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Effective Tax and Subsidy Rates on Human Capital in Canada

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Abstract

Effective tax and subsidy rates (ETRs and ESRs) on human capital investment via post-secondary education are estimated for Canada in the years 2000 and 2006. The flattening of the federal personal income tax structure in 2001 substantially reduced the tax disincentive for investment in human capital. Effective subsidy rates also declined as public spending did not keep pace with rising tuition fees. The change on the tax side was strong enough to dominate the subsidy reduction according to our main results, but disaggregation shows that this result did not hold in all cases. Results are shown for College, Master's, and PhD programs, in addition to Bachelor's degrees. They are also broken down by gender, and are shown for the 25^{th} and 75^{th} percentiles as well as the median. Provincial detail and 1997 results are provided in the case of Bachelor's graduates.

1. Introduction

The calculation of effective marginal tax rates (EMTRs) on investment projects has proven to be useful in the study of tax incentives affecting physical capital (King and Fullerton, 1984; Boadway et al, 1984; Papke, 1991; McKenzie et al., 1998). In earlier work, two of us proposed the effective tax rate or ETR on a full program of post-secondary study as an appropriate tool in studies for *human* capital and estimated this ETR at the Bachelor's degree level for Canada (Collins and Davies, 2004, 2005a,b).[1] For a complete approach, in the case of human capital the expenditure side of government operations must also be taken into account. The effective subsidy rate or ESR may be defined consistently with the ETR, allowing the net incentive or disincentive effect of government intervention to be assessed.[2] Collins and Davies (2004, 2005b) estimated the ESR for Canada at the Bachelor's level, finding that in most cases it exceeded the ESR.

The ETR and ESR estimates of Collins and Davies were based on Survey of Consumer Finance (SCF) earnings data and were limited to Bachelor's degree programs. It is important to go beyond this, to look at the tax/subsidy treatment of College[3], Master's and Doctoral programs as well. Also, new work is needed since in the last decade a range of tax and expenditure changes affecting human capital ETRs and ESRs have occurred. These changes have included a flattening of the federal income tax structure, a large increase in tax credits for post-secondary education (PSE), higher tuition fees, and a reduction in real public expenditure per student. We

[1] Collins and Davies (2004) provides the most detailed analysis, both in theoretical and applied terms. It uses 1995 Survey of Consumer Finance data. Collins and Davies (2005a and 2005b) extend the analysis to 2003, using 1998 SCF data to model earnings and updating taxes and public spending over time.
[2] This point is stressed in Mintz (2001), which incorporates ETRs and ESRs on human capital in its estimates of effective tax rates on labor. See Collins and Davies (2005a, footnote 15) for a summary of the differences between our approach and that of Mintz.
[3] "College" refers to a community college program.

need to know how much the financial incentives for investment in human capital altered in the face of such changes.

This paper estimates ETRs and ESRs for Canada in the years 1997, 2000 and 2006, although the 1997 results are for Bachelor's graduates only, due to data limitations. Throughout we use year 2000 real earnings profiles from the 2001 Census, allowing us to isolate the impact of tax and public spending changes. In contrast to the former SCF and current SLID data sources, the Census has rich detail on educational achievement. This allows us to look separately at College, Bachelor's, Master's and Doctoral graduates. National results are provided by gender and for 25th and 75th earnings quantiles as well as the median. In addition, provincial detail is given in the case of Bachelor's graduates.[4]

The rest of the paper is organized as follows. First, in Section 2, we summarize the results of previous work, identifying those aspects that await study here and in subsequent work. In Section 3 we outline methods and data. Results are reported in Section 4. We discuss some possible implications and extensions of the results in Section 5. Section 6 concludes.

2. ETRs and ESRs: Background

The effective tax rate (ETR) on human capital may be defined as the proportional difference between an individual's gross or before-tax and net or after-tax rates of return to particular investments in human capital, which we denote r_g and r_n respectively[5]. The effective subsidy rate (ESR) is the proportional difference between r_g and the public rate of return, r_p .

[4] It is unfortunately not possible to generate provincial results for the other education levels due to incomplete or poor data on the relevant public spending or tuition fees at the provincial level in the years we study here.

[5] Our ETR applies to a lumpy investment, unlike the EMTR used in the study of physical capital, which is the effective tax rate on a small hypothetical increase in investment. Like Papke (1991) we define the ETR as the difference in before- and after-tax internal rates of return. EMTRs are, in contrast, often computed as the tax rate that equalizes before- and after-tax present values of income streams. See Davies and Glenday (1990) for an exploration of the latter aspect.

The latter is equivalent to the social rate of return except that it omits the portion of the social return that accrues in the form of externalities. The investments considered are complete programs of post-secondary study, for example two years of college study leading to a diploma, or four years of university study leading to a Bachelor's degree.

There is a large literature generating estimates of the rate of return to human capital investment. One strand interprets the coefficient on years of schooling in a standard "Mincer regression" as the average rate of return to education. Estimates from this literature are not helpful here because they estimate a single average rate of return to schooling, rather than separate returns by level of education. There is also now a long history of direct estimates of the rate of return to a Bachelor's degree in Canada (see e.g. Stager, 1994; Vaillancourt, 1995; Vaillancourt and Bourdeau-Primeau, 2002; and the survey by Emery, 2004) and in other countries (see e.g. Psacharopoulos and Patrinos, 2004). In this direct approach, the cross-section of earnings is taken as a snapshot of a society experiencing steady state growth. Taking into account the costs of schooling as well, these earnings data are used to estimate rates of return using age profiles of median or expected earnings. In some cases, as in this paper, quantiles other than the median are also studied. In addition to studies of Bachelor's graduates in general, rates of return to graduate degrees and to different areas of study have also been studied (Dodge and Stager, 1972; Vaillancourt, 1995; Stark, 2007).

If estimates of r_g , r_n , and r_p , defined as in this paper, had been published in previous research by others, we could now easily compute a rich set of estimates of ETRs and ESRs. Unfortunately, estimates of r_n were not always made in previous work and when they were it is not generally clear that the treatment of taxes is as required in our approach.

For Canada both r_g and r_n have been estimated by Collins and Davies (2004) with 1995 SCF data and by Collins and Davies (2005a,b) using the 1998 SCF and tax/expenditure systems from various years. Collins and Davies estimated r_g and r_n for median males and females obtaining Bachelor's degrees in Canada, but also for individuals at the 25th and 75th percentiles of gender specific earnings distributions. Their "base case" was for a never-married individual with only standard tax deductions and credits making no use of student loans and receiving no bursaries or scholarships. Variants were also studied with student loans and with Registered Education Saving Plans (RESPs). Collins and Davies (2005b) found ETRs for median males and females were 17.2% and 10.0% respectively in 1998. Higher rates were found by Collins and Davies (2005a) for the 75th earnings quantile - - 23.4% and 17.8% for men and women respectively in 1998. These findings suggested that tax-side human capital investment disincentives could be important, especially at higher earning levels.

Adjusting 1998 SCF earnings profiles to 2003 for the average change in wages, and using the 2003 tax and expenditure systems, Collins and Davies (2005b) obtained ETR estimates for median males and females of 11.9 and 7.5% - - a sizeable drop from 1998. Collins and Davies (2004, 2005b) also looked at ESRs at the Bachelor's level. The ESRs were larger than the ETRs, and the ESR – ETR gap increased from 1998 to 2003. Averaging across men and women, the estimated 1998 ESR for median earners in the base case was 19.4% and the 2003 ESR was 20.5% (Collins and Davies, 2005b). Subtracting the gender-mean ETRs of 13.6% and 9.7%, this gives net subsidies, that is ESR – ETR, of 5.8% and 10.8% in 1998 and 2003 respectively.

The Collins and Davies results are limited to undergraduate university studies. It is important to know also how tax and expenditure systems affect incentives to invest in College diplomas, and in Master's and Doctoral degrees. Data from the 2007 Labour Force Survey

indicate that a Bachelor's degree is the highest level of education for only about 20 percent of young men and 25 percent of young women. Close to 40 percent of young men and women are post-secondary grads without a Bachelor's or higher degree. Nine percent of 35 to 39 year old men and eight percent of 35 to 39 year old women have a higher university degree. These numbers suggest it is important to investigate the ETRs and ESRs for groups other than Bachelor's grads.

3. Methods and Data

Defining Rates of Return, ETR and ESR

On setting out on an educational program *i*, the student will already have completed the immediately lower level of education *j*. If instead of taking further education the student took a full-time job he/she could earn E_t^j from the current year, $t = 1$, to the last year of the working life, $t = R$. Program *i*, on the other hand, will take *n* years to complete, but will lead to higher full-time earnings, E_t^i, that will be received from $t = n + 1$ to $t = R$. Letting C_t^i represent annual direct costs of program *i* , assumed constant for simplicity, the gross (internal) rate of return to program *i* is defined implicitly by the requirement that the difference in the discounted present value of the alternative earnings streams net of direct schooling costs generated by programs *j* and *i* should equal zero:

$$(1)\quad \sum_{t=1}^{R} \frac{E_t^i - E_t^j - C_t^i}{(1+r_g)^t} = 0,$$

A strictly analogous procedure can be used to define the net of tax rate of return, r_n . We must simply re-define E_t^i, E_t^j , and C_t^i in (1) to be measured net of tax.

In order to compute r_g and r_n, in addition to knowing the direct costs of schooling, one must forecast a lifetime of earnings under alternative education scenarios. While, in principle, profiles based on the earnings experience of actual past cohorts could be used, such an approach runs into practical difficulties and data limitations. Also, it is a backward-looking exercise. In practice in the human capital rate of return literature earnings profiles are derived treating the cross-section of earnings in a particular year as a snapshot from an economy in a steady state or balanced growth. In Section 5 below we discuss the possible effects of relaxing this assumption and acknowledging shifts in earnings profiles between cohorts in Canada.

There are some significant issues in applying the cross section approach, including whether to allow for secular growth in earnings, and whether to make an adjustment to correct for greater ability of students proceeding to higher levels of education. We take the not unusual approach of ignoring secular earnings growth, which is justified by the difficulty of forecasting future growth rates and the fact that real wage rates have risen only slowly in Canada in recent decades. And we do not adjust for ability in our main results, although we experiment with such an adjustment as a robustness check in the case of Bachelor's graduates in the next section.

To arrive at after-tax rate of return, two kinds of adjustment are required in applying equation (1). First, in computing the earnings gain from education one must use the after-tax earnings that would be received by graduates. Second, one must take account of the impact of the various kinds of tax relief that students receive. While participating in post-secondary programs, students may receive tuition and education amount credits from the federal and provincial governments. We assume that their full value accrues to the students, on the grounds that unused credits may either be carried forward (and used to reduce taxes after graduation, which is not too far in the future, so the lack of discounting of those benefits is not too serious)

or transferred to family members. In the latter case we are assuming that the family members recycle the tax relief *they* receive to the students by supporting their education.

Once we have the before- and after-tax rates of return, the effective tax rate is simply the proportional difference between the two,

$$(2)\quad ETR = 1 - \frac{r_n}{r_g}.$$

In order to calculate the ESR, which is given by

$$(3)\quad ESR = 1 - \frac{r_p}{r_g},$$

we need a measure of the public (sometimes referred to as "total") rate of return, r_p. As in computing the before-tax rate of return, r_g, one uses the projected stream of before-tax earnings gains from a particular diploma or degree. Direct costs must again be deducted from this stream of benefits, as in the calculation of private rates of return – with the difference that direct costs now include those borne both privately and publicly.

It is evident that the ETRs and ESRs defined here will depend on the shape of earnings profiles, and on the gross rate of return to human capital investment. Thus, ETRs and ESRs may differ according to such aspects as a graduate's sex and relative position in the income distribution. This represents a contrast with the literature for physical capital, where differences in EMTRs arise from such features as differences in tax treatment and financial or investment structure across industries or jurisdictions. In the physical capital literature, gross rates of return are typically assumed values treated as equilibrium rates in competitive capital markets, rather than estimated actual rates of return.

Timing of Education and the Working Life

We differentiate between four investments: a two-year College diploma, a four-year Bachelor's university degree, a two-year Master's degree, and a Doctorate, which we assume takes four years to complete.[6] For each program, we assume that students commence their studies at age 19. We assume continuous schooling, with no false starts (e.g. changes from college to university, or re-starting in a different subject area). The result is that if a student is to earn a Master's degree, he/she would enter university at age 19, complete a Bachelor's degree at 22, and graduate with a Master's degree at age 24. The student would then enter the workforce the following year, at age 25. We assume that everyone retires at age 60.[7]

In computing the earnings gains from education, for both the before- and after-tax cases, as mentioned above one must decide how to establish counterfactual earnings. Also, in the case of advanced degrees, interest may centre on a *step comparison* with a lower degree, or with the return over the complete university education achieved. When computing rates of return at the Bachelor's level we assume that the median Bachelor's grad would have earned the same amount as the median high school (HS) grad if he/she had not gone to university. Some authors have assumed e.g. that university grads would earn 10% more than HS grads due to higher ability alone, and that their earnings should therefore be reduced by 10% in computing rates of return in order to avoid ability bias (see, e.g., Stager, 1994). An ability adjustment is not universally adopted, the size of the required adjustment is unclear, and there are special difficulties in

[6] Our assumptions about degree length are similar to those of Vaillancourt (1995). The only difference is that, like Drewes (2006), we assume it takes two years to complete college, instead of three.

