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THE EARNINGS FUNCTION: A GLIMPSE
INSIDE THE BLACK BOX

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SUMMARY

The Earnings Function: A Glimpse
inside the Black Box

This paper studies the wage determination process for a group of managerial employees in a major U.S. airline. As would be expected, those with greater-than-average schooling, pre-company labor market experience, and company service receive greater-than-average earnings. The analysis also addresses the question of whether or not the managers within a grade level who are paid more receive higher performance ratings by their supervisors. The answer is "no" in the case of those with more pre-company labor market experience (i.e., those who are older) and with more company service. This suggests that the salaries received by managers within a grade reflect their age and tenure with the company more than their present performance.

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The relationship between educational background, work experience and earnings--"the earnings function"--has been the focus of much of the empirical work done by labor economists during the past fifteen years.¹ Nevertheless, very little attention has been devoted to a number of basic questions concerning the impact of schooling and work history on labor market success. One particularly important one is: Why do individuals with more schooling and work experience receive higher earnings than otherwise-similar individuals? This is the question addressed in this paper, which presents relevant evidence based on an econometric analysis of a unique set of data for the managers of a major U.S. airline (hereafter called the Company).

Because of the type of information collected for data files available to the public, no one study has been able to analyze the way in which the dimensions of schooling and work history are associated with both earnings and a nonearnings measure of job-related performance. In the vast majority of discussions about the earnings function, it has been assumed implicitly or explicitly that earnings differentials are attributable to productivity or performance differentials. There have been, however, a few attempts at directly measuring the association of schooling and work history with a nonearnings measure of performance or productivity. Some studies have used aggregate data to derive production function estimates of the impact of years of schooling on value added or value of shipments per labor hour.² Another has presented estimates of educational production functions where output was defined as the change in a student's achievement test score and the input set included the schooling background and experience of the student's teacher.³ In addition, there is a group of studies, done primarily by industrial psychologists, that present estimates of the effect of educational level on an overall job performance rating (usually

done by a worker's immediate supervisor).⁴ Nowhere in the literature, however, does there appear to be a study providing a comparison of productivity or performance differentials with earnings differentials among the same workers. By offering a comparison of this nature, the present study differentiates itself from its predecessors.

Section I discusses the data used in isolating the relationship of each element in vectors describing educational background and labor market experience with both earnings and a supervisor rating of job performance. The data file includes information on the nature of each manager's schooling (level of schooling, names of institutions attended, and majors) and work history (time with the Company and time spent in jobs with specified prior employers). In addition, it contains an evaluation of each manager's job-related performance (along a number of dimensions).

Section II first presents estimates of the coefficients of the schooling and work history variables that come from fitting variants of the standard earnings function form. These findings appear to be quite consistent with what has been found in the large number of related studies. The section then provides job performance and earnings regressions that are directly comparable in that each holds constant an individual's position in the managerial hierarchy and has a dependent variable that has been transformed into z-score units.

Section III asks what these within management-level earnings and performance results imply about the workings of the black box that transforms schooling and work experience into earnings. In particular, it focuses on the question: Within a level of management do individuals with more schooling and work experience receive higher earnings solely because they are more productive?

I. The Data

Like many major U.S. corporations, the airline whose managers are being studied collects and computerizes a great deal of information about its managerial employees. This section provides a detailed discussion of the collection of these data and the manner in which they have been transformed for use in this analysis.⁵

In the fall of 1972 the Company began a program under which each of its managers was asked to fill out a "Personal Information Questionnaire." The cover of this questionnaire states:

The Personal Information Questionnaire (PIQ) System is a corporate-wide management employee skills inventory, using a computer to give [the Company] quickly available data on the qualifications of its management employees. It will be used in conjunction with pertinent payroll and management appraisal data to select appropriate candidates for promotion and advancement.

The questionnaire elicits information on a number of aspects of an individual's background, such as his or her: education, employment with other companies, job skills, licenses, certificates, languages, honors and awards, and military experience.

Educational Background. Exhibit 1 is the page from the questionnaire that explains to respondents the information on their educational background that is sought. There are two additional pages in the education section that give codes for 127 potential major courses of study, which are classified by the Company into six groups (business, engineering, life sciences, physical sciences, and other).

The sample used in this analysis included only those individuals who had at least some college. The responses of these individuals were transformed to capture the salient characteristics of their college and graduate school

backgrounds. The level of schooling information was recoded as follows to create a variable equal to the number of years of college: PIQ code 08 = 1, codes 09 and 10 = 2, code 11 = 3 and codes 12 and 13 = 4.

Since number of years is only one dimension of an individual's college background, additional information from the PIQ was used to capture the academic and social environment in which the post-secondary schooling took place. The characteristics of the colleges and universities at which each manager studied could be obtained since the Company's file has the name of each institution attended. In particular, it was possible to obtain data by college on the average amount of institution expenditures per student, the average aptitude of the student body, and the distribution of the students' families by income.⁶

The enrollment and expenditure data were compiled from the Higher Education General Institutional Survey conducted annually between 1966 and 1974 by the U.S. Office of Education.⁷ Data for the 1970, 1971 and 1972 academic years were used, since enrollment data for years preceding and following this period are not strictly comparable. The enrollment figures used in the analysis were each relevant institution's estimate of its full-time equivalent students. The expenditures data used are under the category "Educational and General Expenditures: Total."⁸ The post-1970 expenditures were deflated to 1970 dollars with the Consumer Price Index. Then, the mean amount of expenditures per full-time equivalent student for the 1970 to 1972 period was calculated for each relevant institution.

The average academic ability of each relevant college's undergraduates was approximated by an estimate of the average combined verbal and math Scholastic Aptitude Test scores of the school's 1971 entering freshmen. These estimates (which involved some imputations) are discussed at length in Astin and Henson.⁹

PART 12 EDUCATION

In this section, enter up to 4 schools you have attended. List the most recent LAST. If you have been enrolled in more than 4 schools, enter the most significant to your employment with [the Company]

LAST YEAR – Enter the last year in which you were enrolled.

NAME OF SCHOOL – Enter the name of the school, beginning in the leftmost block.

LEVEL – From the EDUCATION LEVEL CODES following, indicate the highest level reached at each school attended.

COURSE – From the COURSE CODES following, enter the code which corresponds to your major course of study. If you are unable to specify a major course of study within a Course Group, enter the general Course Group Code (0100, 0200, etc.).

