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PRIVATE MONETARY RETURNS TO BACCALAUREATE EDUCATION

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

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FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Private Monetary Returns to Baccalaureate Education" submitted by Kevin Arthur Wilson in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

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Supervisor

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External Examiner

Date July 31st, 1970

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ABSTRACT

This study is an investigation of the financial returns to Alberta males who undertook baccalaureate education in Engineering, Arts, Science or Education. The mode of analysis used, which is derived from investment theory, ascertained the extent of private investment in university education by males of various ages, and then calculated the rates of return on the investments.

The investment amount for each subject type was made up of two components: actual expenditures for fees and books, and foregone earnings or the earnings an investor would have received were he not engaged in a period of further study. In 1968 dollars, the total private cost of the four-year Engineering program was estimated as $12,454 if commenced at age 18, $19,192 at age 25, and $22,799 at age 30; for a three-year Arts or Science program the costs were $9,079 at age 18, $14,321 at age 25, and $17,350 at age 30; and for a four-year teacher education program, $12,100 at age 18, $18,837 at age 25, and $22,443 at age 30. The marked increase in total costs for older males resulted from the substantial rise in the foregone earnings component of the costs.

Financial benefits resulting from the acquired educational increment were ascertained by assuming that the marginal earnings for each of the three subject types represented the benefits gained from the investment in university education. Marginal earnings for graduates of the three programs were taken as the difference between their estimated annual earnings and the estimated earnings of high

school graduates of the same age. Lifetime marginal earnings from age 18 were $161,700 for Engineers, $131,100 for Arts or Science graduates, and $151,000 for teacher graduates. From age 30, the lifetime marginal earnings for the three subject types were $83,200, $56,800 and $72,800 respectively.

Expressed in terms of discounted marginal lifetime earnings (discounted at 8%) the ranking of the investment options for 18 year old decision-makers was: Engineering ($24,896), followed by teacher education ($19,884), then by Arts or Science ($16,992). However, when ranked by internal rates of return for the same age level, the order was: Engineering (21.1%), followed by Arts or Science (19.4%), then by teacher education (17.9%).

When an external rate of 8% was stipulated as a minimum return for each of the three educational investments, the following results were obtained: a person entering an Engineering program would have to begin his studies at or before the age of 33; one undertaking a four-year teacher education program at or before the age of 28; and, one who chose to do an Arts or Science degree at or before the age of 26.

The present study was able to show that university education not only pays as an investment for high school leavers, but for older persons as well. The results also indicated that the internal rate of return taken alone as an evaluation device can lead to spurious findings, for ratings of investment options by this measure were found, in some cases, to be different from ratings by discounted present value. Such a conclusion does not condemn the use of the internal rate but suggests that it should be used in conjunction with the concomitant present value.

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CHAPTER I

INTRODUCTION

During the past ten years there has been considerable interest in, and research of, an area of knowledge referred to as the economics of education. The time period has been so definitively placed because of the immediate and continuing reaction to the presidential address delivered by Theodore W. Schultz, Professor of Economics at the University of Chicago, on the occasion of the Annual Meeting of the American Economic Association in December, 1960. The salient notion that he propounded on that occasion was to re-emphasize the extension of the concept of capital to include man:

> Although it is obvious that people acquire useful skills and knowledge, it is not obvious that these skills and knowledge are a form of capital, that this capital is in substantial part a product of deliberate investment, that it has grown in Western societies at a much faster rate than convential (nonhuman) capital, and that its growth may well be the most distinctive feature of the economic system (Schultz, 1961, p.1).

Initial responses to this idea, understandably enough, came from those directly concerned with the field of economics and more specifically those concerned with growth economics, that branch of the discipline which deals with the explanation and prediction of economic growth. Latterly, the interest of those more directly associated with education, the providers of educational services and the consumers of those services, has been aroused. Their attention has been caught by reports of studies (Hansen, 1963; Becker, 1964; Schultz, 1967) which use the concept of human capital formation to relate costs incurred in acquiring a given

level of education to benefits which, in large measure, are attributed to the higher level of education attained. The focus of this study was in the same domain, namely, returns to investment in education.

Outline of the Study

The major purpose of this study was to make a systematic economic evaluation of the private returns to investment in particular forms of baccalaureate education for Alberta males. The programs chosen for analysis were a four-year degree in Engineering, a four-year program consisting of a three-year degree in Arts or Science plus a year of teacher education, and a three-year degree in Arts or Science. The first two programs prepare individuals for specific callings, engineering and teaching respectively; the third route, the three-year degree in Arts or Science, is unlike the other two in that it is not necessarily a prerequisite for particular occupations.

In past research studies, the economic evaluation of different forms of investment in education involved the derivation of economic measures which were functionally related to the level and type of education sought, and the length of the educational program. Furthermore, the determination to invest in education was treated as a once in a lifetime decision made at some minimum age level fixed by convention or attendance regulations. Available data show the returns to secondary schooling for students twelve to eighteen years of age and the returns to university education data are for individuals who make such an investment decision at about age eighteen. In other words, reports which describe the returns to

investment in formal education have tended to be confined to an investigation of cohorts of individuals who do not enter the labor force until some continuous formal education program has been completed.

The present study appraised the decision to invest in university education at age eighteen, but in addition, economic evaluation of similar investment decisions at later ages were included. The latter cases therefore deal with the situations confronting individuals who choose to re-enter a program of formal education after spending one or more years in the labor force.

In summary, this investigation examined the private monetary returns to Alberta males who might have undertaken one of several forms of baccalaureate education. The report provides an assessment of the functional relationship between an individual's monetary returns and the following variables: the type of program, and hence the length of program, and the age at which the individual chooses to embark on such a program.

This study is presented in six chapters. Chapter II restates the research problem as a series of questions and establishes the framework for the research by outlining the delimitations and the assumptions. The chapter also contains argument dealing with the significance and relevance of this research for various audiences. Terms which have explicit meanings in rate of return studies and which, perforce, appear throughout the dissertation are explained.

Chapter III begins by placing the present study in the general field of the economics of education. The major focus of the

chapter, however, is the development of a theoretical framework for the estimation of private returns to university education. In order to do this, the concept of human capital is treated in detail, the derivation of monetary costs and monetary benefits is described and the distinction between social returns and private returns is drawn. Some attention is paid to the criticisms of the rate of return method of evaluation, and the chapter includes an examination of different methods adopted for calculating rates of return: internal rate of return, present value and cost/benefit ratio. The chapter concludes with a brief resumé of rate of return studies carried out elsewhere.

Chapter IV deals with the cost and benefits data used in this study. The cost data, indicating the extent of private investment in education for each of the patterns, are described and justifications for the non-inclusion of some costs are outlined. The earnings streams for each of the three cohorts in this study were derived from several sources, so a detailed description of the calculation of each stream is provided.

Chapter V, the analysis chapter, presents the results of computations of the returns to certain baccalaureate education for Alberta males. Comparisons are made between the three patterns investigated, as well as within the patterns, according to the age at which a program was commenced. Several possible applications of the rate of return analysis are suggested, and the implications of the findings are discussed. The chapter concludes by making comparisons between this and other Canadian studies.

The final chapter, Chapter VI, summarizes the study,

presents some conclusions from the research carried out, and makes several recommendations for further research.

CHAPTER II

STATEMENT OF THE PROBLEM

The central focus of this study may be stated thus:

WHAT ARE THE PRESENT VALUES, AND INTERNAL RATES OF RETURN, OF THE MARGINAL EARNINGS STREAMS FOR ALBERTA MALES, WHO MADE INVESTMENTS IN DIFFERENT KINDS OF BACCALAUREATE EDUCATION AT DIFFERENT AGES?

This major question was subdivided for the purposes of analysis as follows:

1. What are the estimated private costs of investment in three forms of baccalaureate education commenced at various ages: Bachelor of Arts or Science, Bachelor of Engineering and Bachelor of Arts or Science plus one year of teacher education?

2. When comparisons are made with the estimated earnings of high school graduates, what are the consequential marginal earnings streams for each of the three patterns of university education commenced at various ages?

3. What are the present values of each of the marginal earnings streams?

4. What are the internal rates of return for each of the marginal earnings streams?

5. What implications do the findings have for those contemplating investment in university education?

6. What implications do the findings have for policy-makers concerned with the establishment of adult re-training programs?

7. What implications do the findings have for university administrators who make decisions about the length of university programs?

8. How do the findings reported in this study compare with findings of other rate of return studies?

Delimitations

The placing of limits on the study were not only prompted by the nature of the questions asked under the general problem but also by the availability of suitable data for the analysis. The delimitations were as follows:

1. The study was restricted to an evaluation of monetary costs and benefits for males who made a decision to invest in a university education.

2. The types of university education chosen for the investigation were two four-year programs and one three-year program, namely, Bachelor of Engineering, Bachelor of Arts or Science plus a year of teacher education, and Bachelor of Arts or Science respectively.

3. The subjects treated as the decision-makers in the research

problem were males who took their university education at the University of Alberta.

4. Subjects excluded from the study were those who proceeded with further university education after completion of their first degree, and those who entered administrative or managerial levels in their occupations.

5. The base year for all data used in the analysis was 1968.

Assumptions

The assumptions underlying the present study are common to all rate of return studies, and are as follows:

1. that human capital formation and physical capital formation are conceptually similar,

2. that education is a measure of productivity and hence of earning potential, and

3. that cross-sectional data provide reliable estimates for earnings streams of individuals over a lifetime.

Each of these assumptions is discussed at length in Chapter III.

Significance of the Study

Perusal of current literature in the economics of education indicates no dearth of research dealing with the returns to investment in education. Furthermore, studies of this nature have usually

been carried out by economists rather than educators. It is to observations such as these that the following remarks are addressed.

The relevance and worth of a research study, *per se*, may be judged according to several criteria: the reasonableness of the research question; the validity and reliability of the research methods employed in the analysis; the contribution of the study, by way of methodology or findings, to some larger body of research which pre- or post-dates the study; and, the usefulness the findings may have in providing information for some one or more decision-makers.

For the present study, the first two criteria specified are so obviously connected to the theoretical background, which supports and fosters research dealing with returns to investment in education, that discussion of them is postponed until Chapter III. The last two criteria mentioned are elaborated below.

Contribution to a Larger Body of Research

1. A recent survey of rate of return research (Dibski, 1969) reviewed twenty-seven studies. Of those reported, most were carried out in the United States and Europe; only four which were conducted on Canadian data were described (Podoluk, 1965; Wilkinson, 1966; Dupuis, 1968; Stager, 1968). Additional studies in Canada are therefore warranted to give a more comprehensive description of local circumstances.

2. As far as the writer can ascertain, all rate of return studies to date have not only treated the decision to invest in undergraduate education as a once in a lifetime decision, but also

as a decision which is made at the "average" age of completion of high school. Whatever the reason, the restriction of return studies to individuals who begin university at about age eighteen gives an incomplete picture. For example, during the 1968-69 academic year, the number of Alberta males, twenty-five years and older, enrolled in undergraduate degrees in Arts, Science and Engineering was about fifteen hundred (DBS Survey, 1969). The present study had as one of its major objectives the correction of the shortcoming described above.

3. Part of this study focussed on returns to teacher education by assessing the costs and benefits associated with one of the possible routes available to those who enter a teaching career with the equivalent of four years of university education. When combined with two companion studies (Dibski, 1970; Wallace, 1970) a comprehensive description of returns to investment in teacher education in Alberta will be available.

Provision of Information for Decision-Makers

1. The findings of this study have direct relevance for those who invest in undergraduate education. The decision-makers referred to here may be divided into two broad categories: those who have just completed high school and are faced with making a choice between several forms of baccalaureate education leading to different vocations, and those who have been part of the labor force for one or more years, after successful completion of high school, and then contemplate returning to full-time formal education to prepare

themselves for a different occupation. While admitting that a number of factors are taken into account in career selection, the economic information provided by studies such as the one reported here may have a marked influence on the choice an individual makes. For individuals in the second category described above, the economic determinant would likely be the most influential factor in the decision process.

This kind of argument is valid only if two prior conditions are met: salient information is available, and the information is disseminated. The first condition is satisfied when sufficient studies are carried out to supply the necessary knowledge, the second is dependent on the ability and willingness of counselling and guidance agencies to make use of the information.

2. Information provided by rate of return studies may be of value in establishing policies for labor supply. From a theoretical standpoint, supply curves indicate that the quantity of a specific type of labor available should vary directly in accord with the price paid for that labor. Higher returns to any sector of the labor force, in the absence of restrictive entry policies, should bring about higher enrolments in university programs insofar as university education is a prerequisite for such occupations.

3. In the perfect market system, rates of return on investment in all forms of capital measure the efficiency with which scarce resources are assigned. For example, if investment in physical capital yields a return of 14%, but investment in university education yields 18-20%, then it is reasonable to suppose that general economic

productivity would be enhanced by a diversion of resources from machine capital to human capital. Such a supposition points to the need for serious consideration of incentives to encourage individuals to invest in university education.

4. The purpose of including in this study the costs and benefits that accrue to individuals who undertake university education some years after completion of high school has a very real connection to the matter of adult re-training. The need for re-training is expected to increase, resulting from the creation of new occupations as developing technologies find applications, and also because technological innovations will make some occupations redundant. Government officials charged with the recommendation and implementation of contingent social policies will require relevant data concerning costs and benefits of the various types of formal education. Educational administrators, too, will be vitally affected because provision of programs for "rejuvenation" of sections of the work force will occupy an increasing proportion of their time.

Assessment of costs and benefits of formal education for adults, particularly in the twenty-five to thirty-five year age group, should shed light on the amount of financial support that should be given to enable and indeed encourage people to undertake re-training programs.

5. A further justification, more general in nature, is connected with the assumption that education, along with research and development and the building of physical capital, is a form of

investment. In one compares the decision apparatus for the three forms of investment, one is struck by the alertness of entrepreneurs and management to take advantage of profitable investments in physical capital and research and development; but it is not at all clear that there is an equally alert decision apparatus for education. Studies in the economics of education, and more particularly rate of return studies carried out and reported by educators, should make policy-makers in education aware of the investment nature of their enterprise, sensitive to the need for commanding adequate resources, and furnish some knowledge about the outcomes of their resource allocation.

Explanation of Terms

Earnings

This term is used to refer to the money income individuals receive, in wages and salaries, for services rendered in their occupation. Money acquired through gifts, loans, the ownership or sale of property, investments, and from extra-occupational labor, are excluded.

