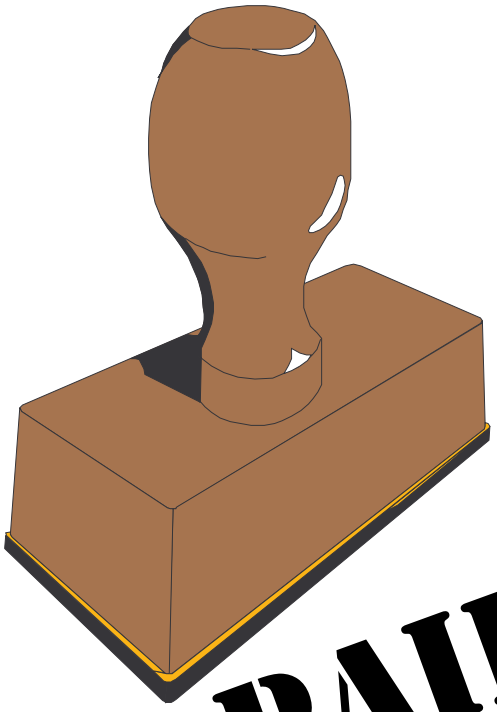

PAID IN FULL

WHO PAYS FOR UNIVERSITY EDUCATION IN BC?

BY ROBERT ALLEN

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Thanks

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About the Author

Bob Allen is Professor of Economics at the University of British Columbia, where he has taught since 1975. He received his Ph.D. from Harvard University. Bob Allen has published three books and numerous articles in professional journals. This research has focused on economic growth and technological change in North America and Europe. Bob Allen is a research associate with the Canadian Centre for Policy Alternatives–BC Office, and a Fellow of the Royal Society of Canada.

EXECUTIVE SUMMARY

This paper analyzes the widely held view that university students are heavily subsidized because tuition amounts to one third of the cost of their educations. I argue that students, in fact, pay the full costs of their education. They pay in two ways—with tuition fees while they are students and through higher taxes after they graduate. The latter payments are ignored in conventional thinking. They are important and mean that Canada already has a contingent payment system for financing its universities.

The argument is developed in several steps. First, data from the 1991 census are used to show that university graduates have higher earnings than people with less education. This is true for women in all fields and for men in most fields of study. The possibility that these higher earnings are due to superior ability rather than more education is considered—and rejected—with a statistical analysis of the BC labour market. Second, a model of the tax system in British Columbia is estimated from the Family Expenditure Survey of 1992 and used to compute the taxes paid by the individuals whose earnings were recorded in the census. Third, the capital and operating costs of university education in BC are computed. Fourth, the earnings and tax patterns estimated from the Census and the Family Expenditure Survey are projected into the future under various assumptions about economic growth and income inequality. With conservative assumptions, university students pay more than $50,000 in additional taxes because of their enhanced earning power. As a result, virtually all undergraduate programs pay their way. University education is a good investment for the treasury. Fifth, it is also shown that undergraduate education is a good investment for students. Sixth, it is shown that university education also pays for itself in the sense that the economic growth it causes exceeds the income that could have been realized had the resources invested in university education been applied to alternative uses. Therefore, it pays to expand the university system.

Finally, the policy implications of these policies are considered. Since students already pay for their educations, policies aimed at increasing fees will overcharge students for their educations and reduce access. Instead, it should be recognized that students pay their way through compulsory "alumni contributions" collected via the tax system. The federal and BC governments should return these sums to the universities rather than reduce the national debt or apply them to other purposes.

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Introduction

Who pays for BC's universities? The usual answer is the taxpayer. With tuition amounting to one third of university costs, students appear to be a heavily subsidized group. In an era when "user pay" and "cost recovery" are the dominant philosophies of public finance, these apparent subsidies are being called into question. One result is a demand for greater accountability by the universities in how they spend public money. Another is a movement to shift the burden of universities from taxpayers to students by raising tuition fees. Recent and prospective federal initiatives to allow registered educational savings plans, expand university scholarships, and introduce a contingent repayment scheme for student loans all presuppose that students are subsidized and should pay for more of the cost of their education.

Before we can assess proposals like these, we must establish—more carefully than has been done—who, in fact, pays for Canadian university education**.** In contrast to the usual view, this paper argues that students more than pay for their education under the existing system of taxes and fees. The argument is simple. Students attend university, in part, to increase their lifetime earnings. They succeed in this with the result that they pay higher taxes after graduation than they would have paid without their education. These higher taxes are their payments for their education. The research presented here shows in detail that the numbers add up. On average, students in almost all programs pay for their university education through higher taxes.[1]

Canadian university education is already financed very much like contingent repayment schemes. This financing system is the consequence of two fundamental features of Canadian universities—public ownership and a tax system in which tax payments increase with earnings. Since the government owns the universities, the treasury pays for them—hence, the apparent subsidy. However, the (government) treasury also recaptures a high proportion of the income gains flowing from university education since tax payments increase with income.

Reality is, of course, more complicated than this depiction since there are actually thirteen treasuries—one federal, ten provincial, and two territorial—rather than just one. This multiplicity raises important questions about the fiscal relations between different Canadian governments. However, those questions should be addressed only after the fundamentals of university financing have been established, and those fundamentals can best be grasped by treating the public sector as an undifferentiated whole.

In contrast to the usual view, this paper argues that students more than pay for their education under the existing system of taxes and fees.

The question of whether students pay the treasury for their education raises further questions about our ability to pay for our universities. One question is whether university education is a good investment for the students themselves. A broader question is whether universities create enough economic growth to pay for their costs. These questions turn out to be closely interrelated, as will be shown. Furthermore, the answers to all three are in the affirmative—students do pay the treasury for the cost of their education, the educations is a good investment for the students as well, and university education indeed generates enough economic growth to cover its costs (see Appendix 3).

The argument is developed in the following stages. First, evidence showing the superior employment prospects of university graduates is presented since the argument that students pay for their education would be false if that were not true. Second, the increased lifetime tax payments of university graduates are quantified and their total payments for their degrees are calculated. Third, the costs of undergraduate education are established using data on the costs of constructing and operating BC universities. Fourth, comparison with the payments made by students show that they pay for their degrees. These comparisons involve projecting the experience of 1990 into the future—an exercise that involves anticipating how the new global economy will influence labour markets in BC Fifth, university education is analyzed as an investment by students, and it is shown that it is a profitable one for them despite the higher tax payments they make to the government. Sixth, the relationship between treasury profitability, student profitability, and social profitability is established. It is then shown that undergraduate education pays for itself in the sense that the economic growth it generates exceeds the output that would have been generated had the resources allocated to universities been deployed elsewhere in the economy. Seventh, the implications of these findings for university finances are discussed.

I. The Economic Gains from Education

The analysis of this paper makes sense only if university education raises graduates' incomes. High unemployment rates among generation X, visions of English majors making cappuccinos at Starbuck's, and the pervasive ethic of practicality have encouraged the view that university education is unsuited for success in the late twentieth century. Technical training and the vocational/career programs offered by two year colleges are seen by many as the way to a high income.

So many factors contribute to economic success that it is easy to find examples of rich people who dropped out of high school and of university graduates without a job. To get an overview of the effects of education on success; therefore, it is necessary to take an average of a large number of representative cases. Calculating averages can be done with surveys like the Census of Canada and the Labour Force Survey. I will use these surveys to measure the effects of university education on employment and earnings.

Throughout the 1990s, university graduates have consistently had the lowest unemployment rates—often half the rate of any other group.

Figure 1 shows unemployment rates in BC broken down by level of education. Throughout the 1990s, university graduates have consistently had the lowest unemployment rates—often half the rate of any other