		LAST YEAR	NAME OF SCHOOL	LEVEL LIST	COURSE LIST
12	EDUCATION	66	ELGIN HIGH SCHOOL	05	06, 02
12		68	ELGIN COMMUNITY COLLEGE	100	12, 5
12		70	UNIV. OF KANSAS	13	05, 42
12		71	UNIV. OF MO., KANSAS CITY	15	01, 25

Name of High School → (points to ELGIN HIGH SCHOOL)
 Last Year Attended: 1966 → (points to 66)
 Gen. Academic Curriculum → (points to 05)
 High School → (points to ELGIN HIGH SCHOOL)
 Last Year Attended: 1971 → (points to 71)
 Name of University → (points to UNIV. OF MO., KANSAS CITY)
 University → (points to 15)
 Business Adm. → (points to 01, 25)

EDUCATION LEVEL CODES	
01	No High School Education
02	1 Year High School
03	2 Years High School
04	3 Years High School
05	High School Graduate
06	Certificate of Completion
08	1 Year College
09	2 Years College
10	Associate Degree
11	3 Years College
12	4 Years College
13	Bachelors Degree
15	Graduate Hours
16	Masters Degree
17	Doctorate Hours
21	Doctorate (Degree)
18	Law – L.L.B.
19	Law – J.D.
20	Law – Other
22	Medical – M.D.
23	Medical – D.D.S.
24	Medical – D.V.M.
14	Medical – Other
07	Other

Data relating to the income distribution of the families of undergraduate students were collected from the "Tripartite Application" (i.e., "Institutional Application to Participate in Federal Student Financial Aid Programs"), a standard form (#1035) of the U.S. Office of Education.¹⁰ On the 1974 application (from which the data were obtained), each school was asked to estimate the number of full-time and half-time undergraduates from families in the following income ranges: \$0-5,999, \$6,000-8,999, \$9,000-11,000, and \$12,000 and above. Full-time and half-time students were combined for this study by multiplying the latter by .50 to obtain the total number of full-time equivalent undergraduate students from families in each of the four income classes.

Any manager with at least one year of college had appended to his or her record weighted average figures on expenditures per student, combined SAT scores and the distribution of family income, where the weights reflected the amount of time spent at various undergraduate institutions (for which the relevant data were available).

About 10% of the managers on the file had masters degrees. Two questions concerning the years spent obtaining these degrees seemed pertinent for this analysis: Was the individual studying business? If so, what is the academic quality of the business school at the degree awarding institution? To capture the nature of the graduate school background of each manager, dummy variables were formed which indicated whether or not he or she received a masters degree, whether or not it was in business,¹¹ and whether or not it was from a "top 15" business school. A "top 15" business school is one which was rated among the best 15 in terms of academic quality by a panel of business school deans surveyed by MBA magazine in 1975. The very few individuals with law or medical school backgrounds or with doctorates were dropped from the sample, since their assignments are most likely very different from those given to other managers.

Work History. Exhibit 2 is a photoreduction of the section from the Company's Personal Information Questionnaire dealing with the manager's employment record with firms other than the Company. The computer file stores data on the five most recent employment experiences. The jobs used in the construction of variables for this study were those held by managers (before joining the Company) after the completion of their last year of college. Because only five pre-Company jobs were coded, it is likely that some prior work history was lost for the very small percentage of managers who had five or more post-college pre-Company jobs and a time gap between the last year of college and the first listed pre-Company job. For this reason, these individuals were not included in the sample.

The responses coded from the pre-Company work experience part of the questionnaire were transformed to yield the following variables deemed relevant for an analysis of the performance of managers in the airline industry: years in airline industry prior to the Company (based on the names of the companies that were previous employers), years in all other transportation industries prior to the Company, and years in the military.¹²

The current personnel record of each manager gives the month, day, and year from which his or her Company service should be calculated. Hence, it was possible to determine the number of days each individual has been permanently attached to the Company. In addition, a variable was constructed that equals age minus schooling (prior to joining the Company) minus Company service minus five. Since virtually all of the managers (especially the subsample of white males to be used in the statistical analysis) had uninterrupted employment (including military service as employment) after completion of their schooling, this construct closely approximates total years worked prior to being hired by the Company.

Exhibit 2

PART 16 EMPLOYMENT RECORD (OTHER THAN [the Company])

This section of the Personal Information Questionnaire will reflect work experience you acquired outside [the Company]. Enter your earliest job first and your most recent job last. If you have worked on any special contract assignment for [the Company] or with any of [the Company's] associated companies include such jobs in this section. Military job experience may be used if you feel it is pertinent to your career with [the Company].

NUMBER OF YEARS - Enter the NUMBER OF YEARS you were employed with each company. All entries must consist of two digits; i.e., if you worked 9 years enter 09, not 9.

END DATE - Enter the MONTH and YEAR you left each company; i.e., if you left a company in July of 1969, enter 07 in the month blocks and 69 in the year blocks.

NAME OF COMPANY - Enter the name of the firm or [the Company] associated company.

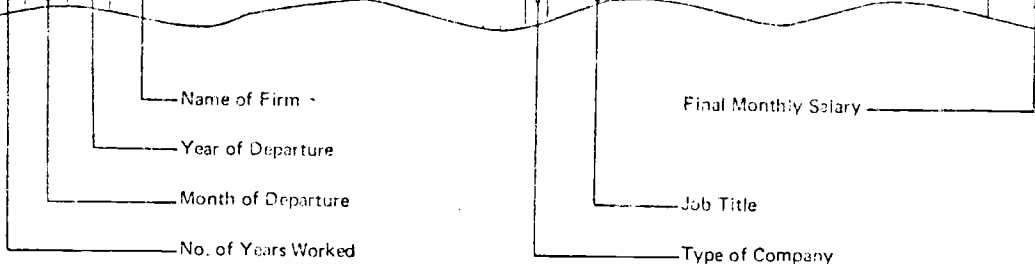
TYPE - From the following list enter the one-letter code which most closely identifies the type of company for which you worked. If none is accurate, enter the code for Other.

JOB TITLE - Enter your job title or a brief description of your duties.

SALARY - Enter your final monthly salary in dollars. If you were paid on an hourly basis estimate your monthly earnings (there are 22 working days in a month). All 4 blanks of the MONTHLY SALARY block must be completed, so if you were earning less than \$1000, precede your salary with a zero; i.e., if your salary was \$300, enter 0300, not 800.

TYPE OF COMPANY CODES	
A Association (Union, Auto Club, etc.)	J Military
B Construction	K Processing Co. (Food, Drugs, etc.)
C Entertainment (T.V., Sports, etc.)	L Production Co. (Chemicals, Paper, Steel, etc.)
D Financial (Bank, Insurance Co., etc.)	M Research and Development
E Food - Lodging (Hotel, Restaurant, etc.)	N Sales
F Government	O Service (Laundry, Garage, etc.)
G Hospital	P Transportation
H Management Consulting	Q Other
I Manufacturing	

EMPLOYMENT RECORD (OTHER THAN [the Company])					
NO.	END DATE		NAME OF COMPANY	JOB TITLE OR DUTIES	MONTHLY SALARY
	YRS.	NO. YEAR			
16	05	09	HOLIDAY INNS	EDIRECTOR-PUBLIC RELATIONS	1,875
16	04	70	WATTMORE MFG CO.	IVP ADVERTISING + PUB RELS	2,250
16					



Performance Appraisal. A 1973 Bureau of National Affairs (BNA) survey of 139 companies (referenced as "Management Performance Appraisal Programs") indicates that the Company's performance appraisal practices are similar in most respects to those of many other U.S. firms. Seventy-six percent of the companies in the BNA sample had a formal performance appraisal program for their supervisory (first-level) employees, 72 percent had a formal program for evaluating middle management and 49 percent had one for top management (p. 2). The factors most commonly used in appraising managerial performance in the surveyed companies were: "Managerial skills (e.g., knowledge and experience, ability to organize, communication skills, etc.)" used in 81 percent of responding companies, "Achievement of goals (completion of programs, costs, production, etc.)" used in 77 percent, "Personal traits (attitudes, intelligence, dependability, etc.)" used in 69 percent, "Job behavior (as related to duties specified in job description)" used in 66 percent, and "Potential (capacity for development and advancement)" used in 52 percent (pp. 4-5).