[7] Rathje (2003) reports that the median retirement age for both male university and high school grads in the period 1996-2000 was 60. Sensitivity of results to this assumption was examined by using a retirement age of 65 instead (results available from the authors); there was little impact since the later years of the working life are relatively unimportant due to discounting.

specifying an adjustment in our context.[8] However, we do check the robustness of our results to such an adjustment for Bachelor's grads, in the next section.

To compute typical earnings gains, we use profiles of medians rather than average earnings, for a number of reasons.[9] One is that since the degree of skewness changes over the working lifetime the average does not correspond to the same quantile at all ages. Another is that the median is a more robust statistic. Finally, the median earner is the *average person* (the one "in the middle") whereas average earnings accrue to someone higher in the distribution due to skewness.

We also present results for graduates at the 25th and 75th percentiles of the gender-specific earnings distribution. In these cases we have assumed that if the education had not been obtained the individual would have earned at the comparable percentile for the lower level of education (that is, we compare "like with like"; for example the 25th high school quantile, with the 25th university quantile). In addition, we have computed both step comparisons and *total comparisons* for Master's and Doctoral levels. The step comparisons are based on rates of return to the incremental degree. In estimating rates of return to graduate degrees, earnings gains are the difference between the earnings of Master's or Doctoral graduates vs. Bachelor's grads and foregone earnings are those of a Bachelor's grad.[10] Estimated rates of return in the step

[8] It is not clear how great the ability bias is in estimates of the rate of return to education. As reported in Section 4, surveys arrive at different conclusions, suggesting summary figures for the bias ranging form 10-15% to 1/3. The task of picking a realistic adjustment is further complicated here by the fact that we not only estimate rates of return for median earners, but also for graduates at 25th and 75th quantiles. The literature provides little guidance to how ability bias varies by earnings level.

[9] While we prefer to use the median for the reasons stated in this paragraph, we note that Boudarbat et al. (2010) find that when using 2001 Census data, similar returns to a Bachelor's degree are found using either medians or means.

[10] Using the earnings of Master's grads to compute foregone earnings and earnings gains for Doctoral grads results in a high frequency of negative or undetermined rates of return, especially for males. This is partly due to the fact that the Census does not distinguish between Master's grads with professional degrees, such as MBAs, vs. those with academic degrees. Master's grads with professional degrees earn more than those with academic degrees. Since Doctoral students generally have academic rather than professional Master's degrees, using the earnings of

comparisons for these advanced degrees can be quite low, and in some cases at the Doctoral level are not uniquely determined. An alternative view of tax and expenditure incentives for these longer programs of university study may be obtained by thinking of the whole university education that terminates in one of these advanced degrees as a unit, giving total rather than step comparisons. In the main text we present the step comparisons. The total comparisons are shown in Appendix B (Tables 8b and 9b).

Direct Costs of Schooling

Private direct costs of schooling include tuition and additional compulsory fees, and "other expenses" - - principally books and equipment. National figures for university tuition and additional fees per full time equivalent (FTE) student are provided by Statistics Canada.[11] Statistics Canada does not provide estimates for college fees; figures were derived from information in Junor and Usher (2004) as explained Appendix A. The numbers used are shown in Table 1. For 1997 we only have data at the Bachelor's level. Costs were similar to those in 2000 - - fees rose 19.7% in nominal terms and 13.5% in real terms between the two years. After 2000 there was a further increase. Between 2000 and 2006, fees rose 18.8%, 29.3% and 63.1% in nominal terms at the College, Bachelor's and graduate levels respectively. In real terms these increases were 3.8%, 13.0% and 42.6%. We set "other expenses" at $1,000 in 2006 for college students and undergraduate university students, and assume they were the same, in real terms, in

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Master's grads from the Census would likely exaggerate the foregone earnings of Doctoral students and understate the earnings gain from their studies, biasing estimated rates of return downwards.

[11] Statistics Canada gives a single number for fees at the graduate level, that is it does not distinguish between Master's and Doctoral students. We assume fees were the same at these two levels. This is appropriate for students in non-professional programs, but fees are higher for those in professional Master's programs. Assuming the same fees at the two levels may bias rates of return upwards at the Master's level and downwards at the Doctoral level somewhat.

earlier years.[12] Other expenses for graduate students were set at the same fraction of graduate tuition fees as holds for undergraduates here.

Students' direct costs may be reduced through student loans[13], bursaries, and scholarships. For college students and university undergraduates no assistance of this kind is received in our base case. In the period studied, about 30% of university students qualified for loans or needs-based assistance, and likely less than 20% received scholarships awarded on the basis of ability.[14] This leaves about 50% of students in the middle, who finance their education unassisted, except for help from their families. The fraction of college students who do not receive assistance, other than from family, appears to be about the same.[15] Our central results are for "median graduates" – those whose earnings are at the median for their age/gender group as they move through their working lives. For these graduates the assumption of no non-family assistance seems realistic. The assumption is, however, strained in the case of the 25th quantile and that should be borne in mind in interpreting our results.

At the Master's and Doctoral levels it is important to take into account the assistance students receive in the form of scholarships and other grants both from their universities and government sources. We estimate that this assistance averaged $2,520 for Master's students and $4,201 for Ph.D. students in the year 2000 (see Appendix A). We assume that these amounts stayed constant in real terms from 2000 to 2006. These amounts are additional to what graduate

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[12] Estimates of other expenses were found on Statistics Canada databases, university Web sites, and in university calendars. The $1,000 figure is representative of the estimates provided.

[13] Student loans reduce direct costs insofar as they are subsidized. In Canada, while students pay interest on their loans at a market rate, payments do not commence until six months after graduation. There is therefore a significant element of subsidy.

[14] In a 2002 survey 31.2% of university students received a government loan or bursary. (See Junor and Usher, 2004, p. 171.) Bursaries are often needs-based, although this is not always the case. In another survey conducted in 2001-02, 23% of university students reported that they had some kind of merit-based scholarship although evidence on the aggregate amount provided in this way suggests this number is "high" (Junor and Usher, 2004, p. 174).

[15] Compared with university students, more college students receive government loans or grants, but fewer get merit-based assistance. See Junor and Usher (2004, pp. 172-174).

students earn in the form of teaching or research assistantships. The latter are allowed for through the assumption that they perform the equivalent of four months full-time work each year (as is also assumed for undergraduates to allow for their summer and part-time earnings).

Taxes

The Census provides us with before-tax earnings. In order to compute after-tax earnings in our base case, we assume individuals are unmarried, have no dependents, do not use student loans, and aside from personal credits qualify only for education-related credits and deductions. There is no use of Registered Education Saving Plans (RESPs). We believe that ignoring marriage and dependents likely has relatively little impact on our results. First, Canadians are taxed on an individual basis, so that rate structure does not depend on marital status. Second, the value of the credit for a dependent spouse is not affected by the taxpayer's own income and therefore has no impact on the gain from education or our ETRs. Third, while the clawback of child-related tax credits may reduce the net income gain from postsecondary education for some graduates this effect is offset to an extent by that of the deduction for child care expense, which tends to be more valuable for people in higher tax brackets.

We do not believe that abstracting from RESPs has a large impact on results over the period we study, but in future studies the effect of taking them into account may grow. Until 1998 RESPs were not very popular, there being other, often more attractive ways to shelter savings from taxation. In 1998 Canada Education Savings Grants (CESGs), to be used in association with RESPs, were introduced, however. These subsidized contributions at a 20% rate up to a maximum contribution of $2,000 per child per year. Collins and Davies (2005b) found that, in families where regular contributions were made over a 15 year period under this new regime there would be a large reduction in ETRs for Bachelor's graduates. However,

students graduating in the year 2000 had had no opportunity to benefit from CESGs while the families of 2006 graduates had only had a few years to accumulate CESGs before those students entered post-secondary programs, and it was still a minority of students who had an RESP at that time.[16]

Federal personal income tax rates and brackets for 1997, 2000 and 2006 are shown in the first panel of Table 2.[17] As can be seen, while the changes between 1997 and 2000 were minor, those between 2000 and 2006 were substantial; the PIT system was flattened, thresholds were increased, and the surtax levied at higher tax levels was removed. The most dramatic development was the introduction of a fourth tax bracket in the 2001 tax year. One can transform the 2000 structure to the 2006 system by creating a new upper tax bracket starting at about $100,000; reducing marginal rates for those below this level; and then raising brackets over the six years by about 20%. The overall impact is a reduction in progressivity that has strong implications for human capital ETRs. In the pre-2001 system many of those with Bachelor's degrees, and most of those with higher degrees, could expect to spend a substantial part of their working lives in the top tax bracket, reducing their r_n and boosting their ETRs significantly. In the post-2001 system, however, this is no longer true. As we see in the next section, the fraction of graduates who will stray into the top tax bracket over their working lives is reduced, and the length of time they will spend there is shorter. Net rates of return therefore increased and ETRs fell under this new system.

[16] To the extent that 2006 graduates did benefit from CESGs and the increasing use of RESPs, note that our finding that ETRs fell from 2000 to 2006 would be reinforced.

[17] As of July 1, 2006 the bottom rate became 15.5%. In practice the change in this bottom rate makes an extremely small difference to the IRRs and ETRs.

As in the previous work by Collins and Davies, we use Ontario to represent provincial taxes in our base case.[18] As reflected in the second panel of Table 2, in 1997 Ontario had a "tax on tax" system with the same brackets as the federal government and rates set as 48% of the federal ones. In the later years Ontario was on the "tax on income" system. Note that it did not follow the federal government in introducing a fourth tax bracket after 2000. In 2006 tax rates were reduced slightly in the bottom two brackets. With the marginal tax rate being held constant in the top bracket, progressivity increased slightly in the Ontario system between 2000 and 2006. Since the change in the Ontario tax structure was small compared to the dramatic change in federal structure, however, overall progressivity fell for Ontarians between 2000 and 2006.

Public Costs and the Public Rate of Return

In order to calculate the ESR we need a measure of the public (sometimes referred to as "total") rate of return, r_p. As in computing the before-tax rate of return, r_g, one uses the projected stream of before-tax earnings gains from a particular diploma or degree. Direct costs must be deducted from this stream of benefits, as in the calculation of private rates of return – the difference is that direct costs now include both students' private costs and those borne by government or other non-student funders of education. Students' "other expenses" are one component of direct costs. The other component is the portion of the costs of running colleges and universities that can be attributed to the institutions' teaching function at the various program levels. This portion is estimated in line with previous practice, as described in Appendix A. The resulting numbers are shown in Table 3.

[18] It is not uncommon to use the Ontario tax system as roughly representative. Ontario is the largest province, with close to 40% of the country's population (38.9% in 2006 according to Statistics Canada). Taking into account surtaxes, its provincial income tax structure appears more progressive than those in the Prairie provinces, but less progressive than those in Quebec or the Atlantic provinces.

Earlier we noted that private direct costs rose fairly sharply from 1997 to 2000 at the Bachelor's level and from 2000 to 2006 at both undergraduate and graduate levels while rising only moderately at the college level. The picture is different for public costs. From 1997 to 2000 we estimate that public direct cost per student fell 3.7% in nominal terms and 8.7% in real terms at the Bachelor's level. From 2000 to 2006 there were nominal increases of 9.2%, 8.9%, 11.5% and 9.8% at the College, Bachelor's, Master's, and Doctoral levels respectively, translating into real decreases of 4.5%, 4.7%, 2.5% and 4.0%. These declines, caused by enrolments rising faster than real public spending, act to push up r_p and reduce the ESR computed for each education level over time.

Earnings

Our focus is on how changes in tax and transfer structures alter rates of return to education as well as ETRs and ESRs. In order to isolate these effects, as explained earlier, we keep the real earnings structure frozen as it appeared in the 2001 Census.The census data allow us to identify earners whose educational qualifications are college only, and university only. Other Canadian data sets do not allow these groups to be cleanly separated from those who have a mixture of college and university training, as is crucial in estimating the returns to college or university. (See e.g. Boothby and Drewes, 2006, on this point.) Strengths of census data are the large sample, high response rate, detailed information on schooling, and good information on individual characteristics, including immigration aspects. The Survey of Consumer Finances (SCF), the Survey of Labour Income Dynamics (SLID) and the Labour Force Survey (LFS) have only one or two questions on education; the 2001 census has nine. We use the 2001 census to give us a snapshot of annual earnings in 2000, conditional on age, sex, education and province.