Figure 1
BC Unemployment Rates
by educational attainment

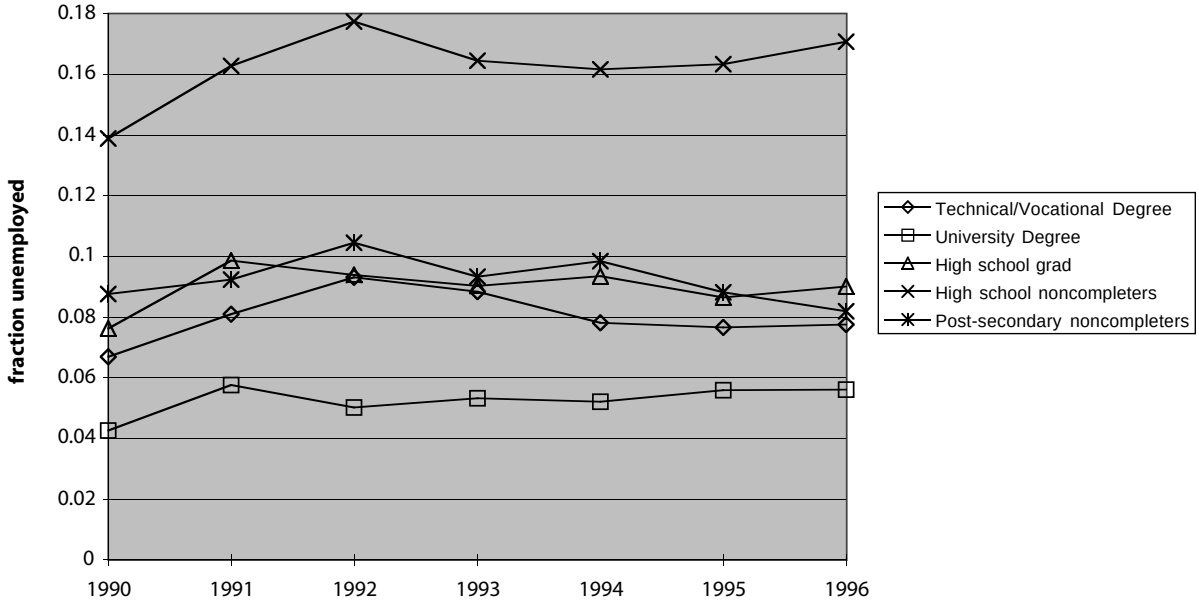

Figure 2
Education Raises Women's Earnings
full time paid employees, 1990

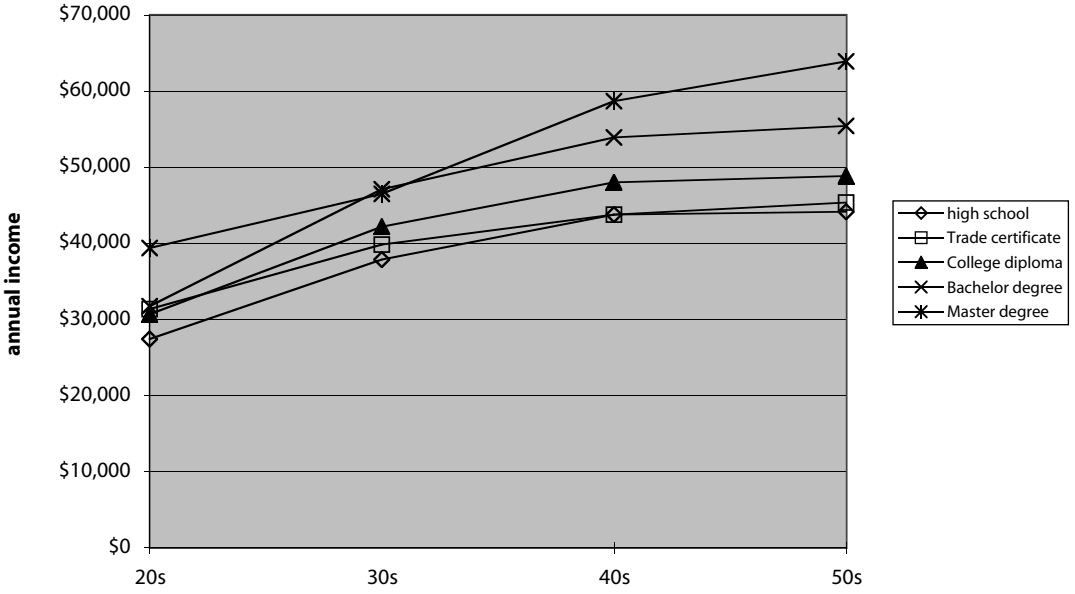

Figure 3
Education Raises Men's Earnings
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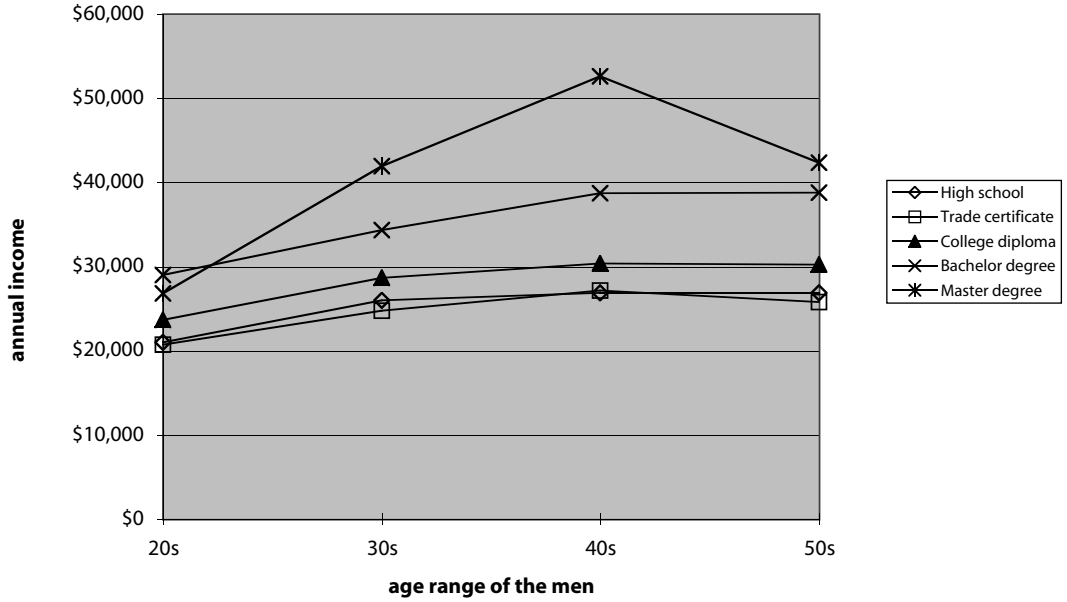

group. High school graduates, people completing one and two year training and college programs, and people who dropped out of post-secondary programs have experienced higher rates. People who did not finish high school have suffered the highest rates of all. The view that university graduates have a particularly bad unemployment record is refuted by Statistics Canada surveys of unemployment.

But what kind of jobs? A widely held view is that university graduates have been pushed down the job ladder and are performing work that does not require their education. This theory can be tested with income data, which indicate the relative productivity of university and high school graduates. Pay is a measure of productivity since businesses will not hire employees unless they can generate at least the net income to pay their wage. Hence, businesses will pay university graduates more than people with less education if and only if the university graduates are more productive (generate more net income). And if the university graduates are more productive, of course, they are not interchangeable with less educated employees—they are not doing the same job.

The data on earnings are quite clear. For almost all types of degrees, university graduates are paid more than people with less education. Figures 2 and 3 show "age-earnings profiles" for graduates in BC with "terminal" bachelor degrees—i.e. people without a post-graduate credential. The age earnings profiles show how earnings increased with age for women and men in 1991. [2] Comparing the profiles across levels of education shows the impact of education on earnings. Clearly, university graduates always came out on top.

Graduates with Arts degrees, which are often dismissed by practically minded critics as economically irrelevant, also share in this success. Men and women with social science degrees earn as much as the average undergraduate, as shown in Figures 2 and 3. Women with humanities and fine arts degrees have higher lifetime earnings than do women with a college certificate (let alone a high school diploma). The only group whose earnings are not superior are men with terminal humanities degrees. They earn about as much as men with college certificate and more than men with only a high school diploma. It should be noted in this regard (1) that most humanities graduates are women, (2) that these earnings, as noted, are those of "terminal BA's" (people who do not get any further degrees) (3) that most arts graduates do continue their studies in other professional programs, and (4) that the earnings realized by humanities undergraduates who then get masters degrees, education degrees, law degrees, etc. are much higher than those of college or high school graduates. For women, undergraduate humanities degrees are superior economic credentials in their own right. For men, they become superior credentials when they are followed by the post-graduate programs which have traditionally succeeded them.

Comparing the age-earnings profiles of high school and university graduates in order to measure the earnings gain from university education raises one critical question. Is the gain attributable to the education, as I have assumed, or does it reflect the superior ability of university students? In the latter case, one might argue that the university graduates would have earned more than the average high school graduate even without a university education. In that case, Figures 2 and 3 overstate the gain to university education.

Undergraduate education pays for itself in the sense that the economic growth it generates exceeds the output that would have been generated had the resources allocated to universities been deployed elsewhere in the economy.

This question has been investigated extensively. Surprisingly, perhaps, the income gain to university education is not reduced by correcting for ability. In one recent study (Ashenfelter and Krueger 1994), for instance, the earnings of identical twins were analyzed in an effort to hold genetics and family background—the factors that affect ability—constant. The returns to university education were as high among identical twins as in the population at large. Other approaches have been taken to this question, and the literature is reviewed in Appendix I. The appendix also reports results from applying one new method, instrumental variables, to BC data. As with most recent literature, this procedure confirms that the returns to education are not biased upward by excluding ability. Hence, in the remainder of this paper, I will interpret differences in age-earnings profiles for different education levels as measures of the economic benefits of education.

II. What Students Pay

We can use the finding that university education generates substantial gains in income to show that students pay for their education. They make two kinds of payments. The first is tuition fees paid while attending university. Fees can be defined in various ways. The most encompassing definition is total student fees received by the universities divided by the number of full time equivalent students. For UBC in 1995/6, the figures are $81,824,000 paid by 25,424 students or $3218 per full time student per year. [3]

Most university graduates are more likely to be employed and to earn more money than high school graduates. This, of course, means that university graduates pay more taxes. It is these higher taxes that pay for their degrees.