The two appraisal techniques most frequently employed in the BNA sample were essay evaluations (used by 52 percent of responding companies) and rating scales for various factors (used by 45 percent). These management reviews were done once a year by 82 percent of the BNA respondents. They were typically done by the manager's immediate supervisor (96 percent of the respondents) and discussed with the manager (91 percent). The four most commonly cited uses of the appraisal information were: "Salary adjustments" (85 percent of the responding companies), "Promotion decisions" (64 percent), "Setting goals" (57 percent), and "Determining management development needs" (56 percent) (pp. 5-8).

The Company calls its formal performance review for individuals at all levels of management: "A planning, evaluation and development program." The first page of the Reviewer's Workbook states the program's potential uses to the reviewer:

--to help you improve the performance of your unit by providing systematic, corrective feedback;

--to provide feedback to help your subordinate manager improve his or her performance and develop his or her career potential;

--to assist [the Company] in identifying and utilizing management effectively and efficiently.

Under the Company's program, each manager is supposed to be appraised annually (usually every twelve months from the date a job is assumed) by his immediate supervisor. The appraisal is then discussed with the manager who presents his own self-evaluation. During this meeting, there is discussion of the skill and performance areas in which the reviewer feels that the manager needs improvement. In addition, there is discussion of the manager's career path aspirations in terms of the additional experience and training that could (perhaps) make them realities.

The actual formal appraisal involves rating the manager's unit achievement, subordinate coaching, teamwork and overall performance. The Reviewer's Workbook instructs the reviewer to:

Record specific examples of the manager's performance over a twelve month period. Record and evaluate what the manager has accomplished. Do not think in terms of personal characteristics or other subjective factors. [Italics in original.]

The Unit Achievement page of the Workbook states:

Describe the major results accomplished by the manager's unit during the year. Unit refers to the manager's job or area of responsibility. Which targets and objectives did the manager meet and which did he or she fail to meet? To what extent did his or her unit fulfill your performance expectations?

Possible information sources are correspondence with the manager, record of performance in relation to goals or quotas such as Minority Hiring and Affirmative Action reports, the City Performance Report and budget reports, etc., and notes on specific instances where the manager exceeded or fell short of your expectations.

The Subordinate Coaching page states:

Describe significant achievements in the manager's work with subordinates. Has the manager developed subordinates to initiate tasks they think are important? Has the manager developed subordinates' job skills? Has the manager recognized and effectively utilized the individual skills of subordinates?

Possible information sources are exit interviews, informal conversations, employee surveys, grievance sessions, etc. This section may not be applicable for managers who do not have the opportunity to supervise other employees.

The Teamwork page states:

Describe significant achievement on the part of the manager in developing effective teamwork in the organization. What did the manager do to reinforce and upgrade the quality of teamwork in the office. Was the manager supportive of other units in achieving overall goals, standards, and objectives?

Finally, the Overall Evaluation page states:

Considering the specific performance evaluations on the preceding pages, state below your overall evaluation of the manager's performance over the past 12 months. Think in terms of results achieved and new approaches that he or she used, not in terms of personal characteristics or other subjective factors.

In addition to providing specific examples, the reviewer is asked to rate the manager on each of these four performance dimensions using an integer scale from 1 (unsatisfactory) to 6 (exceptional). After the feedback meeting, the reviewer's ratings are sent to the personnel department to be added to the manager's computerized personnel record.

According to the Rating Category Description in the Reviewer's Workbook (see page 15 below) a manager's performance rating is based on reasonable and realistic standards for his job. Each manager's job has been described as of the most recent change in its content in a "Management Description Position Form." This form, which is filed by a job's immediate supervisor, reads as follows:

PURPOSE OF POSITION - Concisely summarize the basic function of the position.

MAJOR DUTIES - In order of significance, list responsibilities and tasks which will require the major portion of the position's attention. Use action verbs; e.g., analyze, interpret, develop, recommend, etc. (Attach extra sheet if necessary).

CONTACT RELATIONSHIPS - Indicate the primary positions inside or outside the company with which this position has regular contact and the reasons for this contact.

Basic title of highest level subordinate: _____.
Number of individuals directly supervised at this level: _____,
number of individuals directly supervised, but at lower levels _____,
total number of individuals directly and indirectly supervised _____.

The information on the difficulty and importance of jobs obtained from the Management Position Forms is used by the Company's personnel department in assigning a grade level to each managerial assignment. The Company's Management Policy & Procedure Manual describes this process as follows:

The evaluation process generally includes an assessment of the relative importance of a position, the value of specific duties and responsibilities listed in the job description and relevant activity data which demonstrate either or both quantity (i.e., volume) or quality elements of the job.

The Company has five grade levels for its First Level Supervisor jobs and fourteen levels for the other management jobs covered under its formal appraisal program. Periodically the personnel department (with the approval of the Company's top executives) attaches to each grade level a salary range--a minimum salary, a standard salary and a maximum salary. (The average within-grade coefficient of variation for the sample members evaluated in 1976 was .11). Where within this range a manager's salary falls is determined by his immediate supervisor.

The personnel record of each manager included in the sample to be analyzed had information on his grade level at the time of his most recent performance appraisal. Since grade levels are attached to jobs in accordance with the

responsibilities, tasks and importance of the positions, each manager's performance rating is taken as conditional on his grade and therefore as relative only to other individuals who are in positions that the Company's personnel department considers comparable. Because of the procedure used to assign grade levels to positions, the limited number of distinct managerial functions and the large number of grade levels, it seems very unlikely that employees within the same grade have jobs that are significantly different from one another.

Treating the six potential ratings for each dimension of performance at each grade level as dichotomous variables would have substantially increased the complexity of the analysis. For this reason, the set of 1 to 6 ratings for each performance dimension at each grade level was transformed into a set of unit normal (z) scores. These transformations could take place under the assumption that the "true" unobserved distribution of each performance dimension among sample members at each grade level is normal. This assumption is justified by first observing that each performance dimension represents the combined effect of a large number of independent factors, and then appealing to the central limit theorem. Under the normality assumption, it was possible to calculate a mean z -score for sample members at each grade level with each rating on a given performance dimension.

To do this, within-grade level cumulative frequency distributions were calculated for each performance dimension giving the fraction of all sample members at each grade level evaluated in 1974, 1975 or 1976 (along the relevant dimension) who had a rating (r_i) less than or equal to each of the possible six. Since the underlying density functions are assumed to be normal, it was possible to use the within-grade cumulative frequency at each rating [$F(r_i)$] on a given performance dimension, in conjunction with tables on the cumulative normal

distribution and on the ordinates of the normal density function, to determine the density $[f(r_i)]$ at the rating. With $F(r_i)$ and $f(r_i)$ the mean z-score $[\bar{z}(r_i)]$ between ratings r_i and r_{i-1} on a given dimension could be calculated for each grade. It is shown in Johnson and Kotz (p. 81) that

$$\bar{z}(r_i) \equiv \frac{\int_{z(r_{i-1})}^{z(r_i)} z f(z) dz}{\int_{z(r_{i-1})}^{z(r_i)} f(z) dz} = [f(r_{i-1}) - f(r_i)] / [F(r_i) - F(r_{i-1})].$$

Each sample member at a given grade with a rating of r_i on a given performance dimension received the unit-normal score $\bar{z}(r_i)$.

