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Education and Technological Revolutions

The Role of the Social Sciences and the Humanities in the Knowledge Based Economy by Robert C. Allen

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I. Introduction

The modern economy is characterized by a high rate of technological progress involving new "high-tech" products. This phase of history began in the late 19th century with the invention of chemical dyes, the first pharmaceuticals, electrical equipment, the internal combustion engine, and the telephone. Research oriented universities and the industrial research laboratory date back to this period. The 20th century has seen many new high-tech products ranging from the automobile to the airplane, modern electronics and chemicals. In recent decades the computer and information technology have revolutionized the economy and are continuing to do so. We may witness the birth of even more dramatic changes arising from biotechnology.

The question is: what sort of educational programs will help Canada capitalize on the possibilities raised by modern technological revolutions? A common answer is that since technological revolutions involve high-tech products, what Canada needs is technologists. I will refer to this view as "Techism". Its proponents — "techniks"— maintain that our prosperity requires a redirection of resources towards technical education.

Techism comes in two forms. High-level Techism, as exemplified by the upcoming report of the Advisory Council on Science and Technology, emphasizes the need for highly educated scientists and engineers to promote the expansion of high-tech manufacturing and related businesses. Basic Techism, as exemplified by reports like the government of British Columbia's *Training for What?*, emphasizes the need for the technical skills taught in one- and two-year college programs. Enthusiasts of Techism either explicitly argue that too many resources are currently allocated to education, the humanities, and the social sciences, or make the same point implicitly by omitting them from their recommendations for future funding.

This paper argues that Techism is too narrow to prepare Canada for the new millennium. While techniks are right that the demand for technically trained workers is growing, the same is true for graduates in education, the humanities, and social sciences. Resources must be directed to these fields to meet the needs of the new knowledge-based economy.

Instead of Techism, educational programs should be assessed in terms of their contribution to economic development. This is the "Productivity Approach" to educational planning. This approach emphasizes that the Canadian standard of living depends on output per worker in the economy as a whole. Educational programs should be supported if they raise labour productivity anywhere. The empirical evidence reviewed here shows that the demand for graduates in the social sciences and humanities is growing rapidly, that they earn high salaries, and that the rate of return to investing in their education is as high as that of sciences and engineering. These findings mean that education in the humanities and social sciences is raising productivity in Canada.

Education in the humanities and social sciences is meeting the needs of the Canadian economy because the widespread utilization of computers and information technology has revolutionized the organization of businesses and government bureaucracies. The new-style organizations put a premium on workers who can relate models to real situations, work well with other members of a management team or with clients, and who can speak and write effectively. These skills are developed in humanities and social science programs. Techism, which concentrates on the production of new technologies and on the nuts and bolts of their operation, misses the organizational revolutions that accompany the adoption of the new technologies. The Productivity Approach accepts the need to respond to changes in labour demand wherever they occur and, therefore, recognizes the high value of the skills taught in humanities and social science programs. These skills meet the needs of new-style organizations, thereby contributing to rising productivity and living standards in Canada as a whole.

2. The economic success of graduates in 1996

A common view that underlies Techism is the belief that graduates in education, the humanities and social sciences cannot find good jobs. Since they do not have the skills that employers require — so the argument goes — Arts graduates end up driving taxis or making capuccinos if they can find jobs at all. What is needed for success say the techniks, is technical training — either the sort taught in one- and two-year technical/trade/vocational/career courses or the sophisticated sort taught in university engineering departments.

This common view can be explored using census data. I begin with the 1996 census and then add information from the 1991 census for comparison. Both censuses collected information about the employment, earnings, and job characteristics of Canadian workers. All figures in this study are computed from microdata files. The microdata files contain coded information on the individual census returns of about 3% of the Canadian population. The Canadian census is a critical source for assessing Techism, for it is one of the very few large-scale surveys that includes the individual's field of study. With census microdata, one can compare the employment success of engineers and humanities graduates, for instance, and that is what we shall do. The comparisons call into question the common view that the humanities and social sciences are poor preparation for the emerging knowledge-based economy.

Unemployment rates provide a basic test of employability. Table 1 shows unemployment rates for various education levels and fields of study. Unemployment is a more serious problem for younger people than for older people, so Table 1 concentrates on Canadians aged 25-29. If Arts graduates cannot find work, the problem should show up in that age group.

What Table 2 instead shows is that Arts graduates do well in the labour market. As a general rule, unemployment is worse for the uneducated, and Table 1 bears that out. Thus, the highest unemployment rates are those of high school dropouts. They are followed by high school graduates and people with a technical or trade certificate and then by those with a college diploma. (Generally, trade certificates are awarded for completing training courses of less than a year, but they are also awarded to graduates of apprenticeship programs. College diplomas are awarded for completing two-year programs.) University graduates had the best unemployment experience. Table 1 is not exceptional—this pattern is repeatedly observed in labour force survey data. The mediocre performance of those with a college diploma and the poor performance of those with a trade certificate is inconsistent with the basic technik view that specific skills guarantee a job in the new knowledge-based economy.

Table 2 shows unemployment rates for 25-29 year olds with a Bachelor degree. The results are broken down by field of study. The experience of women is remarkably inconsistent with high-level Techism, for the worst employment records were those of women in engineering followed by women in mathematics and in the physical and biological sciences. Graduates in the humanities did better than these, and the records of graduates in the social sciences and education were exceptionally fine.

The experience of men was not quite as favourable. Social science and humanities graduates had unemployment rates that were slightly above those of men in engineering or commerce. However, the unemployment rate of men in the humanities was still less than the rate for men with colleges diploma and much below that for men with technical or trade certificates. The evidence of unemployment rates is, therefore, strongly inconsistent with Techism.

Graduates in the humanities, social sciences, and education may have been able to get jobs, but were they good jobs? Table 3 shows the proportion of employed people with managerial or professional jobs. Clearly, the probability of having a managerial or professional job increased with educational attainment—the probability was only 13.9% for a high school drop out and over 95% for an MD or a Ph.D. University graduates all had much higher probabilities than those with less education.

This positive outcome extended to graduates in education, the social sciences, and the humanities, as Table 4 shows. Graduates of programs targeted to particular professions had the highest chances of being professional or managerial employees, notably graduates in nursing or health (90%), followed closely by education (85%). Engineering and physical science graduates had somewhat lower probabilities of managerial or professional work (just over 80%). The remaining programs had the lowest probability, but their rankings were almost identical (around 70%). This very broad group includes graduates in fine arts, the humanities, and social sciences — no surprise to proponents of Techism — but also commerce and the biological sciences. While commerce is reputed to teach management skills, it is significant that commerce is no more successful than the social sciences or fine arts in placing its graduates in managerial and professional work. While graduates in the humanities, social sciences, commerce, and biology had a lesser chance of landing a professional or managerial job than did graduates in health, this lesser probability was still much higher than that of a two-year college graduate (49%). Universities claim to prepare people for managerial and professional work, and Tables 3 and 4 show that the boast is not an idle one.

