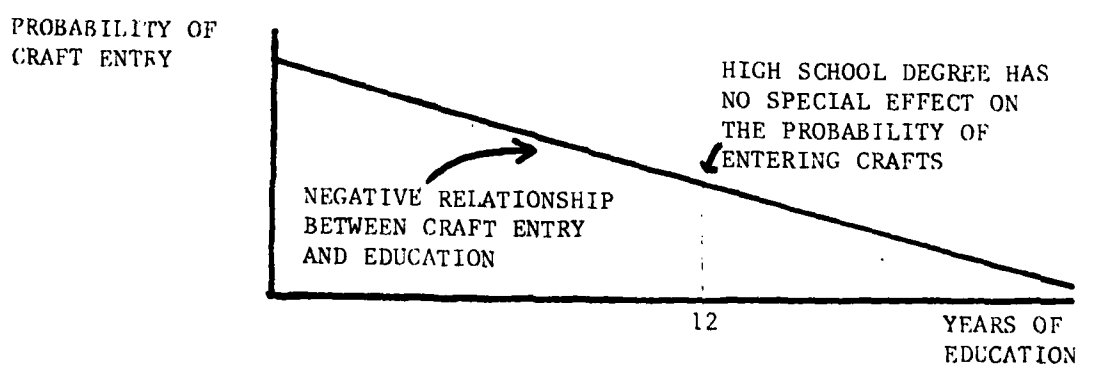


FIGURE III.1

POSSIBLE RELATIONSHIPS BETWEEN CRAFT ENTRY AND EDUCATION

may aspire to crafts, attain lower levels of education, and have fathers who are craftsmen. For this reason, the absence of a direct measure of ability should not be a large problem in the model. Similarly, the aspirations dummy may identify individuals who are attracted to craft work by the leisure they associate with it.

It is difficult to directly measure the effect of leisure on the decision of an individual to enter crafts. In considering leisure, an individual is likely to compare the leisure he expects in his alternative job opportunities. One cannot hope to have such detailed information about individuals. One possible proxy for this information is the average number of hours worked in crafts relative to other occupations. This measure is only available on a regional basis for the NLS. Since hours of work do not vary much in such aggregate measures (see Chapter V, Table V.1), the derivation of such a measure holds little promise. As noted above, however, the aspirations dummy may identify individuals who are attracted to craft work by the leisure they associate with it.

4. Empirical Results

The estimates of the model are displayed in Table III.1 together with the corresponding means and standard errors. The mean values for the variables are given for the entire sample and for two subsets of individuals, those who entered the selected crafts and those who did not enter the selected crafts. As a comparison of means in the last two columns shows, the individuals who entered crafts found employment in industries where craft earnings were higher and where craft employment was growing more rapidly. A relatively large percentage of these individuals aspired to enter a selected craft, had craft vocational education, and had a parent who was a selected craftsman. They tended to be white and married and to have less education, a lower IQ, and to come from smaller families. These findings are consistent with the theory discussed in Section 2, but none of the differences are statistically significant at even the ten percent level of a one tail test. The multiple regression analysis shows many significant relationships.

Ordinary least squares was used to obtain initial estimates of the model. These estimates are consistent, but they are inherently heteroscedastic because the dependent variable is dichotomous. (For a discussion

Table III.1

Occupational Choice Model
Factors That Influence Young Males to Enter Crafts

Variables	Probit Coefficient (S.E.)	OLS Coefficient (S.E.)	All Observations Mean (S.E.)	Craft Participation Yes Mean (S.E.)	Craft Participation No Mean (S.E.)
Constant	-0.130 (0.488)	0.263 (0.090)			
Earnings of craftsmen by industry	0.070** (0.027)	0.013 (0.005)	7.074 (1.570)	7.482 (1.509)	6.986 (1.574)
Craft aspirations dummy	0.814** (0.097)	0.232 (0.193)	0.396 (0.489)	0.782 (0.414)	0.313 (0.464)
High school dummy	-0.086 (0.159)	-0.053 (-0.034)	0.924 (0.264)	0.839 (0.368)	0.943 (0.232)
Vocational education for crafts dummy	0.405** (0.096)	0.114 (0.021)	0.234 (0.423)	0.513 (0.501)	0.174 (0.379)
Father's occupation in crafts dummy	0.150 (0.099)	0.036 (0.020)	0.202 (0.402)	0.305 (0.461)	0.180 (0.384)
Marital Status dummy	0.218* (0.114)	0.069 (0.024)	0.162 (0.369)	0.309 (0.463)	0.131 (0.337)
Unemployment rate of region	-0.039* (0.022)	-0.005 (0.004)	4.309 (2.104)	4.145 (1.961)	4.343 (2.134)
Growth rate of employment of craftsmen by industry	1.577** (0.204)	0.399 (0.034)	-0.028 (0.241)	0.099 (0.174)	-0.055 (0.245)

- continued -

Table III.1 continued

Occupational Choice Model
Factors That Influence Young Males to Enter Crafts

	Probit Coefficient (S.E.)	OLS Coefficient (S.E.)	All Observations Mean (S.E.)	Craft Participation	
				Yes Mean (S.E.)	No Mean (S.E.)
Intelligence quotient	0.296 (0.358)	0.071 (0.066)	1.035 (0.151)	0.996 (0.133)	1.043 (0.153)
Nonwhite dummy	-0.556** (0.163)	-0.098 (0.027)	0.123 (0.329)	0.057 (0.232)	0.137 (0.344)
Family size	-0.047* (0.025)	-0.007 (0.004)	4.731 (2.038)	4.309 (1.820)	4.821 (2.071)
R^2	.409	.279			
Number of observations	1696	1696	1696	298	1398

Source: All data for these estimates were derived from Center for Human Resources Analysis, National Longitudinal Study of Young Men, (Columbus: Ohio State University) except for the earnings and growth rate employment variables; these were derived from the Bureau of the Census, 1970 Public Use Sample.

Note: ** - Significant at the one percent level

* - Significant at the ten percent level

of this and other methodological problems, see Appendix A.) In addition, a transformation was necessary to constrain the model's predicted probability to the zero-one range. Maximum likelihood estimation of a probit transformation was utilized to obtain a constrained model with consistent and asymptotically efficient estimates.[17]

The probit estimates indicate that craft entry is positively related to earnings, craft aspirations, craft vocational education, marriage and craft employment growth. These estimates also indicate that craft entry is negatively related to years of education, the unemployment rate, race (nonwhite) and family size. Other variables, completion of high school, father's occupation in a craft and IQ have their expected signs, but are not significant.

The earnings variable is significant with a t ratio of 2.57. This suggests that the decision of young people to enter a craft is influenced by craft earnings. As previously noted, this variable may be interpreted in two ways. First, since the earnings proxy is derived on an industry basis, it suggests that the earnings an industry pays affect its ability to attract young craftsmen. Second, as a proxy for earnings opportunities in local labor markets, it suggests that occupational choice is influenced by earnings. It should be noted that this proxy is derived using national data so that there is no control for geographic variation in industry earnings. This lack of control reduces the precision with which the variable reflects local craft earnings opportunities. In spite of this lack in precision, the earnings variable still shows a significant relationship to craft entry. This finding strongly suggests that earnings influence the decision of young people to enter crafts.

The controls for the demand for craftsmen are also significant. The growth in craft employment variable is highly significant with a t ratio of 7.74. The unemployment rate by region of residence is significant at the 10% level (t = 1.72).

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[17] Research was begun using a logit transformation, but previous to completion of the analysis, probit software became available that had fewer limitations. Because of computational costs, logit estimates were not carried past the preliminary stages. These results lead, however, to the same conclusions as those derived from the probit transformation.

While an individual's opportunities to enter crafts are diminished by low demand for craftsmen, they can be increased by prior training. The findings of this model suggest that individuals who have craft vocational education are more likely to be able to enter crafts. The craft vocational education dummy is highly significant with a t ratio of 4.22. As noted, the model includes a number of powerful controls for craft aspirations; without these, the impact of the craft vocational education dummy would be higher. Craft vocational education remains a highly significant explanatory variable in the presence of these controls, which suggests that craft vocational education provides useful skills that make its recipients more qualified to enter crafts.

One of the principal craft aspirations controls is the craft aspirations dummy. It is a powerful control with a t ratio of 8.42. The other significant craft aspiration control is the education variable. Its t ratio is -4.39. Individuals who acquire higher levels of education are likely to enter occupations that require that education; they are less likely to enter crafts.

The marital status dummy is significant (t = 1.90). The significance of this variable suggests that young people who are married have longer time horizons on average than those who are not. Young people who have longer time horizons are more likely to enter crafts because they perceive the future gains of investing in training for crafts.

Another human-capital-oriented variable acts as a constraint to craft entry. The findings of this model suggest that young people who have large families are less likely to enter crafts (t = -1.90). The need for immediate income may prevent individuals in large families from investing in training for crafts.

The results of the model also suggest that race acts as a constraint to craft entry. The nonwhite dummy is significant with a t ratio of -3.42. This relationship is estimated while controls are provided for important human capital variables, e.g., education, craft vocational training, and IQ. Given these controls, the significance of the nonwhite dummy suggests that nonwhites either face discrimination or are less informed about craft opportunities.

As previously noted, if an individual's father is a craftsman, he may be more likely to enter a craft for several reasons, i.e., role modeling, nepotism or information availability. The father's occupation in crafts dummy is just short of significance at the 10 percent level ($t = 1.52$). Of interest, when the model is specified without the aspirations dummy, the father's occupation in crafts dummy is significant. These results suggest that the aspirations dummy controls for the role modeling (aspirations) effect of the father's occupation and that nepotism and a father's information about crafts do not have a strong effect by themselves.

An additional inference can be made concerning craft entry and information about crafts. As previously noted, it appears that craftsmen do not give their sons information which helps them enter crafts. Given this, it is unclear what kind of information nonwhites could be lacking which would hinder their access to crafts. If lack of information about craft entry is discounted as a cause of nonwhites' lower craft entry, then other factors must be important, perhaps racial discrimination.

The intelligence quotient is insignificant. Its positive sign is, however, consistent with the discussion in Section 2. The mean values of IQ and education given in Table III.1 suggest that they both are negatively related to craft entry. In the regressions, however, the effect of IQ can be seen while controlling for the level of education. When controlling for education, the effect of IQ is not significantly different from zero.

The completion of high school is not found to be a significant predictor of craft entry. This may be the result of a balance between its screening effect and immediate income implication, or both of these may be insignificant. In either case, completion of high school is not a significant predictor of craft entry.

5. Partial Effects and Policy Implications

Because of the nature of the probit transformation, the parameters of the model cannot be interpreted directly. The partial effect of a variable can be found by evaluating the model at two values of the variable while holding the remaining variables at their mean values. Following this procedure, the estimated partial effect of earnings is shown in Table III.2. The probability of a young person deciding to enter a craft is given for various levels of earnings. The partial effect is the difference in probabilities between each level of earnings, for example, Prob ($8,000) - Prob ($7,000) = .122-.108 = .014.

Table III.2

The Partial Effect of Earnings on the Probability of Entering a Craft Occupation

Earnings in 1969	$5,000	$6,000	$7,000	$8,000	$9,000	$10,000
Probability of Craft Entry	.084	.096	.108	.122	.137	.152
Change in Probability		.012	.012	.014	.015	.015

In interpreting Table III.2 it is important to note that the earnings variable is a proxy for the earnings paid to craftsmen in the local labor market where an individual resides. Keeping this in mind, the model estimates suggest than an increase of earnings from $7,000 to $8,000 raises the likelihood that an individual will enter a craft by 1.4 percentage points. In terms of the supply of young craftsmen to an industry, the partial effect is not as clear. Each one thousand dollars of earnings should increase the probability of individuals entering crafts by 1.4 percentage points. But the size of the labor market over which the earnings effect extends is unknown. Without such knowledge, the partial effect cannot be translated into a flow of individuals. Thus, the partial effects estimated in this model can only be used as a rough measure of the impact of earnings (and other variables) on supply.

The partial effects of all the significant variables in the probit analysis are shown in Table III.3. Ordinary least squares partial effects are also shown. They are consistent, but they are not constrained to yield estimates in the zero-one probability range. The probit partial effects given are correct in the range of the means of the variables. The reader might note from Table III.3 that the probit transformation generates a larger partial effect as the predicted probability of the model becomes larger. This continues until the predicted probability is greater than .5 (See Appendix A.3).

The partial effects listed in Table III.3 measure the impact of the variables on the flow of young people into crafts. Besides the earnings variable discussed above, two other variables are of interest. The partial effect of the craft vocational education dummy suggests that individuals who have craft vocational education are 8.6 percentage points more likely to enter crafts. This partial effect is estimated while controlling for craft aspirations. Given this control, the craft vocational education partial effect provides an indirect measure of the usefulness of craft vocational training. Although this relationship suggests that craft vocational education increases productivity, it is not possible to convert the 8.6 probability measure into a productivity measure. Without a conversion to productivity terms, the measure cannot be interpreted within the benefit-cost framework. What can be inferred is that by participating in craft vocational education a young man increases his chance of entering a selected craft by 8.6 percentage points.

The partial effect of the nonwhite dummy suggests that nonwhites are eight percentage points less likely to enter crafts than whites. As mentioned in Section 4, this measure is obtained while controlling for many important factors. This finding suggests that nonwhites are not entering crafts either as a result of racial discrimination or due to lack of information about the craft labor market. In either event, work force productivity and equity could be improved by removing these barriers to entry.

Table III.3

Probit and OLS Partial Effects for the Probability of a Young Man Entering a Craft Occupation

Variables	Probit	∂ Probability/∂ Variable	
	Parameters	Probit	OLS
Earnings (in thousands)	0.070	0.014	0.013
Craft aspirations (dummy)	0.814	0.170	0.232
Education (in years)	-0.131	-0.026	-0.019
Craft vocational education (dummy)	0.405	0.086	0.114
Marital status (dummy)	0.218	0.044	0.069
Unemployment rate (for one percentage point change)	-0.039	-0.007	-0.005
Growth rate of employment of craftsmen (for one percentage point change)	0.0157	0.0037	0.0040
Nonwhite (dummy)	-0.556	-0.080	-0.098
Family size	-0.047	-0.009	-0.007

Note: Only significant variables are listed in this table, i.e., ones with t ratios greater than 1.65.

A final policy implication concerns the insignificance of the father's occupation in crafts variable. It appears that craftsmen do not have special information that they can use to help their sons enter crafts. If such special information were important, children of non-craftsmen would have less access to one of the higher paying occupational classes. In this case, policies might be undertaken to provide this information, thereby improving both efficiency and equity in the labor market. As special information does not appear to be conveyed from a craftsman to his son, policies to provide information do not appear warranted.

6. Summary

In this chapter a number of variables are found to have a significant influence on the flow of young people into crafts. These are earnings, craft aspirations, years of education, craft vocational education, marital status, the unemployment rate, the growth rate of craft employment, race, and family size. Variables that are insignificant are completion of high school, parental occupation, and IQ.

The significant variables can be classified according to their role in the model. Some of the variables are included in the model simply as controls. Variables measuring craft aspirations, years of education, the growth rate of craft employment, and the unemployment rate serve this purpose. The first two variables are controls on the supply side, the latter two are controls on the demand side. Two other variables, marital status and family size, are particularly important because they emphasize the human capital aspects of craft entry.

Three of the variables have policy implications. One of the implications is that craft earnings are an important factor in the decision of a young person to enter a craft occupation. A variation of this interpretation is that young people are more likely to enter crafts in industries that pay higher wages. Another implication pertains to the race variable; it appears that work force productivity could be increased and equity improved by reducing barriers to entry of nonwhites into crafts.

Another productivity implication concerns craft vocational education. The significance of this factor suggests that craft vocational education provides training to young people that is useful in crafts; it also suggests that the supply of craftsmen can be augmented through provision of craft vocational education.

CHAPTER IV

FACTORS THAT INFLUENCE YOUNG MALES TO PARTICIPATE IN CRAFT VOCATIONAL EDUCATION WITH COMPARISONS TO FACTORS THAT INFLUENCE ENTRY TO CRAFT OCCUPATIONS

1. Introduction

The flow of young workers into the craft occupations of an industry is affected by many factors, including craft vocational education. Young people who have this training are more likely to enter craft occupations for two reasons. First, factors that lead an individual to participate in craft vocational education are likely to lead him to enter a craft occupation. Second, participation in craft vocational education provides young people with skills that increase their productivity as craftsmen. For these reasons the supply of young craftsmen to an industry is directly related to the number of young people who have craft vocational education. The objective of this chapter is to analyze factors that influence young people to participate in craft vocational education. The analysis has policy implications concerning how the number of young people who take craft vocational education may be increased.

The factors that influence participation in craft vocational education are similar to those that influence entry into craft occupations. Of particular interest in this chapter are differences in the impact of these factors on these two related decisions. These differences are explained, at least in part, by two characteristics of craft vocational education. First, the personal investment required to take it is relatively small. Second, it is readily available to most young people who want to take it. In the next section, discussion is presented concerning the nature of investment in training and how

this investment differs between vocational training and on-the-job training. Also discussed in the next section is the widespread availability of vocational education. In the following section, a brief discussion of the vocational education literature is presented. In latter sections a theoretical model and corresponding empirical equation are developed. Following this discussion, the empirical results are reported and the partial effects of the significant variables are discussed. These findings are then compared to the results of the occupational choice analysis in Chapter III. The chapter concludes with some policy implications of the analysis and a summary of the findings.

2. Investment in Vocational Education and On-the-job Training

As first formalized by Gary Becker, investment in human capital involves direct costs and opportunity costs.[1] Direct costs are expenses such as tuition and books. Opportunity costs are implicit costs of earnings foregone while training. Vocational education costs are largely composed of opportunity costs because tuition and other direct costs are often subsidized by the federal government.[2] Since passage of the Vocational Education Acts of 1963 and 1968, vocational education has been increasingly available in public schools, private schools, and private training institutes.[3] Many of these programs are subsidized, either

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[1] Gary S. Becker, Human Capital, 2nd ed., (New York: National Bureau of Economic Research, 1975), pp. 37-38

[2] The Department of Labor and the Department of Health Education and Welfare sponsor a variety of training programs. See U.S. Department of Labor, Employment and Training Report of the President: 1977 (Washington, D.C.: U.S. Government Printing Office, 1977) Tables F1, F2, F14 and F17. It should be noted that little of the available information regarding the nature of investment in vocational education refers specifically to craft vocational education; as distinct from other types, e.g., business, drafting, engineering, clerical, and agricultural vocational education. For this reason the phrase "vocational education" is used in this section instead of "craft vocational education."

[3] See A. Levitan and Robert Taggart, Social Experimentation and Manpower Policy, the Rhetoric and the Reality, (Baltimore: Johns Hopkins Press, 1971), pp.36-9, 132-6.

completely or partially. This subsidization reduces the direct investment costs of training to individuals. Additionally, the opportunity costs for some vocational education participants are near zero. Some secondary school vocational education majors would finish high school even if vocational education were not available; these individuals do not sacrifice full-time employment to take it. Zero opportunity costs may be the rule rather than the exception, as a study by Leonard Lecht suggests that vocational education does not influence young people to stay in high school.[4] The majority of vocational education is provided in secondary schools, which suggests that total vocational training costs are near zero for a large proportion of vocational education participants.[5]

Most on-the-job trainees, however, bear the cost of their general on-the-job training.[6] General on-the-job training is comparable to vocational training which is general by nature. The investment cost to the on-the-job trainee is the opportunity cost of the extra earnings that he could receive by working at a job that provides less training but pays a higher wage.

