THE RATE OF RETURN TO TECHNICAL EDUCATION IN OKLAHOMA

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PREFACE

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TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

In broad terms, the goals of society are progress, justice, freedom and security. Public expenditures are one means used by society to reach these goals. All forms of public expenditures are not equally effective means to achieve these goals. Economics deals with how means such as public expenditures can be used to reach objectives as fully as possible. This economic study deals with one means, expenditures on education, and principally one objective, economic efficiency, which is a subset of the goal of progress stated above. More specifically, this study focuses on the economic payoff from expenditures on technical (vocational) education at Oklahoma State Tech located at Okmulgee, Oklahoma.

Estimates of costs and benefits resulting from investment in technical (vocational) education not only are needed to better allocate resources for national economic efficiency and growth, but also to help individuals to make choices consistent with their goals.

The basic assumption in economics is that goods are scarce; and society seeks an "optimal" level of resource allocation. If society has resources to be expended on

vocational and academic education, it is relevant to employ resources in a program which has the highest productivity. To optimize public expenditures for vocational and academic education, society should spend resources on each to the point where the additional benefits from an additional dollar spent on the two programs will be equal. With respect to vocational education, this implies that dollars should be invested in those skill areas which yield the highest return per extra dollar invested.

Moreover, in response to the rapid scientific and technological advancement, society is not only concerned with exploring and transmitting new knowledge, but also with recognizing the needs of a dynamic economy. Various training programs have been enacted to avoid unemployment resulting from structural change in a particular industry, occupation, or geographic location.

The frequent return of rural farm workers to their disadvantaged regions and the high unemployment rate among the youth can be partially explained by the lack of training. Without additional training, many of these people will not develop their full potential for economic advancement. Several studies have evaluated government retraining programs.[1] Some showed that investment in retraining

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[1]For specific studies see, David A. Page, Retraining Under the Manpower Development Act: A Cost Benefit Analysis, Studies of Government Finance, Reprint 86 (Washington, 1964); and Ernest W. Stromsdorfer, "Determinants of Economic Success in Retraining the Unemployed: The West Virginia Experience," Journal of Human Resources, Volume III, No. 2

under-employed and unemployed persons gave high rates of return.

Apart from economic efficiency and national productivity, other "benefits" justify research in vocational education. The individual is concerned with whether to continue or terminate his education and what kind of further education he should receive. Determination of the relative costs and returns of the different educational programs should be useful to resolve these concerns. Internal rates of return to the different fields in technical education were determined in this study. An understanding of the economic payoff to Oklahoma State Technical students from their technical education is an important guideline in judging the potential for improving the economic position of an individual who decides to invest in technical education.

Background of the Economics of Education

Economists have long recognized the importance of human resource development. Notable early writers on the subject include Adam Smith whose statement on acquired and useful abilities of the members of society is particularly relevant to his concept of fixed capital:

> The acquisition of such talents, by the maintenance of the acquirer during his education, study or apprenticeship, always costs a real expense, which is a capital fixed and realized, as it were,

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(Spring, 1968), pp. 139-158.

> in his person. ... The improved dexterity of a workman may be considered in the same light as a machine ... which facilitates and abridges labor, and which, though it costs a certain expense, repays that expense with profit.[2]

Alfred Marshall not only emphasized the importance of general education, which he considered "as a national investment," but also technical education:

> ... which is aiming firstly, at giving a general command over the use of eyes and fingers (though there are signs that this work is being taken over by general education, to which it properly belongs); and secondly at imparting artistic skill and knowledge, and methods of investigation, which are useful in particular occupation, but are seldom properly acquired in the course of practical work.[3]

However, only recently have economists focused on the money costs and returns to schooling. The research efforts have shown that education produces capital in the form of improved intellectual equipment for future service in a society. The production process of education involves the creation, stimulation and distribution of knowledge which are basic ingredients for economic growth.

Using cross sectional data from 1939-1958, Herman P. Miller estimated lifetime income based on variations in the expected payments to individuals to different age and education groups at a given time. He found that additional schooling was associated with a large increase in lifetime

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[2]Adam Smith, An Inquiry Into the Nature and Causes of the Wealth of Nations (New York, 1937), pp. 265-266.

[3]Alfred Marshall, Principles of Economics (London, 1960), pp. 173-174.

income. In 1958, for example, a high school graduate could expect to receive, in his lifetime, an average of 76,000 dollars more than the person who terminated his formal education before completing the twelfth year, and a college graduate could expect to receive 177,000 dollars more than an average high school graduate.[4]

H. S. Houthakker calculated the present value of lifetime income, both before and after tax, for different interest rates. On the whole, he found that additional education was positively correlated with higher discounted mean income.[5]

W. Lee Hansen calculated the rate of return on investment in schooling, ranging from 29 per cent for the completion of the eighth grade instead of the seventh, and 15.6 per cent for the completion of four years in college instead of three.[6]

Several studies have focused on the economics of vocational education. Arthur J. Corazzini conducted a study of costs and benefits of a general high school vocational

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[4]Herman P. Miller, "Annual and Lifetime Income in Relation to Education: 1939-1959." American and Economic Review, Volume L (December, 1960), pp. 962-986.

[5]H. S. Houthakker, "Education and Income," Review of Economics and Statistics, Volume XLI (February, 1959), pp. 24-28.

[6]W. Lee Hansen, "Total and Private Rates of Return to Investment in Schooling." Journal of Political Economy, Volume LXXI (April, 1963), pp. 128-140.

education in Worchester, Massachusetts.[7] He found that the public per pupil costs of vocational education for males, whether at the high school or post high school level, were 2.3 times those of regular high school education. In order to justify expenditures on this more expensive kind of education, the extra earnings that a vocational graduate receives over the high school graduate must be of such magnitude that the present value of these extra returns would be just equal to the present value of the extra costs incurred. His starting-wage data revealed that vocational graduates earn slightly higher wages than untrained regular high school graduates, and the size of the differentials varied inversely with the size of the hiring firm.[8] It was argued that the wage differentials would decrease over time because a high school graduate would have acquired as much on-the-job training as that of the vocational graduate. Since the wage differentials did not increase over time, then the initial advantage enjoyed by the vocational graduate was erased, making vocational investment unprofitable.

The study also attempted to evaluate the role of

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[7]Arthur J. Corazzini, Vocational Education, A Study of Benefits and Costs (Princeton, 1966), p. 111.

[8]It appears that labor unions play a major role in setting requirements for entry-jobs in large firms. The presence of a union apprentice program which varies in length from 6 months to 5 years can change the entire nature of the hiring process. For example, some vocational graduates were placed in jobs not related to their training; others were required to repeat training already accomplished during the formal technical schooling.

vocational education in preventing high school dropouts and its role in increasing the mobility of workers. The study showed that the program was "marginally profitable" only if the vocational graduate was considered to have been prevented from dropping out of school.[9] In conclusion, the author was pessimistic about vocational education in Worchester and questioned the economic value of that program.

Another study estimated costs and returns for investments in two years of post-secondary, technical schooling for graduates of Gaston Technical Institute.[10] The income earned by the Tech graduates was compared with the income of 45 white high school graduates who did not attend the technical school, but attended the same high school and were in the same graduating class of the Tech graduates. The average total social cost per student for the two year period was $7,425.[11]

The income advantage was computed for four years after graduation. The average monetary returns to technical education in the first year was estimated to be $555, and it increased by $161 per year during the first four years. Therefore, the estimated return in the fourth year was $1,038. In addition to this figure, $446 per year was

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[9]Ibid., p. 115.

[10]Adger Carrol and Loren Ihnen, Costs and Returns for Investments in Technical Schooling by a Group of North Carolina High School Graduates. (Raleigh, 1967), pp. 34-37.

[11]This includes $770 for books, supplies, and tuition, $1,468 for school expenses and $5,197 for foregone earnings.

added to the benefits for additional leisure available to Tech graduates. To estimate the additional lifetime benefits, two projections of future returns were made. The first assumed that future incomes of high school graduates will increase at the same rate as that of Tech graduates, so that the maximum annual income advantage in the fourth year ($1,482) was projected over the remaining part of the working period until the retirement age of 65. The second projection was made using cross-sectional income data from the 1960 census and applying a two per cent annual growth rate to both groups in order to adjust for secular growth.

The estimated rates of return on total investment in technical education was 16.7 per cent for projection one and 20.1 per cent for projection two, while the private rates of return were 23.9 per cent for projection one and 25.9 per cent for projection two.

Svetozar Pejovich and William Sullivan evaluated the private and social costs and returns occurring from investments in rural schools based on questionnaire data supplied by a group of Winona Area Technical School (WATS) in Minnesota.[12] They found that the median private rate of return for the different instructional programs ranged from 11 to 53 per cent and the median social rate of return ranged from 9 to 35.5 per cent.

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[12]Svetozar Pejovich and William Sullivan, The Role of Technical Schools in Improving Skills and Earning Capacity of Rural Manpower: A Case Study. (Washington, 1966), pp. 18-19.

In another mail questionnaire study, Kaufman evaluated the money returns to vocational education in Pennsylvania.[13] The results showed that:

1. During the first year after graduation, the vocational technical graduates earned a net (adjusted for socio-demographic factors) of $800 more than the non-college academic graduates, and the first group was employed about 2 months more than the latter.
2. Vocational-technical graduates had, on the average, earned $480 per year more than the non-college graduates during the six year period after graduation.
3. The estimated average marginal internal rate of return to the vocational-technical curriculum was 29 per cent, assuming that the net annual benefit streams of $480 are constant in perpetuity.

A more recent mail questionnaire study was conducted in Oklahoma to estimate the benefits to technical education.[14] The study was limited to 1967 graduates of Oklahoma's three post high school technical institutes and

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[13] Jacob J. Kaufman, et al., An Analysis of the Comparative Costs and Benefits of Vocational Versus Academic Education in Secondary Schools (Washington, 1967), pp. 111-148.

[14] Robert L. Dupree, A Cost-Benefit Study of Post-High School Technical Education in Oklahoma (unpub. M.S. thesis, Stillwater, Oklahoma State University, 1968), p. 30.

to technical graduates of five Oklahoma junior colleges. The sample consisted of 220 observations.

The projected lifetime income of this group was based on their six months average starting salaries after graduation from technical school. The results showed 35 and 25 per cent rates of return to society and individuals, respectively, resulting from investment in technical education. The Oklahoma study was hampered by a short history of earnings. It is hazardous to project lifetime earnings on the basis of starting salaries.

Limitations of Past Research

The review of literature section showed conflicting rates of return resulting from investment in vocational-technical education. The differences in results raise serious questions concerning the benefits of many vocational programs and point to the need for further research in technical education. The following factors help to explain the wide variation in results among the evaluation studies.

First, many studies of vocational education contain very limited data about school graduates -- no more information than a placement job record. The collection of additional information about the individual (such as health, cognitive abilities, family background, etc.) would be needed to estimate the relationship between income and education net of the effect of the other variables.

Second, differences in the rates of return are partly

attributed to the use of inappropriate control groups. Many factors significantly affect earnings and employment, and differences in the performance of two groups may be attributed to the students' background instead of the effects of vocational training. Ideally, it is wanted to compare two homogenous groups (with similar geographic, social, and economic backgrounds) which differ only because one group does not have technical training.

Third, past research has relied primarily on earnings data immediately following training. These starting-income figures were used to project future income benefits by assuming that the differential in starting income between the experimental group and the control group persists over a lifetime. The earning differential may increase the first few years past graduation, but then may decline in future periods as vocational skills become obsolete.

Fourth, the rates of return of the different evaluation studies differ by regions (low income versus high income regions) and type of training (formal training versus on-the-job training). The conflicting results point to the need for additional research to provide further evidence on the returns from technical education.

Features of This Study

This study complements past research in several ways.

First, most of the past studies have been carried out in the North and East and few studies directed their efforts

to the Southwest and to depressed regions. Despite the increasing public interest in alleviating rural poverty, economists have not assigned high priority to the study of human resources in the depressed areas. It is believed that education and training offer the potential for more complete utilization of those resources.

Second, it was mentioned in the previous section that differences in results among the research efforts reflect differences in the use of control groups. This study employs two control groups to measure foregone earnings. The first is high school (non-college bound) graduates in the Southern United States, and the second is a group with the same socio-economic background as that of Oklahoma State Tech (OST) graduates but without the latter's technical training. The earnings of the latter control group are estimated by the OST graduates themselves.

Third, while this study like several previous studies relies on data from a mail questionnaire, a follow-up sample is used to correct for sample bias. Those who respond first may be financially better off than non-respondents. Information from the follow-up group was used to adjust downward the income reported by the initial group of respondents.

Finally, the income data in this study cover a period of 21 years, a substantially longer period than considered in previous economic studies of vocational education.

The Objectives

The general objective of this study is to evaluate the economic benefits accruing to individuals and society from investment in two years of technical schooling (post high school) at Oklahoma State Tech, Okmulgee, Oklahoma.

The specific objectives are to: (1) determine costs incurred by individuals and society; (2) determine economic benefits accruing to individuals and society; and (3) compute internal rates of return resulting from investment in the different fields of study offered at OST.

Thesis Organization

The remainder of this thesis will be divided into five chapters. Chapter II describes the institutional setting of Oklahoma State Tech, the procedure for obtaining data, and the method of analysis. Chapter III presents the private and social costs for the different fields of study offered at OST. Chapter IV contains least squares estimates of functions relating lifetime earnings of OST graduates to age, experience and other variables. The cost and income streams provide a means for finding the discounted net benefits resulting from investment in technical education. Chapter V presents the estimated rates of return on such investment. Finally, Chapter VI contains the summary and conclusions from this study.

CHAPTER II

STUDY PROCEDURE

Introduction

The purpose of this chapter is to describe briefly the institutional setting of Oklahoma State Tech, to reveal the nature of the programs for vocational students, and to describe the procedure for obtaining and analyzing the data.

The Institutional Setting

The Oklahoma State University, Stillwater, Oklahoma, organized the Oklahoma State Tech branch in Okmulgee on October 1, 1946, to provide vocational and technical education for both men and women. Enrollment is open to a high school or non-high school graduate who is at least seventeen and one-half years of age.

Tech operates on a tri-mester plan, three 16-week terms; students are able to complete any field in two years or less. Students spend four hours each day in shops and another two hours in general education subjects related to the particular occupation.

For the purpose of this study, the major programs offered have been grouped into the following occupational fields: automotive, building trades, commerce, diesel,

drafting, electronics and electricity, food and cullinary arts, refrigeration, printing, and a final category composed of all other courses.[1]

The enrollment figures were obtained from the Office of the Registrar at Oklahoma State Tech. These figures were reported on a tri-mester basis and do not include persons who dropped out of school during the semester.

Since the interest is in calculating costs per student, the enrollment figures reported were converted into a yearly student equivalent basis (average number of full-time student equivalents per year). The total enrollment figures were divided by the number of tri-mesters per year.

Table I shows the number of full-time student equivalents, by major field of study, for the fiscal years 1947-1968. Inspection of Table I reveals that automotive has been the largest field, with a total enrollment of 5,474 students, followed by electronics and electricity with 4,127, and diesel with 3,446 students. The number of students in 1968 was more than 4 times that of 1947, and the number of students in the past nine years was greater than that in the first 13 years. Commerce and refrigeration enrollments increased markedly between the periods 1947-1959 and 1960-1968.

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[1]The category "others" consists of the following fields: dry cleaning, watch making, landscaping, and general farming.

TABLE I

NUMBER OF FULL-TIME STUDENT EQUIVALENTS AT OKLAHOMA STATE TECH BY MAJOR FIELD OF STUDY 1947-1968[1]

Year	Automotive	Building Trade	Commerce	Diesel	Drafting	Electronics	Food	Printing	Refrigeration	Others	Total
1947	109	4	36	68	12	65	10	9	68	44	425
1948	129	13	43	83	33	96	38	19	66	106	626
1949	208	27	52	109	49	125	69	34	71	238	982
1950	329	34	41	131	48	150	89	41	59	351	1273
1951	302	31	34	127	47	124	69	39	31	274	1079
1952	300	22	42	91	39	117	46	35	18	292	1002
1953	114	16	43	91	46	125	13	39	30	166	683
1954	136	16	58	158	67	208	32	40	37	110	862
1955	186	22	72	213	101	289	41	59	52	134	1169
1956	166	22	73	159	124	257	33	62	62	119	1077
1957	138	17	78	125	139	229	30	55	58	107	976
1958	194	11	79	119	160	234	29	53	62	109	1050
1959	158	13	86	117	92	227	27	50	62	82	914
1960	213	17	76	128	139	229	27	53	71	92	1045
1961	253	11	77	141	126	215	27	68	44	81	1053
1962	262	9	82	169	127	195	36	64	81	79	1104
1963	287	9	122	174	138	201	49	71	93	78	1222
1964	308	15	140	178	156	197	45	79	120	103	1341
1965	330	54	171	230	159	226	75	72	128	80	1525
1966	391	75	220	287	176	221	87	84	148	83	1772
1967	402	62	275	278	205	207	94	86	139	83	1831
1968	379	53	339	270	192	230	88	72	136	64	1823
1947-59	2469	247	737	1591	957	2206	526	534	665	2132	12117
1960-68	2825	305	1502	1855	1418	1921	528	649	960	743	12706
1947-68	5474	552	2239	3446	2375	4127	1054	1183	1625	2875	24832

[1] Source: Office of the Registrar, Oklahoma State Tech.