Income is another indicator of job quality. Tables 5 and 6 summarize the annual earnings of full-time, full-year workers in 1995. (The effects of non-employment and part-time work will be considered latter when social rates of return are calculated.) Separate tables are shown for men and women, and earnings are broken down by age. They show that graduates in the humanities and social sciences generally earn more than people who did not go to university and therefore contradict the common view that graduates in these fields do not have the skills that employers require.

Tabulations of earnings typically show that they increase with age due to greater experience and with educational level. Tables 5 and 6 show the same patterns with an important exception — namely the experience of people with trade or technical certificates. Here, women, generally earned less than high school graduates did. The same was true of men in the older age groups. These results parallel earlier findings about unemployment rates and parallels will turn up when employment growth is analyzed. These findings contradict basic Techism by showing that those who complete one-year training programs do not readily find jobs or earn high incomes. More generally, the result is an important example of how specific skills training — by itself — has no pay-off in the knowledge-based economy.

Tables 5 and 6 show that university degrees led to higher incomes. The success of university graduates with Bachelor degrees included women in all fields, for their average earnings always exceeded those of college graduates, let alone high school graduates. It is true that the earnings of humanities, social science, and education graduates were at the low end of the distribution scale for women in their twenties, but graduates in these fields also had the highest rate of growth of earnings and ended up at the top of the distribution scale for women in their fifties. Arts graduates tend to earn less in their twenties than do people who have completed more specifically focused programs, but the Arts graduates often catch up with, and then surpass, people in other fields.

Men with Bachelor degrees in the humanities and social sciences also did well, but there are some facts that give prima facie support to Techism. In three out of the four age groups, engineers earned the highest income, which supports high-level Techism. In most age groups, however, graduates in social science, commerce, and the physical sciences were not far behind. Graduates in health, the biological sciences, education, and the humanities had lower incomes. Graduates in education and the humanities earned less than, or about the same as, college graduates in their twenties and thirties, but realized higher incomes after the age of forty. The slower start of humanities graduates provides some support for basic Techism. Nevertheless, their earnings exceeded those of high school graduates at all ages, which makes degrees in the humanities a profitable investment for men, as we shall see. The notion that men with degrees in the humanities cannot find well-paying jobs is refuted by Table 6.

High-level Techism places great emphasis on the need for graduate education in the sciences and engineering, but the labour market places less value on those degrees. The high marketability of the MBA means that graduate degrees in commerce netted the highest earnings in most age groups. Engineers and scientists were not far behind, as were social scientists whose earnings were frequently on a par. Graduates in the humanities and education were not at the top of the distribution of graduate earnings, but nonetheless earned more than people with undergraduate degrees in the same area. Graduate education was increasing the economic value of graduates in the humanities and education as well as in the social sciences.

The snapshot of the labour market in 1995 and 1996 provides support for some aspects of Techism but also shows that it is too narrow a view of what is demanded by employers. It is a big mistake to believe that one-year technical or trade courses lead to a good job with high earnings, for these people experience high unemployment and little or no income gain over high school earnings. Graduates of two-year college programs do better in terms of income and employment. The lowest unemployment rates, highest occupational status and highest incomes are realized by university graduates. These favourable outcomes are realized by humanities, social science, and education graduates as well as by those in engineering and the natural sciences.

3. Rates of return

While university graduates generally earn more than those with less education, do they earn enough to justify the costs of that education? This question is particularly important for the humanities, social sciences, and education since they were not at the top of the earnings distribution. Are the earnings of their graduates with Bachelor degrees enough above those of high school graduates to cover the cost of undergraduate education? And are the earnings of those with Masters and Ph.D.s high enough to cover the cost of expensive graduate programs?

These questions are usually addressed by computing the social rate of return to education. In this approach, education is analyzed as an investment. The investors are the students, who do the studying, and the governments (federal and provincial), which provide the university. The benefit or gain from this investment is the rise in income that students earn after graduation. This gain is ultimately divided between the student and the government since some of the increased income is taxed away. That division, however, is irrelevant in a social rate of return calculation, which analyzes the combined costs and benefits of all parties.

The cost of the investment consists of (1) the earnings the student loses by studying instead of working, (2) the cost of books and supplies needed for their courses, and (3) the cost to the government of operating the university. The costs do not include food, clothing, or housing since these expenses would be incurred whether or not the student studying, nor do they include tuition fees. Tuition fees are a cost to the student but a gain to the university and so cancel out when the combined (that is "social") rate of return is calculated. The level of tuition fees as well as taxes on income earned after graduation affect how the profits of education are divided between the student and the government but do not affect the profitability of the investment to the student and the state together. That joint rate of profit is the social rate of return.

How is the social rate of return measured? Calculating the increase in income that results from additional education first requires that a time path be specified. For Bachelor degrees, I assumed that the student attended university from ages 18 through 21, that is, immediately after high school. The income gain from the investment is measured as the average income earned by university graduates minus the average income earned by high school graduates.[1] These increases were computed from tables like similar to Tables 5 and 6. To compute the rate of return, three modifications were made to the tables. First, average incomes were calculated for more age categories, specifically 20-24, 25-29, 30-39, 40-49, 50-59, and 60-65. More categories mean that the averages provide a more exact tracking of the sharp increases in income that occur in the 20's and the fall-off in income that occurs in the 60's as people retire. Second, the income concept was broadened to include self-employment income rather than just wages and salaries. Third, the averages were taken over all people in the age group whether they were working or not. In that

[1] One might reasonably ask whether the income difference does not also reflect an ability difference and consequently whether the income difference overstates the productivity raising effects of education. This issue has been explored at length by labour economists and other social sciences, and the consensus is that the rates of return computed without correcting for ability are accurate. Social factors play a major role in determining university attendance. Moreover, "ability" is multi-faceted, and the ability to do well in academic programs is not the same as the ability to earn a high income. Allen (1998b) reviews the literature and presents new Canadian evidence.

way, the effects of non-employment and part-time work are included. If the educational investment turns out to be profitable, it means that the earnings of the employed university graduates are large enough to cover not only the costs of their own education's but also the costs of those not working.

The tabulated data on average earnings provide a snap shot of the situation in 1995, which was taken to represent the situation at the time of graduation. If those average earnings were never to change, then the 1995 age-earnings profile would indicate the earnings of an individual over the course of his or her whole working life. However, both inflation and economic growth will cause the age-earnings profile to shift. To project an individual's earnings in the future, the age-earnings profile was increased by 2% per year for inflation and 1% per year for economic growth. The latter represents the long-run growth in productivity and is the assumption that the OECD makes when it computes rates of return to education (Alsalam and Condy 1995, *Education at a Glance: OECD Indicators*, 1997). Separate projections were made for men and women in each field of study and for high school graduates to compute the rise in income from university education.

The same logic was applied to the earnings increase from graduate education, but the procedure had to be modified in detail. Graduate education was modeled as occurring immediately after undergraduate education. Masters degrees were analyzed as either one- or two-year programs. Ph.D. programs were treated as being four years long (two years of courses and two years of thesis supervision) and were analyzed as following immediately after the completion of a one-year Masters program. Rates of return were calculated for the combined Masters/Ph.D. sequence.