Students at BC universities received Canada Student Loans and BC loans and grants. The government subsidies implicit in this financial aid need to be subtracted from the fees in order to compute the net payment of the student. [4] There are three sorts of subsidies. First, some BC aid is in the form of grants. In the 1997 winter session at UBC, grants (all of which go to undergraduates) amounted to $2,390,998 or $119 per undergraduate FTE using the 1995/6 enrollment figure of 20,017. [5] Second, BC and Canada pay a 5% "risk premium" to the banks that making the loans as compensation for student defaults. In the winter session of 1997, $50,292,483 of BC and Canada student loans were awarded at UBC to a student body of 25,424 FTE's. At 5%, the subsidy is $99 per student. Third, Some BC loans are "remitted"—that is, paid off by the provincial government—for students with high debt loads and meeting other criteria. The value of remissions is projected to be 19% of the value of BC student loans. [6] Applying that percentage to the $17,422,780 of BC loans made at UBC implies a subsidy of $130 per full time equivalent student. These calculations suggest that the subsidy implicit in student financial aid amounts to $348 (=$119+$99+130) per student. The net tuition fee is, therefore, $2870 (=$3218-$348) per full time equivalent student per year. Net tuition for a four year undergraduate degree, therefore, equals $11,480 using these figures.

The second, and less obvious, payment made by students are the increased taxes paid later in life. One of the purposes of a university education is to get work that pays better than the work available to a high school graduate. As we have just seen, most university graduates are successful in this quest—they are more likely to be employed and to earn more money than high school graduates. This, of course, means that university graduates pay more taxes. It is these higher taxes that pay for their degrees.

I will quantify this argument using the microdata file from the 1991 Census of Canada, supplemented with other information. The census data set indicates the respondent's pretax income and many other relevant

characteristics like age, sex, labour force status, educational attainment, and field of study. It is this last variable which makes the census microdata set of such great interest since it allows comparisons of the economic returns of different fields of study.

The census microdata set, however, lacks one important variable—the taxes the respondent pays. I have calculated these using a model of the tax system estimated from the 1992 Family Expenditure Survey. It shows pretax incomes and income tax payments for many individuals as well as the incomes and spending patterns of their households. From the latter, one can calculate sales and other indirect taxes paid. The research strategy is to use the Survey of Family Expenditure to estimate an equation showing tax payments as a function of income. This equation is then used to compute the tax payments of all the respondents in the census data set. The model is described in Appendix II.

University students pay more than $50,000 in additional taxes because of their enhanced earning power. This is a minimum figure calculated on conservative assumptions.

The tax concept used here is quite broad. By taxes, I mean net taxes; that is, taxes paid less transfer payments received. Taxes include income taxes, Canada pension plan contributions, unemployment insurance payments, etc., and indirect taxes include sales taxes and property taxes. Transfer payments include unemployment insurance benefits, income received from the Canada Pension Plan, etc. Since the object of the exercise is to see whether students pay for their education, it is the net payments of students to the government—i.e. taxes less transfers—that is the relevant concept, and it is the one adopted here. An example shows the logic of this approach: University graduates have lower unemployment rates than do high school graduates and so cost the unemployment insurance system less money. This benefit of universities is reflected in my calculations as a higher net tax paid, on average, by university graduates and, consequently, as a contribution to the cost of their degree.

Table 1
Taxes Paid in 1990 by BC Women with Undergraduate Degrees

	age				
	20s	**30s**	**40s**	**50s**	**60s**
fine arts	3,248	5,608	5,763	1,240	11,072
humanities	3,940	4,110	5,932	7,619	4,564
social sciences	5,054	5,378	8,972	7,195	4,357
commerce	6,469	5,799	8,632	3,568	1,063
agriculture/biology	5,592	4,666	6,368	7,265	1,752
engineering	***	***	***	***	***
nursing	5,310	6,587	7,463	7,102	2,466
other health	6,925	8,226	9,747	10,777	5,066
math/physical science	5,962	7,796	7,588	6,027	10,249
average undergraduate	6,584	5,642	7,416	6,758	4,290
high school	3,176	3,851	4,506	3,816	2,028

Notes:

*** indicates insufficient data.

High school indicates the averages for women who completed high school and received no post-secondary education.

Tables 1 and 2 summarize my estimates of total net taxes paid per year by people with high school and university educations at various ages. These averages are across the whole population and include full time workers, part time workers, and those not working at all. It

is important to include everyone in the averages since costs are incurred in educating graduates whether they later work or not. The incremental tax paid by university graduates is the difference between their tax payments and those of high school graduates of the same age.

Tables 1 and 2 give snapshots of the relationship between tax payments and income at one point in time—1990. In assessing whether the students of the 1990s are paying for their degrees, it is necessary to project the relationship between tax and income into the future. Computationally, the simplest procedure is to assume that Tables 1 and 2 will remain constant for the lives of today's graduates. There is, in fact, good reason to do this, particularly for women, since constancy of income has been their experience in the recent past. For men, the story is more complicated and the row in Table 2 showing the evolution of tax payments for male high school graduates under the assumption that their incomes will fall at the rate of 1% per year is one plausible scenario. This issue will be discussed fully when payments are compared to costs.

Net tuition for a four year undergraduate degree, therefore, equals $11,480 using these figures.

To determine the tax contribution of university graduates to the cost of their education, the additional tax payments must be discounted back to the time of education and then summed. Since the incremental taxes were estimated from a cross-sectional data set in which the price level was the same for all individuals, a real interest rate of 4% was used. This is approximately the current rate on indexed government bonds and is also defensible in terms of the difference between interest and inflation rates.

These calculations show that university students pay more than $50,000 in additional taxes because of their enhanced earning power. This is a minimum figure calculated on conservative assumptions. Higher values are more defensible. But does $50,000 cover the cost of the degree?

Table 2
Taxes Paid in 1990 by BC Men with Undergraduate Degrees

	age				
	20s	**30s**	**40s**	**50s**	**60s**
fine arts	***	***	***	***	***
humanities	3,717	12,324	10,456	11,552	5,147
social sciences	7,011	13,596	15,696	14,838	12,879
commerce	6,221	15,231	17,877	15,238	8,726
agriculture/biology	6,281	12,970	14,181	4,665	5,600
engineering	9,656	14,448	19,845	17,864	15,032
nursing	4,788	13,735	13,820	11,732	7,799
other health	***	***	***	***	***
math/physical science	7,940	14,525	14,782	17,392	3,759
average undergraduate	6,952	13,889	16,011	15,253	9,958
high school	5,747	9,701	11,561	10,031	4,214
high school (-1%)	5,416	8,053	8,501	6,526	2,659

Notes:

*** indicates insufficient data.

High school indicates the averages for men who completed high school and received no post-secondary education.

High school (-1%) indicates the average taxes implied by reducing high school earnings by 1% per year.

III. What is the cost of an undergraduate education?

To determine whether students pay for their education, the fees and additional taxes they pay must be compared to the cost of the degree. Those costs were developed from Statistics Canada data on the costs of building and operating BC universities. The calculation is summarized in Table 3 and consists of four steps.

1) The Cost of Building and Operating BC's universities

The cost of the universities has two components—operating expenses and capital costs. The largest component is the operating expense, which includes the wages and salaries of faculty and staff as well as the cost of materials and supplies. Administration, student services, libraries, physical plant, and computing centres are included in this expenditure. In 1989/90, the operating expenses of BC universities equalled $561 million.

Capital costs are the second component of cost. Since the 1920s, the government of British Columbia has spent money to construct buildings and buy equipment for the province's universities. These expenditures create facilities that provide services for many years. If university fees were set on a cost recovery basis, students would have to pay back the government for these outlays.

As with any business, the annual cost of the plant and equipment equals the interest and depreciation on its value. I have followed normal business practice and valued the capital at acquisition prices, and so, in this calculation, I have used the nominal interest rate, which was very high in 1989/90—12%. [7] I use a 2% depreciation rate since most investment was for buildings and they have very long lives. [8] The value of the capital stock is built up from its initial value of zero by adding gross investment in each successive year and subtracting depreciation. While the cumulation of investment should, in principle, be started with the construction of the UBC campus around 1920, the calculations are started in 1950. Expenditures in the 1920s have born so much cumulative depreciation as to be of negligible importance now. A walk around the province's campuses confirms this procedure by showing that most facilities—indeed, most campuses—have been constructed since 1950. I have experimented with various allowances for the value of capital existing in 1950, and the final calculation is insensitive to the choice of this value since it, too, is depreciated to a low figure by 1990.

In 1989/90, interest and depreciation on the government's cash outlays for the construction of BC's universities amounted to $108 million dollars.

This is the cost of using university facilities. The total cost of BC's universities was, thus, $669 million in 1989/90.

2) The Share of Teaching in Cost

Universities are multi-product organizations producing research and community service in addition to teaching. The user-pay philosophy requires students to pay for all of the costs of their education but not for the costs of research and service. Hence, it is necessary to reduce the $669 million by the cost of research and service to the community.

The $669 million pays for only part of university research. Much of it is financed with external grants. They usually pay for research assistants, computers, travel, and supplies, as well as the salaries of some university professors.

The best basis for determining research costs at BC universities uses a regression equation estimated by Hettich (1971) from data on research costs, the value of external research grants, and total university expenditures. [9] The Hettich formula implies that research performed by BC universities cost $288 million in 1989/90. I assume this figure includes service as well since the two are often linked. $105 million of this total was defrayed by external grants leaving $183 million (mainly faculty salaries) financed out of operating expenditures. Since the latter equalled $561 million, the Hettich formula implies that teaching expenses equalled 67% of operating expenses. This compares well with the fraction of 71% used by Taubman and Wales (1974, p. 253). Deducting $183 million of research costs from $669 million dollars of operating and capital expenses implies that teaching cost $486 million.

