Tuition Increases and Inequality in Post-Secondary Education Attendance

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Abstract

Universities and colleges in several Canadian provinces increased tuition markedly over the 1990s, while some provincial governments instituted tuition freezes. Any negative impacts of these cost increases on the decision to attend post-secondary education (PSE) may be larger for those least able to pay for PSE - those from low income families. Information on youth from the Canadian Survey of Labour and Income Dynamics (SLID) was employed to analyze the relationship between tuition and attendance by parental income. Comparisons between youth from Provinces that increased tuition sharply in the second half of the 1990s and youth from Provinces that instituted tuition freezes were key to identifying impacts. The impact of factors affecting the aggregate supply of and demand for PSE places, such as government funding and cohort size, were also ascertained. Both difference in differences and multi-nomial logit model estimates suggest that tuition increases have increased inequality of attendance at universities in Canada, but not altered inequality of attendance at the other PSE (college, etc.) level.

*The statistical analysis presented in this document was produced from Statistics Canada microdata. The interpretation and opinions expressed are those of the author and do not represent those of Statistics Canada.

1 Introduction

The education level of individuals is strongly related to labour market earnings and to various measures of health and wellbeing. Ensuring equality of access to education possibilities is thus a key component in establishing equality of individual outcomes. Tuition fees at universities and colleges are a direct cost to youth of obtaining post-secondary education (PSE) in the US and Canada in particular. Revenue from these fees are an important component in funding places at PSE institutions. Tuition increases may thus have two competing impacts on whether youth attend PSE. Higher tuition fees may discourage some youth from attending, as direct costs have risen. Increased tuition revenue at PSE institutions may also encourage institutions to provide more places for prospective students given government support levels, reducing any existing rationing. Determining the impact of tuition increases on equality of access to PSE is important when analyzing the full impact of any such tuition increases. This paper focuses on determining this impact.

Government subsidization of education at the PSE level often takes the form of tuition fees being set at below the full cost of providing the education. One main argument for such subsidization is to ensure education is affordable for all youth, irrespective of family background. Markets for education services may not clear at below-cost tuition levels, if more youth demand places at these subsidized levels than there are places made available by PSE institutions. The number of available places will be reliant on the level of government support.

The education attainment of youth in the vast majority of countries is strongly related to family background, particularly to income and education levels of parents[1]. The negative impact of tuition increases on the demand for attending PSE may be larger for those least able to pay - those from low income families. On the other hand, reduced rationing of PSE places may raise the probability of youth from low income families being accepted at a PSE institution. Limited PSE places are generally rationed using the measured high school achievement (grades) of applicants. Achievement reflects family background, as youth from wealthier back-

[1] Shavit and Blossfeld (1993) have put together studies documenting this relationship for 13 countries, including Canada and the US.

grounds may receive more support both in school and prior to attending school. Inequality of PSE attendance may not increase as tuition increases, if the demand elasticity is not large. In addition, PSE institutions may use any increased tuition revenue to provide scholarships or bursaries to less-advantaged youth directly. The question of whether tuition increases have raised inequality of education attainment must be answered with empirical evidence.

Universities and colleges in several Canadian provinces increased tuition markedly over the 1990's, while some provincial governments instituted tuition freezes over the same period. This sharp contrast in tuition changes provides a reliable means for identifying the impact of tuition changes on inequality in PSE attendance. The analysis conducted here employs data on individual youth from the Canadian Survey of Labour and Income Dynamics (SLID). This Survey provides information which is well-suited to this analysis. Accurate measures of the income and education levels of parent of Canadian youth can be constructed, and the education decisions of youth can be observed over several years. A number of recent studies have attempted to uncover the impact of tuition increases on education attendance inequality in Canada. The ability of these studies in properly analyzing the tuition-attendance relationship have been hampered by data limitations. This analysis is the first to employ both panels I and II of the SLID to test whether recent large tuition increases have increased inequality of access to PSE for Canadian youth.

Empirical studies of the US experience generally found a small negative relationship between tuition levels and PSE attendance, with youth from less advantaged backgrounds most sensitive to changes in tuition levels[2]. Many of the US studies, however, employed cross-sectional variation in tuition levels only (across US states), and may not have adequately controlled for cross-state differences in unobserved characteristics of PSE opportunities. In addition, a sharp contrast in tuition changes that is comparable to the recent Canadian experience has not occurred in the US[3].

Estimates of the tuition-attendance relationship in the US may reflect the education and so-

[2]See Heller (1997) for a review of the US literature. There has recently been disagreement in the US economics literature, however, on whether PSE tuition levels really matter for inequality of education attainment.

[3]This is especially true when confined to periods for which there is good data on the education decisions of US youth available.

cial structure in that country only, and may not adequately represent the Canadian experience. For example, Canada may have a more equitable school structure than in the US, with high school achievement less variable across the population. Results from international studies of school student achievement highlight the much larger variance in achievement in the US than in Canada. A careful analysis of the Canadian tuition-attendance relationship thus appears of considerable value. The results are of value beyond the Canadian experience, given the strong data variation it provides. US policymakers may also see value in measures of the impact of tuition on inequality in a jurisdiction where high school achievement is more equal across family background groups. Several important policies in the US have been implemented over the past few decades with the goal of improving equality in high school achievement.

The results of this analysis do show evidence of tuition increases being correlated with increases in inequality of university attendance. The probability of university attendance for youth from low income backgrounds is negatively related to tuition levels while youth from middle and high income backgrounds do not respond significantly to tuition levels. Inequality of attendance at other PSE institutions (college, etc.) has not been affected by changes in tuition levels.

The outline of the paper is as follows. A short description of the Canadian PSE experience is presented in Section 2, along with a review of Canadian studies of PSE attendance. The US literature on tuition, PSE attendance and inequality is reviewed in Section 3. A standard economic model of the PSE attendance decisions of youth is described in Section 4. The SLID data set is described in Section 5, along with a description of the main measures employed in the analysis. Difference in differences estimates of the impact of tuition increases on inequality in PSE attendance are presented in Section 6. Section 7 summarizes the results of multi-nomial logit model estimates of PSE attendance decisions. I discuss several extensions to the basic attendance model in Section 8. Section 9 concludes.

2 The Canadian Experience and Literature

The vast majority of universities and colleges in Canada are publicly owned. Provincial governments control funding of these institutions, particularly with regards to the educational component of their operations. If desired, they can also exercise control over tuition and enrolment levels at institutions. The Canadian Federal government also provides funding to PSE institutions, but mostly to fund the research component of their operations. The Federal government also provides funding directly to students, via student loans (or loan guarantees) and scholarships. The direct control of PSE institutions remains in provincial government hands.

As noted above, universities and colleges in several Canadian provinces increased tuition markedly over the 1990's, particularly in Ontario, Alberta and Nova Scotia. Tuition fees were deregulated in several provinces. The Quebec and British Columbia provincial governments, however, instituted tuition freezes over this period. Universities and colleges in those two provinces could not raise tuition levels during the freeze. British Columbia lifted the freeze in 2002, while in Quebec, tuition has still not increased since the mid-1990s[4]. Provincial average university tuition increases ranged from minus 4% to plus 64% from 1995-96 to 2001-02, while college tuition increases ranged from minus 5% to plus 200% over the same period. Movements in provincial average real tuition levels at universities and colleges are illustrated in Figures One (a) and (b).

The 1990s tuition increases were often rationalized by the need to increase supply of PSE places to meet growing demand. Labour market returns to higher education remained high in Canada over the period. At the same time, provincial government funding remained stagnant or fell in real terms over the 1990s (see Figure Two), as did government funding of most expenditure categories over the 1990s. Aggregate enrolment at PSE institutions in Canada stagnated over the 1990s, but it did not fall (see Figure Three). Overall education attainment of Canadian youth does not appear to have been negatively affected by the increases in tuition in many provinces. Measuring the impact of these tuition increases on the inequality of education attendance, however, is important when determining the full impact of such policies on

[4]The Quebec government is currently reviewing the freeze.

Canadian youth.

Studies of the determinants of university and college attendance in Canada are not prevalent, but there are several recent attempts. Corak, Lipps and Zhao (2004) analyzed the relationship between family income and attendance of youth at PSE institutions in Canada using data from the Survey of Consumer Finances (SCF) and the General Social Survey (GSS). They found no evidence of rising inequality in PSE attendance in Canada as a whole at either the university or college level over the late 1990s. The late 1990s saw large increases in tuition levels in many provinces. This study updated the results of Bouchard and Zhao (2000) using the GSS for 2001, finding a small improvement in equality of attendance over the 1994 to 2001 period. Inequality deteriorated from 1986 to 1994, however. Due to small sample sizes in the GSS, no analysis could be conducted at the province level. The GSS provides no direct measures of parental income either. Socio-economic status derived from parental occupation and education levels was employed as the measure of family background. No deterioration in inequality of attendance was observed over the 1990s employing data from the SCF either[5]. A significant restriction on the usefulness of the SCF data is that parental income could only be measured for youth who live at home, potentially biasing any results.

Butlin (1999) found that high school grades had a large impact on university attendance. Only those youth with grades above some particular level are generally accepted at university. However, grades may reflect the motivation students have for attending university in the future. If some students do not believe that they will be able to attend university given their family circumstances, the motivation to study hard at school may be reduced. In other words, high school grades may be endogenous. Including grades in estimation may confound estimates of the impact of parental income and tuition on university attendance.

The SLID has been employed by several researchers to analyze particular aspects of the higher education decisions of Canadian youth. Frenette (2002, 2003) highlighted the strong impact of distance from the family home to the closest university and college in determining attendance. Knighton and Mirza (2002) analyzed the simultaneous impacts of parental educa-

[5]The analysis using the SCF updated and improved upon earlier work by Christofides, Cirrello and Hoy (2001).

tion and parental income on attendance at PSE institutions in Canada. These two studies did not test directly whether tuition increases impacted inequality of PSE attendance.

3 The US Literature

There is a vast US literature on inequality in college attendance[6], particularly with regards to visible minorities. Some examples are given in the survey of Haveman and Wolfe (1995). The overriding conclusion drawn from this literature is that parental income and education matter in the education attainment of youth. Once differences in these family characteristics are controlled for, visible minorities are no less likely to attend college than other youth.

Heller (1997) updated the influential Leslie and Brinkman (1987) survey of US studies on the impact of tuition fees and financial aid on the demand for higher education. The main conclusions of this survey are: (a) tuition increases and financial aid decreases lead to declines in enrolment, (b) enrolment is more sensitive to changes in grants than to changes in loans or work-study, (c) youth from low income backgrounds are most sensitive to tuition and financial aid changes, (d) black students are more sensitive to tuition and financial aid than white students, and (e) students in community colleges (two-year courses) are more sensitive to tuition and financial aid changes than those at four-year colleges and universities.

The importance of parental income in determining the education attainment of youth is commonly given the interpretation that youth face borrowing constraints when making investments in education. Cameron and Heckman (2001) challenged this conclusion. The authors estimated a sequential grade transition model of education attainment using data from the 1979 US National Longitudinal Survey of Youth (NLSY). A statistically significant impact of parental income on college attendance conditional on high school graduation was found, even after controlling for the effects of dynamic selection bias. However, including Armed Forces Qualifying Test (AFQT) scores led to parental income no longer being a statistically significant determinant of college attendance. The authors interpret this finding as evidence

[6]This includes attendance at four year colleges, which is the equivalent of university in Canada. Attendance at two year colleges in the US is comparable to college attendance in Canada.

that short term liquidity constraints play no significant role in college attendance decisions and claim tuition subsidies have no appreciable impact on inequality in college attendance. Early learning outcomes are much more important, so policies aimed at earlier youth outcomes will have a larger impact on inequality in education attainment.

Keane and Wolpin (2001) also show (using the same NLSY data) that the parental income-education attainment relationship is compatible with a model where borrowing constraints have little impact on college attendance. They do, however, have a large impact on hours of work and consumption levels while in college. In other words, borrowing constraints are very tight in their estimates, but do not impact the college attendance decision to any significant degree. Tuition subsidies do affect attendance in their estimates, and they affect less-advantaged youth most, which is consistent with the literature reviewed by Heller (1997). Tuition levels appear to impact the desirability of attendance directly (a price impact) rather than via altering borrowing constraints. Keane and Wolpin (2001) argued against including AFQT scores in estimation. Test scores may actually reflect future expected borrowing constraints, as effort while in high school (which increases AFQT scores) may be related to future PSE opportunities. Keane and Wolpin (1997) found that tuition subsidies can change behaviour in high school, increasing high school attendance rates.

