# The Impact of Cost on the Choice of University*

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April 2011

*The authors gratefully acknowledge the research assistance of Cesar Furtado and Olesya Vovk, the comments of Lynn Lethbridge and George Granger, and the support of the Social Sciences and Humanities Research Council, the Canadian Education Statistics Council, the Ontario Universities Application Centre, the Canadian Foundation for Innovation, the Ontario Innovation Trust, and McMaster University.

## 1. Introduction

A sizable number of recent Canadian studies have analyzed the likelihood of enrolment in university and the influence of cost in particular. Coelli (2009) reviews this literature and reports on the common failure to estimate a negative relationship between tuition fees and university enrolment. Coelli also analyzes this relationship using data from the Survey of Labour and Income Dynamics and finds that the impact of tuition on enrollment depends on family income. Increases in provincial tuition rates are associated with reduced university enrolment among the children of low-income parents but with constant or even increasing enrollment among the children of middle- and high-income parents.

A much smaller number of Canadian studies have analyzed the choice of university and no previous study of which we are aware has analyzed the impact of cost (to the student) on this decision. This paper provides the first such study. One reason for this small literature is that the provinces have historically regulated tuition and fees in such a way as to greatly limit price competition among institutions. In Ontario, all tuition fees were regulated prior to the mid-1990s. A subsequent deregulation process has permitted limited freedom to set fees in arts and science programs and greater freedom in professional programs. One consequence of this deregulation has been an increase in the variation in tuition and fees among universities.

Since the mid-1990s, a second factor has contributed to an increase in the variation in the effective cost of attending different Ontario universities. A growing number of institutions have made the decision to compete for academically strong entrants by establishing programs of guaranteed merit scholarships for incoming, and in some cases, continuing students. These programs guarantee a scholarship of $X to all registrants with a grade point average (GPA) between Y and Z. Between 1994 and 2005, Ontario had, for the purposes of admissions and financial aid, 19 universities.[1] In 1994 only five of these universities had

[1] Brock, Carleton, Guelph, Lakehead, Laurentian (including Algoma), McMaster, Nipissing, Ottawa, Queen's, Ryerson, Toronto (Mississauga), Toronto (St. George), Toronto (Scarborough), Trent, Waterloo, Western Ontario, Wilfred Laurier, Windsor, and York. Throughout this paper, we divide the University of Toronto into its three separate

guaranteed entry scholarships for students with a high school grade point average (GPA) of 80 to 90 and another eight universities had guaranteed entry scholarships for students with a GPA of 90 to 100. By 2005, fifteen (nineteen) of the 19 universities had guaranteed entry scholarships for students with a GPA of 80 to 90 (90 to 100) or more. In this paper, we use the term "net cost" of university to refer to the level of tuition and fees at a university minus the guaranteed entry scholarship to which a student with a given high school grade average would be entitled. During the past two decades, price competition (variation in net cost) among Ontario universities has increased due both to tuition and fee deregulation, and to the spread of guaranteed entry scholarships.

Ontario provides a good context in which to analyze the impact of net cost on the decision of which university to attend for several reasons. First, as indicated above, there has been substantial growth in the variation in net cost among institutions. Second, the Ontario university system is large, publicly-funded and quite self-contained. Ninety-five percent of undergraduate university students from Ontario are enrolled at Ontario universities and 95% of Canadian undergraduate students enrolled at Ontario universities are from Ontario (Statistics Canada 2008).[2] As a result, these institutions largely compete for the same pool of in-province students. Third, students apply for admission to Ontario universities via a centralized process and the authors have been granted access to these data for research purposes.

In this paper, we use twelve years of data from the Ontario Universities Application Centre to answer three questions. First, does lower net cost (relative to other Ontario universities) enable a school to attract a larger share of academically strong students from Ontario? Second, does the impact of net cost depend on the economic background of students as found by Coelli? Specifically, is lower net cost more successful in

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campuses in our analyses. We believe that this approach is clearly justified indicated by the differences in admissions procedures, merit aid programs and the academic records entering students at these campuses.

[2] For convenience, we use the term "Ontario university" to refer to the publicly-funded universities in the province. The two privately-funded universities in Ontario account for less than 1% of total enrollment in the province, a figure that was calculated by the authors from enrolment data provided on the websites of the private universities and the annual universities issue of Maclean's magazine.

attracting strong students from low income neighbourhoods than those from high income neighbourhoods? Third, what are the distributional implications of guaranteed entry scholarships? Specifically, are the students from high income neighbourhoods disproportionately likely to benefit from such scholarships due to a positive correlation between high school grades and economic background?

Why are these questions of interest? We believe that universities are especially interested in the first two questions. A policy of low net cost (low tuition and fees and/or generous guaranteed scholarships) limits the revenue available for many other uses including the quantity and quality of programs that may also be used to attract strong students. Does merit aid attract students or mainly create rents for those who would come anyway? Universities also generally prefer to attract a mix of students from different backgrounds for reasons of both educational quality and public image. Lower cost may attract strong students from low-income families but have little impact upon or even deter strong students from middle- or high-income families. If so, than price competition will alter the mix of students that a university attracts.

We believe that this paper is also of interest to the broader research and policy community. Effective access to university means not just a place at one institution but reasonable access to a range of institutions and programs. Hence, we believe there is more general interest in the extent to which the emergence of variation in the net cost of university has led (or not) to a reallocation of low and high income students to low and high net cost institutions respectively. There is also a clear general interest in the third of our questions. If high school grades and family income are strongly correlated among university registrants, then merit aid may, in effect, be creating a two tier structure that imposes higher costs of attending university on students from low income backgrounds.

The next section provides a review of the literature. We provide a discussion of theoretical considerations in Section 3. The empirical model and data are presented in Section 4. Our regression results are presented and discussed in Section 5. A summary and conclusion are in Section 6.

## 2. Literature Review

For an excellent review of the Canadian literature on the effects of tuition on the likelihood of enrolling in university, we refer the interested reader to Coelli (2009). Only three recent Canadian studies of which we are aware have examined the decision as to the choice of university at which to apply or enroll. Two of these studies used the university level data provided by the annual "Universities" issue of Maclean's magazine. Mueller and Rockerbie (2005) report that the annual rankings in Maclean's magazine have a significant impact on both total applications and high school grade averages among first year students at Ontario universities for the period 1994 through 2000. This effect was strongest for Medical/Doctoral universities and weakest for Primarily Undergraduate universities. Kong and Veall (2005) use similar measures for all Canadian universities over the period 1991 through 2004. They find that an increase in the Maclean's ranking is associated only weakly with an increase in high school grade averages among entering students at Medical/Doctoral universities and is not associated with increased enrolments at any category of university. Drewes and Michael (2004) use individual application data from the Ontario Universities Application Centre (OUAC) for Ontario students applying for admission in the 2001-2002 academic year. A low Maclean's ranking reduces applications from academically stronger students to Primarily Undergraduate universities but not at other institutions. They also report that applicants prefer universities that spend a larger proportion of their operating budget on scholarships and non-academic student services. To our knowledge, no prior papers have analyzed the impact of cost on the choice of Canadian university.[3]

## 3. Theoretical Considerations

[3] See Frenette (2005) for a study of fee deregulation in postgraduate professional programs such as law and medicine. There is a substantial literature on university merit aid in the U.S. such as the HOPE program in Georgia. The US programs are different in structure and purpose than the Ontario programs that are the subject of this paper. The US programs were established by state legislatures to boost participation in post-secondary education and encourage high ability students to stay in state. Merit aid in Ontario has been established by individual universities in order to attract a larger share of academically strong students almost all of whom will pursue post-secondary education in province. Hence we do not summarize the findings from the US literature here.

Equation (1) is a modified version of the provincial level demand for university education provided by Coelli (2009).

$$\text{Ln } [D/Pop] = B_0 + B_1 \ln(F) + B_2'X + B_3'Z + e_d \quad (1)$$

where D is the aggregate demand for places and Pop is the size of the cohort of school leaving age. The variable F is the cost to the student of attending university including tuition and fees net of scholarship aid, books and indicators of opportunity costs such as the unemployment rate. Vector X contains observable individual and family characteristics such as average parental income. Vector Z includes a vector of other variables which may influence the decision to attend university such as the average quality of university programs and the cost and quality of educational alternatives such as a college program of study.

Equation (2) is the provincial level supply function for university spaces provided by Coelli (2009).

$$\text{Ln } [S/Pop] = A_0 + A_1 \ln(F) + A_2'\ln[G/Pop] + B_3\ln(Pop) + e_s \quad (2)$$

where S is the aggregate supply of places and G is aggregate government funding for universities. Coelli (2009) points out that the data needed for identification of this model are generally lacking and most studies estimate a reduced form function such as he uses in Equation (3).

$$\text{Ln } [E/Pop] = C_0 + C_1 \ln(F) + C_2'X + C_3'Z + C_4\ln[G/Pop] + C_5\ln(Pop) + e_{ds} \quad (3)$$

where E is the provincial level of university enrollments.

Coelli estimated an individual level version of (3) using data from the Survey of Labour and Income

Dynamics to assess the impact of tuition fees on the likelihood of enrolling in university. Our focus is on the choice of university among academically strong students. An individual level approach would be to estimate a multinomial model of university choice using individual student observations from our OUAC data. We do not take this approach for the following reasons. First, we have very few characteristics of the individual students in our data set. Second, there are 19 publicly funded universities in Ontario which would mean estimating an unwieldy number of equations (18) and parameters. Third, our data sharing agreement prohibits the identification of individual universities thereby limiting a key benefit of the multinomial approach.

The empirical approach we adopt instead is to take the university as the individual unit of observation and to model the effect of institutional characteristics, especially cost to the student, on the share of academically strong registrants that the school is able to attract. Specifically we estimate an equation similar to that in (3) above in which "Ei" is the number of academically strong entering students at university 'i' and "Pop" is the total number of strong students entering all Ontario universities. The estimation method which we employ allows us to consider not only the effect of institutional characteristics but also that of the average income of the neighbourhood from which the students comes so as to test Coelli's finding for differences in the response to cost by the socioeconomic background of the student. We provide a more detailed specification in section 4.4 below.

Our empirical approach raises the question of why a university should seek to increase its share of strong students especially by offering such students a lower entry price. Most universities, like other not-for-profit organizations, have a non-distribution constraint, that is, revenues may exceed costs but there are no owners to whom the excess revenues are distributed. As with other nonprofits, there is also no single simple alternative to profit maximization. Existing models of university behaviour recognize that decisions may be influenced by the utility functions of the members of at least four different parties: trustees or governors, administrators, professional staff and students (Garvin 1980). Raines and Leathers (2003) point out that many decisions can be usefully explained in terms of a "convergence of elements" in the interests of those

parties. These same authors highlight institutional prestige as a common element in the utility functions of these four parties. Prestige can bring not only psychic but pecuniary rewards, for example; higher salaries for administrators, larger research grants for faculty and better jobs for graduates. Winston (1999), Clotfelter (1996) and James (1990) all also refer to the "pursuit of excellence" or "prestige maximization" as a key objective of universities. These authors also stress the positional aspect of this goal (relative status matters) and the common use of quantitative measures to establish rankings. Many quantitative measures are used including the value of research grants, numbers of citations and, of particular relevance for this paper, the university's ability to attract academically strong applicants and registrants.