Table 3
The Cost of University Education in BC, 1989-90

operating expenses of B.C. universities	$561 million
interest and depreciation of facilities	$108 million
total cost	$669 million
cost assignable to teaching	$486 million
teaching cost per WFTE student	$4,860

Sources and Notes:

Operating expenses of BC universities — Statistics Canada, Financial Statistics of Education, 1989-90, catalogue # 81-208, Tables 17 and 25.

Interest and depreciation — computed as interest plus depreciation on the capital stock in 1989-90. Interest and depreciation rates discussed in text. The capital stock was cumulated from capital expenditure figures reported in Statistics Canada, Financial Statistics of Education, various years, catalogue # 81-208. Capital investment figures for BC before 1969 were interpolated from the reported provincial and Canadian series.

Cost assignable to teaching — see text.

Teaching cost per WFTE (weighted full time equivalent student) — teaching cost divided by an estimated 100,000 weighted full time equivalent students in 1989/90, as indicated in U.BC Office of Budget and Planning, Fact Book, eleventh edition, 1997, p. 32.

3) Cost Per Weighted Full Time Equivalent Student (WFTE)

To determine the cost of an undergraduate degree, one must first determine the cost per student per year. First, part time and full time students must be combined to form full time equivalents (FTE's). Then differences in program costs must be recognized by weighting programs in proportion to these differences. The weights usually used for this purpose range from 1.0 for first and second year Arts students to 6.0 for doctoral and medical students. [10] Upper level arts and commerce students receive weights of 1.5. Science, engineering and health undergraduates are weighted

at 2.0. When the number of FTE's in the various programs at BC universities are weighted and then totalled, one finds there were about 100,000 weighted full time equivalent students enrolled in 1989/90. [11] The teaching cost per weighted full time equivalent student at BC universities was, therefore, $4860 (= $486 million/100,000) per year in 1989/90.

4) Weighted years per program

The cost of an undergraduate degree is determined by multiplying the teaching cost per WFTE ($4860) by the number of weighted years in the program. First and second year arts, for instance, each are weighted as 1.0, while third and fourth year arts are more expensive and receive a weight of 1.5 each. The total weight of an undergraduate arts degree, which takes four years, is, therefore, 5 = 1 + 1 +1.5 +1.5. Hence, an undergraduate arts degree costs $24,300= 5 x $4860. In contrast, an undergraduate science degree takes four years each of which receives a weight of 2 due to the greater cost of science courses. An undergraduate science degree, therefore, costs 8 WFTE's or $38,880.

The costs of undergraduate degrees in these and other fields are shown in Table 4. A cost recovery or user-pay approach to university finance in British Columbia would require students to recompense the government these sums for their university educations.

Table 4
Cost of Undergraduate Degrees in BC

	weight/ year	cost of degree
fine arts	1.500	29,160
humanities	1.250	24,300
social sciences	1.250	24,300
commerce	1.375	26,730
agriculture/biology	2.000	38,800
engineering	2.000	38,800
nursing	2.000	38,800
other health	2.000	38,800
math/physical science	2.000	38,800

Notes:

Cost of degree computed as 4 x weight/year x $4860, the cost per weighted full time equivalent student.

Weight per year is weighted average of weights for the various years of the program.

Fields are Statistics Canada categories. Weights for predominant program category used in computed weight/year for the field, e.g. fine arts students were assumed to be students in music, the most popular and most expensive program in fine arts.

IV. How Students Pay for Their Degrees

Tables 5 and 6 contrast the costs of university degrees with the payments made by students. Their payments consist of tuition and the present value of additional taxes after graduation. The students are presumed to be out of the labour force for the eight months a year that the university is in session. Consequently, their payments for their degrees are reduced by an estimate of the taxes they would have paid had they worked instead of studied. This sum is designated as "foregone taxes" in the tables.

The tables show clearly that university graduates pay more for their educations than their degrees cost. Women as a whole pay $61,066, while the average program taken by female students costs $28,469. Men pay more—$74,376—for a degree costing on average $30,099.

University graduates pay more for their educations than their degrees cost. Women as a whole pay $61,066, while the average program taken by female students costs $28,469. Men pay more—$74,376—for a degree costing on average $30,099. In particular, men and women in the social sciences pay much more than the cost of their degrees.

Tables 5 and 6 break down costs and payments by field of study and show that most students in most fields pay for their degrees**.** In particular, men and women in the social sciences pay much more than the cost of their degrees. Women in fine arts and the humanities also fully pay the costs of their educations. The only group for which this is not true is men receiving terminal bachelor degrees in the humanities. As already discussed, however, this is not a large number of students since there are not many male humanities majors, and many of them continue their educations in other professional fields. Those combined programs generate an income that pays the full cost of the education.

It is important to emphasize that these calculations of taxes paid are extrapolations into the future of the cross-sectional experience of people shown in the 1990 census. In other words, the calculations assume that when someone who graduates from university in the 1990s reaches age 50, his or her tax payments (on average) will be the same as those of a corresponding fifty year old in 1990.

How reasonable is this extrapolation? There are two aspects to predicting future tax payments. The first is predicting the tax system; the second is predicting income growth. In this paper, I assume that the tax system will remain as it was in 1991/2. Clearly, if the tax system changes radically, the payments of students will change as well, but there is little basis for guessing how the tax system might evolve. There is more to be said about the growth in income, however. In considering that question, we can distinguish five scenarios. Table 7 summarizes calculations of the present value of taxes paid for each scenario. I begin with the most optimistic.

Table 5
Payments for Undergraduate Degrees — Women

	cost of degree	present value of extra taxes	+	tuition	-	less foregone taxes	=	total
fine arts	29,160	27,135	+	11480	-	6254	=	32,361
humanities	24,300	25,669	+	11480	-	6254	=	30,895
social sciences	24,300	51,465	+	11480	-	6254	=	56,691
commerce	26,730	48,425	+	11480	-	6254	=	53,651
agriculture/biology	38,800	37,554	+	11480	-	6254	=	42,780
engineering	38,800	***		***		***		***
nursing	38,800	51,827	+	11480	-	6254	=	57,053
other health	38,800	94,569	+	11480	-	6254	=	99,795
math/physical science	38,800	70,166	+	11480	-	6254	=	75,392
average undergraduate	28,469	55,840	+	11480	-	6254	=	61,066

Notes:

Cost of degree computed as 4 x weight/year x $4860, the cost per weighted full time equivalent student.

Weight per year is weighted average of weights for the various years of the program.

Fields are Statistics Canada categories. Weights for predominant program category used in computed weight/year for the field, e.g. fine arts students were assumed to be students in music, the most popular and most expensive program in fine arts.

Overall cost of an undergraduate degree computed as a weighted average of the costs for the fields shown. Weights are degrees grants in each field as shown in Statistics Canada, Education in Canada, 1990-1, catalogue #81-229.

Table 6
Payments for Undergraduate Degrees — Men

	cost of degree	present value of extra taxes	+	tuition	-	less foregone taxes	=	total
fine arts	29,160	***		***		***		***
humanities	24,300	1,139	+	11480	-	7232	=	5,387
social sciences	24,300	69,854	+	11480	-	7232	=	74,102
commerce	26,730	79,115	+	11480	-	7232	=	83,363
agriculture/biology	38,800	19,051	+	11480	-	7232	=	23,299
engineering	38,800	120,051	+	11480	-	7232	=	124,298
nursing	38,800	***		***		***		***
other health	38,800	33,800	+	11480	-	7232	=	38,048
math/physical science	38,800	74,093	+	11480	-	7232	=	78,341
average undergraduate	30,099	70,128	+	11480	-	7232	=	74,376

Notes:

Cost of degree computed as 4 x weight/year x $4860, the cost per weighted full time equivalent student.

Weight per year is weighted average of weights for the various years of the program.

Fields are Statistics Canada categories. Weights for predominant program category used in computed weight/year for the field, e.g. fine arts students were assumed to be students in music, the most popular and most expensive program in fine arts.

Overall cost of an undergraduate degree computed as a weighted average of the costs for the fields shown. Weights are degrees grants in each field as shown in Statistics Canada, Education in Canada, 1990-1, catalogue #81-229.

1) Golden Age Regained

During the 1950s and 1960s, economic growth "trickled down" to most Canadians in the sense that wages and salaries rose in line with the growth in per capita gross domestic product. Successive censuses showed that the relative incomes of people with different educational credentials were stable. In that case, the returns to education could be projected by taking one census cross section and inflating everyone's incomes by a forecast of the rate of economic growth (Rosen 1977, pp.5-6).

Today such an exercise must be regarded as the height of optimism, for real wages have not increased in the past two decades even though per capita GDP has risen. Nonetheless, Table 7, row 1, shows the present value of additional tax payments for men and women on the assumption that the real wages of university and high school graduates will each grow at only 1% per year. Notice that the additional taxes paid by both men and women still rise. Under this most favourable scenario, university students will be paying even more for their degrees than calculated previously.