Hilmer (1998) analyzes the impact of tuition levels on the decision of youth to start education at a university (4 year course), community college (2 year course), or neither. A model employing the assumption that the attendance decision is based on the probability of course completion yields a natural ordering of the three options. Ordered probit estimation was conducted based on this natural ordering. Results suggested that own price effects were negative, while cross-price effects were positive.

4 A Model of the PSE Attendance Decision of Youth

Formal economic treatment of the education attendance decisions of youth dates back to the influential work of Becker in the 1960s[7]. Youth make an economically rational decision on

[7] See Becker (1967, 1975), for example.

whether to undertake further study by weighing expected benefits against costs. Expected benefits of higher education include higher salaries, lower unemployment rates, more interesting work, higher occupational prestige, and perhaps utility directly from studying. Costs include direct outlays such as tuition, books, supplies, and potentially the higher costs for travelling and living away from home. A major indirect cost is the income forgone while studying.

A major potential constraint on youth attaining their individually optimal level of education is the incompleteness of loan markets for funding education investments. Private lenders are generally unwilling to lend to youth to finance education, as human capital cannot be repossessed by lenders if default occurs. Returns on educational investments are also uncertain, particularly as they depend on the effort of individuals both during study and during their working lives. Governments and even individual PSE institutions often provide student loans (or loan guarantees) and some non-repayable grants to students to minimize this loan market incompleteness[8].

Youth wishing to attend PSE may respond in a number of ways to tuition increases. They may decide to: (a) not attend, (b) attend a cheaper PSE institution (e.g. college instead of university), (c) attend closer to home and live with parents at lower cost, (d) obtain higher levels of support from parents if possible, (e) increase borrowing if available, (f) delay study until after working and saving, and / or (g) work more while studying.

The empirical analysis conducted here focuses on the attendance decision. I consider several extensions of the basic model in Section 7 below. This includes an analysis of the residence (live with parents or not) and the hours of work decisions of students. The impact of tuition increases on the attendance decision alone may not capture the full impact of those increases. Youth may respond by working more while studying, lengthening degree completion times and reducing academic performance. If youth choose to attend an institution closer to home and remain living with parents, it may put added pressure on parents. The program at the

[8]Canadian federal and provincial governments provide student loans (or loan guarantees), some non-repayable grants and scholarships to needy students. Such provision may be another form of subsidy to encourage attendance beyond individually rational levels if there exist education externalities. Many universities also provide scholarships and bursaries directly to students.

institution closer to home may also not be the best match for the student. Analyzing these additional responses to tuition increases may be required to identify the full impacts of tuition increases on youth from different family backgrounds.

4.1 The Model

A simple discrete-choice model of PSE attendance is considered here. This model follows Keane (2002). For more details of derivations of the model, see Coelli (2004). The main objective of describing the model is to motivate the empirical analysis to follow. A model with no borrowing constraints will be discussed first, with constraints added soon enough. The features of the model are as follows.

(a) Agents live for an infinite number of discrete time periods.

(b) Agents have per period preferences over consumption c and leisure l, represented by $u(c, l)$, concave in both arguments.

(c) Agents are endowed with L units of time each period, so $0 \leq l \leq L$.

(d) In period 1, agents decide whether or not to attend PSE. Tuition costs are τ, while PSE requires s units of time. Agents receive direct utility from PSE attendance of ϕ.

(e) In period 1, agents can choose to work any feasible $h \geq 0$ units of time at wage rate w_1. They also receive a transfer payment y_1 from parents[9].

(f) In every other period, agents inelastically supply one unit of time to work. The discount factor on future periods is $\beta = 1/(1 + \rho)$. If the agent attended PSE in period 1, they earn wage $w_2 + \pi$ each period. If not, they earn w_2.

(g) Agents can choose to borrow any amount b in period 1. From period 2 on, they make fixed annuity payments of rb on the loan (b can be negative).

[9]These transfers will be a function of parental wealth, number of siblings, etcetera.

Lifetime utility of an agent who attends PSE is:

$$V_s = \max_{\{h,b\}} u(y_1 + w_1 h + b - \tau, L - h - s) + \phi + \sum_{i=1}^{\infty} \beta^i u(w_2 + \pi - rb, L - 1)$$
$$= \max_{\{h,b\}} u(y_1 + w_1 h + b - \tau, L - h - s) + \phi + \rho^{-1} u(w_2 + \pi - rb, L - 1) \quad (1)$$

Thus our infinitely lived agent model is essentially only a two period model in this framework, simplifying the analysis considerably. Lifetime utility for an agent who chooses not to attend PSE is:

$$V_o = \max_{\{h,b\}} u(y_1 + w_1 h + b, L - h) + \rho^{-1} u(w_2 - rb, L - 1) \quad (2)$$

These two maximization problems can each be solved for optimal h and b[10], subject to $0 \leq l \leq L$. Assuming an interior solution for both h_s and h_o, we can use the point of indifference between attending PSE and not ($V_s = V_o$) to construct an approximate[11] decision rule for PSE attendance. The agent chooses to attend PSE if:

$$\frac{\pi}{r} + \frac{\phi}{u_{c1o}} \geqslant \tau + w_1 s \quad (3)$$

The term u_{c1o} is the marginal utility of consumption in period 1, evaluated at the consumption level given non-attendance. Equation (3) highlights the direct trade-off between the benefits of a PSE education (wage premium π) versus the costs of tuition and income foregone. The direct utility from PSE attendance ϕ is appropriately weighted by the marginal value of an extra dollar of consumption.

In this model with no borrowing constraints, the only role for parental transfers in the attendance decision is via the direct utility from attendance. Raising y_1 lowers u_{c1o} given decreasing marginal utility, raising the relative benefits of attendance[12]. Note that parental transfers here are not contingent upon the youth attending PSE. Contingent transfers will be discussed below.

[10] Optimal levels for these two decisions will not necessarily be the same for PSE attenders and non-attenders.

[11] Keane (2002) generated this approximate decision rule employing a first order Taylor series approximation around the point of indifference.

[12] If the agent has dis-utility from university attendance ($\phi < 0$), higher parental transfers will result in a lower probability of attendance. Thus extra income assists the agent in avoiding this dis-utility.

The PSE wage premium π and the utility of attendance ϕ can be treated as unobserved variables, heterogeneous across the population. Such treatment generates a random utility model. Some agents may have very large dis-utility from attendance, if effort required to complete study is large. These agents may choose not to attend even when the expected monetary payoff appears large. In addition, larger parental transfers, raising ϕ/u_{c1o}, imply that the reservation level of π for attendance is lower. This in turn implies that, on average, the return to PSE should be lower for agents with wealthier parents.

Now consider the case where there are borrowing constraints in period 1. Agents cannot borrow in period 1 unless they attend PSE. There is also a limit on borrowing given attendance of some fraction θ of tuition level τ. Equivalently, a limit based on total PSE costs $\tau + w_1 s$ could have been assumed[13].

Consider the case where the constraint binds[14], and all students borrow $\theta\tau$. Also, assume non-students are constrained to borrow nothing. The borrowing constraint for non-students will be binding if:

$$u_{c1o} > \frac{r}{\rho} u_{c2o} \tag{4}$$

Here, u_{c2o} refers to the marginal utility of consumption in all periods after period 1. Solving for optimal h_s and h_o, and working from the point of indifference $V_s = V_o$, the approximate decision rule is now:

$$\frac{\pi}{r} \left[\frac{r}{\rho}\frac{u_{c2o}}{u_{c1o}}\right] + \frac{\phi}{u_{c1o}} \geqslant \theta\tau \left[\frac{r}{\rho}\frac{u_{c2o}}{u_{c1o}}\right] + \tau(1-\theta) + w_1 s \tag{5}$$

If the borrowing constraint is binding, the term in the square brackets is necessarily less than one. Taking the simplest case where utility from attendance ϕ is zero, the presence of borrowing constraints makes it less likely that agents will choose to attend. The left hand side of the inequality in equation (5) is reduced more than the right hand side[15]. Increasing parental transfers y_1 will increase the term in square brackets towards unity, mitigating the borrowing constraint and making attendance more likely.

[13] Borrowing constraints which are fixed at any level less than total costs of university attendance will also yield results with the same interpretation.

[14] If the constraint does not bind, the problem collapses to the case above.

[15] If all PSE costs ($\tau + w_1 s$) could be borrowed, attendance may be more likely if ϕ is positive.

As it stands, nothing in equation (5) predicts that a higher proportion of less wealthy agents will choose not to attend PSE as tuition rises. The proportion of agents at the margin of the decision rule, given parental transfers y_1, is a function of the distributions of the unobservable heterogeneous variables ϕ and π. Tuition increases may not necessarily increase inequality in attendance.

However, if parents choose to make a transfer y_s contingent upon the child attending PSE, it directly lowers the cost of attendance, just like a tuition subsidy or a government grant. The decision rule would be:

$$\frac{\pi}{r}\left[\frac{r}{\rho}\frac{u_{c2o}}{u_{c1o}}\right]+\frac{\phi}{u_{c1o}} \geqslant \theta\tau\left[\frac{r}{\rho}\frac{u_{c2o}}{u_{c1o}}\right]+\tau(1-\theta)+w_1 s-y_s \tag{6}$$

If such transfers are important, the responses of youth to tuition increases may differ considerably by parental wealth. If parents obtain some discrete increase in utility if children attend PSE, contingent transfers are rational for parents[16]. Parents may find it optimal to raise transfers to overcome any tuition increases to keep their children at PSE. High wealth parents are able to absorb tuition increases while still benefitting from children attending. Parents with less wealth may not be able to absorb tuition increases without too large a reduction in their own consumption. Casual observation suggests that contingent transfers are common.

5 The SLID Data

The Survey of Labour and Income Dynamics (SLID) is a household-level longitudinal survey of Canadians. Approximately 15,000 Canadian households are chosen for inclusion in the Survey every three years. Once a household is chosen for inclusion in the survey, all members of the household at the time of first interview are denoted as longitudinal respondents. Each longitudinal respondent is interviewed annually for six years, even if they leave the household at any stage during the period[17]. Interviewing survey respondents annually irrespective of where they live is especially important for this study, as youth of school leaving age may

[16] See Coelli (2004) for a discussion of the rationality of contingent parental transfers.

[17] Individuals who enter a household where a SLID longitudinal respondent resides during this six year period are also interviewed, but are not longitudinal respondents and are not included in this analysis.

leave the parental home to either work or study. This analysis requires information on the PSE attendance decisions of youth just prior and following high school. Youth who leave the household are followed to their new residence and surveyed in the same manner as youth who remain in the parental home.

The first longitudinal panel of the SLID runs from 1993 to 1998. The second panel runs from 1996 to 2001. A third panel was begun in 1999. Data from 1993 to 2001 are currently available for analysis[18]. Outcomes for youth from panels one and two are analyzed here. In this analysis, youth will first be observed at age 16, when they are still in high school, prior to making their own decisions on education attendance. At this age, the vast majority of youth still live with at least one parent (around 98%). Accurate family background information is thus obtained for the vast majority of youth in the sample. The education decisions of these youth will then be observed from age 16 until a maximum age of 20. By age 19 or 20, most Canadian youth have had the opportunity to obtain the education pre-requisites for university and college acceptance.

5.1 Construction of Measures Employed in the Analysis

The main focus of this study is the post-secondary education (PSE) attendance decisions of youth, and the relationship with parental income. PSE attendance is identified as follows for each youth.

- Attended university - if youth attended university for any length of time and at any age from 16 up to and including the second year after normal completion of university entrance requirements.

- Attended other PSE only - if youth ever attended a college, *CEGEP*[19], business school, trade school or vocational course at any age from 16 up to and including the second

[18] Access to the full SLID data was made possible via Statistics Canada's Research Data Centre (RDC) at the University of British Columbia.

[19] The Quebec college system, collège d'enseignement général et professionel.

year after normal completion of university entrance requirements, but never attended university over the same period.

- Attended any PSE - if either of the above two items are true.

