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Determining demand for university education in Ontario by type of student

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Abstract

We specify and estimate a demand equation for university education in Canada that is a function of tuition fees, real disposable income per capita and other variables that capture a student's opportunity cost. Our model has a number of novel features. We utilize application data, rather than enrollment data, due to the disequilibrium nature of Canada's university system. We also disaggregate demand into demographic components: male and female, secondary school applicants and "other" applicants, and type of university. A last novel feature is the use of the *Maclean's* university rankings as a determinant of demand. Our results suggest that the demand functions differ across the demographic characteristics in sensible ways. Broadly speaking, male applicants tend to be more price sensitive than females and tend to exhibit stronger income effects. Students applying from high school do not object to paying for a quality education, whereas "other" students tend to be more discriminating on price. In most cases, an improvement in a university's ranking exerts a positive influence on the number of applications received.

JEL classification: I20; I21

Keywords: Education demand; Type of applicant

1. Introduction

University administrators typically need to estimate the demand for student slots for the coming academic year in order to budget for classroom space, new buildings, new faculty hires, library acquisitions, and so on. Demand is measured by the number of applications received that are competing for the available slots. Administrators usually determine the number of available slots based on the capacity of the university and the budget, then attempt to match the number of applications to these slots using a variety of methods. In some countries, public universities are required to admit all applicants and so the task of matching is straightforward (King, 1993; Duschesne & Nonneman, 1998). Technically, the supply curve of slots is completely elastic so that all applicants can be admitted. Capacity then increases to whatever is necessary to accommodate student demand. In the United States, there is a larger presence of private universities that operate in a competitive market for students. Private universities have the ability to adjust tuition fees in order to match student applicants to available slots. We then observe

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for these universities that demand and supply interact to determine an equilibrium tuition fee that does the matching.

Canadian universities are publicly funded but face a constraint on the ability to use tuition fees to match demand and supply. Provincial regulations impose caps on tuition fees that are usually a fixed percentage of the operating budget (e.g., 30% in the province of Alberta). This fact has placed Canadian universities in a difficult situation. More students who manage to enroll in a Canadian university are finishing their degrees. The secondary school dropout rate fell from 18% in 1991 to only 12% in 1999 across Canada.[1] Employers are demanding workers with higher education. The share of the workforce with at least an undergraduate degree increased from 18.4% in 1991 to 23.2% in 2001. University enrollment increased by just under 7% over the same sample period; however, this modest growth has been coupled with rising admission standards, suggesting that enrollment growth could have been much larger.

Over the period 1992–2002, only Saskatchewan and Manitoba have benefitted from increases in real funding per full-time enrollment (17% and 19%, respectively). All other provinces have experienced reductions in funding, ranging from −1% for Quebec to −36% for Prince Edward Island. Ontario has experienced a 33% drop in real funding. The student–faculty ratio has increased only slightly from 17.5 students in 1991 to 19.7 students in 2000, but this masks the impending cascade of retiring faculty members over the next 10 years.

Canadian universities are not required to admit all students who apply and so the supply curve of slots is not completely elastic. Since tuition fees are too low to equate demand and supply, Canadian universities face a continual excess demand for available slots. The number of applicants to universities in the province of Ontario was roughly 1.79 times greater than the number of available slots for the years 1991–2000.[2] Ontario is the Canadian province with the largest number of universities (17), and hence provides a good barometer for student demand for the rest of the country.

Government and universities responded to rapid increases in demand in the 1960s by building new universities and colleges and expanding existing ones. Since that time, the post-secondary infrastructure in Canada has grown very modestly, despite large increases in demand in the 1990s. Besides hiring new faculty, budget dollars are also needed to replace and expand a crumbling infrastructure. The AUCC and the Canadian Association of University Business Officers (CAUBO) estimated in the year 2000 that $3.58 billion would be needed for repairs and new facilities.[3] With inaction and inflation, this figure will surely rise over the next decade.

It does not seem likely that Canada will experience the same expansion in its post-secondary capacity that it witnessed in the 1960s. With this in mind, it is very important for post-secondary institutions to manage the increasing excess demand by employing their resources in the most efficient manner possible, while lobbying for greater funding. Understanding how changes in the economy and the demography of Canada affect university demand is now more critical than ever for the university administrator.

Our task is to estimate an economic model of student demand for university slots that takes into account the unique characteristics of the Canadian university system. The disequilibrium nature of the Canadian system would normally require the use of subtle econometric techniques if only the number of slots filled were observed. In our case, this is made simpler since data are available on the number of applications. Hence, a student demand curve can be estimated using least squares by assuming that tuition fees are exogenous in the short run.[4]

We incorporate three additional innovations into our economic model of student demand that are specific to Canada. First, we utilize application data rather than enrollment data and we recognize that there are unique factors that govern the number of applications for different types of applicants. We find that applicants who are applying in their final year of Ontario high school consider different factors when deciding where to apply than applicants who come from other backgrounds: out of province high school students, college transfer students, mature students, foreign students, etc. Second, we incorporate the *Maclean's* rankings of universities into our demand functions. These rankings can be used as a sort of a *Consumer Reports* by applicants (and their parents) when "shopping" for a university. Despite their noted shortcomings, they are becoming an annual institution in Canada.[5] We find that

[1] All statistics in this section are taken from Catano and Turk (2003).

[2] This is based on an average of 4996 first-choice applications per institution and an average of 2788 registrations from this same group. The figure was computed from data provided by the Council of Ontario Universities (COU). A total of 168 university-years are included (i.e., 17 universities over 10 years less data in 1991 and 1992 for Nipissing since this institution did not enter the COU data until 1993). Details follow in the text.

[3] See Giroux (2001).

[4] Mueller and Rockerbie (2004) develop a formal model of demand *and supply* for student slots when tuition fees are not allowed to clear the market. We make the same assumption here concerning the exogeneity of the tuition fee, without the formal development.

