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The Determinants of University Participation in Canada (1977–2003)

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ABSTRACT

The decision to attend university is influenced by a large set of factors, ranging from economic considerations that affect affordability to family characteristics such as parental education levels. We examine the relationship between university participation and various economic and non-economic variables over the past twenty-five years in Canada. We quantify the importance of the various factors in the data sets available to us in order to understand trends in university participation and, in particular, to take account of the increasingly greater propensity of young women than men to attend university.

RÉSUMÉ

Toute une gamme de nombreux facteurs influencent la décision de suivre des cours à l'université ; des facteurs allant des considérations économiques impactant la capacité financière jusqu'aux caractéristiques familiales telle que le niveau de scolarité des parents. Nous avons examiné la relation existant entre la participation à l'université et plusieurs variables économiques et non économiques sur une période des dernières 25 années au Canada. Nous avons quantifié l'importance de plusieurs facteurs trouvés dans les bases de données nous étant disponibles. Nous voulions comprendre les tendances portant sur la participation à l'université, et en particulier la tendance récente démontrant qu'un plus grand nombre de jeunes femmes que d'hommes choisissent de suivre des cours universitaires.

INTRODUCTION

Governments typically play significant roles in shaping a country's post-secondary education (PSE) system, and this is certainly the case in Canada. Policy is generally driven by both equity and efficiency concerns. A more highly educated workforce has clear economic advantages for both individuals and the country at large. Accessibility to PSE from all segments of society is also considered desirable from an equity perspective, as is a fair method of assigning the cost of education across participants and non-participants. Consider, for example, the government's involvement with setting or influencing tuition levels. Since children of families with higher income tend to use the PSE system with greater frequency, shifting the cost of post-secondary education from tuition fees to government subsidization is often thought to be a regressive policy. On the other hand, high tuition fees may restrict access, especially for children from low-income families. Moreover, it is often argued that it is difficult for students to borrow at a time when they have little collateral to offer as a guarantee of repayment and that government-sponsored student loans are typically only accessible for a fraction of students. Thus, increasing the cost of education through higher tuition fees can lead to too few people obtaining high skill levels through university education. Any positive externalities flowing from post-secondary education, such as improved citizenship, would exacerbate a concern with higher tuition fees.

In this article, we examine the factors that influence individual decisions to obtain post-secondary education in order to provide important input into the public-policy discussions that shape the extent to and the manner in which governments should finance higher learning. We shed light on such issues by considering various factors that have influenced university attendance in Canada over the period from 1977 to 2003. In particular, we show that government policies that lead to higher tuition fees may well have negative consequences for university attendance. Other economic factors, as reflected by the impact of family income and the return to PSE on university attendance, suggest that financial incentives beyond tuition should also be considered by government policy-makers.

Many of the forces that impinge on decisions to acquire post-secondary education (such as increases in family income, level of parental education, the additional earnings and indirect costs involved from further education, and increases in tuition fees) unfold gradually and may exert their effects more clearly over long periods of time, since only then do modest but persistent changes of variables in the same direction cumulate to large enough effects for them to be discerned. It is, therefore, necessary to study the long run to identify such effects. Two studies that adopted this approach were those of Christofides, Cirello, and Hoy (2001) and Johnson and Rahman (2005). Although these studies are strongly complementary to ours, room for further work remains. In the words of Johnson and Rahman (2005), "It seems sensible to use different data … and … models to improve our understanding of the university participation decision" (p. 107). To that end, we used Statistics Canada's master files of the SCF (Survey of Consumer Finance) and SLID (Survey of Labour Income Dynamics), housed at its data resource centres in Waterloo and Toronto, thus gaining access to additional information not available to Christofides et al. (2001) or to Johnson and Rahman (2005). Our work with these master files enabled us to identify the gender of the children in the family and whether they attended college or university, as well as further details that are useful in a study of university attendance but unavailable in other public-use data sets.

We focus here on university rather than post-secondary or college attendance for several reasons. First, the ability to take into account the gender of a family's children allowed us to explore the increasing university gender participation gap. Neither the SCF nor the SLID data indicate any noteworthy college participation gap: in recent years, the college participation rate for both females and males has been around 20%. Second, family income is likely to be a more significant determinant of university attendance than of college attendance since the overall costs and benefits are generally higher for a university education.[1] Third, university tuition fees are generally higher but fees have also increased more for universities than those for colleges. The average tuition fee for a Bachelor of Arts program in Canada (expressed in 2001 dollars) rose from $1,866 in 1990–91 to $3,456 in 1999–2000 (see Corak, Lipps, & Zhao, 2003). Using the long data set that we have put together, we considered whether there is evidence that the recent increase in tuition fees has restricted accessibility to universities.

A fourth reason to focus specifically on university participation is the very different relative returns to university and college education. The university premium, so usefully considered by Bar-Or, Burbidge, and Robb (1995) and Burbidge, Magee, and Robb (2002) and used in Johnson and Rahman (2005), attracted a good deal of recent attention in the U.S. literature of Jacob (2002) and Goldin, Katz, and Kuziemko (2006) and, as such, bears further scrutiny. Indeed, we followed a suggestion in Bar-Or et al. (1995) and focused particularly on the returns to university education (relative to high school education only) in the years immediately after individuals complete their education. Thus, this credible alternative definition of the university premium is not based on the experience of all individuals to the age of retirement but rather on the five years immediately after completing school. This may well be the period of greatest interest to individuals making human capital acquisition decisions and may better predict the future gains of a university education.