Universities in Ontario compete for academically strong students for many specific reasons beyond general institutional prestige. Such students are more likely to enroll in honours programs which bring a higher subsidy from the Ontario government. Strong students are more likely to persist in their programs thereby lowering turnover costs. Such students are also often more pleasant to teach, help to teach weaker students, appeal to donors, and ultimately become more influential and affluent alumni.

Universities also compete for academically strong students in different ways. Tuition, fees and guaranteed merit aid are all forms of cost competition. Other forms of competition include the quality and variety of academic programs, guaranteed residency space, extracurricular activities, recreational facilities, etc. Universities and students are heterogeneous in their qualities and interests. Hence, heterogeneity in competition strategies is to be expected. As indicated in the Introduction, we expect that low cost strategies may appeal more strongly to students from less affluent backgrounds. Other strategies (class size, facilities, etc.) should appeal more strongly to students from more affluent backgrounds. Hence, one prediction from these assumptions is that an effective merit aid strategy should change the mix of the academically strong students that a university attracts along with, possibly, the overall proportion of such strong students in the province that attend the institution.

## 4. Data and Empirical Model

### 4.1 Tuition and Entry Scholarships Data

We have assembled information concerning tuition and mandatory fees from a variety of data sources including the Council of Ontario Universities, university web sites, and the Statistics Canada Survey of Tuition and Living Costs. For each university and year, the level of tuition and fees are identical for Arts programs and Science programs in any given university. Hence, we combine values for these two faculties in the figures below. The level of tuition and fees is higher in professional programs than in than Arts and Sciences. The tuition charges for Commerce and Engineering programs are not exactly the same but sufficiently similar that we have combined them as well in the figures below. Figure 1a provides the maximum, minimum and 25$^{th}$, 50$^{th}$ and 75$^{th}$ percentiles of tuition and fees for programs in the Arts (Humanities and Social Sciences) and Sciences in 2001 dollars. The dollar values of each of these characteristics of the distribution increased by about 50% over our data period. The range was $585 in 1994 and increased to $801 by 2005. (For the editor and referees, Table A-1 in the Appendix is the basis for these figures.) Figure 1b provides the same information for Commerce and Engineering. In this case, the effect of deregulation is more apparent. The values of both the 75$^{th}$ percentile and the maximum value double while the increase is just over 50% at the 50$^{th}$ percentile and below. The range grew from $1245 to $4002 and the inter-quartile range increased from $228 to $1777 which is much larger than the inter-quartile range of $265 for Arts and Sciences in 2005.

Financial support for students has a number of sources, some at the institutional level and some at provincial or national levels. Ontario students can apply to a single source, the Ontario Student Assistance Program (OSAP), for provincial and federal grants and loans. Students are awarded financial support based on costs, past student savings, student earnings and parental income. Loans are interest-free while the recipient is a student and repayable only after graduation or discontinuation of study. Awards are portable between universities and programs though a cost of living allowance is added for students at schools more

than 40 kilometers from home. There are also portable entry scholarships and bursaries provided by private donors.

Over our data period, Ontario universities increased financial aid from 3% to 10% of operating budgets (Maclean's 1994 through 2005) and new undergraduate scholarship support has often been in the form of guaranteed merit based scholarships. The federal and Ontario governments have also expanded the amounts of repayable and non-repayable (grants, bursaries and scholarships) aid available to university students. Ontario universities want to make sure that their merit aid programs truly lower the cost of attendance. Hence, both the universities and OSAP take strong steps to ensure that financial aid from these two sources supplement rather than replace each other. This is especially true in the case of non-repayable forms of aid. To this end, the formula used to determine the amount of repayable and non-repayable aid to which a student is entitled incorporates substantial exemptions for merit based entry awards. In almost all cases, a merit-based entry scholarship will not reduce the amount of non-repayable aid available from government sources.[4]

We have collected individual university scholarship data from a variety of sources including the annual INFO publication of the Ontario Universities Application Centre, the Maclean's Magazine Annual Report on Universities, individual university web sites, and personal communications with university administrators. The proportion of university budgets devoted to scholarships and bursaries increased from 3.1% on average in 1994 to 5.2% in 1999 and to 10.7% in 2005. Some of this increase was due to a requirement of the funding Ministry that tuition increases be accompanied by increased student support. The Ministry placed few restrictions, however, on the manner in which additional funds for scholarships were to be allocated.

As indicated in the Introduction, the number of universities that offer merit-based entry awards for students with a GPA of 80 to 90 rose from 5 in 1994 to 15 (out of a total of 19) in 2005 and the number with

[4] The principal exception would be a student who receives both a merit based entry scholarship from the university and a scholarship from some other non-governmental source. The current values of the exemptions for merit scholarships are $4400 for the federal and $3500 for provincial aid.

an award for students with a GPA of 90 to 100 rose from 13 to 19. At all institutions, the value of merit entry awards is the same across programs. There are considerable differences over time and across institutions in the dollar value of awards and in the grade categories for which these awards are made. Some institutions have had as many as five different categories of awards for GPAs between 80 and 100. As a means of condensing this information, we have calculated the expected value (2001 dollars) of a guaranteed entry scholarship for a student in the grade range of 80 to 90 and in the range of 90 to 100 at each university including those that offer no guaranteed merit aid.[5] This expected value takes into account both the award offered at each grade level (80, 81, 82 etc.) and the distribution in that range of the GPA's of students who actually register in the university.[6] (For the editor and referees, Table A-2 in the Appendix contains these values.) For the 80-90 grade range, the median scholarship (over all the universities) increased from $0 to $571 over our data period and the inter-quartile range grew from $216 to $954. In the 90-100 grade range, the median almost doubled from $1156 to $2023 but the inter-quartile range actually decreased from $1734 to $1067.[7]

Our central interest is in the effect of the cost to the student on which university to attend. The key variable that we use in our multivariate analysis is "net cost" of a program/university which we have defined as tuition and mandatory fees minus the expected value of a guaranteed entry scholarship for a student in each of our two grade ranges. The distribution of net cost across universities depends on three factors: the distribution of tuition and fees; the distribution of entry scholarships; and the correlation of tuition and fees with entry scholarships. Figure 2a provides the maximum, minimum and 25$^{th}$, 50$^{th}$ and 75$^{th}$ percentiles of net

[5] Universities differ in their cutoff points. For some institutions, 90 means 90.0 or better whereas for others this 90 means 89.5 or better. We have followed each university's policies in our calculations but, for simplicity, use the terms 80-90 and 90-100 in our text.

[6] We also calculated the expected value of these awards using a common distribution of GPA's. This common distribution was the average GPA distribution across all universities and years. The correlation between this alternative expected value and that used in the paper is 0.99. In other words, almost all of the variation in the expected value of an award is due to variation in the dollar value attached to different levels of GPA.

[7] In two different specifications, we regressed the proportion of university budgets devoted to scholarships and bursaries on the expected scholarship value in the 80-90 grade range and, in a separate regression, on the expected scholarship value in the 90-100 grade range along with university fixed effect and year fixed effects. The coefficients for the expected scholarship value in the 80-90 grade range were significantly positive but small in value. The coefficients for the expected scholarship value in the 90-100 grade range were positive but not significantly different from zero.

cost for students with a GPA of from 80 to 90 in the Arts and Sciences. (For the editor and referees, table A-3 in the Appendix is the basis for these figures.) Median net cost rose by about one-third over the period. The inter-quartile range increased from $398 to $1102 whereas the corresponding difference for tuition and fees only rose from $188 to $265. The range in net cost (maximum minus minimum) was little changed, however, at about $1800. Figure 2b provides the same information for Commerce and Engineering.[8] In this case, the inter-quartile range increased by almost $1700 from $336 to $2035 and the overall range by almost $3000 from $2401 to $5331. Figures 2c and 2d show the distribution of expected net costs for students in the 90 to 100 grade range. For Arts and Sciences, the inter-quartile range actually decreased slightly by about $300 from $1661 to $1364 but the range increased by over $1100 from $2292 to $3446. In the case of Commerce and Engineering, the inter-quartile range increased by almost $700 from $1596 to $2287 and the range increased by $3833 from $3119 to $6952. In summary, differences among universities in net cost grew more rapidly in Commerce and Engineering than in Arts and Sciences

### 4.2 Ontario University Application Data

All applicants to Ontario universities from Ontario high schools submit a common form to the Ontario Universities Application Centre in which they rank their choices of universities and programs. Both mature Ontario applicants and non-Ontario applicants follow a different application procedure, are relatively small in number, and come from very heterogeneous academic backgrounds. The application information and marks (provided directly by Ontario high schools) are forwarded by OUAC to each program and institution of choice, and OUAC later receives confirmation from the university, if any, at which the student has registered. Our OUAC data file contains information about applications and registrations at Ontario universities, high school grades, age, gender, and the student's postal code at the time of application.

[8] As in Figure 1b, we have combined the distributions for Commerce and Engineering because the individual distributions are so similar.

Our full OUAC data set contains the records of all Ontario high school students who applied for admission to start in the fall of 1994 through the fall of 2005.[9] The focus of this paper is on the choice of university at which to enroll and, hence, we analyze the subset of applicants who registered at an Ontario university during that time period. Over our sample period, the proportion of OUAC applicants in our sample who registered at an Ontario university was quite stable at approximately 70% for all applicants and at approximately 85% for all applicants with a grade average of 80 and over. Our data set does not include Ontario high school graduates who register at a university outside of Ontario or who postpone enrolment in university. As indicated in the Introduction, only 5% of Ontarians who are enrolled in a Canadian university attend a university in a different province (Statistics Canada 2008). Data concerning the number of Canadian students who enroll in university abroad are not readily available. However, the 2006 Census revealed that only 2% of Canadians whose highest degree is a BA degree earned that BA degree outside of Canada. (Honours Thesis, Rose Chen UBC Economics.) Hence, we believe our data capture the overwhelming majority of all Ontaria high school graduates who proceed directly to university.[10]

We did restrict our sample in two additional ways. We restricted our sample to those registrants who were students in high schools that offered the standard academic curriculum and to those registrants who registered initially in a full-time degree program. These two restrictions eliminated only 3.1% of registrants leaving a sample of 537,801. The restriction to schools with the standard academic curriculum means that we exclude students from such heterogeneous educational backgrounds as adult education centers, treatment schools, night schools, and special education schools. Our sample includes students from the public school system, the publicly-funded Catholic school system and the small number of privately-funded high schools. The purpose of our restriction to registrants in full-time degree programs was to focus on students with relatively homogeneous educational aspirations.

[9] Merit aid is not limited to students from in province but, given the closed nature of the system, the main purpose of the scholarships is to attract a larger share of the academically strong students from Ontario to the individual institution.
[10] See Table 1 below for trends in the proportion of 19 year olds in Ontario who register at an Ontario university.