Table 7
Present Value of Tax Payments for all Final Bachelor Degrees
alternative assumptions about income growth

scenario	growth rate, high school	growth rate, university	present value of taxes, men	present value of taxes, women
1 golden age regained	+1%	+1%	$103,241	$60,417
2 American pattern	0%	+1%	152,954	78,137
3 Canadian women's pattern	0%	0%	70,128	55,840
4 Canadian men's pattern	-1%	0%	106,362	68,569
5 Canadian men's pattern	-1%	-0.5%	77,765	46,549

2) American Style Inequality

The pattern of income change in the United States is another possible future. In that country, inequality has been increasing dramatically. One manifestation of that increase is a rise in the income of university graduates and a fall in the income of high school graduates. Row 2 of Table 7 simulates a tempered version of that future under the assumption that the incomes of university graduates grow at 1% per year, while the incomes of high school graduates remain constant. These assumptions raise the present value of tax payments to even higher levels than previously. Indeed, forecasting tax payments under the more pessimistic assumption that high school incomes will actually

drop as they have in the U.S.A. leads to even greater payments by university graduates.

Inequality has not increased in Canada to the extent it has in the United States, which suggests that the American scenario may be inappropriate for forecasting the BC future. It is worth probing, however, why there has been a difference in the experience of the two countries. Recently, Murphy, Riddell, and Romer (1997) have argued that labour demand has changed in similar ways in both countries—the demand for university graduates has increased, while the demand for high school graduates has fallen. That is the new world economy at work. Wages and salaries have evolved differently in the two countries, however, due to the different post-secondary education policies pursued. In the United States, university enrollments have remained a constant fraction of the population, while they have risen in Canada. The rising number of graduates in Canada has offset the growth in demand holding the wages of university graduates constant. Sending more people to university has reduced the supply of high school graduates in step with the fall in the demand for their labour. Thus, expanding post-secondary education has helped maintain the incomes of those not receiving the education.

Expanding post-secondary education has helped maintain the incomes of those not receiving the education.

The likelihood of scenario 2 depends on the university policy followed in Canada. If universities are expanded, then we may be able to avoid the American pattern.

3) Constant Incomes

One way to forecast the future is to project current trends forward. Beaudry and Green (1996) have disaggregated the wage data by age cohorts and verified that the real wages of university and high school educated women in Canada have been stable for almost three decades. The expansion of post-secondary education has probably caused the stability, as just discussed. Row 3 of Table 7 shows the present value of tax payments under the assumption of no change in incomes. This scenario corresponds to the calculations already discussed in Tables 5 and 6.

4) and 5) Future Deterioration

Beaudry and Green (1996) have also found that the economic situation of men has deteriorated more than that of women since the late 1960s. Without a doubt, the wages of male high school graduates have been falling rapidly. In addition to changing labour demand in the new world economy, institutional factors like the decline in private sector unionism have probably played a role. If Canada continues to follow the United States in this regard, further wage declines for this group can be anticipated. Both scenarios 4 and 5 postulate that the incomes of high school graduates will fall at 1% per year.

The experience of male university graduates is less clear cut. There was perhaps some initial decline in their incomes, but stability has been achieved. Certainly, male university graduates have maintained their incomes much better than have high school graduates. Hence, I simulate two possibilities. Scenario 4 posits no change in the wages of university graduates, while scenario 5 postulates a fall of .5% per year. Recent experience suggests that scenario 4 is the more accurate projection of the future.

Neither scenario threatens the conclusion that university graduates pay the treasury for the full cost of their degree. Both men and women pay the treasury more under scenario 4 than they would under the base case scenario of no change in incomes. Under scenario 5, men still pay more than they would under the base case; women pay only marginally less.

The important conclusion is that under any scenario, university graduates will pay for their degrees so long as the tax system remains as it has been. This conclusion applies to graduates in almost all fields of study.

Forecasting the future is obviously difficult. The only way to approach the problem is by considering plausible lines of development. Five scenarios span the possibilities defined by history as it has been unfolding here and in the United States. The important conclusion is that under any scenario, university graduates will pay for their degrees so long as the tax system remains as it has been. This conclusion applies to graduates in almost all fields of study.

V. The Student's Return to University Education

University education is a profitable investment from the treasury's point of view, but what about the students'? While the benefit to the treasury from someone's attending university is the increase in taxes collected out of the graduate's enlarged wages, the benefit to the student is in part the increase in income after tax. The present value of that extra income must be greater than the cost of attending university for the additional schooling to be a profitable investment for students.

The increase in pretax income from attending university was computed for the main programs from the 1991 census microdata file, and the estimates of taxes paid were subtracted from those income increases to calculate the rise in aftertax income. Present values of the extra income after taxes are presented for the main programs in Tables 8 and 9.

The costs of university education include (1) tuition, (2) books and other necessary supplies, and (3) the wages that are lost by attending university rather than working. The total of these costs are shown in Tables 8 and 9.

Table 8
Costs and Benefits of Undergraduate Degrees for Women
(income growth assumed to be zero)

	pretax foregone wages	-	taxes on foregone wages	+	books & supplies	+	tuition	=	total cost	present value of extra wages
fine arts	24,104	-	6,254	+	5,000	+	11480	=	34,330	45,498
humanities	24,104	-	6,254	+	5,000	+	11480	=	34,330	52,167
soc science	24,104	-	6,254	+	5,000	+	11480	=	34,330	106,538
commerce	24,104	-	6,254	+	5,000	+	11480	=	34,330	100,692
ag/bio	24,104	-	6,254	+	6,000	+	11480	=	35,330	71,947
engineering	24,104	-	6,254	+	6,000	+	11480	=	35,330	***
nursing	24,104	-	6,254	+	5,600	+	11480	=	34,930	107,265
other health	24,104	-	6,254	+	5,600	+	11480	=	34,930	197,833
math/PS	24,104	-	6,254	+	5,600	+	11480	=	34,930	141,566
average undergrad	24,104	-	6,254	+	5,192	+	11480	=	34,522	96,273

Notes:

Foregone wages equal two thirds of the average annual wages and self-employment income of high school graduates aged 18-21 in BC The average is over all high school graduates not attending an educational establishment whether they are working or not.

Books and supplies from Stager (1996, p. 17).

The comparison of costs and benefits shown in Tables 8 and 9 indicate that almost all university programs are profitable for the students who complete them. For both men and women, the average university degree generates a present value of almost $100,000 in extra after-tax income. The cost of the average degree is under $50,000, so the ratio of benefits to costs is over two to one. This high ratio means that completing an undergraduate university program is a highly profitable investment for the average student. All undergraduate programs—including, in particular, fine arts and humanities—are profitable for women. For men, the results are mixed as they were when university education was considered from the treasury's point of view. Neither terminal degrees in the humanities nor the agricultural and biological sciences are profitable for men since graduates from these programs do not earn incomes appreciably higher than high school graduates. If humanities, agriculture, and biology degrees are followed by postgraduate work, however, the combined programs can be profitable investments.

Almost all university programs are profitable for the students who complete them. For both men and women, the average university degree generates a present value of almost $100,000 in extra after-tax income. The cost of the average degree is under $50,000, so the ratio of benefits to costs is over two to one.

The cost and benefits shown in Tables 8 and 9 presume zero growth in real income—more precisely, zero increase in the relationship between earnings and age—for either university or high school graduates. These calculations, therefore, correspond

Table 9
Costs and Benefits of Undergraduate Degrees for Men
(income growth assumed to be zero)

	pretax foregone wages	-	taxes on foregone wages	+	books & supplies	+	tuition	=	total cost	present value of extra wages
fine arts	28,492	-	7,232	+	5,000	+	11480	=	37,740	***
humanities	28,492	-	7,232	+	5,000	+	11480	=	37,740	-720
soc sciences	28,492	-	7,232	+	5,000	+	11480	=	37,740	89,105
commerce	28,492	-	7,232	+	5,000	+	11480	=	37,740	98,041
ag/bio	28,492	-	7,232	+	6,000	+	11480	=	38,740	20,330
engineering	28,492	-	7,232	+	6,000	+	11480	=	38,740	174,260
nursing	28,492	-	7,232	+	5,600	+	11480	=	38,430	***
other health	28,492	-	7,232	+	5,600	+	11480	=	38,430	55,951
math/PS	28,492	-	7,232	+	5,600	+	11480	=	38,430	107,321
average undergrad	28,492	-	7,232	+	5,306	+	11480	=	38,046	95,117

Notes:

Foregone wages equal two thirds of the average annual wages and self-employment income of high school graduates aged 18-21 in BC The average is over all high school graduates not attending an educational establishment whether they are working or not.

Books and supplies from Stager (1996, p. 17).

to row 3 in Table 7. They also correspond to the recent experience of Canadian women—and so the balance of benefits and costs for women shown in Table 8 represents the best judgment for the future—but not to the recent experience of Canadian men. As previously indicated, however, the wages of male high school graduates have been falling. If the profitability calculations for men in Table 9 are recomputed on the assumption that the age-earnings profile of high school graduates will decline at 1% per year (corresponding to row 4 in Table 7), then it is necessary to add slightly more than $50,000 to each of the present values of future earnings shown in Table 9. Adding those sums increases the profitability of all programs, and, in particular, makes terminal undergraduate degrees in the humanities and agricultural and biological sciences profitable for men.