Our investigation of whether recent increases in university tuition have had a substantial effect on university participation is an important contribution to the literature. Earlier evidence of the impact of tuition fees in Canada has been mixed. Rivard and Raymond (2004), using the Youth in Transition Survey for

1997–1999 and for all provinces but Quebec and Ontario, found no evidence that tuition fees influenced post-secondary attendance; Christofides et al. (2001) covered a period that extended only to 1993 (thus excluding more recent periods when tuition-fee increases have been substantial) and also found tuition fees had no effects on post-secondary attendance. However, Johnson and Rahman (2005) found some negative tuition effects on the younger of the two groups (17, 18, and 19 year olds) that they studied. Believing that tuition fees are endogenous, and using data from the master files of Statistics Canada's LFS (Labour Force Survey) for the 1979 to 2001 period, Neill (2005) estimated demand for university places by instrumenting tuition fees with the political party in power for the relevant province; she found some negative effects of tuition on the demand for university places. Coelli (2005a) used data from the first two panels (1993–1998 and 1996–2001) of SLID but found negative tuition effects only for children from low-income families.[2] Fortin (2005) exploited differences across Canadian provinces and American states for the 1973 to 1999 period, finding some negative effects. In general, as noted earlier, the results of Canadian studies have been quite mixed. Substantial research has been conducted on the effect of tuition fees on enrolments in U.S. post-secondary education, and surveys of these studies have indicated that tuition increases have a negative impact on rates of enrolment (see Heller, 1997; Leslie & Brinkman, 1987). Thus, in this article, we offer an in-depth analysis of the impact of increases in real tuition fees on the demand for university attendance over a long period of time.

Although improved information through Statistics Canada's master files and an extended time period are our major thrusts, we also followed Johnson and Rahman's (2005) recommendation to use different models, by estimating not only Linear Probability but also Poisson and Probit models in our statistical work; these provided useful additional checks and a sensitivity analysis. In addition, we explored and report briefly on the issue of the possible endogeneity of tuition fees. Finally, since funding approaches and other factors that influence university participation likely differ across regions, we have estimated our models separately to investigate regional differences, although the results are not reported here.[3] This process led us to statistical specifications that are both more flexible and more appropriate and has shed new light on understanding university participation.

We discovered that tuition fees, family income, and parental educational attainment, as well as the university premium, all played significant roles in shaping university attendance. Based on these findings, we evaluated the contribution of each of these (and other) variables to the increase in university attendance that occurred over the sample period, having checked for the possible endogeneity of tuition fees.

An overview of the trends in university participation is provided in the next section. Our data and sources are discussed in the third section, and a formal presentation of the econometric models we used and the results we obtained is offered in the fourth. Concluding comments appear in the final section.

OVERALL TRENDS IN POST-SECONDARY EDUCATION ATTENDANCE

For each family that we examined over the period from 1977 to 2003, we considered the propensity of its children aged 17 to 24 to attend university. We studied the number of children at university (CAU) and CAU as a proportion of the total number of children in this age group (17 to 24) in the family (i.e., PROPU being the proportion of children in the relevant age group who attend university). Table 1 presents summary statistics on these variables and establishes the patterns for the years we were able to analyze. From 1997 to 2003, there was for the most part a steady increase in the participation rate of CAU from 11% overall in 1977 to 22% in 2003.[4] Since our unit of analysis was the family, Columns 6 and 7 show the value of PROPU for families with only male and only female children, respectively. These columns highlight an important pattern: the so-called gender gap. This strong tendency for all-girl families to send more children to university than all-boy families is an issue to which we have paid special attention.[5]

Although not reported in detail here (see Appendix B of Christofides, Hoy, & Yang [2008] for more details), tuition levels over the 1977–2003 period rose substantially.[6] In most provinces, real tuition fees (for Bachelor of Arts programs) in the largest provincial university more than doubled; Newfoundland, New Brunswick, and Quebec were the exceptions. Newfoundland implemented the lowest percentage increase, but, even in Newfoundland, an 83.3% increase in real tuition fees can be discerned over this period.

DATA, SOURCES, AND VARIABLE DEFINITIONS

Data from the SCF covering the years 1977 to 1997 for which comparable surveys were available and SLID covering the years 1998 to 2003 were used; in both cases, the master file versions of these Statistics Canada surveys were relied on.[7] The SCF was a cross-section survey conducted annually to provide information on Canadian household/family income, labour-market information, and other socio-demographic variables such as education attainment. The SLID, started in 1993, is a longitudinal survey that contains panel data on a set of families over a six-year period. The SCF was terminated in reference year 1998 and formally replaced by SLID from 1998 on.

Economic families, defined in these data sets as units of persons residing together and related by blood, marriage, or adoption, were the focus of our study. For our purpose of investigating possible factors influencing university attendance, we used only the sub-sample of economic families with children between 17 and 24 in the corresponding survey year. We set up variable definitions to ensure as seamless a transition from the SCF to the SLID as possible and, as an extra precaution, included the dummy variable SLID, which takes the value of 1 for all observations from that survey and is equal to 0 otherwise. The sampling weights provided by each survey were used throughout.

Table 1
Descriptive Statistics

	Mean Values					
Year	Real Income	CAU (number of children at university)	Children (number of children of relevant age)	PROPU (proportion of children at university)	$PROPU_m$ (PROPU for families with only boys	$PROPU_f$ (PROPU for families with only girls)
1977	40,557.00	0.17	1.47	0.11	0.11	0.12
1979	41,053.65	0.15	1.46	0.10	0.10	0.11
1981	42,048.75	0.18	1.47	0.12	0.11	0.13
1982	41,258.74	0.18	1.48	0.12	0.11	0.13
1984	40,170.71	0.18	1.42	0.12	0.11	0.13
1985	41,105.25	0.19	1.37	0.13	0.12	0.15
1986	41,537.31	0.19	1.38	0.13	0.12	0.16
1987	40,494.71	0.21	1.36	0.14	0.14	0.17
1988	41,862.17	0.21	1.34	0.15	0.15	0.17
1989	43,018.26	0.22	1.30	0.16	0.14	0.20
1990	42,318.66	0.23	1.34	0.16	0.15	0.20
1991	41,708.59	0.25	1.31	0.18	0.16	0.21
1992	42,283.50	0.26	1.33	0.18	0.17	0.21
1993	42,035.06	0.26	1.33	0.18	0.16	0.22
1994	42,574.98	0.25	1.33	0.18	0.15	0.22
1995	41,842.00	0.23	1.32	0.16	0.15	0.19
1996	43,086.98	0.23	1.32	0.16	0.15	0.20
1997	41,665.95	0.24	1.33	0.17	0.15	0.20
1998	45,746.45	0.29	1.35	0.20	0.19	0.23
1999	47,604.90	0.29	1.33	0.21	0.18	0.26
2000	50,936.97	0.28	1.34	0.20	0.16	0.25
2001	51,376.77	0.28	1.33	0.20	0.17	0.25
2003	50,206.84	0.31	1.32	0.22	0.17	0.26

Note. The variable Children is the total number of children aged 17–24 in the family; a number such as 1.47 represents the average number of such children in the families of our sample in 1977. The variable CAU is the number of children from this age group who attended university. PROPU is CAU divided by Children. The variables CAU and PROPU, $PROPU_m$, and $PROPU_f$ are all based on children aged 17–24.