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[4]Leonard O. Lecht, Evaluating Vocational Education - Policies and Plans for the 1970s, (New York, Praeger, 1974), pp. 87-9.

[5]Secondary students comprise approximately three-fourths of vocational education enrollees under the age of 24. Department of Health Education and Welfare, Vocational and Technical Education Selected Statistical Tables, F.Y. 1975, (Washington, D.C.: Office of Education, 1975) p.33. Moreover, HEW vocational education programs comprise approximately three-fourths of all federally assisted training. Department of Labor, Employment and Training Report of the President: 1977, Tables F1 and F2; U.S. Department of Health, Education and Welfare. Vocational and Technical Education Selected Statistical Tables Fiscal Year 1976, (Washington, D.C.: Office of Education, Bureau of Occupational Adult Education, 1976), p. 262.

[6]Becker, Human Capital, pp. 19-20. The worker is willing and required to cover the cost of his general training because his marginal product rises in other firms as he gains general skills. Some of the direct costs of on-the-job trainees in the Bureau of Apprenticeship programs are subsidized. But, the size of this program is relatively small when compared to vocational education programs. Department of Labor, Employment and Training Report of the President 1977, Tables F1, F2 and F14.

The difference between investment made in vocational education and on-the-job training is where the burden of the cost falls. The bulk of vocational education for young males is provided by secondary schools where most direct costs are covered. An unknown portion of these trainees also have near zero opportunity costs because their decision to finish high school is independent of their decision to take vocational training. In contrast, most on-the-job trainees must cover the direct and indirect costs of their training. The relatively low personal investment required to take vocational education and its widespread availability should increase participation in craft vocational education and decrease the influence of factors commonly associated with investment in human capital.

3. The Vocational Education Literature

There is a large literature on the costs and benefits of vocational education and manpower programs.[7] There is also a body of knowledge concerning the sources and quantity of private vocational training.[8] There is, however, only a small amount of information on factors which influence young people to take vocational training. Some of this information is found in Leonard Lecht's study; he provides some background characteristics of vocational education students.[9] A similar but more detailed study was conducted by Morgan Lewis and Elchanan Cohn.[10] They review the demographic characteristics of "potential" and actual Concentrated Employment Program

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[7]A recent survey of these is provided by Leonard Lecht, Evaluating Vocational Education, pp. 80-84. These studies and others are listed in the bibliography under vocational education.

[8]Department of Labor, Employment and Training Report to the President, 1977, Tables, F1, F2, F14 and A. Harvey Belitsky, Private Vocational Schools and Their Students, (Cambridge, Massachusetts: Schenkan, 1965), pp. 8, 9, 160. Other sources of information are listed in the bibliography under vocational education.

[9]Leonard O. Lecht, Evaluating Vocational Education, pp. 15-18

[10]Morgan V. Lewis and Elchanan Cohn, "Recruiting and Retaining Participants in a Manpower Program," Industrial and Labor Relations Review 26 (January 1973): 842-50.

participants.[11] Potential participants are defined as people who showed some interest in the program but did not enroll. They find no striking differences between the demographic characteristics of the potential and actual participants. (They do not make comparisons with the general population.) The present study utilizes a large random sample and a probit transformation to analyze the effects of a variety of economic and demographic factors on participation in craft vocational education. These factors are discussed in the next section.

4. A Model of the Decision to Participate in Craft Vocational Education

A. The Utility Function - Craft vocational training is preparation for a craft occupation; hence, the utility function relating to participation in vocational education is similar to the one pertaining to craft entry. For example, high craft earnings may make craft vocational training more attractive, i.e., the returns from a career in crafts may influence the decision to take preparatory training in the form of craft vocational education. Individuals who are married may have longer time horizons than those who are not; they may be more career oriented and wish to prepare for a career in crafts by obtaining craft vocational training. Occupational preference for crafts should also play an important role in the decision to participate in craft vocational education. Such a preference may be revealed in a number of ways, one of which would be a stated preference by the individual. As indicated in the preceding chapter less direct indicators of occupational preferences may be education, IQ, and parental occupation. As far as occupational aspirations are concerned, education is expected to be negatively related to participation in craft vocational education. Individuals who have high levels of education may aspire to occupations other than crafts and not be inclined to take craft vocational training. Similarly, IQ is included as a control for occupational aspirations. Finally, if the father of an individual is a craftsman, this may have a role model effect on his decision to obtain vocational training for a craft career.

[11] The Concentrated Employment Program was one of several manpower programs begun in the 1960s that was targeted at disadvantaged groups.

In terms of these factors, the only major difference pertains to craft earnings. Craft earnings lie in the near future for individuals contemplating entering a craft occupation; they lie in the more remote future, however, for individuals considering participation in craft vocational education. Craft earnings should be discounted more in the craft vocational education decision. Additionally, young men considering participation in craft vocational education may have less direct information about the earnings of craftsmen than young men who are actually looking for a craft job. For these reasons, the influence of craft earnings on participation in craft vocational education should not be as strong as it is on entry of craft occupations.

A weaker effect may also hold for marital status because of the remoteness of craft earnings to craft vocational education. As noted above, in the craft vocational education decision an individual should discount craft earnings more than he does in the craft entry decision. He may also have less information about craft earnings than he does in the craft entry decision. The inferred longer time horizon of many married young men may not be long enough for a relationship to exist between marital status and participation in craft vocational education.

B. Constraints to Participation in Vocational Education - As described at the beginning of the chapter, personal investment costs of craft vocational education are likely to be low and access to it is likely to be easy. Some individuals may, however, have positive opportunity costs of participation in craft vocational education, that is, in order to participate they may have to stay in school longer than they otherwise would. Some of these individuals may have immediate income needs to support a large family. Hence, family size may be a constraining factor in participation in craft vocational education for some individuals. But as the cost of participation in craft vocational education is low for most young people, the influence of family size should be weaker than in the craft entry situation. Similarly, while craft vocational education is generally available in high schools, it is possible that in some parts of the nation craft vocational education programs are not well developed or available at all. The quality of craft vocational education at an individual's school may be a constraining factor in this regard.

While it seems unlikely, it is possible that an individual's personal characteristics, e.g., race, formal education, IQ, and father's occupation might limit his access to craft vocational education. For example, craft vocational education may be less available to minority groups. This is not expected, however, since many federal training programs are targeted at minority groups.[12] As findings in Chapter III suggest that race is a factor constraining entry in crafts, it is of interest to determine if a similar barrier to craft vocational education exists.

As noted in the previous section, young men with high levels of formal education may not be inclined to participate in craft vocational education. Viewed not as a control for occupational aspirations, but as a constraint, formal education may also have an indirect influence on participation in craft vocational education. Formal education is not a prerequisite to enter craft vocational education, but the length of time that an individual stays in school influences his opportunity to take it. Since the largest craft vocational education programs are offered as part of secondary school curricula, individuals who drop out of school do not have access to the largest source of craft vocational training.

Since formal education may be related to participation in craft vocational education as control for occupational aspirations and as a constraint, the composite relationship may be a curvalinear one. Individuals who drop out of school at low levels sever their access to craft vocational education and individuals who stay in school to high levels are not likely to be interested in craft vocational education. Individuals who leave school after eleven to twelve years have access to and perhaps an inclination toward craft vocational education. They seem the most likely ones to take it. The relationship between formal education and participation in craft vocational education may be a negative quadratic one as depicted in Figure IV.1.

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[12] Levitan and Taggart, Manpower Policy, pp. 132-6.

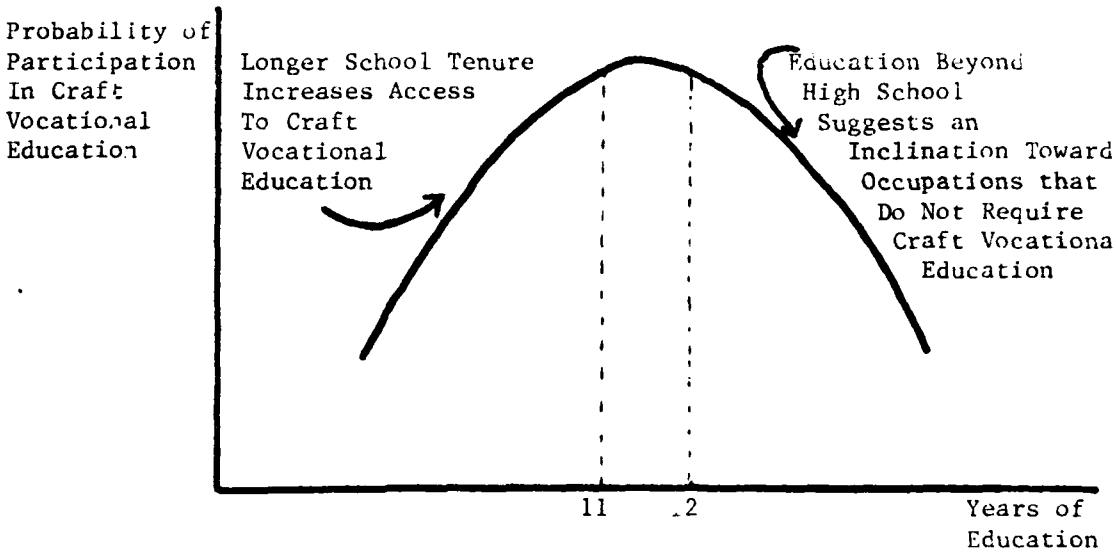

Figure IV.1

Years of Education as Related to the Probability of Participation in Craft Vocational Education

The difference between the effect of education in this model and the craft entry model is twofold. First, in the craft entry model it does not appear that lack of education limits access to craft occupations. In the craft vocational education model, an individual must reach secondary school in order to have access to the programs there. Second, in the craft vocational education model completion of the twelfth grade is of no special importance. A young person can enroll in craft vocational education early in high school. In the craft entry model, a high school degree is of possible importance because it is used as a screening device by employers in many occupations. Thus, unlike the craft entry model, there is likely to be a curvalinear relationship without a special effect for completion of high school.

The demand for craftsmen may influence participation in craft vocational education, but not as directly as it influences craft entry. Participation in craft vocational education is not directly constrained by the demand for craftsmen, but lack of demand may discourage participation . Conversely, high demand for craftsmen may encourage participation in craft vocational education.

Another demand variable, unemployment, may also influence participation in craft vocational education. An individual's decision to remain in school, and less directly to train for crafts, should be influenced by his alternative uses of time in the job market. In this sense, high unemployment limits an individual's use of time and may be related to participation in craft vocational education. When unemployment is high, the opportunity cost of participating in craft vocational education is low. Conversely, when unemployment is low an individual may forego additional schooling and participation in craft vocational education to take a job.

5. Participation in Craft Vocational Education
The Empirical Equation

The empirical equation is based on the constrained utility model of the preceding section. All variables are entered linearly except education, which is entered in quadratic form. The utility model suggests no other specific relationships and is shown below.

$$\begin{aligned} Voc = {} & \alpha + \beta_1 Earn + \beta_2 Asp + \beta_3 Ed + \beta_4 Ed^2 \\ & + \beta_5 IQ + \beta_6 FOc + \beta_7 Mr + \beta_8 SQ + \beta_9 R \\ & + \beta_{10} FS + \beta_{11} Grth \ \& \ \beta_{12} Ue + \varepsilon \end{aligned}$$

Voc: Vocational education dummy, = 1 if an individual participates in craft vocational education = 0 otherwise

Earn: Mean earnings of all Census craft workers in 1969 by industry as specified in Appendix V.1

Asp: Craft aspiration dummy, = 1 if an individual aspires to one of the selected crafts

Ed: Highest level of education completed by 1973

IQ: Intelligence quotient

FOc: Father's occupation in crafts dummy, = 1 if the father of an individual is in one of the selected crafts

Mr: Marital status dummy, = 1 if the individual married at any time between 1966 and 1973

SQ: Index of school quality

R: Race dummy, = 1 if nonwhite

FS: Number of people in family

Grth: Percentage change in employment of all Census craft workers between 1965 and 1970 by industry as specified in Appendix V.1

UE: Unemployment rate in the region of residence.

The data set used for this chapter is similar to the one used in the craft entry chapter; it is derived from the NLS and PUS. All the variables are derived and specified in the same manner except for a few, which are discussed below.

The education specification is different for reasons noted in the previous section. The expected quadratic specification of education requires the squared education term. No dummy variable for it is included for completion of high school since this particular year of education is not expected to have a special influence on participation in craft vocational education.

The earnings variable is derived differently for the craft vocational education model than for the craft entry model. In a craft vocational education model, a measure of the craft earnings in individual's local labor markets is needed. Ordinarily, the individual is still in school when he considers craft vocational education. When considering craft vocational education he may observe the level of craft earnings in his labor market. In order to measure those earnings, the individual's subsequent industries of employment were examined. The craft earnings in those industries were taken to represent the craft earnings opportunities that existed and that he may have perceived. As most young men were employed in several industries between 1966 and 1973, each individual's craft earnings opportunities were estimated by taking the average of the mean craft earnings of his industries of employment. If young men take their craft earnings opportunities into account in their craft vocational education decision, this craft earnings variable should be higher, on average, for individuals who participate in craft vocational education.

It should be noted at this point that this measure of craft earnings is likely to carry a positive bias when used in a craft vocational education participation model. Before discussing the bias, it should also be noted that it does not alter the implications of the findings; to preview them, the earnings variable is found to be insignificant in spite of the bias in favor of significance. Discussion of the findings is given later in the chapter.

Findings in Chapter III suggest that young craftsmen enter industries where craft earnings are relatively high. When measuring local craft earnings by averaging industry craft earnings (as described above), this will cause the craft earnings opportunities of young craftsmen to appear high. This correlation is a problem in a craft vocational education model due to an additional relationship suggested by Chapter III; individuals who have craft vocational education are more likely to enter a craft occupation $(\partial C/\partial V > 0)$. Inversely, young craftsmen are more likely to have had craft vocational education $(\partial V/\partial C > 0)$. The chain effects are as follows.

$$\frac{dV}{dE} = \frac{\partial V}{\partial C} \cdot \frac{\partial C}{\partial E} + \frac{\partial V}{\partial E} \qquad \frac{\partial V}{\partial C}, \frac{\partial C}{\partial V} > 0,$$

where the first right-hand term is the bias. It is due to the effect of craft employment on the earnings measure , $\partial E/\partial C$, and the accompanying relationship between participation in craft vocational education and craft employment, $\partial C/\partial V$.

The same bias may exist for the growth in craft employment variable; it is derived as an average of industry growth rates in a parallel fashion to the earnings variable. Each industry used in the craft earnings derivation is also used in the growth in craft employment derivation. This variable is an average of the percentage change in craft employment, between 1965 and 1970 in the above described industries. It is a measure of the increase in demand for craftsmen in the local labor market of the individual. The bias can be described as

$$\frac{dV}{dG} = \frac{\partial V}{\partial C} \cdot \frac{\partial C}{\partial G} + \frac{\partial V}{\partial G} \qquad \frac{\partial G}{\partial C}, \frac{\partial C}{\partial V} > 0 .$$

The effect of craft employment on the growth variable, $\partial G/\partial C$, combined with the relationship between participation in craft vocational education and craft employment, $\partial C/\partial V$, creates a positive bias.

To better define local labor markets the earnings variable is derived on a regional basis. An explicit description of the procedure is given in Appendix IV.1. The growth of the craft employment variable is derived on a national basis due to small cell sizes involved in using the PUS for three-digit industries by region. Small cell sizes are not as great a problem with the earnings variable as it is a simple average rather than a percentage change.

Also, as was the case in the craft entry chapter, the growth in craft employment variable is multiplied by the aspirations dummy. Individuals who did not aspire to enter crafts worked in industries that frequently had large percentage declines in craft employment. As described in Chapter III, this creates a spurious correlation that is dealt with by multiplying the growth in craft employment variable by the aspirations dummy.

There is one variable in the craft vocational education model that is not in the craft entry model. This variable is a school quality index collected in the 1968 survey of high schools (the NLS in 1968). It reflects many characteristics of the school system that an individual attended, one of which is the quality of craft vocational education offered. A better measure would focus directly on the quality of the craft vocational education program, but the correlation between general school quality and craft vocational education quality may be high. Individuals who attend schools of poor quality may not have access to good craft vocational education programs; with a less attractive program the likelihood of participation should be lower. It should be noted that many individuals who attend better schools may come from upper middle class families and may wish to take college preparatory courses as opposed to craft vocational education. This effect should, however, be partially controlled by the education variable. Individuals who aspire to white collar occupations and not to craft ones should tend

to attain higher levels of education. Conversely, the individuals who should be attracted to craft vocational education are the ones at high quality high schools who do not desire more formal education. They may view high quality craft vocational education as a means of entering a better paying occupation.

6. Empirical Results

The estimates of the model with the corresponding means and standard errors are found in Table IV.1. The mean values of the variables are given for the whole sample and for two subsets; one subset contains the individuals who participated in craft vocational education and the other contains the individuals who did not. On average, individuals who participated in craft vocational education lived in areas where the earnings of craftsmen were higher and went to schools where general school quality was higher. A higher proportion of individuals who participated in craft vocational education aspired to enter a craft occupation, were married in 1966, and had a father who was a craftsman. Individuals who participated in craft vocational education also had less education and smaller families than individuals who did not participate. None of the differences in these means are, however, statistically significant. Multiple regression, on the other hand, shows several significant relationships. OLS is used to obtain initial estimates of the model; its parameters are consistent but because this model has a dichotomous dependent variable, its standard errors are heteroscedastic. As noted in Chapter III, maximum likelihood estimation of a probit transformation can be used for models of this type. This methodology yields consistent and asymptotically efficient parameter estimates and a predicted probability constrained to lie between 0 and 1. (See Appendix A.)