VI. Conclusion

The chief findings of this study can be summarized briefly: First, undergraduate university education is a profitable investment for almost all students in British Columbia. Second, undergraduate education is also a profitable investment for the treasury when the tuition and, particularly, the extra taxes paid by graduates are set against the costs incurred by the government in operating the universities. Third, since undergraduate education is profitable for both the student and the treasury, it is a profitable investment for the province as a whole. It generates more economic growth than it costs. Consequently, university education should be expanded.

The finding that university education is profitable has implications for two commonly held beliefs. First, the finding contradicts the widely held view that university education is irrelevant because the economy now requires the specific skills traditionally taught in one and two year vocational, technical, and career programs. In fact, the skills taught in almost all university programs have a high pay-off in the economy of the 1990s. Universities need to be expanded to meet the employment needs of the new world economy.

Second, the finding shows that university students are not receiving an unwarranted share of government spending. They are not being subsidized; they pay the full costs of their educations. They do this with tuition payments as students and, more importantly, with the heightened taxes they pay on their augmented incomes throughout their working lives. This is true for all students in all major programs when recent trends reflecting the evolution of the global economy are projected into the future. The notion that university teaching is subsidized by the taxpayer is not supported by the best evidence and analysis.

Several Canadian governments are considering proposals that would shift university revenues more toward fees. Ontario is cutting support to some programs and letting the universities charge full cost fees. The aim is make students pay for the program out of their enhanced earnings. The federal government's Millennium Scholarship program, registered educational savings plans, and its proposals for contingent repayment schemes would facilitate a shift to a fee-based financing system. British Columbia is a notable exception to this trend for it has frozen fees.

The findings of this paper have important implications for these proposals. The most important is that Canada already operates a contingent payment scheme through the tax system. Canadian students already pay the full cost of their programs. Proposals to raise fees under the present

circumstances will make students pay more than the cost of their degrees. High fees will reduce access by lowering the profitability of university education for students. Even if fees are paid with income contingent repayment loans, the profitability of university education will decline. There might be a case for higher fees if the high fees eliminated a subsidy—although even that conclusion is debatable—but in the present circumstances they do not. Higher fees will simply over charge students for their educations and, in the process, reduce access on the part of those who have to borrow to attend.

In the United States, many universities finance themselves through alumni contributions, that is, successful graduates voluntarily contribute some of their enhanced earnings to their alma mater. Canada operates a similar system, although that is not usually recognized. In Canada, the contributions are compulsory through the tax system. There is a problem of university finance, however, since governments do not pass the contributions on to the universities responsible for generating them.

This problem arises for three reasons. First, the tax receipts attributable to universities are not identified as such, so they are lost in general revenues. Second, there is an issue of interprovincial equity since some provinces educate graduates who move to other provinces and pay their provincial taxes there. Third, much of the tax revenue is collected by the federal treasury and has been used to reduce the federal deficit rather than being passed back to the provinces as transfer payments. Solving the problem of university finance requires that the "alumni contributions" be recognized as such, be rebated by the federal government to the provinces, and be credited to the universities by the provincial governments that finance them.

There are two coherent models for organizing universities. In the Canadian model, the universities are operated by the state, tax rates are high, and students pay for their educations primarily through the tax system. In the American model, the universities are private, tax rates are low, and students pay for their educations primarily through fees and alumni contributions. In both systems, costs are paid—on average—by the students. By raising university fees, Canada would create a hybrid system in which students paid much more than the full cost of their educations.

Appendix I: Ability and the Relationship of Earnings to Education

The calculations of this paper involve comparing the incomes and taxes of university graduates with those of high school graduates in order to compute the income or tax gain from university education. The implicit assumption is that the average university graduate would have earned the same amount as the average high school graduate in the absence of the university education. In other words, this paper assumes that the income premium realized by the university graduate is due to his or her additional education rather than to superior ability. This assumption may seem strange since universities admit students based on ability. In fact, however, leaving ability out of the analysis does not overstate the gains to university education since so many factors besides scholastic ability affect both university attendance and earnings.

The relationship between education, ability, and earnings has been explored in numerous studies by economists. The approach that was most common in the 1960s and early 1970s was to assemble data sets that included ability measures like IQ or aptitude test scores as well as age, education, and earnings. Ability could, therefore, be included in the earnings regressions.

> The first and most obvious way to probe the education coefficient in an earnings function is to add measures of ability and background... Such analyses yield a definite conclusion: education matters about as much in the presence of those measures as in their absence. For instance, an IQ measure of ability has only modest effects on earnings while measures of parental occupational status and education have, if anything, even weaker effects. [12]

Likewise, Willis (1986, p. 590) concluded that "the simple Mincer-type earnings function does a surprisingly good job of estimating the returns to education" despite omitting ability. One reason for this is that ability and education were, in fact, not highly correlated. First, "ability" itself is multifaceted, and the constellation of aptitudes and traits that make for economic success may not be the same as those that make for scholastic success, although the two may be correlated. Second, scholastic ability is not perfectly correlated with attending and completing university since many social and economic factors play a major role. Third, in the case of the data analyzed here, scholastic ability may be negatively related to inclusion in the sample of university graduates, for that sample includes only terminal bachelor degree holders and excludes people who get graduate or professional degrees. Since entry into those programs is highly meritocratic, the people in the sample

of terminal bachelors may be from the less academically gifted portion of university students. Together these factors may mean that there is no correlation between ability (in so far as it is economically relevant) and education in the sample analyzed here.

One limitation of these studies is that they have to define ability in order to include it in the analysis, and any definition of ability is debatable since it is so multifaceted. Since the mid-1970s, two other approaches have been taken that avoid that problem. One approach has been to gather repeated information on the same person or on the experience of identical twins. Both methods are intended to provide a way to hold "ability" constant without actually specifying what it is. These studies have found that the returns to education are the same as (or sometimes larger than) those estimated from cross sectional data lacking ability measures. [13]

The second approach has been to use "instrumental variables" to eliminate the bias from omitting ability. When ability is left out of the regression of earnings on education, education takes over some of the explanatory role of ability on the assumption that (1) ability and schooling are correlated and (2) ability and earnings are correlated. While the coefficient of education is biased upwards (given the two assumptions), it does not take over completely for ability. In that case, the regression underpredicts earnings for high ability people and overpredicts earnings for low ability people. There will consequently be a correlation between the errors of the model and the schooling variable—for instance, high ability people are likely to have both a high level of schooling and a positive prediction error. A standard result is that the coefficient of schooling will be biased, as we have already argued. More to the point, however, the problem can be solved by finding another variable— called an instrument—that is correlated with schooling and uncorrelated with the disturbance term. Schooling is regressed on the instrument, and the predicted values of schooling from that regression are used instead of schooling in the earnings function. The coefficient of schooling in this regression is an unbiased estimate of the true effect of schooling since the effect of personal ability, which was causing the bias, has been purged from the variable. Geographical variables have proved useful instruments for schooling. The

Table I-1
Earnings Functions for Women, Alternative Estimators
(t-ratios in parentheses)

number	1	2	3	4
dependent	wages	wages	log wages	log wages
estimator	OLS	IV	OLS	IV
constant	-6806.89	-6647.07	8.63541	8.6375
	(-2.63695)	(-2.53345)	(86.3389)	(85.0556)
age	1495.07	1472.96	0.06659	0.066302
	(10.6066)	(9.54223)	(12.1926)	(11.0973)
age squared	-15.6288	-15.3381	-0.00071632	-0.00071252
	(-8.55541)	(-7.64814)	(-10.1203)	(-9.17949)
UNIV	10788.4	12337.9	0.381415	0.401632
	(16.8839)	(2.78456)	(15.4058)	(2.34194)
R^2	0.19	0.19	0.18	0.18
N	2454	2454	2454	2454

presence of a nearby college is uncorrelated with someone's ability but highly correlated with the probability of attending university since proximity to the university reduces the cost of attending and increases the awareness of the possibilities. Like the twin studies, the instrumental variables studies find that the true returns to university education are equal to or greater than the returns implied by correlations (uncorrected for ability) between education and earnings in cross sectional data sets. [14]

Thus, the literature on ability, education, and earnings suggests that the calculations of this paper do not overstate the returns to university education or the payments (in the form of future taxes) that university students will make for their education. We can strengthen this conclusion by adapting the methodologies used elsewhere to BC data. Instrumental variables is the easiest approach to replicate. I follow Card's (1995b) lead in using geography as an instrument.

The data set I analyze is the same as I have used before—the microdata file for BC residents from the 1991 census. To avoid unnecessary complexities, I have limited the analysis to a comparison of the earnings of people who were full-time paid employees for all of 1990. To sharpen the comparison, only people with terminal high school and university degrees are included. People with other educational credentials are excluded. Only people born in Canada are included [15] to avoid the problems of modelling the assimilation of immigrants. The simplest statistical specifications current in the literature are employed.