Table 1 gives the cross-grade level average relative and cumulative frequencies at each r_i of the most recent Overall Evaluation ratings received by sample members appraised during the 1974 to 1976 period. For expositional purposes, it is assumed that these are the frequencies for one grade level, say, grade-level k. The table also gives the corresponding unit-normal density and mean z-score for grade-level k. As can be seen from the final column, the z-score transformation imposes a meaningful metric with which the "distance" between two rating categories can be calibrated for sample members at grade-level k. With this metric, someone at grade k who received an Overall Evaluation that placed him in, say, rating category 4 would be given an Overall Evaluation rating score of -.50, while someone at k placed in, say, category 5 would receive a score of .75.

Other data. In addition to the data discussed above, the Company provided information on the earnings and demographic characteristics of each manager. The 1974, 1975, and 1976 annual taxable remuneration (referred to below as "earnings") received by each individual came from the Company's computerized file of Internal Revenue Service W-4 forms. In the statistical analysis, the

TABLE 1

Distribution of (Most Recent) Overall Evaluation Ratings at Grade Level "k"

Rating Category (r_i)	Description	Relative Frequency (Based on Cross-Grade Level Average)	Cumulative Frequency (Based on Cross-Grade Level Average)	Unit Normal Density Corresponding to Cumulative Frequency $f(r_i)^*$	Between r_i and r_{i-1}
			$F(r_i)^*$	$f(r_i)^*$	$\bar{z}(r_i) = \frac{[f(r_{i-1}) - f(r_i)]}{[F(r_i) - F(r_{i-1})]}$
(1)	Unsatisfactory-Presently not acceptable. Requires continual close supervision and direction. Substantial and immediate improvement required.	.00141	.00141	.00462	-3.27
(2)	Unsatisfactory-Normally meets minimum job requirements but requires above normal supervision and direction. Manager meets minimum standards but requires improvement over the long term.	.00283	.00424	.01249	-2.78
(3)	Satisfactory-Manager meets reasonable and realistic standards. Results represent more than a minimum effort. Manager requires some periodic supervision and direction.	.10750	.11174	.19016	-1.65
(4)	Satisfactory-Meets reasonable and realistic job requirements and often exceeds them. Manager is effective with only occasional guidance and supervision.	.41443	.52617	.39808	-0.50
(5)	Satisfactory-Consistently exceeds requirements and standards. Highly effective with only general guidance required. Manager substantially above expected standards.	.44554	.97171	.06480	0.75
(6)	Exceptional-Outstanding performance on a level rarely achieved. Requirements and standards being accomplished at the highest possible level. Manager has been unique and outstanding over the last 12 months.	.02829	1.00000	.00000	2.29

*Note that when $i = 1$, $F(r_{i-1}) = 0$ and $f(r_{i-1}) = 0$.

earnings measure used is 1974 to 1976 average annual earnings in 1976 (CPI-inflated) dollars.

The data on race, sex, date of birth, and geographic location of assignment came from each individual's "current" personnel record (i.e., his record as of December 1976). The sample chosen for this study was limited to white male U.S. nationals who were managers at the time of their most recent performance evaluation, who were with the Company from January 1974 until December 1976, whose educational background and pre-Company work experience met the additional sample inclusion criteria described on pages 3 to 7, and for whom all of the requisite data were available.¹³

III. Results

This section first presents findings concerning the relationship between schooling, work experience and earnings in the sample of managers under analysis. These results are quite consistent with those presented in the myriad other studies of the earnings function. It then offers results on the relationship between schooling, work experience and within-grade level performance, which can be compared with results concerning the determinants of within-grade level earnings.

Earnings. The 1974 to 1976 mean annual earnings (in 1976 dollars) of managers grouped by their graduate school backgrounds and pre-Company work experience appear in Table 2. These mean earnings indicate a number of interesting relationships. First, managers with masters degrees earned 14 percent more than managers who went to work immediately after completing college. Second, managers with masters in business earned 16 percent more than managers without masters and about 7 percent more than managers with masters in a nonbusiness area. Third, the few managers with masters from top 15 business schools had earnings

TABLE 2

Mean [Standard Deviation] 1974 to 1976 Annual Earnings (in 1976 \$)
by Nature of Graduate School Background
and Pre-Company Work Experience

N = 707

<u>Group Characteristic:</u>	<u>Fraction of All Managers</u>	<u>Mean [S.D.] 1974-76 Earnings (in 1976 \$)</u>
All Managers	1.00	21,524 [4,804]
No masters degree	.904	21,237 [4,673]
Masters degree	.096	24,219 [5,203]
Nonbusiness masters	.024	23,038 [4,120]
Business masters	.072	24,612 [5,496]
Business masters from nonelite school	.054	23,689 [5,235]
Business masters from top 15 school	.018	27,312 [5,549]
In military prior to Company	.129	21,438 [4,447]
In transportation other than airlines prior to Company	.062	21,685 [5,061]
In airlines prior to Company	.065	22,137 [5,029]

29 percent above those of managers without masters and 16 percent above those managers with masters from nonelite business schools. Fourth, managers with pre-Company experience in the military or in the nonairlines portion of the transportation sector earned virtually the same as other managers, while those with experience in airlines earned 3 percent more than the all management average.

The regressions presented in Table 3 permit comparisons of groups of managers stratified by both educational background and work history. Regressions 1 to 4 are based on a standard earnings function of the form:

$$\ln y = \alpha + \beta x + \varepsilon,$$

where y represents mean 1974 to 1976 annual earnings, x is a vector whose elements represent various dimensions of educational background and work experience, ε is an error term, and α and β are the parameters to be estimated. Regressions 5 to 8 also include sixteen grade-level dummies (two grades included no members of the sample) and two year-of-evaluation dummies. These eighteen dummy variables, which must be included in the performance regressions since an individual's rating is assumed to be relative to others at the same grade-level and since a rating could be affected by the overall well-being of the Company at the time of the evaluation, are included in earnings regressions 5 to 8 so that comparisons of the same individuals will underlie the estimates of both within-level earnings and performance differentials. Regressions 1 to 8 also include twenty-four dummy variables which capture the state in which each sample member works. These controls are meant to hold constant for salary differentials that might reflect (among other things) geographic differentials in the cost of living. The fact that the residual ε is likely to be correlated with the elements of x (especially within grade levels) does not create a problem for a comparison of the earnings and performance differentials of individuals stratified by

schooling and work history, which is the focus of this study. Bias attributable to, say, an omitted unobserved ability variable or sample selection would be a problem only if the issue at hand was the effects of schooling and experience on earnings and within-level performance.¹⁴

Regression 1 in Table 3 indicates that managers within the Company who have a masters receive earnings that are about 15 percent higher than those received by managers without a masters who attended college for the same length of time, have the same pre-Company work history and have been with the Company for the same duration. Regression 2 demonstrates that managers with masters in business earn about 10 percent more than do managers with similar backgrounds who have received nonbusiness masters, who in turn earn about 7 percent more than do comparable managers who did not obtain a masters after completing college. Regression 3 implies that there is a differential of about 19 percent in the earnings received by individuals with a masters degree from a top 15 business school and individuals with similar backgrounds who have a masters in business from a nonelite institution.

