Restructuring the University System: What Level of Public Support?

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It seems inevitable that universities in Canada will be increasing their reliance on tuition as a source of income. This paper works out an optimal tuition subsidy formula for a full tuition university system where investments in higher education are treated by the tax system in the same way as investments in physical capital. The optimal subsidy is quite substantial in some cases. In general, with enlightened tax policy, there is no reason to fear that a full tuition regime will reduce the quality, equity, or accessibility of the university system.

Universities in Canada are moving toward a system of funding that relies less on public support and much more on tuition payments from students and their parents. This trend may help to reduce the chronic underfunding that has plagued universities over the last decade. It may also change the relative emphasis placed on teaching and research at universities. Differential tuition rates across programs and institutions may also lead to greater specialization and diversity. While all these changes may be for the better, tuition increases are not popular. Many are concerned that increases in tuition will reduce the accessibility of higher education and therefore reduce equity and efficiency.

Observation of the US system indicates that the full market price for tuition can be extremely high. Nonetheless, this paper will argue that with enlightened tax policy such a system can be equitable, efficient and accessible. The key to equity and efficiency is simply to treat investments in human capital the same way as we treat investments in physical capital. This ensures that those with the ability to enter university are treated in the same manner as those without this ability, and also ensures that the tax system does not distort individual decisions. Accessibility is enhanced by provision of an up-front subsidy in lieu of the normal tax deduction against income earned from the investment. Accessibility can be further enhanced with the use of instruments such as student loan plans.

In a simple framework this paper will work out explicitly the optimal subsidy for postsecondary
education in several different cases. It does not attempt to address the familiar argument that education of the elites, and support for the university system in general, has unmeasured public benefits for everyone. These public benefits surely exist, and so the numbers calculated should be seen as minimal levels for public support of the university system. Even so, the optimal subsidy is surprisingly large in some cases.

The next section defines efficiency and equity in the context of investments in physical and human capital and works out an expression for the optimal public subsidy for the investment in each case. This is followed by a series of examples based on figures for the cost of education in Ontario. A subsequent section addresses the issue of accessibility.

**EQUITY AND EFFICIENCY**

As a guiding principle, we propose that the tax system should treat investments in education in the same way it treats investments in physical capital. In other words, a high school graduate with the ability to enter university should be treated exactly the same by the tax system as a high school graduate who does not have this ability. This principle seems equitable to those who are not able to benefit from a university education but might be able to benefit from an investment in the tools of another trade. It also ensures that young people will make efficient personal decisions. A person with the opportunity to enter university will make the appropriate choice between doing so and investing in a private business venture.¹

Equity does not just depend on the tax system, of course. Since many people do not have the ability to benefit from a university education, a second aspect of equity is that the marginal rate of return on a university education should be comparable with the rates of return available elsewhere in the economy. The data in Stager (1996) suggest that substantial increases in tuition fees would be necessary to bring the average rate of return down to a market rate, but since abilities differ across people this by itself is not evidence that postsecondary education is being rationed. We briefly return to this point later.

At the time any investment is made the benefits are unknown. However, the individual surely knows more about the potential benefits than the government, and so it must be the individual’s decision to make the investment or not. We begin with a very simple investment that costs an amount $C$ in period one and some time later (period two) is expected to return the total benefit $R$. The cost must be paid out of after-tax savings.

If an individual just puts money in the bank over this period, he or she would earn interest at the rate $r$. Thus the savings would grow to the amount $C(1+r)$. However, the government will collect tax on the interest income, so the after-tax wealth is only $C(1+r)–rCt$, where $t$ is the tax rate. This can be written as $C(1+r(1–t))$, where $r(1–t)$ is the after-tax rate of return on savings. The amount

$$\frac{R}{1+r(1–t)}$$  \hspace{1cm} (1)

is the amount of money one would have to put in the bank in period one in order to have the amount $R$ in period two. This is the present discounted value of the amount $R$.

Suppose the individual decides to buy a physical asset, like a car, that would be used to earn income through a personal business. In this case the amount $C$ is spent on the car, and an amount $R$ shows up as income some time later. However, even though the investor earns total income $R$ from the use of the automobile, he or she does not have to pay tax on this full amount. Instead they are allowed to deduct the cost of buying the car from income before calculating tax, so that after-tax wealth is $R–t(R–C)$.