Table I-2
Earnings Functions for Men, Alternative Estimators
(t-ratios in parentheses)

number	1	2	3	4
dependent	wages	wages	log wages	log wages
estimator	OLS	IV	OLS	IV
constant	-29342.8	-28941.4	8.04061	8.03245
	(-7.57657)	(-5.90241)	(85.4177)	(67.4016)
age	2934.65	2904.77	0.112222	0.11283
	(14.0127)	(9.47775)	(22.0462)	(15.1471)
age squared	-27.6018	-27.2605	-0.00118263	-0.00118957
	(-10.2614)	(-7.34604)	(-18.0886)	(-13.1893)
UNIV	9559.06	10385.7	0.179255	0.162450
	(12.7728)	(1.66541)	(9.85441)	(1.07180)
R^2	0.24	0.23	0.28	0.28
N	3299	3299	3299	3299

To implement instrumental variables estimators, the data must be analyzed in a regression framework rather than with tables, as done earlier. I begin with the ordinary least squares regression that is the analogue of the previous tables and that may yield overestimates of the returns to university by leaving ability out of the analysis. That is the issue to be explored. Equation 1 in Tables I-1 and I-2 shows the earnings functions for men and women respectively. The dependent variable is annual wages and salaries received. Age and age squared are included to allow earnings to increase with age (implied by the positive coefficient of age) but at a diminishing rate (implied by the negative coefficient of age squared). The

coefficient of UNIV (a so called dummy variable that has a value of one for university graduates and zero for high school graduates) shows the income gain in dollars per year from completing university. No allowance is made in this specification for differences between fields of study, and the income gain is constrained to have the same value at all ages. The income gains are substantial and larger for women than for men, which is consistent with our earlier discussion and with most recent Canadian studies.[16] All variables are significant by the usual criteria.

Equation 3 in each table is identical to equation 1 except that the dependent variable is the logarithm of earnings. This is, in fact, a more common specification. Its virtue is that the coefficient of UNIV is the rate of return to the four years in university. Taking the fourth root of one plus that coefficient gives the average annual social (pretax) rate of return to university education: 4.2% for men and 8.4% for women. The return for women substantially exceeds the real interest rate (4%); the return for men is slightly above it.

The question, of course, is whether the returns to university implied by these regressions are biased upward by the exclusion of ability as a variable. That bias can be eliminated with an instrumental variables estimator. I use province of birth as an instrument. Most students were educated in the province where they were born and the provinces differ dramatically in the proportion of students who attend university. In 1986-7, the ratio of female university students to women aged 18-21 was 18.1% in British Columbia and 37.6% in Nova Scotia.[17] This difference is not because people in Nova Scotia are smarter than people in British Columbia but because Nova Scotia has chosen to send more of its residents to university. Place of birth is, therefore, correlated with an individual's schooling but uncorrelated with his or her ability, so it can be used as an instrument for university attendance.

Table I-3
Earnings Functions for Women, Alternative Estimators
interprovincial migrants
(t-ratios in parentheses)

number	1	2	3	4
dependent	wages	wages	log wages	log wages
estimator	OLS	IV	OLS	IV
constant	-5429.69	-5422.89	8.86163	8.86520
	(-1.14755)	(-1.14285)	(49.958)	(49.7455)
age	1440.34	1438.35	0.054395	0.053349
	(5.82881)	(5.3616)	(5.87179)	(5.29495)
age squared	-15.36	-15.3318	-0.000570816	-0.000555963
	(-5.00347)	(-4.49725)	(-4.95988)	(-4.34216)
UNIV	12371.6	12500.9	0.422544	0.490539
	(12.7003)	(1.82328)	(11.5707)	(1.90498)
R^2	0.19	0.19	0.18	0.17
N	951	951	951	951

Equations 2 and 4 in Tables I-1 and I-2 show instrumental variables estimates of the earnings function. Province of birth, age, and age squared are used as instruments. Other equations were also estimated in which the provincial categories were further divided into two

depending on whether the individual was older or young than age 20 in 1965. This division allows for the major expansion of universities in the 1960s. The results with this specification were very close to those reported here.

The important point is that the coefficient of UNIV is not smaller when an instrumental variables estimate is used. Indeed, it is usually slightly bigger, a finding common in this literature.[18] Applying the most sophisticated methods currently used in labour economics to British Columbia data indicates that the returns to education used in this paper are not biased by omitting ability measures.

Instrumental variables can give misleading results if the instrument measures factors beyond those intended. It is possible, for instance, that interprovincial migrants are more enterprising than people who do not move, so that the people in BC born elsewhere may earn more money than the natives due to superior ability in that sense. To investigate that possibility, earnings functions were fit only to the data describing interprovincial migrants in BC For women, the results were very similar to those estimated for the full samples (Table I-3). For men the procedure did not work because there was no correlation between place of birth and university attendance. This result is partly bad luck and partly structural—the power of place of birth as an instrument depends on the comparison between BC and other provinces since B.C. has such a small university sector. Leaving out people born in BC greatly reduces the correlation between place of birth and university attendance. In the case of men, the correlation in the sample was zero, while, in the case of women, it was still positive, so some results were obtained. The similarity of the results for women in Tables I-1 and I-3 indicates that interprovincial migrants are not notably more enterprising than nonmigrants, so Tables I-1 and I-2 are not distorted for that reason.

Appendix II: Modelling Tax Payments

To determine tax payments as a function of age for each degree and field of study, it was necessary to estimate the tax payments of each individual in the 1991 census microdata file. In studies like this, taxes are sometimes estimated with tax simulator models, i.e. the tax returns for each person is completed based on all the available information in the census and making plausible assumptions about deductions, etc. Instead, I estimate taxes paid as functions of income earned based on another data set—the Survey of Family Expenditure for 1992 for British Columbia. Deductions, etc., are not modelled as such; only the resulting relationships between income and tax are examined. Separate functions were estimated for direct and indirect taxes due to the different ways they were reported in the Survey of Family Expenditure.

Table II-1
Tax Functions
(t-ratios in parentheses)

equation	1	2
dep variable	net tax	indirect tax
constant	-1550.205317	2414.897933
	(-10.242)	(19.924)
income	44.631209	***
	(1.904)	
$income^2$	6.833375	1.356601
	(8.649)	(11.392)
$income^3$	-0.053330	-0.011326
	(-6.759)	(-7.207)
$income^4$	0.0001403594	0.00002860587
	(6.214)	(5.752)
R^2	0.76	0.46
N	1601	729

Notes:

The dependent variable in equation 1 is income tax paid minus transfer payments received.

The dependent variable in equation 2 is indirect taxes paid, federal and provincial sales and excise taxes plus property taxes.

The independent variables are wages plus self-employment income raised to the indicated powers.

The function for income taxes was estimated from the personal information reported for respondents and their spouses. There were 1601 observations on the two combined. The tax concept in these regressions was net income tax defined as income taxes paid minus transfer payments received. Net tax was regressed on a fourth order polynomial of wages plus self-employment income. The results are shown in Table II-1, equation 1. The coefficients are significant statistically, and the R2 is quite high for a cross sectional regression like this.

It should be noted that net income tax includes taxes paid on investment income. Much thought was given to the question of whether this should be included or excluded, but a choice in this matter makes little difference since investment income was rarely substantial.

The function for direct taxes was estimated from the household information in the survey since property taxes and expenses were reported for the household and not for individuals. The Survey of Family Expenditure does not report excise payments (e.g. G.S.T., provincial sales tax, alcohol, tobacco, fuel, and hotel taxes), but they could be calculated from the detailed information on spending that was reported. This information was available for 729 households. As with income, fourth order polynomials

were fit to the data relating total indirect taxes paid to wages and selfemployment income for the household. The first order term was not significant in this regression and regressions omitting that term are reported in Table II-1. As with the net income tax regressions, the functions for indirect taxes meet the usual statistical requirements for reliability.

The tax functions are plausible in view of the findings of Vermaeten, Gillespie, and Vermaeten (1994, 1995) and Ruggeri, Van Wart, and Howard (1994).

Appendix III: Social Benefit-Cost Ratios

Economists traditionally evaluate university education with social profitability calculations or, equivalently, with social benefit-cost ratios. The purpose of this appendix is to show the relationship of the methodology of this study to the standard benefit-cost analysis. Earlier, I showed that undergraduate degrees are profitable investments for both the treasury and the student and remarked that this dual profitability meant that university education was profitable for society as a whole. In this appendix, I will development that claim by relating the treasury's and the student's benefit-cost calculations to the conventional analysis of university education and economic growth. This analysis evaluates university education from the perspective of an imaginary and omniscient social planner who aims to maximize the welfare of everyone in society. The planner tries to apply society's resources to their best economic ends, taking into account all of the ramifications in the society.

From the planner's perspective, university education should be expanded if the increase in gross domestic product produced by educating another worker—that is, the economic growth due to university education—exceeds the goods and services that could otherwise be produced with the resources required to educate that person. The difficulties in implementing this rule lie in measuring the increased GDP and the foregone output. Conventional benefit-cost analysis adopts unrealistic assumptions to solve these problems, and I do the same in order to show the relationship between the analysis and the calculations presented earlier.

In the conventional view, the increased GDP from educating the worker equals the increase in his or her wage on the assumption that the wage equals the "value of the marginal product of labour," that is, the increase in output generated by employing another worker. (This assumption is common since it means that employers hire workers if and only if they generate enough net income to cover their wages. If firms maximize profits, they will expand employment until the net income produced by each extra worker falls to the level of the wage; at which point, there is no net income over and above the wage to form profits.) The rise in GDP, thus, equals the rise in the pretax wage. This, of course, equals the sum of the increased taxes (the treasury's benefit) and the increased aftertax wage (the student's benefit) in the earlier analyses of this paper. Because the increased income arises throughout the graduate's life, the stream of enhanced earnings must be discounted back to the time of the student's education to implement the planner's perspective.