Source: Master files of Survey of Consumer Finance and Survey of Labour and Income Dynamics, Statistics Canada.

Three variables measuring university participation — PROPU, CAU, and PROBU — were defined and used as dependent variables in our econometric analysis. PROPU (the proportion of children between 17 and 24 at university for each family) was used as the dependent variable in Linear Probability models based on Ordinary Least Squares (OLS). CAU measured the absolute number of children between 17 and 24 attending university in each family and constituted the dependent variable in a Poisson Count model. Finally, PROBU (the probability that at least one child from the family attends university) was assigned the value of unity if a family had at least one child between 17 and 24 attending university (otherwise, it was equal to zero); PROBU was the dependent variable in Probit regressions of the probability of attending university. These three variables are related to a number of explanatory variables (covariates), which are described next.

The real tuition fee variable (Tuition) is the tuition in the province where the economic family resided in a given year; nominal tuition fees were deflated by the All Items Consumer Price Index (CPI), with 1992 set at 100 for the largest city in the relevant province. Real after-tax family income (Income) is the sum of parental income and was converted into real terms using the All Items CPI (1992 = 100) for the largest city in the province in which the family resided. Its powers (squared and cubed) were also included in the regressions. From descriptive data (see Table 2), it was clear that over the study's time period, university participation rates were higher for children from higher-income families. However, it was also evident that this difference was shrinking over time. The number of children in the family (Children) were included, as was its square.[8]

Geographic location as it relates to urban size is generally viewed as a potentially strong determinant of university participation. Thus, the dummy variable UrbanM was used to indicate if the family lived in an urban area of 29,001 to 99,000 inhabitants, and UrbanL was equal to 1 if the family lived in an urban area of more than 99,000; otherwise, these dummy variables were set to 0.[9]

The education level of the head of the family is commonly used to explain university attendance.[10] In our study, five dummy variables were used for this purpose. NonGrad indicates that the family head had not finished high school; this was used as the omitted (base) category in our regressions. Grad equals 1 if the family head had graduated from high school without further education. Some Post equals 1 if the family head had received some post-secondary education (PSE) without receiving any certificate, diploma, or degree. Post equals 1 if the family head had received some PSE and some form of certificate (but no degree). Degree equals 1 if the family head had received a university degree. All of these dummy variables equal 0 when the condition was not met.

Some studies have used separate variables to capture the education level of both father and mother. However, when analysis is restricted to two-parent households, these variables are highly correlated and thus raise multicollinearity issues.[11] An interesting study by Buchmann, DiPrete, and Powell (2003) that included both parental education levels found mixed effects as to which parent's education had more influence on a child's PSE-participation decision (see their Table 2); of particular note is their finding that daughters differentially benefit from both their mother's and father's higher levels of education (see pp. 24–25). Given that parental education levels are highly correlated, by using the education level of only the family head, we indirectly measured the impact of both parents' education and the importance of trends in parental education over time on university enrolments without creating a multicollinearity problem. A more-detailed analysis of the effects of mothers' and fathers' education — and

Table 2
Proportion of Children (PROPU) at University by Income Group (1992 constant dollars)

Income	Year							
Range ($)	1977	1982	1985	1989	1993	1997	2000	2003
0–10,000	0.08	0.06	0.11	0.09	0.13	0.12	0.20	0.20
10,001–20,000	0.04	0.07	0.07	0.08	0.13	0.14	0.11	0.18
20,001–30,000	0.07	0.10	0.09	0.12	0.13	0.12	0.15	0.16
30,001–40,000	0.09	0.13	0.11	0.12	0.15	0.17	0.18	0.18
40,001–50,000	0.12	0.13	0.13	0.18	0.18	0.16	0.17	0.19
50,001–60,000	0.12	0.16	0.15	0.19	0.21	0.16	0.20	0.22
60,001–70,000	0.17	0.16	0.20	0.22	0.25	0.23	0.23	0.27
70,001–80,000	0.20	0.16	0.25	0.21	0.33	0.27	0.26	0.31
80,001–90,000	0.29	0.15	0.31	0.23	0.26	0.29	0.28	0.34
90,001–100,000	0.36	0.10	0.37	0.53	0.39	0.17	0.34	0.37
100,000+	0.27	0.15	0.36	0.32	0.35	0.33	0.39	0.36

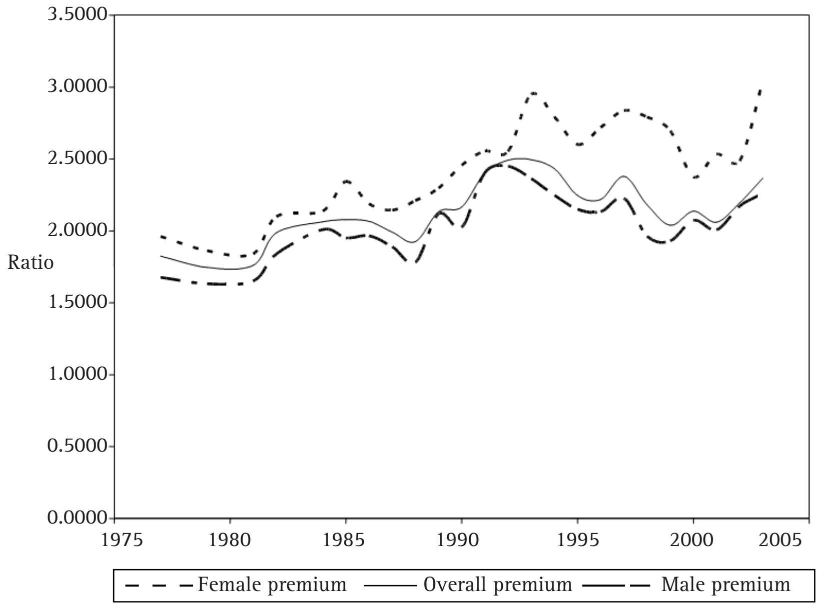
Note. PROPU is the proportion of children at university (CAU) to the total number of children (Children) in the economic family.