Cross-sectional Earnings and Cost Data

Cross-sectional earnings data present a picture, at one point in time, of the range of earnings within an occupational group as a function of age. Cross-sectional cost data likewise indicate the range of costs, at a focal date, incurred in funding some project over a period of years. The focal date for costs and earnings data in this study was set at 1968.

Foregone Earnings

These are the earnings an individual would have received were he not engaged in a period of further education. This forfeiture is sometimes referred to as opportunity cost.

Marginal Earnings

The term "marginal" has wide use in economics; it is employed to denote 'extra' or 'additional'. In this study the additional amount of an individual's earnings which is attributed to some educational increment, is called the marginal earnings.

Lifetime Earnings Stream

This refers to the set of annual earnings of an individual from the time at which he enters the labor force until he retires at age sixty-five.

Private Educational Costs

These are the financial costs assumed in this study to be incurred by individuals who undertake a particular education program; included are foregone earnings, tuition fees and other academic expenses by way of costs of books and supplies.

Social Educational Costs

These costs are deemed to include the total financial allocation which society makes to an enterprise. Included are the private costs referred to above, but added in are costs of providing and provisioning the educational institution: capital and current expenditure on land, buildings and equipment, debt charges, salaries

of academic and non-academic staff, etc.

Private Educational Benefits

The total of the marginal lifetime earnings stream of an individual who acquires a particular level of education is treated as the private benefits of education.

Social Educational Benefits

The total of the before tax marginal lifetime earnings stream of an individual is used as a first approximation for the returns from society's investment in the education of that individual.

Discount Rate

The discount rate is the compound interest rate used to calculate the present value of money due at some future date.

Present Value

The present value of future income is its equivalent in current income after discounting. This is assessed by applying a compound interest rate and discounting each annual income back to the present time. The present value of a lifetime earnings stream would be the sum of the discounted annual incomes. Another way of expressing this relationship is that the present value indicates the amount of money which would have to be invested now, at an interest rate equal to the discount rate selected, to produce a sum equal to the future income.

Net Present Value

The net present value refers to the present value of the total benefits attributed to the investment in education (the marginal lifetime earnings described above) minus the total cost of the investment, both discounted at the same rate to the same year.

Internal Rate of Return

This is the discount rate which equates the present value of returns on an investment to the present value of costs incurred in making the investment.

External Rate

An external interest rate is an interest rate used for comparative purposes to judge the relative merit of an internal rate-of-return.

Benefit/Cost Ratio

The benefit/cost ratio is the present value of the total benefits attributed to the investment divided by the total cost of the investment, both discounted at the same rate to the same year.

CHAPTER III

THEORETICAL FRAMEWORK

Blaug (1966) succinctly describes the economics of education as a new subject with a very old history, for many of the treatises on the economics of education start out by pointing to the foundation laid down by the classical economists. Particular deference is paid to the writings of Adam Smith (1723-1790) who is credited with making the piquant observation that investment in man, by way of educational expenditures, may just as reasonably be treated as capital formation, as is the case when funds are committed to some physical good with the expectation of producing a fair return over and above the original capital outlay (Adam Smith, quoted in Renshaw, 1960, p.318).

The modern school of educational economics borrows more than inspiration from the classical school, it takes as well its style. The *modus operandi* adopted by present economists is similar to that of the classicists--deductive reasoning bulwarked by shrewd observation. And yet, there is a very real difference. The classicists' mode of thought was untested deduction from a few rather simple premises. Maybe the recent application of the concept of human capital is also an elaborate guess, but it is buttressed by many studies using both theoretical and empirical data.

If the germ of the notion of human capital was apparent almost two hundred years ago, one may wonder why it took so long to flare up from its dormant state and blossom into a major area of study. Soule (1952) makes a telling comment which may be appropos of the present discussion:

> Each body of economic doctrine arises from the needs or circumstances of its time; each may be used--or misused--by some group of special advocates. Each, too, contains some lasting truth (p.29).

The time was apparently ripe for such a development after World War II. As old nations, crippled by the ravages of war, struggled to recover, and newly-formed nations tried desperately to develop their economies, the study of economic growth became the center of economic discussion.

In seeking an explanation for economic growth, economists found that the conventional assessment, by using land, labor and physical capital as the major generative factors, was insufficient. This conclusion was exemplified with observations of a rapidly recovering economy in Europe, despite the almost complete destruction of physical capital (Koulourianos, 1967, pp.2-3), and the fact that the post-war rate of growth of national income in the United States outstripped the combined amount of land, man-hours worked, and the stock of reproducible capital used to produce the income (Schultz, 1961, p.6).

Hitherto, education was considered a consumption item and not an element to be considered in the calculation of a nation's wealth. But once the economic importance of education was recognized, a neglected field of economic analysis was reopened and a new set of questions were raised for investigation.

The major approaches followed are outlined below in order to place the rate of return approach in the general area of studies in the economics of education.

Correlation Analysis

This method assumes that if some measure of educational activity is correlated with some factors which indicate economic performance, then the degree of association will be an indicator of the effect of education on economic growth.

Typical measures of educational activity have included enrolment ratios, number of teachers in relation to the total population, or the amount of expenditure on education. The variables usually considered as measuring economic performance are such things as Gross National Product, per capita income or the rate of growth of GNP. The resulting correlations may be either cross-sectional or inter-temporal.

A United Nations publication (1961) reports one such study which correlated educational variables with socio-economic variables in 74 countries at different stages of development. Some of the correlation coefficients computed are listed below:

School enrolment ratio	Per capita income	+0.84
School enrolment ratio	Per capita energy consumption	+0.76
School enrolment ratio	Level of urbanization	+0.71
School enrolment ratio	Percentage of literate population (15 years old and over)	+0.78
School enrolment ratio	Percentage of male labor force in agriculture	-0.81
School enrolment ratio	Infant mortality rate	-0.67

(U.N., 1961, pp.41-42)

Such studies are reported with the usual cautions which accompany correlational analyses. That is to say, significant correlation coefficients do not establish any causal connection between the variables; furthermore, the variables chosen for comparison may not be the fundamental issues at stake.

The Residual Approach

Economists have found economic growth exceedingly difficult to explain. The customary approach of taking the amount of economic activity occurring in the fields of land, labor and capital as generative factors, left a substantial residual unaccounted for. This prompted a search for other quantifiable information which could account for some of the unexplained growth. Education was suggested as one of the major operative factors in the residual. For example, a detailed study carried out by Kendrick (1961) attributes the increase in the productivity of labor and capital, i.e., the residual, to better education and health of the labor force and improved organization, processes and instruments of production. He says of education that:

> . . . it seems inevitable that the striking advance in the education attainments of the American people should have increased the skills, efficiency and inventive potential of the labor force (p.79).

Denison (1962) also attempted to isolate and measure the contribution of various factors that comprise the residual. He paid particular attention to education as a source of economic growth. His estimate for the contribution of education, in the form of more education per worker, is equal to about 23% of the growth of national income.

The Cost or Investment Approach

The major study in this field was done by Schultz (1960). He calculated the educational stock of the United States as a form of human capital, created by education and evaluated at its cost of production for the years 1929-1957. He subsequently performed additional analysis by employing different rates of return to the amount of educational stock calculated, and concluded that:

> . . . additional schooling in the labor force accounts for 16.5 or 20% of the total growth depending on whether the 9 or 11% rate of return is employed (Schultz, 1963, pp.45-46).

Returns to Education

While an over-riding emphasis on the role of education comes through in all the approaches outlined above, the rate of return approach, which is the major interest of the present study, can be seen as an outgrowth of the cost or investment approach.

A theoretical analysis of returns to education is based on several major premises:

1. that human capital formation and physical capital formation are conceptually similar,

2. that education is a measure of productivity and hence of earning potential, and

3. that cross-sectional data provide reliable estimates for earnings streams of individuals over a lifetime.

Each of these premises is discussed below.

The Concept of Human Capital

The critics of the application of this concept have said that it erroneously implies the existence of a rational calculus of educational and occupational choice:

> . . . 'investment in man' is essentially different from investment in human capital. The difference arises largely from the fact that, as a general rule, at least a part of any one direct expenditure for the improvement of man is not investment as the term is usually used, i.e., it is undertaken for reasons other than the expectation of a monetary return, it has not traceable effects on future output and it satisfies wants directly. To the extent to which any part of such an expenditure is investment in this sense it is rarely if ever 'rational' investment based on a careful comparison of alternate investment opportunities, with the anticipated monetary return and the degree of safety as guiding rods (Shaffer, 1961, p.1027).

But, the critics seem to have missed the reason behind the positing of such a concept; its application is making use of a device which, in the classical tradition, is the chief stock-in-trade of economists. The tool referred to is deductive reasoning. The economist has found that he can reason fruitfully by assuming certain oversimplified postulates, abstracted from reality, and then discover by deduction the consequences of those assumptions. There is something of what Kaplan (1964) calls the pragmatic approach involved here: "The pragmatic approach is prospective; what counts is not origins but outcomes, not the connections with experience antecedently given but those which are yet to be instituted (p.42)." Perhaps the most telling argument supporting the use of conceptual tools is expressed by the same writer:

> A scientist *may* use whatever concepts he *can* use, whatever ones he finds useful in fact. The restriction to which he is subject is only that what he says be capable of being checked by experience, or alternatively, capable of providing some guidance to action (Kaplan, 1964, p.79).

One may question, as the critics do, if private educational decisions are economically rational, but it is an unfair question. The proponents of the human capital concept do not say that the decision to acquire further education *is* or *should be* economically rational, but rather: if one *assumes* that such decisions about education *are* based on an economic rational calculus, can one derive useful information from the contingent consequences? Data used to give substance and form to this approach are exemplified in Chapter IV.

Apart from what might be called the *validity* problem, discussed above, there is too an *analogy* question. Expenditures on human capital formation can be likened to outlays on other forms of capital; the disbursement of goods and services in the educational sector precludes their use for other purposes. The educated person, can be said also to possess a stock of capital, for which he receives a series of returns in future years.

In other ways, expenditures on education differ from expenditures on physical capital. Eckaus (1962, p.104) indicates that the process of human capital formation not only develops labor skills but locates them as well. The result is both an improvement in quality and an increase in the quantity of talent. Wilkinson develops this theme further:

> The talent so developed can be employed not only in production of consumer goods, physical and human capital, but also in invention and innovation along scientific, technical, or administrative lines. Furthermore, human capital is likely to be more flexible in the number of different jobs it can perform than are many types of physical capital (Wilkinson, 1966, p.7).

Such remarks are complementary to the notion of human capital, but they are comments focussing on the output or benefit side of the investment. On the cost side, a marked difference between human and nonhuman capital is apparent. When expenditures are made on physical capital, then the outlay is, without dispute, investment; but, expenditures on education have a consumption, in addition to an investment aspect. Furthermore, the proportion of the one element relative to the other is unclear. In the light of the difficulties associated with separating consumption from investment expenditures, Wilkinson (1966, p.9) suggests that all educational outlays can be treated as investment:

> This procedure is not entirely satisfactory but it is to be hoped that as more becomes known about the purposes for which people obtain education and the contribution to productivity which various subjects make, a less arbitrary method might be possible (Wilkinson, 1966, p.9).

Education and Earnings

When economists investigate the manner in which earnings are allocated, they are in effect measuring one of the attributes of the economic behavior of society. Not only do they seek to explain the network of actual relationships, for example, that between level of education and level of earnings, but attempts are made to predict the consequences of those relationships.

The assumption which relates earnings and education has been stated thus:

> . . . because differentials in earnings correspond closely to corresponding differentials in education, they strongly suggest that one is the consequence of the other (Schultz, 1961, p.4).

Within such an assumption there are two major assertions: that earnings are an accurate reflection of productivity, and that level of education is *the* significant proxy for a number of variables which may contribute to productivity.

This assumed relationship between education and earnings has been illustrated by:

1. comparing the annual incomes of persons who are in the same age bracket but who differ according to their level of educational attainment, and

2. comparing the lifetime incomes of persons who have attained different levels of education.

Education and annual earnings. Miller (1960, pp.962-86) reports significant variations in average annual earnings for United States males who have different levels of education. For example, in the age category from 25 to 34 years, average annual earnings in 1958 were $3,663 for elementary school graduates, $4,909 for high school graduates, and $7,152 for college graduates. Earnings for persons in the years of peak earning power, the forty-five to fifty-five age bracket, were $4,337 for elementary school graduates, $6,295 for high school graduates, and $12,009 for college graduates. The rising educational level of the general population in the United States has not reduced this pattern of differences, in fact, the evidence indicates the reverse to be true:

> In 1949, the average high school graduate had an income 34% greater than the elementary school graduate, while the college

> graduate's income exceeded that of the high school graduate by 63%. By 1958, the high school graduate's advantage over the elementary school graduate had increased to 48%, and that of the college graduate over the high school graduate to 65% (Innes, Jacobson & Pellegrin, 1965, pp.39-40).

The same pattern of differentials seems to obtain in Canada. In 1961, male university graduates engaged in managerial occupations had an average annual income 1.49* times greater than their counterparts whose highest level of education was secondary school. For all occupations the difference was 1.67* times greater in favor of degree holders.

This strong relationship between income levels and educational attainments has been reported by the Economic Council of Canada. In the Second Annual Review, a table illustrating the connection shows, in 1961 figures, the average annual income for males by levels of education (Economic Council of Canada, 1965, p.86). This table has been reproduced here as Table I. The accompanying report emphasizes that higher education not only helps account for higher initial earnings, but that the higher the level of education, the greater are the earnings differences between younger and older age groups:

> . . . advances in an individual's earnings potential are more pronounced and prolonged in professional, managerial and other occupations requiring relatively higher degrees of education, skill and flexibility. They are less pronounced and declines set in earlier for those in unskilled or semi-skilled occupations requiring relatively lower educational attainments (Economic Council of Canada, 1965, p.86).

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*Calculated by the writer from 1961 census data.

TABLE I

AVERAGE ANNUAL INCOME FROM EMPLOYMENT OF LEVELS OF EDUCATION, MALE NONFARM LABOUR FORCE, 1960

	Dollars	Index (0-8 years = 100)
0 - 8 years elementary	3,526	100
1 - 3 years high school	4,478	127
4 - 5 years high school	5,493	156
Some university	6,130	174
University degree	9,188	261
Total	4,602	

Source: Based on data from *1961 Census of Canada.*

Education and lifetime earnings. The connection between education and earnings has been further explored by calculating lifetime earnings as a function of education.

The advantage has been found to be clearly with persons who have the most education. Miller (1960, p.983) using 1958 as the focal year, reports that the average lifetime income for the elementary school graduate was $179,000; for the high school graduate, $240,000; and for the college graduate, $420,000.