The significant variables are craft employment growth, unemployment, craft aspirations, education, and school quality. The insignificant variables are largely those whose influence depends on the cost of and access to craft vocational education and its remoteness to craft earnings. The insignificant variables are marital status,

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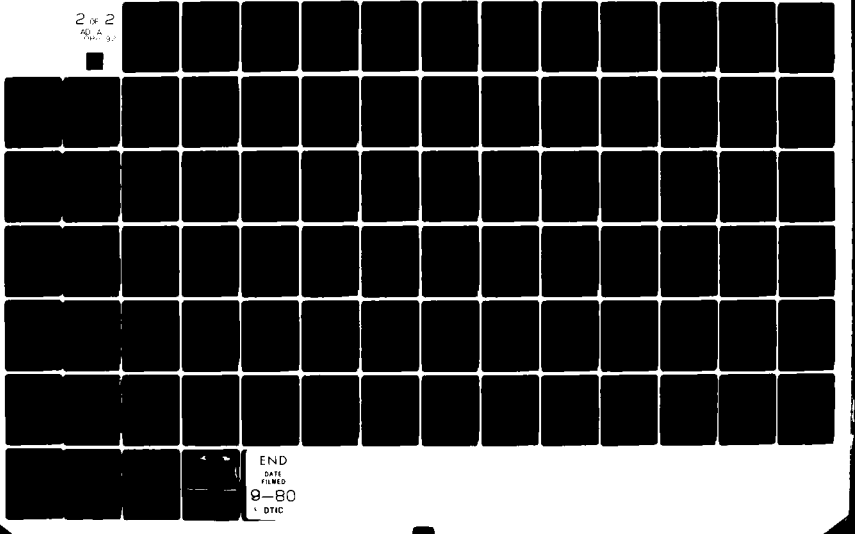

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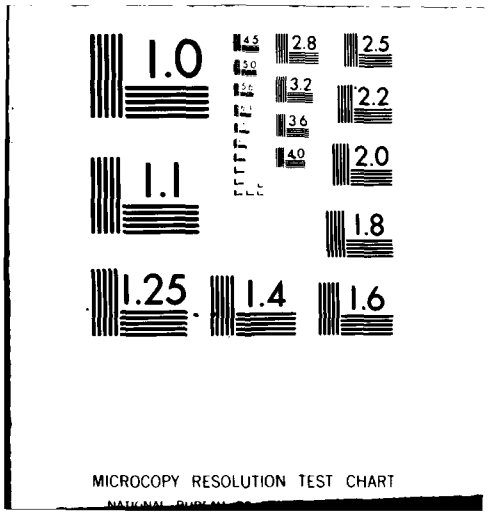
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Table IV.1

Vocational Education Participation Model
Factors That Influence Young Males to Participate
in Craft Vocational Education

Variables	Probit Coefficient (S.E.)	OLS Coefficient (S.E.)	All Observations Mean (S.E.)	Participation in Craft Vocational Education	
				Yes	No
				Mean (S.E.)	Mean (S.E.)
Constant	-6.8652** (1.7001)	-0.0107 (0.3742)			
Growth in craft employment	1.0684** (0.2473)	0.3755 (0.0668)	-0.004 (0.135)	0.026 (0.162)	-0.013 (0.124)
Unemployment rate	0.0341* (0.0181)	0.0091 (0.0043)	4.295 (2.084)	4.446 (2.135)	4.251 (2.068)
Index of school quality	0.3442** (0.1326)	0.0911 (0.0309)	0.513 (0.290)	0.536 (0.277)	0.506 (0.293)
Craft aspirations dummy	0.7664** (0.0808)	0.2366 (0.0208)	0.390 (0.488)	0.731 (0.444)	0.291 (0.454)
Years of education (divided by 10)	10.1454** (2.5462)	0.4835 (0.5356)	1.381 (0.220)	1.236 (0.139)	1.413 (0.222)
Years of education squared	-4.4450** (0.9414)	-0.3100 (0.1879)	1.955 (0.621)	1.546 (0.360)	2.074 (0.630)
Earnings of craftsmen in 1969	0.0427 (0.0287)	0.0108 (0.0066)	7.268 (1.363)	7.501 (1.294)	7.198 (1.381)
Intelligence quotient	-0.3635 (0.3147)	-0.0714 (0.0741)	1.037 (0.023)	0.978 (0.132)	1.054 (0.152)
Father's occupation in crafts dummy	0.0707 (0.0904)	0.0227 (0.0225)	0.198 (0.399)	0.264 (0.441)	0.179 (0.384)
Marital status dummy	0.1318 (0.1059)	0.0382 (0.0269)	0.161 (0.367)	0.234 (0.424)	0.139 (0.346)

- continued -

Table IV.1 continued

Variables	Probit Coefficient (S.E.)	OLS Coefficient (S.E.)	All Observations Mean (S.E.)	Participation in Craft Vocational Education	
				Yes Mean (S.E.)	No Mean (S.E.)
Family size	-0.0114 (0.0202)	-0.0034 (0.0049)	4.723 (2.021)	4.699 (2.104)	4.730 (1.998)
Nonwhite dummy	0.0175 (0.1193)	-0.0006 (0.0303)	0.120 (0.325)	0.142 (0.349)	0.114 (0.318)
R^2	0.4209	0.2107			
# Observations	1781	1781	1781	402	1379

Source: All data for these estimates are derived from the National Longitudinal Study except the earnings and growth variables. They are derived from the Public Use Sample.

Note: ** - Significant at the one percent level

* - Significant at the ten percent level

family size, father's occupation in crafts, race, and IQ. While not significant here, most of these variables are significant in the craft entry model where the cost of training is relatively high, access to crafts relatively limited and craft earnings close at hand.

The demand oriented variables are both significant. The craft employment growth variable has a t ratio of 4.32; this suggests that individuals consider their prospects for finding a craft job when they make the craft vocational education participation decision. As noted in the previous section, however, a bias may exist that causes this significance. Hence, one may observe the high t statistic and infer that a relationship exists, but the extent of the bias cannot be known. Only with this reservation may one infer from these findings that growth in craft employment increases participation in craft vocational education. The other demand-oriented variable, the unemployment rate, is also significant with t ratio of 1.89. It appears that individuals are less willing to forego employment to take craft vocational education when the job market is tight. Conversely, when jobs are easy to find, i.e., unemployment is low, young men appear less likely to participate in craft vocational education.

As shown in Chapter III, the craft aspirations dummy is a powerful control for the desire to enter crafts. This desire is important in the craft vocational education decision where the variable has a t ratio of 9.48.

The significance of the education variable is partially attributable to its role as an indicator of occupational aspirations and partially as a constraint. Education has its expected negative quadratic relationship with participation in craft vocational education. The t ratio for the linear education term is 3.985 and the t ratio for the squared education term is -4.722. The estimated coefficients of these terms can be used to show the level of education for which individuals are most likely to participate in craft vocational education. This level of education is 11.3 years suggesting that, as expected, individuals who finish 11 or 12 years of formal education are the most likely to participate.

Education is negatively related to participation in craft vocational education for individuals with more than twelve years of education. The higher the educational attainment of an individual beyond this level, the more likely he is to aspire to occupations that require higher levels of education. Education is positively related to participation in craft vocational education for individuals who attain less than eleven years of education. Individuals who drop out of school early lose access to the largest source of craft vocational education. Differentiating the model with respect to education yields the 11.3 figure.

$$\frac{\partial V}{\partial Ed} = 9.5186 - (2)(4.2093)Ed = 0$$

$$Ed = 9.5186/8.4186 = 1.13 \text{ , } 1.13*10 = 11.3 \text{ years.}$$

(Note: The years of education variable is divided by ten to reduce scaling problems in estimation.)

The school quality variable is significant with a t ratio of 2.595. Schools with high quality ratings are likely to have a large well-financed craft vocational education program. The significance of the school quality variable suggests that the size and quality of the craft vocation education program available to an individual affects his opportunity and desire to participate.

The earnings variable is insignificant at the ten percent level ($t = 1.489$), which suggests that young men do not consider craft earnings when they make the craft vocational education decision. As suggested in Section 2, this may be due to several factors, for example, the remoteness of craft earnings in the individual's future, the lack of information about craft earnings, or the low personal cost and wide availability of craft vocational education. While these factors should weaken the influence of craft earnings, there may be some effect which is undetected by this analysis; data limitations described in Section 5 require that a measure of craft earnings be used that is less precise than would otherwise be desired. It should also be noted that the bias described in Section 5 works in favor of the earnings variable significance. As it is still insignificant, the bias does not alter the inference of no influence.

The wide availability and low private cost of craft vocational education is consistent with the insignificance of marital status, family size, father's occupation in crafts, and race. Findings in Chapter III suggest that married individuals have longer time horizons and are thereby more inclined to invest in human capital. But, as the personal investment required to take craft vocational education is low, this effect should not be as important. Individuals who have large families to support may obtain craft vocational education at school at little direct cost. They may also be able to take craft vocational education for crafts at school without staying in school any longer than they otherwise would. In such cases, its opportunity cost is near zero and participation in it is less likely to be influenced by immediate income needs found, for example, in large families. While a craftsman may be able to help his son enter a craft, this aid to entry is inapplicable to participation in craft vocational education. Similarly, race is of little importance when access to craft vocational education is concerned.

Finally, the intelligence quotient is insignificant. With education in the model, the relationship between IQ and participation in craft vocational education is tested while controlling for differences in education. In this context, IQ is not significantly related to participation in craft vocational education. It can also be seen in Table IV.1 that individuals who did not participate in craft vocational education have higher mean IQ (105.4 versus 97.8). But, the difference between these means is not statistically significant. These findings suggest that no strong relationship exists between IQ and participation in craft vocational education.

7. The Partial Effects of Growth in Craft Employment, Unemployment, Education, School Quality, and Craft Aspirations

As noted in Chapter III, the probit parameters cannot be interpreted directly as partial derivatives because the probit transformation maps the model into the cumulative density function of the normal distribution. (See Appendix A.) To calculate the partial effects of a variable, the prediction of the model must be evaluated for two values of that variable. The other variables are held constant at their means.

The partial effects of all the significant linear variables are shown in Table IV.2. (They all happen to be positive.) The OLS partial effects are given along with the probit ones. OLS parameters are consistent, but they are not constrained to yield predictions that are in the zero-one range of a probability. (See Appendix A.) The probit partial effects given are appropriate in the range of the means of the variables.

Table IV.2

Probit and OLS Partial Effects for the Probability of Participation in Craft Vocational Education

Variables	Probit Parameters	∂ Probability/∂ Variable	
		Probit	OLS
Growth in Craft employment[a]	.0106	.0027	.0037
Unemployment[a]	.0341	.0085	.0091
School quality index[a]	.0034	.0008	.0009
Craft aspirations (dummy)	.7664	.1968	.2294

Note: Only significant variables are included in this table, i.e., ones with t ratios greater than 1.65.

[a]The probit parameter and partial effect are given for a one percentage point change, e.g., an increase in the growth in craft employment variable from .00 to .01 will result in the table partial effects.

Education has a negative quadratic relationship with participation in craft vocational education as shown in Table IV.3. The quadratic nature of the relationship is reflected in the changing sign and magnitude of the partial effect. The magnitude of the partial effect is also influenced by the probit transformation. Other things equal, the size of a probit partial effect is largest when the predicted probability is near .5. (See Appendix A.)

Table IV.3

The Partial Effect of Education on the Probability of Participation in Craft Vocational Education

Years of Education	10	11	12	13	14	15
Probability of Participation	.273	.291	.287	.253	.198	.132
Change in Probability	.055	.018	-.004	-.034	-.055	-.066

In the next section, the impact of selected variables in this model is compared to their impact on the decision to enter crafts. Many of these are insignificant in this model but not in the craft entry model.

8. Variables Common to the Craft Vocational Education and Craft Entry Models - A Comparison of Effects

The craft vocational education model of this chapter and the craft entry model of Chapter III have several variables in common. A comparison between models of the effects of some of those variables is of particular interest. The decision to participate in craft vocational education is similar to the decision to enter crafts, but important differences exist between them. These differences should cause the effects of the common variables to differ between models.

The lower personal investment required to participate in craft vocational education and its wide availability should cause the personal characteristics/human capital-oriented variables to be less important in the craft vocational education decision than in the craft entry decision. Consistent with this expectation are the t statistics and partial effects of the family size and race variables shown in Table IV.4. In the craft vocational education decision, the family size and race variables are not significant. They are significant in the craft entry decision. The family size variable has a weaker effect on participation in craft vocational education due to the low personal investment costs of craft vocational education. The race variable is weaker in the craft vocational decision because craft vocational education is readily available to young

Table IV.4

Comparison of Selected Variables in the
Craft Vocational Education and Craft Entry Models

Variables	Models			
	Craft Vocational Education		Craft Entry	
	t Statistic	Partial Effect	t Statistic	Partial Effect
Family size	-0.567	-.003	-1.899	-0.009
Nonwhite status	0.147	.004	-3.419	-0.080
Earnings	1.489	.010	2.570	0.014
Marital status	1.245	.034	1.902	0.044
Growth in craft employment	4.320	.003	7.740	0.004

people regardless of race. Access to crafts is not, however, free of racial influence. Either discrimination or information effects play a role. The nonwhite dummy shows a significant negative relationship to the probability of entering a craft.

The influence of craft earnings and marital status also appear to be weaker in the craft vocational education decision (see Table IV.4). This finding is consistent with the discussion in Section 2. Earnings are in the more remote future of an individual contemplating participation in craft vocational education. These earnings should be discounted more and the individual may be less informed about them. Hence, craft earnings should have a weaker effect. The weaker effect of marital status is explained by remote craft earnings exceeding even the longer time horizons of married individuals. The differences must be viewed as suggestive at most, but they are consistent with human capital and information theory.

The growth in craft employment also has a weaker effect in the craft vocational education model. The demand for craftsmen is a direct constraint on the ability of young to enter craft occupations. It is only an indirect constraint in the craft vocational education decision.

A young man may be discouraged by low demand for craftsmen but he can still participate in craft vocational education if he so desires, e.g., in the hope that employment prospects will be improved in his locality when he completes his education.

9. Summary and Policy Implications

In this chapter the demand for craftsmen, the level of unemployment, craft aspirations, and school quality are found to be significant positive determinants of participation in craft vocational education. Education is found to have a significant negative quadratic relationship and other variables, in particular, craft earnings, marital status, family size, parental occupation, IQ, and race are found to be insignificant.

In general, economic factors appear to have a weaker effect on participation in craft vocational education than on entry of craft occupations. The remoteness of craft vocational education from craft earnings and employment is consistent with smaller effects craft earnings and employment opportunities. Either lack of information about these opportunities or limited time horizons of young people may explain the weaker effects. Similarly, the weaker effect of the marital status variable suggests that remoteness of craft vocational education from future craft earnings extends beyond even the time horizons of many married young individuals. In addition, immediate income needs (family size) and race appear to have weaker effects in the craft vocational education decision than in the craft entry decision. Those weaker effects are explained by two characteristics of participation in craft vocational education that do not hold for entry of crafts, low personal cost, and wide availability.

The findings of this chapter have several policy implications, one of which directly concerns the effect of craft vocational education on the supply of young craftsmen. Findings in Chapter III suggest that young people who have craft vocational education are more qualified and more likely to enter crafts. Hence, factors that affect participation in craft vocational education directly affect the supply of young craftsmen.

In terms of costs, an industry may benefit in two ways from a larger supply of individuals who have craft vocational education. An industry may be able to hire a higher percentage of individuals who have this training. This would lower training costs because more individuals would come into the industry with general training; this will cause a direct reduction in training costs to the industry if it bears any portion of general on-the-job training. Or, if as Becker suggests, the worker finances all of his general on-the-job training, then public financing of that training through craft vocational education will make craft employment more attractive. A larger pool of individuals who have preparation for crafts may lead to an increase in the supply of young craftsmen, thereby permitting the industry to hire young workers at a lower wage than it would otherwise have to pay.

Findings in this analysis suggest that participation in craft vocational education is responsive to the demand for craftsmen but not their earnings. Industries can expect the pool of craft vocational trainees to expand in anticipation of finding craft jobs when craft employment is rising. Participation in craft vocational education does not appear to be influenced by craft earnings, that is, craft earnings do not appear to have an influence independent of new job openings. This lack of influence may be due to lack of information about craft earnings. If the apparent lack of influence of craft earnings is due to poor information and not to short time horizons, then employers of craftsmen might increase participation in craft vocational education and, subsequently, the supply of young craftsmen by providing that information. Perhaps dissemination of information about craft earnings to high schools would generate a greater supply response in terms of craft vocational training. Information concerning openings could also be distributed, thereby increasing a supply response, which already appears to exist.

The insignificance of the family size variable can be attributed to the low personal investment required to participate in craft vocational education. The policy implication of these findings

concerns this low cost. Young people would be less likely to participate in craft vocational education if it were not available at such low cost. From the significance of the school quality variable, it also appears that young men are responsive not only to the low cost of craft vocational education, but also to its benefits, i.e., quality. Further, the insignificance of the race variable suggests that craft vocational education is available to all races, at least at some level of quality.

As noted above, public provision of craft vocational education appears to provide useful general training; this should decrease the amount of training necessary on the job and increase the supply of young craftsmen. While this may benefit young craftsmen and their employers, from the standpoint of society, the costs of vocational education may be greater or less than the benefits. There is a wide literature on this question.[13] It is not, however within the scope of this paper to discuss this issue. The findings in this paper do suggest, however, that young people would be less likely to participate in craft vocational education if it were not publicly provided.

The findings of this model suggest two important factors which affect the supply of young craftsmen. First, public provision of craft vocational education increases the number of young people who obtain general craft training. Second, the demand for craftsmen appears to influence the decision of young people to take craft vocational education, but craft earnings do not appear to have an influence independent of craft demand.

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[13] An increase in the number of young people who possess craft training will make it easier for an industry to meet its needs for young craftsmen. It is not the objective of this study to analyze the costs and benefits of public provision of vocational education. Many studies have done this with varying results. See, for example, John Grasso, "The Contribution of Vocational Education, Training and Work Experience to the Early Career Achievement of Young Men," see International Dissertation Abstracts 36 (February, 1976): 5452-A. Grasso finds that vocational education only increases earnings when combined with work experience and when obtained by young whites. Other sources which find more widespread effects are listed under vocational education in the bibliography.

APPENDIX IV.1

THE EARNINGS AND GROWTH IN CRAFT EMPLOYMENT PROXIES OF THE CRAFT VOCATIONAL EDUCATION MODEL

In a participation in craft vocational education model, a measure of craft earnings for local labor markets is needed. An ideal measure would be a weighted average of the earnings of craftsmen in the labor market of an individual. The NLS gives however, only the region of an individual. For this reason another way of defining craft earnings must be devised. The NLS includes the industries in which an individual was employed for the years between 1966 and 1973. These industries are used to derive an earnings proxy in the following manner. The PUS is used to find average craft earnings by industry. The industry classifications in the NLS and PUS are similar so that the PUS earnings values can be matched well with NLS industry codes. With the industry earnings values prepared, an average of these values can be calculated for each individual on the basis of the industries that he was in. More explicitly,

$$\text{Earnings proxy} = 1/N \sum_{n=1}^{N} \text{average craft earnings in industry } j$$

where

N = the number of years for which an industry of employment is reported for the individual

j = the industry in which the individual was employed in the nth year.

To obtain a closer approximation of craft earnings in local labor markets, the earnings proxy is derived on a regional basis.[14] The

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[14] Originally, the craft earnings variable was derived only on a national basis; this gives a weaker relationship than its regional measure. In spite of the more accurate regional measure and the bias in favor of significance, the craft earnings variable is still not significant. Craft earnings might be related to participation in craft vocational education, but it seems that a better data set, i.e., one with direct information on local craft earnings, will be necessary to show a relationship.

notation becomes

$$\text{Earnings proxy} = 1/N \sum_{n=1}^{N} \text{average craft earnings in industry}_{j,r}$$

where r = Census region where an individual resides; r = 1 to 9.