The second year after normal completion of university entrance requirements is defined as age 20 for youth from Quebec and Ontario, and age 19 for youth from one of the remaining eight provinces of Canada. The difference reflects the extra year of study in Ontario (grade 13) required for acceptance by many universities in that province[20]. It also reflects the Quebec system, where youth must attend a CEGEP for two years after grade 11 in order to attend university. A grade 12 education is generally required in all remaining provinces for university entrance. Children are required to enter grade 1 in the year they turn 6 in Canada.

To be included in this analysis, each youth in the SLID sample must be observed annually from age 16 up to 19 or 20, depending on the province of residence at age 16. Thus Quebec and Ontario youth aged 15 or 16 at the start of each panel, and those aged 14, 15 or 16 in the remaining provinces, are included in the analysis. The final sample employed covered 1,874 observations, from a potential sample size of 2,909. Of the final sample, 32% attended university, 36% attended other PSE only (not university), while the remaining 32% did not attend any PSE by the relevant age. See Appendix A for details of how the final sample was obtained.

Parental income was calculated as the average annual real[21] parental income after tax over the three years when the youth was aged 16, 17 and 18. The parentage of youth was determined by the family structure of the household when the youth was aged 16, i.e. whether the youth lived with both parents or only one at that age.

Living costs vary considerably across Canada. For example, rent is much higher in the city of Vancouver than in rural Saskatchewan. Statistics Canada constructs annual measures of Low Income Cut-offs (LICOs) which vary by family size and by size of the area of residence (four sizes of urban areas and rural areas separately). Differences in these LICO measures

[20]This requirement was dropped in 2003, but this is after the time period being studied here, which is 1993 to 2001.

[21]Nominal income measures were deflated by the Canada-wide CPI index.

between rural and urban areas reflect differences in costs of living. These measures were employed to adjust parental income for living cost differences prior to splitting youth into parental income quantiles. Youth were divided into three equal groups (high, middle and low) by average real after tax parental income in excess of the appropriate LICO measure for the household [22]. Low income youth were those with average 2001 dollar pre-tax annual parental income below approximately $40,000. High income youth were those with parental income above approximately $70,000.

The method of adjustment of parental income chosen here deserves further consideration. Prior research in this area employed alternative procedures for adjusting family income. Some researchers did not adjust parental income at all, such as Corak, Lipps & Zhao (2004) and Knighton & Mirza (2002). Researchers have also normalized family income by dividing it by the square root of family size[23] prior to analysis. This procedure was not followed here. Differences in family composition will be controlled for more flexibly in the analysis to follow, by including indicators of lone parents and measures of the number of children directly in estimation.

In response to observed differences in costs of living by the size of the place of residence, researchers have constructed their indicators of parental income quantiles separately by size of area of residence. For example, quantiles are constructed first for families from rural areas, then for families from small urban areas, etcetera[24]. This method may yield unexpected results if, for example, the vast majority of families in rural areas are actually low income. Constructing quantiles separately for rural residents will result in one third of those rural residents being identified as high income and another third as middle income, even if their income levels are significantly lower than those of families from the rest of Canada. The method of adjustment chosen here (income in excess of LICOs) will avoid such outcomes.

The method of adjustment chosen here will not account for observed difference in living costs between large cities such as high cost Vancouver and lower cost Montreal. However, ad-

[22] Youth were divided into these three quantiles for each panel separately using the appropriate weights in the SLID.

[23] Frenette (2003) is an example.

[24] Frenette (2003) constructed parental income quantiles in this manner.

justing income by city of residence may again yield unexpected results. Cost differences may reflect a desire of more people to live in Vancouver than in Montreal. High income individuals may use part of their higher income to live in the city of their choice, resulting in a correlation between living costs and income levels. Living in a large city may be required to obtain certain high income jobs, as certain workers may be more productive in cities, rationalizing the higher wages. Controlling for city versus rural differences in costs of living thus appears warranted. Controlling for differences between large cities is not justified if firms and individuals are free to make rational choices of where to locate[25].

6 Difference in Differences Estimators

6.1 Simple Measures of PSE Attendance Inequality

A simple measure of inequality in PSE attendance for youth is the ratio of the percentage of youth from wealthy backgrounds who attend PSE to the percentage for youth from less-advantaged backgrounds. This is referred to as the *Odds* ratio. A similar measure is the difference between these two percentages, referred to as the *Gap* measure. These two simple measures were constructed for the entire sample, and for the first two panels of the SLID separately, with the results presented in Table 1.

For the entire sample, high income youth are 2.25 times as likely to attend university than low income youth. This difference is non-existent for attendance at other PSE institutions (mostly colleges) only. In fact, low and middle income youth are more likely than high income youth to attend other PSE. Overall, high income youth are most likely to attend any type of PSE institution due to their much higher probability of attending university. Over this entire sample period, Canada is a considerable distance from equality in PSE attendance.

There is no evidence that these inequality measures deteriorated over the second half of the 1990s for Canada as a whole. In fact, the measures improved slightly from panel one to panel two of the SLID. The included panel one youth would normally enter university from 1995 to

[25]There would be justification if workers are much more productive in Vancouver than Montreal based on locality alone. This seems unlikely.

Table 1: **Odds and Gap Measures of PSE Attendance Inequality**

	Prob. attendance				
Attending	Low	Middle	High	Odds	Gap
Both Panels					
University	19.5	30.6	43.9	2.25	24.4
Other PSE	36.1	38.8	32.8	0.91	-3.3
Any PSE	55.6	69.4	76.7	2.13	21.1
Observations	1,874				
Panel 1					
University	18.8	31.8	45.8	2.43	26.9
Other PSE	32.4	37.1	27.5	0.85	-4.9
Any PSE	51.3	68.9	73.2	1.43	22.0
Observations	958				
Panel 2					
University	20.2	29.3	42.0	2.08	21.8
Other PSE	39.6	40.6	38.0	0.96	-1.6
Any PSE	59.8	69.9	80.1	1.34	20.2
Observations	916				

1997; the panel two youth from 1998 to 2000. The *Odds* measure for the university attendance of high income versus low income youth improved from 2.43 to 2.08 over the period. This overall improvement co-incides with the findings of Corak, Lipps and Zhao (2004) employing an alternative data set.

6.2 The Estimators

Two difference in differences (D in D) estimators of the impact of tuition changes on inequality in PSE attendance were constructed. These estimators will be employed to test whether inequality in PSE attendance increased over the late 1990s in provinces where PSE institutions raised tuition relative to provinces that instituted tuition freezes. They employ the *Odds* and *Gap* measures of inequality respectively, and will be valid tests if all observable and unobservable characteristics of youth are randomly distributed. The estimators control for any fixed provincial impacts on the probability of attendance, and for any Canada-wide trends in any explanatory variables.

Youth were first divided into three parental income groups as described above. They were further divided into two provincial regions[26]: those that instituted tuition freezes throughout the second half of the 1990s (Quebec and British Columbia) and those that did not. The average nominal university tuition increases over the second half of the 1990s in those eight remaining provinces ranged from 20% in Manitoba to 60% in Ontario. For colleges, tuition increases were even larger. They ranged from 33% in P.E.I. to 200% in New Brunswick. Youth were finally divided into two time periods: observations from panel one and panel two of the SLID.

The following difference in differences estimator employing the *Odds* ratio was constructed:

$$\Delta_o = \left[\left(\frac{P_{hr2}}{P_{lr2}}\right) - \left(\frac{P_{hf2}}{P_{lf2}}\right)\right] - \left[\left(\frac{P_{hr1}}{P_{lr1}}\right) - \left(\frac{P_{hf1}}{P_{lf1}}\right)\right] \tag{7}$$

In equation (7), P_{ijt} refers to the probability of PSE attendance for youth from parental income group i in provincial region j in time period t. The subscripts h and l refer to youth from the highest and lowest parental income groups respectively. The subscripts f and r refer to the groups of provinces that froze tuition and those that raised it respectively. The subscripts

[26]This division was made based on the province of residence at the end of the year that the youth turned 16.

1 and 2 refer to youth from panels one and two of the SLID respectively. If the difference in differences estimate (Δ_o) is positive and statistically different from zero, it suggests that tuition increases have coincided with an increase in inequality in PSE attendance.

The difference in differences estimator based on the *Gap* measure (Δ_g) is of the same form as equation (7) above, with the ratios of probabilities replaced by differences. For example, the ratio (P_{hr2}/P_{lr2}) is replaced by the difference ($P_{hr2} - P_{lr2}$). The two estimators may yield conflicting results if there is a significant overall trend in the probability of PSE attendance in Canada over this period. Aggregate measures of attendance suggest that this has not been the case (see Figure Three).

6.3 Results

Difference in differences estimates of the impact of tuition increases on PSE attendance inequality are provided in Table 2. Tests of the statistical significance of the estimates, versus the null hypothesis of a zero difference, are also provided. Estimates are constructed for high versus low income youth, high versus middle income youth, and finally for middle versus low income youth[27].

For university attendance, there is evidence of an increase in inequality over the late 1990s in provinces that raised tuition relative to those that did not. Both the *Odds* and *Gap* estimates are large in size and positive for high versus low income youth, and for middle versus low income youth. They are only statistically significant at the 15% level, however. The large estimates are the combined effect of increased inequality in provinces that raised tuition and reduced inequality in provinces that instituted tuition freezes. As noted above, over Canada as a whole, the inequality measures did not deteriorate over this period. To properly measure the impact of tuition increases on inequality it was necessary to look separately at provinces that

[27]The estimates and the associated tests of significance were constructed by estimating linear probability models of indicators of attendance on twelve dummy variables (no constant) denoting the twelve observation cells described above. The cells are: three income groups times two provincial regions times two time periods. Standard errors were adjusted using the White procedure for potential heteroscedasticity. Probability weights were used in estimation, to take account of the stratified nature of the SLID sample.

Table 2: **D in D Estimates of Tuition Impacts on PSE Attendance Inequality**

	Odds Ratio			Gap Measure		
Attending	Estimate	F statistic	P-value	Estimate	F statistic	P-value
University						
High vs Low	4.04	2.40	0.122	22.8	2.32	0.128
High vs Mid.	-0.10	0.02	0.887	-1.4	0.01	0.929
Mid. vs Low	3.03	2.27	0.132	24.2	2.83	0.093
Other PSE						
High vs Low	0.08	0.04	0.845	0.2	0.00	0.992
High vs Mid.	0.26	0.58	0.446	5.2	0.11	0.741
Mid. vs Low	-0.16	0.11	0.736	-5.0	0.09	0.763
Any PSE						
High vs Low	0.45	1.47	0.225	22.9	2.01	0.157
High vs Mid.	0.06	0.08	0.779	3.8	0.08	0.779
Mid. vs Low	0.40	1.28	0.258	19.2	1.48	0.224
Observations	1,874					

raised tuition versus those that did not.

For other PSE attendance, none of the estimates are large, or even close to being statistically significant. Some are even negative in sign. This may reflect individuals switching from university to other PSE in provinces that raised tuition, as tuition levels remained lower at colleges (the bulk of other PSE attendance for youth in Canada) than at universities in all provinces.

7 Decision Rule Estimation

In this section, the model outlined in Section 4 is employed as a basis for developing attendance decision rules that can be estimated using standard limited dependent variable techniques. If

the assumption that characteristics of youth are randomly distributed across individuals is relaxed, controlling for these characteristics will be important when testing the impact of tuition increases on inequality in PSE attendance. The multi-nomial logit technique was employed to estimate the PSE attendance decision of Canadian youth among the following three choices: (a) attend university, (b) attend other PSE (primarily college), and (c) not attend PSE at all. The two-option model of Section 4 can easily be expanded to this three-option choice. Youth will choose the option that maximizes their net expected lifetime utility. This technique places no ordering on the three choices, unlike the ordered probit technique employed by Hilmer (1998).

A list of covariates included in the decision rule estimates is provided in Table 3, along with sample summary statistics. The first parental education indicator denotes that neither parent (or the one parent if a single parent family) graduated from high school. The second denotes that at least one parent completed some kind of post-secondary degree, but neither completed a university bachelors degree or higher. The third indicator denotes that at least one parent completed a university bachelors degree or higher. There are four indicators for whether the residence of the youth at age 16 was further than forty and eighty kilometres from the nearest university or college (community college, CEGEP, etc.[28]).