Characteristics of age-education-earnings profiles. The major characteristics of these profiles have been summarized as follows:

> 1. All the profiles, irrespective of the level of education increase with age up to a maximum and then decline. The obvious explanation is that age acts as a proxy for work-experience, raising earnings until educational obsolescence catches up with it.
>
> 2. The higher the educational attainment the higher the starting salary and the steeper the rise in earnings throughout the early phases of working life.
>
> 3. The higher the educational attainment, the later the year at which maximum earnings are reached and the gentler the decline of earnings from the maximum point (Blaug, Peston, & Ziderman, 1967, pp.9-10).

Criticisms. The major argument against the linking of earnings to level of education is the *ceritus paribus* assumption employed in the analysis. The critics argue that many other factors apart from level of educational attainment may be operative. Such things as natural ability, ambition, motivation, social class, race and educational level of parents are cited as crucial variables which each, or together, may be equally or more significant determinants of earnings than education alone.

Supporters of the returns approach concede this point (Schultz, 1961, p.1037); but to admit that other factors play a role in setting earnings is not to admit the total futility of the human capital approach. Education itself, is so obviously related to the factors mentioned above that it must enjoy a measure of respectability as a proxy for them.

What the critics can assert with some justification is that as modes of analysis become more sophisticated, efforts should be made to separate out the influence of education relative to other variables. One such attempt is reported by Hunt (1964), who uses multiple linear regression analysis to take account of other income determinants like ability, parents' education and occupation; but the researcher is loathe to generalize from the results because of attendant data difficulties.

The knowledge and understanding of economic man grows by accretions; the model employed in the rate of return approach may result in only a small increment of knowledge, but it is a significant increment in the light of the very little headway made prior to its introduction in recent research.

Use of Cross-section Data

The use of cross-section data is questionable to the extent that it differs markedly from life-cycle data; underestimation of earnings may be acceptable, whereas overestimation would be suspect.

As successive age groups gain more and more education, which is true of Canada since World War II, there would tend to be (one

would suspect) a narrowing of earnings differentials at any age level. This line of reasoning would mean that present cross-section statistics would over-estimate future income differentials. The stock answer to this objection is found in the studies done by Miller (1960), cited earlier, which showed that differentials between high school and college graduates showed a marked increase for the twenty year period immediately following World War II.

Over or under-estimation of earnings after the first ten years is almost inconsequential anyway, because in discounting the value of future income, the figures in the first few years have most bearing on the rate of return calculation. Therefore, providing the earnings for years in close proximity to the focal date of the study were carefully estimated from contemporary earnings, later discrepancies in estimation will have little effect.

Several distinct benefits from the utilization of cross-section data are stated:

> . . . cross-section data have a distinct advantage over genuine life-cycle data in that they are free from the influence of the trade-cycle and implicitly provide estimates in money of constant purchasing power. Furthermore, they reflect the way in which private choices are actually made; an average person forms his expectations of the financial benefits of additional years of schooling by comparing the present earnings of different occupations requiring various amounts of education, that is, by cross-section comparisons (Blaug, 1968, p.233).

In the absence of adequate life-cycle data, cross-section statistics appear to provide reasonable approximations.

Costs and Benefits of Education

A previous section, dealing with the relationship between education and earnings was restricted to a description of the apparent financial benefits accruing to individuals with particular levels of education. The present section shows how, by taking that relationship as a given, researchers have assessed the benefits of education relative to its cost. The explication then, is of the way in which the investment model has been applied to education. First, the cost and the benefit measures are discussed.

Assessing the Costs of Education

Hansen (1963, p.133) distinguishes between *total* resource costs and *private* resource costs. The former is considered to have three major components: (a) education costs incurred by society, for example, teachers' salaries, capital and current expenditures on buildings, equipment and supplies, interest and depreciation on capital, (b) opportunity costs or foregone income incurred by individuals during the period when further education is acquired, and (c) additional school-related costs incurred by individuals, for example, books, equipment and clothing. The private resource costs include (b) and (c) above, but for (a) costs of tuition and fees are substituted.

The inclusion of (a) and (c) in total and private costs is recognized as providing measures of educational expenditures, but the inclusion of (b) has not won universal support. Vaizey says:

> . . . the inclusion of income foregone in the costs of education opens the gate to a flood of approximations which would take the concept of national income away from its origin as an estimation of the measurable flows of the economy (Vaizey, 1962, p.43).

This charge is rebuffed by Blaug who argues that "to measure the net flow of goods and services in the economy is one thing; to measure the real cost of a particular activity is another (Blaug, 1965, p.225)."

Koulourianos (1967, pp.46-47) discusses costs by distinguishing *private* from *social* and *direct* from *indirect* costs. The private direct cost includes actual payments by the student or, on his behalf, by his parents. Following Hansen (1963), these costs are made up of tuition fees, books, supplies, and living expenses over and above those paid had the student not been undertaking further schooling. To calculate the direct social cost, expenditures undertaken by society, and not charged to the student, are added to the above private direct costs. So direct social costs incorporate total educational expenditures (current and capital) by schools or universities.

As stated previously, the estimation of indirect cost is controversial. The usual method employed to calculate private indirect cost is to estimate the student's foregone earnings as the income received by persons of the same age and education. Koulourianos (1967, p.47) says that this procedure is legitimately questioned from the point of view that under conditions of extensive unemployment, one cannot assume that students now in school could earn as much as people already in the labor force. This argument is seen as more conclusive in the case of indirect social cost, for in under-developed countries, where widespread unemployment and underemployment prevails, the indirect social cost is close to zero, and hence education in such countries is less expensive than in economies which have few employment problems.

One further matter which has to be taken into account is the question of whether a part of the costs should be regarded as expenditures for consumption. Rather than tinkering with various proportions for consumption and investment, most researchers have assumed that all expenditures are for investment. The adoption of this procedure means that to the extent that some educational expenditures are recognized as being for consumption, the returns on the investment will vary.

Assessing the Benefits of Education

While the usual approach to the calculation of benefits is to confine the investigation to direct monetary returns to individuals (as in the present study), there are additional benefits, external to the student investor, which make the adequacy of educational expenditures of immediate public concern. These additional benefits are worthy of some attention as they point to further ramifications of the rate of return approach to investment in education.

> . . . a 'benefit' of education will refer to anything that pushes outward the utility possibility function for the society. Included would be (1) anything which increases production possibilities, such as increased labor productivity; (2) anything which reduces costs and thereby makes resources available for more productive uses, such as increased employment opportunities, which may release resources from law enforcement by cutting crime rates; and (3) anything which increases welfare possibilities directly, such as development of public-spiritedness or social consciousness of one's neighbor (Weisbrod, 1962, p.108).

Direct financial return. This is calculated by considering either before or after-income tax lifetime earnings differentials of people who acquire different amounts of education. This method is not without difficulties because of a number of concomitant variables.

Koulourianos (1967, p.37) warns against attributing differentials in earnings entirely to education, as people with the same amount of schooling can reasonably be expected to differ in natural ability, motivation, socio-economic class, and so on. Estimates of the proportion of the earnings differentials which can be attributed to such factors range from about 10 to 40% (Becker, 1964, pp.79-88). Researchers have dealt with this problem by making certain assumptions:

1. that education accounts for 100% of the earnings differential;

or 2. that education accounts for some part, say two-thirds, of the differential.

Returns to educational investment can then be interpolated for any proportion between two such assumptions.

Financial option return. One may speak of the value of additional education as having two components: (a) the additional earnings resulting from the attainment of a given level of education, and (b) the value of the 'option' to undertake still further education and its contingent rewards.

Consideration of (b), the opportunity to invest in further education, would add to the return on baccalaureate education, for example. For if the direct financial return to undergraduate education was found to be marginal, the decision-maker may still be prompted to undertake such a program by viewing it as a step towards graduate education and hence higher financial returns.

Non-financial options. In addition to accounting for options which have monetary returns Weisbrod (1962, p.116) suggests that one should recognize that by acquiring an educational increment an individual widens his job opportunities, enhances his leisure, security and way-of-life options, and increases his ability to adjust to changing job opportunities.

Second-round benefits. So-called second-round benefits refer to the advantages resulting from the association of others with the educated person. The line of argument outlining these benefits speaks of three groups of people who receive advantages from a student's education: (a) residence-related beneficiaries; (b) occupation-related beneficiaries; (c) society in general.

Under (a) for example, it is contended that siblings and future children of a student are likely to receive encouragement to reach, if not exceed the educational level of the student model. An example of (b) would be the increased productivity of a work group resulting from the inclusion in its membership of an educated worker. Matters relative to (c) include the advantages to society resulting from a literate citizenry.

Doubtless non-pecuniary rewards are perceived by those who invest in, and those who sponsor, education; but such real or apparent gains cannot be included in a financial assessment of benefits because of the impossibility of stating a price for them.

Mathematical Calculation of Returns to Education

Before proceeding with a description of the calculation of returns to education, one should re-emphasize that the methodology employed is borrowed from a branch of economics: the theory of capital. The essence of this theory is to regard 'capital' as including anything that yields a stream of income over time. "From this point of view, . . . all categories of income describe yields on various forms of capital, and can be expressed as rates of interest or return on the corresponding items of capital (Johnson, 1964, p.220)." The accumulation of capital, or investment, involves incurring costs in the form of use of current resources which may have been applied elsewhere. Investment is said to be gainful if the rate of return over cost exceeds the general rate of interest, or the capital value of the additional income yielded exceeds the cost of obtaining it. Furthermore, investment analysis guides the allocation of investment resources according to priorities set by the relative rates of return on alternative investments.

The use of the investment model in education can be demonstrated through its application to *private* and *social* returns.

Private Returns

In measuring private monetary returns to education, the researcher uses the following data:

1. the year by year earnings, to age of retirement, of an individual who undertook a particular educational program (say, a

university degree) before entering an occupation;

2. the year by year earnings, to age of retirement, made by a comparable individual who did not undertake the university program but proceeded immediately to an occupation after successful completion of high school; (in 1 and 2 earnings are usually after income tax figures)

3. the private costs incurred by the individual who took the university program; such costs would include tuition fees, costs of books and supplies, and foregone income; and

4. a knowledge of market discount rates.

Using these data, the two components of the investment syndrome, costs and benefits, are calculated and standardized to a base year. In this case the year in which the university program was commenced would be the focal date.

From 1 and 2 above, the marginal lifetime earnings are calculated as follows:

$$MLE = \sum_{i=1}^{N} (EWD - EOD)$$

where MLE = marginal lifetime earnings,

N = number of earning years,

EWD = earnings with a degree, and

EOD = earnings without a degree.

Costs are then calculated from 3 above:

$$C = c_1 + c_2 + c_3$$

where C = total private costs,

c_1 = tuition fees,

c_2 = other academic expenses, and

c_3 = foregone income.

Several methods may then be employed to evaluate the returns to the investment in university education:

Discounted net present value. The discounted net present value is the present value of the total benefits attributed to the investment in education (the marginal lifetime earnings described above) minus the total cost of the investment, both discounted at an appropriate rate to the same year. The calculation is described by the following formula:

$$V_{18} = \sum_{t=m+1}^{64} \frac{MLE_t}{(1+i)^{t-18}} - \sum_{t=18}^{m} \frac{C_t}{(1+i)^{t-18}}$$

where V_{18} = the discounted net present value of the investment at age 18,

C_t = the cost of the university education in year t,

m = the length of the educational program in years,

i = the discount rate,

64 = the terminal year of earnings, and

MLE_t = the marginal lifetime earnings in year t.

Benefit/cost ratio. This ratio is found by dividing the discounted present value of the total benefits attributed to the investment by the discounted value of the total cost incurred in that investment. In other words, the two major components of the discounted net present value formula are again juxtaposed. But instead of finding their difference, the total discounted marginal benefit is multiplied by the reciprocal of the total discounted cost. The formula reads:

$$B/C = \sum_{t=m+1}^{64} \frac{MLE_t}{(1+i)^{t-18}} \cdot \left(\sum_{t=19}^{m} \frac{C_t}{(1+i)^{t-18}} \right)^{-1}$$

where B/C = the benefit/cost ratio.

Internal rate of return. The relationship between costs and benefits can be found in a different way by defining the internal rate of return, which is a rate of discount equating the present value of returns to the present value of costs. The formula for this calculation is written as:

$$\sum_{t=m+1}^{64} \frac{MLE_t}{(1+r)^{t-18}} - \sum_{t=18}^{m} \frac{C_t}{(1+r)^{t-18}} = 0$$

where r = the internal rate of return.

In all three methods described above the rate or rates chosen for discounting are of crucial importance. The appropriateness of rates has been a controversial issue in studies of public investment.

Prest and Turvey (1965, p.700) advise:

> In practice, the most usual kind of procedure is to select an interest rate or rates, on the basis of observed rates ruling at the time, for calculating present values, . . . the choice of varying discount rates does not, within the 4-8% band, make much difference to assessments of a project.

Hirshleifer, Dettaven & Milliman (1960, p.144) suggest that the rate of interest:

> . . . can with sufficient closeness be approximated by the federal borrowing rate for loans of the same order of maturity as the anticipated project life. The longest-term federal bonds would be ordinarily used. . .

One further matter begs discussion: Which of the three modes of analysis outlined above is preferable for the private decision-maker?

The benefit/cost ratio method is similar to the internal rate of return method if the decision is whether to accept or reject a particular investment. In other words, a proposal will be accepted if its internal rate of return is greater than the external rate (the rate used for discounting costs and benefits), or if the benefit/cost ratio exceeds unity when benefits and costs are discounted at this external rate. However, if the investor wishes to choose between alternative forms of university education, the internal rate and the benefit/cost ratio may provide insufficient information. Presumably the decision-maker will want to know which alternative produces the maximum present value. In this case, he would be guided by the net present value of earnings for the options reviewed.

Social Returns

Social rates of return for a person acquiring a university degree are calculated in a similar way to private returns. There

are several differences: added to the private costs are public expenditures supporting the educational program, and the marginal benefits are calculated from before tax earnings.

The question arises as to what constitutes the public contribution. The usual practice has been to consider social or total resource costs as including three components: (a) school costs incurred by society, that is, teachers' salaries, supplies, interest and depreciation on capital, (b) opportunity costs incurred by individuals, namely, income foregone during school attendance, and (c) incidental school-related costs incurred by individuals.