[5] Although the information used to compile the rankings may be useful, there still exist problems with respect to how the rankings are compiled, how they are ranked, and how the final

the *Maclean's* ranking for a university can have a significant effect on the number of applications it receives. Monks and Ehrenberg (1999) find the same result for education demand for the United States using the US News and World Report university rankings. Finally, and most importantly, we also distinguish between applicants who are recent Ontario school graduates and applicants who are not. We find significant differences between how these two types of students react to changes in real tuition fees and real disposable income that seem logical in light of economic intuition. University administrators are all too aware of the different backgrounds of student applicants, but they may not be aware of the characteristics we address here.

2. Data

We collected a sample of quality rankings for each university in our sample from the *Maclean's* magazine annual ranking of Canadian universities. This special edition of Canada's main news magazine has been published each November since 1991. The rankings divide Canadian universities into three broad groups: *Medical/Doctoral* are the large research universities with major Ph.D. programs and medical schools; *Comprehensive* universities tend to be smaller institutions that offer a wide range of programs, including professional schools, at both the undergraduate and graduate levels, and *Primarily Undergraduate* schools have few graduate programs and focus on undergraduate education. Each university that participates in the rankings is placed within one of the groups and then ranked against other universities in the group (i.e., its peer institutions). Each institution has remained within one of these three groups over the life of the rankings.

Since 1992, a final ranking within each group is based on a weighting of six categories, each of which is based on a number of weighted subcategories. For example, the category of "student body" contains subcategories on the quality of students attending the university based on high school marks, proportion of out-of-province and international students attending, and student awards. The remaining five categories address other qualitative aspects of each university. These include class sizes, the quality of the faculty, institutional finances, library quality, and institutional reputation. The ranking methodology is outlined in Mueller and Rockerbie (2004). The final rankings for all Ontario universities, as well as the total number of institutions ranked each year across Canada, are presented in Table 1.

Unlike the (arguably) better-known college rankings from *US News & World Report* in the United States, the methodology used to compile the rankings has changed very little since they began over a decade ago.[6] This provides us a consistent data set over a 10-yr period (1992–2001). Furthermore, the weighting of each subcategory differs only slightly between groups (e.g., the total number of volumes in the university library is included as a criteria for medical/doctoral institutions, but not for the other two groups). Thus, although the rankings are within group, prospective students can still make comparisons between groups.

An important source of data was provided by the Council of Ontario Universities (COU).[7] A unique feature of applying for university in Ontario is the application form. Up until 1998, students could apply to as many as three Ontario universities using one application (since 1998 students can apply to any of universities up to all 17).[8] Students rank order their preferences on this application form although this does not influence a university's decision to extend an offer of acceptance. The applications are then processed by the Ontario Universities Application Center (OUAC) and forwarded to individual universities for a final admissions decision. Universities then attempt to admit students to their highest preference ranking using some sort of rationing device, normally high school grades, until all positions are filled. This means that all Ontario universities subscribe to the same initial application process and might coordinate their admission strategies. Students may receive an offer from more than one university in the first round of offers (extended by May 13). Students who do not receive an offer in the first round may receive an offer in the second round (extended by June 13) if acceptances are below the number of available slots at each university. Approximately 66% of all offers are accepted. The COU data allow us to determine: (1) the total number of applications for each institution from both secondary school and non-secondary school applicants; (2) the rank ordering of these applications, and (3) the number of students who registered at each institution. Furthermore, these data are disaggregated by gender. The admission process, coupled with the fact that almost all

(*footnote continued*)
results should be interpreted. These problems have been adequately addressed elsewhere Page (1995), (1996), (1998), (1999); Page, Cramer, and Page (2001). What has not been addressed in the Canadian context is the *behavioural* response to these rankings.

[6]The ranking methodology did change somewhat in 1992, but has remained essentially the same since. See Mueller and Rockerbie (2004) for details.

[7]Thanks to Judith Pearse of the Council of Ontario Universities for providing us with these data.

[8]To ensure compatibility between years, only the number of applications from students who rank a university in the top three positions are used from 1998 forward.

Table 1
The *Maclean's* ranking of Ontario Universities, 1991–2001

Group/University	Year										
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Medical/Doctoral											
McMaster	4	4	5	5	5	5	5	6	6	7	8
Ottawa	9	8	9	11	9	10	11	11	12	9	10
Queen's	2	3	2	2	2	2	2	2	2	3	3
Toronto	3	2	3	1	1	1	1	1	1	1	1
Western	10	10	11	8	7	6	9	5	5	5	6
Total number of institutions ranked	15	15	15	11	11	13	15	15	15	15	15
Comprehensive											
Carleton[a]	11	6	9		8	9	7	7	7	8	8
Guelph	1	3	4	4	4	4	2	2	1	2	3
Waterloo	4	1	2	1	3	2	4	3	2	3	1
Windsor	9	11	10	7	7	7	8	8	8	7	9
York	3	5	5	5	5	5	5	5	5	5	6
Total number of institutions ranked	12	11	13	7	9	11	13	12	12	11	11
Primarily undergraduate											
Brock	14	11	13	11	13	14	14	17	19	15	12
Lakehead	13	12	18	14	16	17	15	18	20	21	13
Laurentian	16	16	19	15	18	18	17	16	15	17	18
Nippising[b]			22	15	15	16	20	21	18	14	17
Ryerson[c]			21	18	17	19	19	19	17	19	19
Trent	6	2	2	2	2	3	3	4	3	4	3
Wilfrid Laurier	12	4	6	5	4	4	5	5	5	5	7
Total number of institutions ranked	18	18	23	18	19	19	23	21	21	21	21

[a]Carleton did not take part in the rankings in 1994.
[b]Nippising became independent of Laurentian only in 1993.
[c]Ryerson did not take part in the rankings until 1993.

applicants are Ontario residents, results in a very homogeneous sample.

Since it is likely that applying to a university depends on a number of factors other than a magazine ranking, we supplement the above data with Ontario macroeconomic data from the Statistics Canada CANSIM II database.