Tabulating average earnings was not an effective way of computing the earnings gain from graduate degrees because there were not enough observations in each age group to map out a stable age-earnings profile. Instead, regression analysis was used. The sample was all of the observations of people aged 20 to 65 with Bachelors, Masters, or Doctoral degrees, whether they worked or not. The dependent variable was wages and salaries plus the net income from self-employment. The explanatory variables were age, age squared, and age to the fourth power — these captured the rise of income with experience for people in their twenties and the fall in income as people retired — and dummy variables for gender, a Masters degree, and a Ph.D.[2] The dummy variables measured the effects of gender and graduate degrees on income.

The regression results are summarized in Table 7. The age variables are generally significant and imply plausible age-earnings profiles. The coefficient of the gender variable measures the economic disadvantage of being a woman. In nursing, it is negligible. In the fine arts and humanities, it is about $8000 a year. The disadvantage increases to $10,000 in education, $14,000 in the sciences, $16,000 in commerce, and $18,000-$19,000 in social sciences, engineering, and other health-related fields.

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[2]Age cubed was entered in all of the regressions but was never significant and is not included in the final models. Models were also estimated using Mincerian potential experience instead of age. In other models potential experience was also interacted with the Masters and Ph.D. dummy variables to allow the age-earnings profiles to vary by degree. These alterations did not lead to systematically different results.

The coefficients of the Masters and Ph.D. variables measure the extra income (compared with a Bachelor degree in the same field) earned by those graduate degrees. The highest returns for Masters degrees are realized in education, commerce, nursing, and other health-related fields. Masters degrees in the humanities and social sciences command income gains that exceed the gains in the sciences and engineering, where they are not statistically significant. Doctoral degrees in education, the humanities, and the social sciences realize income gains that are on a par with those in most other fields. The low-income gain from a Ph.D. in engineering raises the question of whether the market values the skills of those highly trained technologists as much as high-level techniks believe.

In the regressions for education, the humanities, and social sciences, the coefficients of the Ph.D. are substantially greater than those of the Masters, indicating that the Ph.D. adds a lot to the earnings of a Masters. This gain largely disappears in the case of commerce for the coefficient of the Ph.D. is only slightly above that of the Masters; in other words, the MBA gives so much earning power that a Ph.D. can barely top it. The situation is different again in engineering and the natural sciences. For those fields the Masters ads very little to the earnings of an undergraduate, but the Ph.D. provides a significant return. Nursing shows a significant return to both the Masters and the Ph.D., while "other health fields", which includes, at the graduate level, many health administrators. exhibits a pattern like commerce — the Masters degree substantially raises earnings, while the Ph.D. adds little more. The plausibility of these results gives credence to the regression analysis.

In estimating the rates of return to graduate degrees, the coefficients of the Masters and Ph.D. variables in Table 7 were used as the measures of the increased income from the degree.[3] They were projected into the future to reflect inflation and economic growth.

To compute the rate of return, the projected benefits must be set against the costs, namely the foregone earnings of the student, the costs of books and supplies, and the government's cost of providing the education. The cost of books and supplies was taken to be $1000 a year. For students in undergraduate programs, the foregone earnings were calculated from the average earnings of someone with a high school diploma of the corresponding age, while the calculations for graduate students used the corresponding earnings of someone with a Bachelor degree. It was assumed that undergraduates worked in the summer and gave up two-thirds of a year's earnings. The same assumption was made for students in two-year Masters programs. In computing the cost of a one-year Masters program, it was assumed that the student did not work and therefore gave up a full year's earnings. Ph.D. students doing their two-years of course work were assumed to work in the summer and hence to give up two-thirds of a year's earnings. When writing their theses, they were assumed to work more and to give up half a year's earnings.

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[3]More complicated specifications were also estimated in which gender was interacted with the variables representing the Masters and Ph.D. degrees to see if the returns to those programs varied between men and women. Statistically significant effects were detected at the doctoral level for graduates in the humanities and at the Masters level in other health areas. There may also have been effects for fine arts graduates, but they were hard to pin down due to the small number of people in the sample with graduate degrees in this field. These estimated differences in the returns to graduate degrees were incorporated into the rates of return but with reservations since these effects may reflect old patterns of discrimination against women that may not persist in the future.

The cost of university programs is determined in a series of steps. Statistics Canada reports that the total operating costs of Canadian universities in 1995-96 were $9,824,237,000. Interest and depreciation on the buildings and equipment were $1,136,968,000.[4] The total cost of university activities was, therefore, $10,961,250,000. These activities included research as well as teaching. Several approaches suggest that about two-thirds of university costs are chargeable to teaching. One is the Hettich (1971) formula, derived from the accounts of Canadian universities, and it implies that teaching costs were $7,462,259,000 in 1995-96 (Dickson et al. 1996).

The total teaching costs are allocated among programs in proportion to enrollment weighted by relative cost. Statistics Canada tabulates full- and part-time enrollment by field of study and degree. Those enrollment figures are converted to full-time equivalents (FTE's) on the assumption that a part-time student equals one third of a full-time student. Various schemes are available showing the relative cost of programs. Typically, if a first-year arts student is rated at 1.0, then a 3rd or 4th year arts, commerce, or education student is 1.5, and a science or health student is rated at 2.0. Graduate students cost more. A master's student in the arts is rated at 3.0 and in the sciences and health disciplines at 4.0. Medical students are typically rated at 5.0 or 6.0. I have rated Ph.D. students at the same level as Masters students since they often take the same classes, but Ph.D. students have been rated as high as 6.0. This rating seems to reflect the politics of funding rather than the cost of the programs. These program weights imply that there were 1,185,516 weighted full-time equivalent (WFTE) students in Canadian universities in 1995/96, so the cost per WFTE was $6295. The cost of a degree can then be computed from the number of WFTE's involved. Therefore, a four-year undergraduate science degree costs $50,360 (8 x $6295) since it consists of two WFTE's a year for four years.

Juxtaposing the costs and benefits of university programs implies social rates of return. These are shown in Tables 8 and 9. The rate of return on long-term government bonds is about 5%, so that is the threshold that educational programs must meet in order to be good investments. Degrees in the humanities, social sciences, and education surpass that threshold.

I begin with the Bachelor degree. In the case of women, the rates of return to SSHRC fields were very close to the average for all women with Bachelor degrees (16.8%). The humanities, social sciences, and education fields formed part of a group that also included engineering, math and physical sciences, and nursing. Rates of return for all these fields were very similar, and very much above the 5% threshold.

The rates of return to undergraduate degrees are more varied for men than they are for women. Men in the humanities (7.6%) and education (13.6%) easily surpass the 5% threshold, while the social sciences (18%) are one of the highest return fields, realizing almost as much profit as engineering (19.5%) and commerce (21.1%). Undergraduate degrees in the humanities, social sciences, and education are good investments for Canada.