This system treats people who invest in physical assets the same way it treats people who put their
money in the bank. In each case tax is payable only on the extra earnings from the use of the amount C. Suppose that the amount R is exactly equal to C(1+r), so that the total return (including taxes given to the government) from the two options is the same. Then the amount of tax paid by the two individuals, and thus their after-tax wealth, should also be the same. In fact, the after-tax wealth of a potential investor is

\[ R - t(R - C) = [C(1+r)-t(C(1+r)-C)] = [C(1+r)-rCt]. \] (2)

It follows as well that if the total return from making the physical investment is higher, i.e., \( R > C(1+r) \), the after-tax income to the individual making the decision to invest is also higher. In this sense we can expect the right decisions to be made.

**Note that the tax system could achieve the same effect through a subsidy to the cost of investing, rather than by allowing a deduction from the returns.** This might be preferred when individuals find it difficult to raise the money to pay for the investment up front. Suppose we subsidize the investment by the amount S when it is made, and tax the benefits fully when they are received. The investment now costs only \((C-S)\) but the after-tax return is only \(R(1-t)\). If the amount \((C-S)\) were put in the bank, the total return after-tax would be \((C-S)(1+r)-r(C-S)t\). To ensure equitable treatment of the two activities, we want to choose the subsidy \(S\) so that the after-tax returns are equal whenever the total returns are equal. A bit of algebra reveals we should choose \(S\) such that

\[ S = \frac{rC}{1 + r(1-t)}. \] (3)

The required subsidy is equivalent to the present discounted value of the tax deduction that is received under the usual scheme.

People buy assets for pleasure as well. In this case there is no increase in income, and so the benefits of the investment are not taxed. Thus we do not generally allow people to deduct the cost of an investment from income that does not derive from the investment, and we do not generally subsidize the cost of assets that are used only for pleasure.

With this background, we are ready to look at the case of postsecondary education. To determine the tuition subsidy that would treat investments in education similarly to investments in physical capital, we can proceed as follows. Suppose a person with a high school diploma would earn the amount \(w_1\) during his first four years and \(w_2\) thereafter. Going to university increases earnings after graduation by the amount \(R\). Individuals are taxed at the average rate \(t_j\) if their wages are low (\(w_1\) or \(w_2\)), but we assume the marginal rate on higher earnings, denoted by \(t_2\), is larger. To attend university he must pay four years full cost tuition \(T^2\) moving and other incidental expenses \(M\), and four years living expenses \(L\). Suppose we give him a non-taxable subsidy \(S\) to help defray these costs. Then the net present value of the returns to an individual from attending university, after tax, are given by:

\[ (-T-M-L) + S \frac{1}{1 + r(1-t_1)} (w_1(1-t_1) - L) + \frac{1}{1 + r(1-t_2)} R(1-t_2). \] (4)

If the individual does not go to university, he gets the discounted return:

\[ (w_1(1-t_1) - L) + \frac{1}{1 + r(1-t_1)} (w_2(1-t_2) - L). \] (5)

Subtracting the expression (5) from (4) above we see that living expenses and \(w_2\) cancel out, so the net after-tax return from going to university is just:

\[ - (T + M + w_1(1-t_1)) + S \frac{1}{1 + r(1-t_2)} R(1-t_2). \] (6)

Note the similarity to the earlier expressions for a physical investment. The net cost to an individual of attending university includes tuition, moving expenses, and the opportunity cost (after-tax) of not earning money for the four years one is in school. It does not include the cost of living at university, since living costs must be paid wherever you reside.
We can also work out the overall net benefits (including taxes paid to the government) of going to university. These are given by:

\[-(T + M + w_1) + \frac{R}{1 + r}\]  

(7)

We now want to find the subsidy $S$ that will ensure that the private net benefits of attending university (6) are zero whenever the overall benefits (7) are zero. This is the same principle used in calculating the tax treatment for investments in physical capital. In other words, whenever the overall benefit (including taxes paid to the government) of entering the labour force right out of high school, we want the after-tax benefits to be the same as well. This will ensure that university entrants are being treated exactly the same as non-entrants. A (fair) bit of algebra reveals that the subsidy

\[S = \frac{(T + M + w_1) t_2}{1 + r(1 - t_2)} - w_1 t_1\]  

(8)

will do the trick.

This expression looks complicated, but it is not that difficult to interpret. In the first term, the out-of-pocket costs of university ($T+M$) and the opportunity cost ($w_1$) are treated in exactly the same way as the costs of any physical investment — that is, they are subsidized at the same rate as the benefits are taxed. But the opportunity cost is itself subject to tax at the rate $t_1$. In other words, by taxing the opportunity cost of an education, the tax system already provides an implicit subsidy to students (i.e., it makes attending university more attractive). The second term in the expression corrects for this implicit subsidy. Note that to compute the optimal subsidy we do not need to predict the future earnings of the student, but only his or her tax bracket ($t_2$.