Our data period witnessed a major secondary curriculum change in Ontario that shortened the number of years of high school for university bound students from five years to four for the majority of students. This resulted in two cohorts of high school students having a normal high school graduation date in June of 2003 (commonly known as the "double cohort" year). Under the pre-2003 system, students would normally progress to university after 13 years of schooling, but outstanding students could proceed after 12 years and some students would take 14 years. After the curriculum change, it became very difficult to graduate before the normal time of 12 years but it was still possible and not uncommon to take an extra year.

Table 1 provides summary statistics on our OUAC sample. Column 2 indicates that the number of new registrants was relatively stable in the 1990s but started to increase markedly in 2002 both in absolute terms and as a percent of 19 year olds (see column 3) with what appears to be the arrival of an unusually large number of students who completed an academic high school degree in only four years under the old system to avoid the "double cohort" year. The number of registrants declines after 2003 but remains substantially above the levels at the turn of the century. The number of registrants in 2004 (relative to 2001 or even to 2002) likely reflects some students who postponed registration for a year in order to avoid the big entry cohort of 2003. The effect of the double cohort is also shown in Column 3 where the ratio of registrants to 19 year-olds grew from about 26% to 30% from the beginning to the end of the periood.

Columns 4 and 5 of Table 1 demonstrate the increasing proportions of students being awarded high school grade averages of 80% or better and 90% or better.[11] This suggests some grade inflation given that the same or an increasing fraction of the relevant age group registers each year (except for the 2003 to 2004 drop after the double cohort year). The noticeably improved grades in the double cohort year of 2003 likely reflect both increased selectivity as universities make offers to the better applicants and some additional

[11] Grade averages (GPAs) are calculated from grades submitted by the high schools to the Application Centre. These are calculated as the average of the best 6 courses needed for university admission in Ontario.

grade inflation. That the higher marks seem concentrated in the 80-90 range and not in the 90-100 range suggests that it is mainly selection.[12]

### 4.3 Neighbourhood Income Data

Two of the three questions that we are considering in this paper require information about the socioeconomic background of students. The OUAC data do not contain family income information but they do contain the student's postal code at the time of application and this can be linked to the Enumeration Area (EA) of the family in the 1996 Census and the Dissemination Area (DA) of the family in the 2001 and 2006 Censuses. The EA/DA is a relatively stable geographic unit with a population of 400 to 700 persons and is the smallest standard geographic area for which all Canadian census data are disseminated. We use the characteristics of the residents of an EA/DA to represent the characteristics of the applicant's family.

In order to consider socioeconomic differences among OUAC applicants and registrants, we first calculated the equivalent average household income in each EA/DA in each of our three Census years.[13] We then used linear interpolation to derive a value of equivalent average household income for each EA/DA in each of our sample years, 1994 through 2005. Some postal codes cross EA/DA boundaries and we associated such postal codes with that EA/DA which contains the largest proportion of the population of the postal code. This process allowed us to associate each entering student in our OUAC sample with a single EA/DA.

For our empirical model, it was most convenient to derive a categorical measure of equivalent average household income and we chose to classify students as having a home residence that is in a low-,

[12] If teachers were giving better grades to 'help' students in the double cohort year one might have expected the increases to have been seen throughout the distribution.

[13] Equivalent average household income is equal to average household income divided by the square root of the average number of persons per household in the EA/DA. This is analogous to a commonly used measure of equivalent household income, specifically, household income divided by the square root of the number of persons in the household.

middle- or high-income EA/DA. For the purpose of deriving tercile cutoffs, we used all postal codes in Ontario and not just the subset of postal codes in which the OUAC students reside. In each of the three Censuses, we set tercile cutoffs using the 33rd and 67$^{th}$ percentiles of the distribution of all postal codes in Ontario when ranked by equivalent average household income. We then used linear interpolation to derive a value for these cutoffs in each of our sample years. This allowed us to categorize each student (based on her or his postal code) in our OUAC data as residing in a low-, middle- or high-income in the year in which the student registered at university.

We use these income terciles to answer the third of the three questions that we pose in this paper which concerns the distribution of the benefits of merit aid across students from different socioeconomic backgrounds. The top row of Table 2 shows that 40% of all Ontarians aged 15-24 lived in low-income DA's and 35% in high-income DA's in 2001. The second panel of Table 2 shows that only 20% to 25% of registrants in our data set come from a low-income EA/DA and 46% to 48% come from a high-income EA/DA.

The forgoing demonstrates the unsurprising finding that university registrants do indeed come disproportionately from higher income neighbourhoods. But what of access to merit aid, given university registration? Are the affluent more favoured among the population of university students? The third and fourth panels of Table 2 reveal that the distributions by neighbourhood income of either students with grade averages of 90 to 100 or of students with grade averages from 80 to 90 (that is, recipients of merit aid) are very similar to the distribution of all registrants in the second panel above. Registrants with the highest grades (90-100) are only slightly more likely (1 to 4 percentage points) to come from high income neighbourhoods than are all registrants. The sharpest difference by far in Table 2 is between university registrants and all persons age 15-24. Merit aid does favour more economically privileged students in Ontario but only because such students are more likely to attend university. Conditional upon registration, the differences in the proportions of students from low-income and high-income areas that would qualify for a merit-based entry scholarship at a given university are small. (The same is true of applicants.) A different

picture might be painted, of course, by a data set with information on other forms of financial aid and/or individual family income.

### 4.4 Empirical Model

As indicated in Section 2, we wish to estimate a reduced form equation similar to equation (3) in which the share of academically strong entering students in a given university in a given year is a function of net cost to the student (tuition and fees minus any merit scholarship) and other variables. Our first decision was to estimate separate regressions by academic program and grade level. We estimated separate regressions for registrants in Arts, Science, Commerce and Engineering for the following reasons. First, many academically strong students commonly apply to more than one university but our data show that less than 20% apply to more than one of the foregoing programs. In other words, competition for these accomplished students takes place primarily within these four program categories. Second, Figures 1 and 2 demonstrate that these four programs differ substantially in terms of tuition, fees and net cost. The programs also differ in terms of entering grade distributions. For example, engineering programs have both the highest net costs and the registrants with the highest grades. For this reason alone, a regression combining all programs might spuriously indicate that high net cost attracts more strong students.[14]

We also estimated separate regressions for the grade categories 80-90 and 90-100. The value of the merit awards is typically larger, up to three times as large, for students in the higher grade range. Even more importantly, the relationship between grades and merit aid awards differs noticeably across universities.

[14] Arts, Science, Commerce and Engineering are by far the largest categories in the classification system for academic programs recognized by OUAC. However, there are other categories such as Architecture, Nursing, Education and Agriculture. In the regressions reported below, we have assigned all registrants in our sample to one of our four basic programs. For example, Nursing and Agriculture registrants were reassigned to Science and Architecture registrants were reassigned to Engineering. We have also estimated the same regressions using only those registrants whose initial classification was one of Arts, Science, Commerce and Engineering. These more narrowly defined samples yielded very similar regression estimates to those reported below.

Hence, one gets a more accurate measure of the relative size of offers being made to students by different institutions by disaggregating the data into the above two grade ranges.[15]

Table 3 illustrates the distribution of student shares (the proportion of students who enrol at given universities) by program and grade level in 1994 and 2005. The data for other years show a similar pattern. The mean share for Arts, Sciences and Commerce is 5.3% (which is one divided by the number of universities or 19). The mean share for Engineering is either 7.7% or 7.1% (depending on the year) because five universities do not have this program and one initiated its first Engineering program in 2001. The most noticeable difference by program is that Engineering students are more concentrated than students in other programs even when one accounts for the fact that there are fewer Engineering programs. Another result not shown in Table 3 is that there are frequent changes across years in the ordering of the universities by share of students including which university occupies first place.[16] A final characteristic of the dependent variable demonstrated by Table 3 is that the absolute value of these shares of students varies considerably across universities and, hence, we use the natural logarithm of this proportion as the dependent variable in our regressions.

We wish to include two types of independent variables in our regressions. The first type of variable reflects institutional characteristics. The most important of these, for our research purposes, is net cost which varies by university, year, faculty and grade level (see Figure 2). We also include three other university level variables. One is a binary variable equal to 1 if the university offers guaranteed entry scholarships in the relevant grade category (80-90 and 90-100) and equal to 0 otherwise. In the course of collecting and

[15] We have considered estimating separate regression for clusters of universities. We looked for such clusters by tabulating the second and third place choices among all students whose first choice was a given university. For no university, does the most common second choice account for more than 40% of the second choices. For only two universities, does the most common second choice account for more than 30% of the second choices. For only one university, do the three most common second choices account for more than 60% of the second choices. Furthermore, these tabulations often reveal asymmetry, that is, university X is clearly most common second choice among students who put university Y in first place but university Y is a far less common second choice among students who chose university X first. In sum, the data do not indicate that the applications generally break down into well defined clusters of competing universities.

[16] We remind the reader that our data sharing agreement prohibits the identification of individual universities.

checking our data on guaranteed entry scholarships, it was often mentioned by the university administrators that the attraction of these scholarships for students is two-fold. The scholarships both lower net cost and provide prestige. This binary variable is intended to capture the prestige factor. Over our sample period, the proportion of universities with a guaranteed entry scholarship program increased from 32% to 61% for the 80-90 grade range and from 68% to 100% for the 90-100 grade range. The final two university level variables which we use are the proportion of the operating budget that the university spends on scholarships and bursaries and the proportion of the operating budget that the university spends on student services. The values of these last two measures, which vary only by university and year, were taken from the annual Maclean's issue on Canadian universities. Over our sample period, the mean values increased from 3.1% to 10.7% for scholarships and from 4.5% to 6.3% for student services.[17]

The second type of independent variable in which we are interested is a characteristic not of the university but of the neighbourhood (EA/DA) of the student's home residence. We wish to test Coelli's (2009) finding that students from low-income backgrounds respond differently to variations in cost than do students from high-income backgrounds. Hence, we must incorporate this student-level characteristic (strictly speaking neighbourhood-level characteristic) into our analysis. We do so by partitioning the students in our data set by neighbourhood average (equivalent) income tercile in addition to partitioning by other characteristics.

We calculate the student shares (the dependent variable) as follows. Within each combination of year, program (arts, science, commerce and engineering) and grade range (80-90 or 90-100), we calculate the

[17] As noted in Section 2, three previous papers have used the rankings of universities by Maclean's magazine in their analyses. We do not do so for three reasons. First, the Maclean's rankings are within three categories: Medical/Doctoral, Comprehensive and Primarily Undergraduate. There is no ranking of universities across the categories. That is why two of the papers cited in Section 2 used rankings within categories and the third analysed the impact of changes in rank. We do not believe that either strategy is appropriate for our analysis. Our data reveal that students very commonly apply to universities from two or all three of the Maclean's categories. In addition, we focus on the cost of attending different institutions. Students are concerned with the level of such costs and not recent changes therein. Second, the Maclean's rankings are quite stable over our data period. We wish to include a university fixed effect in our regressions to control for unobserved and unchanging institutional characteristics. These fixed effects and the Maclean's rankings are quite collinear. Third, we have divided the University of Toronto into its three separate campuses for our analysis. We believe that this approach is clearly justified indicated by the separate admissions procedures and differences in standards among entering students at these campuses. Maclean's, however, does not provide separate rankings for these three campuses.

distribution of student shares by university and income tercile. More specifically, for each combination of, university and income tercile, we calculate

$Prop_{ijt}$ = proportion of the annual total of registrants in the $t^{th}$ year who are at the $i^{th}$ university, and in the $j^{th}$ neighbourhood income category (high, middle, low) or more formally,

$Prop_{ijt} = Reg_{ijt} / (\Sigma_{ij} Reg_{ijt})$ where Reg stands for the number of registrants.