When defining earnings on a regional basis it is necessary to control for regional variation in the general level of earnings. The higher the general level of earnings is in a region, the higher craft earnings must be to be attractive. Differences in the general level of earnings between regions are controlled for in the following manner. The average earnings of young workers for each region and for the nation is derived from the PUS. The ratio of the earnings in each region to the national average is then calculated.

$$\text{Ratio}_r = \frac{\text{Average earnings of region}_r}{\text{Average earnings of nation}}$$

The ratio that corresponds to the region of an individual is used to normalize the earnings variable assigned to him.

$$\text{Normalized earnings}_i = \text{Earnings}_{i/\text{Ratio}_r}$$

i = the ith individual

If an individual lives in a region where the general level of earnings is low, Ratio_r will be less than one. The division of his earnings by Ratio_r will increase its value. The opposite effect is achieved for individuals in regions where the general level of earnings is high. In this way, the measure of earnings becomes a relative value. The earnings proxy for the relative earnings of craftsmen in the labor market of an individual can be expressed in terms of the preceding notation.

$$\text{Regional relative earnings of craftsmen proxy for individual}_i = \frac{1/N \sum_{n=1}^{N} \text{average craft earnings in industry}_{jr}}{\text{Ratio}_r}$$

The growth in craft employment variable is derived in an analogous manner to the earnings variable except that no regional distinction is made. When creating industry proxied from the PUS, cell sizes become too small to calculate percentage changes on a regional and industry basis. More explicitly, the percentage change in craft employment is measured for each industry as,

$$\text{Growth in Industry} = \frac{\text{C.E.}_{70} - \text{C.E.}_{65}}{\text{C.E.}_{65}}$$

This measure is averaged for each individual as described for the earnings variable. As explained in Chapter III the growth in craft employment variable is entered in the model as the product of itself and the aspirations dummy. This is necessary to deal with a spurious correlation that otherwise would exist.

CHAPTER V

FACTORS WHICH INFLUENCE YOUNG CRAFTSMEN TO STAY IN AN INDUSTRY

1. Introduction

Economic and demographic factors that influence young craftsmen to stay in, or conversely, to leave an industry are examined in this chapter. These factors affect the supply of young craftsmen to an industry and the turnover costs experienced by an industry. Industries that incur training costs to develop specific skills in young craftsmen must recoup these costs before the craftsmen decide to leave the industry, otherwise production costs will rise.[1] Since young craftsmen comprise an important part of the work force in many industries, e.g., shipbuilding where turnover is high, their decision to stay in or leave an industry is selected for detailed analysis.

Among the factors considered that may influence turnover are current earnings and future wages. Inclusion of future wages as a variable is a unique feature of the analysis. Other variables in the analysis have implications for turnover policy. Before presenting a systematic discussion of the model used in the analysis, however, a review of the turnover literature is provided. This review describes variables used in other studies and more recent approaches to analysis of turnover. Following this review is a model of the decision to stay in or leave an industry and the empirical equation derived from it. In the latter parts

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[1] See Gary S. Becker, Human Capital, 2nd ed., (New York: National Bureau of Economic Research, 1975), pp. 16-38 and David J. Farber, "Apprenticeship in the United States, Labor Market Forces and Social Policy," Journal of Human Resources 2 (Winter 1967): 72-80.

of the chapter the empirical results are presented and their policy implications are discussed in terms of the supply of young craftsmen and turnover costs.

2. The Labor Turnover Literature

The labor turnover literature is conveniently divided into two categories. The earlier analyses used industry quit rates to measure turnover.[2] More recent studies examine the turnover decisions of individuals and have two general advantages.[3] First, they more precisely associate the explanatory variables with turnover. For example, the industry quit rate models can only associate the average educational attainment in an industry with the industry quit rate, while in an individual decision model the level of education of each person who has stayed in or left an industry can be determined. Second, simultaneous equations bias is a problem in industry quit rate models but not in individual decision models. As noted by Pencavel, wage rates may influence quit rates but quit rates may also influence wage rates.[4] Such interactions create a simultaneous equations bias in industry quit rate models. Simultaneity is not a problem in individual decision models. The decision of a single individual to change industry does not affect the wage rate; for this reason the wage rate is exogenous in this type of model.

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[2]See, for example, John Pencavel, "Wages, Specific Training and Labor Turnover in the U.S. Manufacturing Industries," International Economic Review, 13 (February 1972): 53-64. Other studies are listed in the bibliography under labor turnover.

[3]Two of these are Philip L. Cottell, Occupational Choice and Employment Stability Among Forest Workers, (New Haven: Yale University, 1974), esp. pp. 198-113, 122-3; Morely Gunderson, "Determinants of Success in On-The-Job Training." Journal of Human Resources 8 (Fall 1973): 472-484.

[4]John Pencavel, An Analysis of the Quit Rate in American Manufacturing Industry, (Princeton: Industrial Relations Section, Princeton University, 1970), pp. 6-8; and Pencavel, "Wages, Specific Training and Labor Turnover," pp. 53-64.

Of the two turnover studies that analyze individual decisions, one, by Philip Cottell, examines turnover among Canadian forest workers.[5] Cottell includes a large number of explanatory variables in his study, but his sample is small (75 individuals). The other study, by Morely Gunderson, examines the turnover behavior of Canadian manpower trainees.[6] Gunderson's sample is large but his model does not include a good measure of wages. Gunderson uses the pretraining wage to measure the wage effect on post training turnover. Not surprisingly, he finds it to be insignificant.[7] The present study includes a measure of not only the current wage of craftsmen, but a future wage as well. There are other features that distinguish this study from the work of Cottell and Gunderson. Before discussing the future wage or other variables, however, it is preferable to explain the model in a systematic way.

3. A Model of The Decision to Stay in an Industry

A. The Relationship Between Industrial and Occupational Change

Before discussing factors which influence a young craftsmen to leave an industry, it is important to note two general reasons which may underlie the decision to change industries. A young craftsman might decide to leave an industry for industrial or occupational reasons. If he is satisfied with his choice of occupation, he is probably moving to a more attractive industry. This aspect of industrial mobility is the focus of this study. A young craftsman may, however, be dissatisfied with his

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[5] Cottell, Occupational Choice, esp. pp. 108-113, 122-3.

[6] Gunderson, "On-The-Job-Training," pp. 472-84.

[7] Gunderson observes whether or not a trainee remains with his pretraining employer after training, but the posttraining wage is available only for workers who remained with their pretraining employer. Thus, Gunderson does not have a measure of the separated trainee's posttraining wage and cannot use it in his model. He uses the pretraining one instead. The posttraining wage is the one that influences the posttraining decision to change firms and it may not be closely related to the pretraining wage. Gunderson finds that the pretraining wage does not affect the posttraining decision, which is not surprising. He really needs the posttraining wage in his model. Ibid.

current occupation and may move to a new industry as a consequence of changing his occupation. Factors influencing this type of industrial mobility are not emphasized in this model. In this study, the decision to leave an industry is analyzed without controlling for change in occupation. This simplification should not invalidate conclusions pertaining to industrial causes of industry mobility. Factors such as earnings, that make an industry attractive to a young craftsman should have a positive effect on his decision to stay whether or not he is satisfied with his choice of occupation.

In emphasizing industrial mobility, it might be thought that individuals who change occupation should be excluded from the data set. To do this, however, would reduce the predictive value of the model. If those who change occupation are excluded from the analysis, then the model only estimates a conditional probability. In other words, the model will only yield the probability of staying in an industry, given that a young craftsman does not change occupation. While no attempt is made to model occupational change, per se, it is preferable to analyze industry mobility in its more general form.

The best way to isolate industrial and occupational change is to use a three-equation quadcotomous model that defines the four possible combinations of occupational and industrial change. Two aspects of such a study, however, should be emphasized. First, a model of occupational change needs to be carefully constructed; this is clearly a large task and to keep the study manageable it is not attempted. Second, even given the equations for the quadcotomous model, software would have to be developed to allow for the different model forms. This work is a possible subject for future research. The present study is limited to a simpler, more tractable dichotomous model in which only industry mobility is considered.

Some human capital variables may explain both industrial and occupational choice. To the degree that a change in occupation leads to a change in industry, these variables will reflect both effects in an industry change model. This conforms to the objective of this study,

which is to model industry turnover for whatever reason. Hence, the combined industrial and occupational effects of the variables is what is desired. In the following section the economic and demographic variables expected to influence mobility are discussed. Special reference is made to the effect of the interaction of occupational and industrial change on the expected signs of the human capital variables.

B. Factors That Influence a Young Craftsman to Stay in an Industry

In deciding whether or not to stay in an industry, a young craftsman is likely to emphasize the industry-oriented variables in his utility function. The utility function can be expressed as

$$U = U(PDV_E, \text{Job Satisfaction})$$

where

$$PDV_E = PDV_E \text{ (Earnings, Expected future earnings, Discount rate, Time horizon)}$$

$$\text{Job Satisfaction} = \text{J.S. (Type of occupation, Nature of industry, Amount of leisure associated with job)}$$

The utility that a young craftsman derives from a job is determined by its monetary rewards and by its nonpecuniary aspects, e.g., working conditions. The present discounted value of the earnings in an industry is the monetary reward of working in the industry. The present discounted value of earnings depends on the individual's current earnings, expected future earnings, discount rate, and time horizon. Less tangible factors determine the amount of job satisfaction (negative or positive) that an individual obtains from a job. Important factors in job satisfaction are the type of occupation, the nature of the industry, and the amount of leisure associated with the job.

The effect of future earnings and their interaction with the discount rate and time horizon merits further discussion. Craft occupations involve both general and specific on-the-job training. As noted by Becker and the apprenticeship literature, the trainee pays for general

training and part of specific training.[8] The payback on his training cost is the future wages he can earn in the industry. The present value of this payback depends on the young craftsman's time horizon and discount rate. As he becomes skilled, he can leave the industry where he is training and earn a higher wage in an industry that requires his level of skill but provides little additional training. The shorter his time horizon and the higher his discount rate, the less likely he is to stay in his industry and complete his training. If the time horizon of a young craftsman is not too short or his discount rate too high, his decision to stay in or leave his industry will be influenced by his future wages there.

In maximizing his utility, i.e., in finding a job that suits him best, the young craftsman is constrained by information costs, his personal characteristics, and the demand for labor. As noted below, lack of work experience may limit the information that a young craftsman has about his industrial and occupational alternatives. And through work experience, a young craftsman may develop general and specific human capital. Specific human capital will limit his mobility while general human capital will have the opposite effect. Another information-human capital variable, formal education, may also affect the likelihood of a young craftsman changing industry and occupation.

Other personal characteristics may influence industrial mobility besides those relating to human capital. Race may be related to mobility in a number of ways. High school drop-outs may be more likely to change industries and young craftsmen who are married may be geographically or financially constrained.

The aforementioned constraints pertain to the supply of labor; there are also constraints that operate on the demand side. The decision of a young craftsman to stay in or leave his industry may be constrained

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[8] Farber, "Apprenticeship," pp. 72-80; A. Harvey Belitsky, "Apprenticeship in the United States, Discussion," Journal of Human Resources 2 (Winter 1967): 81-3; Becker, Human Capital, pp. 37-8.

by the demand for craftsmen in his own industry and by the demand for labor in other industries and occupations.

a. Work experience - Information costs make it difficult for individuals to know about all of their opportunities. Despite the difficulty of obtaining information about current earnings, future earnings, and other less tangible aspects of employment in alternative industries, young people do accumulate some information from indirect sources or through first hand-experience. The more work experience a young person has when he enters an industry the more information he is likely to have about it and alternative ones; he is less likely to be disappointed in it or to discover a more desirable one at a later date. Thus, he is more likely to stay in the industry in future years.

A similar relationship should hold between work experience, information, and occupational satisfaction. The more work experience a young person has when he enters an occupation, the more likely he is to stay in the occupation at a later date. Since occupational mobility often results in industrial mobility, young craftsmen with work experience seem even more likely to stay in an industry. The relationship between work experience and occupational mobility reinforces the relationship between work experience and industrial mobility. The key to these relationships is the affect of information on industrial and occupational satisfaction.

As a human capital variable, it may be argued that work experience influences the decision to stay in an industry in two ways. As a young craftsman obtains work experience, he acquires specific and general training. If the young craftsman obtains his work experience in a number of industries his training is likely to be varied and, in this case, he will be more mobile between industries. If, however, his experience is gained in one industry, then his human capital is more specific. In this case, he will be less mobile between industries. Without knowing whether the work experience is specific or general, its mobility effect is ambiguous. Considering its information effect, however, it seems likely that work experience should have a positive influence on the decision to stay in an industry.

b. Craft vocational education - Another human capital variable that may affect the opportunities of a young craftsman is craft vocational education. Craft vocational education provides general training that tends to make young craftsmen more mobile between industries. This effect, however, may be counter-balanced by the exposure that it gives to crafts. That is, craft vocational education provides information about crafts and perhaps the industries in which craftsmen are employed. Young craftsmen who enter a craft after having taken it may be less likely to change occupation and, hence, less likely to change industry.

These two effects of craft vocational education offset each other and together suggest an ambiguous relationship. Craft vocational education may not reveal anything about the likelihood of a young craftsman staying in an industry. Its usefulness as a predictor depends on the relative strengths of these opposing tendencies.

c. Formal education - Formal education is another type of human capital that may affect the opportunities of young craftsmen. Educational requirements for craftsmen may vary among industries. There may be varying requirements to work with numbers, read blueprints , or follow written procedures. The more education a young craftsman has the more mobile he is between industries. A similar relationship exists with respect to occupational mobility. Young craftsmen who have higher levels of education may be more likely to leave crafts and therefore to change industry. These effects suggest that the higher the educational attainment of a young craftsman the less likely he is to stay in an industry.

One level of education, completion of high school, may have a unique impact on the likelihood of a young craftsman staying in his industry. Young craftsmen who drop out of high school probably do so either because they have pressing income needs or simply because they do not have the perserverance to finish.[9] These factors may influence

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[9]Similar perseverance implications of the high school degree are found in Sheldon Haber, "Factors Influencing Attrition in the Marine Corps," (Technical Paper, Serial T-306, Program in Logistics, The George Washington University, March 4, 1975), pp. 34-6.

turnover because of the long training period that young craftsmen typically undergo. During this training period, they finance their general training and part of their specific training.[10] They do this by working for a lower wage than they could obtain in an industry that provides less training. If a young craftsman leaves high school because of pressing income needs, these same income needs may cause him to transfer to a higher paying industry that provides little additional training. Similarly, if a young craftsman leaves high school because he lacks perserverance, he may transfer to a higher paying industry that provides little additional training.

Counteracting the immediate income and perserverance implications of completion of high school is the possibility that possession of a high school diploma gives young craftsmen an extra degree of mobility. The high school diploma is a common screening device. As it is with the vocational education variable, a significant coefficient of the high school dummy will indicate dominance of one of the hypothesized effects. In Figure V.1 three relationships between education and the probability of staying in an industry are depicted. Each frame of the diagram represents a different balance between the offsetting effects of a high school degree.

d. Race - The race of a young craftsman may also affect his opportunities. Employment opportunities may be limited in industries other than his own due to racial discrimination. It is also possible, however, that a young craftsman may leave his industry because of racial discrimination that makes it an unpleasant place to work. These two alternatives offset each other and suggest that racial discrimination could exist throughout the labor market, but have no distinguishable effect on the decision to stay in an industry.

Race could serve as a proxy for different levels of information about the labor market. A young craftsman who has little knowledge

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[10] Becker, Human Capital, pp. 35-36 and Farber, "Apprenticeship." pp. 72-80.

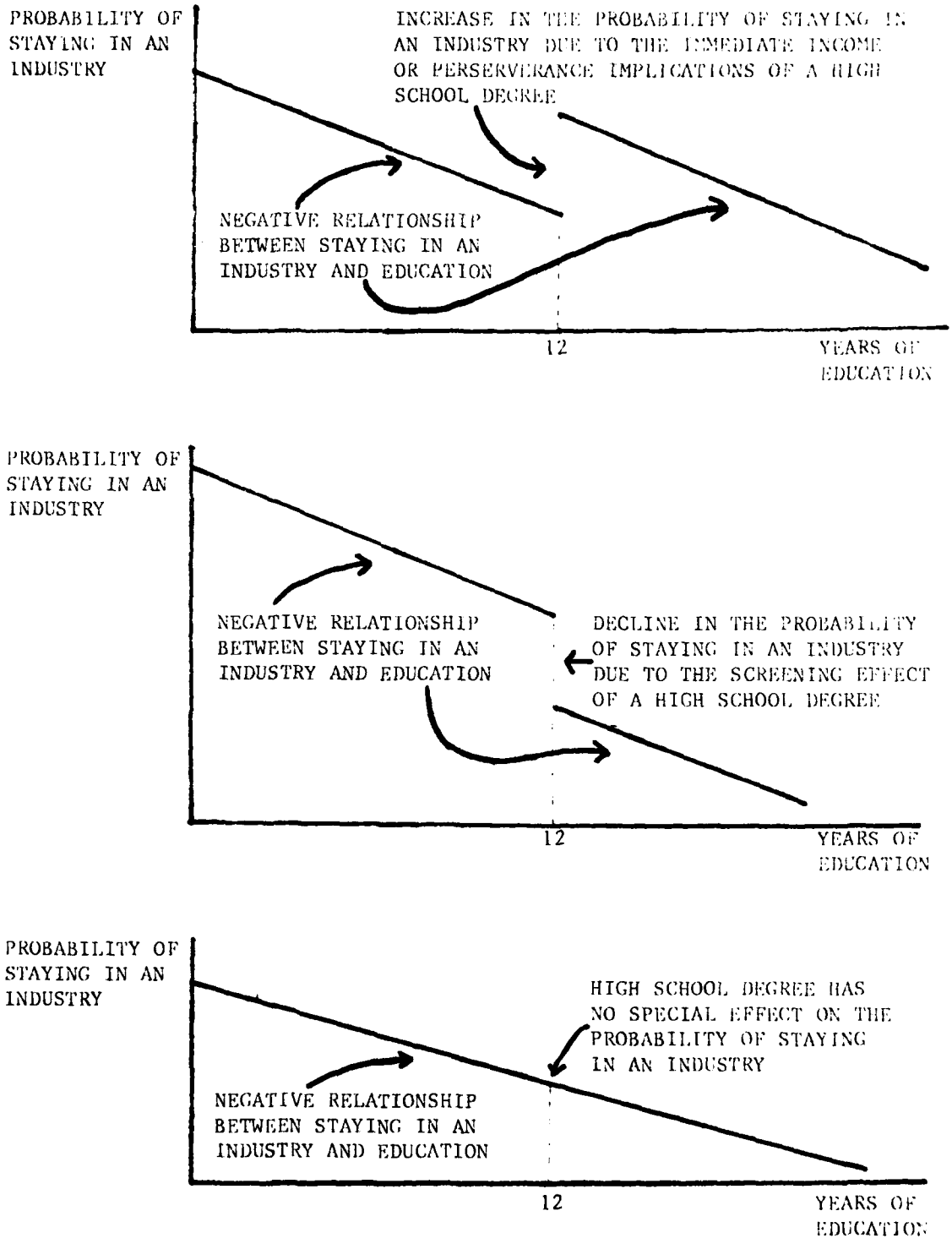

FIGURE V.1

POSSIBLE RELATIONSHIPS BETWEEN
INDUSTRY MOBILITY OF YOUNG CRAFTSMEN AND EDUCATION

about alternative opportunities might be more prone to leave his industry. This would be true if he overestimates the earnings available in alternative occupations or industries. An equally plausible reaction to lack of information, however, is inaction. Thus, even if race and access to information are related, it is not clear how this relationship might effect the decision of a young craftsman to stay in an industry.

e. Unions - Young craftsmen in unions may be more likely to stay in their industry because job security and other benefits may be more valuable in union employment than in nonunion employment. An offsetting effect may also exist. If a young craftsman is in a craft union, the Brotherhood of Electricians for example, he may be able to enter union shops in other industries more easily.