To obtain age-earnings profiles for various quantiles, and for each education group, we use a quantile regression. Conditional medians can be estimated by the least absolute deviations estimator, which minimizes the absolute values of the residuals. Koenker and Bassett (1978) generalized this method to other quantiles. We estimate quantile regressions using Stata software. The profiles are quartic polynomials in age. This has become a popular regressor specification for earnings equations since Murphy and Welch (1990).

The census data are available for all of Canada, or for six regions: the Maritimes, Quebec, Ontario, Manitoba/Saskatchewan, Alberta and British Columbia. We work with pooled data for the majority of our cases, but use regional estimates as well in the provincial breakdown for Bachelor's graduates shown in the next section. The next section also shows and compares age-earnings profiles from our quantile regressions for the various schooling levels.

4. Results

Bachelor's Degree: General Case

Table 4 provides our estimated rates of return, ETRs and ESRs for Bachelor's level males and females at the 25th quantile (Q25), median (Q50), and 75th quantile (Q75) of gender-specific earnings distributions. ETRs were unchanged from 1997 to 2000 for lower earners and decreased slightly for higher earners. The gross private rate of return, r_g , decreased slightly for both men and women, reflecting the rise in tuition fees in these years.[19] But the big story is that the ESRs went down significantly - - for example from 15.4% to 11.8% for median males and from 19.9% to 15.4% for median females. The drop in ESRs reflects the decline in real public spending per student over this interval noted earlier. The result of the fall in ESRs and small

[19] The rate of return appears to be the same (13.6%) for 25th quantile men in both years. This is due to rounding.

change in ETRs is a distinct decline in the net subsidy rate, ESR – ETR, for each quantile and gender - - for example from 2.6% to 0.0% for median males and from 10.6% to 6.0% for median females.

Before-tax rates of return in Table 4 all fell from 2000 to 2006 due to the rise of tuition fees. In contrast, after-tax rates of return increased, because of reduced income tax progressivity. In all cases there was a fall in both the ETR and ESR from 2000 to 2006. The decline in ETRs dominated however, and the net subsidy rate, ESR – ETR, increased across the board. Thus while public spending on undergraduate education continued to decline after 2000, this was more than offset in our terms by the reduction in ETRs caused by the flattening of the income tax system in 2001.

Table 4b reports the results of an "ability adjustment" experiment that puts an upper bound on the effect of ability bias on our results. There has been considerable discussion of the extent of ability bias in the measured returns to education. Card (1999) surveys the literature and concludes that the bias in estimated rates of return to a Bachelor's degree is likely in the 10-15% range. However, others have concluded that the bias may be up to 1/3 (see e.g. Wolff, 2009). We try to put an upper bound on the required adjustment here by increasing the foregone earnings of Bachelor's grads sufficiently to reduce their gross rate of return by 1/3 compared with our base case. Results are shown in Table 4b. We find that the ETRs rise and the ESRs fall for both males and females. However, the overall downward trend in ETRs and ESRs for both sexes from 1997 to 2006 is preserved, as is the pattern of the net subsidy ESR - ETR declining from 1997 to 2000 and then rising to 2006.

Figures 1 and 2 throw light on how the tax changes between 2000 and 2006 led to large declines in ETRs. The figures show the 2000 and 2006 age-earnings profiles for male and

female median earners with a Bachelor's degree as well as the thresholds of federal tax brackets in the two years. The grey-dashed lines depict the breaks from one federal bracket to the next in 2000, while the black-dashed lines are for 2006. For example, the black-dashed horizontal line just under $40,000 ($36,378 to be exact) represents the step from being taxed at 15.25% to being taxed at 22% on income above $36,378, but below $72,756 in 2006.

Figures 1 and 2 show that under both the 2000 and 2006 tax systems median graduates rise into the second tax bracket within a few years of entering the workforce at age 23. They then spend most of their lives in this bracket, except that males cross into the third tax bracket for about 10 to 12 years. From 2000 to 2006 the federal marginal tax rate fell from 25 to 22% in the second bracket and from 29 to 26% in the third bracket (see Table 2). Holding earnings trajectories constant, these tax declines lead to a significant increase in the after-tax return to a university education and a corresponding decline in the ETR.

Bachelor's Degree: Provincial Breakdown

The above results use a combination of Canada-wide earnings data and the tax system prevailing in Ontario. Using Ontario as a roughly representative province is not uncommon in tax analysis. However, we need to test how good that approximation is here. Also, an investigation of differences in human capital ETRs and ESRs across provinces is interesting for its own sake. Unfortunately, due to data limitations we are only able to provide provincial results at the Bachelor's level.

In order to estimate separate rates of return, ETRs, and ESRs by province we have taken into account each province's specific tax system, tuition fees, additional compulsory fees, and instructional costs. (See Appendix C for details.) Modelling earnings on a provincial basis is not

possible, however, except in the case of the largest provinces, due to issues of sample size. We therefore divide the labor market into two components only: Quebec and the rest of Canada (ROC). This affects the interpretation of our results. For example, while our median results for Quebec represent the situation of a person earning at the gender-specific median *in that province* over their working life, this is not true for the other provinces. For each of the other provinces, the results reflect the case of a person earning at the ROC median throughout their career.[20]

Table 5 shows the variation in rates of return, ETRs and ESRs across provinces and averaging across genders. Variation within the ROC is due to differences in tuition fees, public spending on post-secondary education (PSE) and provincial tax systems, since a common earnings distribution is used for all provinces in the ROC. Unweighted average r_g and r_n for the ROC provinces are 18.7% and 16.1% in 2000 respectively, and the degree of variation is modest. Quebec has both higher r_g , at 20.7%, and higher r_n (17.7%). While we are modelling earnings in Quebec separately, that is not the main source of its higher rates of return. The difference is due mostly to tuition fees in Quebec being about half those in the ROC (see Appendix C). The Quebec tax structure is somewhat more progressive than in most other provinces, leading to a slightly higher ETR - - 14.8% vs. an average of 14.1% for the ROC in 2000 for example. The lowest ETRs are found in Ontario (12.2% in 2000). The Atlantic provinces, with their fairly progressive and heavy personal income taxes mostly have ETRs only slightly below Quebec's. The Western provinces are intermediate between Ontario and the Atlantic provinces.

Prior to 1998, with the exception of Quebec which collected its income tax separately, the provinces were constrained to levy a "tax on tax" under their tax collection agreements with the federal government. That is, basic provincial tax was a simple multiple of basic federal tax. In

[20] Justification for this asymmetric treatment does not lie only in sample size considerations. English Canada and French Canada represent two fairly distinct labor markets. Within each there is high geographic mobility, but there is less mobility between them.

1999 the less restrictive "tax on income" approach was adopted, under which the agreeing provinces must use the definition of net income set by the federal government but are free to set their own schedule of tax rates. In the year 2000 a few provinces had taken advantage of this change to alter their tax system significantly, but most still followed the federal structure. By 2006 there was significant divergence however. Nova Scotia, New Brunswick, and British Columbia had added a fourth (and in BC's case, a fifth) bracket and Alberta had gone even further, introducing a flat provincial income tax in 2001. On the other hand, Newfoundland, PEI, Ontario, Manitoba and Saskatchewan had not introduced a fourth tax bracket or significantly flattened their rate structure.

Table 5 shows a somewhat complex pattern of changes from 1997 to 2000. For Ontario we have qualitatively similar results to Table 4: r_g falls from 1997 to 2000 as do both the ETR and ESR; the drop in the ESR dominates and the net subsidy, ESR–ETR falls from -3.7% to -7.2%. All of the other provinces, except Quebec, also have a decline in both the ESR and ESR-ETR from 1997 to 2000. In Quebec, both the ESR and ESR-ETR increase. The r_g and ETR changes are mixed across the provinces.

Looking at the 2000 and 2006 panels in Table 5 we begin to see effects of the change from "tax on tax" to "tax on income" provincial tax systems. From 2000 to 2006 all provinces saw a decline in their ETR, but the size of the drop varied. At one extreme we have Quebec, where there was little change in the provincial tax system and the ETR fell by only 0.3 % points. At the other extreme are Saskatchewan and New Brunswick with falls of 5.0 and 5.4 % points.

Interestingly, despite adopting a flat tax Alberta is not the leader among the provinces in the ETR decline, seeing only a drop of 4.2 % points, and ending with the third-lowest, rather than the lowest ETR. This illustrates the fact that a flat tax is still a progressive tax. The Alberta

flat tax provides a significantly larger amount of tax-free income than is available in other provinces. That acts to depress the after-tax rate of return to human capital, offsetting the effect of reduced marginal tax rates at higher incomes, which is to increase r_n.[21]

Finally, what light does Table 5 throw on our main results, where we use Canada-wide age-earnings profiles but the Ontario tax system? First, trends differ across the provinces, for example in the 1997 to 2000 interval when the net subsidy to Bachelor's level PSE was declining in nine provinces but increasing in Quebec. It is clearly valuable to look beyond national averages if possible. Second, when the Ontario tax system is used as representative for the country as a whole, too much confidence should not be placed in the direction of small changes. In our main results we found a small increase in the net subsidy rate from 2000 to 2006 - - from 3.0% to 3.5% averaging across genders. But here, while the net subsidy rate does increase in Ontario and three other provinces, nationally it declines a little - - from 1.6% to 1.1%. The provincial ETRs and ESRs all fall (except for an increase in the ESR in Newfoundland), just as we found for the country as a whole in our main results. But modelling the separate provincial tax systems turns around the result that the decline in ETR outweighed the drop in ESR nationally. Thus when we look at the other PSE levels, where data limitations do not allow separate calculations for the provinces, we should evidently be cautious in interpreting small changes in ESR – ETR.

Needs-Based Student Assistance

So far we have abstracted from student assistance, on the grounds that graduates with median earnings are unlikely to have received much assistance, either in the needs-based or

[21] See Collins and Davies (2004) for a theoretical demonstration of this effect. "Foregone taxes" on foregone earnings while going to school are an implicit subsidy to human capital investment. Reducing these foregone taxes reduces the after-tax internal rate of return to education.

ability-based categories. How do the results change if we allow average levels of student assistance? We focus our attention on needs-based assistance. Needs-based assistance is becoming available to more students over time, even if per student amounts have not necessarily kept pace with student expenses.[22]

To assess the possible impact of needs-based assistance we recomputed our rates of return, ETRs and ESRs for median Bachelor's graduates assuming that they receive annual student assistance equal to the average for all undergraduates. We use aggregate needs-based assistance data from Berger et al. (2007, see Figure 4.IV.1), and Statistics Canada enrolment numbers, to compute assistance per FTE student of $1,493 for 2000 and $1,458 for 2006.

As reflected in Table 6, student assistance has no impact on the public rate of return, r_p, since it is merely a transfer. However, both the before- and after-tax rates of return, r_g and r_n rise, since the costs borne by students decline. There is a small decrease in the ETRs. The ESRs rise substantially, with the greatest effect for female students, since the assistance is larger relative to their (smaller) earnings. The further result is a large increase in the net subsidy rate, ESR – ETR, relative to the base case in both 2000 and 2006 and for both sexes. The impact was somewhat smaller in 2006, however, since assistance per student declined a little in real terms. The upward movement of ESR-ETR from 2000 to 2006 found in the main results is replaced by small decreases for both men and women.

College

[22] One element in this trend was the termination of the Canada Millennium Scholarship Foundation announced in the 2008 federal budget and the conversion of its scholarships to needs-based assistance under the new Canada Student Grants Program, which commenced in fall 2009.

The results shown in Table 7 indicate that college graduates get higher before- and after-tax rates of return than university graduates.[23] This is due in large part to the smaller direct costs they face. For example, as of 2006 university students faced annual direct costs of $5,966, while college students bore a direct cost of just $2,604 per year (Table 1). The difference in rates of return is also due, in part, to the fact that each college graduate enters the labour force two years sooner than a Bachelor's graduate.

Like Bachelor's grads, both male and female college graduates had lower ETRs in 2006 than in 2000. On the other hand, their ESRs mainly increased, opposite to the Bachelor's case, reflecting a much smaller rise in fees. The result is a larger increase in the net subsidy, ESR-ETR for college than for Bachelor's grads between 2000 and 2006.

Male college graduates are estimated here to have lower ETRs than Bachelor's grads while the reverse is true for female graduates. The explanation for this gender difference is interesting. College students and graduates have lower earnings than their Bachelor's counterparts. This means their returns are taxed at a lower rate, but it also means the implicit subsidy provided by the tax system on their foregone earnings while in school is lower. The former effect dominates when we compare male college and Bachelor's grads, but the latter effect dominates in the case of females.