These data are then used to estimate the following regression equation for each of two grade ranges (80-90 and 90-100) and four academic programs (Arts, Science, Commerce and Engineering):

$$Ln\ (Prop)_{ijt} = \beta_0 + \beta_1\ Relative\ Net\ Cost_{it} + \beta_2\ Relative\ Net\ Cost_{it} \times Low\ Income + \beta_3\ Relative\ Net\ Cost_{it} \times High\ Income + \beta_4\ Scholarship_{it} + \beta_5\ Low\ Income + \beta_6\ High\ Income + \beta_7\ Prop\ Scholarships_{it} + \beta_8\ Prop\ Student\ Services_{it} + \beta_9 `U_i + \varepsilon_{ijt} \quad (4)$$

where

Relative Net $Cost_{it}$ = net cost (tuition plus mandatory fees minus expected[18] value of a guaranteed entry scholarship) at the $i^{th}$ university in the $t^{th}$ year relative to the provincial average of this variable for the same year, program and grade range).

$Scholarship_{it}$ = binary variable equal to 1 if the university offers a guaranteed entry scholarship and equal to 0 otherwise.

Low Income = binary variable equal to 1 for students from low neighbourhood-income categories and equal to 0 otherwise.

High Income = binary variable equal to 1 for students high neighbourhood-income categories and equal to 0 otherwise

Relative Prop Scholarship $_{it}$ = proportion of the operating budget of the university spent on scholarships and bursaries at the $i^{th}$ university in the $t^{th}$ year relative to the provincial average of this variable for the same year.

Relative Prop Student $Services_{it}$ = proportion of the operating budget of the university spent on student services at the $i^{th}$ university in the $t^{th}$ year relative to the provincial average of this variable for the same year.

$U_i$ = vector of binary variables for each university (save that in omitted case), the estimates for which are not reported in this paper due to the nature of our data sharing agreement.

$\varepsilon_{ijt}$ = error term

[18] See the earlier discussion in Section 4.1 for the meaning of 'expected' in this context.

The interactions between net cost and the binary variables for low and high neighbourhood income reflect our expectation that students from low-income areas respond differently to cost than do students from high-income areas. The absence of year dummies is due to the nature of our dependent variable which is the share of registrants within a given year. These shares always add to 100% in any year and, hence, the average value cannot rise or fall over time. [19] In each year and grade range, there are 57 observations (19 universities and 3 income categories) for Arts, Science and Commerce. Engineering has 39 observations (13 universities) prior to 2001 and 42 observations (14 universities) thereafter.

For summary statistics on these variables, please see Table 3 (dependent variable), Figure 2 (net cost), and Table 2 (neighourhood income). The sample means for the entry scholarship dummy variables are 47% for the 80-90 grade range and 84% for the 90-100 grade range. The sample means for the proportions of operating budget spent on scholarships and students services are 7.1% and 5.4% respectively. Note that in the regressions we measure these latter two (Maclean's) variables relative to the provincial average for that year just as with the net cost variable. This reflects our model's focus on the decision of which university to attend and not whether to attend university.

Before proceeding to the regression results, it is appropriate to discuss several limitations of our analysis. As stressed in Section 3, universities compete for academically strong students in many ways only one of which is net cost. Alternative competitive strategies include other types of scholarships and bursaries, the quality and diversity of academic programs, co-op programs, and many non-academic features of university life such as preferred access to student housing, athletic and social facilities, exchange programs, etc. All such lures are costly and a decision to spend more on entry scholarships must, at least in the short run, lead to tradeoffs with other costs or services. As indicated above, our expectation is that net cost would be more effective in attracting students from lower income backgrounds. The corollary of this expectation is

[19] Note that we do not encounter a singularity problem and have had no difficulty in estimating our model using Stata. Our model has just one equation in which the shares of students across universities add to 1. This is unlike a typical consumer demand model, where one is estimating a series of equations (one for each type of good) in which the same set of independent variables (prices and income) appear on the right hand side of each share equation. The observed goods shares for each consumer add to 1 across equations and it is this that creates a singularity.

that students from higher income backgrounds will give relatively greater weight to the other features of university life listed above. Indeed, Coelli (2009) found that higher tuition may increase the likelihood of enrollment among students from middle or high income families. One reason for this may be that higher tuition reflects higher quality programs.

One shortcoming of our analysis is that we do not have measures for the factors listed in the preceding paragraph that may likely influence student enrolment decisions. For example, we do not have controls for the average awards of other types made to students at different grade levels. All we know are the value of the guaranteed (and hence clearly advertised) merit awards and the proportion of the university's operating budget that is allocated to scholarships and bursaries.[20] One concern is that those universities with no merit aid (or awards with relatively low value) may be compensating by making relatively large non-guaranteed awards to strong applicants. If true, then the estimated impact of guaranteed merit awards should be weaker or harder to discern. Reliable measures of other factors that influence enrolment decisions such as the quality and variety of academic programs and non-academic services are also hard to come by. Coelli (2009), for example, had no measures of financial aid, programs and services and his analysis is typical of the Canadian literature.

A second shortcoming of our analysis is that of possible endogeneity, that is, a university may decide to initiate or enrich entry scholarships as a consequence of a declining share of academically strong students. In constructing our data set we have been careful to match the timing of the variables so as to minimize this problem, i.e., the net cost variable is based on the tuition, fees and scholarships that students would have observed at the time of application. Both of these problems, incomplete measures of university

[20] We would very much like to have incorporated additional information on sources of aid other than guaranteed entry scholarships. Unfortunately, such information is not reported to OUAC and would have to come from the administrative files of each of the 19 universities. The task of assembling such a data set poses formidable challenges even given university consent and such permission is highly unlikely to be given at all or even most institutions. Hence, the best available control for sources of aid other than guaranteed entry scholarships is the Maclean's measure of the proportion of the operating budget of the university spent on scholarships and bursaries.

characteristics other than merit aid and endogeneity, also characterize the Canadian papers discussed in Section 2 and the U.S. literature.

The era of growing price competition among Ontario universities was initiated by the partial deregulation of university tuition and fees in Ontario. This policy change took place, however, prior to the period for which data are available and is therefore of limited use in identifying our parameter estimates. We also considered the use of a regression discontinuity estimation strategy. As explained in section 4.1, however, there are considerable differences over time and across institutions in the dollar value of awards and in the grade categories for which these awards are made. Some institutions have had as many as five different categories of awards for GPA's between 80 and 100. Hence, this strategy was not applicable.

## 5. Regression Estimates

We report the regression results for registrants in Arts and Sciences programs in Table 4 and for registrants in Commerce and Engineering in Table 5. For each program, we report the results for the registrants with a high school average in the 80-90 range in columns 1, 2 and 3, and the results for the registrants with a high school average in the 90-100 range in columns 4, 5, and 6. The first specification assumes that net cost has a similar effect across all income groups of students. The second specification allows net cost to have a different effect across the three income groupings (low, middle, and high). The third specification allows for interactions and also includes the binary variable for the presence of a guaranteed entry scholarship program. As indicated above, we have measured the dependent variable in natural logarithms due to the wide variations in the scale of the shares between larger and smaller universities. The p-values are in parentheses. In the text, we shall refer to estimates with a p-value of 0.10 or less as "significant" (though in the tables we identify as well the 0.05 and 0.01 p-values as well).

Our main interest is in the cost coefficients. Hence, we begin with a discussion of these results for Arts and Sciences in Table 4 focusing initially on the estimates of the simplest specification in columns 1

and 4. Neither coefficient is significant for Arts whereas this estimate is positive and significant for Science students in the 80-90 grade range and negative and significant for Science students in the 90-100 grade range. The instability in the net cost coefficient in our simplest model may reflect the fact that the impact of this variable differs by the economic background of the student. Hence, we turn the estimates in columns 2 and 5 that allow net cost to have a different effect across income categories.

The coefficient on net cost (row 1) reflects the effect of a change in the relative net cost for registrants that is common to all income categories and, given our specification, the total net cost effect for students from middle income neighborhoods. The additional net cost effect for students from low income is the interaction coefficient in Row 6 while the additional effect for students from high income neighborhoods is the interaction coefficient reported in Row 8. We report the total net cost effect for low income students (Row 1 plus Row 6) in Row 7 and the total net cost effect for high income students (Row 1 plus Row 8) in Row 9. In Row 10, we report the difference between the high and low income interaction coefficients (Row 8 minus Row 6) which reflects the impact of net cost on the relative proportions of students coming from the most affluent and the least affluent neighbourhoods.

The interaction coefficients for low income neighbourhoods in Row 6 are usually negative but significant only in the case of Arts students in the 80-90 grade range. In contrast, the interaction coefficients for high income neighbourhoods in Row 8 are all positive and significant. Hence, a consistent difference is that the impact of net cost among students from high income neighbourhoods, who represent almost one-half of the sample, is more positive than among students from middle and low income neighbourhoods. Row 10 reveals that the difference between the interaction terms for high income and low income students is also positive and usually significant.

What of the total net cost effects? The total net cost effects for low income students in Row 7 is usually negative but significant only in the case of Science students in the 90-100 grade range (the Arts p-values are “close”). In contrast, the total net cost effects for high income students in Row 9 are all positive and usually significant. Why would net cost have a positive effect on the share of students that register at a

university? As discussed in Section 2, all studies in this literature, including this one, have few controls for the quality of academic programs and other services provided by universities and for scholarships other than guaranteed merit aid. Hence, universities with lower merit aid awards might be channeling more funds towards services that high income students value highly, e.g., smaller classes, better facilities, etc. Another possibility is that universities without guaranteed merit scholarships are allocating financial aid in a way that favours high income students such as extracurricular activities or civic involvement. We do include the Maclean's measures of the proportions of the operating budget devoted to scholarships and student services but these are very approximate indicators of program quality and other features of student life.[21] Moreover, the net cost coefficients change little if either or both of these Maclean's variables are excluded from the regression.

Another interesting finding from Table 4 is that the net cost effect common to all students in Row 1 is positive though not significant for students in the 80-90 grade range but negative and significant for students in the 90-100 grade range. One reason for this finding may arise from differences in the likelihood of renewing an entry scholarship. Dooley, Payne and Robb (2011) study OUAC data which is linked to administrative data from four Ontario universities that account for about 30% all university students in Ontario. These data indicate that student grade averages tend to decline by about ten percentage points on average between the last year of high school and the first year of university. Many (though not all) guaranteed entry scholarships are renewable but such renewals usually require a university grade average of at least 80. As a result, the likelihood of retaining a merit-based scholarship beyond year one is much higher for students with a 90-100 high school grade average than it is for students with a 80-90 high school grade average. Hence, the negative response to variation in net costs exhibited by the 90-100 students in Table 4 may reflect the fact that these students are responding to multi-year differences in net costs among universities in contrast with the 80-90 students many of whom may be anticipating only a one-year merit scholarship.