4. The Decision to Stay in an Industry - The Empirical Equation

An empirical equation can be derived from the above constrained utility model. The form of the equation is shown below.

$$T = \alpha_0 C + \alpha_1 R + \alpha_2 Ed + \alpha_3 Voc + \alpha_4 HS + \alpha_5 WE + \alpha_6 Hrs + \alpha_7 Y$$

$$+ \alpha_8 \Delta W + \alpha_9 Grth + \alpha_{10} UE + \alpha_{11} Mr + \varepsilon$$

where

T - Turnover dummy, = 1 if the young craftsman is in the same industry in 1965 and 1970, = 0 otherwise

C - Constant

R - Race dummy, = 1 if nonwhite

Ed - Highest grade completed as of 1970

Voc - Vocational education dummy, = 1 if vocational education in crafts

HS - High school dummy, = 1 if completion of high school by 1970

Y - Earnings in 1969, a proxy measure of the young craftsman's earnings in 1965 based on his industry, craft, race, vocational education, and formal education

ΔW - Future wage proxy, a measure of the change in wage that the young craftsman may expect if he stays in his industry for six years (based on his industry, craft, race, vocational education, and formal education)

Hrs - Hours of work in 1969, a proxy measure of the young craftman's hours of work (based on his industry, craft, race, vocational education, and formal education)

WE - Work experience, age in 1965 minus (Ed + 5)

UE - State unemployment rate in 1965

Grth - Rate of growth (percentage change) of the number of craftsmen between 1965-1970 in the industry in which the young craftsman was employed in 1965

Mr - Marital status dummy, = 1 if married in 1965

All variables in the equation are entered linearly since the utility model does not suggest specific curvalinear relationships. The data set used for estimating the equation is from the 1970 Public Use Sample. The data pertains to individuals who were 18 to 24 years of age in 1965 and employed as carpenters, electricians, machinists, painters, pipefitters, precision machine operatives, and welders at that time. These occupations were selected because of their importance in shipbuilding.

The turnover behavior of an individual is indicated by a dichotomous variable. It indicates whether or not a young craftsman was in the same industry in 1965 and 1970. Because the PUS data cover a five-year period, they are different from the BLS separation data which include both layoffs and quits on a monthly basis. A young craftsman who changed industries between 1965 and 1970 in the PUS data in all likelihood made a voluntary change, in the sense that he could have returned to the industry if he so desired.[11]

Discussion of the utility function suggests that the earnings a young craftsman receives should influence his decision whether or not to stay in his industry. The PUS contains the industry of an individual in 1965, but it does not contain his earnings in 1965. In this absence of 1965 earnings data, a proxy measure of earnings was derived. The procedure used for obtaining this measure is described below.

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[11] An individual may be laid off and not rehired in a declining industry and, hence, be separated involuntarily. A measure of industry demand is included in the model to control for this effect.

The PUS contains the 1969 earnings of an individual plus his 1970 industry and occupation. It also indicates his race, craft, vocational training, level of education, and age as of 1970. Eighteen industry groups were formed and further divided into categories according to craft vocational education, formal education, and age; these characteristics appear to be important factors that relate to productivity and earnings. A separate cell in a multidimensional matrix was assigned to each combination of these parameters. The earnings of the individuals having the characteristics of each cell were then averaged to create a proxy value for those characteristics. The individuals in the sample are assigned an earnings value on the basis of their 1965 industry, occupation, and other characteristics. It should be noted that the earnings proxy represents the earnings of individuals in 1969; their decision to change industry was influenced by their earnings in 1965 through 1969. Due to data limitations, it is assumed that the structure of earnings by industry, occupation, and age, etc., was the same in 1969 as in the period 1965-1969.

Discussion of the utility function also suggests that the decision to remain in or leave an industry depends, in part, on the expected future wage that could be earned in that industry. A future wage proxy is used instead of a future earnings proxy because young craftsmen are more likely to have information about future wage rates than future earnings; wage rates are published in union contract books, earnings are not.

The PUS does not contain a direct measure of wages. It does, however, contain the number of weeks worked in 1969 and the number of hours worked per week in 1970. This information is used to derive a total number of hours worked. The future wage proxy is computed in the same way as the current earnings proxy. For every earnings proxy, there is a corresponding hours proxy. The hours proxy is used to convert the earnings to a wage rate. In this manner the future wage is created.

The future wage variable used in this model is entered as the difference between the wage in the young craftsman's age group, 18-24, and the age group, 25-30, i.e.,

$$\Delta w = w_{(30-25)} - w_{(24-18)} \cdot$$

The implicit assumption in this specification is that only the wage rate that he expects to receive in the immediate future affects his decision to stay in an industry. Preliminary screening indicates that more remote future wages do not add explanatory power to the model. This may be because the increase in wages in the near future is representative of the more remote periods. Alternatively, it may be that the time horizon of most young craftsmen does not extend beyond the near future.

Besides the current earnings and future wages associated with industry of a young craftsman, other factors may influence his utility. With earnings held constant, young craftsmen should prefer industries with more leisure. The hours proxy can be used to measure the young craftsmen's leisure, but as previously described, this measure is an industry average and consequently exhibits little variation. With so little variation, the impact of leisure on the decision to stay in an industry is difficult to ascertain.

The empirical model also includes variables to control for factors that constrain the opportunities of young craftsmen. Among these variables are the human capital-information variables: work experience, education and craft vocational education. The PUS provides the level of education and attainment of craft vocational education as of 1970. In this analysis, it is assumed that a young craftsman's educational attainment in 1965 was the same as in 1970. A young craftsman may continue his education; however, the values generated by the work experience variable, described below, suggest that this is rare. Also, if he had craft vocational training, he is assumed to have taken it by 1965. It is not likely that a young craftsman would take craft vocational training after entering crafts; such training is unlikely to add much to the on-the-job training that a young craftsman normally obtains in becoming a craftsman.

Work experience is calculated as the difference between the 1965 age of a young craftsman and his level of education plus five (W.E. = Age_{1965} - (Education + 5)). The values generated for the work experience variable are almost always positive suggesting that the 1970 level of education is a good substitute for the 1965 level of education. The few negative values of the work experience variable were set to zero; only continued schooling after employment in 1965 can yield these values. Measuring work experience as the difference between age and education has obvious faults, but it appears to be a reasonable approximation.

It should be noted that the industries and occupations in which this work experience was gained is not available in the PUS. This is important because the interpretation of this variable hinges on assumptions made about this previous experience. One assumption might be that all of pre-1965 work experience was gained in the 1965 industry and occupation. This sort of experience should be related to the likelihood of staying in the 1965 industry until 1970. If all of the young craftsman's work experience was of this type, the work experience variable could only be interpreted as a control for tenure in the industry. As suggested, however, in the discussion of information costs and work experience, work experience gained outside of the 1965 craft and industry should increase the likelihood that a young craftsman will be satisfied in his 1965 industry. Insofar as some of the pre-1965 work experience was of this type, the work experience variable can be interpreted as more than a control. Previous work experience might be used to screen new hires in order to reduce their subsequent turnover.

Other constraining factors are included in the model. These include dummy variables for race, completion of high school, and marital status. The PUS gives the individual's age at the time of his first marriage (if ever married). This information is used to determine if a young craftsman was married in 1965 or earlier. It is not a perfect measure since even a person who was of 18-24 years of age in 1965 might have been married and divorced by that time.

Two variables are included to control for the effect of the demand for labor on the decision of whether or not to stay in an industry. To measure industry demand for craftsmen, the percentage change in employment of craftsmen is included in the model. This variable is associated with each craftsman on the basis of his 1965 industry and is derived in the following manner. The PUS contains the individual's occupation and industry in 1965 and 1970. This information is used to measure the total number of craftsmen in each industry in those years. The percentage change between those years represents the growth of craft employment by industry between 1965 and 1970. In industries with high percentage changes, it can be presumed that the demand for craftsmen between 1965 and 1970 was high. In industries with low or negative percentage changes, the demand for craftsmen is likely to have been low.

To measure the opportunities of the young craftsman in his local labor market, the unemployment rate of his state of residence is used.[12] (The PUS includes the 1965 state of residence.) Local labor markets are not likely to coincide with state boundaries, but this is as precise a measure as can be incorporated into the model.

As previously noted, union membership may decrease the mobility of young craftsmen. Unfortunately, the PUS does not include an individual's union or nonunion status. The degree of unionization in the young craftsman's industry might be used to test the effect of unionization on turnover, but a measure of unionization in craft occupations rather than all occupations would be needed. The percent of employees in unions may vary widely from industry to industry due to differences in occupational mix, while the percent of young craftsmen in unions may remain relatively constant. As the degree of craft unionization by industry is not available, no control for unionization is included in the model.

The model does not include measures of the less tangible aspects of an industry, e.g., working conditions, health benefits, etc. A

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[12]The state unemployment rates were obtained from the Department of Labor, Area Trends in Employment and Unemployment, May 1967, (Washington, D.C.: U.S. Government Printing Office, 1967), p. 50.

measure of these factors is not available, so the probable effect of these omitted factors is at issue. It is possible, for example, that a negative correlation exists between working conditions and earnings. Industries that are generally less desirable to work in may pay higher earnings to maintain their supply of labor. It is also possible, however, that industries that have poor working conditions require or attract only workers with lower skills. If industries with poor working conditions do tend to use lower skills, they may pay lower earnings. Evaluation of the effects of these intangible qualities become more complex when it is realized that skills, e.g., work experience and craft vocational training, are partially controlled for in this model. On balance, it seems likely that if any correlation exists between working conditions and earnings, it is probably a negative one. This would cause the impact of earnings in the model to be understated.

Whereas earnings may tend to be higher in industries with poor working conditions, an opposite relationship may exist between earnings and fringe benefits. Industries where earnings are high may also have higher fringe benefits. The absence of a measure of fringe benefits in the model may cause the impact of earnings to be overstated.

Additional discussion is possible on the relationship of less tangible factors with other factors that influence turnover. When all the less tangible factors of industries are considered, however, the variation in "desirableness" between industries may not be great. Further, the less tangible these qualities become, the more difficult it is for a young person to obtain information upon which to make comparisons. Misinformation about the less tangible nature of industries might cause a "true" measure of that nature to be uncorrelated with turnover. Finally, conditions that are unpleasant to one young craftsman may not bother another one and vice versa. On balance, the lack of a measure of the less tangible variables may not be a problem.

5. Empirical Analysis

The estimates of the model are displayed in Table V.1 along with the corresponding means and standard errors. The mean values for the variables are given for the whole sample and for two subsets. One subset contains the young craftsmen who were in the same industry in 1965 and 1970; the other subset contains the young craftsmen who left their 1965 industry. The stayers are in industries characterized by higher mean earnings, higher future wage increases and higher growth rates. The stayers also have more work experience and a higher percentage of both high school graduates and nonwhites. Simple tests for differences in these means, however, show none of the differences to be significant. Multiple regression analysis is far more revealing since it controls for other variables. OLS is used to obtain initial estimates of the model; as noted in previous chapters, its standard errors are inherently heteroscedastic, but its parameters are consistent. They agree in sign with the probit parameters, which are estimated by maximum likelihood estimation. Maximum likelihood estimation yields consistent and asymptotically efficient estimates.

The probit estimates show earnings, future wages, industry growth, race (nonwhite), high school graduation, and years of work experience to be positive significant determinants of the probability of staying. Other variables, marital status, the unemployment rate, hours of work per year, years of education, and craft vocational education, all have their expected signs but are insignificant.

The earnings and future wage variables conform well to expectations with t ratios of 6.10 and 7.57 respectively. These results show that young craftsmen are influenced by not only current monetary incentives, but future ones as well. The significance of the future wage variable suggests that the time horizon of young craftsmen extends into the near future. (In preliminary tests of the model, more remote future wages were found to have little relationship with the probability of staying. Further support is given to these findings in the next section where the impact of present earnings is shown to be greater than that of future earnings.)

Table V.1

Turnover Model for Young Craftsmen

Variables	Probit Coefficient (S.E.)	OLS Coefficient (S.E.)	All Observations Mean (S.E.)	Stayers Mean (S.E.)	Leavers Mean (S.E.)
Constant	-.934* (.458)	.144 (.173)			
Race-nonwhite dummy	.373** (.127)	.138 (.048)	0.036 (0.187)	0.038 (0.192)	0.034 (0.180)
Vocational training in crafts dummy	.031 (.051)	.011 (.022)	0.69 (0.46)	0.72 (0.45)	0.66 (0.47)
Years of education	-.018 (.022)	-.006 (.008)	13.20[a] (1.91)	13.19[a] (1.92)	13.23[a] (1.89)
High school dummy	.137* (.061)	.053 (.023)	0.57 (0.49)	0.60 (0.49)	0.53 (0.50)
Years of work experience	.065** (.013)	.025 (.005)	4.21 (2.64)	4.44 (2.61)	3.94 (2.66)
Hours of work per year in thousands	-.249 (.184)	-.091 (.070)	1.96 (0.13)	1.97 (0.14)	1.96 (0.13)
Earnings in thousands	.160** (.026)	.059 (.010)	5.75 (1.16)	5.82 (1.20)	5.66 (1.12)
Future wage increment	.251** (.033)	.092 (.012)	1.28 (0.84)	1.37 (0.85)	1.18 (0.81)
Growth rate of industry	.840** (.113)	.301 (.040)	0.07 (0.22)	0.09 (0.17)	0.04 (0.26)
Unemployment rate	.011 (.021)	.004 (.008)	4.11 (1.06)	4.12 (1.01)	4.11 (1.13)
Marital status dummy	.063 (.051)	.024 (.019)	0.66 (0.40)	0.63 (0.48)	0.71 (0.45)
R^2	.096[b]	.0583[b]			
# Observations	3270	3270	3270	1773	1497

Sources: All data except the unemployment variable are from the Bureau of the Census, 1970 Public Use Sample. The unemployment variable is taken from Department of Labor, Area Trends in Employment and Unemployment, May 1967, (Washington, D.C., U.S. Government Printing Office, 1967). p. 50

Note: * - Significant at the five percent level

** - Significant at the one percent level

[a]PUS data use the number 14 to indicate 12 years of school.

[b]Models with dichotomous dependent variables are likely to have low R^2 values. See Appendix B.

The industry growth variable also shows high significance with a t ratio of 7.47. This suggests that young craftsmen are more likely to be permanently laid off or disappointed in declining industries, or conversely that they are more likely to be retained or promoted in rapidly growing industries.

The nonwhite dummy is significant with a t ratio of 2.93. This suggests that nonwhite young craftsmen are more likely to stay in an industry than white young craftsmen. This may be due to either racial discrimination or lack of information about the labor market. Nonwhite young craftsmen may experience discrimination in job search and tend to stay in an industry once having entered it. This may be particularly true in craft occupations where earnings are higher than in other blue-collar occupations (see Chapter II); young craftsmen have more to lose and may be less willing to leave their job in search of another one. Alternatively, nonwhites may have less information about the labor market and consequently be limited in their access to other jobs.

The high school graduation dummy is significant with a t ratio of 2.24. This suggests that high school dropouts change industries in order to increase their immediate income or because they lack perserverance to complete the training in their industry. Midway through their training, young craftsmen can often transfer to industries that pay higher wages but provide little additional training. The high school degree may be a useful screening device for hiring young craftsmen who are likely to remain in their industry.

The work experience variable has a t ratio of 4.92. Young craftsmen who had more work experience in 1965 were more likely to remain in their industry until 1970. One explanation of this is that the young craftsmen with more work experience had more information about alternative industries and occupations; having this information they were less likely to be disappointed in their 1965 industry and leave it. Another explanation is that young craftsmen with more work experience in 1965 had been in their 1965 industry longer than other young craftsmen; having been

there longer that they were more likely to be satisfied with it. If the former explanation is accepted as a partial cause, then work experience may be used as a screening device to hire young craftsmen who are more likely to remain in an industry.

Marital status is insignificant. This suggests that married young craftsmen are not appreciably constrained in changing industries. The mobility of young craftsmen may not be constrained in any fashion by marriage but important offsetting effects may occur, that is, the responsibilities of a family may require a stable income and job, but an employed wife may provide income while the young craftsman is between jobs.

The insignificance of the state unemployment rate also suggests that it is not a useful predictor of turnover. Its low significance may be due to the lack of correspondence between an individual's job market and state boundaries.

The insignificance of the hours of work variable may be due to the lack of variation that it exhibits (see Table V.1). This lack of variation suggests that young craftsmen can expect to work about the same number of hours in most industries. In this sense, it is not likely to be a highly influential determinant of turnover.

Years of education are insignificant. This implies that education does not increase the mobility of young craftsmen appreciably. It also suggests that young craftsmen who have higher levels of education are not likely to aspire to occupations that cause them to leave their industry.

The insignificance of craft vocational education may mean that the mobility that it provides is merely balanced by the information that it provides. Craft vocational education usually provides general skills that make young craftsmen more mobile. Opposed to this effect is the predisposition of young craftsmen who have craft vocational education to remain in crafts; young craftsmen who leave crafts are likely to change industry. Regardless of the cause, it is clear that craft vocational training by itself is not a useful predictor of turnover.

6. The Partial Effects of Earnings, Future Wages, Industry Growth, Race, High School Graduation, and Work Experience.

The derivation of partial effects from probit parameters is slightly complex because the probit transformation maps the model into the cumulative density function of the normal distribution. (See Appendix A,) To calculate the partial effect of a variable, the prediction of the model must be evaluated at two values of that variable with the other variables held constant at their means.

With all the variables represented by their means, the model predicts the probability of a young craftsmen staying in his industry for five years at .544. The proportion of young craftsmen who actually stayed in their industry is .542. The effect of earnings on the probability of staying can be seen in Table V.2. It gives the predicted probabilities of staying for various levels of earnings.

Table V.2

The Partial Effect of Earnings on the Probability of Staying in an Industry

Earnings in 1969	$4,000	$5,000	$6,000	$7,000	$8,000	$9,000
Probability of Staying	.433	.496	.559	.621	.680	.735
Change in Probability		.063	.063	.063	.059	.055

In Table V.2 the partial effect of earnings on the probability of staying is seen to be approximately six percentage points per thousand dollars of earnings. Similar calculations for the future wage variable show its partial effect to be almost ten percentage points per dollar increase in future hourly wages. The future wage partial effect may appear to be larger than the current earnings partial effect, but it is not. The future wage appears to have a larger effect because it is measured in dollars per hour while the current earnings are measured in dollars per year.

Comparison of the partial effects of the earnings and future wage variables is of interest. The future wage can be converted to earnings by using the mean value of hours worked in a year. The variation of hours of work per year is shown to be small in Table V.1. This lack of

variation is desirable when converting wages to earnings. Young craftsmen work approximately 1,960 hours per year. This suggests that a dollar increase in future wages is equivalent to a $1,960 increase in future earnings. (If young craftsmen expect their future number of hours of work to increase, the increase in future earnings would be greater.) The increase in future wages necessary to generate a $1,000 increase in future earnings is $.51 ($.51 · 1,960 = $1,000). Thus, an increase in future earnings of $1,000 has a partial effect of 5.05 percentage points (.51 x 9.9 = 5.05).

The estimated partial effect of future earnings is substantial, but it is less than the partial effect of present earnings (5.05 < 6.30). This conforms to the notion that future earnings are discounted and should have a smaller effect on the decision to stay in an industry.