[4] Interest and depreciation are computed from the capital stock of the universities. Statistics Canada uses four different measures of the capital stock. The capital costs used here are computed from the delayed depreciation stock ($16,242.4 million), which is one of the highest and appears to correspond best to the life expectation of university assets. Interest was computed at 5% and depreciation at 2%.

The same is true of graduate programs. Masters degrees are analyzed as requiring either one- or two-years since programs are organized in both ways. Rates of return are always lower under the two-year format since the income gain is the same in both cases, but the costs are higher if the degree is done in two years. Professional programs in commerce, education, nursing, and other health areas give the highest rates of return. Next come the social sciences, humanities, and fine arts, which yield rates of return above the 5% threshold. Finally, Masters degrees in the sciences and engineering give the lowest rates of returns. Engineering is never as profitable an investment, nor are the sciences if the programs are done in a two-year format.

Ph.D. programs are profitable for both men and women in all fields of study. As with Masters degrees, the return for Ph.D.s in health and education is always high. The humanities and social sciences are on a par with commerce and generate returns that exceed those in engineering, mathematics, and the physical sciences. The returns for Ph.D.s in agriculture and biology are not much better. High-level techniks attribute more importance to these fields than the market does, judging by the rates of return to graduate programs in science and engineering.

4. Employment Changes, 1991-96

The 1996 census provides a snapshot of the labour market at a particular time. While that snapshot has much to teach, it cannot answer all the questions. What we really want to know is how the labour market is changing. Is the demand growing rapidly for people with technical skills and slowly — or even declining — for graduates in education, the humanities, and social sciences? Or does the emerging knowledge-based economy require a broad range of education and training? To answer these questions, we need to compare the labour market at two dates, and we shall do so using the 1991 and 1996 censuses. Two snapshots become a film, and we move from static to a dynamic analysis of education and the labour market.

A first step in investigating how the demand for labour has been changing is to examine trends in employment. Table 10 shows employment in Canada for various levels of educational attainment according to the 1991 and 1996 censuses. The table also shows the increase in the number of jobs held by people at each educational level and the percentage change of that increase. Table 11 breaks the evidence of university graduates down by field of study. Several findings are immediately apparent from the two tables:

First, there was a large employment drop for people who had not finished high school. All commentators agree that completing high school is essential for success in the new knowledge-based economy, and Table 10 bears that out.

Second, employment also declined — but by a smaller extent — for high school graduates and for those holding trade certificates. The decline in employment for those holding trade certificates contradicts basic Techism, which maintains that the new economy requires more of those technical skills. This result parallels the earlier findings about the high unemployment and relatively low earnings of people with trade certificates. One-year trade certificates are insufficient preparation for the economy of the 21st century.

Third, the expansion in employment for those holding college diplomas made the biggest contribution to total employment growth and achieved one of the highest percentage increases between 1991 and 1996.

Basic Techism is on firmer ground when it maintains that the emerging knowledge-based economy requires the skills taught in two-year college programs, for employment of the graduates of such programs has been increasing very rapidly. However, about half of these programs graduates are women and most of them complete nursing, commerce, or clerical programs, rather than technical programs. Among the men, about half complete programs in applied engineering. These technical graduates are the people that basic techniks point to, but they are a minority of college graduates. The experience of the colleges suggests that the emerging new economy demands much more than technical skills.

Fourth, university graduates made almost as big a contribution to employment growth as college graduates. The expansion of employment of those with university degrees or certificates was 456,029 — almost identical to the growth in employment of college graduates. Indeed, the employment category with the biggest percentage increase was people with Ph.D.s. Employment expansion was very strong for those with Masters degrees and Bachelor degrees.

Fifth, the expansion of employment of university graduates extended across all fields. Table 11, which focuses on those receiving a Bachelor degree or higher, shows that the field with the biggest employment growth — both absolutely and on a percentage basis — was social sciences. It was followed closely by commerce. Engineering and the natural sciences, the fields deemed most important by high-level techniks, were in the middle of the pack. Once again, the evidence seems to contradict the technik vision of the emerging knowledge-based economy.

But the matter cannot be left there, for there is a major problem in interpreting Canadian employment trends. The question is: did the employment changes reflect changes in the *demand* for labour or changes in the *supply*? In a country like Canada, where immigration is relatively small, the educational qualifications of the labour force are mainly determined by the output of the education system. Indeed, the technik critique of Canadian education is that the system is not responsive to the needs of the economy and so is producing graduates with a skill mix that is in appropriate for the future. High-level techniks, for instance, would say that the low contribution of engineering to employment growth (Table 11) shows what's wrong with Canadian universities — not how the economy is evolving. Our problem is, therefore, to determine whether changes in the educational credentials of the work-force reflect a non-economic structure of programs or whether they reflect changes in the demand for labour. I shall approach this problem in several steps.

5. From Employment Change to Labour Demand

The history of wages and salaries throws light on the growth of demand for labour. The illumination does not occur, however, without a theory of the labour market. I begin with the theory of competitive markets, which is commonly used in economics. According to this theory, wages and employment are determined by supply and demand. In that case, wages will rise if demand grows faster than supply, and wages will fall when supply grows faster than demand.

Constant wages indicate that supply and demand are changing in step with each other. If the technik critique is right, then the wages of people with trade certificates and college diplomas should be rising with respect to the salaries of humanities and social science graduates (basic Techism). Likewise, the salaries of engineers and scientists should be rising with respect to the salaries of Arts graduates (high-level Techism). Findings of this sort would support the technik critique that Canadian colleges and universities are producing a mix of graduates that do not meet the needs of the economy, and the policy recommendation that resources should be shifted from the humanities and social sciences toward technical fields in order to meet those needs.

To investigate changes in earnings, tables similar to Tables 5 and 6 were compiled for 1990 from the 1991 census. The Consumer Price Index was used to convert the 1990 wages and salaries into 1995 dollars. Comparison of the 1990 and 1995 tables makes two points. First, there was a decline in real earnings for virtually all educational and age groups. This decline was presumably caused by the high unemployment rate at the time.

Second, there was very little change in relative wages between the two periods. To establish this finding, all earnings for each age level were dividing by the earnings of high school graduates of that age. Inspection of the tables suggests that there were no changes in relative wages. To pin the matter down, the relative earnings for men in 1995 are divided by the corresponding relatives for 1990 and similarly for women. If these ratios of ratios equal one, then the wage structure is unchanged. Indeed, that was the case. The conclusion is that the Canadian wage structure was stable.

If wages and employment are determined by supply and demand, a stable wage structure means that demand and supply are growing at the same rate. The increases in employment for humanities and social science graduates, in other words, did not occur because there was an oversupply. To repeat, that situation would be indicated if the salaries of humanities and social science graduates were falling relative to other workers, so employers were hiring Arts graduates for lower skilled work. But their salaries were not falling. The demand for their labour was growing as rapidly as the supply.