This corresponds to the case for physical investments above (expression 3), where the optimal subsidy was also independent of the return.

If the degree provides no increase in earning power then the benefits are not taxed. A bit of algebra here reveals that all we should do is correct for the implicit subsidy to students. To do this we need to put a surcharge of $w_1 t_1$ on top of full-cost tuition. Courses that do not increase future earnings should not be subsidized at all, but in fact should carry a surcharge.

**Some Illustrative Examples**

It will always be the case that some individuals learn more quickly than others, and the existence of the university system means this advantage at learning will lead to higher incomes in later life. In this sense a university system is never equitable. But a full tuition regime, by charging more to those who benefit most, will not reduce equity. As well, with the appropriate tax/subsidy policy, we can treat those who make investments in their education in the same way we treat those who invest in other things.

It may be useful to work out a few illustrative examples. The following tables are based on the figures in Stager (1996), which are in turn based on 1991 Canadian census data. All amounts have been inflated by 15 percent to reflect increases in the Consumer Price Index to 1997. Thus the cost figures in particular reflect university funding at 1990 levels in Ontario. These are based on actual tuition payments plus public funding per student, and do not include research support or other indirect costs. For this reason science programs appear no more expensive than those in arts. Incidentals include books, transportation, and supplies. Wage data are net of summer employment earnings but not taxes, and are inflated to reflect the fact that those students who attended university would have had higher than average earnings if they had entered the workforce. Taxes are direct (income) taxes only. In principle $t_1$ should be the average total tax bite on low incomes and $t_2$ the incremental tax paid on the return $R$. However, the calculated subsidy is most sensitive to ($t_2 - t_1$), so the use of direct tax rates does not affect the calculations greatly.
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TABLE 1
Costs of University

<table>
<thead>
<tr>
<th>Degree</th>
<th>Years</th>
<th>Tuition</th>
<th>Incidentals</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA(hon)</td>
<td>4</td>
<td>$8,234</td>
<td>$1,437</td>
</tr>
<tr>
<td>BSc(hon)</td>
<td>4</td>
<td>$8,234</td>
<td>$1,667</td>
</tr>
<tr>
<td>BEng</td>
<td>4</td>
<td>$10,414</td>
<td>$1,725</td>
</tr>
<tr>
<td>Med</td>
<td>6</td>
<td>$22,879</td>
<td>$2,070</td>
</tr>
</tbody>
</table>

TABLE 2
Alternative Wages

<table>
<thead>
<tr>
<th>Age</th>
<th>Wage Men</th>
<th>Taxes Paid</th>
<th>Wage Women</th>
<th>Taxes Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>$8,858</td>
<td>$546</td>
<td>$6,892</td>
<td>$212</td>
</tr>
<tr>
<td>20</td>
<td>$10,235</td>
<td>$966</td>
<td>$7,968</td>
<td>$369</td>
</tr>
<tr>
<td>21</td>
<td>$11,609</td>
<td>$1,387</td>
<td>$8,906</td>
<td>$702</td>
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<td>22</td>
<td>$12,980</td>
<td>$1,880</td>
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<td>$11,244</td>
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<td>$18,520</td>
<td>$3,352</td>
<td>$12,640</td>
<td>$1,779</td>
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<tr>
<td>4yr av</td>
<td>$10,923</td>
<td>$1,189</td>
<td>$8,405</td>
<td>$546</td>
</tr>
<tr>
<td>6yr av</td>
<td>$12,927</td>
<td>$1,791</td>
<td>$9,585</td>
<td>$887</td>
</tr>
</tbody>
</table>

With these data we can begin to work out the optimal subsidy levels for tuition payments. For the following calculations we take the interest rate to be 50 percent over the relevant time period (even this may be low since earnings stretch out for 40 years beyond graduation). We assume that subsidies will be the same for each year, and use the relevant averages. Since women high school graduates earn less than men, in principle they should get a lower subsidy to attend university. Nonetheless the figures below are worked out for men only.

- A degree in Arts costs $8,234 per year plus incidentals of $1,437 for a total of $9,671. We suppose that the returns to this degree will be taxed at the rate $t_2 = 0.4$, since Arts graduates may not face the highest marginal tax rate. Thus the expression $t_2/(1+r(1-t_2)) = (0.4)/(1.3)$. The subsidy $S$ works out to $(9,671 + 10,923)(0.4)/(1.3) - 1,197 = 5,139$. If the subsidy is paid directly to the university, then the student should pay tuition of $8,234 - 5,140 for a total of $3,094 per year. The student will also pay incidentals out of his own pocket, and forgoes his alternative wage.