Source: Master files of Survey of Consumer Finance and Survey of Labour and Income Dynamics, Statistics Canada, various years.

those of single parents as well — on children's PSE attendance would be fruitful ground for future research.

To investigate the possible effect of changes in the perceived economic returns to a university education on participation decisions, we defined and measured the university premium using the variable Premium. Taking the sample of full-time, full-year paid employees for each year of our surveys,[12] Premium was defined as the ratio of the average earnings of individuals with a degree and up to five years' experience to the average earnings of individuals with 11 to 13 years of schooling and up to five years' experience. Thus, for those with a university degree, we studied individuals aged 25 to 29, and for those with 11 to 13 years of schooling, we studied individuals aged 19 to 23.[13] The Premium variable was calculated for men, for women, and for all individuals together. A family with only boys was assigned the variable Premium_m, the male value of Premium; a family of only girls was indicated by Premium_f, its female value; and for a family that had both boys and girls, the general value of Premium was relevant. Earnings were calculated on a provincial and a national basis, and similar results were obtained; for brevity's sake, the nationally based results are not reported here. The provincially based variable, averaged by year for all observations in that year, revealed a clear upward trend for both the general and the gender-conditioned variants; $Premium_f$ was uniformly higher and rose faster than $Premium_m$ (see Figure 1).

Figure 1
University Premium by Gender



As Table 1 shows, all-girl families were more likely to send their children to university. In our economic family-based study of university participation, the distinction between all-girl and all-boy families was considered to be a proxy for what the U.S. literature has identified as the gender gap, that is, the increasing propensity for more girls than boys to attend university. To explore such effects, three mutually exclusive and exhaustive dummy variables were generated: Only Male Children Family equals 1 if the family had only male children and equals 0 otherwise; Only Female Children Family equals 1 if the family had only female children and equals 0 otherwise; and Both Gender Children Family constitutes the omitted (base) category.

A Trend variable was also included in all equations. For observations in 1977, Trend equals 1; for 1979, 3; for 1981, 5; for 1982, 6; and so on. This variable captures many socio-economic changes (e.g., the tendency for later marriage and family formation) that occurred over time and can be neither measured nor separately identified. Goldin et al. (2006) provide a careful discussion of these changes.

In addition to Canada-wide regressions, regional sub-sample specifications were investigated. These are important because exploring regional effects using intercept differences alone may not capture the diversity of behaviour that may occur in a country as large and as diverse in its treatment of education as Canada. The results of these regressions are reported in detail in Christofides et al. (2008).

RESULTS

Three statistical models, distinguished by the choice of dependent variable, were used. The first and the most straightforward specification, the OLS (Ordinary Least Squares) model, a Linear Probability model, was applied to explain the dependent variable PROPU (proportion of children aged 17 to 24 in a family that attends university). Because this model is often robust against certain misspecifications, it is generally viewed as at least a useful first step in estimation. However, given that the OLS model is based on the presumption that the residual or error term is normally distributed, more statistically appropriate approaches were also adopted. As noted in the previous section, CAU (the number of children in a family that attend university) and PROBU (the probability that at least one child attends university) are two alternative variables that can be used to examine university participation. Since CAU is an integer, Count models are a natural way to proceed. The Poisson regression model assumes that $E(CAU_i | X_i) = \lambda_i$, where

$$\ln \lambda_i = \sum_{j=1}^{q} \beta_j X_{i,j} ,$$

q is the number of j covariates, X_i refers to a particular family's observations, and β_j are constant population parameters to be estimated. And, since the variable PROBU takes on the value of 0 or 1, a natural way to explain it is to use either Logit or Probit — we used the latter. In the Probit model, the probability that the i^{th} family will have at least one child attending university, in which case PROBU assumes the value of unity, is given by

$$\Pr(PROBU_i = 1 | X_i) = \Phi\left(\sum_{j=1}^{q} \beta_j X_{i,j}\right)$$

where Φ is the standard normal cumulative distribution function.[14] In both the Poisson and Probit models, the marginal effect on the dependent variable of a change in the value of any covariate can be computed (see Christofides et al., 2008, for details on the method used).

The regression coefficient estimates and the ratios of the estimated coefficients to their standard errors, along with marginal effects, are reported in Table 3.

Table 3 shows that the results obtained from all three specifications are generally similar. Provincial dummy variables are included, with British Columbia being the omitted province. The provincial effects suggest that significant differences exist between all provinces. These effects are substantial, ranging (in the Probit model) from 0 in Alberta and British Columbia to as high as a 10.3-percentage point greater participation rate in Prince Edward Island.[15] As noted earlier, Christofides et al. (2008) explored regional differences at length by estimating region-specific regressions.[16]

Table 3
Propensity to Attend University in Canada (1977–2003)