The most recent data available from the COU are for 2001, whereas in some cases, the *Maclean's* data are useful only since 1992 (this is because we lag the rankings variable by 1 yr and, since we cannot do this for 1991, 1992 becomes the first year in the sample). Furthermore, some universities either did not participate in the *Maclean's* rankings (i.e., Carleton in 1994), or were not included in all years because they were new universities (i.e., Nippising and Ryerson in 1992). This leaves us with complete information from 1992 through 2001 on 14 universities (140 observations), nine observations on Carleton, and eight observations each on Ryerson and Nipissing. Thus, our final data set consists of 165 observations. At times, however, a more limited sample will be used for reasons that will become apparent.

Finally, the data are also disaggregated into males and females. The COU collects data on two categories of students, new high school graduates and "other" students. The latter category includes students who fall in the following circumstances:

- students who are transferring from an Ontario college;
- Ontario residents who have worked, travelled, etc. after high school graduation;
- Ontario residents who returned to high school to improve their marks, and,
- out of province applicants.

The first three circumstances form the bulk of applicants in the "other" group.

Since the rankings and other explanatory variables may have different effects on each of these groups, each will be treated separately in the following analysis.

3. Approaches to modelling post-secondary demand

In our view, the demand for post-secondary education should be measured by the number of applications, whether adjusted or not for students applying to more than one institution. Most of the papers we consider here use actual enrollments, which is only accurate if all students who apply are admitted. In some European countries, this is in fact the case, but in Canada, this would grossly underestimate demand. In the discussion that follows, we make no distinction between the two; however, it is important to be aware of this measurement problem.

There are three distinct approaches to modelling post-secondary education demand.[9] The simplest and most naïve approach utilizes projection techniques, which are useful for their simplicity in calculation, rather low data requirements, and immediate results for enrollment decisions. University administrators can and do formulate their own enrollment projections using past enrollment data for their institutions. In the United States, the National Center for Education Statistics (Gerald and Hussar, 2002) produces estimates of national and regional post-secondary enrollments. These extrapolations are based on 10-yr projections of the 18-yr-old population obtained from the US Bureau of the Census. The percentage of each annual 18-yr-old cohort that enrolled in post-secondary education over the years since 1972 is calculated, and then projected 10 years into the future. These projections are then applied to the projections obtained from the Bureau of the Census to arrive at the final enrollment projections. To project the percentage of the current cohort that will enroll, a simple exponential smoothing model is used. A multiple regression technique is then used to project the number of earned degrees, expenditures and the number of faculty, etc., utilizing the natural logs of the enrollment projections and a set of independent variables. Of course, reliable and accurate projections for the independent variables must be available.

The second approach, computing the student "matrix", does not provide projections, rather it only addresses the issue of optimal current enrollment when the institution is attempting to achieve a revenue target. This approach uses econometric techniques to provide short-term enrollment projections and to investigate quantitative and qualitative aspects of potential student demand. The matrix approach is useful primarily for private post-secondary institutions that rely on tuition revenue and large endowments (Mueller, 2003). Here, the overall objective is to achieve a revenue target by admitting students of different backgrounds and needs. Student pools are segmented according to levels of financial need and academic desirability that can be identified. Institutions then examine the number of students they are admitting and matriculating in each cell of the needs–ability matrix and, based on the financial aid provided, calculate net revenue and attempt to manage and project enrollment and revenue. Price responsiveness is also taken into account for each cell, but only in a general way that does not claim to reflect willingness to pay. The advantage of the matrix approach over projection methods is that it recognizes that student aid budgets and academic standards must fit within an overall revenue requirement. Its disadvantage is its lack of statistical testing to determine if the student cells are significantly different.

The third method, the econometric approach, is the method we use in this paper. The Canadian system is a special case due to its heavy reliance on public funding and constraints on the ability to raise tuition revenue. A Canadian university typically faces an excess demand where applications outstrip enrollments. The market for new university admissions is not cleared by the price of tuition, necessitating a disequilibrium econometric model. Studies of higher education demand for other countries typically assume that the supply of seats for newly admitted students is infinitely elastic at the market price of tuition. This allows the aggregate education demand function to be identified and estimated using least squares. Examples of this approach are Paulsen and Pogue (1988), King (1993), Duschesne and Nonneman (1998), and Monks and Ehrenberg (1999).

The results of the econometric demand models are mixed and are largely specific to the questions being asked. Paulsen and Pogue (1988) find that, when economic conditions are improving, students tend to enroll in US colleges that emphasize traditional arts and science programs. When economic conditions are worsening, students tend to enroll in US colleges that emphasize occupational programs. King (1993) finds that students tend to have short time horizons when considering whether to attend a university using data from Puerto Rico, contrary to the forward-looking permanent income model. Duschesne and Nonneman (1998) find that enrollment at non-university post-secondary institutions is more sensitive to real income and opportunity costs than university enrollment using data from Belgium. Monks and Ehrenberg (1999) conclude that private US universities that receive low quality rankings, as computed by *US News and World*

[9] An alternative approach to estimating education demand is to use survey data to isolate determinants of institutional choice by individual students (Pissarides, 1982). Typically multinomial logit functions are estimated where students face a choice to enroll or not to enroll. Once enrolled, the student may also choose the particular institution and the type of program to study. The independent variables are similar to those used in the education demand studies. Endogeneity of enrollment demand with supply is not treated in this literature. Surveys can be found in Ordovensky (1995) and Corman and Davidson (1984).

Report, must increase student aid in order to maintain enrollment.

4. Econometric issues

4.1. Choice of demand measure

All of the papers we surveyed use actual enrollments as the quantity measure of post-secondary education demand. This is perfectly acceptable if the post-secondary allows universities to charge market-clearing tuition fees, as is the case in private US colleges and universities. Using enrollment as the measure of demand for Canadian universities could result in serious estimation problems. Since tuition fees are held below market-clearing levels, enrollments are determined by supply considerations, such as increases in operating grants, alumni and endowment funding, and regulated increases in tuition fees. If real incomes are highly correlated with post-secondary funding, it may appear that real incomes are affecting enrollments, when in fact, the correlation is spurious.