This interpretation of the data is predicated on the competitive model of the labour market, a theory that presumes wages move up or down to equate demand and supply. An alternative view of the labour market emphasizes the rigidity of wages, that is, supposes that the wage and salary structure was fixed by collective agreements and bureaucratic policies, so that wages would not adjust if supply and demand were out of balance. Indeed, one might interpret the remarkable constancy of relative earnings as evidence in favour of that view. In that case, the increase in the supply of humanities and social science graduates would result in their unemployment unless the supply growth was matched by demand growth. In section II, we reviewed evidence on unemployment rates that showed they were low for all university graduates including those in education, the humanities, and the social sciences. Unemployment was higher for people with less education. If we take the fixed wage model of the labour market seriously, the conclusion is that the demand and supply of university graduates in all fields were growing in tandem, while supply growth outstripped demand growth for people with less education. The imbalance was greatest at low educational levels. This conclusion does not support Techism but does support the conclusion that the emerging knowledge-based economy requires university graduates in all fields.

6. BC: a case study

Further evidence that rapid economic growth in the 1990s increases the demand for graduates in all fields is provided by the history of British Columbia from 1991 to 1996. While the economy of central Canada was depressed, BC's economy was booming. Indeed, BC accounted for two-thirds of the job growth in Canada as a whole. The study of growth at the regional level is particularly revealing of trends in labour demand. In Canada as a whole, the educational qualifications of the labour force are mainly determined by the size and character of the education system, so one cannot infer changes in the demand for labour from changes in employment without also examining the stability of the wage structure and unemployment rates as we have done. In a regional economy like BC, an increase in labour demand creates jobs that attract migrants from elsewhere in Canada. As a result, the employment pattern is not determined by the provincial educational system but reflects changes in labour demand. So by looking at employment changes in BC in the 1990s, we get another view of how rapid economic growth affects the demand for labour. The important conclusion is that we observe increases in the demand for graduates in the humanities and social sciences that were every bit as large as those for graduates in engineering or commerce.

Tables 12 and 13 summarize the changes in employment in British Columbia from 1991 to 1996. As noted, the total grew much more rapidly in BC than in Canada as a whole, and that has some bearing on the absolute magnitude of the changes, but the relative pattern is similar to that of the whole country. High school dropouts had the worst employment experience, in that their employment level fell even as the whole economy expanded.

The employment of high school graduates and people who completed trade and one-year technical courses grew by a small amount that was considerably less than the growth in total employment. Once again, the employment record of the graduates of one-year technical training programs appears weak.

Most of the employment growth in the province was accounted for by the growth in employment of college and university graduates. Indeed, workers with university degrees, certificates, or diplomas accounted for 48% of the growth in employment. Holders of Ph.D.s and Masters degrees experienced the most rapid growth of all. This is, indeed, the knowledge-based economy.

What sort of knowledge was in demand? Social sciences had the highest rate of employment growth. Physical sciences came in second, and engineering was third — an unexpected result for techniks. Equally surprising was the strong showing of the humanities, which came in fourth, beating out commerce at five. Health, nursing, education, fine arts, and the biological sciences followed.

From the analytical point of view, what is most significant about these increases is that they represent the growth in demand rather than the growth of supply. The increase in employment in all these fields was considerably larger than the number of BC university graduates. The shortfall was met by international and interprovincial migration. Employment growth in BC was demand determined, and not dictated, by the output of the province's universities.

The history of BC in the 1990s projects a vision of Canada's future that is broader than imagined by techniks. They are right that the future economy will be knowledge-based. Even with rapid economic growth there will be little if any employment growth for high school dropouts or for those with only a high school diploma. In contrast to the beliefs of basic techniks, this bleak future extends to graduates of one year technical and trades programs who face weak demand growth in the emerging economy. There will be a significant demand for the graduates of two-year college programs and, to that degree, basic techniks are right.

But most of the growth in labour demand will be for university graduates. In contrast to high-level techniks, the demand will not be limited to engineering or even to other professionally oriented programs. While demand growth will certainly be strong for the graduates of those programs, it will be at least as strong for graduates in the humanities and social sciences. One of the outstanding features of the knowledge-based economy will be the breadth of advanced education and skills it requires.

7. Techism and economic development

In Canada, the demand for graduates in the humanities and social sciences has been growing strongly in the 1990s. This is a challenge to Techism. The next two sections aim to explain why the technological revolutions of our era are increasing the demand for graduates in the humanities and social sciences as much or more than graduates in technical subjects.

Techism adopts an essentially physiocratic view of the economy. The high-tech sectors are regarded as the base on which the rest of the economy is erected. Increase the size of the base, and the economy as a whole expands. Expanding the base requires more technical personnel. Economic growth, in this view, can be understood linearly: more technical personnel increase the output of high-tech products, which, in turn, leads to overall economic expansion.

Both links in this chain are problematic: why will more technical personnel increase high-tech output, and why will more high-tech output lead to overall economic expansion? I concentrate on the second question.

Singling out part of the economy — in this case, the high-tech sector — for special emphasis is different from the usual approach in economics, which treats all sectors as equally important. The size of the economy, the gross domestic product (GDP), is the sum of value added (net output) in each sector. In that case, the rate of growth of GDP equals a weighted average of the growth rates of the sectors where the weights equal the shares of the total economy represented by the sectors:

The rate of growth of GDP =

The sum of sector's share of GDP x sector's growth rate

In this framework, the contribution of the growth of a sector to national economic growth is the sector's growth rate multiplied by its share of the economy. All sectors are equally important except for differences arising due to differences in shares.

To understand the role that technological revolutions play in economic development it is important to distinguish between the *utilization* of high-tech products and the *production* of those products. Consider for instance, a genetically modified variety of wheat that increases the yield per hectare. The *production* of this seed contributes to economic growth by increasing the output of the biotechnology industry. However, the aggregate impact of that output growth may be minor (a) since the share of the biotechnology industry in the Canadian economy is very small and (b) since the output of conventional seed will decline and that fall in output offsets the rise in output of high-tech seed. However, the contribution of the *utilization* of the improved seed could be very large since it will increase agricultural output, and agriculture constitutes a larger fraction of the Canadian economy than the biotechnology industry.

It is likely that many high-tech products contribute more to economic growth by their utilization than by their production. Computers are an example. Even in the United States with its large computer industry, the contribution to GDP growth from the manufacture of computers is probably less than the contribution to growth from using computers in manufacturing, commerce, and administration. This is certainly true of Canada where there is no significant production of computers, but where their use is widespread. Indeed, the Canadian economy generates a per capita income higher than that of Europe or Japan and almost as high as that in the United States, without producing many of the high-tech products of the late 20^{st} century. Canada can do this by using those products, and it gets them through international trade.

The possibility of importing high-tech products must be assumed away in order for Techism to make sense. In the absence of trade, high-tech products cannot be utilized in Canada unless they are produced here, so the contribution of high-tech production to growth includes the utilization contribution as well as the production contribution. This is the implicit assumption of Techism, and is a necessary assumption for that theory. In an era of globalization, it is also an odd and unwarranted assumption.