Once the revised costs and benefits are calculated, they are applied to the formulae listed above, under private returns, to produce the three evaluatory measures of social return. It is to be expected that the social rate of return for an educational investment is generally exceeded by the private rate of return because the former entails a much greater initial expenditure. But the difference between social and private returns is not simply a matter of the amount invested to produce the returns:

> A student generally need only determine the effect of a college education on his earnings, but society needs to determine its effect on national income. Thus if college graduates earn more partly because their productivity was systematically overestimated, private returns would tend to be larger than social ones. A more common criticism, however, is that earnings greatly understate the social productivity of college graduates (and other educated persons) because they are (allegedly) only partly compensated for their effect on the development and spread of economic knowledge (Becker, 1964, p.118).

Rate of Return Studies: A Resumé of the Research

Rate of return studies have been reported from several countries, for various levels and amounts of schooling, as viewed by individuals and society, and using a variety of approaches. The writer has made a selection from these studies and reports below, some which have direct relevance to the present study. Those chosen described returns to university education as money rates of return and were confined to an analysis of undergraduate education. Studies which attempted to measure costs and benefits associated with other levels of education have been excluded.*

1. One of the first attempts made to analyze systematically the private returns to education was by Walsh (1935, pp.255-85). The data used were U.S. statistics of the late 1920's and early 1930's. While he estimated returns and costs for ten educational levels and professions in the case of males and for two in the case of females, his analysis was concentrated on education beyond high school. The earnings differentials for people with college education were discounted back to the first year after graduating using a 4% discount rate. By comparing these present values with the corresponding costs,

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*For a survey of other rate-of-return studies, the reader is referred to: (i) W. G. Bowen, Assessing the economic contribution of education: An appraisal of alternative approaches. In S. E. Harris (Ed.), *Economic aspects of higher education;* (ii) T. W. Schultz, *The economic value of education.* New York: Columbia University Press, 1963, pp.58-63; and (iii) M. J. Bowman, The new economics of education, *International Journal of the Educational Sciences.* I pp.29-46.

he found that benefits always exceeded the costs of college education. The conclusion drawn from these findings was that investment in college education had a return greater than 4%.

2. Using 1949 U.S. Census data, Glick and Miller (1956, pp.307-12) concluded that a college education was worth approximately $100,000. But this apparent gain was not discounted to its present value at the time the educational investment decision was made and no adjustments were made to the data to account for unemployment, mortality and income tax.

3. Houthakker (1959, pp.24-8) also worked on U.S. census data for 1949, but he introduced adjustments for income tax and discounting. His findings clearly indicated the sensitivity of marginal earnings to discounting at various rates. For example, the earnings of a college graduate at zero discount rate were found to be $280,989, but this figure dropped to $106,269 and $30,085 when discount rates of 3% and 8% respectively were applied. He also compared the before-tax life earnings of college and high school graduates and calculated the difference at zero discount rate to be $105,829. By applying an 8% discount rate he found that the difference dropped to $5,095.

4. An article by Becker (1960, pp.346-54) caused widespread reaction partly because of the pertinence of the question to which his article was addressed, 'is there under-investment in college education?' and partly because he introduced a novel way of assessing the returns to investment in education. Instead of following the method practiced in previous studies, that of applying several

discount rates to the marginal earnings stream, he sought the actual rate of return made from an investment in college education. This actual rate, now referred to as the 'internal rate of return' is the discount rate which equates the present value of monetary costs and benefits. Becker found, using 1949 data, that the after-tax private internal rate of return for college graduates was 11.7%, and that the social internal rate of return was 11.5%. Perhaps it is more reasonable to speak of his findings falling within a band of 9-14% because differences result from making adjustments for tax, unemployment, morbidity and mortality rates.

5. Renshaw (1960, pp.318-24) referred to the oft-quoted factors which are positively correlated with education and which by implication are felt to produce an upwards bias in the estimates of returns from schooling; such factors, he suggested, include ability, socio-economic background, experience and determination. He argued therefore, that median income differentials would give less biased results than mean differentials. Using median differentials between college and high school graduates in the United States in 1949, he computed present values by applying 5% and 10% discount rates. For 1949 he also estimated private total cost (direct costs plus foregone income) of college education for males and females. He found that all present values exceeded the corresponding costs at a 5% discount rate, and this was the case when a 10% discount rate was applied except for non-white males. His findings indicated that apart from the exception noted, the private rate of return from college education in the United States in 1949 was greater than 10%.

6. Miller (1960, pp.962-86) used the cross-sectional approach to estimate lifetime earning profiles for individuals holding various levels of education. The figures, drawn from 1949 U.S. census data and adjusted for mortality, showed the difference between the lifetime earnings of high school graduates and college graduates to be about $111,000. Miller demonstrated that the more highly educated group made a relative gain in subsequent years. The differential in favor of college graduates was 48% in 1946 but had increased to 70% in 1958 (Miller, 1960, p.983).

7. Hansen (1963, pp.128-41) also used 1949 U.S. census data, but in addition to calculating the value of lifetime income as set forth by Miller (1960, pp.962-86) and the present value of lifetime income as set forth by Houthakker (1959, pp.24-8), he calculated both the social and private rates of return to investment in schooling.

Before he reported his findings, Hansen took care to point out some of the possible flaws in the data used. For example, that the income profiles were based on all income accruing to an individual, not just earnings from wages and salaries; that there is some doubt about the validity of attributing financial benefits to educational increments alone; that all cost elements were considered as investment even though some portion thereof should be counted as consumption; that the basing of all estimates of costs and benefits on cross-section data assumed no possible future shifts in the relationships of the cost-income streams; and, that other factors such as on-the-job-training and work experience which may impinge on observed income differentials were ignored (Hansen, 1959, pp.134-5).

The section of his findings which are of direct relevance to this study show a private internal rate of return of 11.6% to four-year college graduates over high school graduates and a 10.2% social rate of return. In an additional section of the analysis he reported that the social internal rates of return for two years of college and for four years of college were 5.4% and 15.6% respectively. The comparable figures for the private internal rate of return were 6.2% and 18.7%. The latter findings indicate that a person who completed only two years of college could expect about one-third the return of one who successfully completed a four-year college degree.

8. Podoluk (1965) reported private internal rates of return for various levels of education in Canada. Her calculations were based on the 1961 census data. The rate of return for male university graduates over grade eight graduates was given as 17.1%, and for male university graduates over high school graduates the figure was 19.7%. The data used were for all university graduates in Canada; this would include persons holding professional degrees in medicine, dentistry and law, and those with several degrees including doctorates. For this reason, no direct inferences can be made about returns to three or four years of university education.

9. Wilkinson (1966, pp.556-72) also used 1961 census data to calculate present values of returns to education in Canada. Discounted at 8% the present value of after-tax earnings for all male graduates was reported as $36,700. The present value of before-tax earnings, again discounted at 8%, for engineers and science technicians

who held university degrees were given as $45,500 and $33,500 respectively. In each of the above three cases, present values were discounted back to age 14, and the figures quoted were 1961 dollars. In further analysis, Wilkinson discounted engineers' and teachers' after-tax earnings, for degree-holders, back to age 17. At an 8% discount rate, the 1961 present value of engineers' earnings was $71,100 and the present value of teachers' earnings was $51,600.

10. By far the most extensive study done to date on Canadian data, was recently completed by Stager as a doctoral dissertation at Princeton University (Stager, 1968). One major aspect of his study was concerned with an economic evaluation of different kinds of university education in Ontario. Stager used 1961 census data and adjusted earnings for labor participation rates and mortality. While he presented findings for a wide range of university graduates, only those directly relevant to this study are reported here.

The private return for Arts and Science graduates (before tax, discounted at 5% and rounded to the nearest 100 dollars) was given as $36,800 in net present value terms, with an internal rate of 19.1%; for Engineering graduates the comparable figures quoted were $32,100 and 19.0%; and for Education graduates $14,500 and 11.5%.

The social return figures for the same three groups were given as $33,100 and 14.9% for Arts and Science graduates, $25,700 and 12.4% for Engineering graduates, and $10,600 and 8.6% for Education graduates.

Observations

In reviewing research studies, one notices marked differences in rates of return, present values and lifetime incomes quoted for

similar educational investments. These divergences indicate the sensitivity of the rate of return analyses to the varying assumptions made by researchers in estimating cost and benefit data. A recent investigation of the effects of different adjustments to benefits data particularly, was carried out by Danielson (1970, pp.334-8). He found that private internal rates of return are affected little by adjustments for economic growth, mortality, and income tax because the latter two cancel out the effect of the first. Such is not the case however, for the present values; the same adjustments as before, for economic growth, mortality and income tax, indicated that unadjusted earnings data understate the returns to educational investment.

The rate of return approach used to explore investments in education is still in its infancy. At some later time, when more research findings covering a variety of circumstances become available, a period of synthesis and consolidation will likely overcome many of the present discrepancies.

CHAPTER IV

BACCALAUREATE EDUCATION IN ALBERTA: THE RESEARCH DESIGN

This chapter gives a detailed description of the types of subjects viewed as decision-makers or investors, the kind of cost data attributed to their investment, and the earnings streams resulting from their investment.

Types of Decision-makers

The study was limited to an investigation of financial returns to Alberta males for several reasons: (a) adequate earnings data for females are not readily available because of their inconstant and varied membership in the labor force; (b) an unknown proportion of the married females in the labor force may be underemployed, that is, engaged in an occupation not related to their qualifications; and (c) one of the vocations studied, engineering, is not a usual occupation for females.

The male subjects in this study were first categorized according to the type of baccalaureate education undertaken, and second, by the age at which the program of university study was commenced.

While it is permissible to complete some under-graduate degrees at the University of Alberta with less than full time attendance (a minimum of one year of full attendance is the usual requirement), all subjects were assumed to be in full time attendance for the duration of their program. Furthermore, all subjects were

credited with the successful completion of their program in the number of years stipulated for their degree. There follows, a description of the types of subjects treated as decision-makers.

Type A Decision-makers

Type A decision-makers were those who undertook a four-year program, at the University of Alberta, leading to a Bachelor of Engineering degree. Applicants for admission to this faculty have to possess an Alberta High School diploma (or its equivalent) with a 'B' or higher standing in the subjects listed by the faculty as prerequisites, although a single course deficiency may be made up by an adjustment to their first year university courses.

Matriculation requirements have the effect of setting a minimum age for admission, and for this study this was taken at 18 years. No maximum age, beyond which an applicant would be refused admission, is specified in the 1968-69 University calendar. In fact, during an interview with the Associate Dean of Engineering, Professor L. E. Gads, the researcher was told that a number of students 25-35 years of age, were currently enrolled, and that students much older have been admitted by the faculty. For the purposes of this study, the subjects were classified into 24 groups depending on the age at which the student commenced his degree program. Consecutive ages from 18-41 years inclusive, were chosen.

Type B Decision-makers

Type B decision-makers were those who undertook a three-year program, at the University of Alberta, leading to a Bachelor of Arts

degree. Applicants for admission to this faculty in 1968 had to possess an Alberta High School diploma (or its equivalent) with a 'B' standing or higher in the subjects listed by the faculties as prerequisites.

The subjects were classified into 15 groups according to the age at which the student commenced his degree program. Consecutive ages from 18-31 years inclusive, and age 40 were chosen.

Type C Decision-makers

Type C decision-makers were similar to type B decision-makers up to the point of completion of the Bachelor of Arts or Science program; but thereafter, type C decision-makers completed an after degree program, lasting one academic year, in the Faculty of Education. This year of teacher education is mandatory for general degree holders who wish to teach in Alberta Schools. The total program is recognized by teacher employers, for salary purposes, as four years of university education.

The subjects were classified into 19 groups according to the age at which the student commenced his program. Consecutive ages from 18-35 years inclusive, and age 40 were chosen.

Investment-related Costs

A distinction needs to be drawn between total annual expenditures by the subjects in this study, and those they made which are directly related to their educational investment decision. Payments of the latter kind form part of the annual sum invested, but other

expenditures allocated, for example, to accommodation, travel, entertainment, food and clothing, cannot properly be included unless expenditures so made are contingent upon the decision to attend university, and are in excess of expenditures that would normally be made in these areas. Bearing this provision in mind, the costs for the three patterns of baccalaureate education described above were then determined.

Direct Costs for Type A Decision-makers

Annual investment-related expenses totalled $705, (Table II). The sum was made up of $10 registration fee, $500 for tuition fees, $28 student union fees, $8 University Athletic Board levy, and $159 for other academic expenses. The fee structures, both university and student union, were the same for any of the years in the Bachelor of Engineering program. The annual figure of $159 for other academic expenses was calculated from information provided in the Post-Secondary Student Population Survey (1969, Table 1486) by Alberta students in each of the four years of the program.

Direct Costs for Type B Decision-makers

Annual investment-related expenses totalled $600, (Table III). The sum was made up of $10 registration fee, $400 for tuition fees, $28 student union fees, $8 University Athletic Board levy, and $154 for other academic expenses. The fee structures, both university and student union, were the same for any of the years in the Bachelor of Arts or Science programs. The annual figure of $154 was calculated from information provided in the Post-Secondary Student Population

TABLE II

PRIVATE ACADEMIC EXPENSES FOR FOUR-YEAR BACHELOR OF ENGINEERING PROGRAM, UNIVERSITY OF ALBERTA, 1968-69

Source of cost	Amount per year
Registration fee	$10
Tuition fees	500
Student Union fees	28
University Athletic Board	8
Other academic expenses	159*
Total	705

Sources: University of Alberta Calendar, 1968-69.

*From Post-Secondary Student Population Survey, 1968-69 (Unpublished information, DBS, September). Table 1486.

TABLE III

PRIVATE ACADEMIC EXPENSES FOR THREE-YEAR BACHELOR OF ARTS OR SCIENCE PROGRAM, UNIVERSITY OF ALBERTA, 1968-69

Source of cost	Amount per year
Registration fee	$10
Tuition fees	400
Student Union fees	28
University Athletic Board	8
Other academic expenses	154*
Total	600

Sources: University of Alberta Calendar, 1968-69.

*From Post-Secondary Student Population Survey, 1968-69 (Unpublished information, DBS, September, 1969). Table 1486.

Survey (1969, Table 1486) by Alberta students in each of the three years of the program.

Direct Costs for Type C Decision-makers

Annual investment-related expenses totalled $600 for the first three years of their educational program. This annual sum was identical to that of type B decision-makers because the same programs were followed over that time. But in the fourth year of the investment period type C decision-makers' direct costs were $591, (Table IV). The sum was made up of $400 for tuition fees, $20 student union fees, $8 University Athletic Board levy, and $153 for other academic expenses. The annual figure of $153 was calculated from information provided in the Post-Secondary Student Population Survey (1969, Table 1486) by Alberta students in the Faculty of Education.