Regressions 1 to 3 also include a years of college variable. The estimated coefficients of this variable indicate that managers with an additional year of college earn about 2.2 percent more than do managers whose backgrounds are otherwise similar. Regression 4 is identical to regression 1 except that it includes variables that are meant to describe the nature of the undergraduate institutions attended. As discussed above, these variables are: the combined SAT scores of entering freshmen in 1971/100, the 1970 to 1972 average institutional expenditures per student/10,000, and the fraction of the relevant students' families earning \$12,000 or more in 1974. The estimated coefficients and standard errors indicate that only the aptitude of the studentbody(ies) at the college(s) attended is significantly associated with earnings in the group of managers

under analysis. The results imply that individuals who attended colleges where the average combined SAT score was 100 points higher (the mean [S.D.] of this variable is 974 [115]) than at the colleges attended by individuals with the same work history and an otherwise-similar educational background have earnings that on average are about 2.8 percent higher.

Regressions 1 to 4 in Table 3 include variables that equal Company service/10 and its square/100. The Company service coefficient estimates indicate that real earnings grow with firm tenure at an annual rate of about 1 percent. The Company service squared coefficient estimates, while extremely imprecise, suggest that this annual rate does not diminish by a meaningful amount as one's time with the Company grows.

Regressions 1 to 4 also include variables describing the extent and location of pre-Company work experience. The estimated coefficients of the "total years worked prior to Company/10" variable indicate that an additional year of this construct yields about 44 percent as much earnings as does an extra year of Company service. The estimated coefficients of the variables capturing the location of pre-Company employment, while unfortunately too imprecise to be the basis for firm conclusions, do suggest that years of Pre-Company employment in transportation-related industries are worth more in terms of earnings than years of employment outside the transportation sector.

Regressions 5 to 8 include dummy variables that place each individual at the relevant grade level in the year of his most recent performance appraisal and dummies that indicate the year in which he was appraised. Since much of the return to degrees takes the form of assignments to positions with higher grade levels attached to them, the estimated coefficients of the masters variables in regressions 5 to 8 are substantially smaller than those in regressions 1 to 4. Nevertheless, regression 5 indicates that even within-

TABLE 3

1974 to 1976 Average Annual Earnings

N = 707

Dependent Variable: Ln (1974 to 1976 average annual earnings (1976 \$))*

Coefficients of:	Mean [S.D.]	1	2	3	4	5	6	7	8
Constant	--	9.705 (.046)	9.701 (.046)	9.692 (.046)	9.493 (.093)	9.968 (.029)	9.966 (.029)	9.967 (.029)	10.021 (.052)
Masters degree (yes = 1)	.096 [.295]	.146 (.027)	--	--	.136 (.027)	.043 (.014)	--	--	.043 (.015)
Nonbusiness masters (yes = 1)	.024 [.153]	--	.073 (.049)	.074 (.048)	--	--	.024 (.026)	.024 (.026)	--
Business masters (yes = 1)	.072 [.259]	--	.173 (.031)	--	--	--	.050 (.017)	--	--
Nonelite business masters (yes = 1)	.054 [.226]	--	--	.126 (.034)	--	--	--	.054 (.018)	--
Top 15 business masters (yes = 1)	.018 [.134]	--	--	.317 (.057)	--	--	--	.034 (.032)	--
Total years worked prior to Company/10	.634 [.497]	.041 (.016)	.044 (.016)	.045 (.016)	.034 (.016)	.019 (.008)	.020 (.008)	.020 (.008)	.020 (.009)
Years in transportation excluding airlines prior to Company/10	.012 [.068]	.136 (.113)	.137 (.113)	.141 (.112)	.135 (.112)	.078 (.060)	.079 (.060)	.078 (.060)	.073 (.060)
Years in airlines prior to Company/10	.017 [.083]	.052 (.095)	.047 (.095)	.049 (.094)	.065 (.094)	.048 (.050)	.047 (.050)	.046 (.050)	.047 (.050)
Years in military/10	.043 [.133]	-.021 (.057)	-.027 (.057)	-.032 (.057)	-.016 (.056)	.006 (.030)	.005 (.030)	.005 (.030)	.006 (.030)
Company experience/10	1.363 [.844]	.089 (.038)	.092 (.038)	.103 (.038)	.083 (.038)	.041 (.021)	.042 (.021)	.041 (.021)	.042 (.021)
Company experience squared/100	2.569 [3.036]	-.004 (.010)	-.004 (.010)	-.007 (.010)	-.003 (.010)	-.002 (.006)	-.002 (.006)	-.002 (.006)	-.003 (.006)
Years of college	3.048 [1.168]	.022 (.007)	.022 (.007)	.022 (.007)	.018 (.007)	.001 (.004)	.001 (.004)	.001 (.004)	.002 (.004)
Combined SAT scores at colleges attended/100	9.735 [1.148]	--	--	--	.028 (.011)	--	--	--	-.007 (.006)
Expenditures per student at colleges attended/ 10,000	.198 [.161]	--	--	--	.020 (.067)	--	--	--	.043 (.036)
Fraction of families with \geq \$12,000 at colleges attended	.406 [.187]	--	--	--	-.092 (.054)	--	--	--	.001 (.029)
Year of evaluation dummies (2)	--	no	no	no	no	yes	yes	yes	yes
Grade-level dummies (16)	--	no	no	no	no	yes	yes	yes	yes
State dummies (24)	--	yes	yes	yes	yes	yes	yes	yes	yes
R ² (unadjusted)	--	.154	.159	.170	.169	.774	.774	.774	.774
Standard error of estimate	--	.194	.193	.192	.193	.102	.102	.102	.102

Notes: Standard errors are enclosed in parentheses.

*Mean = 9.955 [S.D. = .206].

grade levels, individuals with masters earn about 4.3 percent more than similar individuals without them. This implies that about 29 percent of the earnings differential associated with a masters degree occurs within the seventeen grade levels.

The estimated coefficients of the Company service variable in regressions 5 to 8 are from 40 to 51 percent of what they were in regressions 1 to 4. Hence, even within jobs classified by the Company as being the same, real earnings grow with Company service at an annual rate of slightly more than .4 percent, which does not appear to diminish meaningfully with additional service. The "age minus schooling minus Company service minus five" construct has statistically significant estimated coefficients in the ln earnings regressions controlling for grade level that are from 44 to 59 percent as large as in the regressions which did not control for position in the managerial hierarchy.

Table 4 presents the results of the overall evaluation rating regressions. These regressions include grade-level and year of evaluation dummies because of the nature of the performance rating process. If the estimated coefficient of x_i in a Table 4 regression is, say, .5, then all else the same, an additional unit of x_i is associated with performance .5 z-score units above the relevant grade-level sample average (not 50 percent above average). Thus, having an additional unit of x_i places an average member of the sample under analysis at the $F(.5) \cdot 100 = 69$ th percentile of the performance distribution of sample members in the same grade level instead of at the $F(0) \cdot 100 = 50$ th percentile.