The measures of real college and university tuition are averages across institutions within each province in the year that the youth would normally enter college or university respectively[33]. See Figure One for movements in tuition across provinces over the period.

The university provided financial aid variable captures the impact of scholarships and bursaries[34] on the demand for university education in certain provinces. This variable is calculated as the annual total amount of financial aid (in 2000/01 dollars) provided directly by universities in a province divided by the total number of full-time university students in that province and year. It thus measures the average expected amount of such financial aid for a youth attending

[28]Many thanks to Marc Frenette of Statistics Canada for providing databases of the postal zones of all these PSE institutions. See Frenette (2002, 2003) for details.

[33]Full time enrolments by university for academic year 1997-98 were used as weights during construction of the university tuition measure. College tuition by province is un-weighted, but there is little variation in college tuition fees within provinces.

[34]Separate measures of scholarship (merit-based) and bursary (need-based) funding were unavailable.

Table 3: **Summary Statistics for Regressors**

Variable	Mean	Standard Deviation
Female	0.484	
French mother tongue	0.222	
Aboriginal descent	0.024	
Parent immigrant[29]	0.239	
Visible minority	0.091	
Lone parent[30]	0.166	
Parents not graduate HS	0.114	
Parents other PSE only	0.445	
Parent completed university	0.203	
Real average parental income ($)	66,158	42,406
Children in family[31]	2.78	1.44
City resident ($\geq$ 100,000)	0.569	
Rural resident[32]	0.152	
University more than 40 km away	0.338	
College more than 40 km away	0.128	
University more than 80 km away	0.177	
College more than 80 km away	0.035	
Real college tuition ($100)	11.89	7.05
Real university tuition ($100)	28.93	7.84
Unemployment rate	8.37	2.87
University financial aid ($100 per stud.)	6.4	2.7
Province cohort size index (1993=100)	103.5	5.7
Province spend - universities ($100 per 18-24)	25.3	3.7
Province spend - colleges ($100 per 18-24)	12.6	7.3
Observations	1,874	

Sources: Survey of Labour and Income Dynamics and Statistics Canada (see Appendix B for details).

university. See Figure Five for movements in this variable over the period by province. All provinces witnessed an increase in this source of student financial aid over the 1990s, with by far the steepest increases in Ontario and Alberta. Strong increases in university tuition levels occurred in these two provinces over the same period, but large tuition increases occurred in other provinces also, especially Nova Scotia and New Brunswick[35].

The final three measures in Table 3 were included in extended estimates of attendance probabilities. These measures and their impact on PSE attendance probabilities will be discussed in the next section, where extensions to the basic model are discussed.

The estimation equations included gender-specific linear time trends[36]. Time trends will account for changes in the average expected PSE wage premium π[37], the future base wage rate w_2, the real long-run interest rate r, and rate of time preference ρ, common to all individuals. This model specification relies on there being an integrated labour market in Canada, with a common PSE wage premium, or a common trend in the premium across provinces. Direct utility from PSE attendance ϕ is proxied by many of the individual characteristics listed in table 3. Note that these characteristics may also impact any individual specific component of PSE wage premium expectations. The opportunity cost of time while studying $w_1 s$ is proxied by provincial unemployment rates[38], which reflect the probability of obtaining employment if youth do not attend PSE[39]. Empirical evidence suggests that school attendance is counter-

[35]The main sources of loans and bursaries for undergraduate students in Canada are the Canadian Student Loan Program (CSLP) and Québec's Aide financière aux études program. Eligibility for financial aid under both programs is based upon parental income, family size, place of residence and direct education costs (particularly tuition). Historic eligibility rules were employed to construct financial aid eligibility indicators for each individual in the sample. These measures were not included in the final analysis due to their very close relationship with the individual characteristics already included in the estimation equations.

[36]Estimates including gender-specific time dummies in place of linear trends did not change the results to any extent.

[37]Estimates of contemporaneous average wage premiums were constructed using SLID data, but showed no strong trend over the period under analysis. University premiums were higher for women than men, while other PSE premiums were higher for men.

[38]The unemployment rate refers to the provincial rate in the year the youth would normally enter PSE.

[39]Measures of alternative wages such as the minimum wage had no significant impact on attendance probabilities in preliminary estimates.

cyclical in Canada (see Beaudry, Lemieux and Parent (2001)).

Parental transfers (contingent or not) are assumed to be some function of parental wealth, proxied here by parental income[40] and number of siblings. The interaction of parental transfers and the costs of education such as tuition in the marginal utility terms of the attendance decision rules suggest either entering interacted parental income and tuition terms in the estimation equation (as in Raymond and Rivard (2003)), or separate estimation by parental income group. The second method is stressed in this analysis, due to the expected non-linear relationship between parental income and attendance.

Provincial region dummies are also included in the estimation equations to control for differences in PSE systems across Canada[41]. Certain degrees and diplomas require university attendance in some provinces while they require attendance at some other type of PSE institution in others. Attendance at university required two years of study at a CEGEP in Quebec. Students in British Columbia can study at a community college for two years after high school before transferring to university to complete their degree.

7.1 Estimation Results

Results of multi-nomial logit estimation of the three option PSE attendance choice of youth are presented in Tables 4 and 5 for attending other PSE and university respectively[42]. The marginal effects presented in the tables are the impact of each covariate on the probability of attending other PSE and university respectively. The marginal effects for the base case of not attending PSE are not reported for brevity. The effects were constructed as the predicted change in the appropriate probability from turning each indicator variable from zero to one. For continuous variables, the marginal effects reflect a one standard deviation increase in each

[40] No wealth measures are available in the SLID.

[41] The model was also estimated including the full set of provincial indicators, but the restriction of including four regional indicators only was easily accepted by the data.

[42] Standard errors were corrected for potential heteroscedasticity using the White correction, and for clustering by province and year. Several of the covariates employed here, such as tuition, are common to all observations in a province-year cell. Probability weights provided in the SLID were employed during estimation.

variable from the sample mean level[43]. These sample means and standard deviations were reported in table 3 above. All marginal effects were calculated with all indicator variables set to zero and continuous variables set to their sample means[44]. The standard errors on these marginal effects are presented in parentheses[45].

The marginal effects on attendance at other PSE institutions (primarily college) for all youth for which data are available are presented in the first column of numbers in Table 4. Indicators for parental income quantile are included in these estimates, but are not interacted with any other variables in the estimated equations. These estimates suggest that females are only marginally more likely to attend other PSE than males. Aboriginal descent, visible minority, immigrant parent and lone parent status have little impact on this choice also. The probability of other PSE attendance is lower if both parents have less than a high school education. Higher parental education levels have economically small impacts. Parental income levels also have economically small impacts despite estimated multi-nomial logit coefficients on these covariates being statistically significant. This suggests that there is little inequality in other PSE attendance rates overall in Canada, which is consistent with the raw attendance probabilities by parental income quantile reported in Table 1.

Tuition fee levels have the economically appropriate impacts on other PSE attendance. Higher college tuition lowers the probability of attending other PSE, providing evidence of a negative own price effect. A $705 increase in college tuition measured in 2000/01 prices from a sample mean level of $1,189 is predicted to lower the probability of a youth attending other PSE by 4.4 percentage points. Remember that approximately 36% of youth in this sample attended other PSE only by age 19 or 20. A one standard deviation increase in university

[43]The time trend was set to a value of three (third year in sample, which is 1997), and the children in the family variable was set to three also. The marginal effects for these two variables reflect an increase of one in each.

[44]Note that the marginal effect for the female indicator worked through both the estimated coefficient on the indicator itself and the female-specific time trend. The female time trend was set to zero for calculating all marginal effects except for the marginal effect of the female-specific trend itself. In this case the female trend was set at the value of three, the same value set for the overall time trend.

[45]The tests of statistical significance reported using asterisks (*) affixed to the marginal effects employed the standard t-statistics for the multi-nomial logit parameter values rather than the t-statistics for the marginal effects reported in the table.

Table 4: **MNL Marginal Effects - Other PSE Attendance**

Variable	All youth	Low Income	Middle Income	High Income
Female	2.2*	-9.3	5.9	2.8**
	(2.8)	(4.9)	(6.6)	(4.7)
French	4.9	6.4	-0.9	10.7
	(10.2)	(11.8)	(7.4)	(13.1)
Aboriginal descent	-2.7	7.5	-13.7**	29.2
	(7.6)	(19.3)	(6.3)	(26.7)
Visible minority	-1.5	-8.1	1.5	-6.1
	(5.7)	(4.9)	(16.5)	(8.1)
Immigrant parent	5	-7.1	-1.3	15.7***
	(7.2)	(5.6)	(9.0)	(11.2)
Lone parent	5.3	7.6	8.1	13.4
	(4.5)	(4.5)	(9.1)	(12.1)
Parents no HS	-9.2**	-1.6	-8.9	-3.4
	(4.3)	(7.2)	(8.3)	(6.3)
Parents other PSE	4.5*	1.2	6.5**	0.2
	(3.5)	(6.2)	(5.9)	(4.7)
Parent University	-2.8***	-1.3**	1.5***	-9.1
	(4.2)	(7.8)	(9.4)	(5.2)
Middle parent inc.	2.2**			
	(4.0)			
High parent inc.	1.4*			
	(5.1)			
Dependent children	-0.4	1	-0.5	-4*
	(0.9)	(1.4)	(1.9)	(2.3)
College tuition	-4.4**	4.5	-6.5	-4.1
	(2.7)	(7.3)	(4.8)	(5.0)
University tuition	4.9	13.6	5.6	13.9
	(5.3)	(10.9)	(10.5)	(10.6)

Table continued over page.

Table 4: **Continued: MNL Marginal Effects - Other PSE Attendance**

Variable	All youth	Low Income	Middle Income	High Income
City over 100,000	-2.7	6.3	-3.6	-5.2
	(2.9)	(6.9)	(5.3)	(5.6)
Rural	1.7	7.2**	-0.8	-4.8
	(2.9)	(7.4)	(4.6)	(5.4)
Univ. over 80km	-3	8.9	0.1	-4.8
	(3.6)	(8.2)	(6.4)	(5.4)
Univ. over 40km	1.2	0.2	-3.4	7.2
	(4.5)	(5.4)	(6.1)	(7.7)
College over 40km	-2.3	-9.4	5.3	-6.8
	(3.4)	(5.8)	(7.4)	(3.1)
Unemployment rate	-1.4	-3.1	-0.1	-0.2
	(3.6)	(5.4)	(5.5)	(4.2)
University financial aid	3.5	5	2.1	8.7**
	(3.0)	(5.8)	(4.4)	(6.1)
Atlantic	-3.8	8.9	-3.6	-9.7
	(8.6)	(18.7)	(13.2)	(6.5)
Quebec	37**	29	48.8*	57.2**
	(13.2)	(30.0)	(16.9)	(17.5)
Prairies	-0.8	7.6**	-0.6	11.3
	(4.5)	(8.0)	(10.5)	(10.1)
BC	0.7	4.9*	14.2	18.8
	(7.3)	(13.7)	(19.7)	(18.3)
Time trend	1.1	-3.6	-0.2	1.5
	(1.2)	(2.5)	(2.4)	(2.0)
Female time trend	-1.3	0.5	3.1	-5.1
	(1.2)	(1.3)	(3.7)	(2.2)
Observations	1,874	554	677	643

Note: One, two and three asterisks (*) denote statistical significance of the underlying estimated multi-nomial logit parameters at the 10%, 5% and 1% respectively. They do not reflect the statistical significance of these reported marginal effects.