As noted in the Section 4, it is possible that the estimate of the partial effect of future earnings might have been found greater than the estimate of the partial effect of current earnings. Such a reversal in impact would suggest an omitted variable bias on the future wage variable, that is, the omitted variables would be more remote future wages than those earned by the 25-30 age group. If the increase in wage that young craftsmen receive aged 25-30 is representative of the raises that they will receive in the more distant future, then the incorporation of more remote future wages into the model would add little explanatory power. The simpler one-period future wage variable would contain all of the information contained in a more inclusive one. In such a circumstance, however, the impact of the simpler future wage variable would be overstated. And, future earnings might show an impact greater than that of the current earnings. While less than conclusive, the smaller partial effect of future earnings suggests that no bias occurs from the ommission of the more remote future wages, that is, they do not influence young craftsmen.

The partial effects of all the significant variables are shown in Table V.3. Ordinary least squares partial effects are also shown. The latter are consistent, but they are not constrained to yield

estimates that lie in the zero-one range of a probability. (See Appendix A.) The probit partial effects given are appropriate in the range of the means of the variables. As Table V.2 shows for earnings, the probit partial effects diminish as the variables are extrapolated far from their means.

Table V.3

Probit and OLS Partial Effects for the Probability of Staying in an Industry

Variables	Probit Parameters	∂ Probability/∂ Variable	
		Probit	OLS
Earnings (in thousands)[a]	.160	.063	.059
Future wage (in dollars)[a]	.251	.099	.092
Industry growth (for one percentage point change)	.0084	.0033	.0030
Nonwhite (dummy)	.373	.142	.138
High school (dummy)	.137	.055	.053
Work experience (in years)	.065	.025	.025

Note: Only significant variables are listed in this table, i.e., ones with t ratios greater than 1.65.

[a]As noted in the text, when both these variables are expressed in the same units, e.g., dollars per year, the earnings variable has a larger partial effect.

7. Implications for Turnover

While the partial effects estimated in this analysis pertain to industry turnover, rather than firm turnover, they are useful at both levels. Industry turnover is of direct interest to a firm, since a young craftsman who leaves a firm often goes to another industry. The shipbuilding industry, for example, loses many workers to manufacturing and construction industries. Industry turnover effects also have implications

for intraindustry turnover. If craftsmen are influenced to change industries, for example, by interindustry earnings differentials, one might expect craftsmen to change firms within an industry in response to intraindustry earnings differentials. Adding the intraindustry and interindustry turnover effects, a firm may expect its turnover effects to be larger than those estimated for industry turnover.

The probit partial derivatives are a measure of the independent effects of the model's variables on turnover. The earnings and future wages variables are measured in 1969 dollars. The partial derivative of the earnings variable means that for each thousand dollars that a young craftsman earns, the probability of his staying increases by 6.3 percentage points. The partial derivative for the future wage variable implies that for each dollar that he expects his wage to rise in the next six years, his probability of staying rises by 9.9 percentage points.

In this model, growth in the employment of craftsmen in the industry of each young craftsman is measured over a five-year period. For each percentage point increase in this measure, the probability of a young craftsman staying in his industry increases by .33 percentage points.

The partial effect of two of the variables may be of interest in screening new hires. If a young craftsman is nonwhite his probability of remaining in an industry increases by 14.2 percentage points. If a young craftsman is a high school graduate his probability of remaining increases by 5.5 percentage points.

Prior work experience might also be used to screen new hires, but the partial effect suggested by this analysis probably overstates the effect of work experience for this application. As previously noted, when using the PUS it is not possible to identify the industry and occupation of work experience obtained prior to 1965. Were it possible to make this distinction, the partial effect of work experience relevant to screening might not be as great. The work experience partial effect estimated with the available data suggests that the probability of staying rises 2.5 percentage points for each year of prior work experience.

The estimated effect of a factor on the industry turnover rate is the same as its effect on individuals, since the expected value of the proportion of young craftsmen who stay in an industry equals the average of their probabilities of staying. That is,

$$E\left[\frac{\text{Young Stayers}}{\text{All Young Craftsmen}}\right] = 1/n \sum_{i=1}^{n} \text{Probability}_i$$

where Probability_i = the probability that the ith young craftsmen will stay in the industry

n = the number of young craftsmen

The partial effect of a factor on the probability of staying is

$$\frac{\partial E\ (\text{Young Stayers/All Young Craftsmen})}{\partial\ \text{Factor}} = 1/n \cdot \sum_{i=1}^{n} \frac{\partial\ \text{Probability}_i}{\partial\ \text{Factor}}$$

But since the estimate of $\partial\ \text{Probability}_i / \partial\ \text{Factor}$ is constant for all young craftsmen, this expression simplifies to the partial effect itself.

$$\frac{\partial E\ (\text{Stayers/All Young Craftsmen})}{\partial\ \text{Factor}} = 1/n \cdot n \cdot \frac{\partial\ \text{Prob}}{\partial\ \text{Factor}} = \frac{\partial\ \text{Prob}}{\partial\ \text{Factor}}$$

The estimated partial effect is the same for the industry turnover rate and the individual. For example, the partial effect of earnings at 6.3 percentage points implies that the turnover rate would be 6.3 percentage points lower if earnings were raised by one thousand dollars. The partial effect of future wage increases suggests that the turnover rate would be 9.9 percentage points lower if the future wage increment was raised by a dollar.

These effects may also be viewed in terms of elasticities. A ten percent increase in earnings from the mean level is $575, which would generate a 3.62 percentage point increase in the stayer rate (.575 thousand · .063 = .0362). The predicted stayer rate for the mean value of all the variables is 54.4 percent meaning that the 3.62 percentage point increase is a 6.7 percent increase in the stayer rate (3.62/54.4 = .067). The elasticity, %Δ stayer rate / %Δ earnings, equals .67 (.067/.10). Similar elasticities exist at low and high levels of earnings. For example, a ten percent increase in earnings from the $8,000 level generates a 4.56 percentage point increase in the stayer rate (.800 thousand · .057 = .0456, where .057 is the partial effect when earnings are $8,000; see Table V.2). This increase is 6.7 percent of the predicted stayer rate at the $8,000 level; 68 percent, (4.56/68.0 = .067). Hence, a ten percent increase in earnings yields a 6.7 percent increase in the stayer rate at high ($8,000) and average ($5,750) levels of earnings. At low levels of earnings the elasticity is smaller due to the small absolute size of a percentage increase in earnings. A ten percent increase in earnings from the $4000 level generates a 2.52 percentage point increase in the stayer rate (.400 thousand · .063 = .0252); this increase is a 5.8 percent increase of the predicted stayer rate at the $4000 level (2.52/43.3 = .058).

Various levels of future wage increases may also be viewed in relative terms. A ten percent increase in the mean future wage increase is not large ($1.28/10 = $.128), but it would generate a 2.3 percent increase in the stayer rate from the .544 predicted value (.128 · .099/.544 = .023). The probability of staying when the future wage increase ranges from $.30 to $2.30 is shown in Table V.4. The partial effect is nearly constant over this range of future wage increases.

Table V.4

Partial Effect of Future Wage Increases
on the Probability of Staying in an Industry

Future Wage Increase	Probability of Staying	Change in Probability
$0.30	.445	.010
.40	.455	.010
.50	.465	.010
.60	.475	.010
.70	.485	.010
.80	.495	.010
.90	.505	.010
1.00	.515	.010
1.10	.525	.010
1.20	.535	.010
1.30	.545	.010
1.40	.555	.010
1.50	.565	.010
1.60	.575	.010
1.70	.585	.010
1.80	.595	.009
1.90	.604	.010
2.00	.614	.010
2.10	.624	.009
2.20	.633	.009
2.30	.642	

In addition to viewing the effects of current earnings and future wages separately, it is of interest to view their effects jointly. While their combined impact can be approximated by using their partial effects, the precise predictions of the model are more easily observed in Table V.5. A young craftsman with current earnings of $7000 and expected future wage increase of $1.50 is 20 percentage points more likely to stay in his industry for five years than if he had current earnings of $4500 and an expected future wage increase of $1.10. The trade-off between current earnings and future wage increases is also observable in the table. Comparable probabilities of staying are found throughout the table, e.g., a young craftsman with current earnings of $6000 and an expected future wage increase of $1.20 is equally likely to stay as when those figures were $5500 and $1.50. Extrapolating the future wage effect to a low level via the partial effects suggested in Table V.4, one finds the probability for $7000 current earnings and $.30 future wage increase to equal that for $5500 and $1.30.

Table V.5

The Probability of Staying in an Industry for Alternative Combinations of Current Earnings and Future Wage Increase

Current Earnings	Future Wage Increase				
	1.10	1.20	1.30	1.40	1.50
4500	.4477	.4576	.4676	.4776	.4876
5000	.4796	.4896	.4996	.5096	.5196
5500	.5118	.5218	.5318	.5418	.5517
6000	.5437	.5536	.5635	.5734	.5832
6500	.5752	.5850	.5948	.6045	.6142
7000	.6063	.6159	.6254	.6349	.6443

Note: The earnings and wage increments are expressed in 1969 dollars. All other variables are held at their mean value.

The future wage increments given in Table V.5 cluster around the sample mean of $1.28. In the sample, however, there is substantial variation in the measure (see Table V.1) indicating that some industries have substantially lower increases and other industries substantially higher ones. The shipbuilding industry, for example, pays older craftsmen little more than young ones, but pays the young ones fairly well.[13] The data in Table V.5 suggest that comparable turnover rates for young craftsmen could be maintained with lower current earnings and higher future wage increments. Restructuring of the age-earnings profile in this manner might be done by increasing the earnings of older craftsmen, who, in the shipbuilding industry, have high turnover rates. The total wage bill could be held constant by holding down the already high earnings of young craftsmen. Their turnover might not increase due to the high earnings they would expect as older craftsmen. From the estimates above, an approximation of this tradeoff can be derived. It appears that a $1,248 increase in future earnings would offset a $1,000 decrease in current earnings.[14]

The earnings and future wage findings are also important as a first step in analyzing the cost-minimizing labor cost-turnover cost trade-off. For such analysis, lower turnover rates must be converted into dollar savings in turnover costs and compared to increased earnings. Lower turnover will decrease hiring costs, but the exact relationship is not known. Lower turnover should also raise average productivity since the proportion of workers in training and providing training would be lower. These exact relationships are also not known. To the degree that reduction of turnover increases productivity, higher wage costs will

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[13] John Martin, "The Labor Market of the U.S. Shipbuilding Industry, 1960-1970," (Technical Paper Serial T-383, Program in Logistics, The George Washington University, June 30, 1978), p. 112.

[14] Partial effects of current and future earnings cancel when (.063) $1,000 = (.0505) $1,248, meaning that the probability of staying would remain the same if current earnings decreased by $1,000 while future earnings increased by $1,248. As previously noted, the future earnings partial effect, .0505, is derived from the future wage partial effect.

be offset. A higher wage might be paid to decrease turnover, but it will only result in lower total costs if higher productivity and lower hiring costs offset the higher wage. This study contributes two kinds of information to this issue. First, it shows the significance of monetary factors in influencing turnover. Second, it provides a general measure of the impact of those monetary factors on turnover; e.g., a 6.7 percent increase in the stayer rate due to a ten percent increase in current earnings.

The findings of this study also suggest that turnover may be reduced by taking some demographic factors into account in hiring policy. It should be noted at the outset of this discussion that no attempt is made to assess the equity, and perhaps legality, of screening young craftsmen by these demographic criteria. From the standpoint of manpower policy the only objective is to state the findings of the analysis and their implications for lower turnover and production cost.[15] It is recognized that the final policy decision may be to ignore gains in efficiency in order to satisfy an equity goal or legal constraint. For example, these findings suggest that turnover would be lower if non-whites were hired instead of otherwise-equal whites, but such a policy might be unacceptable if this racial discrimination is viewed as unfair or illegal.

The demographic characteristics that might be used to screen new hires are race, high school graduation, and work experience. Table V.6 shows the different probabilities of staying in an industry for various combinations of these variables. All variables other than those defined in the table are represented by their mean. By favoring workers in hiring policy who have a higher probability of staying, turnover can be reduced.

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[15]Screening young craftsmen on the basis of demographics related to turnover may not reduce costs if the benefits of this low turnover have been recognized and bid away in a competitive labor market. Were these wages bid up, a firm would have to pay a higher wage to attract, for example, young craftsmen with a high school degree. The firm could afford to pay a higher wage to low turnover groups as long as these higher wage costs were less than or equal to the benefits of lower turnover. The demand for workers in low turnover groups might be high, causing their wages to be high, but a firm whose turnover is particularly costly could still expect to reduce cost by hiring these workers. Their higher wages would be more than offset by cost savings due to their lower turnover. For recent work concerning such wage differentials see, Robert S. Goldfarb and James R. Hosek, "Explaining Male-Female Wage Differentials for the 'Same Job'," Journal of Human Resources 11 (Winter, 1976): 98-108.

Table V.6

The Probability of Staying in an Industry for Alternative Combinations of Work Experience, Completion of High School, and Race

Work Experience in Years	White No H.S.	White H.S.	Nonwhite No H.S.	Nonwhite H.S.
0	.401	.455	.548	.602
1	.426	.481	.574	.626
2	.452	.507	.599	.650
3	.477	.532	.624	.674
4	.503	.558	.648	.697
5	.529	.583	.672	.720
6	.555	.608	.695	.743

Note: All other variables are held at their mean values.

The explanations of the effects of race, high school graduation, and work experience have already been given, but may bear some repetition. The influence of race on the probability of staying may be due to either discrimination or lack of labor market information, both of which may limit the nonwhite's mobility. Young craftsmen who are high school drop-outs may be less likely to remain in an industry for two reasons. They may have high immediate income needs that cause them, when they become semi-skilled, to go to industries where immediate earnings are high but little training is provided. Similarly, high school drop-outs may leave their industries because they lack the perserverance to complete their training. Finally, work experience prior to entering an industry may make a young craftsman more likely to stay because his knowledge of alternative occupations and industries is enhanced by his experience. Young craftsmen with less experience and information may have entered their industry on a random basis and subsequently been disappointed, causing them to leave. It should be emphasized, however, that the work experience variable available in this study does not control for the nature of

prior work experience. If it is assumed that most of the work experience was gained while in the industry, rather than prior to entering it, then no inferences can be made for hiring policy. It may be ignored in Table V.6 by observing only the probabilities where work experience equals 4, its mean value.

8. Summary

In this chapter, earnings, future wages, industry growth, race, high school graduation, and work experience are found to be significant positive factors affecting the likelihood of a young craftsman staying in his industry. Other factors are found to be insignificant; they are marital status, the unemployment rate, hours of work, formal education, and craft vocational education.

Both current earnings and future wages are shown to have the expected positive effect on retaining workers. The significance of the future wage variable means that the time horizons of young craftsmen extend far enough into the future for their turnover to be influenced by future wages. The estimates of this model provide a measure of the change in turnover that is expected from changes in earnings and future wages. These findings answer some of the questions concerning the trade-off between turnover costs and labor costs. Other questions concerning the relationship of turnover and productivity and hiring costs are beyond the scope of this study.

The use of data comprised of individuals allows the effect of race, work experience, marital status, education and craft vocational training to be more precisely associated with turnover. Ignoring questions of equity and legality, and broader options in social policy, findings suggest that race and high school graduation might be used as screening devices in hiring. A measure of the effect of each of these variables on turnover is provided. With less confidence, findings also suggest that work experience could be used as a screening device. The finding that marital status, formal education, and craft vocational training do

not influence turnover has policy implications. If these variables were found to have a significant influence on turnover then they could be used as a basis upon which to screen new hires. Turnover could be reduced by taking into account these factors in hiring policy. Education and craft vocational training can increase the productivity of young craftsmen and on that basis they may be valid criteria upon which to select new hires. From the standpoint of turnover, however, this study provides no evidence that they should be considered in hiring policy.

CHAPTER VI

OVERVIEW

1. Introduction

Economic and demographic factors affect the supply of young craftsmen to an industry. Affecting the flow of young men into crafts in an industry are the decisions whether or not to 1) participate in craft vocational education and 2) enter a craft occupation. Affecting the flow of young craftsmen out of the craft occupations of an industry is 3) the decision of a young craftsman to stay in or leave his industry. In this study, the economic and demographic factors influencing these decision are analyzed. The effects of these factors have policy implications in industry and government, e.g., the effects of earnings, vocational education, and race on entry and mobility in craft occupations. Other findings may be of more purely academic interest, for example, human capital effects.

A summary of the study is provided in the next section where the effects of economic and demographic variables are traced through the occupational and industrial choice process. These effects are shown to be consistent with the descriptive analysis of the career development of young craftsmen, which is described at the end of the next section. Also given at the end of the next section are descriptive findings of the effects of human capital factors on the earnings of young craftsmen. In the last section, major policy implications are presented.

2. General Effects of Economic and Demographic Variables

A. Variables in the Craft Vocational Education, Craft Entry and Industrial Attachment[1] Models - Several economic and demographic variables are common to all three of the choices analyzed in this study, i.e., the craft vocational education participation decision, the craft entry decision and the industrial attachment decision. These common variables are listed in Table VI.1. From the table one can distinguish similarities and differences between their roles and effects in each context.

A major, although not surprising, conclusion of the study is that craft earnings play an important role in the supply of young craftsmen to an industry. High craft earnings appear to attract young men to craft occupations. Similarly, having entered crafts, a young man's decision to stay in or leave his industry appears to depend on how high craft earnings are in that industry. While economic theory suggests that craft earnings might influence the craft vocational education decision, this does not appear to be the case. Craft earnings may be beyond a young man's time horizon when he is considering craft vocational education. Alternatively, he may lack information about craft earnings, as he is not actually looking for a job when he considers craft vocational training.

Another earnings variable should be mentioned at this point, although it is only included in the industrial attachment model. The future wage, that is, the wage that a young craftsman can expect to receive in his industry when he becomes experienced, is found to be important in his decision to stay in or leave his industry. This suggests that the time horizon of young craftsmen extends into the future, i.e., earnings paid to more experienced craftsmen influence turnover of less experienced craftsmen who expect to receive those earnings in the future.

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[1] Industrial "attachment" is used throughout the summary instead of industrial "mobility" or "turnover" used in the study when a short phrase is needed. While "attachment" is not widely used in this context, it facilitates the discussion in this section where phrases like "the probability of staying in an industry" are awkward.

Table VI.1

RELATIONSHIPS OF VARIABLES INCLUDED IN ALL THREE MODELS

Variables	Models		
	Craft Vocational Education	Craft Entry	Industrial Attachment[a]
Craft Earnings	N.S.	+	+
Growth in Craft Employment	+	+	+
Unemployment	+	-	N.S.
Race (Nonwhite = 1)	N.S.	-	+
Marital Status	N.S.	+	N.S.
Education	Neg. Quad.[b]	-	N.S.

Note: "N.S." means not significant.

[a]Industrial "attachment" is used here instead of the term industrial "mobility" or "turnover" used in the study. This is done to avoid confusion in reading the signs in the table, where "+" relates to the likelihood of staying in an industry.

[b]Negative quadratic relationship.