The discounting parallels the present values computed earlier in this paper.

The goods and services that could be produced in the absence of university attendance have several components. First, the faculty, staff, buildings, and equipment could be redeployed to produce other goods and services. On the usual assumptions, the value of that foregone output equals the cost of operating the university, that is, the costs already included in analyzing whether or not students repay the treasury for the expense of their education. Second, the resources used to produce the books and supplies bought by students for their studies could be shifted to other industries to make other products of equal value. Third, instead of attending school, students could work, thereby producing more output. The second and third components of social cost have already been calculated and included in the analysis of the student's return to university education.

One way in which the planner's perspective differs from the treasury's and the students's is that tuition does not appear in the planner's calculus. From the planner's point of view, tuition is a transfer between two sectors of society and does not represent the use of resources that could produce additional goods and services. The treasury's gain is the student's loss, and so the two cancel out. In my application of this analysis, tuition is just another tax paid by students when they are attending university.

The various costs and benefits of university education from the planner's perspective have already been included in the analysis of this paper in calculating whether students will repay the treasury and earn a satisfactory return on their own investments in their future. The planner's perspective is a different way of combining the same elements to relate them to the question of education and economic growth. The relation among the elements can be seen with a little algebra. Let I equal the rise in pretax income due to university education. It equals the sum of additional taxes paid T and additional after tax income A.

$$1) \qquad I = T + A$$

Equation 1 is true for every year and for the present values of the lifetime streams provided that the same discount rate is used for tax payments and after tax incomes, as is done here. Henceforth, I, T and A will be interpreted as present values.

Tuition should be included as a tax T at the time of university attendance. Tuition shifts the distribution of the benefits of university education from the student to the treasury since tuition reduces A by the amount it increases T.

The costs of university education C consist of the treasury's costs CT and the student's costs CS. The former equals the annual cost of providing

the university education including operating and capital costs. The latter consists of the foregone earnings while the student is studying instead of working plus the cost of books and supplies necessary for the academic program:

$$2) \quad C = C_T + C_S$$

From the planner's point of view, university is a good investment for society as a whole if the increased GDP (I) exceeds the lost output required to produce it (C). If I is greater than C, then universities should be expanded. I will be greater than C, if I/C is greater than one:

$$3) \quad \frac{I}{C} = \frac{(T + A)}{C}$$

The right hand side of equation 3 can be rearranged to give:

$$4) \quad \frac{I}{C} = \frac{C_T}{C}\frac{T}{C_T} + \frac{C_S}{C}\frac{A}{C_S}$$

Since $C = C_T + C_S$, the fractions C_T/C and C_S/C are the shares of cost incurred by the treasury and by the students respectively. Let $s_T = C_T/C$ and $s_S = C_S/C$ designate those shares. Equation 4 can be rewritten to give:

$$5) \quad \frac{I}{C} = s_T \frac{T}{C_T} + S_C \frac{A}{C_S}$$

Equation 5 indicates that the social benefit-cost ratio equals a weighted average of the treasury's benefit-cost ratio and the student's benefit-cost ratio where the weights equal their respective contributions to the cost of university education. If university education is profitable from both the treasury's and the student's points of view, it will also be profitable from the planner's. Under the right circumstances, it can still be profitable from the planner's point of view even if the treasury or the student finds it unprofitable.

The calculations presented earlier in this paper are sufficient to conclude that university education is a good investment since it has been shown that it is profitable for both the student and the treasury. To pin the point down, benefit-cost ratios corresponding to equation 5 have been computed. Tables III-1 and III-2 show, for women and men respectively, the student's benefit-cost ratio (A/C_S), the treasury's ratio (T/C_T), and society's ratio (I/C), as defined above. These ratio's must exceed one for university education to be a good investment for the party concerned. If the student's ratio is above one, then the rise in aftertax income is sufficient to compensate the student for the lost wages, books and supplies, and tuition while attending university. If the treasury's ratio exceeds one, then the rise in taxes plus tuition more than covers the costs of providing the undergraduate education. If society's ratio

is greater than one, then the economic growth generated by educating the university students is more than the value of the consumption foregone by investing in university education.

Tables III-1 and III-2 show these ratios for the scenario in which university and high school incomes remain constant into the future. This scenario is the most likely scenario for women, as argued earlier, since this has been their experience in the new global economy. The situation for men has been less favourable in that the wages of high school graduates have been falling, while the earnings of university graduates have remained constant. Table III-3 has been constructed to explore the implications for men of a continuation of that scenario.

As Table III-1 indicates, all benefit-cost ratios for women are above one. University education is a profitable investment for the individuals concerned, for the treasury as paymaster and tax collector, and for society as a whole.

The situation for men is slightly ambiguous. If wages and salaries remain constant into the future, then university education as a whole remains very profitable for the student, the treasury, and for society at large. This conclusion is also true for most programs, as Table III-2 shows. However, neither terminal fine arts degrees nor terminal degrees in agriculture and biology are profitable for the student or society. These results improve dramatically, however, if society continues to evolve as it has done in the recent past so that the wages of high school graduates continue their slow decline. In that case, every undergraduate program is profitable for men (Table III-3).

Table III-1
Benefit-Cost Ratios — Women
(Scenario of zero growth of university or high school incomes)

	student's ratio	treasury's ratio	society's ratio
fine arts	1.38	1.11	1.25
humanities	1.61	1.27	1.46
social sciences	3.48	2.33	2.96
commerce	3.28	2.00	2.67
agriculture/biology	2.22	1.10	1.59
engineering	***	***	***
nursing	3.45	1.47	2.32
other health	6.51	2.57	4.27
math/physical science	4.61	1.94	3.09
average undergraduate	3.08	2.14	2.63

Notes:

Student's ratio — present value of after tax wage divided by pretax foregone wages plus cost of books and supplies. Tuition less tax on foregone wages deducted from wage increase.

Treasury's ratio — present value of extra taxes divided by cost of university program. Tuition less tax on foregone wages added to taxes.

social ratio — present value of pretax wage increase divided by cost of university program plus foregone pretax wages plus cost of books and supplies.

Table III-2
Benefit-Cost Ratios — Men
(Scenario of zero growth of university or high school incomes)

	student's ratio	treasury's ratio	society's ratio
fine arts	***	***	***
humanities	-0.15	0.22	0.01
social sciences	2.53	3.05	2.75
commerce	2.80	3.12	2.94
agriculture/biology	0.47	0.60	0.54
engineering	4.93	3.20	4.02
nursing	***	***	***
other health	1.52	0.98	1.23
math/physical science	3.02	2.02	2.49
average undergraduate	2.69	2.47	2.59

Note:
Ratios defined in Table III-1.

Table III-3
Benefit-Cost Ratios — Men
(Scenario of zero growth of university income
and high school income falling at 1% per year)

	student's ratio	treasury's ratio	society's ratio
fine arts	***	***	***
humanities	1.43	1.75	1.56
social sciences	4.11	4.56	4.31
commerce	4.38	4.51	4.44
agriculture/biology	2.00	1.56	1.77
engineering	6.46	4.16	5.24
nursing	***	***	***
other health	3.07	1.94	2.47
math/physical science	4.58	2.98	3.72
average undergraduate	4.25	3.71	3.99

Note:
Ratios defined in Table III-1.

Notes

1. Dickson et al. (1996) have considered some of the issues discussed here in the case of New Brunswick for which they have come to different conclusions. West (1988), Vaillancourt (1995), and Stager (1996) are important discussions of the economics of education in Canada that have influenced the arguments advanced here.
2. The averages for people with bachelor's degrees exclude degrees in education, law, and medicine since they are, in practice, graduate credentials for most people. These figures are earnings of full-time workers. Part-time workers will be considered later.
3. UBC Fact Book, 1997, pp.44, 48, 149
4. See Kesselman and McGlenen (1996) and Finnie and Schwartz (1996) for discussion of these issues.
5. I thank Mr. Brian Teghtsoonian of the UBC Awards and Financial Aid Office for providing the figures on financial aid at UBC.
6. I thank Mike Colter of the BC Loan Remission Unit for this information.
7. The use of a nominal interest corresponds to valuing investment in nominal prices.
8. The annual charge for using capital is quite insensitive to the choice of depreciation rate since it enters the calculation twice and cancels itself out.
9. Dickson et al. 1996, p. 320
10. The list of weights was supplied by Dr. John S. Chase, Director, UBC Office of Budget and Planning.
11. UBC Fact Book, 1997, p. 33
12. Freeman, 1986, p. 377.
13. Ashenfelter and Krueger 1994, Card 1995a
14. Card 1995a, 1995b.
15. People born in Prince Edward Island and in the Yukon and Northwest Territories are also excluded. The territories are excluded since they do not have universities, and PEI is excluded since it was coded with the territories in the census.
16. Vaillancourt 1995, Stager 1996, Dickson et al. 1996.
17. Statistics Canada, Education in Canada, 1990-1.
18. Card 1995a.

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