Table 5: **MNL Marginal Effects - University Attendance**

Variable	All youth	Low Income	Middle Income	High Income
Female	18.7 (3.9)	22.4*** (10.2)	13.9 (5.7)	20.1 (5.0)
French	-5.4 (5.6)	-12.7 (14.6)	5.3 (12.9)	-17 (10.5)
Aboriginal descent	-14.1** (6.1)	-18.8 (33.3)	-13.4*** (6.8)	-18.4 (12.4)
Visible minority	17.8** (9.1)	21.3** (9.5)	-5.7 (5.0)	35.2** (15.2)
Immigrant parent	12.3*** (4.5)	15.5 (8.5)	18.6*** (8.3)	9.3 (12.9)
Lone parent	-6.8 (4.7)	-15.5 (9.9)	-5.7 (5.2)	19.7 (17.1)
Parents no HS	-7.3 (6.1)	-14.5* (10.2)	-3.5 (7.1)	-18.3* (11.5)
Parents other PSE	4.8* (2.8)	2.3 (9.1)	12.3*** (6.0)	-0.7 (7.8)
Parent University	36.6*** (5.7)	15.1** (9.1)	44.3*** (9.8)	38.1*** (5.7)
Middle parent inc.	13.4*** (5.3)			
High parent inc.	18.7*** (6.9)			
Dependent children	-0.7 (1.4)	-2 (2.9)	0.2 (1.1)	-3.7* (2.7)
College tuition	-6.6*** (3.3)	-16.3 (11.7)	-2.7 (3.1)	-10.5* (7.3)
University tuition	-7.3 (4.8)	-39.4*** (13.7)	-1 (6.6)	-3.6 (10.0)

Table continued over page.

Table 5: **Continued: MNL Marginal Effects - University Attendance**

Variable	All youth	Low Income	Middle Income	High Income
City over 100,000	0.5	-13.3	7.9	-3.1
	(4.4)	(14.1)	(5.2)	(10.5)
Rural	1.8	-4.2	-4.6	16.2**
	(2.8)	(10.7)	(3.5)	(6.0)
Univ. over 80km	-3.9	-35.4***	-0.3	-0.6
	(4.3)	(11.1)	(5.2)	(10.5)
Univ. over 40km	-1.5	1.2	-0.8	0.2
	(4.3)	(9.5)	(6.5)	(10.1)
College over 40km	6.3	13.6	10.5**	-2
	(6.4)	(11.1)	(8.3)	(10.3)
Unemployment rate	-1.8	3.2	2.1	-9.3**
	(2.4)	(7.9)	(3.5)	(5.7)
University financial aid	0.4	-10.6	1.3	4.4*
	(2.1)	(8.1)	(3.7)	(4.0)
Atlantic	11.4	-29*	2.7	49.6***
	(8.9)	(19.0)	(11.9)	(11.4)
Quebec	-16.8	-65.3***	-9.3	-10.6
	(8.7)	(17.3)	(8.9)	(25.1)
Prairies	-10.6***	-51.9***	-7.3	-6.9
	(4.6)	(12.0)	(6.1)	(8.7)
BC	-16.6***	-63.1***	-8.9	-17.7
	(7.3)	(17.2)	(8.8)	(15.4)
Time trend	-0.4	9.3***	-1.2	-5.7**
	(1.2)	(3.7)	(1.7)	(2.6)
Female time trend	4.6*	-0.8	1.5	8.7**
	(2.6)	(2.1)	(3.0)	(3.3)
Observations	1,874	554	677	643

Note: One, two and three asterisks (*) denote statistical significance of the underlying estimated multi-nomial logit parameters at the 10%, 5% and 1% respectively. They do not reflect the statistical significance of these reported marginal effects.

tuition increased the probability of attending other PSE by 4.9 percentage points, highlighting a positive cross-price elasticity. This impact is not statistically different from zero, however.

Geographic variables are economically and statistically insignificant predictors of other PSE attendance. City and rural indicators, and indicators of distance to the closest PSE institutions[46], had economically small and statistically insignificant impacts. The exception here is the indicator for Quebec, which is very large and statistically significant. This reflects the high rate of attendance at CEGEPs in that province.

The marginal effects of each covariate on university attendance for the full sample of youth are presented in the first column of numbers in Table 5. Individual characteristics are much more significant in predicting university attendance than they were in predicting other PSE attendance. Females are much more likely to attend university than males, and this gap appears to be increasing over the period. Youth of aboriginal descent are much less likely to attend university, while visible minorities and youth with an immigrant parent are much more likely. The number of children in the family is unrelated to education choice. Parental education and income levels, however, are strongly positively related to the probability of attending university. Again this coincides with the results of the previous section. University attendance in Canada is a long way from equality.

Changes in both university and college tuition have large negative impacts on university attendance. There appears to be a negative cross-price effect (from college tuition) at the university level. This may be uncovering a negative impact on university attendance via lower college attendance, if college is chosen as an alternative pathway to subsequent university attendance. The estimated negative impact may also reflect the close correlation in the two tuition measures within provinces. Many provinces increased tuition at both universities and colleges at the same time and by similar dollar amounts. The correlation between the two measures at the provincial level is a considerable 0.7 over the period under analysis[47].

[46]The indicator of college over 80 kilometres away was not included in the analysis due to so few youth (3.5%) living this far from a college in the sample.

[47]The correlation is just as high if we look at the whole period from 1990 to 2001. College tuition data is only available from 1990. The correlation is even higher using Canada-wide weighted average college and university tuition levels.

Geographic variables are statistically insignificant predictors of university attendance also. There is a sizable positive impact of living further than 40 kilometres from the nearest college on university attendance. This may reflect the placement of colleges in areas of historically low PSE attendance in order to encourage increased attendance. This variable may thus be proxying characteristics of the neighbourhood of residence on PSE attendance probabilities. The impact of neighbourhood characteristics on attendance will be analyzed further in the next section. The regional indicators highlight the much higher rates of university attendance in Atlantic Canada and Ontario (the omitted region) than in the rest of Canada.

To test whether tuition increases have led to increased inequality in PSE attendance, multinomial logit models were estimated separately for youth from the three parental income groups. Focussing on the marginal effects reported in the last three columns of Table 4, college tuition has statistically insignificant impacts on attendance at other PSE for all three income groups. There are positive impacts of university tuition on other PSE attendance for all income groups, but again the effects are not statistically significant. The marginal effects reported in the last three columns of Table 5 highlight the much larger effects of tuition on university attendance for low income youth. Both college and university tuition levels have large negative impacts on university attendance for low income youth, but not for youth from middle and high income backgrounds. Low income youth appear to be much more sensitive to tuition than youth from other parental income backgrounds. The tuition increases of the late 1990s in many Canadian provinces appear to have increased inequality of attendance at university, but not at other PSE institutions.

The marginal effects reported by parental income group highlight some other interesting differences in the impact of the covariates on PSE attendance. The positive effect on other PSE attendance for females is confined to middle and high income youth. There is a large positive impact of immigrant parent status and a negative impact of family size on other PSE attendance for high income youth only. There is also a surprising positive impact of university-provided financial aid on other PSE attendance for high income youth only. One explanation for this result is that at least some of the university-provided funding is merit-based, attracting students who did well in school, who may dis-proportionally be from wealthier families. The positive

impact of parental education on university attendance is much smaller for low income youth. There is a positive impact of rural residence on university attendance for high income youth only. Living beyond 80 kilometres of a university is a large detriment to university attendance for low income youth only. Overall, there is a trend towards reduced inequality in university attendance over the period, as there is a positive trend in attendance for low income youth but a negative trend for high income youth. This coincides with the findings of Corak, Lipps and Zhao (2004), and with the trends highlighted in Table 1.

8 Model Extensions

Several extensions to the attendance decision model outlined in Section 6 were estimated. These extensions are discussed in turn here. For more details of these model extensions, see the longer version of this analysis (Coelli (2004)).

8.1 Aggregate influences on the demand and supply of PSE places

Trends in cohort size and provincial funding of universities and colleges may also impact the probability of PSE attendance for Canadian youth. Such measures have not commonly been included in previous research on PSE attendance. Card and Lemieux (2000) highlighted the significant impact of cohort size on PSE attendance in the US. Bound and Turner (2003) and Fortin (2003) analyzed the impact of these variables on college-going behaviour in the US also, and found significant relationships. Beaudry, Lemieux and Parent (2001) highlighted the strong relationship between cohort size and school attendance (secondary and post-secondary combined) in Canada.

Movements in provincial cohort size may impact the level of rationing of PSE places in a particular province. If supply of PSE places is constrained for some reason (availability of faculty, classrooms, government funding, etc.), then the probability of being accepted at an institution will be lower if a youth must compete with a larger high school graduating class for a place. Provincial funding will also impact the number of places that PSE institutions can provide, which in turn will impact the probability of a youth being accepted. Constraints on

the ability of PSE institutions to adjust tuition to ensure market clearing (supply and demand of PSE places being equated) will increase the likelihood that cohort size and provincial funding will impact attendance probabilities. Note that higher tuition levels will also generally raise the supply of PSE places in a province, as institutions will have more revenue, given government funding, to fund education activities.

Summary statistics for measures of provincial cohort size and provincial funding of PSE institutions are provided in the bottom panel of Table 3. The cohort size index represents the size of the age 16 population in the province of residence (when the youth is 16) relative to the size of this population in 1993. The index is set to 100 in each province in 1993. If the age 16 population in a province rises by 10% from 1993 to 1998, this index will take the value 110 in 1998. See Figure Four for movements in these indexes over the period. Measures of real provincial spending on universities and colleges are constructed on a per person aged 18 to 24 in the province basis.

The inclusion in the estimating equations of these three additional measures changes the interpretation of these equations to some extent. They are no longer simply linear empirical analogues of individual attendance decision rules. They are now reduced form equations of the impact of both demand and supply variables on the probability of PSE attendance.

Marginal effects for the extended model are reported in Coelli (2004). Inclusion of these additional covariates did not change the estimates of the remaining coefficients to any significant extent for the entire sample of youth. University provided financial aid now has a statistically significant positive impact on university attendance, while the unemployment rate now has a statistically significant negative impact on this choice. Importantly, the impact of college and university tuition on both other PSE and university attendance probabilities did not change, for all youth or separately by parental income group. The conclusions regarding the effect of tuition increases on inequality in attendance are robust to this model extension.

The interesting outcome of including these additional covariates is the significance of cohort size. A 5.7 percentage point increase (one standard deviation) in the size of a youth's cohort lowers the probability of attending university by approximately 4.5 percent for the entire sample of youth. Cohort size does not impact the probability of attending other PSE,

however. Estimation by parental income group highlighted a negative impact of cohort size on the probability of university attendance for all income groups, with the largest impact on youth from low income backgrounds. This suggests that increased competition for university places generally squeezes out youth from low income backgrounds. These youth may have a lower probability of university acceptance as their measured high school achievement may be lower. Youth from middle and high income backgrounds may receive more support from parents (tutors, attending better schools, etcetera) during school years to boost their achievement levels.

Provincial spending had no statistically significant effect on attendance at either the university or other PSE levels. This result may reflect the noise in these measures of spending.

8.2 Neighbourhood Characteristics

There is a growing literature on the effect of neighbourhood characteristics on various outcomes of youth, including health outcomes, criminal behaviour, school achievement and education attainment. An example for Canada is the study by Cartwright and Allen (2002), who look at the effects of neighbourhood characteristics on school achievement. One important pathway by which neighbourhood characteristics may impact the PSE choices of youth is via the presence of role models. If there are a number of adults in the neighbourhood who have achieved success via PSE education, this may encourage youth to pursue such a path. If the majority of adults with whom the youth comes into contact have not attained PSE, the benefits of doing so may not be at all obvious.

The measures of distance to PSE institutions may be proxying neighbourhood characteristics in their impact on the PSE attendance decisions of youth. The positive relationship between attendance and living beyond 40 kilometres of a college appears counter-intuitive on face value. However, if colleges are located by provincial governments in areas that have historically low PSE attendance rates in order to encourage increased attendance, this reverse causation may be what is being uncovered. Low PSE attendance neighbourhoods may be characterized by populations with characteristics which do not encourage participation in PSE. For example, there may be very low levels of education among adults in the neighbourhood.

Fifteen measures of neighbourhood characteristics were included in an additional set of PSE attendance decision estimations. Measures of neighbourhood characteristics were drawn from the 1996 Census[48]. These characteristics were linked to individuals using census tracts where available (city dwellers) and using census subdivisions where not[49]. Summary statistics for the neighbourhood characteristics are reported in Coelli (2004).

The set of marginal effects for these neighbourhood characteristics on the university attendance probability in multi-nomial logit estimation for all youth are presented in Table 6[50]. Marginal effects for all other covariates in the estimated model are not reported for brevity, but are available upon request.