- A degree in Science also costs $8,234 per year plus incidentals of $1,667. In this case the student might expect to be taxed at the highest marginal tax rate, which we take to be $t_2 = 0.5$. Thus the expression $t_2/(1+r(1-t_2)) = (0.5)/(1.25)$. In this case the subsidy works out to $(9,901 + 10,923)(0.5)/(1.25) - 1,197 = 7,123$. The student should pay $8,234 – $7,123 for a total of $1,111 per year, plus incidentals and the alternative wage.

- A medical education costs $22,897 per year, averaged over six years. Doctors will be taxed at the highest marginal rate, so we take $t_2 = 0.5$. The subsidy $S$ works out to approximately $(24,967 + 12,927)(0.5)/(1.25) - 1,791 = 13,367$ per year. Thus tuition should be set at the rate of $9,530 per year, averaged over the six years necessary to get the degree.

These examples illustrate the principle that the more a student is expected to earn in the future the higher should be the subsidy to his education. This may seem perverse, but remember that the payments received by the university are assumed to cover costs at the level of $1,990. As Stager (1996) points out, the average rate of return to degrees in Science is high and in Medicine very high.

It might be argued that it is these high rates of return that are the real source of inequity in the university system — access to this fabulous investment opportunity is restricted to those who do well at school. However, to resolve this issue properly we would need data on the return to a university education for the marginal student. Only if this is
excessive is there a case for raising everyone’s tuition levels. Otherwise we would want to raise tuition only for the intramarginal students, which is more complicated than it might seem. The intramarginal students are the ones who can best afford the costs (i.e., the rich ones), but also the ones with the most to gain (i.e., the best ones).

A move to a completely deregulated tuition regime along with the entry of new private universities would in the long run ensure that the private marginal return to an education meets the market alternative. It would also lead to US-style tuition levels at the more popular universities, and these might be expected to attract the richest and the best students (i.e., the intramarginal ones) who would then have to pay more. However, these students should still receive substantial subsidies.

• Suppose Canada were to move to a US-style system and tuition for a Science degree at some universities rose to $20,000 per year. In this case the required subsidy works out to $(21,667 + 10,923)(0.5)/(1.25) – $1,197 = $11,839. The student should pay $20,000 – $11,839 = $8,161 in tuition per year.

Finally, subsidies should also increase with the opportunity cost of the program. Consider the following example.

• A one-year Master’s program costs $10,000 per year plus incidentals of $2,000. In this case the alternative wage is higher, since the student already has a Bachelor’s degree, and the person will later be subject to the highest marginal rate. We take $w_f = $25,000, $t_f = 0.20$, and the subsidy works out to $(12,000 + 25,000)(0.5)/(1.25) – $(25,000)(0.20) = $9,800. This student should essentially go to school for “free” — i.e., he should pay only $200 in tuition fees.

Perhaps the most interesting aspect of all of these calculated subsidy levels is their generosity. For example, if the Arts major in the first example above were to consider a physical investment costing $9,671, the optimal subsidy would be $S = (0.4) C/(1.3) = $2,976. He gets a much larger yearly subsidy ($5,129) to attend university because to do so he has to forego earnings that are taxed at a lower rate than the returns to his degree.6

It is important to remember that under the subsidy scheme tuition costs are not tax deductible. All this money must be paid out of after-tax income. On the other hand, these numbers reflect the absolute minimum subsidy that should be given to students in order to ensure that they make efficient investments. We have made no provision at all for the external benefits of a university education.7

There might be different ways to achieve these outcomes. For example, if a student has parents who care about him and earn high incomes, we can charge the parents full-cost tuition, letting them deduct tuition plus ancillary expenses, and provide a subsidy (to the student, perhaps) based on the alternative wage and the progressiveness of the tax system. If a student is treated as an individual, then we could charge a fee equal to full-cost tuition minus the full subsidy above, and allow no deductions from post-university earnings. Foreign students, since they may be more likely to leave after graduation and escape taxation in Canada, should be charged full tuition but be allowed to deduct educational expenses from Canadian income if they elect to stay.

ACCESSIBILITY

There is some redistribution of income in the above model that is accomplished through a progressive tax system, and tuition subsidies must be designed to reflect this. Redistribution is ex post, however. Access to courses, whether or not they increase future income, may be restricted to those who can afford the costs, including the foregone income. Note that the practice of subsidizing a student’s investment in education, rather than allowing a tax deduction at a later time, by itself goes a long way
toward enhancing accessibility. In an ideal system, however, admission to university would be based entirely on the ability of the student to benefit from a university education, and have nothing to do with initial wealth.