The number of applications is a better measure of demand, but is not without its problems. Students may apply to any number of universities they like, but ultimately attend only one. This will inflate applications and may make it appear that demand is increasing quickly, when in fact, students are simply being more broad minded in where they apply. Some students might apply to institutions for which they have no intention of actually attending. We address this problem here by considering only the number of top three choices for each university, then using an adjustment method.

4.2. Simultaneity

Many papers do not consider the simultaneity of education demand and supply. This of course results in biased estimates of all demand coefficients and can create very small price elasticities, akin to the "elasticity pessimism" of early export and import demand functions. Duschesne and Nonneman (1998) argue that the supply of enrollment spots in Belgium is infinitely elastic since all students who apply to a university are admitted as a matter of policy. This in itself is not enough to obtain a proper estimate of the demand curve. Variables that shift the supply curve vertically must be included to properly identify the demand specification. This is an old econometric problem, yet rather surprisingly, it has been poorly treated in the education demand literature.

4.3. Disequilibrium models

Proper estimation of a demand specification cannot be performed if the system is in a persistent disequilibrium. A good survey is Quandt (1985). Often the short-side rule is invoked to determine if the observed quantity sold of a good represents demand or supply. With falling prices, observed quantities reflect demand, with rising prices, observed quantities reflect supply. If enough data is available on prices, demand and supply specifications can be estimated using least squares. With regulated tuition fees that rise only slowly to alleviate excess demand, least-squares estimates using Canadian data will likely reflect enrollment supply. Maximum likelihood techniques have been developed to handle cases where sufficient observations are unavailable or the periods of disequilibrium are unknown (Mayer, 1989). The estimation problem largely arises from not having observations for quantities demanded *and* supplied at each observed price. We avoid the difficulty of disequilibrium techniques by utilizing application (i.e., demand) data only.

5. Methodology and estimation

Demand for a good is assumed to be a function of own price, prices of substitute goods, and real income.[10] We calculate a variable for real tuition at each institution using the nominal tuition measure from the *Maclean's* rankings deflated by the consumer price index (CPI) for Ontario (1992 = 100). We chose not to include a measure of substitute good prices. An obvious substitute for attending one Ontario university is just another Ontario university,[11] suggesting that we include

[10]Since the majority of applicants who fall in the "other" category reside in Ontario, we use the same independent variables for the new high school graduates and "other" groups.

[11]Universities that draw students from large urban centres may feel the need to supply more new enrollment slots so that the rationing GPA is not too high. They may feel pressure to do this despite a constant budget per full-time student. This is a slot supply argument that could be captured by including the population of potential students within the appropriate age group who are within some critical distance of the university. In a Canadian study, Christofides, Cirello, and Hoy (2001) find that geographical proximity to a university is an important determinant of where a student will choose to attend. Frenette (2002) has shown that the probability of attending university decreases with the distance from home to the nearest university campus. The question is what distance should be used? Some universities are located within large urban centres and in that case the distance measure would be the city radius. Other universities are quite large but are not located in large urban centres (Queen's University or the University of Western Ontario are examples). Casual empirical evidence suggests that the bulk of full-time students attending a university originate from the province in which the university is located. Queen's University, for example, averaged approximately 87% for the period 1976–99 and all other Ontario universities average

real tuition relative to an average of real tuitions at other Ontario universities. Unfortunately tuition fees at most of these universities tend to move in step and many universities charge identical tuition fees and so little information is captured by relative tuitions. Real income was accounted for by a number of variables, including a measure of ability to pay for university (median disposable income by geographic region in Ontario), the gender-specific unemployment rate (15–24 yr olds by geographic region), a measure of the opportunity cost of attending university (assumed to be real weekly wages in the Ontario service sector[12]—i.e., unskilled wages), and a measure of the annual real rate of interest (reflecting the real interest cost of student loans). Finally, because there is likely to be unobserved heterogeneity between universities, we include a university-specific fixed effect.

The demand model is summarized as

$$\begin{aligned}\text{Applications}_{it} = f(&\text{Macleans Ranking}_{it-1},\\ &\text{Real median income by region}_{it},\\ &\text{Real tuition}_{it},\\ &\text{Regional unemployment rate}_{it},\\ &\text{Real unskilled wages per week}_{t},\\ &\text{Real interest rate}_{t}).\end{aligned} \quad (1)$$

We note here two caveats of the application demand model. First, many variables are included as control variables only, and we do not hypothesize about the theoretically correct sign of these variables since many do not have an unambiguous effect on demand for university admissions. For example, our regional real median income measure could have a positive influence on demand for university education since higher incomes make university more affordable and therefore demand increases (i.e., an income effect). Conversely, it may have a negative effect on demand for higher education since the higher incomes generated by university attendance are no longer as attractive and a university degree is not viewed as desirable in terms of higher lifetime income (i.e., a substitution effect). Similarly, does an increase in the real unskilled weekly wage increase or decrease the demand for higher education? The answer is ambiguous. It could increase demand because of the ability to finance education through part-time employment is enhanced. But an increase in the unskilled weekly wage could also decrease demand because the relative returns to university education may have decreased. The net effect depends on whether the income or substitution effect dominates student choices.

Second, a complete economic model of university demand and slot supply would contain a method to ration applicants to the available slots. This could be done using grade point average, letters of recommendation, entrance exams, etc. We do not attempt to model the rationing mechanism here.[13]

6. Results

Eq. (1) was estimated using ordinary least squares. The main results are contained in Tables 2–5.[14] The first two tables contain estimates for male secondary and male "other" students, while Tables 4 and 5 contain comparable estimates for females. The first column (1) of each table contains the complete model with all of the control variables (described above) and a dummy variable for each university (i.e., a fixed effect) to account for differences in the mean number of applications. Column (1a) of each table provides the estimates of the complete demand model after omitting all independent variables with t-statistics less than 1 in absolute value.[15] Columns (2)–(4) of the tables use the same controls, but first segregate the sample into medical/doctoral (MD), comprehensive (COMP), and primarily undergraduate (PU) institutions before estimating separate regressions for each. Columns (5) and (6) include only the number of first- and third-choice applications, respectively, for each institution as the dependent variable (rather than the total number of first, second, and third choices as in the previous

(*footnote continued*)
approximately 95%. Our purpose here is not to estimate a slot supply function, rather an application demand function. The population of high school graduates could enter the demand function as a constraint on applications. Over our sample period, the percentage of Ontario high school graduates who applied to an Ontario university remained relatively constant at 66% (COU). Hence the constraint was not binding. Including the population of high school graduates might introduce an approximate identity into the regression model that is not behavioural and might account for almost all of the variation in applications.