[21] Maclean's does have measures of class size but, unfortunately, these measures are not consistent over our data period.

What is the impact of adding the dummy variable for the existence of guaranteed entry scholarship program in columns 3 and 6 of Table 4? The coefficient estimates for this variable are generally small and non-significant. The one exception is the positive and significant effects for Science students in the 90-100 grade range. In this case, the addition of the scholarship dummy causes the net cost coefficient in Row 1 to become non-significant. This is understandable because the two variables are highly correlated.

What of the coefficients for the variables other than net cost and the scholarship dummy in Table 4? Rows 2 and 3 contain estimates for the binary variables indicating that the student comes from a low income or high income neighbourhood. Assessing these coefficients is most easily done by observing the estimates of the model without interaction terms in columns 1 and 4. (When there are interaction terms, the coefficients in Rows 2 and 3 reflect the impact of living in a low income or high income neighbourhood when net cost is zero which is clearly a very unrealistic value.) In columns 1 and 4, the low income coefficients are all negative and significant ranging in value from -0.209 to -0.700. The high income coefficients are all positive and significant (with one exception) ranging in value from 0.144 to 0.372. These estimates imply that registrants from low income neighborhoods, other things equal, constitute a share of students that is from 20% to 70% smaller than that of the students from middle-income neighborhoods.[22] Registrants from high income neighborhoods, other things equal, constitute a share of students that is from 14% to 37% larger than that of the students from middle-income neighborhoods. The coefficients for the proportion of operating budgets spent on scholarships and the proportion spent on student services are mixed in sign but not statistically significant in all but one instance. As indicated above, excluding these two Maclean's variables from the regression has little impact on the coefficients for the net cost variable and interactions.

In summary, the estimates in Table 4 offer an uncertain answer to our first question concerning the overall impact of net cost on the share of strong students that a university can attract. Our second question concerned differences among students in the impact of net cost. Table 4 provides a robust answer to this

[22] These refer to proportionate changes in a number that is expressed in percentage points.

question. An increase in net cost is associated with an increase in the ratio of the share of students from high income neighborhoods to the share of students from middle income and low income neighborhoods.

We turn now to the estimates for Commerce and Engineering in Table 5. The net cost coefficients in the simplest model in Columns 1 and 4 are varying in sign as in Table 4 and significant only for Engineering students in the 90-100 grade range. Hence, we turn again to the estimates in columns 2 and 5 that allow net cost to have a different effect across the three income groupings.

The interaction terms for students from low income neighbourhoods in Row 6 are usually negative as expected but never significant. The interaction terms for students from high income neighbourhoods in Row 8 are usually positive as expected but also never significant. Row 10 reveals that the difference between the interaction terms for high income and low income students is always positive as expected but significant only in the case of Engineering students in the 80-90 grade range. Hence, the estimates for students in the professional programs, unlike those in Arts and Sciences, do not indicate that an increase in net cost is associated with an increase in the ratio of the share of students from high income neighborhoods to the share of students from middle income and low income neighborhoods.

The rest of the findings in Table 5 and similar to those in Table 4. The coefficient estimate for the guaranteed scholarship binary variable (Row 11 and Columns 3 and 6) are generally small and non-significant save for the case of Commerce students in the 90-100 grade range. In this case, as with Science students in the 90-100 grade range, the addition of the scholarship dummy causes the net cost coefficient in Row 1 to become non-significant. The common net cost coefficient in Row 1 is more negative for students in the 90-100 grade range than for students in the 80-90 grade range. Here too, the stronger negative response to variation in net costs exhibited by the students in the 90-100 grade range may reflect the fact that these students are, in effect, being offered multi-year scholarships as opposed to the students in the 80-90 grade range. The coefficients for the low income binary variables in the simple model (Row 2 and Columns 1 and 4) are significantly negative whereas the coefficients for the high income binary variables in the simple

model (Row 3 and Columns 1 and 4) are significantly positive. The coefficients for the proportions of the operating budget spent on scholarships and students services (Rows 4 and 5) are mostly not significant.

We undertook two sensitivity tests of the models in Tables 4 and 5 in order to check for the possibility that the double cohort influenced our results. In the first test, we estimated our models using data restricted to the years prior to the (high school) graduation of the "double cohort", that is, 1994 through 2002. In the second test, we created a binary variable for the "double cohort period" of 2002 through 2004 (the double cohort year plus the year on either side). We then estimated a model which included interaction terms between this double cohort variable and each of the university binary variables. In both of these cases, the estimates of both coefficients and standard errors were very similar to those in Tables 4 and 5.

## 6. Summary and Conclusion

Over the past two decades, deregulation has led to large increases in university tuition in Ontario especially in professional programs such as Commerce and Engineering. Other Canadian papers have analyzed the impact of the cost (to the student) on the likelihood of enrollment in university. This paper provides the first Canadian study of the link between cost and the choice of university. Tuition hikes in Ontario were accompanied by substantial increases in financial aid often in the form of guaranteed merit scholarships. This form of financial aid was not the norm at Ontario universities in the mid-1990s but now is offered by most of these institutions. Over this period there have been increases not only in the average value of such scholarships but in the variation among universities in the value of such merit aid. As a result of both fee deregulation and the spread of merit scholarships, there has been a substantial increase in the differences among Ontario universities in "net cost" defined as tuition and mandatory fees minus the expected value to an academically strong student of a guaranteed entry scholarship.

We use data from the Ontario Universities Application Centre on student registrations from 1994 through 2005 to examine three questions. Does a lower net cost enable an Ontario university to attract a

greater share of academically strong high school students? Does the impact of net cost on choice of university vary by the socioeconomic background of the student? Is merit aid of disproportionate benefit to students from more privileged socioeconomic backgrounds?

With regard to the first question, our regression estimates indicate no systematic relationship between net cost and the overall share of strong applicants that a university is able to attract. The net cost coefficients are unstable across programs and grades ranges which may reflect the fact that the effect of this variable differs across students from different backgrounds as posited by the second question above. In this regard, the regression estimates indicate that an increase in net cost is associated with an increase in the proportion of students from high-income areas relative to the proportion from either low income or middle income areas but only among students in Arts and Sciences programs. No such impact of net cost on the type of student attracted is observed among Commerce and Engineering students.

In answer our third question, the data reveal that university registrants do indeed come disproportionately from higher income neighbourhoods. Conditional upon university registration, however, the differences in the proportions of students from low-income and high-income neighbourhoods that qualify for a merit-based entry scholarship at a given university is only one or two percentage points. Hence, among those students who make it to university, merit aid does not appear to be of disproportionate benefit to those from more economically advantaged backgrounds.

Further research on this topic is well warranted. Our findings would clearly be enhanced by additional controls for the characteristics of both universities and the characteristics of students and their families. It would also be very helpful to have data beyond registration that permitted one to assess the impact of merit aid on student progress once in university.

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| Table 1 | | | | |
|---|---|---|---|---|
| **Year One Registrants at Ontario Universities** | | | | |
| (1) | (2) | (3) | (4) | (5) |
| Year | Number of Registrants | Registrants / 19 year olds* | % Registrants with GPA 80+ | % Registrants with GPA 90+ |
| | | | | |
| 1994 | 38972 | 27% | 50% | 9% |
| 1995 | 38199 | 26% | 52% | 9% |
| 1996 | 38933 | 27% | 53% | 10% |
| 1997 | 38386 | 27% | 55% | 11% |
| 1998 | 38928 | 26% | 55% | 11% |
| 1999 | 41138 | 27% | 55% | 12% |
| 2000 | 40250 | 26% | 57% | 13% |
| 2001 | 42101 | 26% | 57% | 13% |
| 2002 | 49168 | 30% | 59% | 14% |
| 2003 | 68958 | 41% | 66% | 15% |
| 2004 | 50552 | 30% | 62% | 13% |
| 2005 | 52216 | 31% | 62% | 14% |

*Number 19 year olds is from Statistics Canada Intercensal Projections.

| Table 2 | | | |
|---|---|---|---|
| **Distribution of Registrants by Neighbourhood Average Income:** | | | |
| **Overall and by Grade Category** | | | |
| (1) | (2) | (3) | (4) |
| **Year** | **Low Income*** | **Middle Income*** | **High Income*** |
| | | | |
| **All Persons Age 15-24 in 2001 Census** | | | |
| | 40% | 25% | 35% |
| | | | |
| Year | **All Registrants** | | |
| 1994 | 24% | 35% | 42% |
| 1995 | 23% | 34% | 42% |
| 1996 | 23% | 35% | 42% |
| 1997 | 23% | 34% | 43% |
| 1998 | 22% | 34% | 44% |
| 1999 | 22% | 34% | 45% |
| 2000 | 22% | 34% | 44% |
| 2001 | 22% | 34% | 45% |
| 2002 | 21% | 34% | 46% |
| 2003 | 20% | 33% | 47% |
| 2004 | 21% | 33% | 47% |
| 2005 | 20% | 33% | 47% |
| | | | |
| Year | **Registrants with GPA 90+** | | |
| 1994 | 21% | 33% | 46% |
| 1995 | 20% | 34% | 46% |
| 1996 | 21% | 34% | 45% |
| 1997 | 21% | 32% | 47% |
| 1998 | 21% | 32% | 47% |
| 1999 | 20% | 32% | 48% |
| 2000 | 19% | 33% | 48% |
| 2001 | 19% | 33% | 48% |
| 2002 | 19% | 32% | 49% |
| 2003 | 19% | 32% | 49% |
| 2004 | 19% | 33% | 48% |
| 2005 | 20% | 32% | 48% |
| | | | |
| Year | **Registrants with GPA 80-90** | | |
| 1994 | 23% | 34% | 43% |
| 1995 | 22% | 34% | 44% |
| 1996 | 22% | 34% | 44% |
| 1997 | 22% | 33% | 45% |
| 1998 | 21% | 33% | 45% |
| 1999 | 21% | 33% | 46% |
| 2000 | 20% | 34% | 46% |
| 2001 | 21% | 33% | 46% |
| 2002 | 20% | 33% | 47% |
| 2003 | 19% | 33% | 48% |
| 2004 | 20% | 33% | 47% |
| 2005 | 20% | 33% | 47% |

*High, Middle and Low are defined by the 33rd and 67th percentililes of the distribution of postal codes by the equivalent average income of the Census Dissemination Area with which the postal code is associated.