Master's Level

At the Master's level counterfactual earnings are those of Bachelor's graduates. We are making a "step comparison", that is we are estimating rates of return to, and ETRs and ESRs on, prolonging one's university education to finish with a Master's rather than Bachelor's degree. In

[23] A similar result was obtained by Boothby and Rowe (2002). In contrast, Drewes (2006) finds similar rates of return for college and university graduates, using 1996 Census data. The contrast with our results may be due to differences in assumptions or procedures, or to the use of 1996 rather than 2001 Census data.

Appendix B we provide alternative estimates, based on a "total comparison", of the rates of return for undertaking the complete package of a Bachelor's degree plus Master's. In the latter exercise rates of return are higher, but ETRs and ESRs are generally lower.

Table 8 indicates smaller rates of return at the Master's level than at the Bachelor's level, and higher values of the ETR (except for 25th quantile females). The higher ETR reflects the fact that Master's grads spend more time in higher tax brackets over their working lives. But ESRs are also greater than those for Bachelor's grads. The "total comparisons" reported in Appendix B indicate the same qualitative differences relative to a Bachelor's degree, but a smaller difference quantitatively.

Looking at the trends between 2000 and 2006 in Table 8 we see that the private rates of return, r_g and r_n , fell for Master's grads from 2000 to 2006. ETRs dropped in all cases but ESRs fell even more, so that ESR-ETR declines in all cases. This is opposite to the finding that ESR-ETR rose in most cases for Bachelor's and college graduates in our main results. The explanation lies in a larger increase in tuition fees at the graduate level than at the undergrad or college levels.

Doctoral Graduates

Table 9 shows that the "step comparison" results for male and female Ph.D.s are quite different from those at lower levels of education. As one would expect from previous work (see e.g. Dodge and Stager, 1972, Vaillancourt, 1995, and Rathje and Emery, 2002), rates of return are low, and for males can be negative.[24] This may partly reflect the fact that many of the rewards from advanced university study are non-pecuniary. ETRs for males are very high, due

[24] Rates of return for Q75 males in both 2000 and 2006 are negative. This would result in negative values of the ETR and ESR if the definitions in (1) and (2) were applied, which is not very meaningful. We therefore do not show values of ETR. ESR, and ESR-ETR in these cases.

to the penetration of high earnings brackets by male Doctoral graduates. And while the ETRs for female Doctoral grads are lower than those of males, they are higher than those of female Master's grads. ESRs are high for both males and females, however, and the result is that the net encouragement for Doctoral study reflected in the ESR – ETR is substantially higher for Doctoral than for Master's students.

Figures 5 and 6 show earnings profiles for Master's and Doctoral graduates. The earnings profile for male Ph.D. graduates is unusual in featuring a long slow increase over the working lifetime: for many years Ph.D. grads earn less than Master's grads. Pecuniary rewards for Doctoral grads are long delayed. Female Ph.D.s earn less than men, and their earnings decline toward the end of the working life, rather than continuing to climb to as high a level as men's. However, they do even worse if they only have a Master's degree. The period during which female Ph.D. earnings are lower than those of Master's grads is much shorter than in the case of males.

5. Discussion

In this section we discuss, first, what implications our results may have for the interpretation of post-secondary enrolment changes. We then discuss the possible effects on our results of bringing in changes in age-earnings profiles over time and between cohorts.

Enrolment Changes

It would be interesting to investigate how changes in ETRs, ESRs and ESR-ETR have affected enrolment demand. To do so rigorously is beyond the scope of this paper. However, it is interesting to note how our results line up with enrolment changes. Most strikingly, there has

been a strong shift in the PSE gender composition toward women at all levels and we see here that rates of return and the net subsidy rate, ESR-ETR, are also generally higher for women than men at all levels. In 1997 56.1% of PSE students were female, whereas in 2006 that figure had risen to 57.5%.[25] This is just one slice of a much longer term trend of course. It is not implausible that there is a connection between the stronger fiscal incentives for PSE participation by women than for men we find here and this long term trend.

Overall trends in university participation among the population aged 18-24 also seem to line up with the changes in incentives seen here. Over the mid- to late 1990s there was a downward trend, with participation falling from 21.8% in 1994 to 19.3% in 1999, but after that participation rose steadily, reaching 26.3% in 2006. This is roughly consistent with an incentives-based story, given our finding that ESR-ETR fell in the late 1990s but increased from 2000 to 2006 for Bachelor's level students of both sexes.

At the college and undergraduate levels it is plausible that changes in enrolment are mostly caused by changes in enrolment demand. At these levels in Canada, actual enrolment rises or falls to meet demand, as a matter of public policy. At the graduate level, however, it is not clear that is the case. The costs of increasing enrolment are larger and changes likely reflect supply-side influences more than at the undergraduate level. It is therefore perhaps not surprising to see that enrolment trends do not line up as well with our estimated incentive trends as at the lower PSE levels. Our results show relatively low and falling values of ESR-ETR at the Master's and Doctoral levels in the 2000 – 2006 interval. However, there was a 34.5% increase in graduate enrolment from 2000 to 2006 for Canada as a whole, contrasting with a rise of only 4.6% over the six years prior to 2000 (CANSIM series V31215616). From our results, it appears unlikely

[25] Calculated from Cansim Series 477-0013. Enrolment numbers include both college students and university students at undergraduate and graduate levels.

that this change was caused by trends in incentives acting on the demand side. It seems more likely that it was due to a planned expansion of graduate places along the lines advocated e.g. by the Rae report in Ontario (see Rae, 2005).

Changes in Age-Earnings Profiles

In order to focus our attention on the impact of tax and public spending changes we have treated age-earnings profiles, as given in the 2001 Census, as constant in real terms over time. This raises two possible issues. First, could changes in the cross-section profiles have caused significant changes in ETRs and ESRs over the period we study, from 1997 to 2006? And second, could our ETRs and ESRs be misleading since they ignore changes in age-earnings profiles from cohort to cohort?

Boudarbat et al. (2010) use Census data to trace changes in cross-section earnings profiles from 1980 to 2005. For our purposes their most notable findings are that 1) over the period as a whole the returns to education increased, correcting for years of experience, although they did so more for men than women, and 2) controlling for education, age-earnings profiles have become steeper over time - - in this case with a larger change for women. We can ask what difference it would make to our results if such trends were introduced in our analysis, using current-year earnings for our computations rather than using the year 2000 earnings structure throughout.

Abstracting from changes in mean earnings, for post-secondary graduates rising returns to education and steeper age-earnings profiles both imply a) lower foregone earnings while in school, and b) longer periods in higher tax brackets over the working lifetime. The effects of the latter two changes would be to raise our r_g s and ETRs, and likely also the r_n s, in later years for

both sexes.[26] Also, note that higher returns to education likely imply higher lifetime earnings for university graduates, making public subsidies smaller in relative terms and giving somewhat lower ESRs in 2006 - - an effect that would be stronger for men than women given the greater increase in male returns to education.[27] Overall, our result that ESR – ETR rose in most cases from 2000 to 2006 would be challenged, and could be reversed. This underlines the value of keeping the earnings structure constant if one wishes to isolate the impact of changes in taxes and public spending.

But what about the experience of individual cohorts? Beaudry and Green (2000) pointed out that rising returns to education over time could either reflect A) steepening earnings profiles within cohorts, or B) a continuing deterioration in the earnings of young workers, reflecting a decline of lifetime earnings from cohort to cohort. They used Survey of Consumer Finance data from 1971 - 1993 and found that while explanation A appeared to hold for early cohorts, for those entering the labour force in the 1970s and 1980 the B alternative fitted for both men and women. Further, they found that earnings profiles were flattening from cohort to younger cohort over this latter period.

Beach and Finnie (2004) updated Beaudry and Green's analysis using the Longitudinal Administrative Database (LAD file) for 1982-99.[28] They found that results for cohorts entering in the 1970s and 1980s were similar to those of Beaudry and Green. However, they found that

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[26] It is a theoretical possibility that the ETR might rise so much that r_n would fall at the same time that r_g rose. However, we have found in this paper that in almost all cases r_g and r_n move in the same direction.and we expect that the same would be true here. Note that the expected changes in rates of return and ETRs are in the same direction for men and women since although while the change in education returns was weaker for women, the increase in steepness of profiles was stronger for women. Given that the two kinds of changes are expected to affect rates of return and ETRs in the same direction, results are qualitatively the same for men and women.

[27] It is unclear that the same could be said for College graduates, whose earnings are closer to the mean. To have both unchanged mean earnings and higher earnings differentials by education, earnings at lower education levels must decrease.

[28] Note that one limitation of the LAD is that, since it is developed using longitudinal administrative and tax records it does not have information on educational achievement. Thus the updating of the Beaudry and Green results by Beach and Finnie was done only for the education levels grouped together.

for cohorts entering in the 1990s the reduction in earnings came to a halt and earnings profiles became steeper with each cohort. Using the analysis applied above, the latter patterns would imply rising ETRs and falling ESRs for the youngest cohorts, other things constant. What about cohorts entering the labor force in the 1970s and 1980s, for whom lifetime earnings were falling while earnings profiles became flatter? Both declining lifetime earnings and flatter profiles weaken the force of progressivity, so that ETRs would likely have fallen from cohort to cohort in this range. On the other hand, education subsidies would be increasing in relative importance, giving rising ESRs.

Our conclusion is that changes in cohort earning profiles likely acted to make ETRs fall for cohorts starting work in the 1970s and then rise for cohorts entering after 1990. The effect on ESRs was likely the opposite. Other things constant, the result would have been rising ESR-ETR for the cohorts of the 1970s and 1980s and declining ESR-ETR after that. But there are qualifications to make. One is that there are frequently significant changes in the tax system, tuition fees, and public expenditures. Such changes were seen over just the 1997 to 2006 period we have looked at. A full examination of how successive cohorts have fared would have to take such changes into account. Thus, for example, one would likely find a larger impact of the flattening of the tax structure in 2001 on young and middle-aged cohorts of post-secondary grads, since they would benefit from the large drop in marginal tax rates in the third federal tax bracket that occurred in 2001 for a larger portion of their working lifetimes than cohorts nearing retirement age.

6. Conclusion

We have examined the impact of tax and public expenditure systems on the incentive to invest in human capital via post-secondary education (PSE) in Canada in 2000 and 2006. Earlier

work of this type was confined to the Bachelor's level and used Survey of Consumer Finance data from the 1990s. Here we use census data, allowing a much richer analysis in which the effective tax and subsidy rates (ETRs and ESRs) faced by graduates at the College, Bachelor's, Master's and Doctoral levels can be distinguished. We have also presented Bachelor's level results for 1997.

While the tax system depresses the private rate of return at all levels, in our base case public spending more than offsets, so that the net subsidy, given by ESR – ETR, is positive in most of the cases examined at each level of education. For males the base case ETRs increase uniformly as we go to higher education levels, due to graduates at higher levels earning more and being taxed more heavily. The picture is more complex for females, where the ETRs mainly fall from the College to the Bachelor's level, before rising at the Master's and Doctoral levels. ESRs fall from the College to Bachelor's levels for females and then rise at the Master's and Doctoral levels. For males, the picture is for ESRs is broadly similar although there is not a uniform change from the College to Bachelor's levels.

Turning to time trends, at the Bachelor's level from 1997 to 2000 ETRs were unchanged for low earners and fell slightly for higher earners. ESRs displayed more dramatic behaviour, falling for both genders and at each quantile examined. The net subsidy rate ESR – ETR also declined. From 2000 to 2006 ETRs fell at both College and Bachelor's levels for both sexes and all quantiles examined, in the base case. ESRs increased at College, and decreased at Bachelor's levels. The net subsidy rate, ESR – ETR, rose by a small amount for both College and Bachelor's, indicating that the drop in ETR caused by the flattening of the federal income tax structure in 2001 overcame the fall in the ESR at the Bachelor' s level.

At the Bachelor's level we have estimated ETRs and ESRs by province, but were unable to do this at the other PSE levels. While there is interesting provincial variation - - for example Quebec bucked the falling trend in incentives in the late 1990s and had an increase in both its ESR and net subsidy rate ESR – ETR from 1997 to 2006 - - aggregating to the national level yields results for the behaviour of the ETRs and ESRs quite similar to those in our main runs. An exception is that in the 2000 to 2006 interval, instead of getting a small increase in ESR – ETR, as in our main results, at the national level the ESR – ETR for median earners declines a little, from 1.6 to 1.1% averaging across the sexes. This finding suggests some caution is needed in interpreting small changes in ESR – ETR.