Low tuition rates certainly make it easier for poorer students to attend university, and in this sense they do increase accessibility. However, there are other instruments that are better suited to this task. So long as the private rate of return to a degree is at least as high as the rate of interest, a program that allows students to borrow against their future income at competitive rates will provide perfect accessibility regardless of the cost of tuition. The problem is not straightforward because investments in human capital do not create an asset that a bank can repossess if a loan is defaulted. For this reason student loan programs are risky, and some government involvement is necessary. The efficient role for government may be just to monitor repayment through the income tax system. (An interesting and very thorough proposal along these lines is worked out by McDonough and Wright, 1998.)

There is not the space here to discuss student loan programs in any detail, but the basic principles are quite straightforward. Briefly, to fix ideas, suppose that the subsidy $S$ discussed above is given to the student in the form of a voucher that can be used to defray tuition expenses. Suppose as well that the amount of the subsidy has been increased to reflect the public benefits that we all receive when more of our fellow citizens become university educated. Nonetheless, there will still be some individuals who are unable to attend university even though they are qualified to do so. There seem to be three basic remedies, all with many potential variations.

- **Wealth Contingent Grants:** Under this scheme, students who qualify for postsecondary education must identify themselves and have their available personal and family wealth verified. If this is deemed to be low enough, the student would receive a direct grant in addition to the subsidy $S$.

- **Student Loans:** Under this scheme, any student who is admitted to university can borrow money without collateral to help defray the tuition and other costs that remain after the subsidy $S$. The government must guarantee the loan, and may subsidize the scheme further by paying the interest while the student is in university. Some students will discover after they graduate that they do not have the income to pay off their loan, and they may consider declaring personal bankruptcy.

- **Income Contingent Student Loans:** These are essentially the same thing as the basic student loan program, but the bankruptcy provisions are different. A student whose post-graduation earnings never rise above a threshold will never have to pay back the loan, and avoids the personal and reputational costs involved in declaring bankruptcy. On the other hand, the spectre of unpaid debts is never really lifted from their shoulders.

Obviously the direct grant scheme can be used in combination with either of the loan schemes. Grants to students from low-income families increase equity among students who are eligible to attend university. However, the loan schemes are more equitable when seen from the perspective of someone who does not have the skills to qualify for university. Remember that the tuition voucher $S$ already accounts (as best it can) for the external benefits of the university system. Those who never go to university should not be asked to pay more than this.

So long as anyone who qualifies for admission to university is eligible for a loan, either of the loan schemes above provides essentially universal access to degrees that are sure to increase future income. The income contingent scheme has a major benefit when the personal financial returns to a degree cannot be assessed with certainty. In this case it acts like a form of insurance against a personally unfortunate choice of program. However, it also provides
what may be an unwanted subsidy to degrees that are not expected to increase future income.

CONCLUSIONS

The issues of equity, efficiency, and accessibility are sometimes difficult to keep separate. However, they are not so closely linked that they cannot all be achieved at once. The key is to treat the problem of accessibility with loan programs, and to use tax policy to ensure that people who invest in human capital are treated the same as those who invest in physical capital. With enlightened policy, a full-cost tuition regime is consistent with equity, efficiency, and accessibility.

NOTES

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1 Recall we are assuming that there are no public benefits to a university education.

2 Under a full-tuition system this will be the average cost of providing the education, and will differ across programs. We work out some examples below.

3 All undergraduate degrees, even those without obvious market value, are associated with increased earnings later on in life.

4 See Stager (1996) for the details.

5 Stager (1996) assumes two years in Biology followed by four years in Medicine.

6 Boskin (1977) seems to be the first to emphasize the tax treatment of the opportunity cost to an education.

7 When educating a student provides external benefits $K$ (per student) to society at large, the subsidy should fully reflect these benefits — i.e., the optimal subsidy (8) becomes

$$S = K + \frac{(T + M + w_1)\tau_2}{1 + \tau(1 - \tau_2)} - w_1\tau_1.$$  

8 Stager (1996) shows that average rates of return for most programs are substantially higher than the rate of interest.

9 The subsidy could also be paid directly to the university, much as it is now. Since the value of the subsidy should vary with the program, this may be easier to implement.

10 In principle this extra amount should also vary by program.

11 It turns out (sparing the algebra) that these students should be allowed to deduct the interest on the loan from their post-graduation taxable income.

REFERENCES