The estimated masters coefficients in regressions 1 and 4, while very imprecise, suggest that individuals with masters degrees outperform by a very small amount individuals without them, who are in the same grade level and have the same work history. Regressions 2 and 3 indicate with little precision that managers with masters from nonelite business schools perform slightly better on

Overall Evaluation Rating

N = 707

Dependent Variable: Overall Evaluation Rating (in z-score units)*

Coefficients of:	Mean (S.D.)	1	2	3	4
Constant	--	.780 (.275)	.772 (.275)	.787 (.276)	.982 (.490)
Masters degree (yes = 1)	.096 [.295]	.119 (.136)	--	--	.139 (.137)
Nonbusiness masters (yes = 1)	.024 [.153]	--	.035 (.245)	.036 (.245)	--
Business masters (yes = 1)	.072 [.259]	--	.150 (.156)	--	--
Nonelite business masters (yes = 1)	.054 [.226]	--	--	.208 (.172)	--
Top 15 business masters (yes = 1)	.018 [.134]	--	--	-.058 (.304)	--
Total years worked prior to Company/10	.634 [.497]	-.327 (.079)	-.324 (.080)	-.326 (.080)	-.310 (.080)
Years in transportation excluding airlines prior to Company/10	.012 [.068]	-.156 (.560)	-.153 (.561)	-.159 (.561)	-.166 (.562)
Years in airlines prior to Company/10	.017 [.083]	.126 (.468)	.122 (.469)	.113 (.469)	.104 (.469)
Years in military/10	.043 [.133]	.149 (.283)	.144 (.283)	.150 (.284)	.144 (.283)
Company experience/10	1.363 [.844]	-.107 (.193)	-.104 (.193)	-.120 (.194)	-.088 (.194)
Company experience squared/100	2.569 [3.306]	-.040 (.053)	-.040 (.053)	-.037 (.053)	-.043 (.053)
Years of college	3.048 [1.168]	-.018 (.037)	-.018 (.037)	-.018 (.037)	-.008 (.039)
Combined SAT scores at colleges attended/100	9.735 [1.168]	--	--	--	-.024 (.054)
Expenditures per student at colleges attended/100	.198 [.161]	--	--	--	-.114 (.335)
Fraction of families with ≥ \$12,000 at colleges attended	.406 [.187]	--	--	--	-.070 (.273)
Year of evaluation dummies (2)	--	yes	yes	yes	yes
Grade level dummies (16)	--	yes	yes	yes	yes
State dummies (24)	--	yes	yes	yes	yes
R ²	--	.135	.135	.136	.137
Standard error of estimate	--	.954	.955	.955	.955

Notes: Standard errors are enclosed in parentheses.

*Mean = .000 [S.D. = .989].

their jobs than do managers with the same work history who did not obtain a masters, obtained a nonbusiness masters, or a masters from a top 15 business school.

In the Table 4 regressions, the "age minus schooling minus Company service minus five" or "total years worked prior to Company" construct has a statistically significant negative estimated coefficient. In addition, within-grade level performance appears to decrease with Company service although this finding is not significant.

To test the sensitivity of these results concerning the relationship between educational background, work history, and within-grade level managerial performance to the assumption that the underlying performance distribution among sample members at each grade is normal, it was assumed instead that the underlying distribution is uniform (a very nonnormal distribution). Under the uniform distribution individuals at a given grade level placed in performance evaluation category r_i were given a cardinal score equal to the within-grade cumulative frequency at r_{i-1} plus one-half the amount by which the within-grade cumulative frequency at r_i exceeds the within-grade cumulative frequency at r_{i-1} . Reestimation of the Table 4 regressions using this construct instead of the mean z-score did not significantly alter any of the conclusions drawn above.

As stated earlier, each manager receives a rating along specific dimensions of performance (Unit Achievement, Subordinate Coaching (if applicable), and Teamwork) in addition to receiving an Overall Evaluation, which was the basis of the preceding analysis. The results of regressions in which the dependent variables were ratings in z-score units along the specific dimensions of performance are presented in Table 5. As was the case with the Overall Evaluation ratings, the strongest predictor of the dimensions of performance is the "total years worked prior to Company" or "age minus schooling minus Company service minus five" variable, which has a statistically significant negative effect on each dimension.

TABLE 5

Other Dimensions of Performance

Dependent Variable: Rating on Relevant Performance Dimension (in z-score units)

Performance Dimension:	Unit Achievement N = 706			Subordinate Coaching N = 492			Teamwork N = 707		
	1	2	3	4	5	6	7	8	9
Coefficients of:									
Constant	.545 (.277)	.563 (.278)	.592 (.278)	.726 (.332)	.708 (.333)	.704 (.335)	.590 (.277)	.581 (.278)	.606 (.279)
Masters degree (yes = 1)	-.150 (.137)	--	--	.145 (.172)	--	--	.014 (.137)	--	--
Nonbusiness masters (yes = 1)	--	.032 (.247)	.033 (.247)	--	-.006 (.320)	-.006 (.320)	--	-.080 (.248)	-.079 (.247)
Business masters (yes = 1)	--	-.218 (.157)	--	--	.196 (.194)	--	--	.049 (.157)	--
Nonelite business masters (yes = 1)	--	--	-.099 (.173)	--	--	.185 (.215)	--	--	.152 (.174)
Top 15 business masters (yes = 1)	--	--	-.640 (.306)	--	--	.233 (.368)	--	--	-.316 (.306)
Total years worked prior to Company/10	-.280 (.080)	-.287 (.080)	-.291 (.080)	-.287 (.101)	-.280 (.102)	-.279 (.102)	-.246 (.080)	-.242 (.080)	-.245 (.080)
Years in transportation excluding airlines/10	-.160 (.565)	-.165 (.565)	-.178 (.564)	-.323 (.591)	-.320 (.592)	-.320 (.592)	-.370 (.566)	-.368 (.566)	-.378 (.566)
Years in airlines prior to Company/10	-.075 (.472)	-.068 (.472)	-.087 (.472)	-.531 (.610)	-.536 (.610)	-.533 (.612)	.041 (.473)	.037 (.473)	.020 (.473)
Years in military/10	.382 (.385)	.394 (.286)	.407 (.285)	.196 (.349)	.181 (.350)	.180 (.351)	-.137 (.286)	-.143 (.286)	-.132 (.286)
Company experience/10	-.031 (.195)	-.087 (.195)	-.118 (.196)	-.032 (.246)	-.027 (.246)	-.024 (.248)	.039 (.195)	.041 (.195)	.014 (.196)
Company experience squared/100	-.048 (.053)	-.048 (.053)	-.041 (.054)	-.043 (.067)	-.043 (.067)	-.043 (.067)	-.061 (.053)	-.061 (.053)	-.055 (.053)
Years of college	-.001 (.308)	-.003 (.038)	-.004 (.038)	-.040 (.047)	-.039 (.047)	-.039 (.047)	-.002 (.038)	-.001 (.038)	-.002 (.038)
Year of evaluation dummies (2)	yes	yes	yes	yes	yes	yes	yes	yes	yes
Grade level dummies (16)	yes	yes	yes	yes	yes	yes	yes	yes	yes
State dummies (24)	yes	yes	yes	yes	yes	yes	yes	yes	yes
R ²	.121	.122	.125	.117	.118	.118	.117	.117	.119
Standard error of estimate	.962	.962	.961	.975	.976	.977	.964	.965	.964
Mean [S.D.] of dependent variable	.000 [.989]	--	--	.000 [.984]	--	--	.000 [.989]	--	--

Notes: Standard errors are enclosed in parentheses.