8. The productivity approach and economic development

The conclusion that utilizing high-tech products increases GDP is consonant with the productivity approach to educational planning. The Productivity Approach insists that a high standard of living (GDP per head) requires high productivity (GDP per worker) across the whole economy. Output per worker in the Canada as a whole is a weighted average of output per worker in all sectors of the economy where the weights are the shares of the workforce in each sector:

output per worker in Canada =

sum of sector's share of employment x output per worker in sector

Output per worker in the economy as a whole can be increased by raising output per worker in any sector, and the overall impact will be greater, the larger the employment in that sector. The production of high-tech products will contribute to growing prosperity if output per worker in high-tech industries exceeds the national average, and if those industries increase their employment faster than the national average. By the same token, if output per worker in the high-tech sector were below the national average, then the expansion of high-tech production would lower the standard of living. While the contribution to the standard of living of producing more high-tech products is uncertain, the utilization of those products will raise output per worker in other sectors and is likely to make a significant contribution to the standard of living in view of the large percentage of the workforce in those sectors.

Anything that increases output per worker anywhere in the economy will tend to increase GDP per head. New technology and capital investment have this effect, as does the employment of more educated people. The increased employment of workers with two-year college or university credentials is an important example of this process. Statistics Canada divides the economy into 16 sectors. From 1991 to 1996, eight of them — manufacturing, wholesale trade, retail trade, finance, business services, education, health, and other services — accounted for 92% of the growth in university graduates. The sectors that did not significantly contribute to employment growth for university graduates were agricultural, other primary industries, construction, transportation, communications, the federal government, provincial and local governments, and the accommodation, food, and beverage sector. (An almost identical list — manufacturing, wholesale trade, retail trade, business services, health, accommodation/food/beverage, other services — accounted for 83% of the growth of graduates from two-year college programs.)

Many factors, like the growth of a sector's output and the intensity with which it employs graduates, play a role in explaining changes in the employment of university graduates. A necessary condition for employment gains for graduates in the 1990s was the increased intensity with which firms hired graduates. Table 13 shows the actual employment increases of university graduates from 1991 to 1996 and the increases that would have occurred, had the percentage of the workforce with degrees remained constant over the period. With the possible exception of business services, the employment gains that occurred would have been much smaller, or negligible, without the increasing tendency of employers to hire graduates. Manufacturing, for instance, increased its employment of university graduates by 37,129 from 1991 to 1996. If the fraction of employees with degrees had not gone up, the employment gain would have been only 2,580. Some other sectors of the economy — notably the government — also saw dramatic increases in the percentage of university graduates employed, but those increases were realized by slashing the employment of people without degrees, so the government sector did not contribute to the overall expansion of employment of graduates. A rising percentage of employees with degrees was a necessary, if not a sufficient, condition for a rise in their employment.

A parallel analysis for the various fields of study reveals significant differences across fields. It is no surprise that the majority of education graduates work in education, and the majority of health and nursing graduates work in the health sector. The great majority of graduates in mathematics, the physical sciences, and engineering work in manufacturing or business services. The latter includes technical consulting firms that employ many scientists and engineers. Graduates in agriculture and the biological sciences have the most dispersed employment pattern of any field of study.

The employment patterns of graduates in the humanities, social sciences, and commerce were different. Most of the growth in employment of fine arts graduates was in other services — which includes artists and the film and entertainment industries — education, and — much more surprising — business services. It accounted for almost a fifth of the increased employment of fine arts graduates.

The employment profiles of humanities, and especially social science graduates, were like those of commerce graduates. The most important sectors employing these graduates were manufacturing, wholesale and retail trade, finance, and business services.[5] It is remarkable that 23% of the increased employment of humanities graduates was concentrated in business services. This percentage was identical to that of commerce graduates. In addition, 10% of the increase of humanities graduates was in manufacturing — an even larger percentage than that achieved by commerce of social science. There, the data on employment growth by sector show that graduates in the humanities and social sciences have a different employment pattern from those in the hard sciences, but one that is not qualitatively different from that of commerce graduates.[6]

Why were social science and humanities graduates as successful as commerce graduates in getting jobs in the business sector? Since employment increased in some sectors — but not all — the employment changes reflect sector specific factors — most likely changes in technology and organization, i.e. the computer revolution or, more generally, the revolution in information technology. Why has it led to the changes in employment by educational level that we have discussed and, in particular, to the increased employment of social science and humanities graduates?

The answer is that computers and information technology have revolutionized business organization and increased the demand for social science and humanities graduates. The old-style business was organized hierarchically. Legions of clerks and middle managers processed information by hand. This was funneled up the hierarchy to the top where decisions were made. Computers and information technology have rendered this form of organization uncompetitive. The fall in the prices of hardware and software has led to the widespread adoption of computers in business and government. Shifting information processing to computers has led to a fall in the demand for clerks and low level managers, which is manifest in employment data as falling or slow growth in employment of high school graduates and dropouts. The adoption of computer-based information technology systems has also cut the cost of information. As computerized databases are enlarged, information can be brought to bear on many more business issues. When supermarkets, for instance, adopt checkout scanners and computers to track inventory, they also make it easy to study the effects of advertising and promotional pricing on sales. In the simplest terms, the number of correlations that can be computed increases exponentially, while databases expand linearly.

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[5] In addition, health and social services employed one fifth of social science graduates and other services employed one fifth of humanities graduates.

[6] Fine Arts graduates were employed mainly in education, business services (probably advertising and commercial art), and "other services," which includes artists and the film and entertainment industries.

The falling cost of information has made the hierarchical organization of business inefficient. Senior management no longer has the time to deal with all the information that can be cheaply and usefully produced. As Herbert Simon (1973), the Nobel prize winning economist, noted,

> "The scarce resource is not information; it is the processing capacity to attend to information. Attention is the chief bottleneck in organizational activity, and the bottleneck becomes narrower and narrower as we move to the tops of organizations." (Simon, 1973)

The result has been three-fold.

First, there is an increased demand for people who can understand the information generated by computer systems, analyze it, relate it to the world, and act on it. These kinds of general intellectual abilities are the sorts that are developed in humanities and social science programs. It is for this reason that the use of computers has led to the growth in demand for people with those degrees.

Second, organizational structures have become flatter. Instead of multiple layers of managers doing routine information processing, there are fewer layers in the hierarchy, and employees are charged with analyzing and acting on the greater volume of processed information available. There is a much greater demand for people who can make critical and independent judgments, and those capacities are cultivated in social science and humanities programs.

Third, the new-style middle managers need greater interpersonal and communication skills both to deal with clients and to work together in self-directing teams. Humanities and social science programs can produce more effective employees in this regard as well.

Technology has affected many sectors of the economy, but not all. The affected sectors include those where the employment of university graduates has expanded the most, as well as the government. Layoffs of clerks and old -style middle managers in manufacturing have been widely reported, since firms in this sector are among the most prominent in the economy. The shift to computer-based, less hierarchical management structures in manufacturing has been widely noted for the same reason. Wholesaling and retailing have also been widely affected. Computerized inventory control has led to the reorganization of many companies and increased possibilities of information analysis, as already noted. New companies have also emerged in this sector based on sales over the Internet. Firms like Amazon.com, without inventories of their own and with highly educated workforce, are setting the pace for the new millennium.