	OLS		Poisson Count Model			Probit Model		
Variable	Coefficient	Coeff./St. Error	Coefficient	Coeff./St. Error	Marginal Effect	Coefficient	Coeff./ St. Error	Marginal Effect
Tuition	-9.76E-07	-0.2	-0.0000478	-1.7	-3.70E-06	-0.0000206	-0.95	-2.61E-06
Premium	0.0200815	4.53	0.1169306	4.78	0.0090397	0.0870908	4.52	0.011019
Income	1.34E-06	12.3	8.39E-06	12.9	6.49E-07	7.19E-06	12.48	9.09E-07
Income Squared	-1.48E-12	-2.56	-2.04E-11	-6.65	-1.58E-12	-1.69E-11	-4.5	-2.14E-12
Income Cubed	4.57E-19	1.31	9.95E-18	5.67	7.69E-19	1.25E-17	2.83	1.58E-18
Children (no. children)	0.0823616	9.64	1.469045	24.37	0.1135698	0.9243336	20.91	0.1169499
Children Squared	-0.0147385	-7.78	-0.1925232	-13.14	-0.0148837	-0.1285023	-12.1	-0.0162586
Male-Children Family	-0.0166945	-3.5	-0.1323573	-5.04	-0.0095841	-0.116417	-5.35	-0.0134742
Female-Children Family	0.0241104	4.64	0.1469228	5.46	0.0122352	0.0791329	3.43	0.0106258
UrbanM	0.0258393	6.37	0.1948807	6.95	0.0166342	0.1400499	6.88	0.0196727
UrbanL	0.0600161	22.32	0.3761974	20.07	0.0353095	0.2951404	22.39	0.0463406
Head Education								
Grad (of secondary school)	0.0360811	10.62	0.3784437	12.78	0.0355628	0.2296671	12.25	0.0344272
Some Post-secondary	0.0516081	8.55	0.476361	12.03	0.047174	0.3107493	11.14	0.049326
Post-secondary (diploma)	0.0528712	13.22	0.4972773	16.45	0.0498052	0.311866	15.67	0.0495418
Degree (university degree)	0.1959766	32.94	1.028848	33.5	0.1389886	0.7782857	34.56	0.1656709
Province								
Newfoundland	0.0780648	10	0.4270728	9.01	0.0411873	0.3505806	9.79	0.057202
Prince Edward Island	0.1179078	14.69	0.7196866	15.8	0.081467	0.552393	15.68	0.1029225
Nova Scotia	0.0659402	9.38	0.4188967	9.26	0.0402224	0.3058485	9.12	0.0483826
New Brunswick	0.0912791	14.03	0.5698569	14.08	0.0593741	0.4253204	14	0.0729929
Quebec	0.0271411	4.45	0.1445329	3.78	0.0120215	0.1450225	5.14	0.0204457
Ontario	0.0243062	4.54	0.1763593	4.98	0.0149102	0.1330486	5.14	0.0185933
Manitoba	0.0667018	10.05	0.3786016	9.74	0.0355806	0.2870591	9.71	0.0448171
Saskatchewan	0.0650348	10.57	0.4038165	10.48	0.0384633	0.2947474	10.28	0.0462662
Alberta	0.0134757	2.28	0.0952476	2.44	0.0077255	0.0558008	1.97	0.0073633
Time Trend	0.0016317	4.22	0.0188785	7.33	0.0014595	0.0102814	5.45	0.0013008
SLID (dummy for 1998 on)	0.0104533	1.68	0.0015955	0.05	0.0001234	0.0175445	0.66	0.0022495
Constant	-0.1636775	-11.77	-4.896785	-56.83		-3.065744	-45.24	
R Squared	0.0807							
Log Likelihood					-18934594			-52646.203

In all three models, an increase in the number of children aged 17 to 24 had an expected positive effect on the relevant dependent variable. When a quadratic specification was adopted to check for possible nonlinearity in this relationship, the effect was diminishing. This is not surprising, given that having more children allows for more participation from a family; however, since more children represent a higher burden of costs for any family, it is perhaps also not surprising that the positive effect is diminishing in the number of children.

Similarly, to estimate the effect of family income on university participation, a nonlinear functional form, including Income, Income Squared, and Income Cubed as covariates, was adopted. The estimated polynomial suggested that as real after-tax family income increases, more children attend university and the probability that a family will have at least one child at university rises essentially throughout the range of incomes observed in the data set. Thus, Income was a significant cross-sectional force on the propensity to attend university. Its capacity to explain the growth in university attendance over time was limited, however. Between 1977 and 2003, average real income increased from $40,557 to $50,207, a change that implies an increase in CAU and PROBU of less than 1 percentage point and that falls considerably short of the actual overall increase in CAU of 6 points and in PROBU of 11 points over this time period.

Tuition has the expected negative coefficient in all three models but was not significantly different from zero at the 5% level. However, our region-specific analyses indicated that Tuition had a negative and statistically significant effect in almost all regions for all statistical specifications; the exceptions were all equations for Quebec and the OLS and the Probit specifications for the Atlantic region (see Christofides et al., 2008). These results offer strong and robust support for the limited evidence thus far available on a tuition effect in Canada.

The increased interest in securing a university education may reflect trends in the additional earnings to be expected from holding a university degree, a hypothesis supported by our regressions. The variable Premium, our measure of the economic return to a university education, had a positive and statistically significant effect in all equations. The impact was greater for females than males. In the Probit model, for example, as the value of Premium increased from its lowest value of 1.63 for males and 1.84 for females to its highest value of 2.45 for males and 3.04 for females, the estimated effect on PROBU was an increase of 0.009 points for males and 0.013 points for females. But this is only one source of the growing gender imbalance in university attendance. We also used dummy variables to capture any inherent gender differences in participation rates not explained by variables such as Premium in the regressions. All of our models suggested unequivocally that families with only boys will have lower rates of PSE attendance than families with only girls (i.e., relative to the comparison group of families with boys and girls). This dummy variable effect was over and above the effect of the higher economic return for girls to attend university.

Included among the variables in the data sets we used were those that are generally adopted in studies attempting to explain differences in university attendance across families. We obtained the expected results. For example, the education level of the family head is a significant factor in decisions affecting university attendance. Indeed, the higher the head's education attainment, the higher the probability of the family having at least one child at university. These effects range (in the Probit model) from 3.4 percentage points in the case of the Grad variable to 16.6 percentage points in the case of Degree variable. Urban families send more children to university than rural families; in fact, in the Probit results, larger-sized urban areas were associated with a 4.63-percentage point and medium-sized urban areas with a 1.97-percentage point additional probability of families having at least one child at university.

Our time trend variable (Trend) was positive and significantly different from zero at the 5% level in all three models. It is noteworthy that the dummy variable SLID was never significant, which suggested that merging the two data sets (SCF and SLID) was not problematic.