Procedure for Obtaining Data

The basic data used for this analysis are individual records from mail questionnaires sent to graduates with available addresses of Oklahoma State Tech between 1948 and 1965. The list of graduates was obtained from school officials.

The bias from excluding persons with no addresses is indeterminant. On the one hand it can be argued that some students were not enthusiastic about keeping contact with OST because their training did not contribute to their economic advancement. As such, the results are biased upward. On the other hand, it may be that other students are geographically mobile and lost contact with OST. If mobility is understood to result in economic gains and leads to higher incomes, then the omission of this group will likely bias the results downward.

The mailing list contained 4,123 addresses; 800 of whom were 1966 and 1967 graduates excluded from the study because it was felt that they did not have enough earnings data beyond graduation. The sample of women was too small to make a reasonably reliable analysis, so they were excluded from this study.

A total of 3,323 letters were mailed. Out of this total, 99 were returned because persons moved and left no forwarding addresses. The net total of graduates who received the questionnaires numbered 2,898. Out of this total, 471 persons responded to the first mailing making

the response rate 16.25%. An additional 80 incomplete questionnaires were received but were considered non-respondents since they failed to provide all necessary information.

Follow-up letters were then mailed to 600 non-respondents selected on a random basis -- every tenth person was chosen from the non-respondents' mailing list (which includes persons with incomplete schedules).

Out of the 600 additional mailed letters, 121 complete questionnaires were received, making the rate of response from the second mailing list 20.16%. The follow-up was designed to reduce bias due to missing data.

In total, 591 complete questionnaires were received, making the over-all response rate 16.92%. However, 535 questionnaires were used in the study after excluding 57 persons who attended another college or university after graduation from Oklahoma State Tech. These persons were omitted from the analysis because their return would be confounded with the return from investment in college education. The omission effect of this group is likely to bias the results of this analysis upward since their technical training was not necessarily useful to their careers.[2]

The questionnaire was designed to obtain data on

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[2]Out of the 57 persons who attended college after graduation from OST, only six majored in the same field in which they specialized at OST.

personal monthly earnings for the period since the respondent graduated from OST.[3] The questionnaire also included characteristics which can affect earnings, such as age, race, grades, family factors (marital status, parent's education, size of family); major area of specialization, additional training, present occupation and unemployment.

The Method of Analysis

The standard method used in computing internal rates of return is to estimate lifetime earnings from either cross-sectional or time series data and then solve for the discount rate at which the present value of the cost outlays would yield the present value of extra earnings.[4] In order to do so one requires data on costs as well as data on age-income pattern. The following is a general outline of the method of analysis which will be discussed in more detail in the following chapters.

1. The Costs

Both private and social costs are estimated on a per student basis.[5] The former costs include direct cash

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[3] It is reproduced in Appendix A.

[4] Hansen, W. L., p. 129.

[5] The cost figures were deflated by the same index used to deflate income. The difficult question arises as to whether the Consumer Price Index (or some other index measuring the relative change in prices over-time) should have been used to deflate the costs instead of the Non-Supervisory Worker Index. If the former represents a better

expenses for such items as books and tuition plus indirect costs in the form of foregone earnings incurred by the individual while attending OST. In addition to the above, total resource costs include expenditures for operating the school plus depreciation and interest charges on physical property.

Since the opportunity cost plays a large role in determining the benefits to technical education, two control groups were used to measure foregone earnings and to estimate what OST students would have earned throughout their lifetime in the absence of OST training. The first employs the 1959 cross-sectional age-earnings data of the One in One Thousand Sample of the 1960 Census of Population.[6] Since Okmulgee is located in the Ozark Region, it is believed that the earnings of high school graduates who do not attend college in the Southern United States represent the best available estimates of the (alternative) value productivity of OST students had they decided to join the labor market and not attend OST.

The second age-earnings "control" profile was constructed from a question dealing with the graduates' estimates as to how much money other people earn with the same

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measure of price change, then the choice of the latter resulted in understanding real costs since it shows greater change in price than the other.

[6]Fred K. Hines, The Incidence of Benefits and Costs of Investment in Education in the United States (unpub. Ph.D. dissertation, Stillwater, Oklahoma State University), 1969.

background as OST graduates, but without the latter's technical training.[7]

2. The Earnings Data[8]

The individual monthly income figures since graduation from OST were deflated, converted into annual dollar income, and adjusted for unemployment.[9]

The use of time series data introduces a bias resulting from the choice of a deflator. The magnitude and direction of bias is determined by the accuracy of the deflator in measuring the relative change in economic conditions over time (prices, wages, and productivity).

The alternative to using time-series data is to employ cross-sectional data. However, the latter also introduces a bias resulting from the use of fewer observations and the omission of other earnings information.

Moreover, the estimates of the cross-sectional data reflect the economic benefits which existed in that year for

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[7]The question was: "How much more (if any) per month do you earn than would a person in your community of similar age and background but without your OST training?" $_____ per month.

[8]The income figures used in this study cover only wages and salaries. Other incomes such as welfare payment, interest and rents were excluded to avoid attributing to schooling special advantages such as family wealth, inheritance, and transfer payments.

[9]The question, "On the average how many weeks per year have you been unemployed since completing your last year of schooling?" was used to adjust the average unemployment rate for each individual. For example, if a person was unemployed four weeks a year then his annual unemployment percentage rate was 4/52 x 100.

which data are shown, while the estimates from the 1948-1968 data are of more historic interest and reflect the benefits derived from technical education in the past 21 years.

The average hourly earnings of production and non-supervisory workers was chosen for deflating the data.[10] The group includes workers such as mechanics, draftsmen, repairmen, teachers and laborers, and is representative of the occupational fields in this study.

Table II shows the index of hourly earnings received by production and non-supervisory workers for 1948-1968 with 1959 as the base year. The 1959 base year placed the income in the sample on the same price level as that of the census control group. The index measures not only changes in prices but also the effects of an improving workers productivity over time. The index of 1948 was 60.64, indicating that 1948 earnings were 60.64 per cent of the earnings in 1959. Similarly, 1968 were 37.13 per cent higher than the earnings in 1959.

From the yearly income figures that were derived, a simple three-year average income (1948-1950; ... 1966-1968) was computed and used in the analysis. This is partly due to the way the respondents reported their income, frequently in three-year intervals, and to reduce the number of variables in the earnings regression function. The number of

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[10] U. S. Department of Labor, Employment and Earnings and Monthly Report of the Labor Force, Volume XIV, No. 10 (Washington, 1968), p. 63.

TABLE II

INDEX OF HOURLY EARNINGS RECEIVED BY PRODUCTION AND NONSUPERVISORY WORKERS IN THE U.S., 1948-1968[1]
(1959 = 100)

Year	Index
1948	60.64
1949	63.12
1950	66.09
1951	71.78
1952	75.25
1953	79.70
1954	81.68
1955	84.65
1956	89.11
1957	93.56
1958	96.53
1959	100.00
1960	103.47
1961	105.94
1962	190.90
1963	112.87
1964	116.83
1965	121.29
1966	126.73
1967	132.67
1968	137.13

[1]Source: U.S. Department of Labor, Employment and Earnings and Monthly Report of the Labor Force, Volume 14, No. 10 (Washington, 1968), p. 63.

individual income observations depends on the person's year of graduation. For example, a person who graduated in 1948 would have seven three-year average income figures (1948-1950; ... 1966-1968), and finally the income of a person who graduated at the end of an interval was considered as the average of that three-year earning interval.

Table III shows the number of questionnaires received as well as the number of income observations to be used in the regression analysis by major field of study.

3. The Earnings Regression Function

In determining benefits, one is interested in estimating the earnings function which relates age to earnings for given socio-economic characteristics. This is done by multiple regression techniques, whereby each income component is used as a dependent variable and the explanatory (independent) variables are used to separate the effects of schooling from other influences on earnings.

In other words, the flow of real earnings, (Y), that a person receives at a given time is a function of his age (A) and various additional factors (S). The function can be summarized as follows:

$$Y = f(A,S). \qquad (2.1)$$

The function relates earnings to age at a particular time, simultaneously making use of information about the individual on a number of other factors. Age-earning

TABLE III

NUMBERS OF QUESTIONNAIRES RECEIVED AND INCOME OBSERVATIONS BY MAJOR FIELD OF STUDY

Major Field of Study	No. of Questionnaires	No. of 3-year Average Income Observations
Automotive	83	272
Commerce	31	99
Diesel	102	328
Drafting	83	241
Electronics	122	428
Food	21	80
Printing	23	70
Refrigeration	41	122
Others	30	107
Total	536	1747

profiles were then constructed by plotting the three-year average annual earnings derived from the estimated regression equation over the lifespan (the averages were plotted at the median year of the age-earnings brackets).

Examination of Table IV reveals that over one-half of the students in the sample graduated at age 22 and over. This means that the majority have worked before attending OST so that their future benefits could be attributed to both their education and to their past working experience.

To overcome this shortcoming of the age-earnings method, another estimation procedure is also used in this study. It involves modifying Equation (2.1) to the following form:

$$Y = f(E,S). \qquad (2.2)$$

The function relates earnings (Y) to years of experience, (E), past graduation from OST and to other characteristics (S). An age-earnings profile was then constructed from the above function. The age-income profiles were assumed to commence at the "median" age (22) of graduation in the sample. For example, earnings of those with three years of experience are related to age 43.

Equation (2.2) however, has the disadvantage of estimating the experience-earnings function for a maximum period of 21 years, since the number of years of experience acquired by the first graduates numbered 21 (1948-1968).

The latter procedure is designed to estimate the net

TABLE IV

NUMBER OF STUDENTS BY AGE AT GRADUATION 1948-1965

Age at Graduation	Number of Students
18	10
19	50
20	98
21	90
22	42
23	32
24	46
25	35
26	32
27	20
28	12
29	12
30 over	57
Total	536

benefits derived from technical education, with experience the prominent variable and age given a secondary role; while the empirical estimates of earnings as a function of age (2.1) focuses on age as the prominent variable, with experience given a secondary role in the estimates.[11]

Finally, lifetime-cost income streams were then constructed with the estimated age-earnings profile and age-cost profiles. This is accomplished by taking the difference between the above two profiles, which reflects at ages 21 and 22 the net income stream resulting from technical education.

4. Calculation of the Internal Rate of Return

The internal rate of return is defined as the rate of discount which equates the present value of net benefits (measured by earnings) resulting from technical education with the present value of costs incurred to obtain that education. The internal rate of return indicates the rate of interest that an individual or society can afford to pay on their total schooling investment and just break even. To compute the internal rate of return (r), the following

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[11]The dummy variable of age at graduation (>25 and <25 years old) is the only variable that represents age in the experience-earnings function; while the same variable represents the only measure of past experience in the age-earnings method. The interaction between age and graduation age variable, in the latter procedure, reduces the effect of past experience. This is discussed in more detail in the chapter on benefits.

formula is solved for r:

$$\sum_{n=1}^{t} \frac{c_n}{(1+r)^n} = \sum_{n=t+1}^{k} \frac{B_n}{(1+r)^n}. \qquad (2.3)$$

where:

c_n = Costs of schooling in year n.

t = Number of years of schooling.

r = Internal rate of return.

B_n = Net earnings in year n.

k = Number of years from the time an individual leaves school to the time where his net earnings become negligible.

CHAPTER III

THE COSTS

This chapter presents two alternative measures of costs - one considers the cost to the individual student and the other estimates the total resource cost. The former costs consist of direct cash expenses for such items as books and tuition plus indirect costs in the form of earnings foregone by OST students while attending school. The latter includes costs of operating the school, such as teachers' salaries, interest and depreciation on physical property as well as the private costs mentioned above.

The private costs allow the computation of a private rate of return which indicates the economic benefit which the individual can expect as a result of his technical education. The social costs are used in measuring the gain (rate of return) to society from investment in technical education.

The cost figures presented in this chapter are derived for each major field of study and for each of the two years typically required to complete the program. The costs for each year are calculated for two reasons. First, since the number of tri-mesters required for graduation are different among the major fields, then the costs for those who are

able to graduate in less than two years will be lower than those who stay the full two years. Second, foregone earnings in the second year of schooling are greater than those of the first year.

Private Costs

The costs borne by the individual student are composed of two main categories:

1. Direct costs are those out-of-pocket expenses incurred for such items as registration and tuition fees, shop and instructional supplies (books, notebooks, pencils, and papers), plus hand tools required in certain fields.

The school administration at Oklahoma State Tech estimates that resident students, enrolled in 21-30 clock hours a week, are charged a fee of $145 a tri-mester ($435 per year). The figure covers all the above costs except hand tools, the cost of which varies from one department to another. Room and board costs were excluded from this computation since it was assumed that the living expenses are the same for those who go to school and those who enter the labor market.

Columns 2 and 5 of Tables V and VI show the direct costs for the first and second year of schooling, respectively. The difference in per student costs among the different fields of study in the first year is attributed to the difference in costs for hand tools. Some fields such as commerce, food, and printing do not require the purchase of

TABLE V

AVERAGE ANNUAL PER STUDENT PRIVATE COSTS FOR 1948-1965 STUDENTS BY MAJOR FIELD OF STUDY
AGE-EARNINGS METHOD
(in Dollars)

Major Field of Study (1)	First Year			Second Year			
	Direct (2)	Indirect[1] (3)	Total[2] (4)	Direct (5)	Indirect[1] (6)	Productivity[3] (7)	Total[4] (8)
Automotive	480	2661	3141	435	3030	N.E.	3465
Commerce	435	2661	3096	290	2020	(1721)	589
Diesel	490	2661	3151	435	3030	N.E.	3465
Drafting	470	2661	3131	435	3030	N.E.	3465
Electronics	485	2661	3146	435	3030	N.E.	3465
Food	435	2661	3096	145	1010	(3962)	(2807)
Printing	435	2661	3096	290	2020	(1547)	763
Refrigeration	480	2661	3141	435	3030	N.E.	3465
Others	480	2661	3141	145	1010	(3782)	(2627)
Average	470	2661	3131	435	3030	N.E.	3465

[1]Based on income earned by high school graduates in the South at ages 21 and 22, respectively.

[2]Obtained by adding columns 2 and 3.

[3]Based on the income earned from the age-earnings method.

[4]Obtained by subtracting the sums of columns 5 and 6 from column 7.

N.E. - No earnings.

Parenthesis indicates positive figures, all others negative.

TABLE VI

AVERAGE ANNUAL PER STUDENT PRIVATE COSTS FOR 1948-1965 STUDENTS BY MAJOR FIELD OF STUDY
EXPERIENCE-EARNINGS METHOD
(in Dollars)

Major Field of Study	First Year			Second Year			
	Direct	Indirect[1]	Total[2]	Direct	Indirect[1]	Productivity[3]	Total[4]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Automotive	480	2661	3141	435	3030	N.E.	3465
Commerce	435	2661	3096	290	2020	(1609)	701
Diesel	490	2661	3151	435	3030	N.E.	3465
Drafting	470	2661	3131	435	3030	N.E.	3465
Electronics	485	2661	3146	435	3030	N.E.	3465
Food	435	2661	3096	145	1010	(3644)	(2489)
Printing	435	2661	3096	290	2020	(1403)	907
Refrigeration	480	2661	3141	435	3030	N.E.	3465
Others	480	2661	3141	145	1010	(3354)	(2199)
Average	470	2661	3131	435	3030	N.E.	3465

[1]Based on income earned by high school graduates in the South at ages 21 and 22, respectively.

[2]Obtained by adding columns 2 and 3.

[3]Based on the income earned from the experience-earnings method.

[4]Obtained by subtracting the sums of columns 5 and 6 from column 7.

N.E. - No earnings.

Parenthesis indicates positive figures, all others negative.

any tools and the direct cost is composed of tuition fees only (which includes books, paper, etc.) The costs of tools per student range from $55 for diesel to $35 for drafting majors. The second year direct costs are different from the first in two respects. First, hand tool costs are charged for the year they were purchased (first year). The tools last the staying period at Tech and even beyond graduation. Second, tuition costs are charged for the actual number of tri-mesters a student has to stay before graduation. Food and "other" majors stay one tri-mester in the second year, while commerce and printing majors stay two tri-mesters in the second year and their costs are calculated accordingly. The rest of the majors are required to spend two full years (six tri-mesters), and their second year costs are lower than the first by the cost of tools. The "average" row indicates the average investment made per OST student. It was assumed that the average student stays two years at OST and spends $435 a year for tuition fees and $35 for hand tools.