[12]Unfortunately we could not locate local service sector wage data. Some local wage data (e.g., for the unionized construction industry) is available, but we do not believe these wages are representative of the opportunities available to high school graduates.

[13]The rationing issue is considered in Mueller and Rockerbie (2004).

[14]Heteroscedasticity (non-constant variance of the error term) occurs frequently in pooled time-series cross-section data. This inflates the standard errors the regression coefficients, resulting in insignificant t-ratios. We correct for this using White's (1980) heteroscedasticity consistent covariance matrix estimator along with a correction for contemporaneous correlation across panels. These corrections are done in all the estimations that follow.

[15]Greene (1997, p. 255) shows that omitting an independent variable with a t-statistic less than 1 in absolute value will improve the adjusted R^2 of the regression. We use this as our criterion for selecting the best fitting demand specification.

Table 2
Estimates of application demand for secondary male applicants (absolute value of *z*-statistics are in parentheses)

	All types		MD only		COMP only		PU only		First choice		Third choice	
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)	(5)	(5a)	(6)	(6a)
Ranking lagged	−0.013	−0.013	−0.010	−0.012	0.013		−0.007	−0.011	−0.011	−0.010	−0.015	−0.015
	(2.13)**	(2.21)**	(1.15)	(1.39)	(0.91)		(0.92)	(1.46)	(1.68)*	(1.68)*	(2.06)**	(2.11)**
Median real after tax income per capita ('000s)	−0.117		0.126		0.269	0.295	−0.395		0.013		−0.173	
	(0.59)		(0.50)		(0.86)	(1.05)	(0.81)		(0.07)		(0.73)	
Real tuition	−0.265	−0.286	0.027		−0.255	−0.240	−0.517	−0.592	−0.242	−0.248	−0.271	−0.295
	(4.36)***	(5.65)***	(0.38)		(2.97)***	(3.03)***	(4.06)***	(7.45)***	(4.00)***	(4.95)***	(3.73)***	(4.89)***
Real unskilled weekly earnings	−0.151		−0.356	−0.366	−0.278		0.006		−0.007		−0.325	
	(0.60)		(1.22)	(1.25)	(0.72)		(0.01)		(0.03)		(1.07)	
Unemployment rate, 15–24 yr olds	−0.013	−0.012	−0.006	−0.009	−0.012	−0.009	−0.016	−0.015	−0.008	−0.008	−0.019	−0.017
	(2.46)**	(2.53)**	(0.76)	(1.66)*	(1.57)	(1.21)	(2.36)**	(2.48)**	(1.36)	(1.59)	(3.15)***	(3.08)***
Real interest rate	0.001		0.001		−0.008		0.003		0.003		0.000	
	(0.16)		(0.09)		(0.59)		(0.21)		(0.27)		(0.02)	
Constant	10.731	8.694	8.997	10.519	7.797	6.110	13.173	9.039	7.246	7.368	11.403	7.826
	(3.94)***	(55.41)***	(2.81)***	(6.73)***	(1.68)*	(1.99)**	(2.25)**	(47.94)***	(2.62)***	(46.50)***	(3.46)***	(41.26)***
R^2	0.9749	0.9748	0.9494	0.9486	0.8855	0.8816	0.9733	0.9730	0.9763	0.9763	0.9566	0.9562
Observations	165	165	50	50	49	49	66	66	165	165	165	165
Number of universities	17	17	5	5	5	5	7	7	17	17	17	17

Note: *denotes significance at 10%, **denotes significance at 5%, and ***denotes significance at 1%.

Table 3
Estimates of application demand for "Other" male applicants (absolute value of z-statistics are in parentheses)

	All types		MD only		COMP only		PU only		First choice		Third choice	
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)	(5)	(5a)	(6)	(6a)
Ranking lagged	−0.016	−0.016	−0.016	−0.019	0.018	0.018	−0.018	−0.018	−0.015	−0.015	−0.015	−0.016
	(2.39)**	(2.39)**	(1.14)	(1.43)	(1.08)	(1.06)	(2.48)**	(2.48)**	(1.95)*	(1.95)*	(1.99)**	(2.18)**
Median real after tax income per capita ('000s)	0.897	0.897	1.366	1.422	1.005	1.065	1.124	1.124	0.929	0.929	0.797	0.915
	(3.70)***	(3.70)***	(3.37)***	(3.59)***	(2.61)***	(2.86)***	(2.57)**	(2.57)**	(3.47)***	(3.47)***	(2.76)***	(3.37)***
Real tuition	−0.569	−0.569	−0.227	−0.237	−0.422	−0.396	−0.988	−0.988	−0.645	−0.645	−0.463	−0.409
	(8.23)***	(8.23)***	(1.90)*	(2.65)***	(3.97)***	(4.14)***	(8.96)***	(8.96)***	(8.70)***	(8.70)***	(5.79)***	(6.20)***
Real unskilled weekly earnings	0.623	0.623	0.413		1.037	1.098	0.427	0.427	0.555	0.555	0.597	0.746
	(2.18)**	(2.18)**	(0.90)		(2.29)**	(2.46)**	(1.19)	(1.19)	(1.76)*	(1.76)*	(1.80)*	(2.40)**
Unemployment rate, 15–24 yr olds	−0.007	−0.007	0.006		0.009	0.011	−0.019	−0.019	−0.010	−0.010	−0.008	
	(1.21)	(1.21)	(0.50)		(0.83)	(1.09)	(3.14)***	(3.14)***	(1.59)	(1.59)	(1.14)	
Real interest rate	−0.013	−0.013	−0.009		−0.009		−0.017	−0.017	−0.018	−0.018	−0.011	
	(1.30)	(1.30)	(0.50)		(0.58)		(1.33)	(1.33)	(1.59)	(1.59)	(0.95)	
Constant	−5.144	−5.144	−8.629	−6.994	−8.150	−9.214	−5.892	−5.892	−5.910	−5.910	−5.340	−7.593
	(1.57)	(1.57)	(1.68)*	(1.63)	(1.51)	(1.79)*	(1.12)	(1.12)	(1.65)*	(1.65)*	(1.38)	(2.22)**
R^2	0.9723	0.9723	0.8521	0.8479	0.9386	0.9383	0.9793	0.9793	0.9679	0.9679	0.9567	0.9563
Observations	165	165	50	50	49	49	66	66	165	165	165	165
Number of universities	17	17	5	5	5	5	7	7	17	17	17	17