| Table 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Distribution of Student Shares by Grade Level, Program and Year** | | | | | | | | | | | |
| | | Percentiles | | | | | | Percentiles | | | |
| | Min | 25th | 50th | 75th | Max | | Min | 25th | 50th | 75th | Max |
| | Arts 80-90 | | | | | | Arts 90+ | | | | |
| 1994 | 0.6% | 2.2% | 4.2% | 6.2% | 17.3% | | 0.0% | 9.9% | 4.3% | 7.1% | 15.6% |
| 2005 | 1.0% | 2.2% | 5.4% | 6.6% | 13.7% | | 1.1% | 13.6% | 3.6% | 7.9% | 14.9% |
| | Science 80-90 | | | | | | Science 90+ | | | | |
| 1994 | 0.2% | 1.4% | 3.4% | 11.6% | 14.8% | | 0.1% | 0.9% | 2.2% | 9.9% | 22.3% |
| 2005 | 0.4% | 1.7% | 3.7% | 8.6% | 14.8% | | 0.4% | 1.0% | 2.6% | 9.0% | 19.1% |
| | Commerce 80-90 | | | | | | Commerce 90+ | | | | |
| 1994 | 0.1% | 2.0% | 4.4% | 8.4% | 17.1% | | 0.0% | 0.7% | 2.3% | 12.2% | 22.3% |
| 2005 | 0.4% | 1.6% | 4.9% | 8.9% | 11.7% | | 0.0% | 0.6% | 1.8% | 9.3% | 19.1% |
| | Engineering 80-90 | | | | | | Engineering 90+ | | | | |
| 1994 | 0.5% | 4.6% | 7.1% | 10.3% | 20.0% | | 0.2% | 1.8% | 3.5% | 7.2% | 34.1% |
| 2005 | 0.2% | 2.0% | 5.7% | 9.6% | 26.1% | | 0.2% | 0.8% | 2.3% | 8.0% | 36.7% |

**Table 4**

**Regressions for Impact of Net Cost on the Share of Registrants: Arts and Science**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | | (1) | (2) | (3) | (4) | (5) | (6) |
| | Faculty | **Arts** | | | | | | | **Science** | | | | | |
| | Grade Range | | **80-90** | | | **90-100** | | | | **80-90** | | | **90-100** | |
| (1) | Net Cost Relative To Provincial Average | 0.401 | 0.074 | 0.176 | -0.271 | -0.387* | -0.149 | | 0.825** | 0.421 | 0.553 | -0.390*** | -0.577*** | -0.537*** |
| | | (0.11) | (0.76) | (0.48) | (0.29) | (0.09) | (0.51) | | (0.03) | (0.20) | (0.17) | (0.00) | (0.01) | (0.01) |
| (2) | Low Income Census Area | -0.489*** | -0.015 | -0.015 | -0.700*** | -0.616** | -0.616** | | -0.371*** | -0.359 | -0.359 | -0.343*** | -0.520** | -0.520** |
| | | (0.00) | (0.88) | (0.88) | (0.00) | (0.03) | (0.03) | | (0.00) | (0.36) | (0.36) | (0.00) | (0.02) | (0.02) |
| (3) | High Income Census Area | 0.296*** | -1.156*** | -1.156*** | 0.345*** | -0.087 | -0.087 | | 0.144*** | -1.078* | -1.078* | 0.324*** | -0.057 | -0.057 |
| | | (0.00) | (0.00) | (0.00) | (0.00) | (0.67) | (0.67) | | (0.00) | (0.09) | (0.09) | (0.00) | (0.74) | (0.74) |
| (4) | Proportion of Operating Budget Spent on | 0.077 | 0.077 | 0.089* | -0.298 | -0.298 | -0.127 | | 0.085 | 0.085 | 0.101 | 0.127 | 0.127 | 0.156 |
| | Scholarships Relative to Provincial Average | (0.17) | (0.17) | (0.08) | (0.12) | (0.12) | (0.35) | | (0.45) | (0.45) | (0.43) | (0.29) | (0.29) | (0.26) |
| (5) | Proportion of Operating Budget Spent on | 0.083 | 0.083 | 0.075 | 0.265 | 0.265 | 0.101 | | -0.002 | -0.002 | -0.012 | -0.004 | -0.004 | -0.031 |
| | Student Services Relative to Provincial Average | (0.35) | (0.35) | (0.37) | (0.27) | (0.27) | (0.64) | | (0.99) | (0.99) | (0.92) | (0.99) | (0.99) | (0.91) |
| (6) | Interaction of Net Cost with Low Income | | -0.473*** | -0.473*** | | -0.084 | -0.084 | | | -0.012 | -0.012 | | 0.178 | 0.178 |
| | Dissemination Area | | (0.00) | (0.00) | | (0.75) | (0.75) | | | (0.97) | (0.97) | | (0.44) | (0.44) |
| (7) | Net Cost plus Low Income Interaction | | -0.399 | -0.297 | | -0.471 | -0.233 | | | 0.409 | 0.541 | | -.399*** | -0.359*** |
| | (1) + (7) | | (0.14) | (0.27) | | (0.19) | (0.46) | | | (0.36) | (0.29) | | (0.00) | (0.02) |
| (8) | Interaction of Net Cost with HIgh Income | | 1.453*** | 1.453*** | | 0.431** | 0.431** | | | 1.221** | 1.221** | | 0.381* | 0.381* |
| | Dissemination Area | | (0.00) | (0.00) | | (0.04) | (0.04) | | | (0.05) | (0.05) | | (0.05) | (0.05) |
| (9) | Net Cost plus High Income Interaction | | 1.527*** | 1.629*** | | 0.044 | 0.282 | | | 1.642** | 1.774** | | -0.196 | -0.156 |
| | (1) + (9) | | (0.00) | (0.00) | | (0.87) | (0.26) | | | (0.02) | (0.02) | | (0.16) | (0.21) |
| (10) | High Income Interaction minus Low | | 1.926*** | 1.926*** | | 0.515** | 0.515** | | | 1.233* | 1.233* | | 0.203 | 0.203 |
| | Income Interaction (9) - (7) | | (0.00) | (0.00) | | (0.04) | (0.04) | | | (0.09) | (0.09) | | (0.25) | (0.25) |
| (11) | Guaranteed Entry Scholarship Program | | | 0.052 | | | 0.742* | | | | 0.067 | | | 0.123 |
| | | | | (0.36) | | | (0.06) | | | | (0.31) | | | (0.30) |
| | Number of observations | 684 | 684 | 684 | 684 | 684 | 684 | | 684 | 684 | 684 | 684 | 684 | 684 |
| | R Squared | 0.87 | 0.89 | 0.89 | 0.67 | 0.67 | 0.68 | | 0.86 | 0.86 | 0.86 | 0.83 | 0.83 | 0.83 |
| | P values in parentheses | *p<0.10, **p<0.05, ***p<0.01 | | | | | | | | | | | | |

**Table 5**

**Regressions for Impact of Net Cost on the Share of Registrants: Arts and Science**

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) | | (1) | (2) | (3) | (4) | (5) | (6) |
| | Faculty | **Commerce** | | | | | | | **Engineering** | | | | | |
| | Grade Range | | **80-90** | | | **90-100** | | | | **80-90** | | | **90-100** | |
| (1) | Net Cost Relative To Provincial Average | 0.298 | 0.366 | 0.363 | -0.174 | -0.262* | -0.135 | | 0.406 | 0.430 | 0.194 | -0.935*** | -0.920*** | -0.763** |
| | | (0.18) | (0.20) | (0.20) | (0.15) | (0.06) | (0.27) | | (0.57) | (0.62) | (0.79) | (0.00) | (0.00) | (0.03) |
| | | | | | | | | | | | | | | |
| (2) | Low Income Census Area | -0.404*** | -0.074 | -0.074 | -0.447** | -0.534** | -0.534** | | -0.209** | 0.522 | 0.522 | -0.349*** | -0.181 | -0.181 |
| | | (0.00) | (0.79) | (0.79) | (0.02) | (0.04) | (0.04) | | (0.03) | (0.32) | (0.32) | (0.00) | (0.33) | (0.33) |
| | | | | | | | | | | | | | | |
| (3) | High Income Census Area | 0.366*** | 0.238 | 0.238 | 0.081 | -0.095 | -0.095 | | 0.307*** | -0.354 | -0.354 | 0.372*** | 0.249 | 0.249 |
| | | (0.00) | (0.40) | (0.40) | (0.56) | (0.73) | (0.73) | | (0.01) | (0.62) | (0.62) | (0.00) | (0.45) | (0.45) |
| | | | | | | | | | | | | | | |
| (4) | Proportion of Operating Budget Spent on | 0.226* | 0.226* | 0.224* | -0.367** | -0.367** | -0.195 | | 0.135 | 0.135 | 0.093 | -0.296 | -0.296 | -0.244 |
| | Scholarships Relative to Provincial Average | (0.09) | (0.09) | (0.10) | (0.03) | (0.03) | (0.20) | | (0.40) | (0.40) | (0.64) | (0.19) | (0.19) | (0.35) |
| | | | | | | | | | | | | | | |
| (5) | Proportion of Operating Budget Spent on | 0.113 | 0.113 | 0.115 | 0.504 | 0.504 | 0.359 | | 0.226 | 0.226 | 0.227 | 0.191 | 0.191 | 0.165 |
| | Student Services Relative to Provincial Average | (0.49) | (0.49) | (0.49) | (0.13) | (0.13) | (0.26) | | (0.50) | (0.50) | (0.50) | (0.48) | (0.49) | (0.52) |
| | | | | | | | | | | | | | | |
| (6) | Interaction of Net Cost with Low Income | | -0.330 | -0.330 | | 0.086 | 0.086 | | | -0.738 | -0.738 | | -0.170 | -0.170 |
| | Dissemination Area | | (0.19) | (0.19) | | (0.43) | (0.43) | | | (0.11) | (0.11) | | (0.21) | (0.21) |
| | | | | | | | | | | | | | | |
| (7) | Net Cost plus Low Income Interaction | | 0.036 | 0.036 | | -0.176 | -0.049 | | | -0.308 | -0.544 | | -1.09*** | -0.933*** |
| | (1) + (7) | | (0.89) | (0.90) | | (0.33) | (0.74) | | | (0.67) | (0.33) | | (0.00) | (0.01) |
| | | | | | | | | | | | | | | |
| (8) | Interaction of Net Cost with High Income | | 0.128 | 0.128 | | 0.176 | 0.176 | | | 0.668 | 0.668 | | 0.124 | 0.124 |
| | Dissemination Area | | (0.59) | (0.59) | | (0.35) | (0.36) | | | (0.29) | (0.29) | | (0.68) | (0.68) |
| | | | | | | | | | | | | | | |
| (9) | Net Cost plus High Income Interaction | | 0.494* | 0.491* | | -0.086 | 0.041 | | | 1.098 | 0.862 | | -0.796** | -0.639* |
| | (1) + (9) | | (0.06) | (0.06) | | (0.60) | (0.76) | | | (0.16) | (0.14) | | (0.05) | (0.09) |
| | | | | | | | | | | | | | | |
| (10) | High Income Interaction minus Low | | 0.458 | 0.458 | | 0.09 | 0.09 | | | 1.406** | 1.406** | | 0.294 | 0.294 |
| | Income Interaction (9) - (7) | | (0.14) | (0.14) | | (0.69) | (0.69) | | | (0.03) | (0.03) | | (0.34) | (0.34) |
| | | | | | | | | | | | | | | |
| (11) | Guaranteed Entry Scholarship Program | | | -0.015 | | | 0.535** | | | | -0.130 | | | 0.205 |
| | | | | (0.80) | | | (0.01) | | | | (0.45) | | | (0.40) |
| | | | | | | | | | | | | | | |
| | Number of observations | 684 | 684 | 684 | 684 | 684 | 684 | | 483 | 483 | 483 | 483 | 483 | 483 |
| | R Squared | 0.82 | 0.82 | 0.82 | 0.71 | 0.71 | 0.71 | | 0.78 | 0.78 | 0.78 | 0.77 | 0.77 | 0.77 |
| | P values in parentheses | *p<0.10, **p<0.05, ***p<0.01 | | | | | | | | | | | | |