The inclusion of the neighbourhood characteristics did not alter the estimates of the remaining parameters in the multi-nomial logit model to any real extent. In particular, the impact of college and university tuition on other PSE and university attendance probabilities remained the same. The distance to PSE measures were actually slightly larger and more statistically significant rather than less. Distance appears to be a robust factor impacting PSE attendance decisions. Inclusion of neighbourhood characteristics more than doubled the size of the positive impact of the Atlantic Canada indicator on university attendance also.

The full set of fifteen neighbourhood characteristics are jointly statistically significant at the 1% level. The characteristics which impacted attendance probabilities the most were percent young (negative), percent immigrant (positive), percent visible minority (negative), percent not graduated high school (large positive but statistically insignificant), unemployment rate (negative), and median income (large and significant positive).

Neighbourhood characteristics may impact attendance decisions differently in cities than

[48] Four additional characteristics were included in preliminary estimation but were dropped here as none were even close to being statistically or economically significant. The dropped characteristics were neighbourhood density, percent of lone parent families, the 25 and over employment rate, and average rental rates.

[49] If the population of the tract or subdivision was below 2,000 people aged 15 and over, averages for the population of the census division were used. This adjustment was made to ensure the neighbourhood characteristics were not too noisy.

[50] Standard errors of the estimated parameters were adjusted for potential heteroscedasticity and for clustering by the neighbourhood and year level.

Table 6: **MNL Marginal Effects, Neighbourhood Chars. - University Attendance**

Variable	Parameter	Standard Error
Young - % popn. 16 and under	-14.7	8.6
Aged - % popn. 65 and over	-6.3	4.7
Immigrant - % popn.	19.8	12.4
Visible minority - % popn.	-6**	2.7
Aboriginal descent - % popn.	1	0.7
French mother tongue - % popn.	2.6	4.3
Non-official mother tongue - % popn.	-2.5	4.5
Attending school - % aged 15 to 24	24.5	22.4
Not graduate high school - % 15 and over	38.4	28.4
Some PSE - % 15 and over	3.9	20.7
University educated - % 15 and over	1.7	8.8
Unemployment rate - 25 and over	-6.8**	3.5
Median income	45**	21.4
Percent popn. Low income	10.9	9.2
Value of dwellings	-4.9	4.5
Observations	1,874	

Note: One, two and three asterisks (*) denote statistical significance of the underlying estimated multi-nomial logit parameters at the 10%, 5% and 1% respectively.

in small urban and rural areas. We could imagine that the benefits of education may be more obvious to city dwellers even if their own neighbours are not well educated. To explore this hypothesis, interactions of the fifteen neighbourhood characteristics with the city (over 100,000 residents) indicator were added to the estimation model of Table 6. These fifteen interacted variables were just jointly statistically significant at the 1% level. Neighbourhood characteristics impacts that were notably different for city dwellers were impacts of average education and income levels. Living in an educated and more wealthy neighbourhood had a much stronger positive impact on university attendance probabilities in large cities than in rural and small urban areas. The negative impact of neighbourhood unemployment rates on attendance was confined to rural and small urban areas.

8.3 Tuition impacts varied by individual characteristics

The impact of tuition increases on PSE attendance probabilities of Canadian youth was analyzed separately by parental income group above. The objective was to determine whether tuition increases have coincided with increases in inequality of PSE attendance on the parental income margin. The evidence suggests that for university attendance the hypothesis holds. Tuition increases may also have different impacts on youth based on other background measures apart from parental income. Varied impacts by family size or by distance to PSE institutions readily come to mind as possibilities. To explore this issue further, an additional set of estimates of PSE attendance probabilities were constructed after inclusion of interactions of tuition and the full set of individual characteristics (apart from the regional indicators). College tuition was employed rather than university tuition when constructing these interactions[51].

The multi-nomial logit parameter estimates on the interaction terms provide information on the direction of any differences in sensitivity to tuition changes by individual characteristic. These estimates implied that females were less sensitive to tuition increases than males. Youth with more educated parents were slightly more sensitive to tuition changes in choosing other PSE but less sensitive in choosing university attendance. Youth from city and rural areas and

[51]Results from estimates which dropped one tuition measure from estimation suggested that college tuition was relatively more important in attendance decisions.

those who live further than 40 kilometres from the nearest university were less tuition sensitive than others. Youth from larger families were slightly more sensitive to tuition changes when choosing university attendance, but the effect was not statistically significant. These estimates are also available upon request.

8.4 Impact of Tuition on the Residence and Hours of Work Decisions of Youth

Increases in tuition may have impacts on youth beyond the choice of attendance at a PSE institution. They may also impact whether youth decide to attend an institution close to home in order to live with parents and save on living expenses. Youth who still choose to attend PSE despite rising tuition costs may also need to work more while studying. If these impacts are stronger for youth from low income families, it may suggest inequitable impacts of tuition increases are not confined to university attendance decisions alone.

Analysis of the residence and hours of work decisions of youth was conducted employing the same strategy as employed for analyzing PSE attendance decisions above. Difference in differences estimates were constructed, and decision equations derived from an extension of the economic model outlined in Section 4 were empirically estimated. Details of the model extension and all the empirical estimates are provided in Coelli (2004).

The percentage of PSE students reported as living with at least one parent was very high (80% to 90%) for all parental income backgrounds. The living arrangement reports were taken at the end of the second year after normal completion of university entrance requirements, i.e. age 19 or 20 depending on province. Non-students were much less likely (around 70%) to live with their parents at the same age, with their higher disposable incomes from work and no education expenses. Average hours of work were also reasonably high for students from all backgrounds. University students worked on average around 500 to 600 hours over the calendar year corresponding to the second year after normal completion of university entrance requirements. Other PSE students worked even more hours. Many students work during the summer. Only 16% of students in the sample worked no hours at all. For non-students, around

10% worked no hours at all at the same age, and average hours of work were around 1400.

Note that the living arrangements measure may not accurately indicate all youth who may reside separately from the parental home while studying. When Statistics Canada contacts SLID households for the annual questionnaire, the person contacted in the household may answer for all family members. The contact person is asked to include all family members who normally reside in the household. If a family member is currently residing elsewhere to attend "school" (perhaps in university residences) but returns to the family home to live during school breaks, they are to be included as members of the respondent household. We may still consider these youth who return to the family home during school breaks as saving on some living costs by doing so. Youth who do not return to the family home during school breaks appear more independent. We may expect that youth with more wealthy parents, who would generally receive higher parental transfers, will also be more able to live independently year-round.

Difference in differences estimates of the impact of tuition increases on residence decisions provided some weak evidence of a corresponding increase in inequality, but most estimates were not statistically different from zero. Estimates for the hours of work decision of students did not suggest an increase in inequality on this margin. Half of the point estimates were of the opposite sign, and were mostly statistically insignificant.

Probit models of the decision of whether to live with parents or not were estimated for all youth in the sample. Separate estimates were conducted by student type: university students, other PSE students and both combined. The estimation results (presented in Coelli (2004)) indicated that female students were less likely to live at home, while visible minority and immigrant students were more likely. Students from middle and high parental income backgrounds were actually more likely to live at home. More siblings lowered the probability of living at home for other PSE students but not for university students. Students who resided in cities at age 16 were more likely to live at home. Students from rural areas and students who resided at some distance from a university at age 16 were much less likely to live at home, as we would expect.

Tuition had a difficult to interpret negative impact on the probability of living at home for

students. Rational choice would imply that tuition increases should lead some students to move home to save on living expenses. One possible explanation for this result is that some students moved away from home in order to prove that they were living without the support of their parents, and thus eligible for student loans, even if their parents' income was considerable. There was no evidence of tuition increases having a stronger impact on the probability of low parental income students living at home. Thus there was no evidence of tuition increases coinciding with higher inequality on the residence decision margin.

Tobit estimates of the hours of work decision of students were constructed. The dependent variable was the number of hours spent working in the calendar year corresponding to the age of the second year after normal completion of university entrance requirements. Separate estimates were conducted by student type: university students, other PSE students and both combined. The estimates suggested that visible minority university students work significantly fewer hours. Students whose parents did not complete high school worked much fewer hours also. Tuition increases had no discernible effect on hours of work. Note also that youth from high income families did not work fewer hours than those from low income families. Again this may represent the impact of financial aid eligibility. The correlation between income groups and eligibility make it difficult to discern separate effects.

Separate Tobit models by parental income group were estimated for all PSE students combined. Tuition levels had no effect on hours worked for youth from middle and high income backgrounds. Surprisingly, there was a statistically significant negative impact of tuition on the hours of work of youth from low income backgrounds.

9 Conclusions

The evidence uncovered in this analysis provide considerable support for the claim that tuition increases in the late 1990s have coincided with an increase in the level of inequality in university attendance in Canada. Tuition increases have had a significant negative impact on the university attendance rates of youth from low income backgrounds, but not on youth from middle and high income backgrounds. The impact of tuition increases on attendance at

non-university PSE institutions (college in particular) was essentially zero, with no discernible differences in the impact across parental income groups.

Cohort size also impacted the probability of attendance at the university level for Canadian youth, implying that there may be significant rationing of places at the university level in Canada. Youth from larger cohorts were less likely to attend university even after controlling for many individual characteristics. This suggests that the higher level of competition for PSE places resulting from larger cohorts is binding on youth. Evidence also implied that the negative impact of cohort size on university attendance was much stronger for youth from low income backgrounds. Rationing may be causing some of the observed inequality in university attendance in Canada. Low income youth may have lower measured achievement during high school, perhaps as a consequence of lower parental support, reducing the probability of acceptance at university.

The analysis uncovered some evidence that neighbourhood characteristics may impact the attendance decisions of youth. The average education and income levels of neighbours were significant predictors of attendance probabilities. The impact of tuition increases on the residence (live with parents or not) and hours of work decisions of youth was insignificant. There was also little evidence of an unequally larger impact on these decisions for youth from low income backgrounds.

Tuition increases potentially have two competing impacts on the PSE attendance probabilities of youth. Higher tuition costs lower the expected net return from PSE attendance, lowering demand for education services. On the other hand, rising tuition levels raise PSE institution revenue, allowing institutions to provide more PSE places given government funding. Separating these competing impacts is an area for future research.

A Final SLID Sample Construction and Panel Attrition

The first two panels of the SLID included 2,909 longitudinal respondents of the appropriate age for inclusion in this study. This included youth aged 15 or 16 at the start of each panel from Quebec and Ontario, and youth aged 14, 15 or 16 from the remaining provinces. Just over one third of this total number of potential observations were not able to be employed in the analysis for a variety of reasons. The following is a list of sequential removal of observations and the reasons why they were removed. In total, 1,035 observations could not be used, representing 36% of the potential sample.

1. Youth not observed at age 16 - 4%.

2. Youth not residing at parental home at age 16, so no parental information available - 3%.

3. Education attendance of youth not reported at all ages required, i.e. each year from 16 to 20 if from Quebec or Ontario, or from 16 to 19 otherwise - 25%.

4. Covariate not defined for youth, e.g. average parental income, number of siblings, parental education - 4%.

A small percentage of youth were not observed at age 16. This will occur if the household the youth belonged to fell out of the longitudinal survey prior to the youth turning 16. Most observations that were lost occurred because the education decisions of the youth were not reported for every year required (25%). This occurred because the family household the youth belonged to fell out of the panel (11%), the youth left the family household and was unable to be contacted by Statistics Canada staff (6%), and because the youth did not answer the attendance questions even if contacted (8%).

Attendance information was imputed for a small number of survey respondents where missing observations were encountered. This was undertaken to minimize sample attrition, and was only followed for youth at ages 16 and 17 where subsequent annual attendance reports justified imputation. Imputation involved attributing high school attendance to youth at age 16 or 17 who were subsequently enrolled at high school at the next annual survey.

Table 7 provides summary information on the sample employed and on the observations that could not be used, where possible. The parental income measure here is for the one year (rather than a three year average) when the youth was aged 16, or the nearest younger age if no details were available at age 16. The characteristics of youth not employed in the analysis is somewhat different to the characteristics of those included. They are more likely to be a visible minority, to be from a lone parent family, and with less educated and lower income parents. Their exclusion from the analysis will only result in biased estimates of the impact of tuition on inequality if there is some unmeasured characteristics of these youth related to their exclusion from the sample, their education attendance, and to their individual characteristics or background.