Indirect Costs for the Three Groups of Decision-makers

Indirect costs differ from direct costs in that the former, unlike the latter, do not involve the actual use of money by the investor for the purchase of goods and/or services. For this study the indirect cost of investing in a university education was taken to be the loss of employment income incurred by the student while he was engaged in full-time university studies.

The data on which the foregone earnings were based were originally reported in the 1961 Census of Canada. Estimates of earnings for age intervals from 15 to 64, for Alberta males, were prepared from these data by Podoluk, of the Census Division, Dominion Bureau of Statistics, (Table V). From these 1961 figures, the

TABLE IV

PRIVATE ACADEMIC EXPENSES FOR ONE YEAR AFTER DEGREE PROGRAM IN FACULTY OF EDUCATION, UNIVERSITY OF ALBERTA, 1968-69

Source of cost	Amount per year
Registration fee	$10
Tuition fees	400
Student Union fees	20
University Athletic Board	8
Other academic expenses	153*
Total	591

Sources: University of Alberta Calendar, 1968-69.

*From Post-Secondary Student Population Survey, 1968-69 (Unpublished information, DBS, September, 1969). Table 1486.

TABLE V

AVERAGE INCOME FROM WAGES AND SALARIES FOR ALBERTA WAGE EARNERS WITH COMPLETED SECONDARY SCHOOLING, 1961

Age interval (years of age)	Average annual wage or salary	
	Male wage earners	Female wage earners
15 - 24	$2,311	$1,788
25 - 34	4,489	2,405
35 - 44	5,238	2,378
45 - 54	5,419	2,610
55 - 64	4,818	2,733

Source: Unpublished *1961 Census of Canada* tabulations obtained from the Census Division, Dominion Bureau of Statistics, Ottawa.

lifetime earnings stream for Alberta male high school graduates were estimated by interpolation and the application of a conversion factor*, (Table VI). The foregone earnings for each subject type can be read off from this table.

Cost Exclusions

Direct costs. No allowance has been made for expenditures by individuals on items such as accommodation, transportation, and personal expenses. The justification for non-inclusion of these costs is that individuals would be making payments in these areas even if they were not attending university. With regard to accommodation and transportation particularly, an increasing proportion of university students in Alberta happen to reside permanently in a university city. The argument of extra living expenses would not apply to this group.

Indirect costs. The direct application of the foregone earnings figures from Table V may be queried on two counts. First, because a number of students take summer employment, one could argue that foregone earnings would be decreased by the amount earned during

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*The conversion factor of 1.33 was calculated from a comparison of 1961 and 1968 average annual incomes for a number of occupations for which high school education was a prerequisite. The sources of these data were the fifth and twelfth annual reports of the Alberta Bureau of Statistics, which are surveys of Alberta salary and wage rates.

TABLE VI

INTERPOLATED 1961 AND ESTIMATED 1968 AVERAGE ANNUAL INCOME FROM WAGES AND SALARIES BY YEARS OF AGE FOR MALE WAGE EARNERS IN ALBERTA WITH COMPLETED SECONDARY SCHOOLING

Age	Annual earnings		Age	Annual earnings	
	1961	1968[b]		1961	1968[b]
15	$1,331	$1,776	40	$5,247	$7,000
16	1,548	2,065	41	5,265	7,024
17	1,767	2,357	42	5,283	7,048
18	1,984	2,647	43	5,301	7,072
19	2,202	2,938	44	5,319	7,096
19.5	2,311[a]	3,083	45	5,338	7,121
			46	5,356	7,145
20	2,420	3,229	47	5,374	7,169
21.	2,638	3,519	48	5,392	7,193
22	2,856	3,810	49	5,410	7,217
23	3,073	4,100			
24	3,291	4,390	49.5	5,419[a]	7,229
25	3,509	4,681	50	5,389	7,189
26	3,727	4,972	51	5,329	7,109
27	3,945	5,263	52	5,268	7,028
28	4,162	5,553	53	5,209	6,949
29	4,380	5,843	54	5,149	6,869
29.5	4,489[a]	5,989	55	5,089	6,789
			56	5,028	6,708
30	4,562	6,038	57	4,968	6,628
31	4,600	6,137	58	4,908	6,548
32	4,676	6,238	59	4,848	6,468
33	4,751	6,338			
34	4,826	6,438	59.5	4,818[a]	6,428
35	4,901	6,538	60	4,788	6,388
36	4,975	6,638	61	4,728	6,308
37	5,050	6,737	62	4,668	6,228
38	5,125	6,837	63	4,608	6,148
39	5,200	6,937	64	4,548	6,067
39.5	5,238[a]	6,988			

[a]Source: Table IV.

[b]Estimated by multiplying interpolated 1961 figures by conversion factor 1.3341.

the summer employment. The findings regarding personal revenue and expenses, contained in Table VII indicate that summer earnings may in fact be merely a subsistence income. Second, one could argue that if the subjects in this study had entered or remained in the labor force rather than enter a university, their average earnings may have been higher because of the ability factor. Stager (1968, pp.97-9) discusses the modification of foregone earnings data to take account of what he calls a motivation-ability difference. His conclusion was that adjusted foregone earnings data made little difference in the computation of returns (Stager, 1968, p.98).

Negative costs. No adjustments to costs were made to take account of incidental payments to students by way of scholarships, bursaries, grants, or remission of fees. The justifications for non-inclusion of these items are two-fold: first adequate information indicating the amount and pattern of these payments is not readily available; and secondly, the potential investor in university education cannot take for granted that such payments will be available to him.

Investment-related Benefits

The benefits accruing to the three types of decision-makers will be treated separately below, but before doing so, several general points need to be made.

1. In this study, the benefits resulting from investment in university education were restricted to earnings, from wages or

TABLE VII

PERSONAL REVENUE AND EXPENSES* FOR MALE ARTS, SCIENCE AND ENGINEERING UNDERGRADUATES, ALBERTA, 1968-69

Study program	Average personal revenue	Average personal expenses	Difference
B.A. or B.Sc.	$829	$904	-$75
B.Eng.	1,146	1,174	- 28

Source: Post-Secondary Population Survey, 1968-69 (Unpublished information, DBS, September, 1969). Tables 1398, 1508.

*Personal expenses cited here do not include academic expenses, or accomodation.

salaries, paid to an individual for services rendered in his chosen occupation. This, then, excluded income which resulted from other investments and other extra-occupational income. In addition, the marginal earnings, and not the gross earnings, from employment were taken as the financial return from the educational investment. The term marginal earnings, it will be recalled, was defined in this study as the additional amount of an individual's earnings which is attributed to some educational increment.

2. As one of the intentions of this study was to compare the returns to three occupational groups there had to be some parity established for the work roles of the different groups. The general assumption made to cover this point was that none of the individuals in the three cohorts functioned at the supervisory or administrative levels. This point is clarified below in the discussion of the earnings data.

3. The earnings streams for all groups in this study were derived from before-tax data; furthermore, no adjustments were made to take account of morbidity, mortality or unemployment rates. The rejection of such modifications to the earnings data was considered to be justifiable on three grounds: (a) the individual investor, from a subjective point of view receives information on salaries from prospective employers in before-tax figures; (b) this study sought to illustrate relationships within and between three types of decision-makers, so only internal consistency in methodology need be satisfied; (c) facts concerning illness, early death and

unemployment may be of particular interest in national labor statistics but they are unlikely to be perceived as contingent matters by the individual decision-maker.

Benefits for Type A Decision-makers (Engineers)

In order to calculate monetary benefits resulting from the acquired educational increment, the researcher had first, to estimate a lifetime earnings profile for Alberta engineers, and then, by relating this profile to that of high school graduates, calculate the year by year earnings differentials.

Earnings of engineers. The salary scale for Alberta engineers was derived from a factual report of salaries actually paid to 10,981 engineers working for 156 organizations in British Columbia, Alberta and Ontario (Association of Professional Engineers, 1969). The report shows the distribution of salaries at a specific point in time, namely July 1st, 1968. The salaries are classified relative to two variables: (a) the number of years of working experience since graduation, and (b) the level of responsibility ascribed to the engineer's work. In accord with an earlier specification, the first three levels of a total of seven were assumed to cover the range of salaries for functioning engineers; that is to say, the supervisory and administrative levels were excluded. The resulting average salary scale calculated from the first three levels is shown in Table VIII. The average beginning salary for Alberta engineers was found to be $7,827. Salaries increased by increments until the eleventh year after graduation, thereafter, minor fluctuations, up

TABLE VIII

ESTIMATED EARNINGS STREAM FOR ENGINEERS IN ALBERTA (1968 dollars)

Years experience from degree	Average annual earnings	Years experience from degree	Average annual earnings
0	$7,827	6	$10,157
1	8,104	7	10,447
2	8,671	8	10,506
3	9,114	9	10,666
4	9,621	10	10,677
5	9,819	>10	10,789

Source: *Report '68 On Salaries, Engineers Joint Survey.* Issued by the Canadian Association of Professional Engineers.

and down, suggested that from the twelfth year on a mean salary of $10,789 should be used.

Earnings of high school graduates. The lifetime earnings stream attributed to male high school graduates is shown in Table IX. The earnings stream shows a salary of $2,647 at age 18, peak earnings of $7,217 at age 49, and a gradual decline to $6,067 at age 64.

Marginal earnings streams for engineers. The marginal earnings streams derived for engineers varied directly according to the age at which the decision-maker began his degree program. This variation was assumed to be caused not by different commencing salaries but by the difference between the engineer's starting salary ($7,217) and the average earnings of a male high school graduate the same age as the beginning engineer. For example, an engineer who commenced his degree at age 18 would have a marginal advantage of $4,017 in his first year of work because his commencing salary would be related to that of a 22 year old male high school graduate. Similarly, one who commenced his degree at age 25 would have a marginal advantage of $1,984, because his commencing salary would be related to that of a 29 year old male high school graduate. Once the beginning point was located, marginal earnings for subsequent years for each of the 24 subject types were found by taking successive differences on the two earnings scales (engineers and high school graduates).

TABLE IX

ESTIMATED EARNINGS STREAM FOR ALBERTA
MALE HIGH SCHOOL GRADUATES
(1968 dollars)

Age	Average annual earnings	Age	Average annual earnings	Age	Average annual earnings
18	$2,647	34	$6,438	49	$7,217
19	2,938	35	6,538	50	7,189
20	3,229	36	6,638	51	7,109
21	3,519	37	6,737	52	7,028
22	3,810	38	6,837	53	6,949
23	4,100	39	6,937	54	6,869
24	4,390	40	7,000	55	6,789
25	4,681	41	7,024	56	6,708
26	4,972	42	7,048	57	6,628
27	5,263	43	7,072	58	6,548
28	5,553	44	7,096	59	6,468
29	5,843	45	7,121	60	6,388
30	6,038	46	7,145	61	6,308
31	6,137	47	7,169	62	6,228
32	6,238	48	7,193	63	6,148
33	6,338			64	6,067

Benefits for Type B Decision-makers (Arts or Science Degree)

To calculate monetary benefits from the acquired educational increment, the researcher had first, to estimate a lifetime earnings profile for Alberta male graduates in Arts or Science, and then by relating this profile to that of high school graduates, calculate the year by year earnings differentials.

Earnings for Arts or Science graduates. The earnings data for this group were drawn from the report of the 1961 Census of Canada. The data, based on a 20% sample of non-farm households shows: "Total income from employment by size for the non-farm male population 25-64 years of age, in the current labour force, by occupation, schooling and age, for Canada, for the year ended May 31, 1961 (Canada, DBS, 1965, B6-1)."

The report indicates that of the total sample, 191,120 individuals held university degrees; these persons were listed under a number of occupations. This necessitated reducing the sample to a residual group of degree-holders which could be reasonably expected to be representative of individuals holding a general Arts or Science degree, and whose members were not employed at the administrative levels. Religion professionals were excluded because their earnings are atypical. Finally, teachers and engineers were also excluded because general degree-holders were to be compared with each of them. Table X indicates the numbers and percentage of each of the culled groups in relation to the total. The group under managerial occupations was the largest at 18.8%, followed by engineers 14.7%,

TABLE X

UNIVERSITY MALE GRADUATES BY OCCUPATION, CANADA, 1961

Occupational group	N	Percentage of total
Physicians and surgeons	16,271	8.5%
Dentists	4,249	2.2
Lawyers	10,088	5.3
Engineers	28,020	14.7
Managerial occupations	35,960	18.8
Teachers	25,056	13.1
Religion professionals	7,806	4.1
Residue	63,670	33.3
Totals	191,120	100.0

Source: Canada, Dominion Bureau of Statistics, 1961 Census of Canada, Incomes of Individuals, No. 98-502 (Ottawa: Queen's Printer, 1965). Table B.6.

teachers 13.1%, physicians and surgeons 8.5%, lawyers 5.3%, religion professionals 4.1% and dentists 2.2%. These exclusions left a residue of 63,670 individuals, or 33.3% of the total of 191,120 degree-holders.

Average incomes from wages and salaries by age categories, for these groups are shown in Table XI. Average earnings of physicians and surgeons was highest at $15,752, followed by dentists $13,705, lawyers $11,718, managerial occupations $11,385, engineers $8,354, teachers $6,633 and religion professionals $3,571. The average income of the residual group was $7,628.

Because the earnings data in the 1961 Census report are for degree-holders age 25 and above, salaries from graduation up to age 25 had to be estimated. These estimates were made from beginning salaries for Arts and Science graduates. A table furnished by the Department of Manpower and Immigration based on figures from a survey of some 300 national employers indicates that starting salaries for this group averaged $6,000 per year (Department of Manpower and Immigration, 1969, p.56). The 1961 Census data were updated to 1968 dollars by a conversion factor of 1.33 (DBS Bulletin, July, 1968). These estimates are shown in Table XII. The estimated average earnings for the 25-34 year old males in 1968 dollars was $8,144, for 35-44 year olds $10,490, 45-54 year olds $10,667, and for 55-64 year olds $10,403.