To obtain a clearer view of the relative importance of the variables we used and to better evaluate the potential cumulative effect of more family heads having tertiary qualifications (Degree, Post) as a way to explain the secular trend in university attendance, we computed the predicted impact due to the changes in explanatory variables between 1977 and 2003. These calculations involved setting each of the stated explanatory variables at its average level for the years 1977 and 2003 and then applying the estimated regression coefficients to generate the predicted change in the dependent variable between these two (extreme) years of our survey. The detailed results of this exercise are provided in Table 4.

Not surprisingly, variables for which there was minimal change over the time period we studied, such as population proportions by province or urban-size variables, explained little of the increasing trend in university attendance from 1977 to 2003. In contrast, our two variables that explicitly accounted for time (i.e., the Trend variable and SLID) were very strong, especially in the Poisson and Probit regressions; in the OLS regression, the SLID effect was relatively stronger. Indeed, the time trend variable captured a number of effects that we could not assign to our particular explanatory variables due to the impossibility of finding or modelling the effect of relevant variables such as relative access to student loans and private-sector borrowing or socio-economic forces, as discussed in Goldin et al. (2006). So it is not surprising that these "time" variables were critical factors. The university premium, which increased (albeit not uniformly) over this time period, also explained a large percentage of the variation in the average rate of attendance between 1977 and 2003 (19.43% to 24.25% of the total predicted change across the various regression equations).

Perhaps of most interest, however, was the way in which the increasing education levels of the family head affected this trend. The combined effect of changes in the proportion of family heads having a university degree (Degree) or a post-secondary education experience leading to a non-degree qualification (Post) over this time period accounted for a large proportion of the total variation in university attendance (from 31% in the Poisson regression to 42% in the

Table 4
Growth in University Attendance between 1977 and 2003: Role of Variables

Variable	OLS		Poisson		Probit	
	Absolute Change	Percentage Change	Absolute Change	Percentage Change	Absolute Change	Percentage Change
Total Change	0.1033	n/a	0.1135	n/a	0.1120	n/a
Tuition	-0.0013	-1.26%	-0.0090	-7.93%	-0.0065	-5.78%
Premium	0.0245	23.68%	0.0221	19.43%	0.0272	24.25%
Income (incl. 2,3)	0.0112	10.82%	0.0067	5.90%	0.0101	8.99%
Children (incl. Sq)	-0.0027	-2.63%	-0.0113	-9.96%	-0.0115	-10.31%
UrbanM	0.0001	0.07%	0.0001	0.06%	0.0001	0.07%
UrbanL	0.0013	1.22%	0.0009	0.79%	0.0012	1.10%
Head Education						
Grad	-0.0087	-8.46%	-0.0099	-8.76%	-0.0107	-9.53%
Some Post	0.0016	1.57%	0.0016	1.38%	0.0018	1.63%
Post	0.0150	14.52%	0.0160	14.12%	0.0176	15.73%
Degree	0.0283	27.37%	0.0196	17.28%	0.0251	22.43%
Province						
Newfoundland	-0.0002	-0.16%	-0.0001	-0.10%	-0.0002	-0.15%
Prince Ed. Island	0.0000	0.01%	0.0000	0.00%	0.0000	0.01%
Nova Scotia	-0.0001	-0.11%	-0.0001	-0.09%	-0.0001	-0.11%
New Brunswick	-0.0001	-0.06%	-0.0001	-0.05%	-0.0001	-0.06%
Quebec	-0.0013	-1.23%	-0.0010	-0.85%	-0.0017	-1.49%
Ontario	0.0003	0.30%	0.0004	0.31%	0.0004	0.40%
Manitoba	-0.0005	-0.46%	-0.0004	-0.34%	-0.0005	-0.43%
Saskatchewan	-0.0004	-0.41%	-0.0004	-0.33%	-0.0005	-0.41%
Alberta	0.0005	0.48%	0.0005	0.44%	0.0005	0.45%
Time Trend	0.0148	14.31%	0.0662	58.37%	0.0414	36.99%
SLID	0.0211	20.43%	0.0117	10.33%	0.0182	16.23%

OLS regression). Thus, increases in university attendance over time are self-reinforcing. This is an intriguing new result that stresses the long-run, additional effects resulting from increased levels of PSE.

Average income over this period grew from approximately $40,600 to $50,200, and the role of this change (taking the combined effect of the Income, Income Squared, and Income Cubed variables) in explaining the overall growth in PSE attendance ranged from 5.9% (Poisson regression) to 10.8% (OLS regression). Although the tuition level had a negative and statistically significant effect in most cases, the size of this effect was modest, holding back growth in PSE attendance by amounts ranging from 1.26% in the OLS regression to 7.93% in the Poisson regression.

It should be noted, however, that the variation of incomes across families within a given year is far more significant than the variation in average incomes over time. Upon computing the average income of the top and bottom deciles of the populations for both 1977 and 2003, we found that the ratio of income for the highest decile to the lowest decile was 10.4 in 1977 and 9.6 in 2003. We then used our regression results to compute the cross-sectional effect of income differences in explaining the variations in the likelihood of children from different family backgrounds attending university in a given year. This turned out to be a very strong effect: the difference in the dependent variable between families from the top to the bottom decile ranged from approximately 0.09 (Poisson regression, 1977) to 0.16 (Probit regression, 2003). Given that the average level of these dependent variables in these years was 0.17 and 0.22, respectively, the effect of family income is an important consideration when examining cross-sectional variation in the relative likelihood of children from different family backgrounds attending post-secondary institutions. Naturally, although numerous robustness checks were performed on the regression models presented in this article, our results at particular points of detail changed. Nevertheless, the results presented and reviewed in this section remained unaffected (see Christofides et al., 2008 for details).