2. Indirect costs include the largest cost of education borne by the individual, the opportunity cost of the student's time spent while he is acquiring his education. The opportunity cost concept is based on the premise that students have before them the option of continuing their schooling or of joining the labor market and producing products and services of value to them and to society. When they choose the first alternative, they forego the

opportunity of earning income chiefly because they expect that the future benefits from their schooling will compensate them from the current loss of income. The difficult question now arises as to what properly represents the opportunity costs. Ideally, one would like to know the earnings of a control group with similar geographic, social, and economic background as that of Oklahoma State Tech graduates, but without OST training. Since such ideal information is not available, two control groups were used in estimating the foregone earnings incurred by Tech students while attending school. The first was taken directly from the age-earnings profiles of U.S. males in the South based on income data from the 1960 census.

Columns 3 and 6 in Tables V and VI show the foregone earnings for the first two years. The figures are based on the assumption that the median graduation age for Tech students in this sample is 22; so that the first year opportunity cost is estimated by the average income ($2,661) a high school (non-college-bound) graduate in the South makes at 21; while the second year cost (Column 6) represents the earnings of a high school graduate at the age of 22. Again, the second year foregone earnings are lower for those majoring in fields requiring less than two years for graduation since they stay for a shorter period of time which also means that they are able to start working before those who stay the full two years. Their earlier entrance into the labor market and their ability to earn income must

be taken into account. This requires adjustment in the second year costs by subtracting what they can earn after graduation from the total cost figure for that year.

The earning capacity (productivity) of those who stay less than two years depends on the method of constructing the age-earnings profile which was briefly discussed in the previous chapter.

The first method involved relating age to income. The income data derived were used to adjust the cost figures for productivity to those who graduate in less than six tri-mesters (commerce, printing, food and others). This is shown in Table V. Commerce majors are able to graduate in five tri-mesters, which means that they are able to work one tri-mester in the second year. The starting salary for commerce students at the age of 22 was $5,163 per year, so that their estimated productivity in that one tri-mester on the job is $1721 = $\frac{(5163)}{3}$. This figure is then deducted from the second year cost to give the net cost incurred for that period (Column 8). The same procedure was followed for printing, food, and "others". The rest of the majors do not have any earnings in the second year so that their costs are not adjusted for productivity.

The second method of constructing the age-earnings profile involved relating years of experience to earnings and then converting them into age-earnings. Table VI contains the same information as that of Table V except for the productivity column which represents the earnings derived

from the second method instead of the first.

The above two tables represent the private costs adjusted for productivity for those who graduate in less than two years. The earnings figures used in the adjustment process mentioned above were derived from the total sample (1948-1965 graduates) using the two different methods of analysis. Table VII shows the average annual per student private costs based on 1960-1965 students in this sample. This table differs from the others in two respects: first, the opportunity costs are different because the median graduation age of this group is 21 instead of 22, so that the foregone earnings in the first year are estimated by the earnings of high school graduates in the South at age 21. Column 3 and 6 show that the 1960-65 graduates forego $2345 and $2661 for the first and second year of enrollment, respectively. The income earned by those graduating in less than two years (commerce, food, printing, and others) is shown in column 7; while column 8 shows the net second year cost after adjusting for productivity.

Upon examination of column 8 in all three tables, it is noticed that the second year cost figures are positive for food and others (in parenthesis) because their early entrance into the labor market and their earnings in that period exceed both the direct and indirect costs.

The other control group used in estimating the foregone earnings was derived from the question dealing with their estimates as to how much more (if any) per month do they

TABLE VII

AVERAGE ANNUAL PER STUDENT PRIVATE COSTS FOR 1960-1965 STUDENTS BY MAJOR FIELD OF STUDY
EXPERIENCE-EARNINGS METHOD
(in Dollars)

Major Field of Study (1)	First Year			Second Year			
	Direct (2)	Indirect[1] (3)	Total[2] (4)	Direct (5)	Indirect[1] (6)	Productivity[3] (7)	Total[4] (8)
Automotive	480	2345	2825	435	2661	N.E.	3096
Commerce	435	2345	2780	290	1774	(1408)	629
Diesel	490	2345	2835	435	2661	N.E.	3096
Drafting	470	2345	2815	435	2661	N.E.	3096
Electronics	485	2345	2830	435	2661	N.E.	3096
Food	435	2345	2780	145	887	(2684)	(1652)
Printing	435	2345	2780	290	1774	(1223)	841
Refrigeration	480	2345	2825	435	2661	N.E.	3096
Others	480	2345	2825	145	887	(2832)	(1800)
Average	470	2345	2815	435	2661	N.E.	3096

[1]Based on income earned by high school graduates in the South at ages 20 and 21, respectively.

[2]Obtained by adding columns 2 and 3.

[3]Based on the income earned from the experience-earnings method.

[4]Obtained by subtracting the sums of columns 5 and 6 from column 7.

N.E. - No earnings.

Parenthesis indicates positive figures, all others negative.

earn than a person with similar age and background, but without vocational training. On the basis of their answer, an age-earning profile was constructed by subtracting their estimate from their income. This will be discussed in more detail in the following chapter. Although these estimates are subjective, they are an estimate of what persons earn without technical education; moreover, these estimates measure indirectly the value OST graduates place on their investment in technical education. OST graduates estimate that their earnings exceed those of other persons with similar background in their community, but without technical training.

Since the derived age-earnings of the questionnaire control group were rough estimates, they were only used to figure the rates of return for all Oklahoma State Tech students as a group and will not be used for computing rates of return on each of the major fields of study. The estimates show that Tech students believe they forego earnings in the amount of $3,301 for every year they are in school; thus, the average annual per student cost for the first year is composed of $470 in direct costs and $3,301 in foregone earnings; and the second year of $435 in direct costs and $3,301 in opportunity costs.

Social Costs[1]

In order to find a measure of the total flows of inputs allocated to education, one needs to consider, in addition to the above costs, the annual flow of services of teachers and administrators, of maintenance and operation of physical plant and of depreciation and interests. The sum of the above costs is a measure of society's total factor costs of investing in technical education.

Total resource costs are composed of the following two categories:

1. Direct social costs are those current and capital expenditures incurred by society and expended to operate the school; they include items such as teachers' salaries, equipment and supplies, maintenance and operation of the physical plant.
2. Indirect or implicit costs include interest and depreciation charges on school buildings, equipment, and non-structural improvements (electric lines, sidewalks, signs and so on), as well as opportunity costs, discussed before.

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[1]The cost figures derived in this section are based on 1960-1968 fiscal years since most of the equipments were purchased during that period and the reported instruction costs were broken down by major fields of study only in recent years. See Appendix B.

1. Direct Costs

For the prupose of this study, the direct social costs were divided into the following:

a. Direct distributed costs cover those costs that are shared by all students and should be distributed on an equal basis irrespective of their major field of study. Such costs cover administrative and general expenses, resident instruction (which include costs of teachers' salaries for general educational subjects that are required by all students) library expenses as well as operation and maintenance of the physical plant. These costs will be the same for all students in all departments since they are determined by the amount of total expenditures allocated to the total number of students in the period under consideration.

b. Direct non-distributed costs are spent specifically in a particular major field of study and are composed mainly of instructional expenses. Such specific costs should only be charged to students in a particular major. The amount will depend on the amount of money spent, as well as the number of students enrolled in that department.

Table VIII shows the per student non-distributed costs (column 4) and per student distributed costs ($381), obtained by dividing the total distributed costs ($4,843,289) by the total number of students (12,706). The total non-distributed cost figures for the average graduate are composed of the sum of the individual department costs

TABLE VIII

AVERAGE ANNUAL PER STUDENT DIRECT COSTS BY MAJOR FIELD OF STUDY
1948-1965[1]
(in Dollars)

Major Field of Study (1)	Total Non-Distributed Costs (2)	Per Student Non-Distributed Costs[2] (3)	Per Student Distributed Costs[3] (4)	Per Student Direct Costs[4] (5)
Automotive	1,167,364	413	381	794
Commerce	888,131	591	381	972
Diesel	782,103	422	381	803
Drafting	393,158	277	381	658
Electronics	805,791	419	381	800
Food	459,341	870	381	1251
Printing	502,599	774	381	1155
Refrigeration	363,777	379	381	760
Others	390,956	526	381	907
Average	6,021,645	474	381	855

[1]For a detailed breakdown of the cost figures see Table XIX in Appendix B.

[2]Column 2 divided by the number of students shown in Table I.

[3]Obtained by dividing the total direct distributed costs, $4,843,289 (shown in the second column of Table XIX in Appendix B) into the total number of OST students (12,706).

[4]Obtained by adding columns 4 and 5.

mentioned here plus the cost of building trades which is not in this study. The number of students in building trades is also added to the total number of students so that the per student direct cost for all graduates represent the average total cost of an OST student. The details of the direct cost figures are shown in Table XIX of Appendix B.

Excluded from the above computations were items such as costs of sponsored research since the interest is only in the costs of instruction. Also excluded were funds for financial aids to students because the funds are considered as transfer payments; and auxiliary enterprises, such as athletic expenditures and school housing programs which are considered as non-educational activities.

2. Indirect Costs

In addition to the above costs, depreciation and interest on physical plant must now be computed in order to complete the analysis of social costs. The indirect costs consist of interest and depreciation charges on existing plant and of capital outlays.

Schultz provides a basic format for calculating the depreciation and interest charges on physical property.[2] He assumes no depreciation on land, two per cent on buildings and improvements and 10 per cent on the book value of

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[2]Theodore W. Schultz, "Capital Formation by Education," Journal of Political Economy, Volume LXVIII (December, 1960), pp. 571-583.

equipment. His interest charge of 5.1% on capital outlays is increased to 6%, which is believed to be the most representative rate of discount for the period under consideration (1948-1968).

The procedure used in the previous section will again be used here to divide the indirect costs into distributed and non-distributed costs. The former costs are composed of depreciation and interest charges on physical property shared by all students. Column 4 of Table IX shows the per student indirect distributed costs obtained by dividing the total implicit charges on both buildings and equipment, $1,915,157, into the total number of students (12,706), while the non-distributed costs include charges on buildings and equipment that are specifically designed for use by a particular department. Upon examining column 3 in Table IX, it is noticed that the per student non-distributed costs range from $13 for commerce to $339 for food. This wide variation is attributed to differences among curriculi in the value of buildings and equipment and the number of students. That is, the total indirect costs for certain departments such as commerce, drafting, and refrigeration are composed only of depreciation and interest charges on equipment since they do not have buildings designed specifically for their use. A high implicit cost combined with low enrollment in a particular department results in a high per student cost.

The per student indirect cost column is obtained by

TABLE IX

AVERAGE ANNUAL PER STUDENT SCHOOLING COSTS BY MAJOR FIELD OF STUDY 1948-1965[1] (in Dollars)

Major Field of Study (1)	Total Non-Distributed Costs[2] (2)	Per Student Non-Distributed Costs[3] (3)	Per Student Distributed Costs[4] (4)	Per Student Indirect Costs[5] (5)
Automotive	217,615	77	151	228
Commerce	20,246	13	151	164
Diesel	345,423	186	151	337
Drafting	32,842	23	151	174
Electronics	116,495	61	151	212
Food	179,165	339	151	490
Printing	175,187	270	151	421
Refrigeration	29,265	30	151	181
Others	133,698	180	151	331
Average	1,249,936	98	151	249

[1]For a detailed breakdown of depreciation and interest on buildings and equipment, see Table XX in Appendix B.

[2]Include total depreciation and interest charges on buildings and equipment.

[3]Column 2 divided by the number of students shown in Table I.

[4]Obtained by dividing the total distributed costs $1,915,157 (shown in Table XX of Appendix B) into the total number of OST students (12,706).

[5]Obtained by adding columns 4 and 5.

adding the per student distributed and non-distributed costs for each department and for all students. Finally, in order to compute the per student social cost, one needs to include the information derived in the previous tables. As described earlier, social costs include (1) direct cash outlays incurred by individuals for tuition and supplies, (2) opportunity costs, namely, income foregone by students during school attendance, and (3) school costs incurred by society, that is, teachers' salaries, supplies, interest and depreciation charges on capital. All costs are figured on a per student basis. The first two items constitute the private costs and were shown in Tables V, VI, and VII for the different methods employed in constructing the age-earnings profile. Item (3) is derived by adding the per student direct and indirect costs, column 5 in Tables VIII and IX.

The private and school costs are added and shown in column 7 of Tables X, XI, and XII to give the per student social costs for the two methods discussed earlier. As discussed above, the difference in costs between the first and second years of enrollment is due to the opportunity costs which are higher in the second year and to the number of tri-mesters required for graduation by the different major fields of study. Notice that the cost figures in the second year for food and others are positive, indicating that their earnings in the second year are greater than the costs incurred.

TABLE X

AVERAGE ANNUAL PER STUDENT SOCIAL COSTS FOR 1948-1965 STUDENTS BY MAJOR FIELD OF STUDY
AGE-EARNINGS METHOD
(in Dollars)

Major Field of Study (1)	First Year Costs			Second Year Costs		
	Private[1] (2)	School[2] (3)	Social[3] (4)	Private[4] (5)	School[5] (6)	Social[6] (7)
Automotive	3141	1022	4163	3465	1022	4487
Commerce	3096	1136	4232	589	758	1347
Diesel	3151	1140	4291	3465	1140	4605
Drafting	3131	832	3963	3465	832	4297
Electronics	3146	1012	4158	3465	1012	4477
Food	3096	1741	4837	(2807)	500	(2227)
Printing	3096	1576	4672	763	1050	1813
Refrigeration	3141	941	4082	3465	941	4406
Others	3141	1238	4379	(2627)	413	(2214)
Average	3131	1104	4235	3465	1104	4569

[1]Taken from column 4 in Table V.

[2]Derived by adding columns 5 and 5 in Tables VIII and IX.

[3]Obtained by adding columns 2 and 3.

[4]Taken from column 8 in Table V.

[5]Derived from column 3 and adjusted for the number of tri-mesters required for graduation.

[6]Obtained by adding columns 5 and 6.

Parenthesis indicates positive figures, all others negative.

TABLE XI

AVERAGE ANNUAL PER STUDENT SOCIAL COSTS FOR 1948-1965 STUDENTS BY MAJOR FIELD OF STUDY
EXPERIENCE-EARNINGS METHOD
(in Dollars)

Major Field of Study (1)	First Year Costs			Second Year Costs		
	Private[1] (2)	School[2] (3)	Social[3] (4)	Private[4] (5)	School[5] (6)	Social[6] (7)
Automotive	3141	1022	4163	3465	1022	4487
Commerce	3096	1136	4232	701	758	1459
Diesel	3151	1140	4291	3465	1140	4605
Drafting	3131	832	3963	3465	832	4297
Electronics	3146	1012	4158	3465	1012	4477
Food	3096	1741	4837	(2489)	580	(1909)
Printing	3096	1576	4672	907	1050	1957
Refrigeration	3141	941	4082	3465	941	4406
Others	3141	1238	4379	(2199)	413	(1786)
Average	3131	1104	4235	3465	1104	4569

[1]Taken from column 4 in Table VI.

[2]Derived by adding columns 5 and 5 in Tables VIII and IX.

[3]Obtained by adding columns 2 and 3.

[4]Taken from column 8 in Table VI.

[5]Derived from column 3 and adjusted for the number of tri-mesters required for graduation.

[6]Obtained by adding columns 5 and 6.

Parenthesis indicates positive figures, all others negative.

TABLE XII

AVERAGE ANNUAL PER STUDENT SOCIAL COSTS FOR 1960-1965 STUDENTS BY MAJOR FIELD OF STUDY
EXPERIENCE-EARNINGS METHOD
(in Dollars)

Major Field of Study (1)	First Year Costs			Second Year Costs		
	Private[1] (2)	School[2] (3)	Social[3] (4)	Private[4] (5)	School[5] (6)	Social[6] (7)
Automotive	2825	1022	3847	3096	1022	4118
Commerce	2780	1136	3916	629	758	1387
Diesel	2835	1140	3975	3096	1140	4236
Drafting	2815	832	3647	3096	832	3928
Electronics	2830	1012	3842	3096	1012	4108
Food	2780	1741	4521	(1652)	580	(1072)
Printing	2780	1576	4356	841	1050	1891
Refrigeration	2825	941	3766	3096	941	4037
Others	2825	1238	4063	(1800)	413	(1387)
Average	2815	1104	3919	3096	1104	4200

[1]Taken from column 4 in Table VII.

[2]Derived by adding columns 5 and 5 in Tables VIII and IX.

[3]Obtained by adding columns 2 and 3.

[4]Taken from column 8 in Table VII.

[5]Derived from column 3 and adjusted for the number of tri-mesters required for graduation.

[6]Obtained by adding columns 5 and 6.

Parenthesis indicates positive figures, all others negative.

The per student social cost for the average student is the same for the two control groups since the average staying period of an OST graduate was assumed to be two years and there was no need to adjust the second year costs for productivity.

Summary

This chapter dealt with estimating the private and social per student costs associated with the different major fields of study offered at OST.