Many economies of new-style of management have been realized by expansion of the business services sector. In accounting firms, for instance, the new-style manager is responsible for a spreadsheet dealing with a particular function — such as taxation, inventory control, etc. The spreadsheet does the calculating that used to require many clerks and managers, and it embodies the tax or inventory model. The operator of the spreadsheet has to know the capabilities of the model and how to apply them to the needs of the client. The new-style managers, therefore, need interpersonal and communications skills, as well as the ability to understand a model and tailor it to a particular application. These skills become critical wherever management has been revolutionized by information technology. Manufacturing, wholesale and retail trade, finance, business services, and the government are the sectors where this revolution has occurred. Aside from the government where cutbacks have reduced overall employment, these are also the sectors where the demand for university graduates in general — and humanities and social science graduates in particular — have expanded.

Computers have led to a technological revolution that has contributed to economic growth in two ways. The production of computers has directly increased GDP, notably in the United States. More generally, the use of computers in many sectors of the economy is contributing to growth by raising output per worker. While the production of computers and software requires people with many technical skills, the use of computers requires the general skills taught in social science and humanities programs. The use of computers affects skills requirements profoundly. The issue is not whether an employee knows how to operate Excel, so much as it is whether the employee can apply a model to a problem, deal effectively with clients and members of a management team, write and speak clearly, and make informed and independent judgments. The reason these skills are in high demand is because business organization has been revolutionized to take advantage of cheap information. That revolution increases the demand for social science and humanities graduates.

Table 1

Unemployment Rates, 25-29 year olds, 1996

	women	men
high school noncom	20.6%	19.0%
high school grad	11.5	10.0
trade certificate	10.6	12.6
college diploma	7.9	6.8
univ less than bach	6.5	7.8
bachelor degree	4.4	4.8
graduate cert or deg	4.8	3.4
overall	10.1%	11.1%

note: excludes people in school in the previous year.

Table 2
Unemployment Rates by field, bachelor degrees, 25-29 year olds

	women	men
education	2.9%	3.5%
fine arts	5.9	6.5
humanities	7.0	6.7
social sciences	3.4	5.5
commerce	4.3	4.3
agric/bio	7.2	4.6
engineering	8.8	4.3
nursing	3.1	0.0
other health	0.6	5.7
math/physics	7.8	3.8

note: excludes people in school in the previous year. "Other" is excluded.

Table 3

Occupations of Canadian Workers, 1996

	percentage with managerial or professional occupation
high school noncom	13.9%
high school grad	25.2
trade certificate	25.4
college diploma	48.5
univ less than bach	59.2
bachelor degree	71.8
univ gt bach	83.3
medicine	95.5
masters	88.4
Ph.D.	95.1
total	37.0%

note: excludes people in school in the previous year.

Table 4

Occupations of Canadian University Graduates, 1996

	percentage with managerial or professional occupation
education	85.1%
fine arts	74.3
humanities	69.9
social sciences	70.9
commerce	70.4
agriculture/biology	70.4
engineering	82.6
nursing	90.6
other health	93.8
mathematics/physical science	80.7
total	77.4%

note: excludes people in school in the previous year. Other excluded. University graduates include people with a bachelor degree or higher.

Table 5

Annual Income of Women by Education and Field of Study, 1995

	age groups			
	20-9	30-9	40-9	50-9
high school noncom	19077	23697	24924	24391
high school grad	20778	27805	29927	29746
trade certificate	21173	26053	28284	29168
college diploma	24499	32169	34308	34351
bachelor degree	30719	41499	45699	47285
education	29820	39296	46493	46356
human/Fine Arts	27474	38543	42328	49343
social science	28275	40968	46756	49352
commerce	30965	44473	44920	42347
ag/bio	30892	37536	41296	47434
engineering	36318	46797	42969	35893
nursing	36799	42543	47081	49216
other health	40125	46669	45554	47071
math/phys sci	36108	44591	50687	45816
graduate degree	38824	46009	53235	55091
education	32094	45635	53683	54866
human/Fine Arts	32643	39935	48661	53117
social science	33379	46233	54757	55603
commerce	39437	52999	59074	57617
ag/bio	33132	40174	43917	57693
engineering	40278	46142	44723	60876
nursing	42500	40321	53869	60290
other health	37893	50259	52895	59699
math/phys sci	32096	47232	58270	51477

note: These are total wages and salaries earned in 1995 by people employed fulltime for 49 or more weeks in the year. Self-employed are excluded as are people enrolled as students during the academic year before the census or reporting total wages and salaries for the year of less than $4000. Degrees in medicine and dentistry are excluded. Graduate degree includes Ph.D., masters, and graduate certificates.

Source: Census of Canada, 1995, microdata file.

Table 6

Annual Income of Men by Education and Field of Study, 1995

	age groups			
	20-9	30-9	40-9	50-9
high school noncom	25063	34145	38228	38735
high school grad	27046	37928	44449	47876
trade certificate	30626	40725	45775	46105
college diploma	32241	42962	49774	52944
bachelor degree	35721	53107	61188	65305
education	31321	43067	52107	54004
human/Fine Arts	29671	39641	52175	55180
social science	33786	53518	61031	68439
commerce	35562	59969	65384	69416
ag/bio	31680	48070	55860	56505
engineering	40800	57162	69162	76189
nursing	34065	42687	42629	48055
other health	42371	53232	57235	54831
math/phys sci	38814	55278	63494	67775
graduate degree	38706	56562	65868	72222
education	35682	49923	58739	63069
human/Fine Arts	34484	40304	51647	60442
social science	36186	56732	66931	76046
commerce	43365	68490	80830	87300
ag/bio	19088	42846	60257	68133
engineering	42045	56352	68256	78449
nursing	***	***	***	***
other health	27200	60179	77113	85851
math/phys sci	36722	53982	65007	73720

note: These are total wages and salaries earned in 1995 by people employed fulltime for 49 or more weeks in the year. Self-employed are excluded as are people enrolled as students during the academic year before the census or reporting total wages and salaries for the year of less than $4000. Degrees in medicine and dentistry are excluded. Graduate degree includes Ph.D., masters, and graduate certificates.

Source: <u>Census of Canada</u>, 1996, microdata file.