DISCUSSION

Over the past few decades, participation in university education in Canada has increased substantially. Moreover, a significant gender imbalance has been established. By using master files from Statistics Canada's SCF (1977 to 1997) and SLID (1998 to 2003), we were able to examine some of the factors that generated these trends in a not previously accomplished way. Panel data sets, such as the recently introduced Youth in Transition Series A and B, allowed us to carry out a more-detailed investigation of factors such as parental expectations, children's development in secondary school, and peer effects. Moreover, because studies based on these types of data sets focus on relatively short time periods, the two types of studies were complementary.[17]

Although many of our results, such as the positive effect on participation rates of the urban size in which families resided, are commonly found, they do not explain the increased participation in university education or the gender imbalance that has evolved. Only variables that have changed substantially over time are likely to explain the trends indicated by our study — specifically, in terms of the impact of increases in the real (average) incomes of families of potential students, increasing real tuition fees, and the additional earnings accruing to those holding university degrees on the proclivity to attend university. An additional dynamic that can be evaluated in the context of a very long time horizon is the possibility that, since more highly educated parents are more likely to send their children to university, the growth over time in the fraction of parents with high levels of education may also contribute to growth in university participation. This interesting dynamic had not yet been quantified in the literature. In addition, we have examined, albeit only partially, why females are now more likely to attend university than males. Clearly, no single study can claim to provide an analysis of sufficient depth and breadth to develop a complete picture of how government should address all aspects of funding policy for universities, but our results do shed light on many of these issues.

In terms of tuition effect, a negative tuition effect is difficult to find in Canadian studies but not in U.S. studies.[18] Although our results were not significantly different (statistically) from zero at the 5% level, we did find a negative coefficient in all three statistical models in our national-level regressions. Furthermore, in our region-specific analyses, tuition had a negative and statistically significant effect in almost all regions for all statistical specifications of our regression models. Given the long time period we used and the fact that tuition increased significantly over that period, these results offer strong and robust support for the limited evidence thus far available for a tuition effect for Canada. From a policy perspective, this suggests that even in the presence of Canada's existing student loan system, concern about student debt may deter some individuals from university participation and higher tuition may reduce growth in university enrolment.

The impact of increasing tuition over time, however, appears to have had only a mildly moderating effect on university participation rates, which is not to say that tuition has a negligible influence in general from the perspective of a cross-section of families at a given point in time. Moreover, without separate data on the supply of university places and the possible effect that changes in tuition levels may have on the desired overall system capacity, we have effectively estimated a reduced form of the "market for university education" model. In a thought-provoking piece, Finnie (2005) pointed out that the only time the (negative) reaction of the participation rate from an increase in price (tuition) will measure a change in demand is when the overall market is in a position of excess supply. He also pointed out that, given rationing based on grades, it follows that some universities may be in a position of excess demand (no capacity) while others may be in a position of excess supply (unutilized capacity). Thus, our results may reflect a combination of demand and supply effects that are generated in an idiosyncratic manner at individual universities but are then aggregated to give some system-wide implications. A further complication arises from the role of provincial governments in establishing tuition levels. The degree to which Canadian universities are free to set tuition levels differs substantially between provinces and even within a given province over time. We have acknowledged these shortcomings in our model, noting that other models have faced the same methodological and estimation challenges due to a lack of direct observations on the desired system capacity at each price (i.e., the supply side).

Over the time period we studied, a substantial increase in the university premium was evident for both females and males — but particularly for females. The impact of this variable on university participation entered the national equations with significant positive coefficients, even when gender dummies picked up much of the higher propensity of children of all-girl families to attend university. Jacob (2002) found similar results for the United States and argued that, throughout their schooling (before PSE), girls display higher non-cognitive skills, such as attentiveness and co-operativeness, which make them better prepared and more likely to be qualified for post-secondary education. In other words, by the time girls complete high school, they tend to have higher grade averages and so are better able to compete for university spots. This factor may well help explain why, at any particular point in time, young women are more likely than young men to gain entry to a Canadian university.

Nonetheless, this female advantage does not fully explain the growing gender imbalance. Some scholars have argued that elementary and secondary education systems have changed in a way that has increasingly favoured girls, but as Dee (2005) noted, "empirical evidence on whether these interactions actually matter is limited and contradictory" (p. 2). In a 2006 article, Goldin et al. pointed out that over the past century, girls in the United States have consistently outperformed boys in post-secondary education. An important lesson to take from their work is that not only has the economic return to PSE recently improved for women relative to men but societal norms have also changed in a way that has led to an increasing tendency for women to participate more in the workforce. We have provided evidence to support one part of this thesis, namely, the differential effect of the university premium on the recent incentives for Canadian women to attend university at a greater rate than men. Our results demonstrate that the differential effect of the return to education favouring women does not explain the entire gender imbalance. Gender dummy variables (i.e., for families with all girls versus all boys) suggested there are further reasons for the female advantage in university participation. Governments should take note of this imbalance and investigate whether programs aimed particularly at boys in elementary and post-secondary schools might be developed to help redress this imbalance.

Our study also indicated that family income played a statistically significant role in explaining the participation decisions of children, although it tended to be primarily at the cross-sectional level of analysis. That is, within any given year, differences in family income are reflected in substantial differences in children's university participation rates. As Table 2 illustrates, this relationship has continued to be of importance in recent years, but to a lesser extent than in earlier years. From 1977 to 2003, average (real) family income increased from approximately $40,500 to $50,200, and according to our various models, this variable was responsible for, at most, 10.8% of the overall growth in university attendance (see OLS result in Table 4). Thus, although family income on average may not appear to be a barrier to children participating in university education, from a cross-sectional perspective, it was a critical determinant of differential participation rates. From a policy perspective, this raises a counterpoint to the argument that high tuition levels may deter growth in university enrolments. Shifting the burden of financing from tuition to taxation implies a greater gain for higher- rather than lower-income families, at least from the benefit perspective. Although the impact of this differential benefit is decreasing, due to the moderate tendency toward convergence in the participation rates across family income groups, there is still a substantial difference based on family income. Government grants to children of lower-income families to offset concern about high tuition may be a more-equitable approach to funding university education than increasing taxation to provide across-the-board cuts in tuition. Also, greater attention to the underlying reasons for the continuing difference in participation rates across income groups raises future research questions that we could not address with our data.[19] However, we have provided some evidence that higher tuition levels impact negatively on university enrolments.