The reasons for private cost variations among the programs are explained by differences in the costs of hand tools and variations in graduation requirements for the different programs. The latter point is important because costs are strongly influenced by the number of tri-mesters a student has to stay before graduation. Students who complete their program in a shorter period at OST incur less costs in tuition and fees, and less opportunity cost because they are able to join the labor market before those who stay six tri-mesters.

The cost figures were calculated for the age-earnings and experience-earnings estimation procedures since the earnings of those who are able to join the labor market in the second year of schooling are different in the two estimation procedures.

The per student total private costs for 1948-1965

graduates ranged from a low of $289 [$607] for food students to a high of $6116 [$6116] for diesel.[3] The private costs for 1960-1965 students ranged from $1025 for "others" to a high of $5931 for diesel majors.

The direct and indirect social costs were divided into distributed and non-distributed costs. The former cover costs that are shared by all students and include such items as teachers' salaries, general school expenses, and depreciation and interest charges on buildings and equipment.

The per student total social costs for 1948-1965 students ranged from $2610 [$2928] for food majors to $8896 [$8896] for diesel majors. The costs for 1960-1965 students ranged from a low of $2676 for "others" to a high of $8890 for diesel majors.

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[3]The figures in brackets represent costs based on the experience-earnings method and the figure preceding it represents the costs obtained from the age-earnings method.

CHAPTER IV

THE BENEFITS

This chapter is divided into two sections; the first deals with estimating empirically the earnings functions, (2.1) $Y = f(A,S)$ and (2.2) $Y = f(E,S)$, as defined in Chapter II. The first function relates age to earnings, taking into account several variables (S); and the second function relates earnings to years of experience after graduation from OST, taking into consideration the same variables (S).

The second section deals with graphing the age-earnings profiles which provide a means of finding the net discounted benefits accruing to the different major fields of study and to the average investment incurred by an OST student.

Empirical Estimation of the Earnings Functions

The objective of this section is to estimate the functional relationship between two years of technical schooling and the income of the respondents for the period since graduation from OST, adjusted for socio-economic factors. A complex relationship exists between numerous characteristics and the level of income; simple comparisons of income to age do not properly indicate the effects of technical

education. Multivariate statistical techniques are used to separate the effects of education and other variables, so that the net effects of education can be isolated.

The multivariate technique is multiple regression with the independent variables divided into mutually exclusive classes. The effect of belonging to each class of each factor is represented by a dummy variable, with a value of one if an observation falls within a class and a value of zero if it does not.[1]

Dummy variables were included to reflect the influence of discontinuous and qualitative variables on earnings. All the explanatory variables, except size of family and parent's education, are qualitative in nature, or "dummy variables".

The age and years-of-experience variables were defined by an interval (e.g., age 23-25, and 1-3 years of experience, etc.). They were assigned a value one if an individual is included in a particular group and a value of zero if he is not.

Interpretation of the Regression Equations

The differences among Tech graduates in earnings are affected by such factors as family background, motivation, intelligence, and occupation. These factors were included

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[1]For further discussion of the subject, see Daniel B. Suits, "Use of Dummy Variables in Regression Equations," Journal of American Statistical Association, Volume LII (December, 1957), pp. 548-551.

as variables in the regression. The size and statistical significance of a coefficient determined the final selection of variables in the regression equation.

1. 1948-1965 Period

Tables XIII and XIV give estimates of coefficients and their standard errors for the two earnings functions (2.1) and (2.2), respectively; using three-year average earnings as the dependent variable Y for two alternative sets of explanatory variables.

The coefficients of those variables that appear in the two regression equations are similar and their difference is attributed to those variables that are present in one equation but not in the other.

Race accounts for some of the differences in earnings among graduates. White graduates earn $1,081 [$1,021] more yearly than the non-white graduate.[2] The considerable difference between the two groups may be attributed to either discrimination in the labor market or to differences in productivity, or to both.

The differences in earnings ability between single, divorced and married students are also considerable. Married students earn $922 [$857] more than single or divorced graduates.

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[2]The figures in brackets represent coefficients derived from the experience-earnings function while the figure preceeding it represents the coefficient obtained from the age-earnings function.

TABLE XIII

ESTIMATES OF THE EARNINGS FUNCTION:
1948-1965 STUDENTS OF AGES 20-64
(in Dollars)

Variable	Coefficient	Standard Error
Age		
20-22[1]		
23-25	263**	176
26-28	991**	189
29-31	1259**	172
32-34	1842**	233
35-37	1700**	260
38-40	1458**	314
41-43	1363**	359
44-46	688	442
47-49	944	611
50-52	-72	669
53-55	-887**	869
56-58	-2047**	993
59-61	-1602	1387
62-64	-1843	1700
Race		
White[1]		
Non-white	-1081**	342
Marital Status		
Married[1]		
Single, Divorced	-922**	206
Grade Average		
Above average	380**	119
Average[1]		
Follow-up Letter		
Yes[1]		
No	185*	148
Physical condition		
Disabled	-1015**	221
Healthy[1]		
Size of family[1]	-90**	26
Major Field of Study		
Automotive[1]		
Commerce	668**	283
Diesel	687**	198
Drafting	1041**	214

TABLE XIII (Continued)

Variable	Coefficient	Standard Error
Electronics	543**	187
Food	1446**	311
Printing	145	324
Refrigeration	916**	264
Others	1178**	281
Father's Occupation		
Farmer, Laborer[1]		
Professional	310**	150
Others	55	152
Graduation Age		
18-24[1]		
25 and over	247*	150
High School Graduate		
Yes[1]		
No	-464**	168
Present Job		
Related to major[1]		
Not related to major	-651**	227
Remotely related to major	40	286
Military Service		
Yes	-5573**	443
No[1]		
Constant term (Automotive majors)	4496	
R^2	.249	
F ratio	16.24**	
Number of Observations	1747	

*Significant at the .05 level.

**Significant at the .01 level.

[1]This element of the set enters into the intercept term since the partial regression coefficient in a subset represents the deviation from the other element in the subset.

TABLE XIV

ESTIMATES OF THE EARNINGS FUNCTION:
1948-1965 STUDENTS WITH 1-21
YEARS OF EXPERIENCE
(in Dollars)

Variable	Coefficient	Standard Error
Years of Experience		
1-3[1]		
4-6	524**	146
7-9	1142**	168
10-12	1484**	204
13-15	1480**	255
16-18	912**	341
19-21	633	471
Race		
White[1]		
Non-White	-1021**	340
Marital Status		
Married[1]		
Single, Divorced	-857**	206
Grade Average		
Above Average	406**	119
Average[1]		
Follow-up Letter		
Yes[1]		
No	265*	147
Physical Condition		
Disabled	-1223**	218
Healthy[1]		
Size of Family[1]	-93**	26
Major Field of Study		
Automotive[1]		
Commerce	778**	281
Diesel	719**	197
Drafting	1113**	215
Electronics	540**	187
Food	1416**	311
Printing	161	323
Refrigeration	935**	263
Others	982**	284

TABLE XIV (Continued)

Variable	Coefficient	Standard Error
Father's Occupation		
Farmer, Laborer[1]		
Professional	327**	149
Others	130	151
Graduation Age		
19-22[1]		
23-25	894**	144
26 and over	1230**	150
High School Graduate		
Yes[1]		
No	-551**	168
Present Job		
Related to major[1]		
Not related to major	-603**	227
Remotely related to major	-169	284
Military Service		
Yes	-5533**	440
No[1]		
Constant Term (Automotive majors)	4049	
R^2	.253	
F Ratio	20.74	
Number of Observations	1747	

*Significant at the .05 level.

**Significant at the .01 level.

[1]This element of the set enters into the intercept term since the partial regression coefficient in a subset represents the deviation from the other element in the subset.

The use of average grades as a proxy measure of intelligence and ability is reflected in the coefficient which shows that those graduates with above average grades earn $380 [$406] more than those who achieved average grades.[3]

Respondents of the follow-up letters earned $185 [$265] less than those who responded to the first mailing. The reason for the variation in income between the two groups can be explained by the argument that the respondents of the follow-up letters represent more closely the average OST graduate as far as earnings are concerned. Those who respond first may be on the average financially better off than the others and are more eager to report. Thus, the earnings reported by respondents were adjusted downward for the bias on the basis of data from the follow-up study.

Disabled persons whose physical or mental handicaps prevent them from earning full-time pay earn $1,015 [$1,223] less than those with no disability.

Size of family is also a significant variable explaining variations in income among graduates. The median family size in the sample was four (including parents).

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[3]It is interesting to note that out of the 536 questionnaires received, none reported grades below average. Moreover, a few respondents reported "average grades" and according to school records their grades should have been classified as above average. It may well be that most people would like to be associated with the "average". (The definition of which may not be too clear.)

The coefficient indicates that a student from a large family tends to earn a lower income.

Father's occupation was included as a variable because it is felt that there is a relationship between education and a particular occupation. This is demonstrated to the children through their father's careers. Children may relate their father's success or failure to his educational achievements. The occupation variable was divided into three subclasses: (1) farmers and laborers, (2) professional (doctor, lawyer, ministers, and teachers), and (3) others (salesmen, skilled workers, and military). The coefficients show that graduates whose father's occupation was classified as professional earned $310 [$327] more than those whose fathers were farmers and laborers.

"High school graduate" describes whether or not an individual received a high school diploma.[4] It was hypothesized that those who completed high school were exposed to schooling which could have helped them in their technical training and choice of a career. The significant coefficient indicates that those who graduated from high school earned an income of $464 [$551] more than those who did not.

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[4]This variable was originally broken down into 0, 1, 2, 3, and 4 years of high school completed. Persons with 1 year of schooling earned more than those who graduated from high school (4 years). This may be due to the additional experience gained in areas requiring mainly skill (e.g. automotive) rather than general education subjects acquired in high school. However, when graduates were compared on the basis of either having or not having high school diplomas, it was found that those with a diploma earned a higher income than those without it.

Majors who are working in an area relative to their specialization earned $651 [$603] more than those who are working in an occupation dissimilar to their OST training.[5]

The military service coefficient indicates that OST students forego $5,573 [$5,533] a year while they are in the service. This variable takes into consideration the effect of variation in income among majors resulting from the time spent in the military.

Finally, the major-field-of-study variable is included in the analysis because the interest is in determining the net benefits accruing to the different occupational fields.[6] This variable was entered by placing a value one if an individual belongs to a certain occupation and zero if he does not. The variable may represent skill and ability as well

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[5]The figures in brackets represent coefficients derived from the experience-earnings function while the figure preceeding it represents the coefficient obtained from the age-earnings function.

[6]In addition to the above variables that were chosen for the final analysis, the following were considered and found insignificant:

a) Parent's education. Years of school completed by parents may affect their children's background and outlook and reflect the transmission of the parent's motivation to send their children to college and their knowledge of market information.

b) On-the-job training. The variable was considered a type of investment in human capital. Its unimportance may be explained by the difficulty in distinguishing between normal work experience and on-the-job training.

c) Location of present job. The variable was used to show the effects of working in places where there are more opportunities. The hypothesis that those who worked in large cities, such as Oklahoma City and Tulsa, earn more than those who stayed in rural areas (Ozark Region) was not confirmed.

as differing opportunities available to persons in the various occupational fields.

In comparing the earning performance of the different fields of study offered at OST, it was noticed that automotive students earned less on the average than others, while "food" majors earned $1,446 [$1,416] more than the automotive students.

The difference in earnings among the various groups is mainly attributed to the relative market demand of the different occupations. For example, "food" majors, unlike (say) draftsmen, may not have to compete with engineers and other college graduates for management positions, and may find administrative positions quite accessible.

The earnings of the different occupational fields are averages for the 1948-1965 period, and the relative earnings could now have shifted markedly among fields. This point will be further examined by estimating the earnings function of recent graduates to compare the earning performance of the different fields over time.

Having explained the effects of the joint variables that were used in both functions, the writer now discusses those variables that were entered differently in the two regressions. The age effects are shown in Table XIII. Earnings increase with age and reach a peak between 32-34 years of age and then decline steadily until 47-49, where they increase slightly. Beyond that interval, earnings drop sharply.

The age variable was probably biasing the graduation age coefficient due to its significant interaction with that variable. The graduation age coefficient, $247, seemed to be low and significant only at the five per cent level, while the same coefficient was significant at the one per cent level and much higher in the experience-earnings function. The reason for this difference is due to the fact that age at graduation is the only variable that represents age in the experience-earnings function, while present age as well as graduation age are both present in the age-earnings function.

The experience variable indicates that persons with 10-12 years of working experience past graduation from OST earned $1,484 more than those who had 1-3 years of experience, and that there is almost no difference in earnings between those with 10-12 and 13-15 years of experience (Table XIV). However, beyond 15 years of experience, earnings drop rather sharply. Again, the coefficient of persons with 19-21 years of experience are based on 26 observations (out of a total of 1,748). The interpretation and use of this coefficient will be discussed in the following section when the age-earnings profiles are constructed.

The coefficients of determination (R^2), indicate that the set of variables explained about one-fourth of the variance of the individuals' earnings. The unexplained variation is attributed to errors in the data, unaccounted for interaction among variables, and missing variables.

Missing variables include measures of ability, intelligence, motivation, and attitude toward work. The R^2's, though low, are in line with those obtained in other studies in the social science field dealing with prediction of individual human behavior.

The F-test is applied to test the significance of the entire regression equation. Both F-values, 16.24 and 20.74 are significant at the one per cent level which means that a high probability exists of correlation between earnings and the linear combinations of the independent variables.

2. 1960-1965 Period

The estimated earnings function for 1960-65 students provides a more realistic measure of the current earnings in various fields, but the job history of necessity must be shorter and observations fewer. Table XV shows the estimated coefficients and their standard errors of the earning function for 1960-1965 students with 1 to 9 years of working experience.

In contrast to results for the 1948-65 period, automotive majors no longer have the lowest earnings and are replaced by "printing" followed by food majors. Drafting majors replaced food majors in having the highest earnings. The results shown here compare more favorably with the OST administrator's observations, but still differ on the earnings of automotive graduates. OST administrators felt that automechanics majors have the highest current earnings,

TABLE XV

ESTIMATES OF THE EARNINGS FUNCTION:
1960-1965 STUDENTS WITH 1-9
YEARS OF EXPERIENCE
(in Dollars)

Variable	Coefficient	Standard Error
Years of Experience		
1-3[1]		
4-6	312**	133
7-9	722**	177
Race		
White[1]		
Nonwhite	-838**	297
Marital Status		
Married[1]		
Single, Divorced	-821**	182
Grade Average		
Average[1]		
Above Average	270**	126
Follow-up Letter		
Yes[1]		
No	-277**	151
Physical Condition		
Disabled	-1681**	284
Healthy[1]		
Size of Family[1]	-88**	30
Major Field of Study		
Automotive[1]		
Commerce	-20	307
Diesel	756**	203
Drafting	854**	211
Electronics	760**	203
Food	-227	404
Printing	-584*	335
Refrigeration	557**	262
Others	5	315
Father's Occupation		
Farmer, Laborer[1]		
Professional	-98	161
Others	-89	160

TABLE XV (Continued)

Variable	Coefficient	Standard Error
Graduation Age		
18-22[1]		
23-25	645**	152
26 and over	517**	186
High School Graduate		
Yes[1]		
No	-160	188
Present Job		
Related to major[1]		
Not related to major	-450**	227
Remotely related to major	-382	404
Military Service		
Yes	-4645**	453
No[1]		
Constant Term		
(Automotive majors)	4253	
R^2	.312	
F-Ratio	14.59	
Number of Observations	797	

*Significant at the .05 level.

**Significant at the .01 level.

[1]This element of the set enters into the intercept term since the partial regression coefficient in a subset represent the deviation from the other element in the subset.

while the results of this study did not show that. This difference can be explained by the fact that the automotive element in the occupation sub-class include not only auto-mechanics majors but also autobody, autotrim, autoparts and service station management; and there is no way to find out the portions of this automotive sample allocated to each of the above. It follows then that automechanics majors may have the highest earnings, but this was obscurred by the automotive sample which also represented the other autofields.

The difference in earnings of the different occupations between the 1948-1965 and the 1960-1965 graduates is of interest. Table XVI summarizes the rank in earnings of the different occupations for the 1948-1965 and the 1960-1965 students. For 1948-1965 students, it can be seen that food majors ranked number 1, in terms of earnings capacity, followed in rank by drafting, other majors, refrigeration, commerce, diesel, drafting, electronics, printing, and finally automotive. Considering only the 1960-1968 data, drafting majors had the highest earnings while printing majors had the lowest. During the past nine years, the relative demand for such fields as automotive, diesel, drafting, and electronics has increased, while the relative opportunities in the other fields, such as food and printing, have declined.