Note: *denotes significance at 10%, **denotes significance at 5%, and ***denotes significance at 1%.

Table 4
Estimates of application demand for secondary female applicants (absolute value of z-statistics are in parentheses)

	All types		MD only		COMP only		PU only		First choice		Third Choice	
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)	(5)	(5a)	(6)	(6a)
Ranking lagged	−0.013	−0.014	−0.023	−0.024	0.007		−0.008	−0.010	−0.010	−0.011	−0.015	−0.016
	(2.38)**	(2.58)***	(2.75)***	(2.92)***	(0.51)		(1.01)	(1.33)	(1.73)*	(1.82)*	(2.37)**	(2.61)***
Median real after tax income per capita ('000s)	−0.067		−0.037		0.067		−0.075	0.030	0.033		−0.093	
	(0.35)		(0.15)		(0.22)		(0.16)	(0.06)	(0.17)		(0.41)	
Real tuition	−0.151	−0.142	0.089	0.106	−0.189	−0.160	−0.379	−0.343	−0.151	−0.126	−0.128	−0.123
	(3.06)***	(3.81)***	(1.65)*	(2.49)**	(2.62)***	(2.79)***	(3.03)***	(2.89)***	(3.14)***	(3.39)***	(2.10)**	(2.64)***
Real unskilled weekly earnings	0.211	0.244	−0.053		−0.022		0.425	0.529	0.299	0.315	0.097	
	(0.89)	(1.07)	(0.20)		(0.06)		(1.05)	(1.44)	(1.17)	(1.29)	(0.34)	
Unemployment rate, 15–24 yr olds	−0.009	−0.008	−0.014	−0.011	−0.019	−0.018	−0.005		−0.007	−0.006	−0.013	−0.012
	(1.63)	(1.55)	(2.09)**	(2.08)**	(2.05)**	(2.24)**	(0.57)		(1.08)	(1.07)	(1.93)*	(2.11)**
Real interest rate	−0.007		−0.009		−0.010		−0.013		−0.007		−0.006	
	(0.75)		(0.81)		(0.82)		(0.97)		(0.74)		(0.57)	
Constant	8.379	7.448	9.548	8.808	8.493	8.682	7.485	5.695	5.586	5.806	8.321	7.799
	(3.14)***	(6.11)***	(3.01)***	(61.97)***	(1.87)*	(58.20)***	(1.32)	(1.08)	(1.92)*	(4.48)***	(2.65)***	(51.51)***
R^2	0.9732	0.9730	0.9515	0.9508	0.9272	0.9256	0.9651	0.9645	0.9733	0.9732	0.9518	0.9516
Observations	165	165	50	50	49	49	66	66	165	165	165	165
Number of universities	17	17	5	5	5	5	7	7	17	17	17	17

Note: *denotes significance at 10%, **denotes significance at 5%, and ***denotes significance at 1%.

Table 5
Estimates of application demand for "other" female applicants (absolute value of z-statistics are in parentheses)

	All types		MD only		COMP only		PU only		First choice		Third choice	
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)	(5)	(5a)	(6)	(6a)
Ranking lagged	−0.011	−0.011	−0.021	−0.021	0.019	0.015	−0.013	−0.013	−0.009	−0.009	−0.010	−0.010
	(1.82)*	(1.82)*	(1.75)*	(1.83)*	(1.45)	(1.22)	(1.60)	(1.60)	(1.27)	(1.27)	(1.54)	(1.54)
Median real after tax income per capita ('000s)	0.483	0.483	0.823	0.865	0.283		0.933	0.933	0.568	0.568	0.324	0.324
	(2.36)**	(2.36)**	(2.18)**	(2.42)**	(0.95)		(2.11)**	(2.11)**	(2.07)**	(2.07)**	(1.59)	(1.59)
Real tuition	−0.384	−0.384	−0.173	−0.165	−0.377	−0.358	−0.674	−0.674	−0.438	−0.438	−0.287	−0.287
	(7.98)***	(7.98)***	(2.31)**	(2.30)**	(5.76)***	(5.59)***	(6.03)***	(6.03)***	(7.25)***	(7.25)***	(5.58)***	(5.58)***
Real unskilled weekly earnings	0.585	0.585	0.029		0.648	0.549	0.832	0.832	0.602	0.602	0.474	0.474
	(2.50)**	(2.50)**	(0.08)		(1.89)*	(1.63)	(2.27)**	(2.27)**	(2.00)**	(2.00)**	(1.93)*	(1.93)*
Unemployment rate, 15–24 yr olds	−0.015	−0.015	−0.010	−0.009	−0.021	−0.024	−0.015	−0.015	−0.013	−0.013	−0.021	−0.021
	(2.67)***	(2.67)***	(1.13)	(1.11)	(2.37)**	(2.87)***	(1.89)*	(1.89)*	(1.90)*	(1.90)*	(3.59)***	(3.59)***
Real interest rate	−0.016	−0.016	−0.005		−0.016	−0.020	−0.027	−0.027	−0.019	−0.019	−0.017	−0.017
	(1.90)*	(1.90)*	(0.33)		(1.33)	(1.65)*	(2.16)**	(2.16)**	(1.69)*	(1.69)*	(1.89)*	(1.89)*
Constant	−0.612	−0.612	−0.452	−0.796	1.669	5.296	−6.387	−6.387	−2.503	−2.503	0.379	0.379
	(0.22)	(0.22)	(0.09)	(0.20)	(0.40)	(2.97)***	(1.21)	(1.21)	(0.71)	(0.71)	(0.14)	(0.14)
R^2	0.9785	0.9785	0.8550	0.8546	0.9635	0.9628	0.9738	0.9733	0.9663	0.9663	0.9728	0.9728
Observations	165	165	50	50	49	49	66	66	165	165	165	165
Number of universities	17	17	5	5	5	5	7	7	17	17	17	17