Returning to Table VI.1, it can be seen that the demand for craftsmen, as measured by growth in craft employment by industry, is another important factor in the flow of young workers into and out of the craft occupations of an industry. Young men appear more likely to participate in craft vocational education, to enter crafts and to remain in the industry where they are employed as craftsmen, when the demand for craftsmen is high.[2] Another demand variable is unemployment. As opposed to the growth in craft employment variable, the unemployment variable has mixed roles and effects in the three models. In the craft vocational education decision, a low unemployment rate implies a high opportunity cost of investing time in craft vocational education. When unemployment is low a young man may be able to find a desirable job without taking craft vocational education. In the craft entry decision, unemployment has a different relationship; it becomes more difficult to enter crafts when unemployment is high, as there are likely to be fewer craft openings. In the decision to stay in or leave his industry, a young craftsman appears to be unaffected by unemployment. It may be that once a young man has some experience as a craftsman, his employment opportunities may be less influenced by the general level of unemployment.

From the estimated relationships of race to craft entry and industrial attachment, it appears that nonwhites are less likely to enter craft occupations and less likely to change industry when they do enter. It may be that nonwhites either experience discrimination in craft occupations or lack information about them that would facilitate entry and mobility. In contrast, participation in craft vocational education does not appear to be influenced by race. This may be due to the public financing and wide availability of craft vocational education that make it accessable to whites and nonwhites alike.

Marital status appears to be related to craft entry. This can be attributed to married young men being more career oriented and having a longer time horizon than single men. In contrast, marital status does

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[2] A bias in favor of the craft vocational education relationship may exist and is noted in Chapter IV.

not appear to be related to craft vocational education. It may be that while married young men have a longer time horizon, the craft vocational education decision is too remote from future craft earnings for the longer horizon to matter. Alternatively, if the individual is not looking for a job when he considers craft vocational education, he may lack information about future earnings, thus making differences in time horizons unimportant. Finally, in the decision to stay in or leave his industry, a young craftsman does not appear to be affected by his marital status. The expected relationship in this decision is not clear as offsetting factors may exist, e.g., a married young craftsman may be less mobile if he has a family to support but he may be more mobile if his wife has an income.

The role and effect of education also differs among models. In the craft vocational education model, individuals who drop out of school lose access to the largest source of craft vocational education. Individuals who stay in school beyond high school, however, tend to be inclined toward occupations which do not require craft vocational education. While this negative craft aspirations effect pertains to individuals with high levels of education, the positive access effect pertains to individuals with low levels of education. These two effects result in a negative quadratic relationship, where individuals who finish eleven or twelve years of school are the most likely to participate in craft vocational education. In the craft entry model only the negative craft aspirations effect appears to be important. In the industry attachment model, formal education does not appear to be important in any way.

Many other variables are important in these decisions but are not included in all three models. For example, craft vocational education and high school graduation are included only in the craft entry and industrial attachment models. (See Table VI.2.)

In the craft entry decision it appears that individuals who have craft vocational education are better prepared and consequently more likely to enter crafts. This relationship is found with strong controls for craft aspirations in the model. Craft vocational education does not appear to be related to the decision of a young craftsmen to stay in or

Table VI.2

Relationships of Variables Included in the
Craft Entry and Industrial Attachment[a] Models

Variables	Models	
	Craft Entry	Industrial Attachment[a]
Craft Vocational Education	+	N.S.
High School	N.S.	+

Note: "N.S." means not significant

[a]Industrial "attachment" is used here instead of the industrial "mobility" or "turnover" used in the rest of the study. This is done to avoid confusion in reading the signs in the table, where "+" relates to the likelihood of staying in an industry.

leave his industry. This result may be due to offsetting effects, e.g., craft vocational education may provide general skills which increase mobility but it may also provide information about crafts and industries which reduces a young craftsman's inclination to leave.

Graduation from high school appears to be an important variable in the industrial attachment model. While the young craftsman's particular level of educational attainment does not appear to affect his mobility, graduation from high school appears to be positively related to the likelihood of a young craftsman staying in his industry. This may be because completion of high school requires perserverance, a quality necessary to remain in an industry where craft training is long and demanding. Alternatively, young craftsmen who drop out of high school may do so because they have immediate income needs. These immediate income needs may cause them to seek employment where initial earnings are higher but where comparatively little additional training is provided.

In contrast, high school graduation does not appear important in the craft entry model. This may be due to offsetting effects. For example, a high school drop-out may have high immediate income needs and be discouraged from entering crafts due to low initial earnings required to finance on-the-job training. On the other hand, high school graduates may find many occupations other than crafts open to them that are not open to high school drop-outs.

Another group of variables are included only in the craft vocational education model and the craft entry model. (See Table VI.3.) One of these is the craft aspirations control. Not surprisingly, it is a powerful explanatory variable in both models.

Family size appears to be negatively related to craft entry. This may be due to immediate income needs that a young man with a large family may have. As noted, with immediate income needs a young man may take a job where his initial earnings are high but where little training for more skilled work, for example, crafts, is provided. Family size does not appear to be important in the craft vocational education decision.

Table VI.3

Relationships of Variables Included in the
Craft Vocational Education and Craft Entry Models

Variables	Models	
	Craft Vocational Education	Craft Entry
Craft Aspirations	+	+
Family Size	N.S.	-
Father's Occupation in Crafts	N.S.	N.S.
Intelligence Quotient	N.S.	N.S.

Note: N.S. means not significant

Provision of craft vocational education through public schools makes this training available to many young men at low cost, thus making immediate income needs unimportant.

Two other variables, father's occupation in crafts, and IQ, do not appear important in either the craft vocational education or craft entry decisions. One might expect the sons of craftsmen to have an advantage in entering crafts since, for example, craftsmen may be able to give their sons information that helps them to enter crafts. This does not appear to be the case. One might expect, at least in some cases, the son of a craftsman to emulate his father's occupation. It appears, however, that this sort of behavior is controlled directly through the craft aspirations variable. For this reason, the father's occupation is found to be unrelated to both craft entry and participation in craft vocational education.

The intelligence quotient appears to be unrelated to both decisions when analyzed with control for educational attainment. This means that for young men with equal educational attainment, differences in mental ability do not influence either participation in craft vocational education or craft entry.

There are a few other variables that pertain to only one of the decisions. In the decision of a young craftsman to stay in or leave his industry, work experience appears to be an important factor. A young craftsman's likelihood of staying in his industry in the future is positively related to his previous work experience, e.g., if viewing two young craftsmen in 1965, the one with more previous work experience is more likely to stay in his industry until 1970, other things being equal. This relationship may be due to several causes having to do with information and job satisfaction. For example, the more experience a young craftsman has in other occupations and industries before entering an industry, the more likely he is to be satisfied in that industry and the less likely he is to leave it in search of a better one.

Another variable included only in the industrial attachment model is an hours-of-work variable. One would expect a young craftsman's decision to stay in or leave his industry to be influenced by the leisure he has there (earnings held constant). The measure of hours of work available in this analysis is, however, an industry-wide measure that displays little variation. Using this measure, hours of work does not appear to influence the young craftsman's decision to stay in or leave his industry. It may be, however, that because hours of work are similar in most industries they do not influence industrial attachment.

A final variable, school quality, is included only in the craft vocational education model. Young men appear to be more likely to participate in craft vocational education when the quality of the program available to them is high. The better the training, the higher the young man's prospective earnings become and the more likely he is to obtain training.

B. Career Development of Young Craftsmen - The career development of young craftsmen, that is, training and occupations prior to entering crafts and occupations subsequent to leaving crafts, appears to be what one would expect, particularly considering the relationships described above. Analysis of occupations prior to entering crafts suggest that young craftsmen often develop craft related skills in lower-paying, lower-skill blue-collar occupations. This is consistent with the above described effects of human capital-oriented variables. For example, consider the negative relationship found between immediate income needs (family size) and craft entry; one can attribute this relationship to the cost of on-the-job training preventing young men with immediate income needs from entering crafts. As discussed in Chapters III-V, the craft trainee finances his on-the-job training by working for a lower wage than he could earn at an alternative job that provides little training. Similarly, the finding that high school drop-outs are more likely to change industry may be due to immediate income needs. These income needs may have induced young men to leave high school and subsequently to leave their initial craft industry; the earnings there may have been low in order to finance high levels of on-the-job training.

Presumably, the high school drop-out changes industry to enter one where initial earnings are higher because little additional training is provided. Hence, the following findings are all consistent with a process in which young men finance their accumulation of human capital through on-the-job training: 1) young craftsmen tend to have prior experience in low-skill blue-collar jobs, 2) individuals who have immediate income needs appear either not to enter a craft or 3) to change industry if they do manage to enter a craft.

In addition to having prior blue-collar experience, it also appears that many young craftsmen who leave crafts go to lower-skill blue-collar occupations. Presumably, these transfers are involuntary as the work is similar but the earnings are lower. Involuntary transfers to other occupations may not result in permanent losses in the supply of young craftsmen. As noted in Chapter II a high proportion, 32 percent, of young craftsmen who leave crafts return to crafts within a few years.

Other changes in occupation may tend, however, to be permanent in nature. One type of occupational change that is likely to be permanent and that appears to be important among young craftsmen is the change to managerial occupations. These transfers are more likely to be voluntary and permanent, since managerial occupations have higher earnings and perhaps more prestige than crafts. Hence, part of industrial turnover of young craftsmen may be due to transfers to more attractive managerial positions, e.g., the manager of a retail gasoline station, business repairs store, restaurant, or bar.

A final note regarding the career development of young craftsmen concerns craft vocational education. In 1970, 25 percent of young craftsmen had craft vocational education. This substantial proportion suggests that individuals with craft vocational education are better prepared for and more likely to enter a craft occupation. It appears from these findings, and the earnings data in the next section, that craft vocational education makes young men more productive young craftsmen.

C. Human Capital and the Earnings of Young Craftsmen - The focus of this study is on factors that influence the flow of young men into and out of the craft occupations of an industry. In addition to these flows, the effects of some human capital factors on the productivity of young craftsmen are considered. In an attempt to explore the relationships between human capital and craft productivity, descriptive data were used pertaining to young craftsmen's earnings and their formal and vocational education.

The findings of this analysis suggest that at all levels of education, craft vocational education yields young craftsmen higher earnings. This is consistent with the inference made in the previous section that craft vocational education increases the productivity of young craftsmen.

It also appears that a high school degree increases the earnings of young craftsmen with or without vocational education, most likely because many types of craft work require the ability to read and work with figures. It was also found, however, that lack of a high school degree can be compensated for with craft vocational training; high school drop-outs with craft vocational education have comparable craft earnings to high school graduates without craft vocational education. It also appears that if a young man completes high school and participates in craft vocational education, his craft earnings will be higher than if he had only one form of training. These types of human capital seem to be useful both separately and in combination in craft work.

Education beyond high school also appears to yield young craftsmen higher earnings, if they also have vocational education of some type. One can infer that the combination of education beyond high school and either craft or noncraft vocational education, e.g., drafting, prepares young craftsmen for more productive work. Without some form of vocational education, education beyond high school seems to yield lower earnings. Apparently, when education beyond high school is acquired without vocational education, any increase in productivity due to the additional years of schooling is more than offset by the craft work experience lost while remaining in school. It may be, however, that the lost craft work experience effect is unimportant among older craftsmen who generally have far

more craft work experience, i.e., education beyond high school may yield a return to older craftsmen even without vocational education.

Young craftsmen who have noncraft vocational education appear to have lower earnings than young craftsmen without any vocational training, (unless they also have education beyond high school). As in the case of education beyond high school, any increase in productivity due to noncraft vocational education appears to be more than offset by lost craft work experience. Young craftsmen who have noncraft vocational training may characteristically miss craft work experience by pursuing noncraft occupations.

Although young craftsmen with noncraft vocational education have lower earnings, this form of training may still increase craft productivity if the craft work experience explanation given above is correct. If data were available to control for craft work experience, the effect of noncraft vocational education on young craftsmen's earnings could be tested directly. Lacking information on craft work experience, the size of the noncraft vocational education negative earnings differential was inspected for less skilled blue-collar workers, i.e., young operatives and laborers. In occupations that require the most training, i.e., crafts, the noncraft vocational education's effect on productivity almost completely offsets the negative craft work experience effect. This is not the case for the lower-skill blue-collar occupations where less training is required. One can infer from this that in craft occupations, noncraft vocational education provides training that increases productivity. Unless combined with education beyond high school, however, this higher productivity does not appear sufficient to compensate for the craft work experience characteristically lost while pursuing noncraft occupations.

3. Major Policy Implications

Many policy implications have been noted in this study. In this section, discussion is limited to three broad areas of concern: 1) the effect of earnings on craft supply and, more particularly, the effect of an industry's age-earnings profile on craft turnover, 2) the effect of craft

vocational education on craft entry and productivity, and 3) the effect of race on access to and mobility in craft occupations.

While not surprising, the finding that craft earnings influence craft entry and turnover has important policy implications. To attract and maintain an adequate supply of young craftsmen, an industry must pay competitive wages. In some industries, shipbuilding for example, young craftsmen are paid more than their counterparts in other industries. The age-earnings profile of such an industry is flat, that is, the wages of older craftsmen do not rise enough to reflect their higher productivity. The low wages of older craftsmen have turnover implications beyond the turnover of older craftsmen. Young craftsmen are aware of what their future wages will be if they stay in their industry, and low future wages discourage them from staying.

An industry with a flat age-earnings profile may be able to reduce turnover without increasing its wage bill. By raising the wages of older craftsmen to the competitive level, their turnover can be reduced. By holding down the wages of young craftsmen, the wage bill could be held constant. The depressed wages of younger craftsmen would tend to increase their turnover, but their higher future wages would tend to offset this effect.

Two findings in this study suggest that craft vocational education increases craft productivity: 1) young men with craft vocational education are more likely to enter crafts, craft aspirations and other factors held constant and 2) young craftsmen with craft vocational education have higher earnings, formal education held constant. These findings should be of interest to young people considering a craft career; they can increase their chances of entering crafts by taking craft vocational education. In addition, employers of craftsmen who think craft vocational education is not useful may want to reconsider their view on this point.

Without public provision of craft vocational education, it is likely that participation in this form of training would be less than it is, particularly among individuals with immediate income needs. Public provision of craft vocational education also appears to make it equally

available to whites and nonwhites. This lack of racial influence is in sharp contrast to the effect of race in craft entry and mobility.

It appears that nonwhites are less likely to enter a craft occupation than whites with comparable IQ, education, father's occupation, craft aspirations, and other factors. If they manage to enter a craft, nonwhites appear less likely to change industry than whites with comparable characteristics. These differences in access and mobility may be due to racial discrimination or lack of information about the craft labor market. Policies might be designed to provide equal information to nonwhites and whites or they might attempt to deal directly with discrimination.

Other policy implications of more narrow scope or lesser importance are noted in the study. All of the policy implications are based on relationships found between a wide array of economic and demographic factors and the supply of young craftsmen to an industry. Influencing the flow of young men into crafts are craft earnings and demand, occupational aspirations variables, craft vocational education, immediate income needs and race. Influencing the turnover of young craftsmen are initial earnings and future wages in their industry, immediate income needs or perserverance, race and work experience. In addition to the policy implications, other relationships of interest are suggested, most notably, human capital effects on industrial and occupational choice and craft earnings.

4. Limitations

While limitations of the analysis have been noted in preceding chapters, some of the more important ones are reviewed in this section. As noted in Chapters III and V, it was not possible to test for the effect of unions in this study. This would be of little consequence if unions were so pervasive in craft occupations that there was little variation in their presence and effect on craft entry and industry withdrawal.

Unfortunately, the requisite union data to test this possibility were unavailable. Additionally, craftsmen with apprenticeship training are not identified in the data. They may have different occupations prior to and subsequent to craft participation and be affected differently by economic and demographic factors.

Limitations of the data prevent union and apprenticed craftsmen from being distinguished from other craftsmen, but beyond this, there is a problem in distinguishing craftsmen from other blue-collar workers. In both the PUS and NLS, craftsmen are self-identifying, i.e., the individuals report their occupation rather than the information being supplied by the employer or union. A young man may be inconsistent in reporting his occupation in different time periods, e.g., identifying himself as a craftsman one time and a helper (laborer) the next time. Occupational identification may also vary with union membership. Members of unions, viewing themselves in a formally defined hierarchy, might regard themselves as helpers or semi-skilled workers rather than craftsmen. Conversely, a nonunion worker doing similar work, but not being part of formal hierarchy, might identify himself as a craftsman.

Some econometric limitations of the analysis should be emphasized. Factors that influence the supply of young craftsmen to an industry have been modeled in terms of occupational choice and turnover equations. These are part of a larger system that accounts for the flow of young men into and out of the craft occupations of an industry. Since estimation was conducted on the equations individually rather than as a system, some concern about simultaneity between the equations may be justified. For example, two equations modeled are:

$$\text{Craft entry} = f(\text{craft vocational education, other})$$

$$\text{Craft vocational education} = g(\text{other}).$$

If participation in craft vocational education were a function of craft entry, simultaneity would exist. As suggested in the text this is not likely to be the case since craft vocational education can add little to

on-the-job training. There may be, however, other factors that are common to both equations, such as craft aspirations and natural ability. Correlation of error terms and a simultaneity problem may arise from these common factors. These sorts of estimation problems exist, however, in almost every study. It seems satisfactory to estimate the equations as if they were recursive.[3]

In addition to this recursive approach, the system of equations is estimated in a conditional way. For example, the decision to stay in or leave an industry is modeled under the condition that the individual is a craftsman. This approach differs from simply modeling the probability of any young man being in a craft and industry. In contrast to the turnover model, the entire young male population is used in the craft entry model, but it is conditional with regard to the craft vocational education decision. A dichotomous variable is used to account for participation in craft vocational education in the craft entry model. An alternative approach would be estimation of different craft entry equations for groups with and without craft vocational education.

It might also be noted that estimation of the three decisions was done using three separate cross-sectional data sets from the NLS and PUS. Alternatively, a cohort of young men might have been followed through time as they made decisions conditioned on prior outcomes. For example, from a sample of the entire population, the decision whether or not to participate in craft vocational education might be modeled. Subsequently, the craft entry decision might be modeled using those in the cohort who had craft vocational education. Finally, the decision to stay in or leave their industry could be modeled, using the individuals who had entered crafts. Following a cohort in this manner might be preferred as a more controlled approach for analyzing the decision process. It would, however, force the use of much smaller sample sizes.

A final note concerning interpretation of the labor turnover model should be made. The labor turnover estimates pertain to industry turnover,

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[3]In the case of the effect of craft vocational education on craft entry, there may be an omitted variable bias due to imperfect control for craft aspirations or natural ability. This is noted in Chapter III.

not firm turnover, but they may still be useful from the perspective of a firm. The industry effects themselves may be of interest, since firms that lose craftsmen often lose them to other industries. A shipbuilding firm, for example, may be concerned about losing craftsmen to nearby construction or manufacturing firms. Industry turnover effects also have implications for intraindustry turnover. If craftsmen are influenced to change industries, for example, by interindustry earnings differentials, one might expect craftsmen to change firms within an industry in response to intraindustry earnings differentials. Adding the intraindustry and interindustry turnover effects, a firm may expect its turnover effects to be larger than those estimated for industry turnover.

APPENDIX A

ESTIMATION OF MODELS WITH A DICHOTOMOUS DEPENDENT VARIABLE

1. The Interpretation of a Dichotomous Dependent Variable as a Probability and the Use of the Probit and Logit Transformations in Constraining the Prediction of the Model to the Value of a Probability

The expected value of a zero-one dichotomous dependent variable is the probability that it equals one. This follows from the equations below.