By combining the updated census data and the estimates of beginning salaries, and then interpolating salaries for individual years, an estimated earnings stream for holders of general degrees in Arts or Science was derived. This earnings stream is presented

TABLE XI

AVERAGE INCOME FROM WAGES AND SALARIES FOR MALE UNIVERSITY GRADUATES, CANADA, 1961

Age	All occupations	Average income							
		Physicians and Surgeons	Dentists	Lawyers	Engineers	Managerial occupations	Teachers	Religion professionals	Residue
25-34	$6,909	$9,411	$14,025	$7,879	$6,858	$8,527	$6,056	$3,096	$6,123
35-44	9,966	18,348	14,936	13,276	9,040	11,140	8,004	3,534	7,887
45-54	10,821	19,728	14,464	13,711	9,976	13,028	9,156	3,776	8,020
55-64	10,609	15,543	10,820	16,322	10,648	13,242	9,455	4,013	7,822

Sources: Canada, Dominion Bureau of Statistics, *1961 Census of Canada*, Incomes of Individuals, No. 98-502 (Ottawa: Queen's Printer, 1965). Table B.6.

TABLE XII

ESTIMATED AVERAGE INCOME FROM WAGES AND SALARIES FOR ALBERTA MALES HOLDING THREE-YEAR BACHELOR OF ARTS OR BACHELOR OF SCIENCE DEGREE, 1961, 1968

Age interval	Estimated average annual wage or salary	
	1961	1968*
25 - 34	$6,123	$8,144
35 - 44	7,887	10,490
45 - 54	8,020	10,667
55 - 64	7,822	10,403

Source: Canada, Dominion Bureau of Statistics, 1961 Census of Canada, Incomes of Individuals, No. 98-502 (Ottawa: Queen's Printer, 1965). Table B.6.

*Estimated by multiplying 1961 figures by conversion factor 1.33.

in Table XIII. The lifetime earnings stream shows a salary of $6,000 at age 18, peak earnings of $10,670 at age 49, and a gradual decline to $10,290 at age 64.

Marginal earnings for Arts or Science graduates. The marginal earnings stream derived for Arts or Science graduates varied directly according to the age at which the decision-maker began his university program. This variation was considered to be caused not by different commencing salaries but by the difference between the starting salary of an Arts or Science graduate ($6,000) and the average earnings of a male high school graduate of the same age. For example, an Arts or Science graduate who commenced his degree at age 18 would have a marginal advantage of $2,481 in his first year of work, because his commencing salary would be related to that of a 21 year old male high school graduate. Similarly, one who commenced his degree at age 25 would have a marginal advantage of $447, because his starting salary would be related to that of a 28 year old male high school graduate. When the starting point for finding marginal earnings was thus located, the differentials for the 15 subject types were found by calculating successive differences from the two earnings streams (Arts or Science graduates and high school graduates).

Benefits for Type C Decision-makers (Teachers)

The calculation of monetary benefits for this group involved the establishment of a lifetime earnings stream for teachers who started their careers accredited with four years of teacher education. This stream of earnings had then to be related to the earnings stream

TABLE XIII

ESTIMATED EARNINGS STREAM FOR CANADIAN MALE UNIVERSITY GRADUATES HOLDING THREE-YEAR BACHELOR OF SCIENCE OR ARTS DEGREES
(1968 dollars*)

Age	Average annual earnings	Age	Average annual earnings
21	$6,000	43	$10,562
22	6,252	44	10,580
23	6,504	45	10,598
24	6,756	46	10,616
25	7,008	47	10,634
26	7,260	48	10,652
27	7,512	49	10,670
28	7,764	50	10,654
29	8,016	51	10,628
30	8,261	52	10,602
31	8,496	53	10,576
32	8,731	54	10,550
33	8,966	55	10,524
34	9,201	56	10,498
35	9,436	57	10,472
36	9,671	58	10,446
37	9,906	59	10,420
38	10,141	60	10,394
39	10,376	61	10,368
40	10,508	62	10,342
41	10,526	63	10,316
42	10,544	64	10,290

*Census data were updated using an index of 1.33, see Appendix.

Source: Canada, Dominion Bureau of Statistics, *1961 Census of Canada*, Incomes of Individuals, No. 98-502 (Ottawa: Queen's Printer, 1965). Table B.6.

of male high school graduates to calculate earnings differentials.

Earnings for teacher graduates. The earnings stream for this group was calculated from figures supplied by the Alberta Teachers' Association. The data obtained from the ATA contained the salary scales for collective agreements made in 105 urban and rural school jurisdictions for the 1968-69 school year. To calculate the lifetime earnings stream for four-year accredited teachers, the 105 scales in existence for this group were averaged. Table XIV contains the results of these calculations. The commencing salary for a four-year trained teacher was assumed to be $6,638 and the earnings increased by years of experience up to $10,765 in the thirteenth year of teaching. Thereafter, the teacher was assumed to receive this latter amount until he reached retirement. Again, it should be emphasized that the subjects were not assumed to move into the administrative levels in education.

Marginal earnings for teacher graduates. As with the previous two subject types, the marginal earnings stream for teacher graduates was assumed to vary directly according to the age at which the decision-maker commenced his university program. In the case of teachers, this assumption is reinforced by actual practice in Alberta, for a beginning teacher starts on the first rung of the salary scale appropriate to his qualifications, not according to his age.

The marginal earnings streams for the teachers were assessed by comparing their earnings with the earnings of high school graduates. Therefore, a teacher who began his four-year university program at

TABLE XIV

AVERAGES OF SALARY SCALES FOR TEACHERS IN ALBERTA

Years of teaching experience	Years of university education			
	One	Two	Three	Four
0	$4,171	$4,752	$5,486	$6,638
1	4,383	5,055	5,811	7,050
2	4,608	5,350	6,131	7,472
3	4,868	5,650	6,451	7,870
4	5,155	5,948	6,768	8,278
5	5,423	6,241	7,080	8,678
6	5,687	6,522	7,382	9,077
7	5,930	6,795	7,683	9,476
8	6,138	7,059	7,978	9,870
9	6,270	7,284	8,255	10,260
10	6,377	7,434	8,490	10,648
11			8,493	10,733
12				10,765

Source: Calculated from Summary of Collective Agreements for 1968-69, (Alberta Teachers' Association).

age 18 had a marginal advantage in his first earnings year of $2,828, because his earnings were related to that of a male high school graduate aged 22. Likewise, a teacher who began his four-year university program at age 25 had a marginal advantage in his first earnings year of $795, because his earnings were related to that of a male high school graduate aged 29. Starting points for the 19 subject types were found in this way and then their respective marginal earnings streams were generated from calculating successive differences on the two earnings streams (teacher graduates and male high school graduates).

CHAPTER V

ANALYSIS AND DISCUSSION OF COSTS AND BENEFITS

The findings reported below are categorized according to the sub-questions given under the major research problem in Chapter II. These were:

1. What are the estimated private costs of investment in three forms of baccalaureate education commenced at various ages: Bachelor of Engineering, Bachelor of Arts or Science, and Bachelor of Arts or Science plus one year of teacher education?

2. When comparisons are made with the estimated earnings of high school graduates, what are the consequential marginal earnings streams for each of the three patterns of university education commenced at various ages?

3. What are the present values of each of the marginal earnings streams?

4. What are the internal rates of return for each of the marginal earnings streams?

5. What implications do the findings have for those contemplating investment in university education?

6. What implications do the findings have for policy-makers concerned with the establishment of adult re-training programs?

7. What implications do the findings have for university administrators?

8. How do the findings reported in this study compare with findings of other rate of return studies?

The Findings

Private Costs

By combining the direct and indirect costs, which were described in Chapter IV, the total investment related costs were derived for each of the subject types in the study. Tables XV, XVI, and XVII contain, as examples, the total private costs for the three subject types at age 18, 25 and 30 respectively. In 1968 dollars the total private cost of the four-year engineering program was assessed as $12,454 if commenced at age 18, $19,192 at age 25, and $22,799 at age 30. The total private cost for an arts or science program was estimated to be $9,079 if commenced at age 18, $14,321 at age 25, and $17,350 at age 30. The total private cost for a teacher education program was calculated to be $12,100 if commenced at age 18, $18,837 at age 25, and $22,443 at age 30.

The substantial increase in total costs relative to age at which a program was commenced by each of the subject types is clearly attributable to the marked rise in the foregone earnings component of the costs. For the older investors, foregone earnings undoubtedly looms large as an element in the decision whether or not to undertake a university education. Unlike their 18 year old counterparts, who

TABLE XV

PRIVATE COSTS OF EDUCATION PER STUDENT BY PROGRAM,
ALBERTA MALES, AGE 18
(1968 dollars)

Program	Fees	Additional academic expenses	Foregone earnings	Total costs (discounted at 8%) Annual	Program
Engineering	$546	$159	$2,647	$3,103	
	546	159	2,938	3,123	
	546	159	3,229	3,123	
	546	159	3,519	3,105	$12,454
Arts or Science	446	154	2,647	3,006	
	446	154	2,938	3,033	
	446	154	3,229	3,040	9,079
Arts or Science plus year of teacher education	446	154	2,647	3,006	
	446	154	2,938	3,033	
	446	154	3,229	3,040	
	438	153	3,519	3,021	12,100

Sources: Tables II, III, IV and IX.

TABLE XVI

PRIVATE COSTS OF EDUCATION PER STUDENT BY PROGRAM, ALBERTA MALES, AGE 25 (1968 dollars)

Program	Fees	Additional academic expenses	Foregone earnings	Total costs (discounted at 8%) Annual	Program
Engineering	$546	$159	$4,681	$4,987	
	546	159	4,972	4,867	
	546	159	5,263	4,738	
	546	159	5,553	4,560	$19,192
Arts or Science	446	154	4,681	4,890	
	446	154	4,972	4,777	
	446	154	5,263	4,654	14,321
Arts or Science plus year of teacher education	446	154	4,681	4,890	
	446	154	4,972	4,777	
	446	154	5,263	4,654	
	438	153	5,543	4,516	18,837

Sources: Tables II, III, IV and IX.

TABLE XVII

PRIVATE COSTS OF EDUCATION PER STUDENT BY PROGRAM,
ALBERTA MALES, AGE 30
(1968 dollars)

Program	Fees	Additional academic expenses	Foregone earnings	Total costs (discounted at 8%) Annual	Program
Engineering	$546	$159	$6,038	$6,244	
	546	159	6,137	5,866	
	546	159	6,238	5,512	
	546	159	6,338	5,177	$22,799
Arts or Science	446	154	6,038	6,146	
	446	154	6,137	5,776	
	446	154	6,238	5,428	17,350
Arts or Science plus year of teacher education	446	154	6,038	6,146	
	446	154	6,137	5,776	
	446	154	6,238	5,428	
	438	153	6,338	5,093	22,443

Sources: Tables II, III, IV and IX.

have not been full time members of the labor force, they can perceive foregone income as a real financial sacrifice.

Marginal Earnings

The marginal earnings or the earnings differentials attributable to each of the subject type's additional education was calculated by summing yearly differences of the university graduate's average earnings and a high school graduate's average earnings. Table XVIII, contains as examples, the sum of marginal earnings streams for 18 to 30 year olds in the three programs. Each of the sums is rounded to the nearest 100 dollars.

The results of this analysis showed that engineers received the highest total marginal earnings at all ages. At age 18 the margin in their favor was $30,000 or 1.23 times more than Arts and Science graduates and $10,000 or 1.07 times more than teacher graduates. The relative advantage to engineers increased directly according to the age at which the university education was begun; at age 30 the engineer received 1.46 times more than Arts and Science graduates and 1.14 times more than teacher graduates.

Present Values and Internal Rates of Return

Engineering graduates. The present values of an engineer's marginal earnings were found by discounting at 6%, 8% and 10%. The choice of these discount rates was arbitrary but they do provide a range of present values which demonstrate the worth of the investment to three classes of decision-makers: 6% was considered an appropriate

TABLE XVIII

LIFETIME MARGINAL EARNINGS ATTRIBUTED TO THREE DEGREE PROGRAMS, ALBERTA MALES, AGES 18-30
(1968 dollars)

Age at which program commenced	Additional lifetime earnings by program		
	Engineering four-year degree	Arts or Science three-year degree	Arts or Science plus year of teacher education four-year program
18 years	$161,700	$131,100	$151,000
19	153,700	123,500	142,900
20	145,700	116,100	135,100
21	138,000	109,000	127,500
22	130,800	102,100	120,300
23	123,900	95,500	113,200
24	117,300	89,100	106,700
25	110,800	83,200	101,300
26	104,700	77,400	94,200
27	98,900	71,800	88,400
28	93,400	66,600	83,000
29	88,000	61,400	77,600
30	83,200	56,800	72,800

Sources: Tables VIII, IX, XIII and XIV.

rate for those persons who are satisfied with a return which, although not the best available rate obtainable on a 'risk-free' investment, is reasonable; 8% was chosen to indicate the worth of the investment in education when compared with a 'risk-free' rate (for example, that available from investment in Canada Savings bonds); and, 10% was chosen to give some measure of the worth of the investment in education when that investment is viewed as entailing some degree of risk, or if the investor has to borrow money to finance his education. Results are shown in Table XIX.

Discounted at 6%, the present value of engineers' total marginal earnings ranged from $37,757 for one who commenced his program at age 18 to $76 for one who commenced at age 41. At an 8% discount rate the present values ranged from $24,896 at age 18 and $68 at age 33; thereafter the discounted earnings streams were negative. At a 10% discount rate, the present values ranged from $16,603 at age 18 to $284 at age 27; thereafter discounted earnings streams were negative.

Internal rates of return ranged from a high of 21.1% at age 18 to a low of 6.0% at age 41. An individual who began his program at any age from 18 to 27 received a return of greater than 10% on his investment. If 8% was considered as the required minimum return, one who invested in the four-year engineering program could expect to yield at least that interest if he began the program at any age from 18 to 33 inclusive. The results for all ages are shown in Table XIX.

TABLE XIX

A COMPARISON OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN A FOUR-YEAR BACHELOR OF ENGINEERING PROGRAM AT VARIOUS AGES, ALBERTA, MALES, 1968

Age at which program commenced	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	8% (3)	10% (4)	Internal rate of return (5)
18 years	$161,707	$37,757	$24,896	$16,603	21.1%
19	153,665	34,838	22,435	14,460	19.1
20	145,714	31,920	19,972	12,312	17.2
21	138,044	29,121	17,609	10,247	15.7
22	130,784	26,515	15,404	8,315	14.4
23	123,923	24,087	13,349	6,506	13.2
24	117,306	21,780	11,397	4,788	12.3
25	110,817	19,539	9,512	3,132	11.4
26	104,709	17,505	7,808	1,638	10.7
27	98,892	15,604	6,259	284	10.1
28	93,366	13,954	4,877	- 913	9.6
29	88,030	12,378	3,600	-2,009	9.2
30	83,184	11,161	2,665	-2,781	8.9
31	78,433	9,981	1,770	-3,510	8.6
32	73,781	8,830	903	-4,213	8.3
33	69,230	7,710	68	-4,886	8.0
34	64,780	6,624	- 734	-5,525	7.8
35	60,429	5,572	-1,501	-6,129	7.5
36	56,178	4,557	-2,229	-6,693	7.2
37	52,027	3,581	-2,915	-7,214	7.0
38	47,975	2,646	-3,557	-7,687	6.8
39	44,022	1,754	-4,151	-8,108	6.5
40	39,415	311	-5,247	-8,987	6.1
41	36,381	76	-5,212	-8,807	6.0

Bachelor of Science or Bachelor of Arts graduates. The present values of Arts or Science graduates' marginal earnings streams were found by discounting at 6%, 8% and 10%. The results for 15 ages are shown in Table XX.