The difference in relative earnings of the different occupations between the two groups (1948-1965 and 1960-1965

TABLE XVI

RANKING OF RELATIVE EARNINGS FOR 1948-1965 AND 1960-1965 STUDENTS BY MAJOR FIELD OF STUDY EXPERIENCE-EARNINGS METHOD

Major Field of Study	1948-1965 Students	1960-1965 Students
Automotive	9	5
Commerce	5	6
Diesel	6	3
Drafting	2	1
Electronics	7	2
Food	1	7
Printing	8	9
Refrigeration	4	8
Others	3	4

students) may be due to differences among occupations in chances for advancement. The opportunity for "moving up" in some occupations into high salaried positions is greater than in others. For example, it was found from the questionnaires that most of the food majors either held administrative jobs or had their own private business.[7]

Age-Earnings Profiles[8]

The next step in the determination of benefits involves combining the results of the regression equations into a schedule of earnings at different ages. However, before the profiles are constructed from the two methods of estimating the earnings function described above, a few comments are warranted on the profiles of two control groups which are designed to represent how OST graduates would have performed had they not decided to attend school.

Two control groups are used in this study.

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[7]It is possible that certain majors begin with low (high) earnings and end high (low). This is demonstrated in the shape of individual field profiles from the regression equations estimated separately for each field with data only for that field. For example, "other" majors had the highest starting salaries but had the fourth lowest earnings at the end of the profile; and that electronics majors began with the fourth lowest earnings and ended with the highest earnings. The single equation that estimates earnings for all fields with a dummy variable for each field does not show that since it forces the age-earnings profiles to differ among fields by a constant. The reason for not using the estimated individual regression equations was due to the small number of income observations for the different major fields of study. The age-earnings profiles estimated for small-sample areas of study were judged to be unreliable.

[8]The age-earnings tables are presented in Appendix C.

U. S. South

The first represents age-earnings profiles of white males in the southern United States based on 1959 census data. The average annual earnings were originally related to the median year of nine age-earnings brackets. These brackets were interpolated on a straight line and transformed into three-year averages as in the regression equations. This put the original estimated earnings on the same age brackets as in this study and achieved a more smooth curve without affecting the general shape of the original profiles. The plotted profile in Figure 1 shows that earnings rise continually and reach a peak of $5,737 at the age of 54.

It should be pointed out here that the income data of this control group were not adjusted for some socio-demographic factors which affect earnings and employment. This implies that an earnings differential between OST graduates and the control group cannot be attributed solely to technical training but must, in part, be attributed to the individual's background and personal characteristics.

Questionnaire

The second control group used in this analysis is based on the graduate's own estimates of how much more (less) do other people earn with similar age and background, but without his technical education. On the basis of the respondents' answers, an age-earnings profile was constructed and

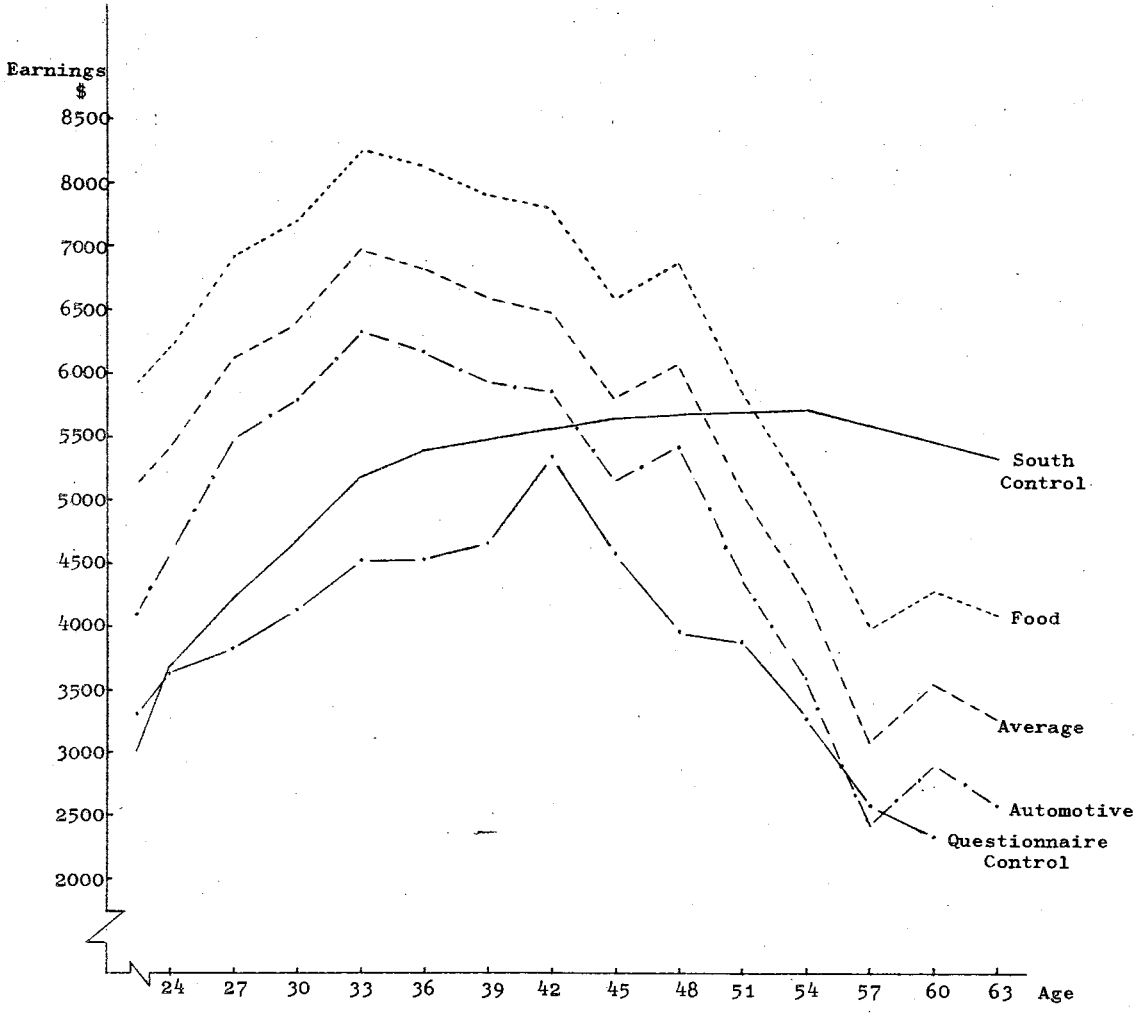

Figure 1. Age-Earnings Profiles for 1948-1965 Students by Major Field of Study and Two Control Groups - Age-Earnings Method

plotted in Figure 1. The general shape of the profile indicates that earnings increase gradually at first and increase sharply approaching age 42, at which earnings reach a maximum, and then drop sharply beyond that age.

In comparing the age-earnings profiles of the two control groups, it was found that the questionnaire profile was lower than that of the U. S. South profile after 25 years of age.

The question now arises as to which profile more nearly represents how OST graduates would have fared had they not decided to attend school? A major advantage of the census control group is the large number of observations used to construct the profile. A disadvantage is that the census data do not apply specifically to eastern Oklahoma, although that area of the state has many economic characteristics that are more like the South than the other regions of the country for which census age-earnings profiles are available. A major advantage of the control age-earnings profile obtained from the former OST students is that it is specific to the relevant population. However, it, like the other data from the sample, may not be from a truly representative sample of former OST students. Furthermore, former students may have little knowledge of what persons without this training may be making, may be unusually subjective in making the estimate, and may give answers that result in a control group age-earnings profile that is biased downward. In short, it is believed that there is not much basis for

selecting one over the other profile. Therefore, both control groups were used to measure the earnings differential of those with and without technical education.

Age-Earnings Method

Using the survey observations relating age to earnings, ten age-earning profiles were constructed. Nine correspond to the different occupational groups and one to the average OST graduate. The profiles were based on age-group midpoints as defined earlier in the regression equation.

Only the lowest and highest age-earning profiles of the different occupations were plotted in Figure 1. These represent automotive students and food majors. The profiles of the other occupations were not plotted in order to avoid crowding the graph. Their shape is identical to the automotive profile. This differs from the automotive profile in highth only; since the respective partial regression coefficients for the different occupations are interpreted as deviations from automotive. For instance, on net, electronics majors earned $543 more than automotive at each midage bracket over all age groups. The detailed age-earnings schedule for each occupation as well as the other information shown in Figure 1 are presented in Table XXI of Appendix C.

Upon examination of the profiles, it can be observed that, between the ages of twenty-two and thirty-three, earnings increase gradually and continuously. After age

thirty-three, earnings decrease until age 45 and increase slightly at age 48, then decline rather sharply beyond that age.

A few remarks are warranted about the shape of the constructed profiles. First, peak earnings are reached at a rather early age. This may be explained by the nature of technical education which requires constant up-dating of knowledge and skills. It is presumed that the more specialized the skills of an individual, the more obsolete becomes his original training over time. The fact that only one-fourth of the graduates in the sample acquired additional training past graduation from OST may have contributed to the decline in earnings at a relatively young age.

Second, earnings drop rather sharply beyond the age of 48. The gradual decline between ages 33 and 45 can be attributed to decreased stamina, dexterity, flexibility or possible unwillingness on the part of some graduates to change jobs for fear of losing seniority or pensions.[9] The sharp decline in earnings beyond age 51 is believed to be attributed to early graduates who were frequently physically handicapped and to a lower quality of training in the early years of the school.

It was assumed that the estimated age-earning profiles will assume the same age-earning schedule as that of the

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[9] J. N. Morgan, M. H. David, W. J. Cohen, and H. E. Brazer, Income and Welfare in the United States (New York, 1962), p. 50.

control group starting at the point where the respective constructed profiles intersect the control group profile. In other words, the net earning differentials between Tech graduates and the control are considered to be zero beyond the point where the two profiles cross one another. Beyond age 51, expected earnings of the average OST student are assumed to be the same as that of a high school graduate in the Southern U. S.

The above assumption also simplifies the interpretation of the rates of return. The time stream of benefits and costs before the assumption is made appears in Figure 2. Here, the net stream of revenues (after subtracting the one stream from the other) changes sign twice which may result in estimating two rates of return for the same benefit-cost stream.

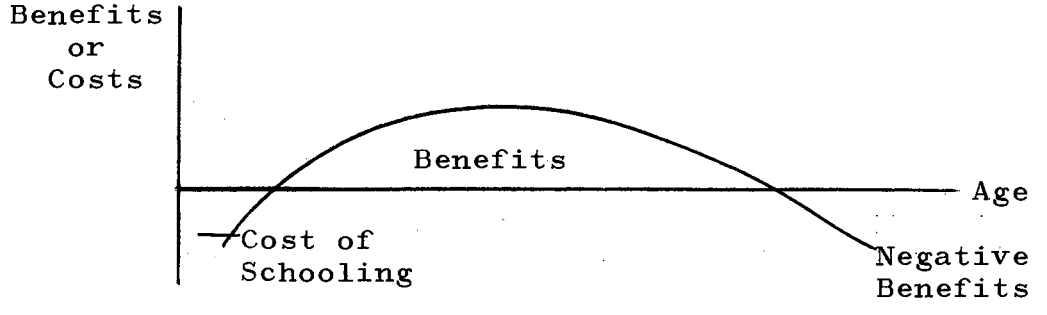

Figure 2. Original Age-Earning Stream With Two Cost Outlays

The assumption that earnings of OST graduates do not fall below earnings of high school graduates is defended on several grounds. First, early OST graduates were frequently handicapped, were without a high school education and in general were from a different statistical population than the recent graduates in which this writer is mainly interested. Second, sampling error may play a role in the data for older ages, where few observations were available. Finally, it is unlikely that high school graduates with OST training would receive less than a high school graduate without the training.

Experience-Earnings Method

The use of this method to construct lifetime earnings allows the computation of net benefits accruing to experience past graduation from OST. As was explained earlier, the sample consisted of graduates with previous working experience before attending OST; so that when earnings are related to age they cannot be solely attributed to technical education. For example, if an individual graduated at age 35, then his earnings at a certain age, say 37, is a result of not only his additional acquired knowledge but also of his accumulated past experiences from jobs held before attending OST.

1. 1948-1965 Students

The coefficients of the experience variables in Table

XIV were used to construct the age-earning profiles from the experience-earnings function. The profiles were assumed to commence at the median age of graduation (22) in this sample. For example, earnings of those with 1-3 years of experience are related to ages 23-25 and earnings of those with 19-21 years of experience are related to ages 41-43. The mid-point of the three year intervals was used to plot the graph; so that earnings at age 24 are associated with the earnings of two years of experience.

Figure 3 shows the plotted age-earnings profiles for food, automotive and the average student. The first two represent the highest and lowest profiles, respectively. Inspection of the general shape of the profiles reveals that earnings increase gradually and reach a peak between the ages of 33 and 36. (This compares to age 33 in the age-earnings method.) The experience-earnings method has the disadvantage of lacking income data beyond age 42. This is due to the number of years of experience acquired by the first graduates since the school started. In other words, those who graduated in 1947 (first graduating class) have a maximum of 21 years of working experience (1948-1968). Therefore, there are only 21 years of income observations.

The questions that were raised in the previous section about the reliability of the estimated earnings of the older graduates still hold for the experience-earnings method. The estimated earnings at age 42 are based on only 17 observations which consist of 1947-1949 students.

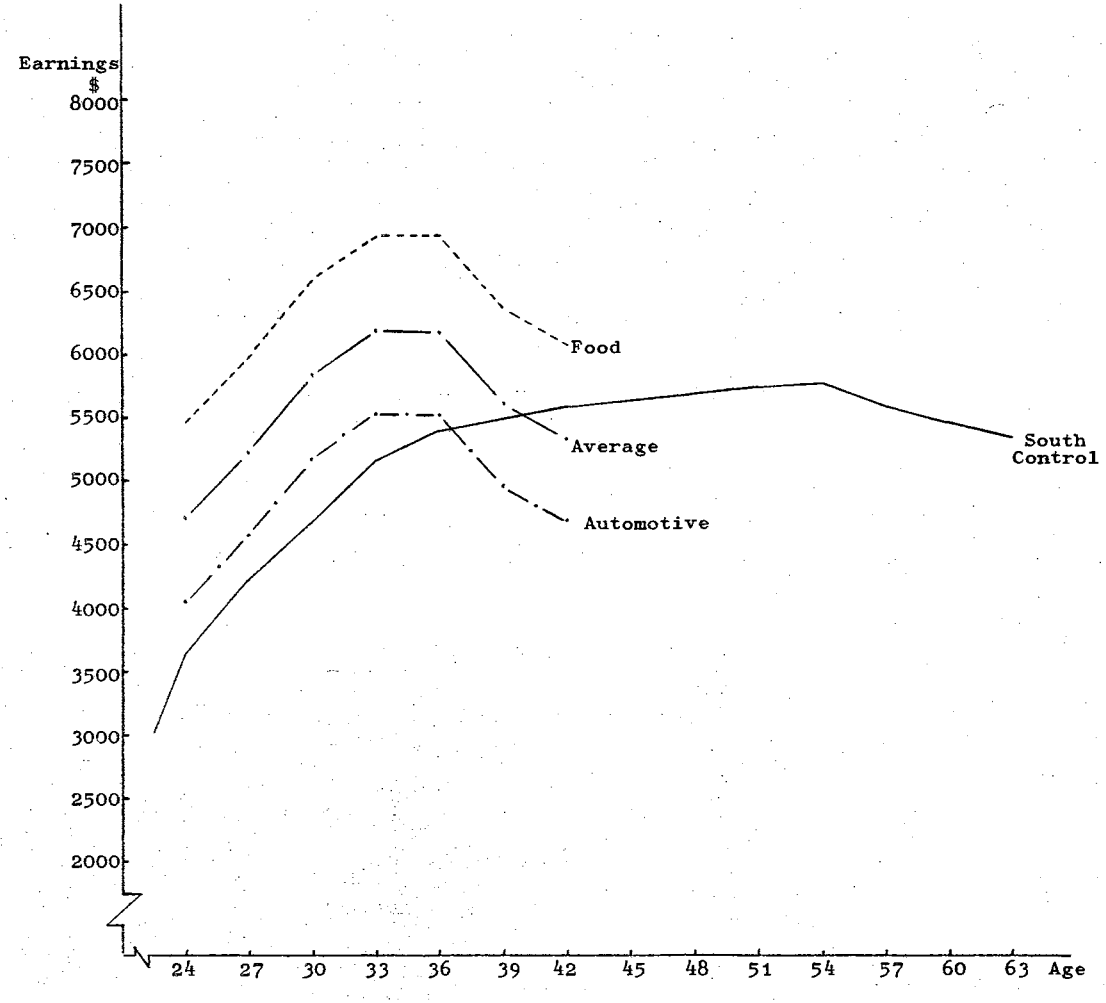

Figure 3. Age-Earnings Profiles for 1948-1965 Students by Major Field of Study and Two Control Groups - Experience-Earnings Method

In order to determine the effect of 1947-1949 students' earnings on the shape of the profile, another regression function was estimated excluding the latter group. It was found that the general shape of the profiles did not change. However, the decline in earnings between ages 36 and 39 was not as steep as that when the 1947-1949 graduates were included. This means that whether or not 1947-1949 graduates were included in the analysis, earnings still declined beyond age 36.