At the Master's and Doctoral levels changes from 2000 to 2006 were qualitatively different from those for Bachelor's grads in our main results. While ETRs and ESRs both fell, as generally found at the Bacehlor's level, the net subsidy ESR – ETR also fell, except in the case of 75th quantile male Master's grads. Averaging across the sexes, ESR – ETR fell from 6.6% to 3.4% for median Master's grads and from 30.6% to 27.5% for median Doctoral grads. While caution is needed in interpreting these results, they suggest a decrease in public incentives for graduate study in this period.

While our base-case results for Master's and Doctoral students take student assistance into account, we have argued that calculations without student assistance give a more accurate picture for median College and Bachelor's grads. Our base case at these levels does not include any form of student assistance. Sensitivity to that assumption has been tested through alternative runs that assign students at the Bachelor's level the overall average amount of needs-based assistance. The ESRs and net subsidy rates rise substantially. The pattern of changes in ETRs

and ESRs from 2000 to 2006 is unaffected qualitatively, but instead of increasing a little the ESR-ETR falls a small amount for both males and females.

This study is subject to various limitations. For example, we have omitted certain tax features that affect ETRs on the grounds that they were relatively unimportant or unrepresentative in the period studied. The Canada Education Savings Grants (CESGs) available through RESPs will, however, become increasingly important for future cohorts of post-secondary students. Also, it would be useful to extend our work to estimate ETRs and ESRs for different areas of university study. Finally, our work in modelling provincial detail at the Bachelor's level indicates some sensitivity of the net subsidy rate, ESR – ETR to aggregation bias. If appropriate data on tuition and public spending at the College, Master's and Doctoral levels can be collected, it would be useful to introduce provincial detail in the modelling at these PSE levels as well.

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Table 1

Annual Private Direct Costs of Education per Student (current $'s)

Education Level	2000			2006		
	Fees	Other Expenses	Total	Fees	Other Expenses	Total
College	1,350	893	2,243	1,604	1,000	2,604
Bachelor's	3,795	893	4688	4,966	1,000	5,966
[1997 amounts]	[3,534]	[829]	[4,363]			
Master's/Doctoral	4,351	1,039	5,390	7,098	1,490	8,588

Table 2
Personal Income Tax Brackets and Rates, 1997, 2000 and 2006

I. Federal

1997		2000		2006	
Income Threshold	Rate (%)	Income Threshold	Rate (%)	Income Threshold	Rate (%)
0	17	0	17	0	15.25
$29,590 (B1)	26	$30,004 (B1)	25	$36,378 (B1)	22
59,180 (B2)	29	60,009 (B2)	29	72,756 (B2)	26
				118,285 (B3)	29

Note: A general surtax of 3% was levied in 1997. An additional surtax of 5% was levied on basic federal tax over $12,500 in 1997 and over $15,500 in 2000. There was no surtax in 2006.

II. Ontario

1997		2000		2006	
Income Threshold	Rate (%)	Income Threshold	Rate (%)	Income Threshold	Rate (%)
0	8.16	0	6.37	0	6.05
$29,590	12.48	$30,004	9.62	$34,758	9.15
59,180	13.92	60,009	11.16	69,517	11.16

Note: In 1997 a "Fair Share Health Care Levy" fell on basic Ontario tax over $4,555 at 20% and on basic Ontario tax over $6,180 at a 26% rate. In 2000 there was a surtax of 20% with a $3,561 threshold, and an additional surtax of 36% over $4,468. Surtaxes at the same rates as 2000 were levied in 2006 but with thresholds of $4,016 and $5,065 respectively.

Table 3

Annual Public Direct Costs of Education per FTE Student (current $'s)

Education Level	2000			2006		
	Instructional Cost	**Students' "Other Expenses"**	**Total**	**Instructional Cost**	**Students' "Other Expenses"**	**Total**
College	3,589	893	4,482	3,895	1,000	4,895
Bachelor's	6,718	893	7,611	7,291	1,000	8,291
[1997]	[7,073]	[829]	[7,902]			
Master's	11,197	1,039	12,236	12,152	1,490	13,642
Doctoral	26,873	1,039	27,912	29,164	1,490	30,654

Table 4

Rates of Return, ETRs and ESRs for Bachelor's Graduates: Males and Females by Earnings Quantile, 1997, 2000 and 2006 Tax/Transfer Structures with 2000 Real Earnings

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
1997						
Q25	13.8	12.6	11.6	8.4	15.8	7.4
Q50	16.1	14.0	13.6	12.8	15.4	2.6
Q75	19.4	16.3	16.6	16.0	14.6	-1.4
2000						
Q25	13.6	12.4	11.9	8.4	12.1	3.7
Q50	15.8	13.9	13.9	11.8	11.8	0.0
Q75	19.1	16.2	17.0	15.3	11.2	-4.1
2006						
Q25	13.3	12.6	12.0	5.3	9.5	4.1
Q50	15.5	14.2	14.1	8.5	9.2	0.7
Q75	18.7	16.4	17.1	12.1	8.7	-3.4

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
1997						
Q25	18.3	17.0	14.5	7.1	20.4	13.3
Q50	21.8	19.8	17.4	9.4	19.9	10.6
Q75	23.3	20.1	18.6	14.0	20.1	6.1
2000						
Q25	17.8	16.6	15.0	7.1	15.7	8.6
Q50	21.3	19.3	18.0	9.4	15.4	6.0
Q75	22.8	19.7	19.2	13.4	15.5	2.2
2006						
Q25	17.3	16.6	15.2	4.2	12.3	8.1
Q50	20.7	19.5	18.2	5.8	12.0	6.2
Q75	22.1	20.1	19.4	9.1	12.1	3.0

Note: Q25, Q50 and Q75 indicate results for individuals assumed to earn the gender-specific 25th, 50th (median) and 75th quantile amounts for those whose highest qualification is a Bachelor's degree, throughout their working lives.

Table 4b

Rates of Return, ETRs and ESRs for Bachelor's Graduates: Median Males and Females, "Ability Adjustment" Case, 1997, 2000 and 2006 Tax/Transfer Structures with 2000 Real Earnings

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
			Males			
1997	21.1	10.3	10.2	14.7	15.1	0.3
2000	11.9	10.3	10.5	13.2	11.5	-1.7
2006	11.6	10.5	10.6	9.9	9.0	-0.9
			Females			
1997	16.3	14.7	13.2	10.1	18.9	8.8
2000	16.0	14.3	13.6	10.1	14.5	4.4
2006	15.5	14.5	13.7	6.5	11.4	4.9

Table 5
Rates of Return, ETRs and ESRs for Bachelor's Graduates by Province: Averages of Male and Female Median Results, 1997, 2000 and 2006 Tax/Transfers with 2000 Real Earnings

	NFLD	PEI	NS	NB	ONT	MAN	SASK	ALTA	BC	QUE	Canada
r_g	18.7	18.6	18.0	19.0	18.4	18.9	18.9	18.5	19.4	22.5	19.1
r_n	15.8	15.9	15.4	16.1	16.0	16.3	16.4	16.2	16.9	18.2	16.3
r_p	15.3	15.4	17.1	17.3	16.7	14.0	13.1	14.8	14.2	17.7	15.6
ETR	15.9	14.7	14.6	14.9	13.1	13.5	13.1	12.7	13.2	19.3	14.5
ESR	18.6	17.5	5.3	8.5	9.4	25.7	30.5	20.2	26.7	21.1	18.4
ESR-ETR	2.7	2.8	-9.2	-6.4	-3.7	12.2	17.4	7.6	13.5	1.9	3.9

2000

	NFLD	PEI	NS	NB	ONT	MAN	SASK	ALTA	BC	QUE	Canada
r_g	18.9	18.7	17.9	18.8	18.1	19.3	18.7	18.3	19.7	20.7	19.0
r_n	15.9	15.9	15.2	16.0	15.9	16.7	16.2	15.9	17.0	17.7	16.2
r_p	15.9	16.0	17.6	17.8	17.2	14.7	13.8	15.4	14.9	16.3	15.9
ETR	15.6	15.0	15.4	15.3	12.2	13.5	13.5	13.0	13.6	14.8	14.3
ESR	16.0	14.6	2.0	5.4	5.0	24.1	26.6	16.0	24.4	21.2	15.9
ESR-ETR	0.4	-0.4	-13.4	-9.9	-7.2	10.6	13.1	3.1	10.8	6.4	1.6

2006

	NFLD	PEI	NS	NB	ONT	MAN	SASK	ALTA	BC	QUE	Canada
r_g	18.7	16.8	15.9	16.8	16.7	18.1	16.9	17.0	17.0	20.8	17.5
r_n	16.3	14.9	13.9	15.2	15.4	16.5	15.5	15.5	15.3	17.8	15.6
r_p	15.2	15.3	16.8	17.0	16.5	14.2	13.3	14.8	14.4	16.6	15.4
ETR	13.1	11.6	12.7	9.9	7.8	9.2	8.5	8.8	9.7	14.5	10.7
ESR	18.6	8.7	-5.7	-1.2	1.1	21.9	21.2	12.7	15.5	20.3	11.8
ESR-ETR	5.5	-3.0	-18.3	-11.1	-6.7	12.7	12.7	3.9	5.8	5.8	1.1

Table 6

Rates of Return, ETRs and ESRs for Bachelor's Graduates: Base Case vs. Needs-based Student Assistance Case, Male and Female Median Results, 2000 and 2006 Tax/Transfers with 2000 Real Earnings (%)

Males, 2000		
	Base Case	Needs-based Assistance Case
r_g	15.8	16.9
r_n	13.9	15.2
r_p	13.9	13.9
ETR	11.8	10.0
ESR	11.8	17.3
ESR-ETR	0.0	7.2

Males, 2006		
	Base Case	Needs-based Assistance Case
r_g	15.5	16.3
r_n	14.2	15.2
r_p	14.1	14.1
ETR	8.5	7.0
ESR	9.2	13.9
ESR-ETR	0.7	6.8

Females, 2000		
	Base Case	Needs-based Assistance Case
r_g	21.3	23.3
r_n	19.3	21.5
r_p	18.0	18.0
ETR	9.4	7.6
ESR	15.4	22.6
ESR-ETR	6.0	15.1

Females, 2006		
	Base Case	Needs-based Assistance Case 2
r_g	20.7	22.2
r_n	19.5	21.3
r_p	18.2	18.2
ETR	5.8	4.2
ESR	12.0	18.2
ESR-ETR	6.2	14.0

Table 7

Rates of Return, ETRs, and ESRs for College Graduates: Males and Females by Earnings Quantile, 2000 and 2006 Tax/Transfers with 2000 Earnings (%)

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	18.4	17.0	16.4	7.4	11.1	3.7
Q50	19.4	17.2	17.4	11.3	10.2	-1.1
Q75	21.3	18.3	19.2	14.2	10.2	-3.9
2006						
Q25	18.6	17.9	16.5	4.0	11.3	7.3
Q50	19.7	18.2	17.6	7.3	10.5	3.1
Q75	21.6	19.5	19.4	10.1	10.5	0.4

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	23.8	21.5	19.9	9.8	16.4	6.6
Q50	28.2	25.0	23.7	11.4	16.0	4.6
Q75	26.4	22.7	22.2	13.9	15.7	1.8
2006						
Q25	24.3	23.0	20.2	5.4	16.9	11.5
Q50	28.8	26.8	24.1	6.9	16.4	9.6
Q75	26.9	24.7	22.6	8.4	16.2	7.7

Note: Q25, Q50 and Q75 indicate results for individuals assumed to earn the gender-specific 25th, 50th (median) and 75th quantile amounts for those whose highest qualification is a college diploma, throughout their working lives.

Table 8

Rates of Return, ETRs, and ESRs for Master's Graduates: Males and Females by Earnings Quantile, 2000 and 2006 Tax/Transfers, Real 2000 Earnings (%)

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	7.6	6.8	6.0	11.6	21.2	9.6
Q50	9.6	7.7	7.4	19.7	23.0	3.3
Q75	9.8	7.7	8.0	21.6	18.3	-3.3
2006						
Q25	7.1	6.5	6.1	8.4	14.9	6.5
Q50	8.8	7.4	7.4	16.4	16.1	-0.4
Q75	9.2	7.5	8.1	19.0	12.7	3.8

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	9.0	8.5	7.3	5.2	19.3	14.1
Q50	11.0	10.0	8.9	9.7	19.6	9.9
Q75	14.6	12.6	11.3	13.6	22.8	9.3
2006						
Q25	8.4	8.3	7.2	1.8	14.6	12.8
Q50	10.3	9.6	8.9	6.5	13.6	7.1
Q75	13.4	12.1	11.3	9.7	15.7	5.9

Note: Q25, Q50 and Q75 indicate results for individuals assumed to earn the gender-specific 25th, 50th (median) and 75th quantile amounts for those whose highest qualification is a Master's degree, throughout their working lives.