Table A-1a (background for editor and referees)

Tuition and Fees for Arts and Sciences (CDN$2001)

| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
|---|---|---|---|---|---|---|---|---|
| 94 | 2982 | 2975 | 2730 | 2860 | 3048 | 3315 | 188 | 585 |
| 95 | 3194 | 3154 | 2997 | 3140 | 3290 | 3530 | 150 | 532 |
| 96 | 3690 | 3658 | 3453 | 3630 | 3779 | 4010 | 149 | 557 |
| 97 | 3962 | 3915 | 3724 | 3849 | 4037 | 4253 | 188 | 529 |
| 98 | 4247 | 4224 | 3985 | 4132 | 4354 | 4595 | 223 | 611 |
| 99 | 4521 | 4487 | 4220 | 4393 | 4626 | 4873 | 233 | 653 |
| 00 | 4562 | 4520 | 4304 | 4444 | 4724 | 4941 | 280 | 637 |
| 01 | 4526 | 4504 | 4278 | 4416 | 4570 | 4933 | 154 | 655 |
| 02 | 4543 | 4539 | 4303 | 4467 | 4597 | 4930 | 130 | 627 |
| 03 | 4569 | 4551 | 4245 | 4424 | 4746 | 4949 | 322 | 704 |
| 04 | 4499 | 4459 | 4165 | 4372 | 4644 | 4928 | 272 | 763 |
| 05 | 4444 | 4411 | 4080 | 4311 | 4576 | 4882 | 265 | 801 |
| | | | | | | | | |
| | | | | | | | | |

Table A-1b

Tuition and Fees for Commerce and Engingeering (CDN$2001)

| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
|---|---|---|---|---|---|---|---|---|
| 94 | 3107 | 3071 | 2730 | 2968 | 3196 | 3975 | 228 | 1245 |
| 95 | 3321 | 3290 | 2997 | 3152 | 3395 | 4363 | 244 | 1366 |
| 96 | 3833 | 3806 | 3453 | 3658 | 3955 | 4962 | 297 | 1509 |
| 97 | 4117 | 4078 | 3724 | 3915 | 4211 | 5253 | 296 | 1530 |
| 98 | 4440 | 4399 | 3985 | 4231 | 4595 | 5559 | 364 | 1574 |
| 99 | 4878 | 4781 | 4220 | 4487 | 5030 | 6237 | 543 | 2017 |
| 00 | 4971 | 4795 | 4304 | 4598 | 5231 | 6362 | 633 | 2058 |
| 01 | 5146 | 4904 | 4278 | 4570 | 5753 | 6537 | 1183 | 2259 |
| 02 | 5272 | 4920 | 4303 | 4597 | 5896 | 7176 | 1299 | 2873 |
| 03 | 5580 | 4954 | 4245 | 4613 | 6469 | 8393 | 1857 | 4148 |
| 04 | 5491 | 4864 | 4165 | 4511 | 6371 | 8219 | 1860 | 4054 |
| 05 | 5414 | 4823 | 4080 | 4530 | 6307 | 8082 | 1777 | 4002 |
| | | | | | | | | |

| Table A-2a (background for editor and referees) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Expected Scholarship 80-90 for All Programs (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 1994 | 171 | 0 | 0 | 0 | 216 | 1156 | 216 | 1156 |
| 1995 | 166 | 0 | 0 | 0 | 211 | 1128 | 211 | 1128 |
| 1996 | 257 | 0 | 0 | 0 | 561 | 1111 | 561 | 1111 |
| 1997 | 313 | 0 | 0 | 0 | 770 | 1091 | 770 | 1091 |
| 1998 | 472 | 209 | 0 | 0 | 1021 | 1598 | 1021 | 1598 |
| 1999 | 615 | 700 | 0 | 0 | 1060 | 1567 | 1060 | 1567 |
| 2000 | 726 | 879 | 0 | 212 | 1093 | 1524 | 881 | 1524 |
| 2001 | 721 | 858 | 0 | 144 | 1182 | 1478 | 1038 | 1478 |
| 2002 | 715 | 841 | 0 | 141 | 1158 | 1448 | 1018 | 1448 |
| 2003 | 609 | 631 | 0 | 137 | 955 | 1291 | 818 | 1291 |
| 2004 | 566 | 582 | 0 | 135 | 916 | 1448 | 782 | 1448 |
| 2005 | 632 | 571 | 0 | 132 | 1086 | 1467 | 954 | 1467 |
| | | | | | | | | |
| Table A-2b | | | | | | | | |
| Expected Scholarship 90-100 for All Programs (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 1994 | 956 | 1156 | 0 | 0 | 1734 | 2139 | 1734 | 2139 |
| 1995 | 933 | 1128 | 0 | 0 | 1692 | 2087 | 1692 | 2087 |
| 1996 | 1049 | 1111 | 0 | 0 | 1906 | 2446 | 1906 | 2446 |
| 1997 | 1416 | 1500 | 0 | 660 | 2182 | 2728 | 1522 | 2728 |
| 1998 | 1676 | 1730 | 0 | 865 | 2354 | 3243 | 1490 | 3243 |
| 1999 | 1977 | 1818 | 0 | 961 | 2807 | 4770 | 1846 | 4770 |
| 2000 | 2047 | 2062 | 0 | 1547 | 2730 | 4640 | 1184 | 4640 |
| 2001 | 1873 | 2000 | 0 | 1500 | 2645 | 4000 | 1145 | 4000 |
| 2002 | 1836 | 1960 | 0 | 1470 | 2593 | 3920 | 1123 | 3920 |
| 2003 | 1802 | 1910 | 0 | 1433 | 2346 | 3820 | 914 | 3820 |
| 2004 | 1801 | 1954 | 0 | 1406 | 2343 | 3748 | 937 | 3748 |
| 2005 | 1921 | 2023 | 223 | 1379 | 2446 | 3676 | 1067 | 3453 |

| Table A-3a (background for editor and referees) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Net Cost 80-90 for Arts and Sciences (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 94 | 2811 | 2957 | 1574 | 2597 | 2995 | 3315 | 398 | 1741 |
| 95 | 3027 | 3154 | 1870 | 2812 | 3238 | 3530 | 426 | 1659 |
| 96 | 3433 | 3638 | 2402 | 3136 | 3738 | 4010 | 602 | 1608 |
| 97 | 3649 | 3915 | 2682 | 3035 | 4024 | 4128 | 989 | 1446 |
| 98 | 3775 | 4165 | 2396 | 3111 | 4284 | 4427 | 1173 | 2030 |
| 99 | 3906 | 3969 | 2704 | 3290 | 4487 | 4801 | 1197 | 2096 |
| 00 | 3836 | 3744 | 2780 | 3359 | 4466 | 4764 | 1107 | 1984 |
| 01 | 3806 | 3751 | 2875 | 3313 | 4446 | 4717 | 1133 | 1842 |
| 02 | 3828 | 3771 | 2901 | 3323 | 4403 | 4719 | 1080 | 1818 |
| 03 | 3959 | 3841 | 2954 | 3649 | 4551 | 4750 | 902 | 1796 |
| 04 | 3933 | 3957 | 2898 | 3581 | 4459 | 4644 | 878 | 1746 |
| 05 | 3812 | 3897 | 2751 | 3298 | 4401 | 4576 | 1102 | 1825 |
| | | | | | | | | |
| Table A-3b | | | | | | | | |
| Net Cost 80-90 for Commerce and Engineering (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 94 | 2958 | 2975 | 1574 | 2860 | 3196 | 3975 | 336 | 2401 |
| 95 | 3175 | 3238 | 1870 | 3043 | 3391 | 4363 | 348 | 2493 |
| 96 | 3603 | 3658 | 2402 | 3225 | 3916 | 4962 | 690 | 2560 |
| 97 | 3832 | 3992 | 2682 | 3441 | 4189 | 5253 | 748 | 2572 |
| 98 | 4000 | 4204 | 2396 | 3381 | 4503 | 5559 | 1121 | 3162 |
| 99 | 4282 | 4389 | 2704 | 3598 | 4801 | 6237 | 1203 | 3532 |
| 00 | 4285 | 4270 | 2780 | 3669 | 4764 | 6362 | 1095 | 3582 |
| 01 | 4468 | 4122 | 2875 | 3510 | 5219 | 6537 | 1709 | 3662 |
| 02 | 4597 | 4119 | 2901 | 3530 | 5248 | 7176 | 1718 | 4275 |
| 03 | 5012 | 4376 | 2954 | 3820 | 5661 | 8393 | 1841 | 5440 |
| 04 | 4957 | 4292 | 2898 | 3820 | 5792 | 8219 | 1972 | 5321 |
| 05 | 4808 | 4167 | 2751 | 3704 | 5740 | 8082 | 2035 | 5331 |
| | | | | | | | | |

| Table A-3c (background for editor and referees) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Net Cost 90-100 for Arts and Sciences (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 94 | 2026 | 1981 | 856 | 1199 | 2860 | 3148 | 1661 | 2292 |
| 95 | 2261 | 2213 | 1097 | 1486 | 3148 | 3335 | 1663 | 2238 |
| 96 | 2641 | 2402 | 1191 | 1788 | 3658 | 3806 | 1870 | 2615 |
| 97 | 2547 | 2435 | 1057 | 1901 | 3376 | 4023 | 1475 | 2965 |
| 98 | 2571 | 2554 | 742 | 1785 | 3339 | 4311 | 1554 | 3570 |
| 99 | 2544 | 2725 | -283 | 1665 | 3639 | 4555 | 1974 | 4838 |
| 00 | 2515 | 2558 | -120 | 1812 | 3074 | 4516 | 1262 | 4636 |
| 01 | 2653 | 2545 | 570 | 1868 | 3096 | 4463 | 1228 | 3893 |
| 02 | 2707 | 2574 | 649 | 1878 | 3148 | 4467 | 1269 | 3819 |
| 03 | 2766 | 2674 | 926 | 2160 | 3118 | 4518 | 959 | 3593 |
| 04 | 2698 | 2593 | 908 | 1985 | 3053 | 4417 | 1068 | 3509 |
| 05 | 2523 | 2544 | 908 | 1649 | 3014 | 4353 | 1364 | 3446 |
| | | | | | | | | |
| Table A-3d | | | | | | | | |
| Net Cost 90-100 for Commerce and Engineering (CDN$2001) | | | | | | | | |
| | mean | p50 | min | p25 | p75 | max | p75-p25 | max-min |
| 94 | 2197 | 2257 | 856 | 1379 | 2975 | 3975 | 1596 | 3119 |
| 95 | 2432 | 2469 | 1097 | 1639 | 3154 | 4363 | 1515 | 3266 |
| 96 | 2847 | 3002 | 1191 | 1970 | 3739 | 4962 | 1769 | 3771 |
| 97 | 2705 | 2524 | 1057 | 2029 | 3376 | 5253 | 1347 | 4196 |
| 98 | 2806 | 2793 | 742 | 2233 | 3347 | 5559 | 1114 | 4817 |
| 00 | 3013 | 2820 | -42 | 2218 | 3717 | 6362 | 1499 | 6404 |
| 01 | 3337 | 2957 | 570 | 2409 | 4525 | 6519 | 2116 | 5949 |
| 02 | 3499 | 3043 | 649 | 2480 | 4743 | 7176 | 2264 | 6527 |
| 03 | 3846 | 3084 | 926 | 2387 | 4857 | 8162 | 2470 | 7236 |
| 04 | 3741 | 3005 | 908 | 2245 | 4824 | 7992 | 2579 | 7083 |
| 05 | 3526 | 2837 | 908 | 2113 | 4401 | 7859 | 2287 | 6952 |