Note: *denotes significance at 10%, **denotes significance at 5%, and ***denotes significance at 1%.

estimates).[16] The reason for these final two estimations is to give us a better idea of the rankings effects on the distribution of applications. For example, an improvement in the ranking could raise the number of first-choice applications while lowering the number of third place applications. In all tables, the number of applications, real tuition, regional real disposable median income and real weekly earnings were logged before estimation and so their coefficients provide elasticities. The lagged *Maclean's* ranking, the regional youth unemployment rate and the real interest rate were not logged and thus their coefficients provide estimates of their semi-elasticities.[17]

6.1. Differences between university types

Table 2 presents the results for male secondary student applications. These are males who are applying to university directly from an Ontario high school. A negative coefficient on the ranking lagged variable should be interpreted as the percentage change in the average number of applications submitted when the lagged rank increases by one (e.g., third to second) place. From column (1a), a one-place increase in the ranking, regardless of school category, results in 1.3% more applications and is statistically significant at 95% confidence. Since the mean number of applications received from this group of males was about 4600 in our sample, this represents approximately 69 more applications in the subsequent year for each one-place increase in ranking, holding all other variables constant. Other coefficient estimates generally have reasonable coefficient values. The income elasticity of regional real disposable median income in Ontario is not significantly different from zero, suggesting that university education is an inferior good for male secondary students. The price elasticity of real tuition is quite inelastic at −0.286, suggesting that Ontario high school graduates are not very price sensitive when choosing which university to attend. The coefficient for the regional youth unemployment rate is negative and significant. The coefficients for real weekly earnings and the real interest rate is not statistically significant in any of the regressions in Table 2 suggesting that the opportunity costs and interest expense of student loans do not affect the decision to attend university. More broadly, the state of the economy is only a minor factor to a graduating Ontario high school student when choosing if and where to attend university, although this result should be tempered by the fact that our sample period is short and does not fully reflect swings in the business cycle.

In columns (2)–(4) of Table 2, where the data are disaggregated by university type, an increase in lagged ranking does not significantly increase student applications. This apparent conflict with the results in column (1a) suggests that students choose the type of university by referring to the rankings. However, having chosen one of the three university categories, recent high school students do not use the rankings to choose individual universities. The average rank for the medical/doctoral schools in Ontario is sixth among all Canadian schools, while the average rank for the primarily undergraduate schools is 13th (calculated from Table 1). This suggests that the variation in the rankings across the university categories is much larger than the variation in the rankings within each category.

The price elasticities of demand in Table 2 vary from −0.592 for primarily undergraduate schools, to −0.24 and 0 for comprehensive and medical/doctoral schools, respectively. It would appear that students view primarily undergraduate schools as relatively more homogeneous in quality and attributes and therefore shop around more than the other categories using tuition. Students who choose a medical/doctoral school do not consider tuition to as great a degree. This cannot be attributed to a lack of variation in tuition among these schools. The standard deviation among average tuition fees for the sample period is $757 (per year) across medical/doctoral schools, while it is $780 for comprehensive schools, and $711 for primarily undergraduate schools.

Since the applicants to Ontario universities rank their choice of universities on a common application form (up to three choices before 1998, and an unlimited number from 1998 forward), we also address the effects of the rankings on the distribution of applications. To do this we disaggregate total applications into first and third choices by multiplying total number of applications by the proportion of first and third. These estimates of these specifications with number of first- and third-choice applications substituted for total number of applications are in columns (5) and (6). The coefficients in both cases are negative and significant, although somewhat larger in the case of third-choice applications. This implies that an improvement in the rankings has a larger effect on the number of third-choice applications compared to the number of first-choice applications. Thus, students might "throw in" a higher ranked university as a third choice if they perceive the probability of being admitted is positive, but perhaps low.

[16] It should be noted that the data set provided by the COU only contains information on the proportion of first-, second- and third-choice applications by type of applicant (i.e., secondary or other), but not by gender. Since the number of first and third-choice applications by type of applicant was constructed by multiplying this fixed proportion by the number of applications by gender, differences in preferences by gender could be masked.

[17] Estimates were also computed using the ratio of the number of applications to the population of 15–24 yr olds as the dependent variable. The results were not qualitatively different from those we present here.

6.2. Differences among type of student

Table 3 presents the results for "other" male applicants. These include those not applying as a full-time student at an Ontario secondary school at the time of application. Thus, out-of-province students (including foreign students), transfer students, mature students, etc. are included in this category.[18] Generally, the results mirror those of the previous estimates for male secondary-school applicants, although the magnitude of the coefficients is generally somewhat larger.[19] This is especially interesting in the cases of real tuition and real disposable income (elasticities of −0.569 and 0.897, respectively) in column (1a). The former result suggests that these individuals possess much more price elastic demand for education than their secondary-school applicant counterparts. Given that the bulk of these applicants are from out-of-province or are transferring from other post-secondary institutions, we might expect greater sensitivity to price. The income elasticity suggests that university education is a normal good for this group. This makes sense insofar as there are benefits to attending institutions that are better ranked and the opportunity costs of attending for this group is somewhat larger compared to secondary school applicants.[20] Also this group may consider all of Canada as the market for a university education, hence they will conduct a more careful search. Together these results suggest that "other" males and secondary males are different groups whose university choices are influenced by different factors; the other group is somewhat more likely to be affected by both real tuition levels and real median disposable income.