To ascertain whether the apparent divergences between the within-grade level performance and earnings differentials associated with some of the variables of interest are statistically significant, earnings and performance must be in comparable units, so that the estimated coefficients of the relevant variables in earnings and performance equations can be compared. To do this, the natural logarithm of the earnings of each individual at a given grade level was transformed into z-score units in a manner which made these scores comparable to those calculated for the limited number of possible Overall Evaluation ratings (the r_i). This was done by determining the ln earnings ($E(r_i)$) at the cumulative frequency of the ln earnings distribution corresponding to the cumulative frequency of the appropriate Overall Evaluation distribution at each r_i . Sample members with ln earnings between $E(r_i)$ and $E(r_{i-1})$ were given the unit-normal score $\bar{z}(r_i)$, whose derivation was discussed on pp. 13-15 above. A regression of the same form as number 5 in Table 3 was fit with the ln earnings z-score as the dependent variable. The estimated coefficients (standard errors) in this regression (which also included 16 grade-level, 2 year-of-evaluation and 24 state dummies) were: Masters degree .324(.137), Years of college .016(.038), Company experience/10 .528(.194), Company experience squared/100 -.060(.053), Total years worked prior to Company/10 .208(.079), Years worked in airlines prior to Company/10 .258(.470), Years worked in transportation excluding airlines prior to Company/10 .673(.562) and Years in military/10 -.082(.284).

The first step in testing whether an estimated coefficient or group of coefficients was statistically different in this earnings regression from what it was in performance rating regression 1 in Table 4 involved fitting a model (with the Time Series Processor's (TSP's) LSQ procedure) under which the relevant estimated coefficients in the two equations were constrained to be equal. This is equivalent to constraining a (set of) variable(s) to on

average move an individual the same distance from the sample means of the relevant within-management level performance and earnings distributions. The second step involved doing a likelihood ratio (LR) test of whether the restriction(s) is (are) rejected.

This two-step procedure yields the following conclusions:

1. The restriction that the estimated masters coefficient be the same in the performance and earnings regressions cannot be rejected at a conventional level of statistical significance (LR = 1.40).
2. The restriction that the estimated coefficient of the Company service variable be the same is rejected at about the .01 level of significance (LR = 6.58).
3. The restrictions that the estimated coefficients of Company service and its square be the same are rejected at the .005 level (LR = 75.28).
4. The restriction that the estimated coefficient of the "Total years worked prior to the Company" or "age minus schooling minus Company service minus five" construct be the same is rejected at the .005 level (LR = 27.48).
5. The restrictions that the estimated coefficients of the two schooling and six work experience variables be the same are rejected at the .005 level (LR = 94.24).

V. Implications

The within-grade level divergence between the earnings and performance differentials of workers with different amounts of "human capital" might not be easily swallowed by those who believe that individuals with more work experience and schooling receive higher earnings solely because they have more productive capacity. One way of attacking the result is to argue that the performance ratings used in the analysis are not valid indicators of productivity, primarily because of their "subjective" nature. While "objective" measures of managerial performance would be most valuable, it is important to remember that (as can be seen on page 10 above) the Company's Reviewer Workbook instructs the reviewer to focus on "what the manager has accomplished" and to "not think in terms of personal characteristics or other subjective factors" (italics in original). In particular, the reviewer is supposed to base his assessment on "objective" factors like city performance reports, budget reports, exit interviews, employee surveys, and grievance sessions. Thus, while the appraisals of managerial performance are done by supervisors, and in this sense are subjective, they are at least supposed to be based on "objective" variables that clearly belong in an index of managerial productivity.

A second attack on the apparent divergence might run as follows: even though the within grade-level human capital earnings differential cannot be explained by a within-grade level performance differential, most of the total earnings differential is between grade levels and can be explained solely by the fact that individuals with more human capital have more productive capacity than those with less. While the glimpse under discussion most certainly takes place only within grade levels, it should be pointed out again that about 29 percent of the total estimated earnings differential associated with a masters, 44 to 59 percent of the differential associated with an additional year of the "age minus

schooling minus Company service minus five" construct, and 40 to 51 percent of the differential associated with an additional year of Company service occurs within grades. It would seem that these percentages are much too large to be dismissed as unimportant. Furthermore, it would seem that direct evidence on how staffing decisions are made is needed to justify the claim that the between-grade level earnings differentials between those with different amounts of work experience and schooling solely reflect differentials in productive capacity.

Assuming that the performance ratings do reflect performance differentials and that the fraction of total earnings differentials occurring within grades is nontrivial, the comparisons of within-grade earnings and performance differentials presented above yield a number of puzzles for theories of wage determination that ignore labor market institutions. The first involves the within-grade level relationship between Company experience, performance and earnings. The regressions presented above indicate that while earnings increase (in real terms) with each year of Company service by a nontrivial amount within-grade levels, job performance does not. To understand this finding it is important to realize that while management employees do not usually get pay increases that are labeled "service" increases their "merit" increases do not depend only on performance. As Sayles and Strauss (p. 379) write in the recent revision of their text on personnel administration, "most executives will receive an increase at least approximating the change in the cost of living since the previous review," which, as the BNA survey discussed on p. 9 above indicated, will most likely have been done one year earlier. The fact that "most" executives get relatively automatic annual increases in their real earnings, in conjunction with the result that within-level management performance does not appear to increase with Company service, make it difficult to argue convincingly that the within-level relationship between Company service and real earnings is due to the growth of employee productivity over time.

It is much more likely that management employees and the Company enter into an implicit contract under which each manager's real earnings will grow annually by at least a minimal amount regardless of the growth in his productivity. While the Company could increase its short-run profits by violating this contract, its reputation as a trustworthy employer would most likely suffer, causing its long-run labor costs to rise and its long-run profits to fall.

A second, but related, puzzling finding for a theory of wages not grounded in institutional reality involves the within-grade earnings and performance differentials associated with the "age minus schooling minus Company service minus five" or "pre-Company experience" variable. The fact that an additional year of this construct is associated with higher earnings within levels of management is consistent with the claim that there is a very general productive skill produced, sold and used by all firms. However, this interpretation is completely at odds with the fact that individuals with more "pre-Company experience" and, hence, more of this skill perform significantly worse within levels of management than comparable individuals with less. The opposite signs of the statistically significant estimated coefficients of the "age minus schooling minus Company service minus five" variable in the performance and earnings equations reflect the difficulty of trying to untangle this variable from age, the real earnings growth that occurs almost automatically for most employees with the passage of time, and the fact that a key determinant of the salary of a newly hired manager coming from another firm is the individual's salary on his or her last job.