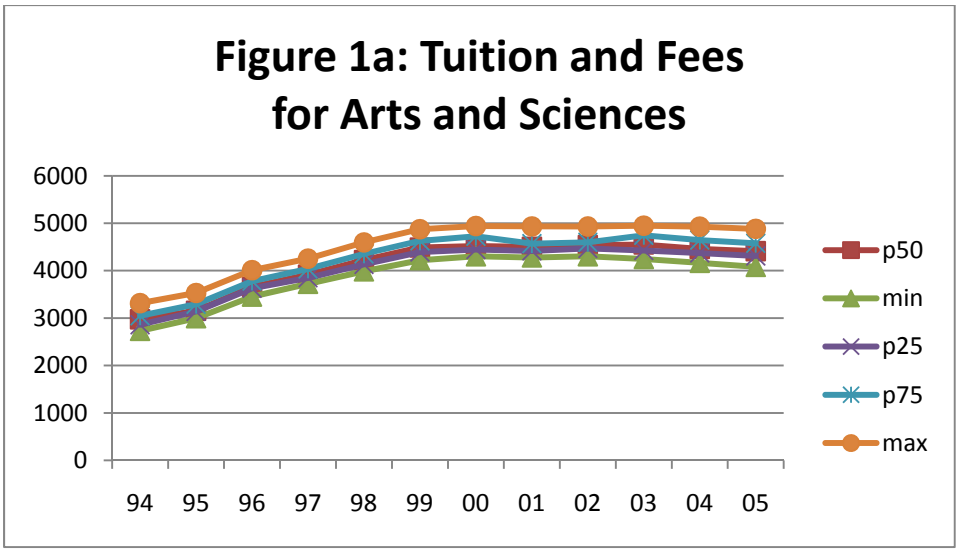


Figure 1a: Tuition and Fees for Arts and Sciences
6000
5000
4000
3000
2000
1000
0
94
95
96
97
98
99
00
01
02
03
04
05
p50
min
p25
p75
max

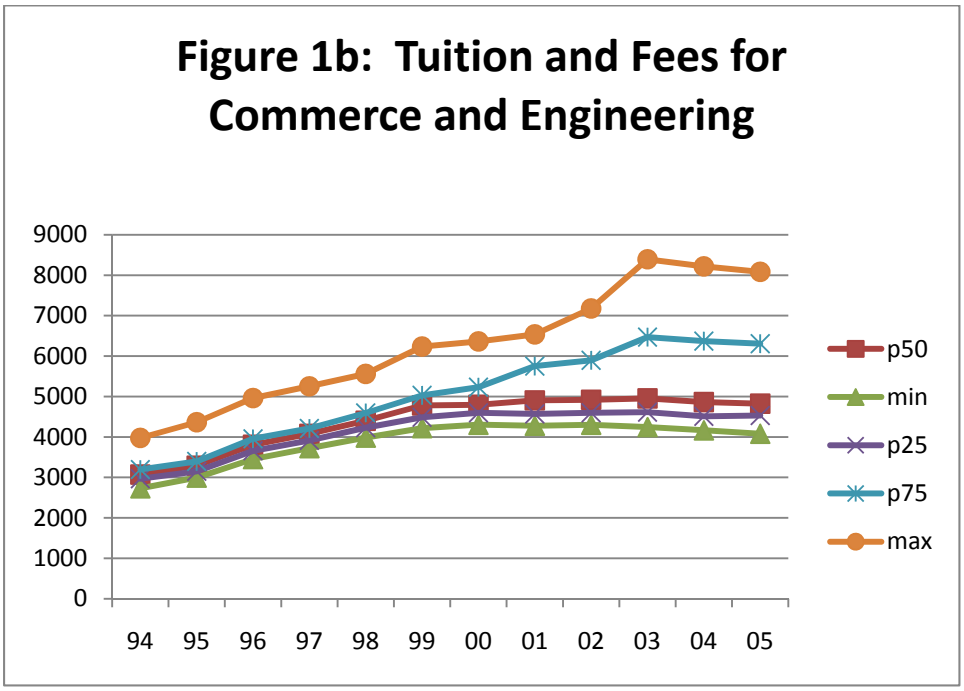


Figure 1b: Tuition and Fees for Commerce and Engineering
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
94
95
96
97
98
99
00
01
02
03
04
05
p50
min
p25
p75
max

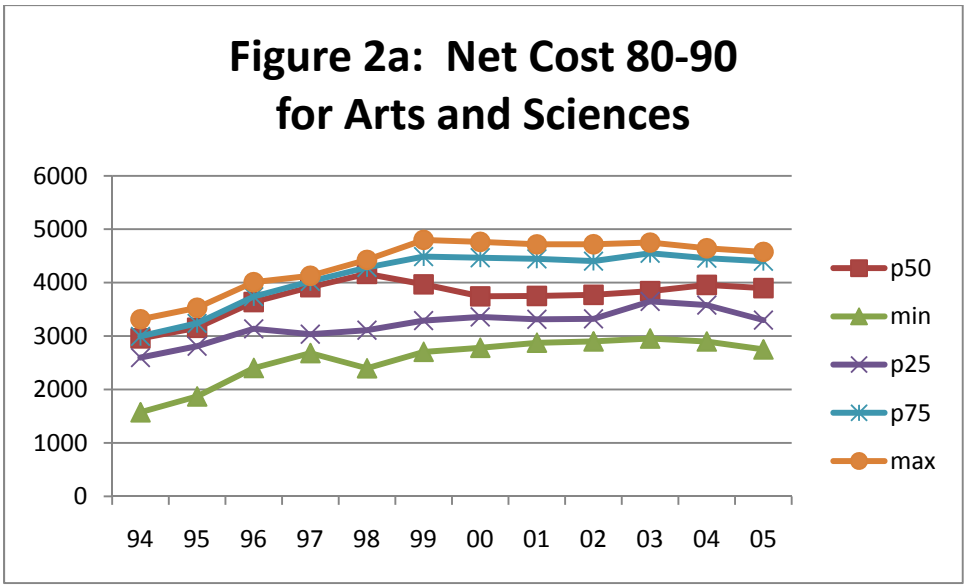


Figure 2a: Net Cost 80-90 for Arts and Sciences
6000
5000
4000
3000
2000
1000
0
94
95
96
97
98
99
00
01
02
03
04
05
p50
min
p25
p75
max

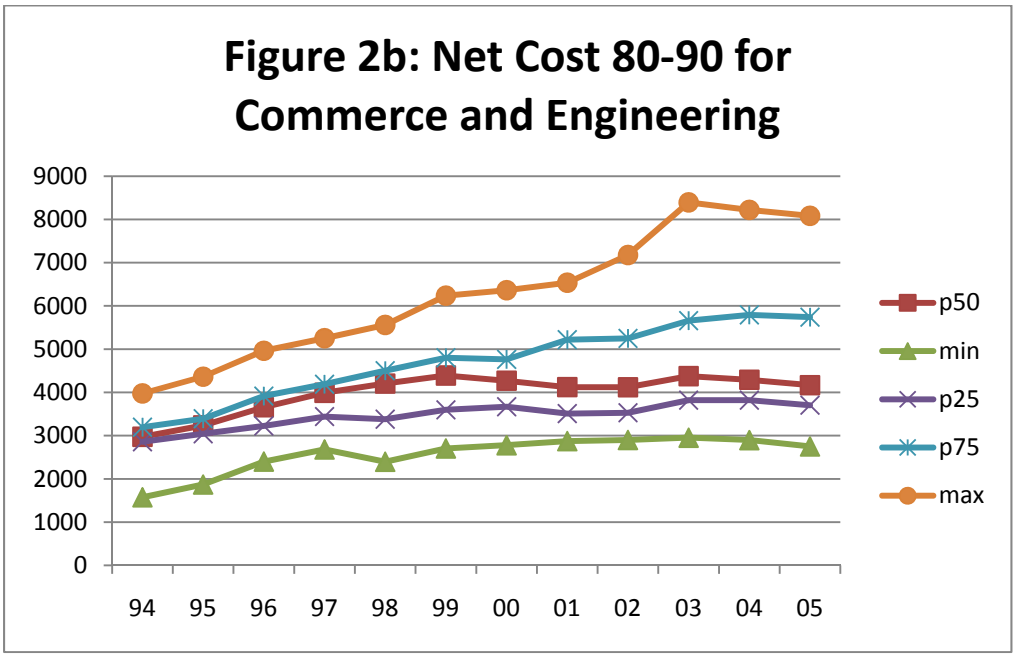
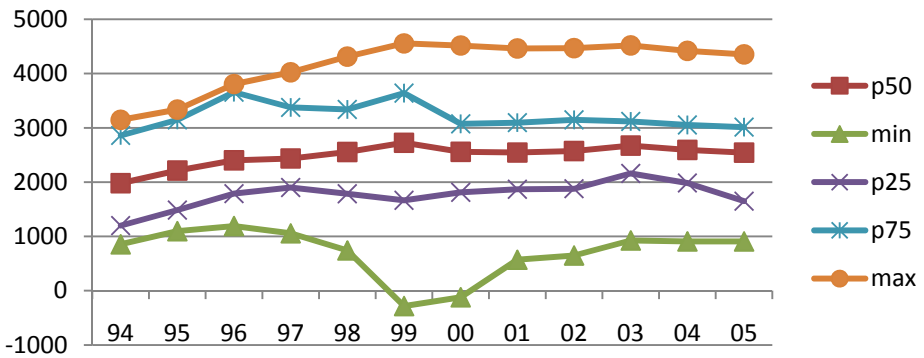


Figure 2b: Net Cost 80-90 for Commerce and Engineering
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
94
95
96
97
98
99
00
01
02
03
04
05
p50
min
p25
p75
max

## Figure 2c: Net Cost 90-100 for Arts and Sciences




## Figure 2d: Net Cost 90-100 for Commerce and Engineering