It is well established in the literature that parental level of education is a strong determinant of the decision to attend university. Knighton and Mirza (2002) reviewed this literature for Canada, using SLID data, and found that parental education may be a more important determinant than household income. Although we found evidence that both income and parental education are relevant factors, from a cross-section perspective, we determined that the role of parental education was substantially more important in explaining the long-term trend in university attendance rates. Given that an increasing fraction of the population holds some post-secondary education qualification, this factor feeds on itself. Our computations (e.g., see our calculations based on OLS results in Table 4) suggested up to 14.5% of the growth in university-attendance rates stems from the head of the household having attained some PSE qualification and 27.3% of the growth stems from the head holding a university degree. For governments hoping to encourage a greater fraction of the population to obtain a university education in order to reap the economic advantages of doing so at the macroeconomic level, this is good news. An increasing education level for the country will lead to an increasing rate of university participation. Clearly, such an effect will by necessity have a limit, but it follows that if a government wishes to create a more highly educated workforce, then measuring the benefits of such expansion from a current set of programs should include the effect that more highly educated parents will enhance the likelihood of university attendance for individuals in future generations. In other words, programs that support adult participation in post-secondary education may improve the likelihood of their children attending university. At the same time, policy-makers may want to make an effort to understand why children from less-well-educated families are so much less likely to participate in university education, since this group will become an increasingly critical source of any potential growth in university attendance. Moreover, the differing rates of economic and social success associated with parental education point to important concerns with intergenerational equity.

There are many details about the relationship between family characteristics and other variables that influence an individual's decision to attend university. It is known, for example, that the usual relationship between the level of parental education and university attendance does not apply to the children of recent immigrants. Aydemir, Chen, and Corak (2008) focused on this issue and demonstrated that, despite the fact that the parent-child relationship differs for immigrants (because second-generation Canadians obtain several more years of schooling *ceteris paribus* than children of Canadian-born parents), the "intergenerational association in educational attainment, including overall average attainment, has been stable across all birth cohorts" (p. 20). Thus, although much research remains to be done, we believe our study of the long-term trends in university participation in Canada provides insights into the determinants of the growth in university attendance and allows for some policy-relevant considerations.

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ENDNOTES

1. For evidence that parental income is a much stronger determinant of who goes to university than to college, see Corak, Lipps, and Zhao (2003), Figures 9 and 10 (pp. 33 & 34). Higher costs and relative returns of attending university rather than college are demonstrated by Vaillancourt (1995), Table 3 (p. 544) and Table 5 (p. 548).
2. Coelli (2005b) also found that unanticipated negative shocks to family income reduce the likelihood of further education of children. Quirke and Davis (2002) considered the importance of tuition fees and family background for students attending the University of Guelph, while Mueller and Rockerbie (2005) looked at factors that determine demand for university education in Ontario.
3. See Christofides, Hoy, and Yang (2008) for details on this and other robustness checks. Of particular note is a check for endogeneity of the Tuition variable, which was not adopted since using past levels of tuition yields very similar results.
4. Note in Table 2 that although the increasing participation rate applies for all income groups, the absolute increase is strongest for lower-income families.
5. See Andres and Adamuti-Trache (2007) for a detailed breakdown by field of study on the evolving gender gap in university attendance for the years 1979 to 2004.
6. The tuition levels for each province are BA tuition from the largest university in that province, based on selected years' data from Statistics Canada's Survey of Tuition and Living Accommodation Costs for Full Time Students at Canadian Degree-granting Universities.
7. Due to restrictions imposed in the master files of SCF, 1975 could not be used and 1977 became the starting point for the current research. Data for 1976, 1978, 1980, and 1983 were not used either, as these were small-sample years of the SCF.
8. In the case of Tuition, Income, Children, and Time Trend, we experimented with various powers of these variables in order to capture important nonlinearities. We reported the statistically most successful implementation of this general-to-particular strategy, but the qualitative nature of our results did not depend on this choice.
9. Frenette (2006) used postal code information to determine distance to the nearest university. He found that children whose family home was "out of commuting distance" – particularly children from lower-income families – were significantly less likely to attend university. Our data set did not allow such detailed information and so the Urban variable acted as an approximation. See also Card (1995).
10. The SCF defines the husband as the head of the family, while SLID selects the major earner. We used the detailed information in the master files to extend the SCF convention into the period covered by SLID, selecting the

husband as the head where this was not the case, in order to maintain consistency in this variable.

11. Using census data, Aydemir, Chen, and Corak (2008) also found near-perfect multicollinearity between mothers' and fathers' education; due to the problem of estimating separate effects, they also dropped the mother's education as an explanatory variable (pp. 16–17).
12. Robb, Magee, and Burbidge (2003) examined SLID and LFS in their role as successors to SCF. They concluded that, for the purposes of studying the education premium, it was reasonable to merge data from SCF and SLID.
13. Bar-Or, Burbidge, and Robb (1995) discussed the relationship between the criterion of 11–13 years of schooling and high school graduation. They also explored (see their Figure 6) the difference between definitions using limited experience (e.g., 5 years), as we did, and those using a much broader concept (e.g., up to 40 years of experience as implied by use of the 25–64 age group). By defining the university premium using the broad-experience concept (instead of 1 to 5 years of experience), their work resulted in a time series for the premium that was very flat over time. By contrast, their Figure 6 for 1 to 5 years of experience had a clear upward trend. We would argue that the decision to attend university is more likely based on the relative earnings of young adults, rather than on those who finished their education a long time ago.
14. For a discussion of Limited Dependent Variable models and Count models in particular, see Greene (2002).
15. This is the marginal effect of switching on this dummy variable.
16. Structural homogeneity tests reject the aggregation of regions into the Canada-wide equations.
17. See Mueller (2008) for a comprehensive survey of studies of PSE attainment in Canada.
18. See Coelli (2005a; 2005b) and Neill (2005) for studies covering a shorter time period and Heller (1997) for a summary of U.S. evidence on the tuition effect.
19. See Corak, Lipps, and Zhao (2003) for documentation on the trend to differential PSE participation by family income. Frennette (2007) provides an engaging investigation into the reasons for this effect, using the more-detailed information available in the Youth in Transition survey, albeit covering a shorter time period.