Table 7

Earnings Regressions

	constant	age	age^2	age^4	masters	Ph.D.	woman
education	50512	-3121	95.5	-.014	10375	16453	-10070
	(5.56)	(-5.2)	(9.0)	(-15.6)	(19.0)	(9.5)	(-22.4)
fine arts	45876	-2752	72.8	-.009	2673	8045	-7642
	(1.7)	(-1.6)	(2.30)	(-3.3)	(1.8)	(1.8)	(-6.4)
humanities	40915	-2498	77.3	-.011	3449	17823	-8910
	(3.2)	(-3.0)	(5.2)	(-8.5)	(4.7)	(12.6)	(-14.5)
social sci	-17497	1820	7.0	-.006	4824	12887	-18135
	(-1.4)	(2.1)	(.45)	(-4.1)	(5.9)	(8.1)	(-29.3)
commerce	-28108	2315	6.2	-.007	12611	14540	-15686
	(-1.8)	(2.2)	(.33)	(-4.4)	(13.9)	(3.6)	(-20.3)
agric/bio	22023	-658	40.5	-.007	1416	14845	-13821
	(1.0)	(-.47)	(1.6)	(-3.4)	(1.1)	(8.5)	(-13.7)
engineer	-16213	1685	13.3	-.007	851	9584	-18823
	(-.86)	(1.4)	(.60)	(-3.6)	(.78)	(4.5)	(-13.7)
nursing	31132	-1540	55.2	-.009	10047	28925	-1868
	(1.3)	(-1.0)	(2.0)	(-3.7)	(5.0)	(3.2)	(-.73)
oth health	-10745	2779	-29.8	.0003	17431	19135	-19276
	(-.30)	(1.2)	(-.71)	(.096)	(9.2)	(7.6)	(-11.6)
mat/physci	759	679	26.1	-.007	2112	11493	-13974
	(.04)	(.50)	(1.08)	(-3.5)	(1.7)	(7.5)	(-13.7)

Note: R^2 ranged from .08 to .22. T-statistics in parentheses.

Table 8

Social Rates of Return to University Programs for Women

	bachelor	1 year master	2 year master/ master	Ph.D.
education	18.1	33.8	19.2	11.3
fine arts	8.8	10.6	6.2	6.4
humanities	15.6	13.1	7.9	9.3
social science	17.3	17.3	10.5	9.4
commerce	22.0	40.5	22.5	10.3
agric/biology	13.2	5.0	2.0	9.1
engineering	16.4	2.5	-0.1	6.3
other health	20.8	25.0	14.4	11.9
nursing	17.2	28.1	16.1	14.7
math/phys. sci.	17.8	7.4	3.9	7.4

Table 9

Social Rates of Return to University Programs for Men

	bachelor	1 year master	2 year master	master/ Ph.D.
education	13.6	31.3	18.3	10.7
fine arts	1.5	9.8	5.9	6.0
humanities	7.6	12.3	7.5	12.2
social science	18.0	16.1	9.9	8.9
commerce	21.1	37.4	21.3	9.8
agric/biology	11.0	4.6	1.8	8.7
engineering	19.5	2.1	-0.3	5.9
other health	17.7	75.0	37.8	11.4
nursing	1.1	26.4	15.4	14.1
math/phys. sci.	18.0	6.9	3.6	7.0

Table 10

Employment in Canada, 1991-1996

	employment 1991	employment 1996	change	percent change
high school noncom	3,702,500	3,192,732	-509,768	-13.8%
high school grad	3,339,400	3,325,536	-13,864	-0.4%
trade certificate	1,703,467	1,646,028	-57,439	-3.4%
college diploma	1,916,267	2,372,688	456,421	23.8%
univ less than bach	309,967	349,092	39,125	12.6%
bachelor degree	1,302,667	1,583,460	280,793	21.6%
univ gt bach	214,900	246,888	31,988	14.9%
medicine	77,100	85,572	8,472	11.0%
masters	326,033	402,660	76,627	23.5%
Ph.D.	65,000	84,024	19,024	29.3%
total	12,957,300	13,288,680	331,380	2.6%

Note: total for 1991 excludes 6233 individuals coded as "degree not available." All figures exclude people in school in previous year.

Table 11

Employment of University Graduates in Canada, 1991-1996

field of study	employment 1991	employment 1996	change	percent change
education	382,467	451,908	69,441	18.2%
fine arts	48,500	59,472	10,972	22.6%
humanities	238,533	272,304	33,771	14.2%
social sciences	363,467	465,912	102,445	28.2%
commerce	304.966	385,056	80,090	26.3%
agriculture/biology	93,167	113,508	20,341	21.8%
engineering	210,966	252,648	41,682	19.8%
nursing	50,733	59,112	8,379	16.5%
other health	138,067	155,160	17,093	12.4%
math/physical science	154,833	187,524	32,691	21.1%
total	1,985,700	2,402,604	416,904	21.0%

Note: All figures exclude people in school in previous year. Commerce includes secretarial science, engineering includes engineering technician, and humanities includes "other." Secretarial science, engineering technician, and "other" contained tiny numbers of people. University graduates include those holding a bachelor degree, graduate certificate greater than a bachelor, medical, etc., degree, masters degree, and Ph.D.

Table 12

Employment in British Columbia, 1991-1996

	employment 1991	employment 1996	change	percent change
high school noncom	407,433	403,812	-3,621	-0.9%
high school grad	423,133	440,532	17,399	4.1%
trade certificate	226,400	242,352	15,952	7.0%
college diploma	238,400	318,636	80,236	33.7%
univ less than bach	37,267	49,320	12,053	32.3%
bachelor degree	146,000	204,660	58,660	40.2%
univ gt bach	22,633	29,880	7,247	32.0%
medicine	9,533	12,636	3,103	32.6%
masters	38,167	54,972	16,805	44.0%
Ph.D.	7,367	12,240	4,873	66.1%
total	1,556,333	1,769,040	212,707	13.7%

Note: total for 1991 excludes 867 individuals coded as "degree not available." All figures exclude people in school in previous year.

Table 13

Employment of University Graduates in B.C., 1991-1996

field of study	employment 1991	employment 1996	change	percent change
education	46,533	59,508	12,975	27.9%
fine arts	6,867	9,036	2,169	31.6%
humanities	25,634	36,360	10,726	41.8%
social sciences	38,900	60,660	21,760	55.9%
commerce	30,200	42,552	12,352	40.9%
agriculture/biology	12,800	17,064	4,264	33.3%
engineering	23,900	34,416	10,516	44.0%
nursing	6,200	8,352	2,152	34.7%
other health	17,300	22,428	5,128	29.6%
math/physical science	16,233	24,012	7,779	47.9%
total	224,567	314,388	89,821	40.0%

Note: All figures exclude people in school in previous year. Commerce includes secretarial science, engineering includes engineering technician, and humanities includes "other." Secretarial science, engineering technician, and "other" contained tiny numbers of people. University graduates include those holding a bachelor degree, graduate certificate greater than a bachelor, medical, etc., degree, masters degree, and Ph.D.

Table 13

Actual and Hypothetical Employment Changes, 1991/6

	actual change	hypothetical change
manufacturing	37,129	2,580
wholesale trade	28,692	10,451
retail trade	34,232	149
finance, insurance, real estate	27,909	-5,348
business services	85,152	51,693
education	62,791	18,416
health	66,619	28,151
other services	18,295	18,819

Actual change shows the change in the number employed in the sector with a university degree.

Hypothetical change shows the change in the number employed in the sector with a university degree that would have occurred if the fraction of employees in that sector with a degree had remained at the 1991 level.

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