The unresolved issue is the rate of decline in earnings past age 36. Since doubt was cast about the reliability of earnings of the older graduates, it was assumed again that the respective constructed profiles will follow the same age-earnings schedule of the control group starting at the point where the two intersect. For example, the average graduate profile will assume the same shape as that of the high school graduate in the Southern U. S. beyond age 39. The automotive profile will have the same schedule as that of the control group starting at age 36.

2. 1960-1965 Students

The purpose of estimating the experience-earnings function for this group was explained earlier. Briefly stated, the function was primarily designed to measure the relative economic performance among the different occupations in recent years as compared to the past twenty-one years. The function estimated earnings for a maximum period of nine

years. The median graduation age for this group was 20 so that earnings are estimated up to age 29. In order to estimate earnings beyond age 29, the profile of the 1948-1965 average graduate was used as a basis for projections.

For instance, earnings of 1960-1965 drafting graduates at age 27 were estimated to be $5,550 and the estimated earnings of the average 1948-1965 graduate at the same age was $5,231. The difference between the two values ($325) was added to each age-group of the latter profile to project earnings of drafting graduates for the ages 29-42. In other words, the age-earnings profile of the 1960-1965 drafting graduates will have the same shape as that of the average 1948-1965 student and differ from the latter by being $525 higher. The same procedure was followed for projecting age-earnings of graduates of the other occupations.

Figure 4 shows that drafting graduates replaced food graduates in having the highest profile and printing graduates now have the lowest profile.

Summary

This chapter was divided into two sections:

1. The first involved estimating emperically two earnings functions, $Y = f(A,S)$; and $Y = f(E,S)$ as defined in Chapter II. Multivariate statistical technique was used to adjust for differences in ability, occupation, family

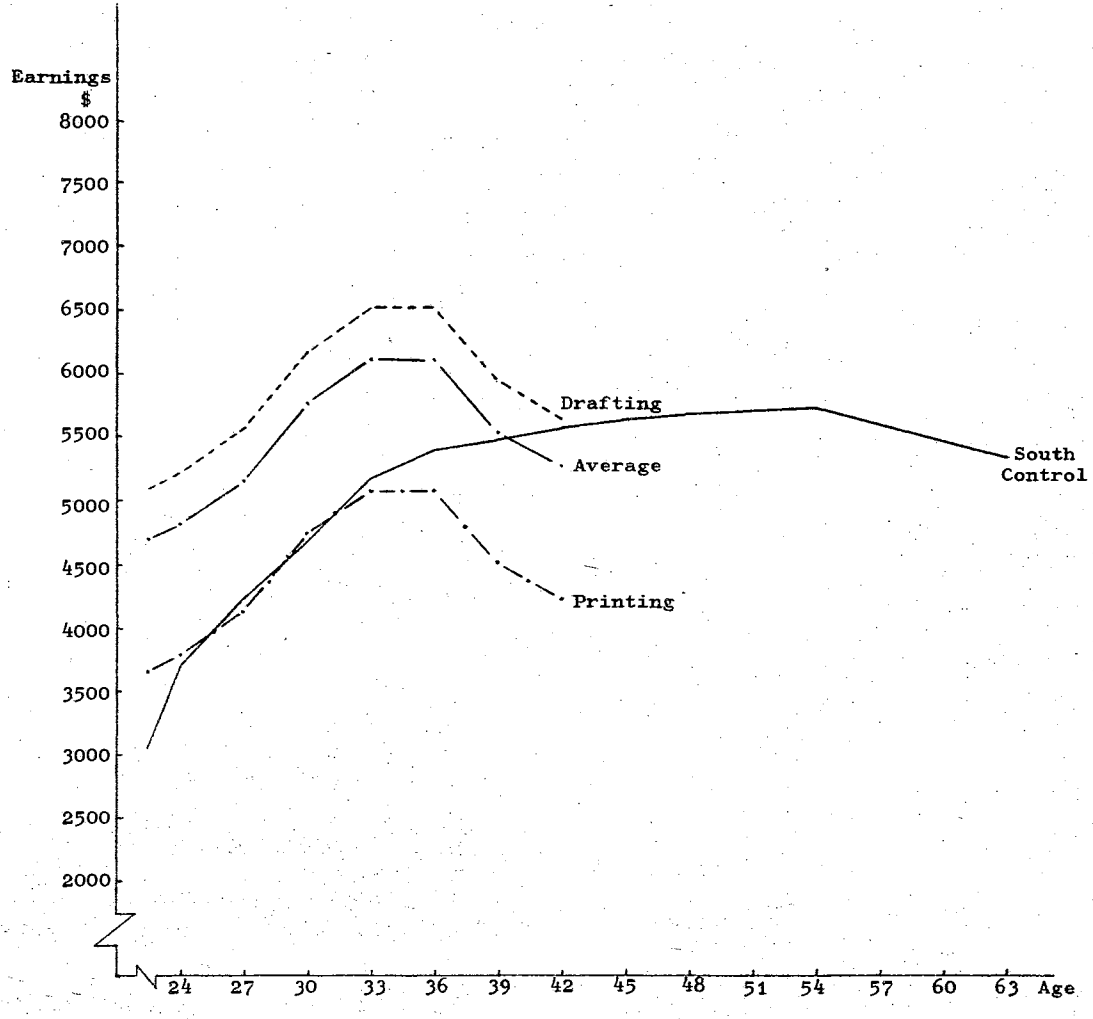

Figure 4. Age-Earnings Profiles for 1960-1965 Students by Major Field of Study and South Control Group - Experience-Earnings Method

background and other socio-economic variables that affect earnings. The variables accounted for one-fourth of the variance in earnings among OST graduates.

The occupation coefficients for 1948-1965 majors showed that "food" majors had the highest earnings, followed in rank by drafting, "others", refrigeration, commerce, diesel, electronics, printing and finally automotive.

2. The second section dealt with plotting the age-earning profiles. Two control group profiles were used to calculate the net discounted benefits accruing to technical education. The first represented earnings of high school (non-college bound) graduates in the Southern U. S. The second was constructed from the questionnaire representing the respondents' estimates of what workers like them but with no vocational education would earn in their community. The latter profile was much lower than the former for older ages.

The constructed profiles from the age-earnings function showed that earnings reach a peak at age 33. The sharp decline in earnings beyond age 51 is primarily due to early

graduates who were frequently physically handicapped, were often without a high school diploma, and received a lower quality of training than that received by more recent graduates of OST. It was assumed that the constructed age earning profiles will have the same schedule as that of the control group starting at the point where the two profiles intersect.

Finally, the constructed profiles from the experience-earnings function were plotted up to age 42. Lifetime earnings beyond that age were projected by assuming the same age-earning schedule as that of the control group.

CHAPTER V

RETURNS TO TECHNICAL EDUCATION

The review of literature section in Chapter I revealed that there are various methods of contrasting the monetary benefits of education -- lifetime income, net present value and rate of return. No attempt will be made here to discuss the issues and problems involved in the specific application of the various investment criteria.[1]

This study will employ the rate of return criterion to assess quantitatively the value of technical education accruing to individuals and to society.

Rates of Return

The rate of return was defined earlier as that interest rate which equates the discounted present value of the additional income flows with the discounted present value of the cost outlays.

The private and social rates of return to technical

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[1]For a fuller treatment of this subject, see A. M. Rivilin, "Research in the Economics of Higher Education: Progress and Problems," Economics of Higher Education, ed. S. J. Mushkin (Washington, 1962), pp. 360-73; and J. Hirschleifer, "On the Theory of Optimal Investment Decision," Journal of Political Economy, Volume LXVI (August, 1958), pp. 392-452.

education for the different fields of study are derived by applying formula (2.3) which was discussed in Chapter II.

Before interpreting the rates of return, a few technical and statistical observations should be considered.

The following estimated rates of return are strictly money rates, (i.e., non-monetary returns are not reflected in these rates) and they are not adjusted for mortality, taxation, ability and improvement in the quality of education during the past twenty-one years. The possible bias from failure to adjust for the above factors will be discussed briefly in the following paragraphs.

Incidence of mortality reflects the probabilities that the benefits (or costs) will occur. It is usually accounted for by multiplying each earnings at each age by the survival rates. The adjustment reduces the estimated rates of return. However, researchers found that the mortality adjustment had only a negligible effect on all social and private returns because of the high probability of individuals being alive at the end of each year.[2]

The adjustment for the progressive federal income tax reduces the net earnings differentials. But if one considers state and local and even some federal taxes that are

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[2]F. K. Hines, M. Redfern, and L. G. Tweeten, Social and Private Rates of Return to Investment in Schooling by Race-Sex Groups and Regions (Stillwater, Oklahoma, 1969), p. 29. The private rate of return to white males college graduates in the U. S. was 13.6 per cent, before and after adjustment for mortality. While the social rate of return was 9.7 per cent before adjustment for mortality and 9.6 after adjustment.

regressive, then the effect of adjustment for taxation may be neutral or even reversed. Hines et al. found the following:

> Adjustment for taxes had little effect on the private rate of return because the foregone earnings ... were adjusted in the same manner as realized earnings. Social rates of return were not adjusted for taxes since taxes are retained and utilized by society and thus constitute part of the return to society provided by schooling.[3]

Failure to adjust for ability may bias the estimated rates of return. The elements of ability include inborn intelligence and acquired abilities such as motivation and skills resulting from experiences outside the regular school.

Ability to earn income is generally positively correlated with the level of schooling. However, the ability of OST students is not believed to differ significantly from ability of the control groups used in this study. Thus, the ability factor is unlikely to bias the results to any sizeable extent.

Finally, it was assumed that the opportunity cost of the value of school property was six per cent. However, if the computed rate of return is to be interpreted as "that rate of interest which society can afford to pay on its total schooling investment and just break even", then six per cent is not the relevant rate to measure what society is

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[3] Ibid., p. 30. The adjusted and unadjusted private rates of return were 13.6 and 13.2 per cent, respectively. While the social rate of return was 9.7 per cent, before and after adjustment for taxes.

able to pay on borrowed capital. Instead, the internal rate of return is the appropriate rate.[4]

The assumption of six per cent charge on capital outlays biases the computed internal rates of return of over six per cent upward and biases the rates of returns of less than six per cent downward.

The following rates of return were not adjusted for the above mentioned biases, some of which offset each other, and the results should be interpreted accordingly.

Private Rates of Return

Table XVII shows the private rates of return by major field of study for 1948-1965 students using two different estimation procedures, and for 1960-1965 graduates using the experience-earnings method for estimating lifetime earnings.

Column 2 shows the private rates of return for the different occupations using the age-earnings method. The rates of return ranged from a low of 13.96 per cent for automotive majors to a high of 61.00 per cent for food students.

The rates of return can be interpreted as the rate of interest that could be paid by individuals for money borrowed to finance their entire education, and just break even on that investment. If an individual can borrow money at six per cent interest rate, then his investment can be considered economically justifiable if the return was higher

[4] Ibid., p. 30.

TABLE XVII

AVERAGE PRIVATE RATES OF RETURN BY MAJOR FIELD OF STUDY AND TWO ESTIMATION PROCEDURES 1948-1965 AND 1960-1965 STUDENTS

Major Field of Study	1948-1965 Students		1960-1965 Students
	Age-Earnings Method	Experience-Earnings Method	Experience-Earnings Method
I. Control Group South:			
Automotive	13.96	N.R.[1]	5.84
Commerce	31.39	19.94	10.64
Diesel	24.00	13.14	21.39
Drafting	28.61	19.47	23.20
Electronics	22.09	9.86	21.48
Food	61.00	44.59	9.71
Printing	22.01	8.57	N.R.[1]
Refrigeration	27.01	16.70	17.70
Others	54.16	33.46	21.43
Average	23.57	12.09	14.79
II. Control Group Questionnaire:			
Average	24.12	13.09	15.64

[1]Negative Returns.

than that interest rate.

Costs have an important influence on the internal rate of return. For example, data in the previous chapter showed that the age-earning profile of diesel students was $19 higher than that of commerce students at each age-group interval; yet the rate of return for the latter group was 7.39 percentage points greater than the former group (using the age-earnings method). This is due to the difference in costs between the two groups. Diesel students incurred $6,616 in total costs during their two year stay at OST, while commerce students incurred only $3,685.

The high rate of return for food graduates, 61.00 per cent, is attributed to low cost combined with high earnings. Food students incurred $289 in costs while attending OST, the lowest cost figure among the occupation groups, and their age-earning profile was the highest. (See Figure 1.)

The rate of return for an average graduate was 23.57 per cent based on the age-earnings schedule of the Southern U. S. high school graduates as the control profile. Based on the constructed control profile from the questionnaire, an average student received 24.12 per cent return on his investment. The generally lower profile of the questionnaire control group was offset by more years of net benefits. When the profile of the South was used, it was assumed that benefits beyond age 51 were zero.

In comparing the results of the age-earning method with

those of the experience-earning method, it can be seen that the rates of return among the different occupations retain the same ranking. However, the estimated rates from the latter procedure were less than those derived from the former method. This is mainly due to the nature of the experience-earnings function which indicated that benefits to technical education were not apparent beyond age 42 (compared to age 51 in the age-earnings function). In addition, rates were lower for the age-experience function because the age-earnings procedure "wrongly" attributed to age the job experience gained before attending OST.

Although the estimated private rates from the experience-earnings procedure were considerably lower than those derived from the first method, they (except for automotive) compare favorably with the rates of other forms of higher education and tend to be higher than average rates of return generally estimated for non-human capital.[5, 6]

Column 4 shows the estimated rates of return from the projected net lifetime earnings of 1960-1965 graduates. The estimates are a more reliable guide for future schooling investment decisions than the 1948-68 rates of return, which are of more historic interest than of predictive value.

Certain factors help to explain the difference in

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[5]Hines et al., p. 19, showed that the average private rate of return for white college graduates in the U. S. was 13.6 per cent.

[6]George S. Stigler, Capital and Rates of Return in Manufacturing Industries (Princeton, 1963).

returns between the two periods, 1948-1968 and 1960-1968. The rates of return for 1960-1965 graduates are based on earnings in the past nine years. The starting salary in the latter period is higher in some fields than in the 1948-1965 period. This initial relationship may not hold over time because the opportunity for moving to high-salaried positions is not the same in all fields. Second, the difference in relative earnings between 1960-1965 and 1948-1965 students may reflect a change in market demand for the various occupations.

The results revealed that 1960-1965 automotive majors earn 5.84 per cent return on their investment as compared to a negative rate of return for 1948-1965 data. Other occupational groups which have shown an increase in the rate of return include the following: diesel with a rate of return of [13.14] 21.39 per cent, drafting [19.47] 23.20 per cent, electronics with [9.86] 21.48 per cent, and refrigeration [16.70] 17.70 per cent.[7] Finally, the average graduate earns [12.09] 14.79 per cent on his investment in education.

The remaining 1960-1965 occupational groups showed a decrease in their estimated returns. They include commerce majors with an estimated rate of return of [19.94] 10.64 per cent, food [44.59] 9.71 per cent, and printing dropped from 8.57 per cent to a negative rate.

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[7]The figures in brackets represent the estimated rates of return for 1948-1965 graduates.

From the above results it can be concluded that private investment in technical education is highly productive. Except for automotive (1948-1965) and printing (1960-1965) in the experience-earnings method, the private rates of returns to other occupations were higher than the average private rates of return to college education.[8]

Social Rates of Return

The interpretation of the social rates of return is the same as that of private rates except that the former is measuring the economic gain (rate of return) to society from public and private investment in technical education.

The social rates of return to the different occupational groups and to the average dollar invested in technical education are calculated from the same age-earnings differentials as used for private returns and from the social schooling costs derived in Tables X, XI, and XII.

Table XVIII shows the estimated social rates of return for 1948-1965 and 1960-1965 students by major field of study using the two estimation procedures discussed before.

The estimated social rates are necessarily lower than the estimated private rates because the costs are greater to society than to individuals, while the monetary benefits

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[8]Giora Hanoch, "An Economic Analysis of Earnings and Schooling," Journal of Human Resources, Volume II, No. 3 (1967), p. 322. His results showed that the private rate of return for college graduates in the South was 10.1 per cent.

TABLE XVIII

AVERAGE SOCIAL RATES OF RETURN BY MAJOR FIELD OF STUDY AND TWO ESTIMATION PROCEDURES 1948-1965 AND 1960-1965 STUDENTS

Major Field of Study	1948-1965 Students		1960-1965 Students
	Age-Earnings Method	Experience-Earnings Method	Experience-Earnings Method
I. Control Group South:			
Automotive	9.55	N.R.[1]	1.35
Commerce	23.03	13.57	4.39
Diesel	17.77	8.22	14.39
Drafting	23.11	15.02	17.40
Electronics	16.66	5.68	15.06
Food	39.63	27.95	.10
Printing	13.69	N.R.[1]	N.R.[1]
Refrigeration	21.11	12.13	12.01
Others	38.96	23.22	12.73
Average	17.52	7.40	8.57
II. Control Group Questionnaire:			
Average	19.12	11.86	11.23

[1]Negative Returns.