When a 6% discount rate was applied the present value of Arts or Science graduates' marginal earnings ranged from $26,877 for one who commenced his program at age 18 to $650 for one who commenced at age 30; thereafter discounted earnings streams were negative. At an 8% discount rate the present values ranged from $16,922 at age 18 to $1,637 at age 25; thereafter the discounted marginal earnings streams were negative. At a 10% discount rate the present values ranged from $10,739 at age 18 to $633 at age 23; thereafter the discounted marginal earnings streams were negative.

Internal rates of return ranged from 19.4% at age 18 to a low of 2.7% at age 40. An individual who began his three-year program at any age between 18 and 23 received a return of greater than 10%. If the required minimum return was set at 8%, this would be equalled or exceeded by investing at any age between 18 and 26 inclusive. In the case of a decision-maker who was satisfied with a return of 6% or better, his expectation would be met if he invested at any age between 18 and 30 inclusive. Internal rates of return for all ages are shown in Table XX.

Teacher graduates. The marginal earnings streams for teacher graduates were also discounted at 6%, 8% and 10% to produce present values. The results are shown in Table XXI.

TABLE XX

COMPARISON OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN A THREE-YEAR BACHELOR OF ARTS OR BACHELOR OF SCIENCE PROGRAM AT VARIOUS AGES, ALBERTA, MALES, 1968

Age at which program commenced	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	8% (3)	10% (4)	Internal rate of return (5)
18 years	$131,097	$26,877	$16,922	$10,739	19.4%
19	123,454	23,935	14,428	8,563	16.8
20	116,077	21,102	12,023	6,458	14.6
21	108,963	18,394	9,720	4,437	12.9
22	102,123	15,810	7,520	2,502	11.5
23	95,530	13,357	5,434	633	10.4
24	89,106	11,034	3,463	- 1,073	9.4
25	83,154	8,885	1,637	- 2,686	8.6
26	77,365	6,882	- 52	- 4,174	8.0
27	71,837	5,047	- 1,587	- 5,520	7.4
28	66,576	3,390	- 2,955	- 6,711	6.9
29	61,381	1,732	- 4,329	- 7,913	6.5
30	56,846	650	- 5,139	- 8,565	6.2
31	52,173	- 541	- 6,047	- 9,305	5.9
40	15,526	-9,305	-12,326	-14,156	2.7

TABLE XXI

A COMPARISON OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN A THREE-YEAR BACHELOR OF ARTS OR BACHELOR OF SCIENCE PLUS ONE YEAR TEACHER EDUCATION PROGRAM AT VARIOUS AGES, ALBERTA, MALES, 1968

Age at which program commenced	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	8% (3)	10% (4)	Internal rate of return (5)
18 years	$151,044	$31,796	$19,884	$12,360	17.9%
19	142,906	28,813	17,369	10,172	16.1
20	135,079	25,952	14,953	8,063	14.5
21	127,543	23,210	12,634	6,034	13.2
22	120,297	20,594	10,420	4,092	12.0
23	113,200	18,052	8,275	2,214	11.0
24	106,702	15,779	6,348	512	10.2
25	101,321	14,178	5,000	- 687	9.7
26	94,248	11,562	2,804	- 2,600	8.9
27	88,445	9,692	1,250	- 3,959	8.4
28	82,943	8,009	- 131	- 5,156	8.0
29	77,631	6,452	-1,386	- 6,229	7.6
30	72,809	5,221	-2,340	- 7,022	7.3
31	68,082	4,045	-3,233	- 7,750	7.0
32	63,454	2,897	-4,098	- 8,453	6.7
33	58,936	1,786	-4,928	- 9,121	6.4
34	54,530	717	-5,716	- 9,749	6.2
35	50,183	- 346	-6,493	-10,362	5.9
40	30,035	-4,989	-9,672	-12,699	4.5

At 6% the present values of teachers' total marginal earnings ranged from $31,796 for one who commenced the program at age 18 to $717 for one who commenced at age 34; thereafter the discounted earnings streams were negative. At an 8% discount rate the present values ranged from $19,884 at age 18 to $1,250 at age 27. When a 10% discount rate was applied, the present values ranged from $12,360 at age 18 to $512 at age 24.

Internal rates of return ranged from a high of 17.9% at age 18 to a low of 4.5% at age 40. A return of 10% or greater would be received by a person who began his four-year program at any age between 18 and 24 inclusive. If the minimum return expected was set at 8%, the program would have to be commenced at least by age 27; and for a minimum return of 6% the investor would need to begin his program at or before the age of 34.

Discussion of Results

The major purpose of this study was to make an economic evaluation of baccalaureate education in Alberta, by reviewing particular programs and their associated costs and benefits for potential investors of varying ages. Specific comparisons were made possible within and between each of the university programs analyzed, by the introduction of the age at which the program was commenced as a variable.

The results of the return analyses, using internal rates of return and present values, showed that there was a substantial net monetary return to investment in under-graduate education for those

who entered such a program of university study at or before the age of 26. Furthermore, the younger the age at which the program was commenced, the greater was the financial return.

The present value method of evaluation or the internal rate of return method taken alone, was shown to be insufficient in ordering the options available according to their financial return. This is illustrated in Table XXII, in which the returns to each of the three programs are set out, by two year intervals, for persons beginning university at ages 18 to 28 inclusive. If an individual decision-maker at age 18 was guided by the internal rate of return figures, he would choose Engineering (which showed an internal rate of 21.1%) over Arts or Science (internal rate of 19.4%), and Arts or Science over a four-year teacher education program (internal rate of 17.4%). But if the same decision-maker was more interested in the net financial gain or present value of his future earnings, he would choose Engineering (which yielded $24,896, discounted at 8%) over four years of teacher education (present value of $19,884), and four years of teacher education over Arts or Science (present value of $16,922).

The observed discrepancy in ordering by the two alternative evaluation methods occurs also at age 19 and 20, but for later ages the classification is the same by both present values and internal rates of return, that is Engineering first, teacher education second, and Arts or Science last.

This finding suggests two things. The first is that an evaluation of educational investments may be misleading if only one of the two approaches is used; and this has been recognized in

TABLE XXII

COMPARISON OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN A THREE-YEAR BACHELOR OF ARTS OR SCIENCE PROGRAM, A FOUR-YEAR TEACHER EDUCATION PROGRAM AND A FOUR-YEAR ENGINEERING PROGRAM AT VARIOUS AGES, ALBERTA, MALES, 1968

Age at which program commenced	Type of program*	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	8% (3)	10% (4)	Internal rate of return (5)
18 years	1	$131,097	$26,877	$16,922	$10,739	19.4%
18	2	151,044	31,796	19,884	12,360	17.9
18	3	161,707	37,757	24,896	16,603	21.1
20	1	116,077	21,102	12,023	6,458	14.6
20	2	135,079	25,952	14,953	8,063	14.5
20	3	145,714	31,920	19,972	12,312	17.2
22	1	102,123	15,810	7,520	2,502	11.5
22	2	120,297	20,594	10,420	4,092	12.0
22	3	130,784	26,515	15,404	8,315	14.4
24	1	89,106	11,034	3,463	-1,073	9.4
24	2	106,702	15,779	6,348	512	10.2
24	3	117,306	21,780	11,397	4,788	12.3
26	1	77,365	6,882	-52	-4,174	8.0
26	2	94,248	11,562	2,804	-2,600	8.9
26	3	104,709	17,505	7,808	1,638	10.7
28	1	66,576	3,390	-2,955	-6,711	6.9
28	2	82,943	8,009	- 131	-5,156	8.0
28	3	93,366	13,954	4,877	- 913	9.6

*Program 1 is a three year B.A. or B.Sc.

Program 2 is a three year B.A. or B.Sc. plus one year of teacher education

Program 3 is a four year B.Eng.

previous studies. Bailey demonstrated formally that "the general solutions of investment decision problems cannot rely solely on either the present value or rate of return reasoning (1959, p.488)." The second, because previous studies on rates of return to university and college education have been focussed entirely on investors who undertake university study immediately after completion of high school, the findings that are based on internal rates of return do not provide valid guidelines for persons who choose to invest in a university education at later ages. If a decision-maker at age 26 say, wanted to maximize the rate of return on his investment, the information available from previous studies could lead him to make the wrong decision. This point is borne out by evidence shown in Table XXII, for at age 18 the internal rate of return figures showed Arts or Science to yield a higher interest than teacher education (19.4% compared to 17.9%), but at age 26 Arts or Science showed a yield of 8.0% compared with 8.9% for teacher education. This shortcoming of previous return studies is not insignificant in the light of support for their use in making private educational decisions more efficient.

A further major finding of this study showed that university education is a worthwhile investment not just for high school leavers, but for older persons as well. The upper age limit, beyond which a university education does not yield an adequate financial return, cannot be accurately pin-pointed because the adequacy of the return is a subjective judgment on the part of an individual decision-maker, and also because the matter of psychic benefits enters the picture. To assess just the financial aspect, one could attribute to the

decision-maker an expectation of at least an 8% return on his investment. With such a reference point in mind, the decision-maker would reap an adequate financial return by choosing to start an Engineering program between the ages of 18 and 33 inclusive, an Arts or Science program between the ages of 18 and 26 inclusive and a four-year teacher education program between the ages of 18 and 28 inclusive. These and other levels of return can be checked by reference to Tables XIX, XX and XXI.

The extended use of rate of return analysis to a range of ages also has some bearing on the question of educational outlays required for adult re-training. It already seems clear that changing occupational demands in the future will mean that for many individuals the first occupational choice could be but one of several made during a lifetime. The findings reported in this study showed a band of ages for which university education is economically profitable for such individuals.

The results can also be used to demonstrate how this kind of economic evaluation can be used for establishing criteria for assessing the level of financial support necessary to make non-profitable investments into profitable ones. To take an extreme case, for example, a 40 year old male does not reap a very handsome return from the three types of university education investigated in this study. However, by reducing the costs of his initial investment by remission of fees and some payment to offset his foregone earnings, his return could be raised to an acceptable level. The extent of financial support required to reduce his costs to an appropriate

level can be found by introducing a series of payments into the cost side of the present value rate of return equation.

Rate-of-return analysis can also be used to show the transformation of a profitable investment into a less profitable one. To illustrate this point, one could assume that the University of Alberta administration announced that the three-year Arts and Science programs would be supplanted by four-year Arts and Science programs from the beginning of 1968. One could further assume that the future earnings of four-year Arts or Science graduates would change little, if at all, from the earnings of three-year Arts or Science graduates, because: (a) the extra year would not entail specialization for a particular occupation, as is the case for most Honors degrees; (b) employers would most likely still treat these persons as holders of general degrees in Arts or Science, rather than four-year as opposed to three-year degree holders.

Bearing these assumptions in mind, the case was tested for the Arts or Science graduates in this study. The returns for a three-year degree are shown in Table XX and were discussed elsewhere. The returns for a four-year degree in Arts and Science were calculated by adding an extra year of costs to those of three-year graduates and attributing the same earnings stream to the four-year graduates as was used for the three-year graduates. The results are contained in Table XXIII. By either method of evaluation, internal rate of return or present value, the extra year required to complete the degree had a marked effect on the individual's financial return. At age 18 the present value, using a discount rate of 8%, of the marginal benefits

TABLE XXIII

COMPARISON OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN A FOUR-YEAR BACHELOR OF ARTS OR BACHELOR OF SCIENCE PROGRAM AT VARIOUS AGES, ALBERTA, MALES, 1968

Age at which program commenced	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	8% (3)	10% (4)	Internal rate of return (5)
18 years	$119,999	$19,442	$10,299	$4,793	13.1%
20	105,234	13,776	5,480	570	10.3
22	91,020	8,385	901	-3,445	8.3
24	78,164	3,674	-3,105	-6,978	6.9

attributed to a three-year program was $16,922, for a four-year program, this dropped to $10,299; the internal rate of return dropped from 19.4% for the three-year program to 13.1% for the four-year program. The difference is even more marked for a student who began university study at age 22: the present value of the marginal benefits again discounted at 8%, was $7,520 for the three-year program, but only $901 for the four-year program; the respective internal rates of return were 11.5% and 8.3%.

The outcome of the above comparison clearly indicates that from a financial point of view an individual should be discouraged from undertaking a four-year program in Arts or Science. He would be better served by investing in a four-year program which enabled him to acquire qualifications for a specific occupation like teaching or engineering. The comparison also indicates that allocation of extra resources to institute a four-year program in Arts or Science would be unwarranted from a social point of view, for the social rate of return would be markedly reduced in the same way as the private rate of return.

Presently, at the University of Alberta, students may take an honors year after a three-year Arts or Science degree. If the honors year is the terminating year of formal education and the program is not prerequisite to a particular occupation, its value from a monetary point of view may be little different from the four-year Arts or Science degree discussed above.

University administrators, therefore, should not overlook the economic repercussions of decisions they make with regard to course requirements. There may be valid educational reasons for proposing

major modifications to degree programs, but if educational justifications alone are used to support action, the decisions taken are based on insufficient evidence.

Attrition Rates and Rates of Return

One of the assumptions upon which the above rates of return were calculated was that *all* the students completed their university programs in the minimum time specified by University regulations. This, of course, is not the case in the real university situation, and to overlook the existence of substantial attrition rates would be misleading the private decision-maker.

Some evidence is available on attrition rates in North American universities. Fleming (1965) found that at the University of Toronto, 24.4% of the 1949 entering class in Arts had withdrawn without a degree by 1955. He also noted that in the 1948 engineering class at McGill, 43.4% failed or withdrew before graduation. In a survey of attrition rate studies carried out in the United States from 1913 to 1962, Summerskill (1962) found a median withdrawal rate of 50%.

Precise data are not readily available for the University of Alberta, but if one were to assume that the attrition rate for a three-year Arts or Science degree was 25%, for a four-year teacher education degree was 33%, and for a four-year Engineering degree was 45%, these rates could be used in conjunction with rates of return to provide additional information to the potential investor.