One check on the representativeness of the final sample employed in the analysis is to compare the outcomes of these youth with the outcomes of a separate sample of youth of the same age. The Canadian Census was employed for this purpose. Some summary statistics of the SLID sample employed here and equivalently aged youth from the 1996 Census Public Use file are provided in Table 8.

The SLID sample of youth employed in this analysis generally were more likely to be students, particularly at other PSE institutions. They are also more likely to live at home, which is most likely due to it being easier to track youth who remain in the family home when undertaking annual SLID questionnaires. SLID final sample youth are also more likely to have worked in the previous year. Care must be taken here as the work questions are much more detailed in the SLID than in the Census, and thus more likely to pick up small amounts of part-time work.

Table 7: **Summary Statistics for Final Sample Analyzed and Dropped Observations**

	Sample	Used	Dropped	Observations	
Variable	Mean	Stand. Dev.	Mean	Stand. Dev.	Obs.
Female	0.484		0.492		1,035
French mother tongue	0.222		0.178		1,035
Aboriginal descent	0.024		0.037		1,035
Parent Immigrant	0.239		0.247		1,035
Visible minority	0.091		0.117		1,035
Lone parent	0.166		0.243		959
Parents not graduate HS	0.114		0.206		961
Parents other PSE only	0.445		0.388		961
Parent completed university	0.203		0.134		961
Children in family	2.781	1.441	2.811	1.547	896
City resident (¿100,000)	0.569		0.624		1,035
Rural resident	0.152		0.119		1,035
Parental income (at 16)	65,421	41,481	60,090	49,050	959
Low parent inc.	0.311		0.406		959
Middle parent inc.	0.340		0.310		959
High parent inc.	0.349		0.284		959
Observations	1,874				

Source: Survey of Labour and Income Dynamics.

Table 8: **Summary Statistics for Final Sample Used and 1996 Census Sample**

	SLID	Census
Attended PSE		
University	0.317	0.280
OPS	0.358	0.259
Any PSE	0.675	0.539
Living with parents		
All	0.828	0.754
Uni student	0.904	0.877
OPS student	0.865	0.801
Non-student	0.690	0.613
Worked past year		
All	0.848	0.765
Uni student	0.834	0.818
OPS student	0.854	0.790
Non-student	0.895	0.782
Observations	1,874	10,535

Source: Survey of Labour and Income Dynamics and 1996 Canadian Census.

B Data Sources

The vast majority of variables employed in this analysis were constructed directly from the SLID internal use data sets made available via the Statistics Canada Research Data Centre at the University of British Columbia. The sources employed during construction of variables not taken from the SLID are listed below.

1. Parental income measures were adjusted using Low Income Cutoff (LICO) measures by size of area of residence and family size taken from the Statistics Canada publication authored by Paquet (2002).

2. Distances to closest PSE institutions (universities and colleges) were constructed using the latitude and longitude of the place of residence of each youth at age 16 taken from the SLID. The latitude and longitude of PSE institutions was constructed using a database of the postal code of each institution in Canada compiled by Marc Frenette of Statistics Canada (see Frenette (2003) for details). Postal codes were transformed into latitude and longitude measures using the Postal Code Conversion File (PCCF) database from Statistics Canada. Straight line distances were constructed using the following formula:

$$Distance = 6,370.997 * \cos^{-1}[\sin(lat_y) * \sin(lat_i) + \cos(lat_y) * \cos(lat_i) * \cos(long_y - long_i)]$$

   In this equation, the latitude (lat) and longitude ($long$) numbers were measured in radians by dividing the original latitude and longitude measures in degrees and decimals by 57.29577951. The subscripts y and i refer to the locations of youths and PSE institutions respectively.

3. Annual average college tuition by province were obtained from statistics reported by the Manitoba Council on Post-Secondary Education. These provincial averages were not weighted within each province, but tuition at publicly funded colleges varied little within provinces. See the following web-site for the data: http://www.copse.mb.ca/en/documents/statistics/index.htn

4. Annual average university tuition by province were constructed from individual university tuition fees for undergraduate arts programs (within-province students) collected by Statistics Canada. Data from 1994/95 were provided directly by Statistics Canada's Centre for Education Statistics. Prior to 1994/95, fees were taken from data release entitled "Tuition and living accommodation costs for full-time students at Canadian degree granting institutions". Averages within each province were calculated using 1997/98 total full-time enrolment numbers as weights. University enrolment numbers were also sourced from Statistics Canada, using Cansim cross-tabulation 580701.

5. Annual Provincial unemployment rates were taken from Statistics Canada's Cansim II table 282-0002.

6. Annual aggregate university-provided financial aid by university was provided by Statistics Canada's Centre for Education Statistics. These numbers were aggregated within provinces then divided by aggregate full-time enrolment at universities within each province.

7. Cohort size indices were constructed using Statistics Canada's annual estimates of population by age and province, sourced from the Cansim II table 51-0001.

8. Data on provincial spending on universities and colleges were sourced from the Cansim II tables 478-0007 and 478-0004 respectively. These aggregate figures were divided by the provincial population aged 18 to 24 (see source above).

9. All variables that were constructed in real terms used the Canada-wide Consumer Price Index, sourced from Cansim II table 326-0001.

10. Neighbourhood characteristics were taken from the 1996 Canadian Census via the 20/20 package of Statistics Canada. These characteristics are for the census tract (where available in cities), census subdivision (where available) or division if both tract and subdivision data are unavailable, where the youth resided at age 16. The 1991 geography enumeration area identifiers available in the SLID were transformed into 1996 Census geography enumeration areas using an electronic file provided by Statistics Canada.

The 1996 enumeration area identifiers were then linked to 1996 Census tract, division and subdivision identifiers using information from the GeoSuite package from Statistics Canada. These tract, division and subdivision identifiers were then used to link characteristics of neighbourhoods to individual youth.

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Figure One (a)

University Tuition

2000/01 dollars - arts undergraduates

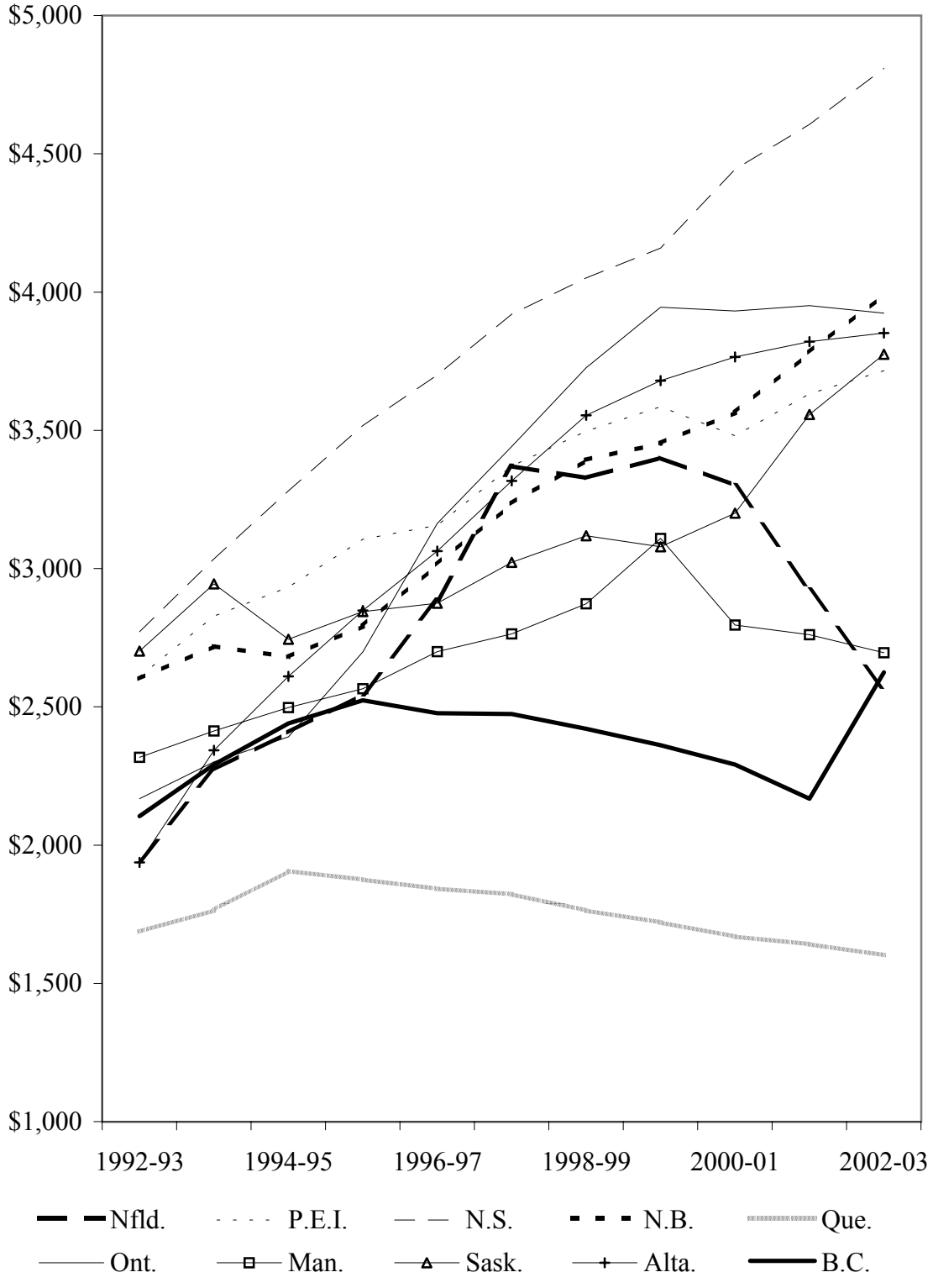

Figure One (b)

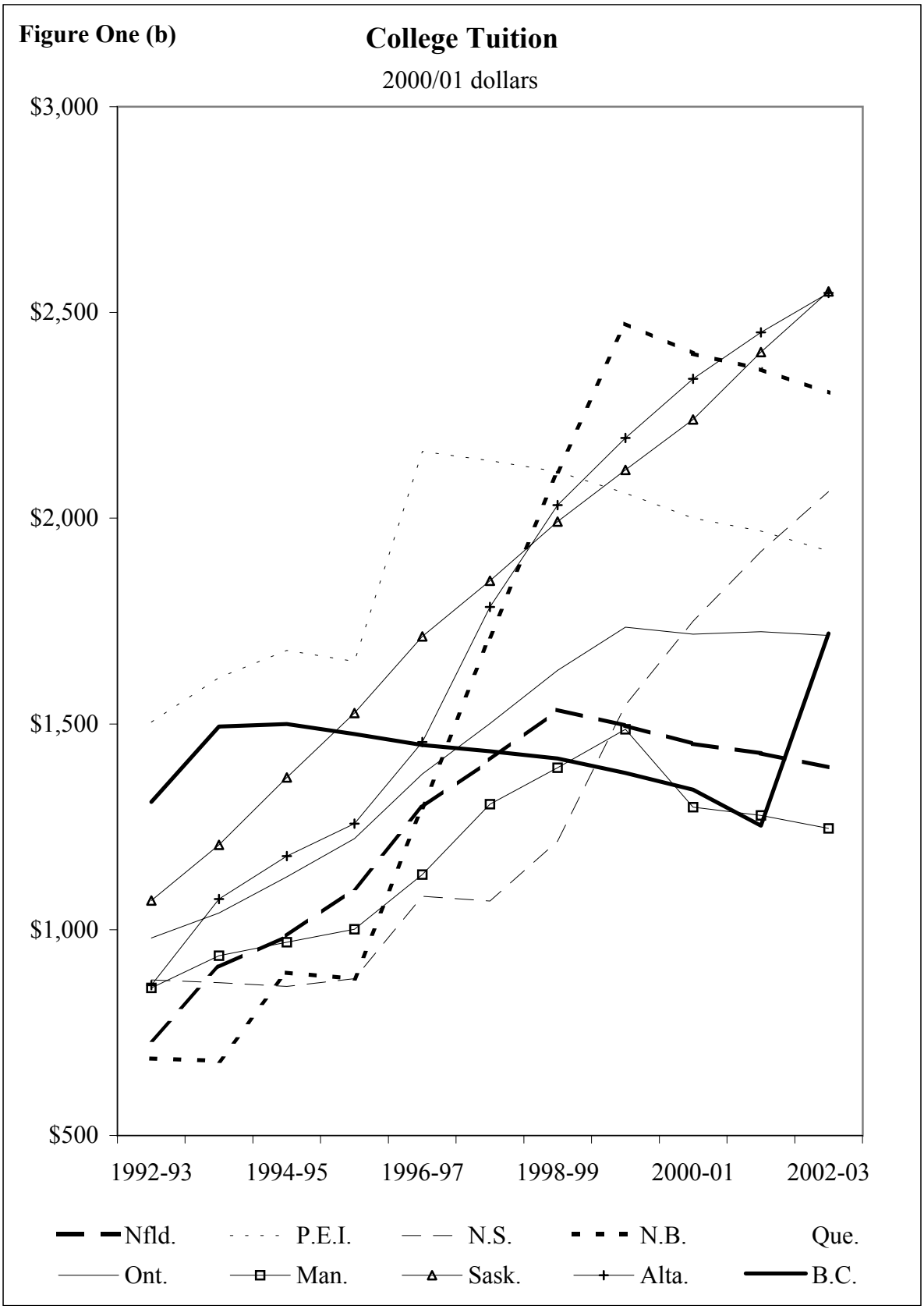
College Tuition
2000/01 dollars
$3,000
$2,500
$2,000
$1,500
$1,000
$500
1992-93
1994-95
1996-97
1998-99
2000-01
2002-03
Nfld.
P.E.I.
N.S.
N.B.
Que.
Ont.
Man.
Sask.
Alta.
B.C.