(net earnings differentials) are considered to be the same for both society and the individual.[9]

The estimated social rates of return that were derived from the age-earnings method (column 2) range from a low of 9.55 per cent return for automotive to 39.63 per cent for food. The rate of return for the average student was 17.52 and 19.12 using the U. S. South and questionnaire control groups, respectively.

The rates in column 3 indicate that investment in automotive, printing and electronics did not cover costs to society, if six per cent interest is assumed to be the cost of funds invested in these fields. Investment in automotive and printing resulted in a negative return, and investment in electronics, 5.68 per cent rate of return.

Returns to social investment in the other fields of study ranged from a low of 8.22 per cent return in commerce to a high of 27.95 per cent return from investment in food.

Column 4 shows the estimated social rates of returns for the different occupations based on projected lifetime earnings of 1960-1965 students. The results reveal that investment in drafting yielded the highest rate of return, 17.40 per cent, among the fields considered. Investment in automotive and printing yielded 1.35 per cent and negative rates of returns, respectively. The social rates of return

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[9] In addition to private costs, social costs include current school expenditures plus depreciation and interest charges on the value of physical property.

from investment in diesel, drafting, and electronics were higher than the returns based on benefits derived from the past 21 years. Finally, the estimated rates of return resulting from social investment in commerce, food, and refrigeration were higher than the average return based on benefits during the past 21 years.

It can be concluded from this section that, except for automotive and printing, social investment in technical education for 1948-1965 period was justified on economic efficiency grounds. Although the rates of return represent the direct monetary gains from technical education, it should be pointed out that the returns do not include the value of training as a consumption good and do not reflect some of the output during the student's training. For example, automotive majors do repair jobs to automobiles as part of their training, and food students frequently serve banquets and provide other services while in training. The value of their products is not shown in this writer's calculations. As such, the calculated social rates of return may underestimate the actual direct monetary benefits derived from investment in technical education. Furthermore, the automotive field rate of return may be biased downward by aggregation problems discussed earlier.

The Use of the Different Estimates

Having determined the private and social rates of returns from the two estimations procedures, the question

now arises as to which approach best estimates the value of technical schooling?

Tables XVII and XVIII reveal that the estimated private and social rates of return from the age-earnings procedure are higher than the rates of return from the experience-earnings method. This is mainly attributed to differences in the shapes of the two age-earnings profiles. For example, it was assumed that benefits to the average OST graduate terminates at age 39 in the experience-earnings method, as compared to age 51 in the age-earnings method.

The termination of benefits at an early age in the experience-earnings method is due to the low estimated earnings of graduates. The latter factor had a lesser effect on the rates of return in the age-earnings method since earnings beyond age 51 were excluded from the analysis. On the other hand, the age-earnings method attributes to OST some of the earnings from experience gained before OST.

No final choice of method is made and hopefully the two approaches may bracket the true figure.

Summary

This chapter dealt with estimating the monetary gains accruing to the individuals and to society from investment in the different occupational fields. The gains were expressed as the rate of return on investment.

The private rates of return ranged from a low of 13.96

per cent for automotive students to a high of 61.00 per cent for food majors. Although the rates of return from the experience-earnings method were lower than the previous method, returns in several fields were favorable and frequently above benefits derived from investment in other forms of education. Automotive and printing showed negative returns, but returns to the other fields ranged from 5.68 per cent from investment in electronics to 27.95 per cent resulting from investment in food.

On the basis of the on-the-job performance of men who were students in 1960-1965, the ranking of returns to the occupational fields show that investment in printing yields negative returns while investment in drafting yields the highest rate of return (17.4 per cent) among the occupations considered.

The social rates of return are necessarily lower than the private rates because the former includes additional costs paid by the public, such as teacher salaries and depreciation and interest on physical property. The direct monetary benefits are assumed to be the same for both the individual and society.

Using the age-earnings method, it was found that the social investment in each field of study is favorable. The rates ranged from 9.55 to 39.63 per cent return to investment in automotive and food majors, respectively. The results from the experience-earnings method (1948-1965 period) showed that the social costs of printing and

automotive exceeded their benefits. The social returns from investment in the other fields were more favorable, especially for food and "others" which showed returns on investment of 27.95 and 23.22 per cent separately.

The social rates of return for 1960-1965 graduates are based on the assumption that the profiles of the recent graduates will have the same shape as that of the 1948-1965 graduates. The estimated rates indicate that further investment in some fields of technical education is justified on the basis of the performance of past students.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The main objective of this thesis is to evaluate the economic benefits accruing to the individuals and to society for investment in certain fields of technical education. The basic earnings data used for this analysis are individual records from mail questionnaires sent to males who were students of Oklahoma State Tech between 1948 and 1965.

The monthly income figures were converted into annual constant dollar income. The average hourly earnings of production and non-supervisory workers was used as an index for deflating the data. The 1959 base period was chosen to put the income in this sample on the same price level as that of the census control group.

Multiple regression techniques were employed to separate the effects of schooling from other influences on earnings. Two procedures were used to estimate the earnings functions, (2.1) and (2.2). The first function relates earnings to age and a number of socio-economic variables. Age was made the prominent explanation variable, with experience given a secondary role in the estimates. The second procedure relates earnings to experience since graduation from OST and to other characteristics. The function

estimates the net benefits derived from technical education with experience the dominant explanatory variable and with age given a secondary role.

The experience-earnings function was used to estimate the earnings attributed to technical training of the 1948-1965 and 1960-1965 OST graduates. The purpose of estimating the earnings function of the latter students was to compare the market performance of recent students with that of the total group in this study.

The explanatory (independent) variables accounted for about one-fourth of the variance among the individuals' earnings. The unexplained variation is due to missing variables, unaccounted for interaction among variables, and errors in the data.

In comparing the earnings of 1948-1965 majors, the results showed that food majors have the highest earnings followed by drafting, "others", refrigeration, commerce, diesel, electronics, printing, and automotive majors.

However, the relative earnings have shifted markedly among fields in recent years. In contrast to results for the 1948-1965 period, the results for the recent period (1960-65 graduates) indicated that drafting majors have the highest earnings, followed by electronics, diesel, "others", automotive, commerce, food, refrigeration, and printing.

The profiles from the age-earnings function showed that earnings increased gradually between ages 22 and 33. Beyond age 33, earnings decreased until age 45, increased slightly

at age 48, then declined rather sharply. The decline in earnings beyond age 51 is believed to be attributed to early postwar students who sometimes had less ability and received a lower quality of training than the more recent students. It was assumed that the estimated age-earnings profiles will follow the same age-earnings schedule as that of the control group after the point where the two profiles cross each other.

Inspection of the general shape of the profiles from the experience-earnings function revealed that earnings increased gradually and reached a peak between ages 33 and 36. Since the number of years of experience acquired by the first graduates numbered 21, and the median graduation age of the group was 22, then earnings are estimated up to age 43. It was assumed again that the constructed profiles will have the same schedule as that of the control group after the point where the two profiles intersect.

The experience-earnings function for 1960-1965 students estimated earnings for a maximum of nine years. The median graduation age of this group was 20 so that earnings are estimated up to age 29. In order to estimate earnings beyond age 29, the profile of the 1948-1965 average student from the experience earnings function was used as a basis for projection.

On the cost side, both private and social costs were estimated on a per student basis. The former costs included out-of-pocket expenses for tuition and books plus indirect

costs in the form of foregone earnings incurred by the individual while attending OST. Since the opportunity cost plays a large role in determining the benefits to technical education, two control groups were used to measure foregone earnings and to estimate what OST students would have earned throughout their lifetime in the absence of OST training. The first was taken directly from the age-earnings profiles of U. S. males in the South based on income data from the 1960 census. The second was constructed from a question dealing with the graduates' estimates of how much other people earn without technical training.

The per student two year private costs for 1948-1965 students ranged from a low of $289 [$607] for food majors to a high of $6116 [$6116] for diesel majors. The private costs for 1960-1965 students ranged from $1025 for "others" to a high of $5931 for diesel majors.[1]

In addition to the above costs, social costs included school expenditures (teachers' salaries and general school expenses) plus depreciation and interest charges on buildings and equipment.

The per student total social costs for 1948-1965 students ranged from $2610 [$2928] to $8896 [$8896] for food and diesel majors, respectively. The costs for 1960-1965 majors ranges from a low of $2676 for "others" to a high of

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[1]The figures in brackets represent costs based on the experience-earnings method and the figure preceding them represents the costs obtained from the age-earnings method.

$8890 for diesel majors.

Lifetime cost-income streams were then constructed from the estimated age-earnings profile and age-cost figures. The difference between the two profiles reflects the net benefits resulting from technical education.

The rate of return was found by equating the discounted present value of the additional income flows with the discounted present value of the cost outlays. This is accomplished by applying formula (2.3).

The private rates of returns for 1948-1965 students ranged from a low of 13.96 per cent (negative returns) for automotive to a high of 61.00 (44.59) per cent for food majors.[2] The average private rates of returns were 23.57 (12.09) and 24.12 (13.09) per cent, using U. S. South and questionnaire as the control groups, respectively.

The estimated private and social rates of return, based on projected lifetime earnings of 1960-1965 students, showed that investment in drafting gave the highest rate of return 23.20 [17.40] per cent among the different fields.[3] Investment in automotive yielded only 5.84 [1.35] per cent and printing negative returns [negative returns]. Finally, the average rates of return for 1960-1965 period were 14.79

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[2]The figures in parenthesis represent the estimated rates of return from the age-earnings method and the figure preceding it represent the return from the experience-earnings method.

[3]The figures in brackets represent the social rates of returns for 1960-1965 majors.

[8.57] and 15.64 [11.23] per cent for the South and questionnaire control group returns, respectively.

According to the results obtained in this study, social and private investment in several fields of technical education gave high rates of return. The average social rate of return from investment in all fields of technical education at OST ranging from 12 to 19 per cent compares favorably with the average rate of return generally estimated for other forms of education and for non-human capital.

The favorable rates of return for vocational training can be partially explained by the nature of the training program and the method of measuring benefits. Since vocational graduates receive specialized training which is more oriented toward tasks to be performed in a particular occupation, then more of the human capital created by technical training may be classified as a producer durable. On the other hand, a four year college program has more courses that are not oriented to a student's particular occupation and, hence, may be related to consumption which in no way enters into measured earnings. Thus, a larger fraction of the rates of returns from technical schooling may be measurable.[4]

From the individuals' point of view, the average private rates of return ranged from 12 to 24 per cent which are

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[4]A. B. Carrol and L. A. Ihnen, "Costs and Returns for Two Years of Post Secondary Technical Schooling: A Pilot Study," Journal of Political Economy, Volume LXXV (December, 1967), pp. 862-873.

above or equal to the average rates of return an individual could expect to receive from other forms of investment.

Apart from productivity gains other benefits could also justify expansion of educational resources in technical programs in Oklahoma. Since Oklahoma State Tech is located in a low income area (Ozark Region), and since the technical training program successfully raised the earning capacity of its trainees, then investment in technical education should be an attractive alternative for alleviating poverty in the Ozark Region by upgrading skills and reducing the incidence of unemployment.

The training program might be expanded, through public financial aid, to include more people from low income areas to increase their earning capacity and to provide them with greater sense of purpose, accomplishment, and prestige.

This does not necessarily imply that investment in vocational education should be expanded along traditional lines. The age-earning profiles showed that technical graduates reach peak earnings at an earlier age than do persons with other forms of education (high school or college graduates). More emphasis might be placed on courses which delay the drop in earnings and which increase opportunities for Tech graduates to advance into management and administrative positions. Furthermore, it was found that the profitability of various fields is shifting over time, and the training fields need to be adjusted to these trends.

Finally, the rates of return of the different

evaluation studies varied by regions, type of training, and method of analysis. The conflicting results point out the need for additional research to provide further evidence on the returns from technical education.

A SELECTED BIBLIOGRAPHY

Anderson, Arnold C., and M. J. Bowman eds. Education and Economic Development. Chicago: Aldine Publishing Company, 1965.

Bauder, W. W., and Lee G. Burchinal. Farm Migrant to the City: A Comparison of the Status, Achievement, Community and Family Relations of Farm Migrants and Urban Natives in Des Moines, Iowa. Ames: Iowa Agriculture Station Research Bulletin 534, March, 1962.

Baumol, W. J. Economic Theory and Operations Analysis. Englewood, New Jersey: McGraw-Hill, 1961.

Becker, Gary S. Human Capital. New York: Columbia University Press for NBER, 1964.

Becker, Gary S. "Investment in Human Capital: A Theoretical Analysis." Journal of Political Economy, Volume LXX (October, 1962), 9-49.

Bowen, Mary J. "Human Capital: Concepts and Measures." The Economics of Higher Education. Ed. Selma J. Mushkin. Washington, D. C.: Government Printing Office, 1962.

Burt, Samuel M. Industry and Vocational Technical Education. New York: McGraw-Hill, 1967.

Cairncross, A. K. "The Place of Capital and Entrepreneurship in Economic Development." International Social Science Bulletin, Volume VI, No. 2, 1954, pp. 232-235.

Carrol, Adger, and Loren Ihnen. Costs and Returns for Investments in Technical Schooling by a Group of North Carolina High School Graduates. Raleigh: Department of Economics, North Carolina State University, Economic Research Report No. 5, 1962.

Corrazzini, A. J. Vocational Education, A Study of Benefits and Costs. Princeton, New Jersey: Industrial Relations Section, 1966.

Correa, H. The Economics of Human Resources. Amsterdam: North Holland Publishing Company, 1963.

Deitch, Kenneth. "Some Observations on the Allocation of Resources in Higher Education." Review of Economics and Statistics, Volume XLII (August, 1960), pp. 192-199.

Denison, E. F. The Source of Growth in the United States and the Alternatives Before Us. New York: Committee for Economic Development, Supplementary Paper No. 13, 1962.

Glick, P. C., and H. P. Miller. "Educational Levels and Potential Income." American Sociological Review, Volume XXI (June, 1956).

Hanoch, Giora. "An Economic Analysis of Earnings and Schooling." Journal of Human Resources, Volume II (Summer, 1967), pp. 310-329.

Hanoch, Giora. Personal Earnings and Investments in Schooling. Unpublished Ph.D. thesis. Chicago: University of Chicago, May, 1965.

Hansen, W. Lee. "Total and Private Rates of Return to Investment in Schooling." Journal of Political Economy, Volume LXXI (April, 1963), pp. 128-140.

Harbison, Frederick, and C. A. Myers. Education, Manpower and Economic Growth: Strategies of Human Resource Development. New York: McGraw-Hill, 1964.

Hines, Fred K. The Incidence of Benefits and Costs of Investment in Education in the United States. Unpublished Ph.D. thesis. Stillwater: Oklahoma State University, Forthcoming.

Hines, F. K., M. Redfern, and L. G. Tweeten. Social and Private Rates of Return to Investment in Schooling by Race-Sex Groups and Regions. Stillwater: Department of Agricultural Economics, Oklahoma State University, Mimeograph, 1969.

Hirshleifer, J. "On the Theory of Optimal Investment Decision." Journal of Political Economy, Volume LXVI (August, 1958), pp. 329-352.

Horvat, S. "The Optimum Rate of Investment." Economic Journal, Volume LXIII (December, 1958), pp. 747-767.

Houthakker, H. S. "Education and Income." Review of Economics and Statistics, Volume XLI (February, 1959), pp. 24-28.

Innes, J. T., et al. The Economic Returns to Education. Eugene, Oregon: University of Oregon Press, 1966.

Kaufman, J. J., et al. An Analysis of Comparative Costs and Benefits of Vocational Versus Academic Education in Secondary Schools. Universtiy Park: Institute for Research on Human Resources, Pennsylvania State University, 1967.

Kendrick, John W. Productivity Trends in the United States. Princeton, New Jersey: Princeton University Press for NBER, 1961.

Machlup, Fritz. The Production and Distribution of Knowledge in the United States. Princeton, New Jersey: Princeton University Press, 1962.

Marshall, Alfred. Principles of Economics. 8th ed. London: The Macmillan Company, 1960.

McClelland, D. C. "Does Education Accelerate Economic Growth?" Economic Development and Cultural Change (April, 1966), pp. 257-287.

Miller, H. P. "Annual and Lifetime Income in Relation to Education." American Economic Review, Volume L (December, 1960), pp. 962-986.

Mincer, Jacob. "On the Job Training: Costs, Returns and Some Implications." Journal of Political Economy, Volume LXX (October, 1962).

Morgan, James N., et al. Income and Welfare in the United States. New York: McGraw-Hill, 1962.

Page, David A. Retraining Under the Manpower Development Act: A Cost Benefit Analysis. Washington, D. C.: The Brookings Institution, 1964.

Pejovich, Svetozar, and William Sullivan. The Role of Technical Schools in Improving Skills and Earning Capacity of Rural Manpower: A Case Study. Washington: Government Printing Office, 1966.

Renshaw, E. F. "Estimating the Returns to Education." Review of Economics and Statistics, Volume XLII (August, 1960), pp. 318-324.

Rivlin, A. M. "Research in the Economics of Education: Progress and Problems." The Economics of Higher Education. Ed. Selma J. Mushkin. Washington, D. C.: Government Printing Office, 1962.