Unlike the comparisons involving Company service and "age minus schooling minus Company service minus five," the within-grade level earnings differential associated with a masters degree does not appear to diverge significantly or

substantially from the within-grade differential in performance. The ratio of the estimated coefficients of the masters variable in the unit-normal performance and earnings regressions presented above indicates with little precision that about 37 percent of the within-grade level masters-nonmasters earnings differential can be explained by a performance differential. This implies that the unexplained within-grade level earnings differential is $((1 - .37) \cdot 4.3 =) 2.7$ percent, a small number with a large standard error. However, it should be pointed out that neither this study nor any other has presented direct evidence on the extent to which differences in productive capacity are likely to explain the 71 percent of the total earnings differential attributable to the way in which those with and without masters are assigned to different positions.

As its title indicates, this econometric case study is only a glimpse and thus obviously cannot come close to giving a full picture of what lies inside the black box called the earnings function. Nevertheless, the study has found a number of anomalies for an interpretation of this relationship which explains earnings differentials solely in terms of productivity differentials. While these findings may be the exception to the rule, it would seem that this should be demonstrated and not just asserted. As more studies like the present one are undertaken and as some direct evidence on why individuals with different characteristics are assigned to different jobs is obtained, it will become possible to determine what is and what is not an aberration and, thus, what really lies behind the statistical phenomenon called the earnings function.

Footnotes

- ¹The classic studies are Becker and Mincer. For analyses which, like the present one, are based on micro data for one company see Wise (June 1975, September/November 1975). For a good general review see Rosen.
- ²The pioneering work in this area was done by and is described in Griliches. See also Fane.
- ³See Summers and Wolfe, which cites other relevant studies dealing with educational production functions.
- ⁴For a discussion of the relevant studies, see Berg.
- ⁵The computerized records provided by the Company contained neither the names or addresses of employees nor their social security numbers. The information used in the regression analysis discussed below can be obtained from the author if it is to be used for academic purposes only.
- ⁶Other studies that have analyzed the relationship between the characteristics of colleges attended and earnings are Taubman and Wales, Johnson and Stafford, Solomon, Wachtel, Wise (June 1975, September/November 1975), and Morgan and Duncan.
- ⁷Gregory Jackson of the Stanford University School of Education was most generous in supplying these data and their description.
- ⁸This category is the sum of the following subcategories: instruction and departmental research, organized activities related to educational departments, sponsored research, other separately budgeted research, other sponsored programs, extension and public service, libraries, physical plant maintenance and operation, and other educational and general.
- ⁹The computer tape containing these scores was provided by the Higher Education Research Institute, Los Angeles, California.

¹⁰These data were also kindly provided by Gregory Jackson.

¹¹The Company's aggregate category "business" includes the following subjects: accounting, advertising, air transportation, banking, business administration, commerce, economics, finance, foreign trade, industrial management, journalism, marketing, personnel administration, statistics, and transportation. Because it is not possible to differentiate MBA's from other masters degrees or differentiate business schools from universities at which they are located, it is possible that an individual with a masters degree in "business" as defined by the Company did not attend what is normally referred to as a "business school." In the discussion below, it will be assumed that a business masters degree was received at a "business school."

¹²Because each of the major branches of the military has an air corps and because only some of the respondents gave a description of what they were doing within a branch, the years military variable could not be very cleanly split into years in air- and nonair-related military variables.

¹³The few employees in the Company's special category "Flight Operations Management" were excluded from the sample analyzed since these individuals were pilots who maintained their union membership with the Airline Pilots Association (and sometimes served on flights) and, unlike all other "management," had earnings that were contractually determined.

¹⁴On bias attributable to an omitted unobserved "ability" variable see Griliches and Mason and Chamberlain. On bias induced by sample selection, a potentially relevant consideration in experiments based on samples of workers grouped by company and/or jobs, see Heckman and Brown.

Bibliography

- Astin, Alexander W. and James W. Henson. "New Measures of College Selectivity," mimeographed, Higher Education Research Institute and University of California, Los Angeles.
- Becker, Gary S. Human Capital: A Theoretical and Empirical Analysis with Special References to Education. New York: National Bureau of Economic Research, 1964.
- Berg, Ivar. Education and Jobs: The Great Training Robbery. Boston: Beacon Press, 1971.
- Brown, Charles. "Education and Jobs: An Interpretation," Journal of Human Resources, forthcoming.
- Chamberlain, Gary. "Omitted Variable Bias in Panel Data: Estimating the Returns to Schooling," paper presented at the INSEE Conference on "Econometrics of Panel Data," Paris, France, August 1977.
- Fane, George. "Education and the Management Efficiency of Farmers," The Review of Economics and Statistics, November 1975.
- Griliches, Zvi. "Notes on the Role of Education in Production Functions and Growth Accounting," in Y. Ben-Porath, et al., Education, Income and Human Capital. New York: National Bureau of Economic Research, 1970.
- Griliches, Zvi and William M. Mason. "Education, Income and Ability," Journal of Political Economy, May/June 1972.
- Heckman, James. "Sample Selection Bias as a Specification Error," mimeographed, February 1977.
- Johnson, George E. and Frank P. Stafford. "Lifetime Earnings in a Professional Labor Market: Academic Economists," Journal of Political Economy, May/June 1974.

Johnson, Norman L. and Samuel Kotz. Continuous Univariate Distributions-1.

New York: Houghton Mifflin, 1970.

"The MBA Survey of Graduate Business Schools: The Top 15." MBA, December 1975.

"Management Performance Appraisal Programs," Personnel Policies Forum Survey

No. 104. Washington: Bureau of National Affairs, Inc., 1974.

Mincer, Jacob. Schooling, Experience and Earnings. New York: National

Bureau of Economic Research, 1974.

Morgan, James N. and Greg J. Duncan. "College Quality and Earnings," in Five-

Thousand American Families--Patterns of Economic Progress, Volume V.

Ann Arbor: Institute for Social Research, 1976.

Rosen, Sherwin. "Human Capital: A Survey of Empirical Research," in R.

Ehrenberg, Research in Labor Economics, Vol. 1, Greenwich, Conn.: Jai

Press, 1977.

Sayles, Leonard, R., and George Strauss. Managing Human Resources. Englewood

Cliffs, N.J.: Prentice Hall, 1977.

Solmon, Lewis C. "The Definition of College Quality and its Impact on Earnings,"

in Explorations in Economic Research: Occasional Papers of the NBER,

Vol. 2. New York: National Bureau of Economic Research, 1975.

Summers, Anita A. and Barbara L. Wolfe. "Do Schools Make a Difference?" American

Economic Review, September 1977.

Taubman, Paul J. and Terence J. Wales. "Higher Education, Mental Ability, and

Screening." Journal of Political Economy, Jan./Feb. 1973.

Wachtel, Paul. "The Effects of Schooling Quality on Achievement, Attainment

Levels, and Lifetime Earnings," in Explorations in Economic Research:

Occasional Papers of the NBER, Vol. 2. New York: National Bureau of

Economic Research, 1975.

Wise, David A. "Academic Achievement and Job Performance," American Economic

Review, June 1975.

_____. "Personal Attributes, Job Performance, and Probability of Pro-
motion," Econometrica, September/November 1975.