Table 9

Rates of Return, ETRs, and ESRs for Doctoral Graduates: Males and Females by Earnings Quantile, 2000 and 2006 Tax/Transfers with Real 2000 Earnings (%)

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	3.1	2.5	1.0	18.6	66.6	47.9
Q50	2.6	1.5	0.8	41.9	68.8	26.8
Q75	-1.9	-2.5	-2.9	-	-	-
2006						
Q25	2.9	2.4	1.1	15.6	61.3	45.7
Q50	2.4	1.4	0.9	40.8	63.5	22.7
Q75	-2.1	-2.6	-2.9	-	-	-

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	6.9	6.3	3.8	9.3	44.6	35.3
Q50	8.2	7.2	4.4	12.4	46.7	34.3
Q75	7.1	5.8	4.1	19.5	42.5	23.1
2006						
Q25	6.5	6.1	3.9	6.3	39.7	33.4
Q50	7.7	6.9	4.5	9.5	41.7	32.2
Q75	6.8	5.6	4.2	17.0	37.9	20.8

Note: Q25, Q50 and Q75 indicate results for individuals assumed to earn the gender-specific 25^{th}, 50^{th} (median) and 75^{th} quantile amounts for those whose highest qualification is a doctoral degree, throughout their working lives.

Figure 1

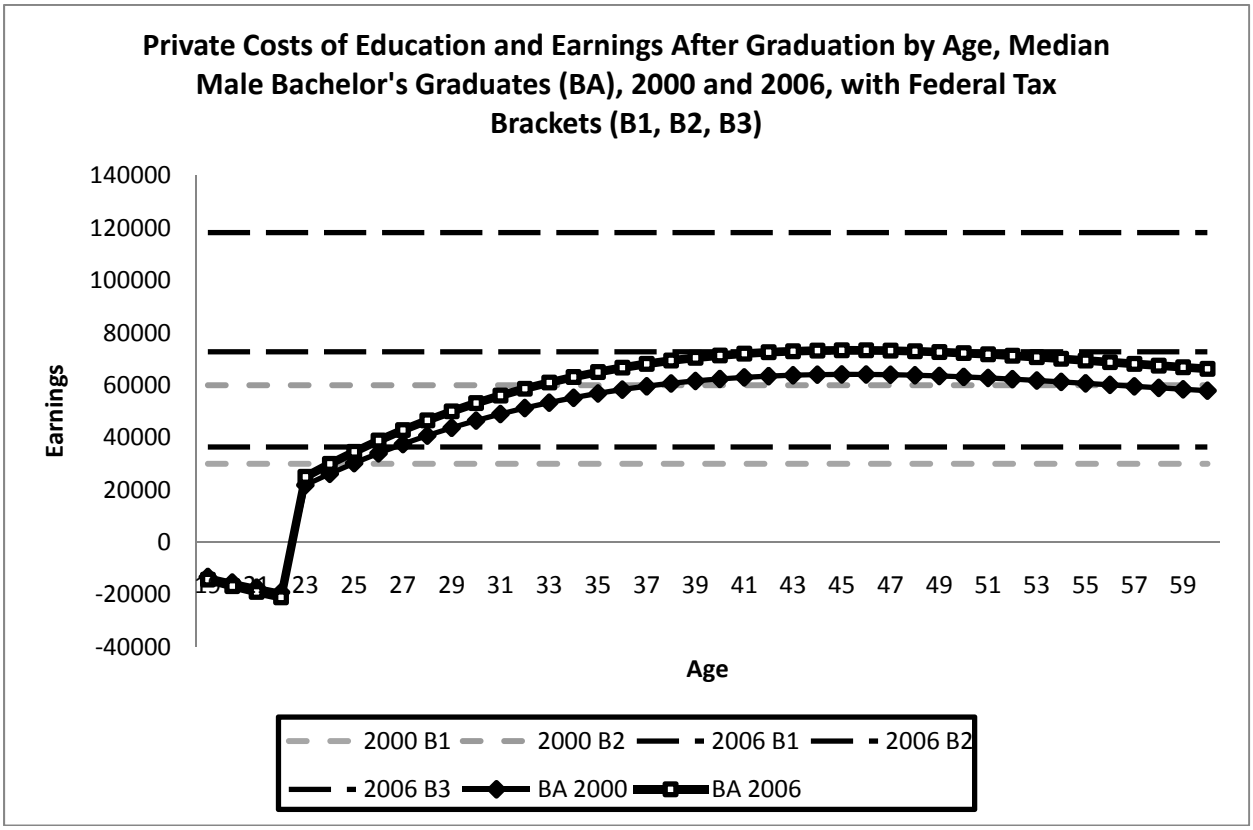

Private Costs of Education and Earnings After Graduation by Age, Median Male Bachelor's Graduates (BA), 2000 and 2006, with Federal Tax Brackets (B1, B2, B3)
Earnings
140000
120000
100000
80000
60000
40000
20000
0
-20000
-40000
19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
BA 2000
BA 2006

Figure 2

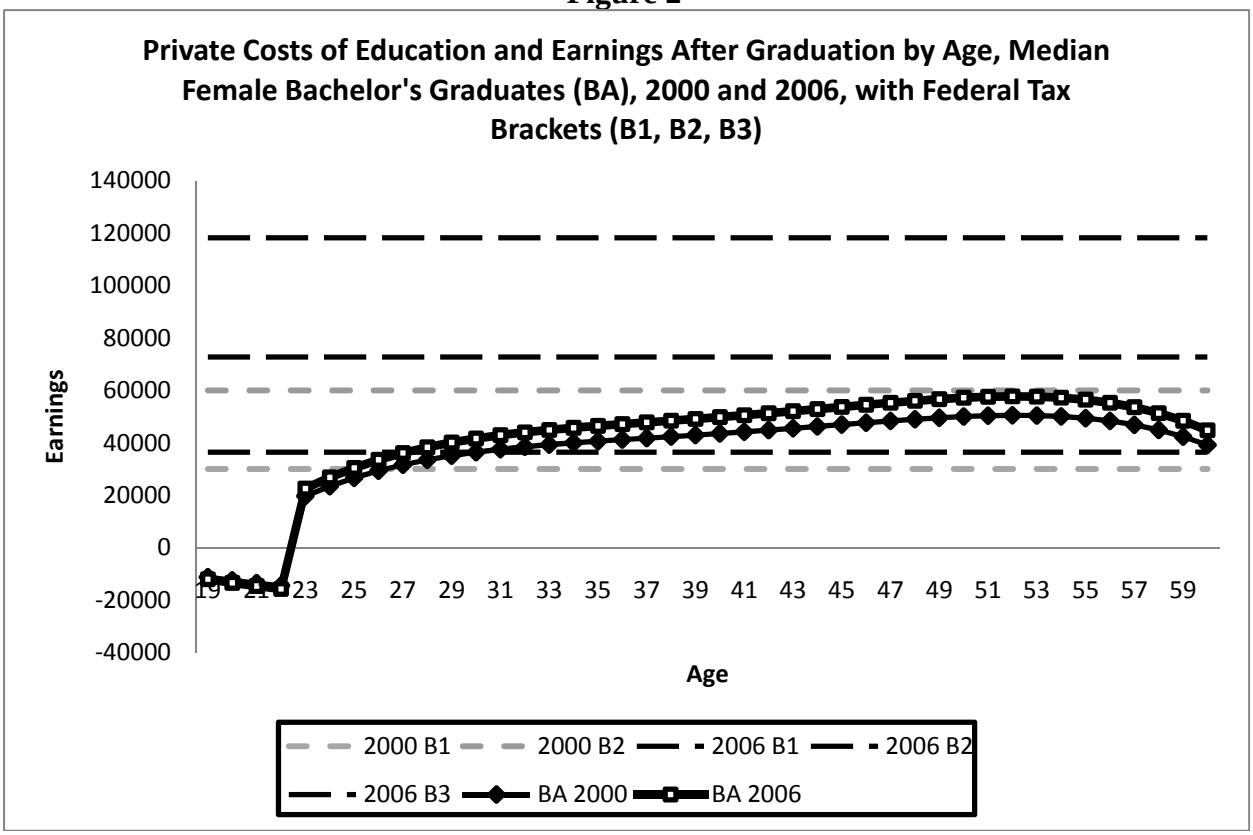

Private Costs of Education and Earnings After Graduation by Age, Median Female Bachelor's Graduates (BA), 2000 and 2006, with Federal Tax Brackets (B1, B2, B3)
Earnings
140000
120000
100000
80000
60000
40000
20000
0
-20000
-40000
19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
BA 2000
BA 2006

Figure 3

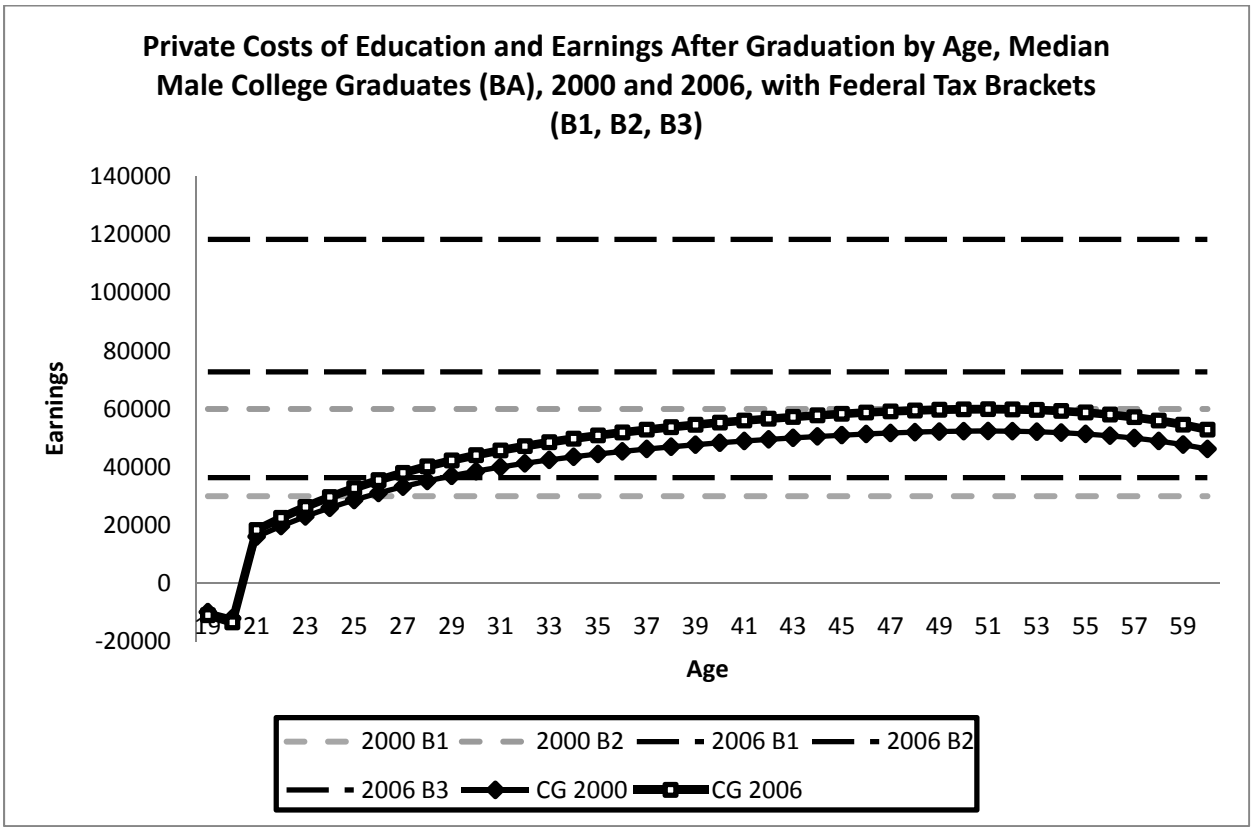

Private Costs of Education and Earnings After Graduation by Age, Median Male College Graduates (BA), 2000 and 2006, with Federal Tax Brackets (B1, B2, B3)
Earnings
140000
120000
100000
80000
60000
40000
20000
0
-20000
19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
CG 2000
CG 2006