Schultz, T. W. "Capital Formation by Education." Journal of Political Economy, Volume LXVIII (December, 1960), pp. 571-583.

Schultz, T. W. "Investment in Human Capital." American Economic Review, Volume LI (March, 1961), pp. 1-17.

Schultz, T. W. "Investment in Man: An Economist's View." Social Science Review, Volume XXXIII (June, 1959), pp. 110-117.

Schultz, T. W. The Economic Value of Education. New York: Colombia University Press, 1963.

Shaffer, H. G. "Investment in Human Capital: Comment." American Economic Review, Volume LI (December, 1961), p. 1027.

Smith, Adam. The Wealth of Nations. New York: The Modern Library, Random House, Inc., 1937.

Somers, Gerald G. Retraining the Unemployed. Madison, Wisconsin: University of Wisconsin Press, 1968.

Stromsdordfer, Ernst W. "Determinants of Economic Success in Retraining the Unemployed: The West Virginia Experience." Journal of Human Resources, Volume III (Spring, 1962), pp. 139-158.

Stigler, George S. Capital and Rates of Return in Manufacturing Industries. Princeton, New Jersey: Princeton University Press for NBER, 1963.

Suits, Daniel B. "Use of Dummy Variables in Regression Equations." Journal of American Statistical Association, Volume LII (December, 1957), pp. 548-551.

Tweeten, Luther G. The Role of Education in Alleviating Rural Poverty. Washington, D. C.: U. S. Department of Agriculture, Economic Report, No. 114, 1967.

U. S. Department of Health, Education, and Welfare. Digest of Educational Statistics. Washington, D. C.: Government Printing Office, 1967.

U. S. Department of Labor. Employment and Earnings for the United States. Washington, D. C.: Bureau of Labor Statistics, Government Printing Office, Vol. XIV, Bulletin No. 1312-5, 1967.

U. S. Department of Labor. Monthly Labor Review. Washington, D. C.: Bureau of Labor Statistics, Government Printing Office, Vol. CXI, No. 8, 1968.

Vaizey, John. The Costs of Education. London: Allen and Unwin, 1958.

Walsh, J. "Capital Concept Applied to Man." Quarterly Journal of Economics, Vol. XLIX (February, 1935), pp. 255-285.

Weisbrod, Burton A. "Education and the Investment in Human Capital." Journal of Political Economy, Vol. LXX (October, 1965), pp. 106-123.

Weisbrod, Burton A. "Investing in Human Capital." Journal of Human Resources, Vol. I (Summer, 1966), pp. 5-22.

APPENDIX A

COPY OF THE QUESTIONNAIRE USED

CONFIDENTIAL

1) Name (optional): _____
2) Age: _____
3) Present Address: _____
4) Sex: Male ☐ Female ☐
5) Race: White ☐ Negro ☐ Indian ☐ Other ☐
6) Marital Status: Married ☐ Single ☐ Other ☐
7) Please list in the table below in order of attendance the name of the school, its location, grades, and dates attended (include Business College training or other Vocational School training).

	Name of School	Location (City & State)	Dates of Attendance (From - To)	Major Field of Study	Grades (Check appropriate box)
High School					Below Average ☐ Average ☐ Above Average ☐
					Below Average ☐ Average ☐ Above Average ☐
College					Below Average ☐ Average ☐ Above Average ☐
					Below Average ☐ Average ☐ Above Average ☐

	Name of School	Location (City & State)	Dates of Attendance (From - To)	Major Field of Study	Grades (Check appropriate box)
Oklahoma State Tech (O.S.T.)					Below Average ☐ Average ☐ Above Average ☐
Other Vocational Training (including on-the-job training)					Below Average ☐ Average ☐ Above Average ☐

(Continue on back of page if necessary)

8) How many years of schooling did your mother complete? ____

9) How many years of schooling did your father complete? ____

10) My father's principal occupation is or was (circle appropriate category):

a. Office work (cashier, clerk, bookkeeper, etc.).
b. Professional (doctor, lawyer, minister, tecaher).
c. Executive (manages large business, industry, firm).
d. Laborer (janitor, farmhand, plumber's helper, waiter, truck driver, etc.).
e. Salesman (insurance, real estate, auto, store, etc.).
f. Skilled work (mechanic, welder, appliance serviceman, etc.).
g. Owns, rents, or manages small business (store, station, cafe, etc.).
h. Farmer (owns, rents, manages, or operates farm or ranch).
i. Military service.

11) Do you have any disability which limits your ability to earn full-time pay?

yes ☐ no ☐

12) a) Have you served in the armed forces? yes ☐ no ☐

b) What (if any) training in vocational skills did you have in the armed forces?

_____

13) a) How many brothers and sisters do you have? _____
b) How many are older than you? _____
c) How old was your father when you were born? _____

14) This question should be answered by persons who have children.

a) How many children do you have? _____
b) How many of these children are attending school this year? _____
c) Do you have any children who have been in school but are not now?

yes ☐ no ☐

If yes, what was their last year of school completed? _____
d) How many years of school do you insist that your children attain? _____

15) Of your <u>total income</u> in 1967, how much of it was made up of:

a) Rents, dividends, interest. _____ Dollars
b) Social Security payments, unemployment compensation, Veteran's Benefits, pensions, welfare _____ Dollars
c) Salary or wages _____ Dollars
d) Self-employment income (farming or business _____ Dollars

16) Job history: Please list in the table below the jobs you have held before attending O.S.T., and all major jobs since leaving O.S.T.

	Dates (From - To)	Occupation or Job (if housewife, so indicate)	Location (City & State)	Average Earnings Per Month (wages, salaries, business income)	Dollar Value of Non Money Earnings Per Month (meals, lodging, etc.)
Last full-time job before attending O.S.T.					
First job after leaving O.S.T.					
Second job after leaving O.S.T.					
Third job after leaving O.S.T.					
Present job					

17) On the average how many weeks per year have you been unemployed since completing your last year of school? _____

18) How much more (if any) per month do you earn than would a person in your community of similar age and background but without your O.S.T. vocational training?
$/month more _____

APPENDIX B

THE COSTS

TABLE XIX

TOTAL ANNUAL DIRECT COSTS BY MAJOR FIELD OF STUDY, 1960-1968 FISCAL YEARS[1]
(in Dollars)[2]

Year	Direct Distributed Costs	Direct Non-Distributed Costs[3]								
	All Fields	Automotive	Commerce	Diesel	Drafting	Electronics	Food	Printing	Refrigeration	Others
1960	443,597	110,545	75,620	69,921	36,947	72,905	41,777	45,032	33,231	34,520
1961	436,929	106,770	78,080	67,534	34,651	70,416	40,350	43,494	32,097	33,341
1962	467,596	114,730	83,900	72,568	37,234	75,665	43,358	46,737	34,489	35,827
1963	487,392	115,513	84,474	73,064	37,489	76,182	43,654	47,055	34,725	36,071
1964	541,501	130,891	95,719	82,790	39,911	86,323	49,465	53,320	39,348	40,873
1965	570,237	122,214	81,693	102,573	43,581	103,058	49,083	82,479	45,509	55,110
1966	573,595	114,668	94,565	97,539	50,779	119,592	63,093	70,753	51,300	53,130
1967	637,323	185,106	138,379	117,196	57,218	99,112	67,431	62,061	49,178	46,562
1968	685,119	166,927	155,691	98,920	55,348	102,538	61,130	51,668	43,900	55,522
Total	4,843,289	1,167,364	888,131	782,103	393,158	805,791	459,341	502,599	363,777	390,956

[1]Source: Oklahoma State University Annual Financial Reports, 1947-1968.

[2]Deflated by the Production and Non-Supervisory Worker Index.

[3]Only the 1965-68 cost figures were originally broken down by major field of study. The procedure used to allocate the total non-distributed costs for 1960-64 period among the different fields was to compute the 4-year average percentage figure of the total resident instruction costs allocated to each area between 1965 and 1968 and then apply that figure to the total non-distributed costs for each year in the 1960-64 period.

TABLE XX

TOTAL ANNUAL INDIRECT COSTS BY MAJOR FIELD OF STUDY 1960-1968 FISCAL YEARS[1]

(in Dollars)

	Indirect Distributed Costs[2]				Indirect Non-Distributed Costs[2]					
	All Fields				Automotive				Commerce	
	Value of Buildings	Depreciation & Interest[3]	Value of Equipments[4]	Depreciation & Interest[5]	Value of Buildings	Depreciation & Interest[3]	Value of Equipments[4]	Depreciation & Interest[5]	Value of Equipments[4]	Depreciation & Interest[5]
1960	1,393,668	111,493	431,626	69,060			152,512	24,402	18,284	2,925
1961	1,460,176	116,814	452,515	72,402			124,554	19,929	14,932	2,389
1962	1,329,337	106,347	520,625	83,300			123,660	19,786	14,825	2,372
1963	1,303,633	104,291	573,282	91,725	119,144	9,532	120,025	19,204	14,389	2,302
1964	1,261,203	100,896	630,576	100,892	105,574	8,446	115,867	18,539	13,891	2,223
1965	1,214,387	97,151	725,071	116,012	102,427	8,194	111,566	17,851	13,375	2,140
1966	1,173,523	93,882	826,917	132,307	97,920	7,834	106,669	17,067	12,788	2,046
1967	1,269,951	101,596	947,117	151,547	93,529	7,482	100,878	16,300	12,213	1,954
1968	1,370,345	109,628	973,875	155,820	90,584	7,247	98,776	15,804	11,842	1,895
Total		942,092		973,065		48,735		168,882		20,246

TABLE XX (Continued)

	Indirect Non-Distributed Costs									
	Diesel				Drafting		Electronics			
	Value of Buildings	Depreciation & Interest [3]	Value of Equipments [4]	Depreciation & Interest [5]	Value of Equipments [4]	Depreciation & Interest [5]	Value of Buildings	Depreciation & Interest [3]	Value of Equipments [4]	Depreciation & Interest [5]
1960	171,180	13,694	212,764	34,042	29,659	4,745			15,801	2,528
1961	153,494	12,280	173,761	27,802	24,222	3,876			12,905	2,065
1962	149,123	11,930	172,514	27,602	24,048	3,848	18,981	1,519	12,812	2,050
1963	144,994	11,599	167,443	26,791	23,341	3,735	237,067	18,965	12,436	1,990
1964	140,005	11,200	161,643	25,863	22,532	3,605	211,533	16,923	12,005	1,921
1965	135,045	10,804	155,642	24,903	21,696	3,471	205,100	16,408	11,559	1,850
1966	129,165	10,333	148,811	23,810	20,744	3,319	196,084	15,687	11,052	1,768
1967	124,898	9,992	142,126	22,740	19,812	3,170	187,292	14,983	10,556	1,689
1968	224,884	17,907	137,799	22,048	19,209	3,073	181,394	14,512	10,234	1,637
Total		109,827		235,601		32,842		98,998		17,498

TABLE XX (Continued)

	Indirect Non-Distributed Costs											
	Food				Printing				Refrigeration		Others	
	Value of Buildings	Depreciation & Interest [3]	Value of Equipments [4]	Depreciation & Interest [5]	Value of Buildings	Depreciation & Interest [3]	Value of Equipments [4]	Depreciation & Interest [5]	Value of Equipments [4]	Depreciation & Interest [5]	Value of Equipments [4]	Depreciation & Interest [5]
1960			120,815	19,330	45,538	3,643	132,141	21,143	26,663	4,266	120,739	19,318
1961			98,668	15,787	44,515	3,562	107,918	17,267	19,888	3,182	98,606	15,777
1962			97,960	15,674	42,861	3,424	107,143	17,143	21,922	3,507	97,898	15,664
1963			95,080	15,213	41,777	3,342	103,994	16,639	20,936	3,350	95,020	15,203
1964	130,501	10,440	91,787	14,685	40,327	3,226	100,392	16,063	20,266	3,243	91,729	14,677
1965	115,740	9,259	88,379	14,141	38,837	3,107	96,665	15,467	19,505	3,121	88,324	14,132
1966	111,505	8,920	84,501	13,520	37,151	2,972	92,422	14,788	18,649	2,984	84,447	13,512
1967	106,437	8,515	807,705	12,913	35,483	2,839	88,270	14,123	17,811	2,850	80,654	12,905
1968	103,090	8,247	78,248	12,520	34,365	2,749	85,583	13,693	17,269	2,763	78,198	12,511
Total		45,381		133,784		28,862		146,326		29,266		133,699

[1]The Value of Buildings were derived from the Oklahoma State University Annual Financial Reports. The Value of Equipments were obtained from the Bursar's Office at OST.

[2]Values shown are deflated by the construction and nonsupervisory worker index (1959=100).

[3]Includes charges of 8% on the value of buildings.

[4]The value of equipment was broken down by major field of study only in 1968. The procedure used to estimate the 1960-68 value of equipments was to take half of the 1968 book value and consider it an an average yearly value of equipment since almost all present day equipment was purchased within the last four years.

[5]Includes charges of 16% on the value of equipments.

APPENDIX C

AGE-EARNINGS PROFILES

TABLE XXI

ESTIMATED AGE-EARNINGS PROFILES FOR 1948-65 STUDENTS BY OF STUDY AND TWO CONTROL GROUPS AGE-EARNINGS METHOD (in Dollars)

Age Group	Average	Automotive	Commerce	Diesel	Drafting	Elec.	Food	Printing	Refrigeration	Others	South	Questionnaire
20-22	5144	4496	5164	5183	5537	5039	5942	4641	5412	5674	3030	3301
23-25	5407	4759	5427	5446	5800	5302	6205	4904	5675	5937	3676	3624
26-28	6135	5487	6155	6174	6528	6030	6933	5632	6403	6665	4223	3831
29-31	6403	5755	6423	6442	6796	6298	7201	5900	6671	6933	4690	4146
32-34	6986	6338	7006	7025	7409	6881	7784	6483	7254	7516	5181	4526
35-37	6844	6196	6837	6883	7237	6739	7642	6341	7112	7374	5405	4531
38-40	6608	5954	6622	6641	6995	6497	7400	6099	6870	7132	5494	4662
41-43	6507	5859	6527	6546	6900	6402	7305	6004	6775	7037	5583	5366
44-46	5832	5184	6852	5671	6225	5727	6604	5329	6100	6362	5652	4581
47-49	6088	5440	6108	6127	6481	5983	6886	5585	6356	6618	5681	4477
50-52	5072	4424	5092	5111	5465	4967	5870	4569	5340	5602	5701	4381
53-55	4257	3609	4277	4296	4650	4152	5055	3754	4525	4787	5737	3276
56-58	3097	2449	3117	3136	3490	2992	3895	2594	3365	3627	5609	2578
59-61	3543	2894	3562	3581	3935	3437	4340	3039	3810	4072	5480	2340
62-64	3300	2653	3321	3340	3694	3196	4099	2798	3567	3831	5352	

TABLE XXII

ESTIMATED AGE-EARNINGS PROFILES FOR 1948-65 STUDENTS BY MAJOR FIELD OF STUDY AND SOUTH CONTROL GROUP EXPERIENCE-EARNINGS METHOD (in Dollars)

Age Group	Average	Automotive	Commerce	Diesel	Drafting	Elec.	Food	Printing	Refrigeration	Others	South
23-25	4707	4049	4827	4768	5162	4589	5465	4210	4984	5031	3676
26-28	5231	4573	5351	5292	5687	5113	5989	4735	5509	5555	4223
29-31	5849	5191	5969	5910	6304	5731	6607	5352	6126	6173	4690
32-34	6191	5533	6310	6251	6646	6073	6948	5694	6468	6515	5181
35-37	6187	5529	6307	6248	6642	6069	6945	5690	6464	6511	5405
38-40	5619	4961	5739	5680	6074	5501	6377	5122	5896	5943	5494
41-43	5340	4682	5469	5400	5795	5222	6098	4843	5617	5664	5583

TABLE XXIII

ESTIMATED AGE-EARNINGS PROFILES FOR 1960-1965 STUDENTS BY MAJOR FIELD OF STUDY AND SOUTH CONTROL GROUP EXPERIENCE-EARNINGS METHOD (in Dollars)

Age Group	Average	Automotive	Commerce	Diesel	Drafting	Elec.	Food	Printing	Refrigeration	Others	South
20-22	4706	4253	4223	5009	5107	5013	4026	3669	4810	4248	3030
23-25	4810	4357	4330	5113	5211	5117	4130	3773	4914	4352	3676
26-28	5155	4701	4682	5448	5556	5462	4475	4118	5259	4696	4223
29-31	5773	5319	5300	6066	6174	6080	5093	4736	5821	5614	4690
32-34	6115	5661	5642	6408	6516	6422	5435	5078	6163	5956	5181
35-37	6111	5657	5638	6404	6512	6418	5431	5074	6159	5952	5405
39-40	5543	5089	5070	5836	5944	5850	4863	4506	5591	5384	5494
41-43	5264	4810	4791	5557	5665	5571	4584	4227	5312	5105	5583

VITA 2

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