One interpretation could be to indicate the probability that the rate of return for a given program would be achieved. For example, by using the hypothetical rates assumed above, one could suggest that the probability of an Arts or Science graduate gaining a return of $130,000 on his investment would be 0.75, for a teacher graduate the probability of achieving a return of $150,000 would be 0.67, and for an engineering graduate the probability of obtaining a return of $160,000 would be 0.55.

A second interpretation is possible if one attributes a greater-risk factor to programs according to the level of attrition rates. From greatest to least risk, the programs could be ordered thus: Engineering, teacher education, Arts or Science. When the returns to each program are discounted by the same rate, this implies no risk difference; but if say 10%, 8% and 6% were applied to the three programs from highest to lowest risk respectively, a more accurate ordering of investment options may result. Present values so calculated for this study would show a return of $26,877 for Arts or Science, $19,884 for teacher education, and $16,603 for Engineering.

Comparisons with Other Studies

While one can be quite emphatic about making comparisons within this study, the same degree of certainty is not present when the findings are compared with those of other studies. This diffidence results not from lack of faith in the results of this or other studies, but for another reason. Benjamin Disraeli is reputed to have said "there are lies, damned lies, and statistics (quoted in Land, 1966,

p.226)." Disraeli's statement sounds a warning note for those who advance number measures to support an argument. Statistics used out of context or directly related to similar evidence, when such sets of evidence were gathered in different ways under different circumstances, can result in the ascription of unwarranted merit and implications to the outcomes of an investigation. This view applies to the discussion which follows, for the varied assumptions adopted by researchers in rate of return studies make direct comparisons between findings difficult. And yet, comparisons have heuristic worth in pointing out not the differences in results, but the effects of different assumptions in producing those results. The comparisons drawn below are confined to other Canadian studies.

Podoluk reported a private before-tax internal rate of return of 19.7% for all Canadian male university graduates (1965, pp.53-9). She did not report a present value figure, but Stager (1968, p.156) estimated it to be about $27,000 when discounted at 5% (1961 dollars). This figure updated to 1968 dollars would be about $36,000, and is in excess of the present values discounted at 6%, for Arts or Science and teacher graduates, found in this study ($26,877 and $31,796 respectively). It should be noted that Podoluk's results were based on earnings of *all* male university graduates in Canada. This means that persons holding graduate degrees, professional degrees in law, medicine and dentistry and several undergraduate degrees were included in the sample. Her findings cannot therefore be ascribed to persons holding any particular degree as is the case in the present study.

Wilkinson (1966, pp.556-72) reported the private net present

value after income tax earnings for all male university graduates, discounted at 5% to age 14, as $12,700. The present value figure discounted back to age 18 instead of 14 would be approximately $15,000 in 1961 dollars. When the figure is updated to 1968 dollars for comparison with the findings in the present study, the present value changes to about $20,000. This is well below the Podoluk estimate of about $36,000, and also below the average of the three present values at age 18 reported in this study, which was about $32,000 when discounted at 6%. Most of the difference between Wilkinson's findings and those of this study can be accounted for because of the fact that he used after income tax earnings data while this study reports findings from before income tax data. It is not possible to make a comparison of internal rates of return because Wilkinson rejects this method of assessing returns to investment in education.

Stager (1968), who, like Podoluk and Wilkinson, based his analysis on 1961 data, reported before income tax net present values and internal rates of return for males who took undergraduate degrees in Engineering, Arts or Science and Education. The net present values of expected lifetime earnings for the three groups, in the same order, were: $32,100, $36,800 and $14,500. The present values were discounted by 5% back to age 19, and were expressed in 1961 dollars. Updated to 1968 figures, the present values would be about $43,000, $48,000 and $20,000 respectively. The before income tax internal rates of return were given as 19.0% for Engineering, 19.1% for Arts or Science, and 11.5% for Education.

Using Stager's findings, the ordering of the three programs, according to private economic returns as measured by present values or internal rates, was Arts or Science first, Engineering second and Education third. This ranking is different from those found at age 19 in the present study: Engineering, Arts or Science then Education by internal rates of return; Engineering, Education then Arts or Science by present values.

Two features of Stager's results rate further comment: the high return attributed to Arts or Science graduates, and the relatively low return assigned to teacher graduates. By assuming "that the earnings data for 'All occupations, university degree' are the most appropriate data for Arts and Science graduates (Stager, 1968, p.216)." Stager produced an earnings stream which was biased upwards for these graduates. To claim that the average earnings for general degree holders would exceed those of engineering graduates seems quite unreasonable, and yet this is the outcome when he uses average earnings for 'All occupations, university degree' as a proxy for Arts and Science graduates' earnings (see Table XI, p.70 in this study).

The lower returns reported by Stager for teacher graduates relative to those for Arts or Science and Engineering graduates can be explained largely by the fact that the teacher graduates were assumed to have taken a five-year university program as opposed to four-year programs for the other two. The analysis of the teacher graduate's investment would therefore include higher initial costs and somewhat lower future benefits; hence, both the internal rate of return and the net present value of lifetime earnings would be diminished.

The above two features of the data he used make comparison of his findings with those of the present study tenuous, to say the least.

Finally, reference can be made to the Ph. D. research of D. J. Dibski, recently completed at the University of Alberta. His investigation deals with returns to differing periods of teacher education for Alberta males who begin their program at various ages. A comparison of his and this study's findings is contained in Table XXIV. In both studies, returns to a four-year teacher education program were shown to be almost the same. Minor differences can be explained by the slightly higher costs incurred by those individuals who took the Arts or Science degree plus a year of teacher education route. However, returns to three-year Arts or Science graduates and three-year teacher graduates indicate a considerable margin in favor of the former. At age 18, the Arts or Science graduate's additional lifetime earnings is almost double that of the teacher graduate: $131,097 compared with $69,681. At age 30, the advantage is even more marked for the Arts or Science graduate's marginal earnings of $56,846 is slightly more than three times that of a teacher graduate's which is shown as $18,710. The internal rates of return for the two groups show a similar pattern. From an economic point of view, one would be prompted to choose as an investment a three-year Arts or Science program rather than three years of teacher education.

TABLE XXIV

COMPARISON OF FINDINGS FOR RETURNS
TO BACCALAUREATE EDUCATION,
ALBERTA, MALES, 1968

Age at which program commenced	Type of program*	Additional lifetime earnings (1)	Present value of additional earnings at 6% (2)	Present value of additional earnings at 8% (3)	Internal rate of return (4)
18 years	W_3	$131,097	$26,877	$16,922	19.4%
18	D_3	69,681	15,302	9,587	16.4
30	W_3	56,846	650	-5,139	6.2
30	D_3	18,710	-8,790	-11,474	2.6
18	W_4	151,044	31,796	19,884	17.9
18	D_4	151,071	31,815	19,902	18.0
30	W_4	72,809	5,221	5,245	7.3
30	D_4	72,836	-2,340	-2,317	7.3

*Program W_3 is a three year B.A. or B.Sc. investigated in Wilson's study.

Program D_3 is three years of teacher education investigated in Dibski's study.

Program W_4 is a three year B.A. or B.Sc. plus a year of teacher education, investigated in Wilson's study.

Program D_4 is a four year B.Ed. investigated in Dibski's study.

CHAPTER VI

SUMMARY, CONCLUSIONS AND IMPLICATIONS

Purpose of the Study

The major purpose of this study was to make a systematic economic evaluation of the private returns to Alberta males, resulting from investment in particular forms of baccalaureate education. The three types of baccalaureate education reviewed as investments were: a four-year Engineering degree, a three-year Arts or Science degree, and a four-year teacher education program consisting of a three-year Arts or Science degree plus one year of teacher education.

Research Procedures

By adopting the basic premise which underpins rate of return studies, that earnings are positively related to level of schooling, an investment analysis of the above three programs was carried out by weighing the costs of acquiring a university degree against the benefits attributed to the resultant educational increment. Both cost and benefit data were discounted to a base year, which was set at 1968.

Cost and Benefit Data

The costs taken as private expenditures on education included payments for tuition and union fees, plus additional study-related costs for books and equipment; and opportunity costs or foregone

income incurred by an individual for the period when he was a full time university student. Annual fees and other academic expenses amounted to $705 for Engineering, $600 for Arts or Science, and $591 for a year of teacher education. Foregone income varied according to the age of the student and consequently this cost item influenced markedly the level of an individual's investment. For example, the total discounted private costs at age 18 were $12,454 for Engineering, $9,079 for Arts or Science, and $12,100 for teacher education, but at age 30 the costs were $22,799 for Engineering, $17,350 for Arts or Science, and $22,443 for teacher education.

The benefits for each of the three cohorts, resulting from the type of university education acquired, were estimated separately by finding the marginal difference between a high school graduate's earnings and the earnings of engineers, Arts or Science graduates and four-year teacher graduates. This procedure involved the estimation of earnings streams for high school graduates, Arts or Science graduates, engineers and four-year teacher graduates.

The first two earnings streams mentioned were derived from 1961 census data, and were updated to 1968 figures by the application of a conversion factor of 1.33. Earnings streams for engineers were calculated from a 1968 survey of engineers' salaries carried out by the Canadian Association of Professional Engineers. The earnings streams for four-year teacher graduates were obtained by averaging the salary scales contained in collective agreements of 105 rural and urban school jurisdictions for the 1968-69 school year.

Evaluation Procedures

Two evaluation methods were used to estimate the private returns for each kind of investment: the net present values of marginal lifetime earnings and internal rates of return. Either method of evaluation implies the notion of some acceptable rate of return or some discount factor. For while the internal rate of return is obtained by simply finding the discount rate which makes the difference between the marginal earnings stream and the investment or cost stream equal zero, the internal rate so derived has then to be compared with an 'external' rate to judge whether the internal rate is relatively high or low. The external rate of return used for comparison therefore serves the same purpose as the discount rate in present value calculations. For this study the discount rate was set at 8%.

Findings

The returns resulting from investment in any one of the three university programs treated in this study were shown to be functionally related to the age at which an investor began his university study. Expressed in terms of discounted marginal lifetime earnings, (discounted at 8%) the ranking of the investment options for decision-makers at age 18 was, Engineering ($24,896) followed by teacher education ($19,884) then by Arts or Science ($16,922). However, when ranked by internal rates of return for decision-makers aged 18, the order was Engineering (21.1%) followed by Arts or Science (19.4%) then by teacher education (17.9%). For potential investors aged 21

and older, the sequence was the same when either present values or internal rates of return were used to produce the ranking; that is, Engineering first, teacher education second and Arts or Science last.

When an external rate of 8% was stipulated as a minimum return for each of the three educational investments, the following results were obtained: a person entering a four-year engineering program would have to begin his studies at or before the age of 33; one undertaking a four-year teacher education program would have to begin at or before the age of 28; and, one who chose to do a three-year Arts or Science degree would have to begin at or before the age of 26.

Conclusions

Researchers who have carried out rate of return studies dealing with investment in university education, some of which were reviewed in connection with this study, have assumed that the decision to invest in a university education is a once in a lifetime decision, made by individuals at the completion of high school. The present study, by extending the application of rate of return analysis, was able to show that university education not only pays as an investment for high school leavers, but for older persons as well. It should be emphasized, however, that if a minimum return on such an investment is expected by an individual decision-maker, there exists an upper age limit, beyond which the return is not economically profitable. While one can determine this upper age by designating a specific rate of return on the individual's investment, age as a limiting factor is really determined by the subjective judgment of the investor,

and not by any arbitrarily chosen discount rate used by the researcher.

The results of the study also indicated that the internal rate of return taken alone as an evaluation device can lead to spurious findings, for ratings of investment options by this measure were found to be different from ratings by discounted present value. Such a conclusion does not condemn the use of the internal rate but suggests that it should be used in conjunction with the concomitant present value.

Implications for Further Research

The writer believes that further research could be profitably undertaken on several fronts. The first is an application of the kind of analysis pursued in this study to other kinds of post-secondary education. Such analyses could evaluate the returns from other university courses, and programs of study undertaken in junior colleges and technical institutes. Secondly, attempts could be made to provide information for female decision-makers, as an increasing proportion of women are re-entering the labor force.

A third area which bears further investigation, is the relationship between the cost and benefits side of the investment analysis. Not only can one introduce age as a variable, as was done in this study, but the cost stream can also be varied by introducing different levels and kinds of negative cost such as remission of fees, scholarships, and grants to the investment equation. Substitutions such as these have particular relevance for students whose returns

from educational investment are found to be marginal.

The rate of return approach used to evaluate private investments in education is but one way of assessing whether or not such an allocation of resources is efficient; and to date its application and the resultant findings have been general in nature. This study pointed to some specific uses of the methodology which could supply additional information for decision-makers.

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APPENDIX

INTERPOLATED 1961[a] AND ESTIMATED 1968[b] AVERAGE ANNUAL INCOME FROM WAGES AND SALARIES BY YEARS OF AGE FOR MALE WAGE EARNERS IN CANADA WITH BACHELOR OF ARTS OR BACHELOR OF SCIENCE DEGREE

Age	Annual Earnings 1961	1968	Age	Annual Earnings 1961	1968
21	$4,511	$6,000	43	$7,941	$10,562
22	4,701	6,252	44	7,955	10,580
23	4,890	6,504	45	7,968	10,598
24	5,080	6,756	46	7,982	10,616
25	5,269	7,008	47	7,995	10,634
26	5,459	7,260	48	8,009	10,652
27	5,648	7,512	49	8,022	10,670
28	5,838	7,764	50	8,010	10,654
29	6,027	8,016	51	7,991	10,628
30	6,211	8,261	52	7,971	10,602
31	6,388	8,496	53	7,952	10,576
32	6,565	8,731	54	7,932	10,550
33	6,741	8,966	55	7,913	10,524
34	6,918	9,201	56	7,893	10,498
35	7,095	9,436	57	7,874	10,472
36	7,271	9,671	58	7,854	10,446
37	7,448	9,906	59	7,834	10,420
38	7,625	10,141	60	7,815	10,394
39	7,802	10,376	61	7,995	10,368
40	7,901	10,508	62	7,844	10,342
41	7,914	10,526	63	7,756	10,316
42	7,928	10,544	64	7,737	10,290

[a]Source: Canada, Dominion Bureau of Statistics, 1961 Census of Canada, Incomes of Individuals, No. 98-502 (Ottawa: Queen's Printer, 1965). Table B.6.

[b]Estimated by multiplying interpolated 1961 figures by conversion factor of 1.33