If $y_i = \alpha + \beta x_i + \varepsilon_i$

then $E(y_i) = \alpha + \beta x_i$,

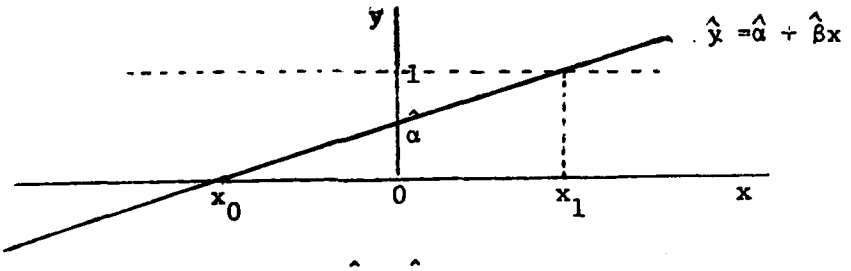
but $E(y_i) = P(1)(1) + P(0)(0)$

$= P(1)$

where $P(1) = \text{Probability}(y_i = 1 / x_i)$.

Hence, $E(y_i) = \alpha + \beta x_i = P(1)$

Ordinary least squares (OLS) yields a regression line such as the one depicted in Figure A.1. The estimate of y, $\hat{y}$, is interpreted as the



$$y = \hat{\alpha} + \hat{\beta}x + e$$

Figure A.1

OLS Prediction of a Dichotomous Dependent Variable

probability that y equals one and should have a value that lies between zero and one. As can be seen in Figure A.1, however, the OLS regression line yields values of $\hat{y}$ which lie below zero and above one. The interpretation of $\hat{y}$ as a probability breaks down in these circumstances, that is, where $x_0 > x > x_1$.

To solve this problem the regression function must be transformed into a cumulative density function. This solves the problem because its value is always between one and zero, a probability. Two ways of accomplishing this transformation were used in this study, the probit and logit transformations. Analysis began with the logit transformation, but, subsequently, probit software became available, which has two advantages. First, the probit software allows the use of more data by storing the data on disc. Second, this probit software converges to a maximum more quickly and is less expensive to use than the logit software. Both the logit and probit are estimated via maximum likelihood estimation where the probabilities are defined as follows.

The probit transformation uses the normal density function to constrain the prediction of the model to value of a probability. The following transformation maps the model into the cumulative normal density function.[1]

$$p(y=1/x) = \frac{1}{2\pi} \int_{-\infty}^{\alpha+\beta x} e^{-t^2/2}\, dt$$

$$p(y=0/x) = 1 - p(1)$$

[1] For further reference of both probit and logit transformations see, Henri Theil, Principles of Econometrics, (New York: John Wiley & Sons, 1971), pp. 630-632

The logit transformation uses the logistic density function to constrain the prediction of the model to the value of a probability. It uses the log-linear transformation.

$$\text{Ln}\,\frac{P(1)}{P(0)} = \alpha + \beta x$$

where

$$p(1) = P(y=1/x)$$

$$p(0) = P(y=0/x) = 1 - p(1)$$

so that

$$p(1)/p(0) = e^{\alpha+\beta x}$$

and

$$p(1) = (1-p(1))\, e^{\alpha+\beta x}$$

$$p(1) = e^{\alpha+\beta x}/1 + e^{\alpha+\beta x}$$

and

$$p(0) = 1 - e^{\alpha+\beta x}/1 + e^{\alpha+\beta x} = \frac{1}{1+e^{\alpha+\beta x}} \quad .$$

These expressions of $p(1)$ and $p(0)$ as a function of $\alpha + \beta x$ are used in the likelihood function to obtain maximum likelihood estimates (MLE) of α and β.

$$L = \prod_{i=1}^{n} p(1)_i \prod_{j=n+1}^{N} p(0)_j \ ,$$

where observations 1 through n are ones where $y_i = 1$ and $n + 1$ through N are ones where $y_i = 0$. It is easier to maximize the ℓnL, so,

$$\ell nL = -\sum_{i=1}^{n} \ell n\left(1+e^{\alpha+\beta x_i}\right) + \sum_{i=1}^{n} (\alpha+\beta x_i) - \sum_{j=n+1}^{N} \ell n\left(1+e^{\alpha+\beta x_j}\right) \quad .$$

This function is maximized via a numerical optimization program. The values $\hat{\alpha}$ and $\hat{\beta}$, that this yields, are maximum likelihood estimates and are therefore consistent and asymptotically efficient.

The result of both the probit and logit transformations is that $\alpha + \beta x$ is mapped into the range $0 - 1$ with $p(1) = p(0) = .5$ at $x = -\hat{\alpha}/\hat{B}$ $(\hat{\alpha}+\hat{B}(-\hat{\alpha}/\hat{B}) = 0)$. The curvature of the transformations differs but they both can be generally depicted by Figure A.2.

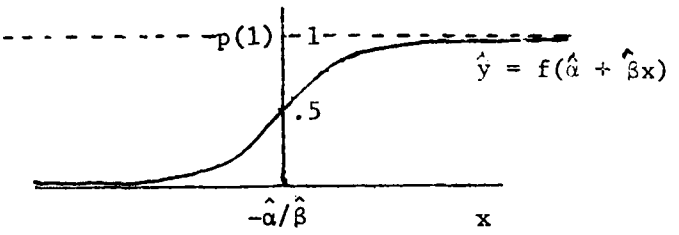


Figure A.2

Probit and Logit Transformations

The shift from this univariate model to multiple regression merely involves substituting the expression XB for $\alpha + \beta x$. The predicted probability of the probit transformation is obtained by reading the probability that corresponds to XB out of a standard normal density table. The logit transformation's implicit constraint on the value of the model's predicted probability is seen from:

$$1 - p(1) = p(0) = 1/(1 + e^{XB}) \rightarrow \frac{1}{1+1} = 1/2 \quad \text{as} \quad XB \rightarrow 0$$

$$\rightarrow \frac{1}{1+0} = 1 \quad \text{as} \quad XB \rightarrow -\infty$$

$$\rightarrow \frac{1}{1+\infty} = 0 \quad \text{as} \quad XB \rightarrow \infty .$$

2. Inherent Heteroscedasticity in OLS Regression of a Model With a Dichotomous Dependent Variable

Another problem that the dichotomous dependent variable creates in OLS is heteroscedasticity.[2] This exists because (in the univariate case again), if

$$y_i = \alpha + \beta x_i + \varepsilon$$

$$E(y_i) = \alpha + \beta x_i$$

$$= P(1)(1) + P(0) \cdot 0$$

$$= P(1)$$

and

$$Var(\varepsilon_i) = P(0)(\varepsilon_i(y=0))^2 + P(1)(\varepsilon_i(y=1))^2$$

$$= (1-\alpha-\beta x_i)(-\alpha-\beta x_i)^2 + (\alpha+\beta x)(1-\alpha-\beta x_i)^2$$

$$= (\alpha+\beta x_i)(1-\alpha-\beta x_i) = E(y_i)(1-E(y_i)) .$$

This means that the $Var(\varepsilon_i)$ is a function of y_i and hence is heteroscedastic. The use of MLE on the probit and logit transformation overcomes this problem. The maximum likelihood estimation only requires that the observations are mutually independent to yield consistent and asymtotically efficient estimates.

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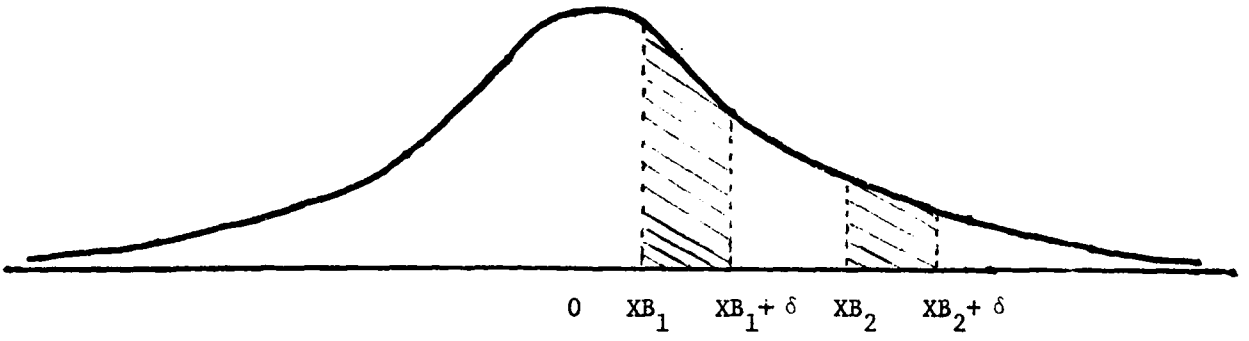
[2] Jan Kmenta, Element of Econometrics (New York: Macmillan Publishing, 1971; London: Collier Macmillan Publishers, 1971), p. 426.

3. The Interpretation of Probit and Logit Estimates as Partial Derivatives

Estimates obtained via the probit and logit transformation cannot be interpreted as simple partial derivatives as they are in OLS. The only way to derive the partial effect of a probit parameter is to evaluate the predicted probability while varying only the variable in question. The size of the partial effect will depend on the values of all variables in the model. This can be seen more easily with the help of Figure A.3.



$$XB = \alpha + \beta_1 X_1 + \beta_2 X_2 \cdots \beta_K X_K$$

$$\delta = \beta_1 \cdot \Delta X_1$$

Figure A.3

The Partial Effect of Any Probit Parameter is a Function of All the Variables in the Model

The shaded areas in Figure A.3 represent the change in the predicted probability caused by varying X_1. If values of the variables in the model yield a starting value of XB near zero (XB_1) then the partial effect of X will be relatively large.

The partial effects in the logit transformation are also a function of all the variables in model.

$$P(1) = \frac{1}{e^{-XB}+1} ,$$

let $A = e^{-XB}+1$ so $p(1) = A^{-1}$

then

$$\frac{\partial p(1)}{\partial x_i} = \frac{\partial p(1)}{\partial A} \cdot \frac{\partial A}{\partial XB} \cdot \frac{\partial XB}{\partial x_i}$$

$$= -A^{-2} \cdot e^{-XB} \cdot (-1) \cdot \frac{\partial XB}{\partial x_i}$$

$$= \frac{e^{-XB}}{(e^{-XB}+1)^2} \cdot \frac{\partial XB}{\partial x_i} .$$

The partial derivative of any variable under logit estimation is a function of all the variables of the model. Still, a ball park estimate of these derivatives is obtainable with only general reference to the rest of the model.

If		then	
$XB \Rightarrow \infty$		$\frac{e^{-XB}}{(e^{-XB}+1)^2} \Rightarrow$	.00
$= 1$		$=$	.20
$= 0$		$=$	.25
$= -1$		$=$	.20
$\Rightarrow -\infty$		$\Rightarrow$	.00 .

The partial derivative is, at most, one-fourth of the logit estimate. Depending upon the value of XB , it may be considerably less than that.

APPENDIX B

THE COEFFICIENT OF MULTIPLE CORRELATION AS A MEASURE OF GOODNESS OF FIT IN A MODEL WITH A DICHOTOMOUS DEPENDENT VARIABLE

The R^2 statistic does not give as good a measure of fit in a model with a dichotomous dependent variable as in one with a continuous dependent variable. This can be seen by comparing scatter diagrams in Figure B.1.

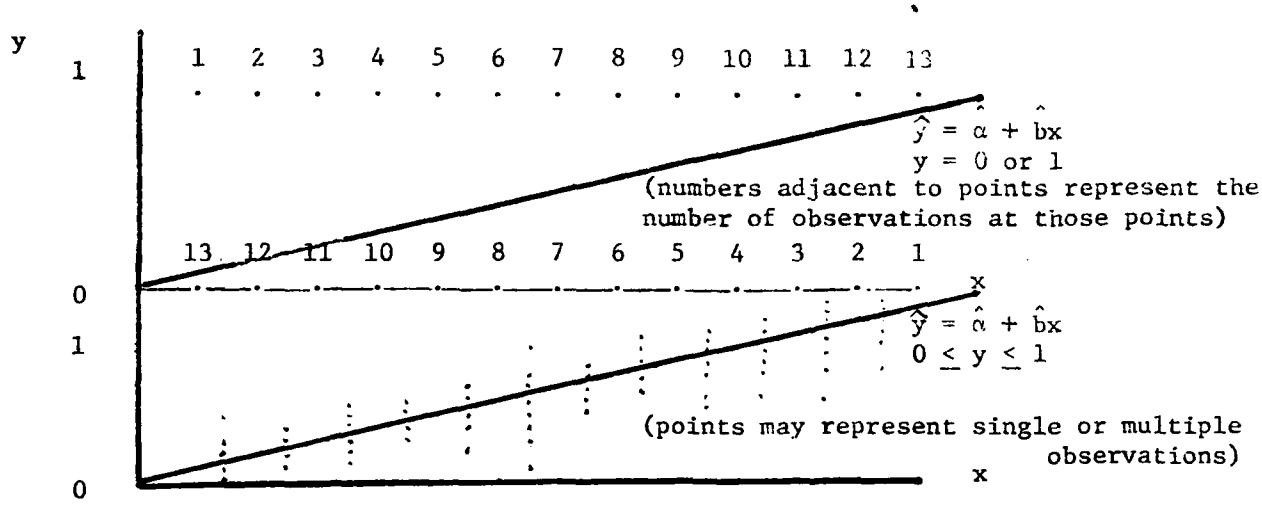


Figure B.1

Goodness of Fit - Dichotomous and Continuous Dependent Variables

Minimizing the sum of the squared errors causes OLS to fit a line that comes closest to observation points where the most observations occur. Maximum likelihood estimation fits a line in a similar but less intuitive fashion. A strong relationship between y and x might look like either of the scatter diagrams in Figure B.1. The sum of the squared errors (SSE) is much greater for the dichotomous model. The total variation (SST) is also greater, however, so that opposing effects on R^2 are present.

$$R^2 = 1 - {}^{SSE}/_{SST} .$$

Intuitively, it seems that the composite effect is a poorer "fit" for the dichotomous model. The difference in the SSE in the two models is readily seen from the scatter diagrams. The observations in the continuous model cluster around the regression line. In the dichotomous model they are close to the regression line only for extreme values of x. The SST is less sensitive to the type of dependent variable. Observations in the dichotomous model are never close to the average value of y. In the continuous model most of the observations are also not close to the average value of y. While this hardly constitutes a formal proof it does suggest that the SSE are disproportionately higher than the SST in dichotomous models.

This same point is made by Robert Pindyck and Daniel Rubinfeld.[1] They refer to work by Donald Morrison[2] and work by John Neter and Scott Maynes.[3] Neter and Maynes discuss the issue in reference to a simple correlation coefficient. Morrison's work is more directly attuned to this exposition. Simplistically, his idea is that an upper bound can be found for R^2 by substituting 0 or 1 for the predicted probabilities. His example yields an upper bound for R^2 of only .167.

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[1] R. S. Pindyck and D. L. Rubinfeld, Econometric Models and Economic Forecasts, (New York: McGraw Hill, 1976), p. 255.

[2] D. G. Morrison, "Upper Bounds for Correlations between Binary Outcomes and Probabilistic Predictions," Journal of the American Statistical Association 67 (March 1972):68-70.

[3] J. Neter and E. S. Maynes, "On the Appropriateness of the Correlation Coefficient with a 0, 1 Dependent Variable," Journal of the American Statistical Association 65 (June 1970):501-9.

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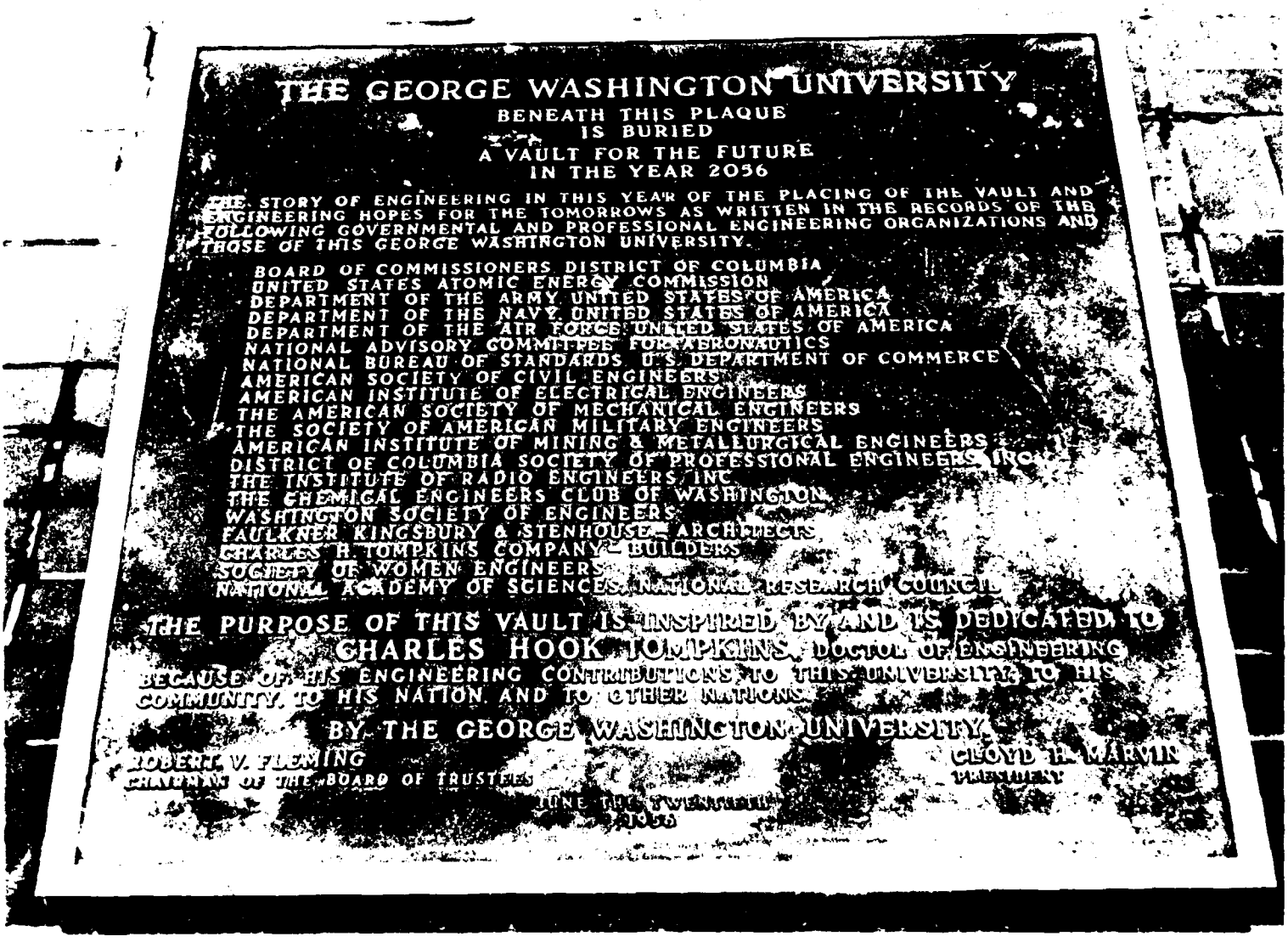

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