Figure 4

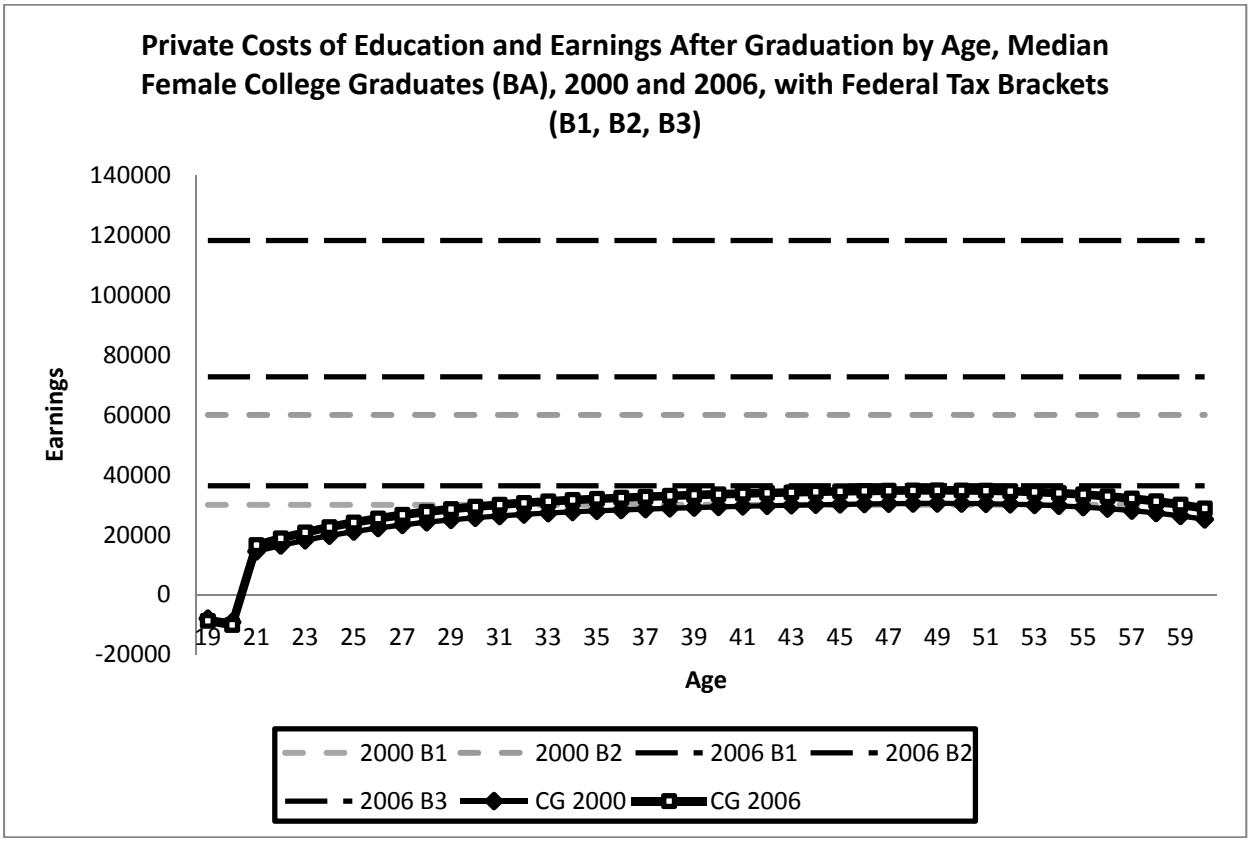

Private Costs of Education and Earnings After Graduation by Age, Median Female College Graduates (BA), 2000 and 2006, with Federal Tax Brackets (B1, B2, B3)
Earnings
140000
120000
100000
80000
60000
40000
20000
0
-20000
19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
CG 2000
CG 2006

Figure 5

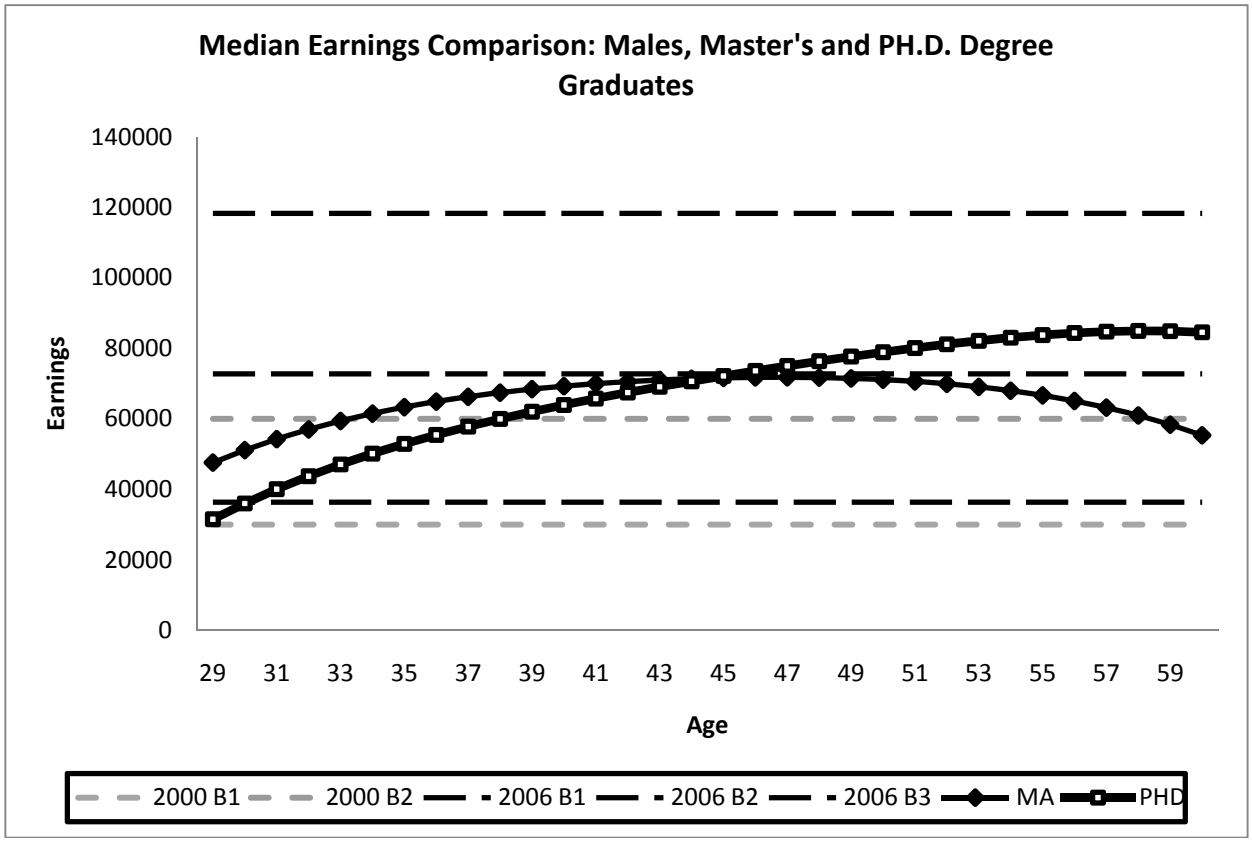
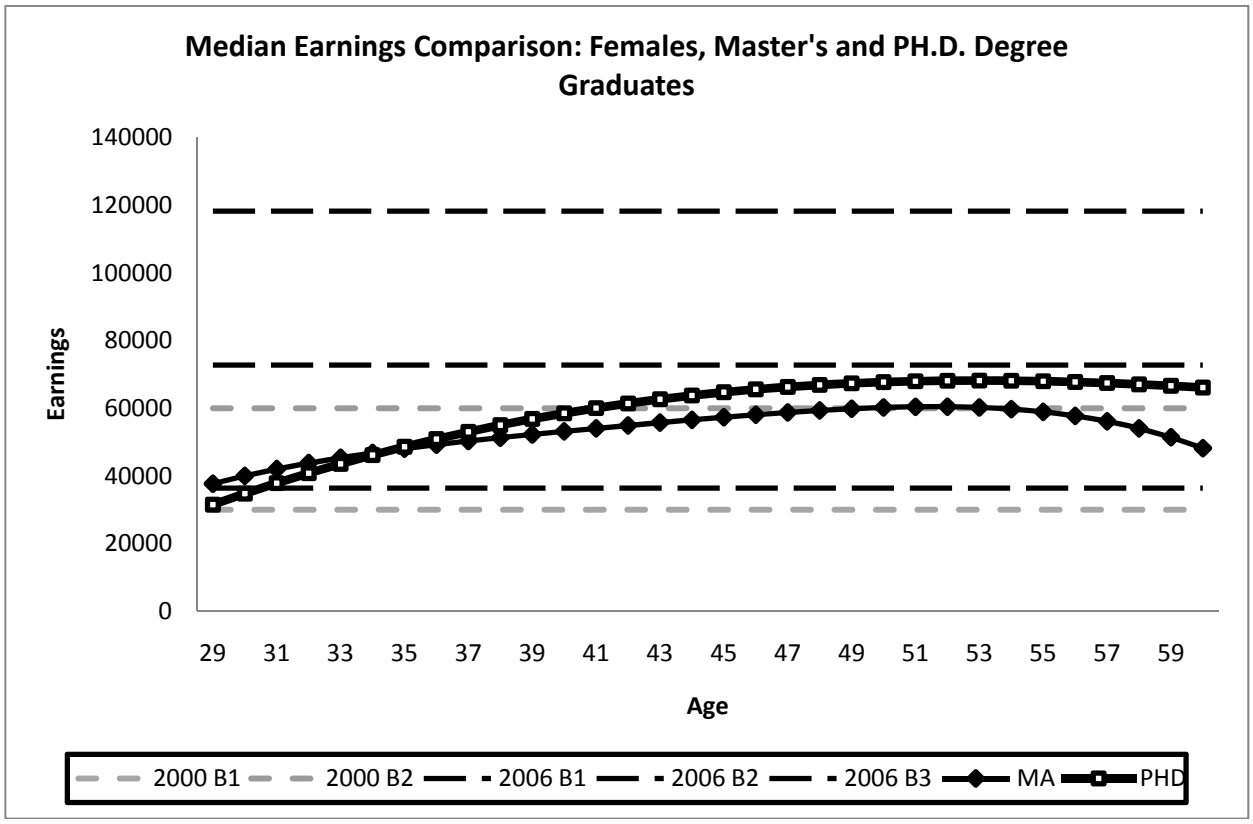

Median Earnings Comparison: Males, Master's and PH.D. Degree Graduates
Earnings
140000
120000
100000
80000
60000
40000
20000
0
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
MA
PHD

Figure 6


Median Earnings Comparison: Females, Master's and PH.D. Degree Graduates
Earnings
140000
120000
100000
80000
60000
40000
20000
0
29
31
33
35
37
39
41
43
45
47
49
51
53
55
57
59
Age
2000 B1
2000 B2
2006 B1
2006 B2
2006 B3
MA
PHD

Appendix A

Data Sources and Assumptions

Private Direct Costs

Canada-wide average university tuition figures are provided by Statistics Canada.[29] Values for the 2000/01 year are $3,405 and $3,961 for undergraduate and graduate degrees, respectively. For 2006/07, the values are $4,347 and $6,479. We assume that the annual tuition fees faced by MA and Ph.D. students are the same. Statistics Canada estimates indicate that the average additional compulsory fees for undergraduate university students were $619 for 2006/07 and $437 in 2000/01.[30] We have assumed the same figures for graduate students, since separate estimates are not available.

Statistics Canada does not report average fees at the College level. Junor and Usher (2004, figure 4.II.1) indicates average tuition fees of approximately $1,150 in 2000/01. For 2003/04 they report that additional fees ranged from $218.80 to $233.50. Taking the midpoint of the latter range ($226.15) and assuming that tuition fees and additional fees were in the same ratio in 2000, we obtain a figure of $1,350 for total fees in 2000. To estimate 2006 College fees we updated the Junor and Usher 2003 figure assuming that the ratio of college to university fees remained constant from 2003 to 2006.

Students' direct costs may be reduced through student loans[31], bursaries, and

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[29] 2000 data on tuition fees are from *The Daily*, August 28, 2000 (http://www.statcan.ca/Daily/English/000828/d000828b.htm) while 2006 data on both tuition fees and additional compulsory fees are from *The Daily*, September 1, 2006 (http://www.statcan.ca/Daily/English/060901/d060901a.htm).

[30] Additional compulsory fees for 2000 are given at http://www.statcan.gc.ca/daily-quotidien/050901/dq050901a-eng.htm.

[31] Student loans reduce direct costs insofar as they are subsidized. In Canada, while students pay interest on their loans at a market rate, payments do not commence until six months after graduation. There is therefore a significant element of subsidy.

scholarships. At the graduate level it is important to take into account the assistance students receive in the form of scholarships and other grants both from their universities and government sources. A large majority of Doctoral students receive some assistance in this form, and although fewer Master's students receive such assistance it is still quite typical. It can be estimated that the average amount of grants received by graduate students in Canada in 2000/01 was $3,193.[32] Assuming that the amount received by Master's students averages 60% of that received by Ph.D. students, this yields $2,520 for Master's students and $4,201 for Doctoral students.[33] We have assumed that these amounts remained constant in real terms from the year 2000 to 2006.