Tables 4 and 5 present estimates for the same specifications for female secondary and other applicants, respectively. The marginal effect of the *Maclean's* ranking for female secondary students is virtually identical to their male counterparts. An improvement in the ranking has the largest effect for medical/doctoral schools, whereas for male applicants, the ranking had no effect for schools within each category. The number of male applications rose steadily over the sample period; however, the number of female applications remained relatively flat. These results suggest that female applicants may be more choosey when it comes to quality of the institution. Real tuition has a negative influence on application behaviour (price elasticity of −0.142), although generally to a slightly lesser magnitude compared to males. Female secondary students tend to be less price sensitive than males. The price elasticity estimates show the same pattern as for male applicants: increasing as one moves from medical/doctoral schools to primarily undergraduate schools. Also the semi-elasticity for the female youth unemployment rate is statistically significant for medical/doctoral and comprehensive schools, and an average value of −0.008 for all types of institutions (column 1a). The negative semi-elasticity is counterintuitive. A possible explanation is the "discouraged worker" effect where a drop in the unemployment rate is the result of female workers dropping out of the labour force and thus not being counted as unemployed. This frees up a pool of discouraged workers who may choose to enroll in university. We also believe this result could be a figment of the short sample period.

From Table 5, "other" female applicants are more price sensitive as reflected by the larger negative coefficients for this group (price elasticity of −0.384 from column (1a)) compared to Ontario secondary school females. The coefficient for regional real median income (0.483) suggests that university education is a normal good for this group, but less so than for males.

In sum, female applicants tend to be more price inelastic than their male counterparts, and university choice appears to be less influenced by real disposable income. It could be that the rate of return to a university degree is higher for a female than a male and hence females are willing to spend more for tuition. We cannot say for sure, however we do note that significantly more females applied to most Ontario universities than males, suggesting their rate of return may be higher. Regardless of gender, Ontario secondary school applicants tend to be more price inelastic than "other" applicants and their income elasticities are smaller. None of the groups (male, female, secondary students,

[18]To give the reader an idea of the qualifications of other applicants, according to the 2000 COU data, 20% of the other applications are from students who matriculated at other Canadian high schools, 17.5% are from individuals applying from other Ontario and Canadian universities and colleges, 17% matriculated from foreign high schools, 12.5% from Ontario CAATs (French-speaking colleges), 10.8% are secondary school applicants from a previous year, 9.8% are from non-Canadian colleges and 4.8% from CEGEPs in Quebec. The remainder of applications are from individuals who were unqualified secondary school applicants from a prior year (2%), came from international bacclaureat programs (1.5%) or Ontario night and correspondence courses (1.1%) and "others" (3%).

[19]A test combining the samples for male secondary students and "other" male students and utilizing dummy variables to distinguish the sample coefficients revealed that the slope coefficients for median disposable income, real tuition and real unskilled weekly earnings are significantly different between the two types of students at 95% confidence.

[20]Regarding the benefits of attending a higher ranked institution, Bloom and Szykman (1998) show that higher program rankings are related to higher starting salaries among MBA graduates in the US. Unfortunately, data limitations prohibited the authors from estimating a similar model for undergraduate starting salaries. The magnitudes of the opportunity costs for the "other" group are probably the greatest for the mature students.

others) appear to be very sensitive to economic conditions or opportunity costs.

7. Conclusions

The purpose of this paper was to specify and estimate demand curves for university education that are distinguished by type of student applicant, gender, and type of university. We estimated demand curves for male and female applicants containing two sub-categories each, Ontario secondary school graduating students, and "other" students. The demand curves were further disaggregated by three university categories: medical/doctoral, comprehensive, and primarily undergraduate schools. Hence, we estimated a total of 12 demand specifications per gender, including aggregated demand specifications. This level of disaggregation is quite unique to the literature. In addition, we utilize the number of applications, rather than the number of students enrolled, as the quantity measure for all of our demand curves. This feature recognizes the disequilibrium nature of the Canadian university system. The *Maclean's* rankings of Canadian universities were used as a measure of quality. Finally, regional median income and unemployment rates were utilized to incorporate further disaggregation.

The effect of the rankings on university choice seems to be similar for male and female applicants across all sub-categories. The effect is strongest for the medical/doctoral schools. A better ranking also appears to increase the number of first- and third-choice applications that a university receives, especially from secondary students and males. Male applicants tend to be more price sensitive than female applicants for all categories and Ontario secondary school applicants tend to be less price sensitive than "other" applicants. The income elasticity for males and females "other" applicants suggests that university education is perceived as a normal good, whereas the income elasticity for male and female secondary applicants suggests that these groups are not influenced by income when applying to university. Finally, neither males nor females (Ontario secondary school students and "others") consider the state of the economy or opportunity costs very much when choosing whether and where to attend university. These results paint a rather fuzzy picture of the typical Canadian student considering to attend university as being quite price insensitive and determined to enroll, but much more so for new high school graduates.

Finally, for policy purposes, real tuition tends to have a smaller effect on the number of applications than the lagged *Maclean's* ranking. A 10% reduction in tuition results in an increase in applications of between 1.4% and 2.9% for female and male secondary applicants, respectively, while a one position improvement in the ranking increases applications by roughly 1.3% for all groups. If in fact the goal is to increase the number of applicants,[21] university administrators should focus on both improving the quality of their programs and obtaining new resources, as reflected (accurately or not) in the *Maclean's* rankings, particularly since lowering real tuition fees does not seem to be in the cards in the near future (this would lower revenues). Lowering real tuition fees to attract "other" male and female applicants is a more viable strategy compared to moving up in the *Maclean's* rankings (although revenue would still fall, but to a lesser degree), but improving the quality of the institution without changing tuition fees will attract more applicants and increase revenues. As is usually the case, higher quality necessitates raising tuition fees. Our results suggest that this is a viable strategy for universities, regardless of what group of students is being considered.

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[21] See Ehrenberg (2000) for an interesting discussion of how some university administrators in the US have attempted to improve their institution's ranking in *US News & World Report*.

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