Public Direct Costs

In order to compute public direct costs, as explained in the main text we need an estimate of the instructional costs per student in the relevant program. These are total instructional costs -- that is they include both those borne by the educational institutions (and ultimately governments and other institutional supporters) and those borne by students through their fees.

In their previous work Collins and Davies assumed that the institutional cost of educating undergraduates equaled 50% of university operating expenditures.[34] Dividing by the number of

[32] Junor and Usher (2004, Figure 5A.IX.4) indicates total non-repayable assistance to graduate students of approximately $300,000 in 2000/01. Dividing by graduate enrolment of 93,967 in that year from CANSIM,we get the figure in the text.

[33] Canada-wide statistics on the financial assistance received by graduate students are not available for recent years. Dodge and Stager (1972, p. 185) used Statistics Canada data for the late 1960s that indicates that the average assistance received by Master's students in Science, Engineering and Business was then 58% of that received by Ph.D. students. Scrutiny of the websites of leading Canadian universities indicates that Master's students in a range of programs receive less financial assistance than Ph.D. students and that a 60% ratio is a reasonable estimate of the relative levels of support.

[34] We believe that about 30% of university expenditures are, on average, dedicated to undergraduate instruction. National data on universities' capital spending are not available. We assume that capital spending equals about 60% of operating expenditure, based on evidence from the early 1990s, If 30% of both operating and capital spending is for undergraduate education, one then gets a figure equal to about 50% of operating expenditure as an estimate of the total direct cost of undergraduate instruction. See Collins and Davies (2004, p. 208, fn. 27) for more detail.

full-time equivalent (FTE) students provides instructional costs per student.[35] We apply this approach to estimate the public rate of return, that is r_p , for Bachelor's level education. Instructional costs per FTE are $6,718 for the year 2000 and $7,291 for 2006.[36] To maintain comparability with previous studies, we estimate public costs for other PSE levels using the same ratios (e.g. College to Bachelor's, MA to Bachelor's, and Doctoral to Bachelor's) used by Vaillancourt (1995) and others. The instructional cost numbers obtained in this way are presented in Table 3.[37]

Appendix B

Rates of Return, ETRs and ESRs for Graduate Degrees: Total Comparisons

In the main text we looked at rates of return, ETRs and ESRs on the incremental education provided by a graduate degree. These were *step comparisons*. In calculating our rates of return to a Master's degree then, for example, the stream of earnings gains came from the difference between the earnings of Master's and Bachelor's graduates. And foregone earnings were based on what a Bachelor's grad would have earned. The rates of return obtained were quite low, and the ETRs and ESRs took on some extreme values since they are calculated based on the percentage differences among the gross, net and public rates of return. Small absolute differences can translate into very large percentage differences. The latter figures are quite sensitive to small changes in the estimated r_g, r_n, and r_p .

[35] A part-time student counts as one third of a full-time student in computing FTEs.
[36] The 2000 figure comes from costs in the 2000/01 academic year. The 2006 figure is from 2004/05 data, which were the most recent available when these calculations were performed.
[37] See Vaillancourt (1995, p.544) for the costs used to calculate our ratios. For colleges Vaillancourt used data from *Education in Canada, 1986-1987,* Statistics Canada (81-229). At the Master's and Ph.D. levels he used Ontario's official Basic Income Unit (BIU) weights to determine funding for graduate students.

The following two tables show *total comparison* results for Master's and Doctoral levels. Here we use rates of return to the total university education that culminates in the advanced degree. Earnings gains are relative to those of a high school graduate throughout, and earnings foregone while in school are those of a high school grad.

Table 8b

Rates of Return, ETRs, and ESRs for Master's Graduates using "Total Comparison": Males and Females by Earnings Quantile, 2000 and 2006 Tax/Transfers, Real 2000 Earnings (%)

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	12.0	11.0	10.2	8.6	15.1	6.5
Q50	14.1	12.3	12.0	12.7	14.6	2.0
Q75	16.1	13.6	14.0	15.8	13.1	-2.7
2006						
Q25	11.5	10.9	10.3	5.3	11.2	5.9
Q50	13.6	12.3	12.1	9.2	10.9	1.6
Q75	15.6	13.6	14.1	12.8	9.8	-3.1

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	15.0	14.1	12.2	5.9	18.3	12.4
Q50	17.5	15.9	14.5	9.1	17.2	8.1
Q75	19.4	16.8	16.0	13.4	17.5	4.1
2006						
Q25	14.3	13.9	12.3	2.8	13.6	10.8
Q50	16.8	15.9	14.6	5.6	12.8	7.2
Q75	18.6	16.8	16.2	9.4	13.1	3.7

Table 9b

Rates of Return, ETRs, and ESRs for Doctoral Graduates using "Total Comparison": Males and Females by Earnings Quantile, 2000 and 2006 Tax/Transfers, Real 2000 Earnings (%)

Males

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	7.1	6.3	4.6	11.2	34.4	23.2
Q50	7.7	6.5	5.3	15.5	32.0	16.4
Q75	7.6	6.0	5.1	20.5	32.6	12.1
2006						
Q25	6.7	6.2	4.7	7.2	29.3	22.1
Q50	7.3	6.5	5.4	12.0	27.1	15.1
Q75	7.2	5.9	5.2	17.1	27.7	10.6

Females

	r_g	r_n	r_p	ETR	ESR	ESR-ETR
2000						
Q25	10.2	9.6	6.7	5.8	34.5	28.7
Q50	12.1	11.0	8.2	9.4	32.4	23.0
Q75	11.8	10.2	8.1	13.3	31.1	17.8
2006						
Q25	9.6	9.3	6.8	2.5	29.2	26.6
Q50	11.4	10.8	8.3	5.7	27.3	21.5
Q75	11.1	10.1	8.2	9.7	26.1	16.5

Appendix C

Data Sources and Assumptions by Province

Tables 11, 12 and 13 show direct costs at the Bachelor's level and tax parameters by province for 1997, 2000 and 2006 respectively. As indicated in the notes to the tables, Statistics Canada data are available for average Tuition and Additional fees (short form for "Additional Compulsory Fees") by province at the Bachelor's level. We do not have separate numbers for Other Expenses by province, and assume the same value across the country. This completes the cost information needed to compute Bachelor's level ETRs by province.

In order to compute ESRs we also need a figure for Instructional Costs by province. These numbers were derived with the help of a table published annually in the CAUT Almanac headed "Provincial Government Transfers to Colleges and Universities per FTE Student Enrolments". These transfers are close to the subsidy that is one of the two funding components for Instructional Costs (along with the students' contribution via their fees). We impute a subsidy per university undergraduate for each province that is equal to the Canada-wide figure for this subsidy used in our main results, multiplied by the ratio of a province's per student transfer to colleges and universities to the national average in the almanac table. This procedure implicitly assumes that funding differences across the provinces are the same, proportionally, for colleges and universities.

Table 11
Bachelor's Direct Costs of Education and Income Tax Parameters, 1997

	NFLD	PEI	NS	NB	ONT	MAN	SASK	ALTA	BC	QUE*	Federal
Direct costs ($)											
Tuition	3211	3162	3892	3026	3293	2921	3074	3241	2518	1916	
Additional Fees	200	357	241	175	435	345	224	391	250	624	
Other Expenses	829	829	829	829	829	829	829	829	829	829	
Instructional Costs	7658	7471	5049	4744	5554	9826	11783	8463	9442	7392	
Tax Parameters											
Prov. tax as % of Federal	69.0	59.5	58.5	63.0	48.0	52.0	50.0	45.5	51.0	n.a.	
Marginal Tax Rates (%)											
Bracket 1										16.0	17.0
2										19.0	26.0
3										21.0	29.0
4										23.0	
5										24.2	
6										25.2	
7										26.4	
Income Thresholds($)											
Bracket 1										$0	$0
2										$7,000	$29,590
3										$14,000	$59,180
4										$23,000	
5										$33,492	
6										$50,000	
7										$55,269	
Basic Personal Amount ($)										$5,900	$6,456
Tax Credits for Students											
Credit Rate (%)											17.0
Education Amount Credit ($)											

Source: Tax parameters are from Canadian Tax Foundation, The National Finances 1997.
Tuition and Additional Fees are from Statistics Canada (The Daily, Wednesday, Aug. 21, 2002) http://www.statcan.gc.ca/daily-quotidien/020821/dq020821b-eng.htm. See text for Other Expenses and Instructional Costs.

Note: All provinces except Quebec used the "tax on tax" approach in which basic provincial tax is a statutory % of basic federal tax.
*Federal tax is reduced in Quebec by a 16.5% abatement.

Table 12
Bachelor's Direct Costs of Education and Income Tax Parameters by Province, 2000

	NFLD*	PEI*	NS	NB	ONT	MAN	SASK*	ALTA*	BC	QUE**	Federal
Direct costs ($)											
Tuition	3300	3480	4408	3519	3971	2873	3409	3841	2520	1624	
Additional Fees	327	354	281	163	480	289	355	384	313	346	
Other Expenses	893	893	893	893	893	893	893	893	893	893	
Instructional Costs	7273	7095	4795	4506	5275	9332	11191	8037	8967	7020	
Tax Parameters											
Prov. tax as % of Federal	62.00	57.50					48.00	44.00			
Marginal Tax Rates (%)											
Bracket 1			9.77	9.94	6.37	8.00			8.40	19.00	17.00
2			14.95	15.21	9.62	12.22			12.40	22.50	25.00
3			16.67	16.96	11.16	13.63			14.35	25.00	29.00
Income Thresholds($)											
Bracket 1			0	0	0	0			0	0	0
2			29,590	29,590	30,004	29,590			30,004	26,000	30,004
3			59,180	59,180	60,009	59,180			60,009	52,000	60,009
Basic Personal Amount ($)			7,231	7,231	7,231	7,231			7,231	5,900	7,231
Tax Credits for students:											
Credit Rate (%)			9.97	9.94	6.37	8.00			8.40	22.00	17.00
Education Amount Credit ($)			200	200	200	200			200	-	200

Source: Tax parameters are from Canadian Tax Foundation, The National Finances 2000 and CTaCS Model (Milligan, 2007).
Tuition Fees are from Statistics Canada (The Daily, Monday, August 28, 2000, http://www.statcan.ca/Daily/English/000828/d000828b.htm. Additional Fees for 2000 were given in The Daily, Thursday, Sept. 21, 2005, http://www.statcan.gc.ca/daily-quotidien/050901/dq050901a-eng.htm. See text for Other Expenses and Instructional Costs.

* Provinces still using the "tax on tax" approach. Basic provincial tax is a statutory % of basic federal tax.
**Federal tax is reduced in Quebec by a 16.5% abatement.

Table 13
Bachelor's Direct Costs and Tax Parameters by Province, 2006

	NFLD	PEI	NS	NB	ONT	MAN	SASK	ALTA	BC	QUE*	Federal
Direct costs of Educ. ($)											
Tuition	2606	4947	6571	5328	5160	3338	5063	4828	4960	1916	
Additional Fees	466	728	572	341	729	458	431	567	442	624	
Other Expenses	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	
Instructional Costs	7893	7700	5204	4890	5725	10127	12145	8722	9731	7298	
Tax Parameters											
Marginal Tax Rates (%)											
Bracket 1	10.57	9.80	8.79	9.68	6.05	10.90	11.00	10.00	6.05	16.00	15.25
2	16.16	13.80	14.95	14.82	9.15	13.50	13.00		9.15	20.00	22.00
3	18.02	16.70	16.67	16.52	11.16	17.40	15.00		11.70	24.00	26.00
4			17.50	17.84					13.70		29.00
5									14.70		
Income Thresholds ($)											
Bracket 1	0	0	0	0	0	0	0		0	0	0
2	29,590	30,754	29,590	33,450	34,758	30,544	37,579		33,755	28,710	36,378
3	59,180	61,509	59,180	66,902	69,517	65,000	107,367		67,511	57,430	72,756
4			93,000	108,768					77,511		118,285
5									94,121		
Basic Personal Amount	7410	7412	7231	8061	8377	7734	8589	14899	8858	6520	8839
Tax Credits for students:											
Credit Rate (%)	10.57	9.80	8.79	9.68	6.05	10.90	11.00	10.00	6.05	20.00	15.25
Educ. and Textbook Amount	200	200	200	400	451	400	400	459	200	-	465

Source: Tax parameters are from Canadian Tax Foundation, The National Finances 2006 and from KPMG.
Tuition and Additional Fees are from Statistics Canada, The Daily, Friday, September 1, 2006 (http://www.statcan.ca/Daily/English/060901/d060901a.htm). For Other Expenses and Instructional Costs see text.

*Federal tax is reduced in Quebec by a 16.5% abatement.