Figure Two

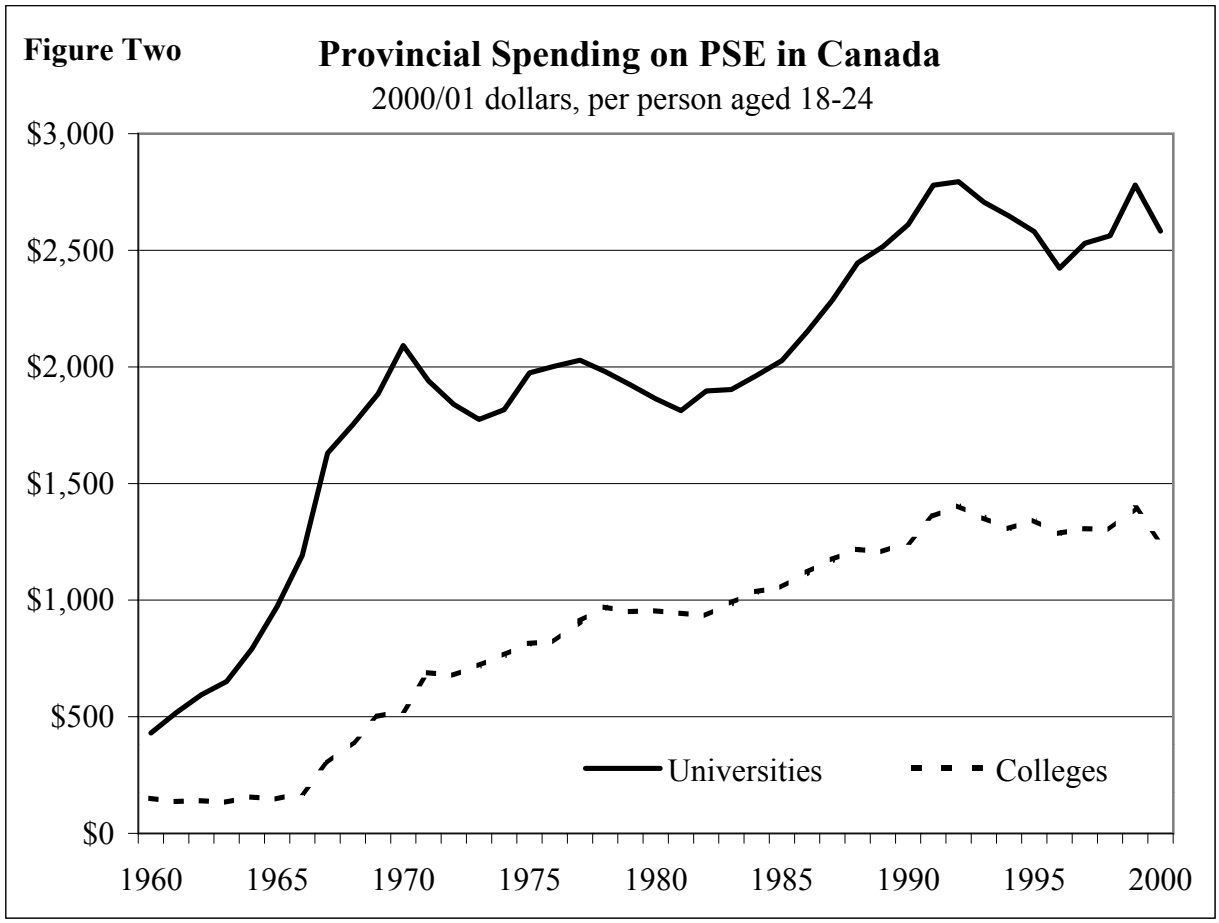
Provincial Spending on PSE in Canada
2000/01 dollars, per person aged 18-24
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0
Universities
Colleges
1960
1965
1970
1975
1980
1985
1990
1995
2000

Figure Three (a)

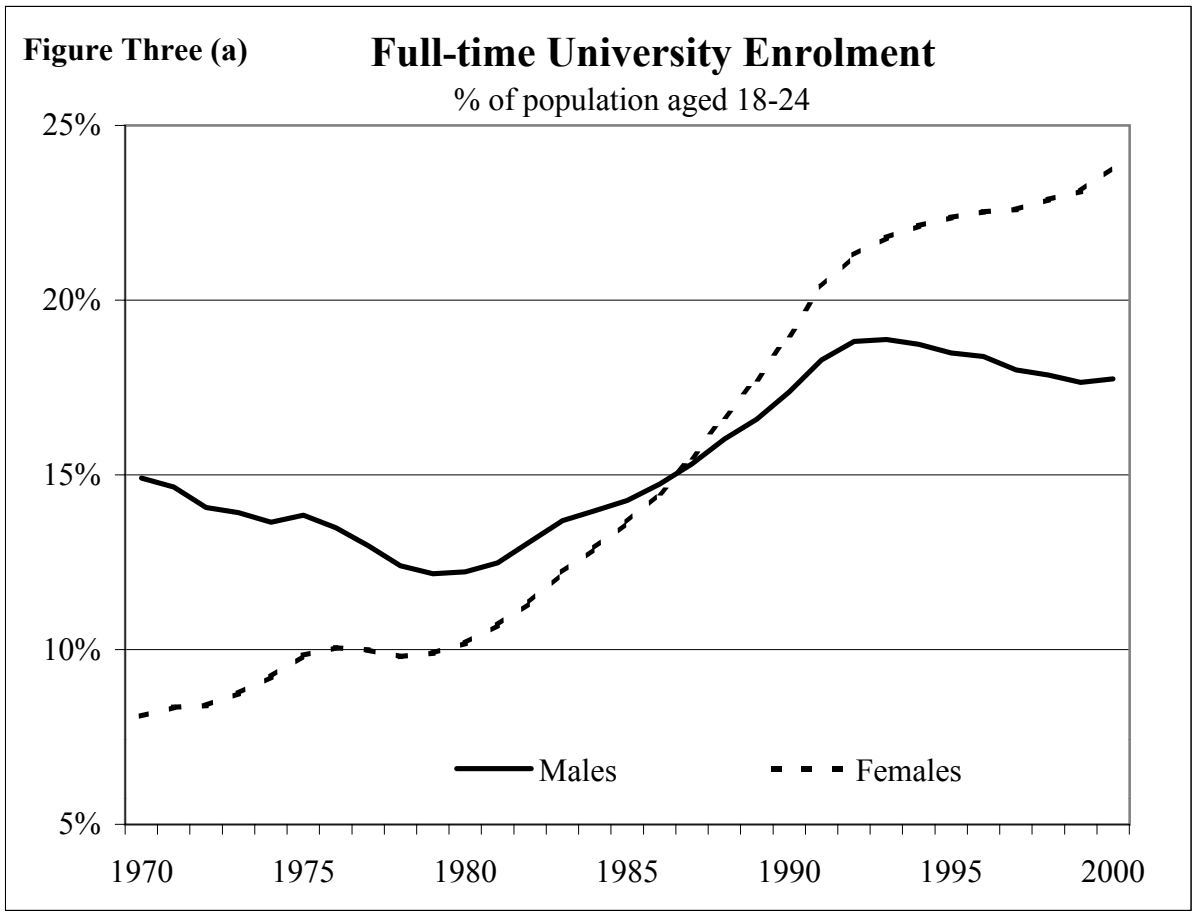

Figure Three (b)

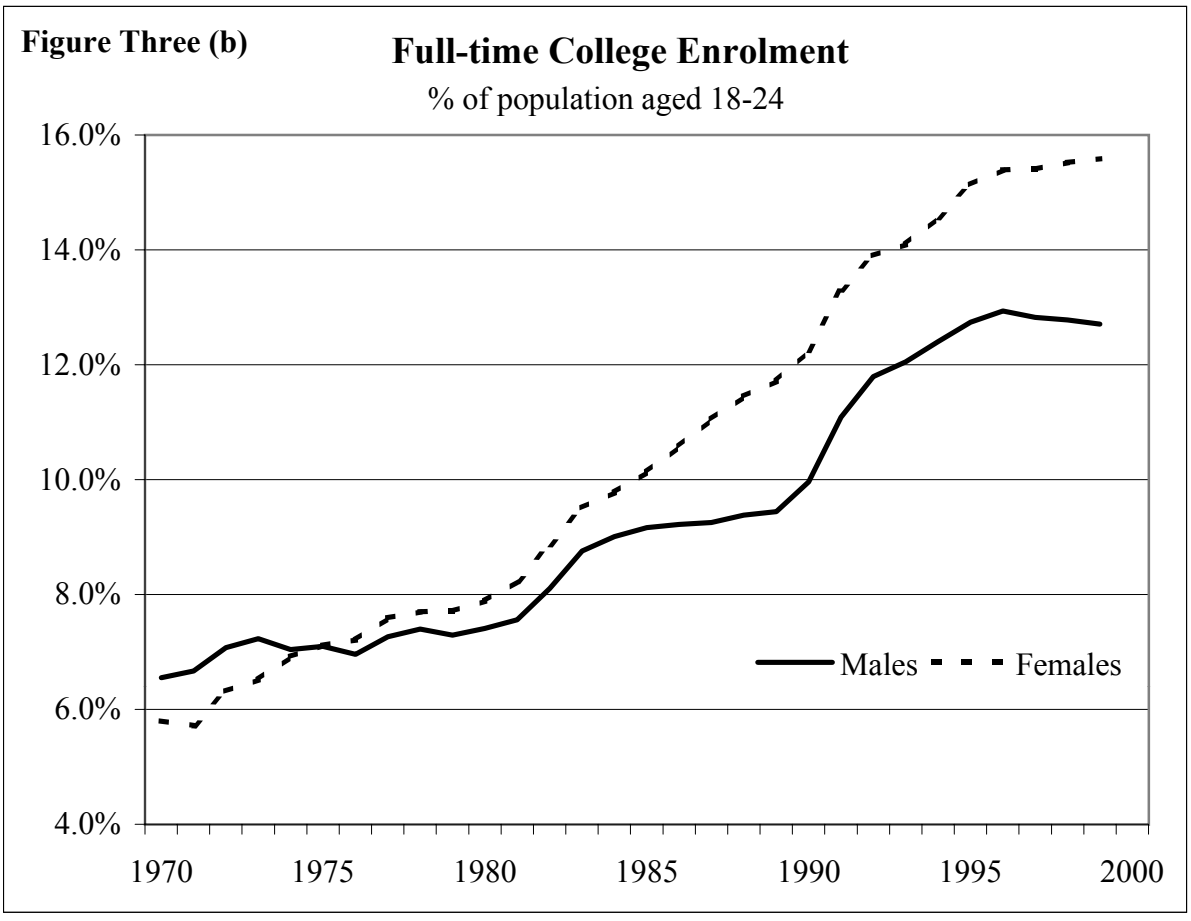

Figure Four

Indexes of Age 16 Population Size

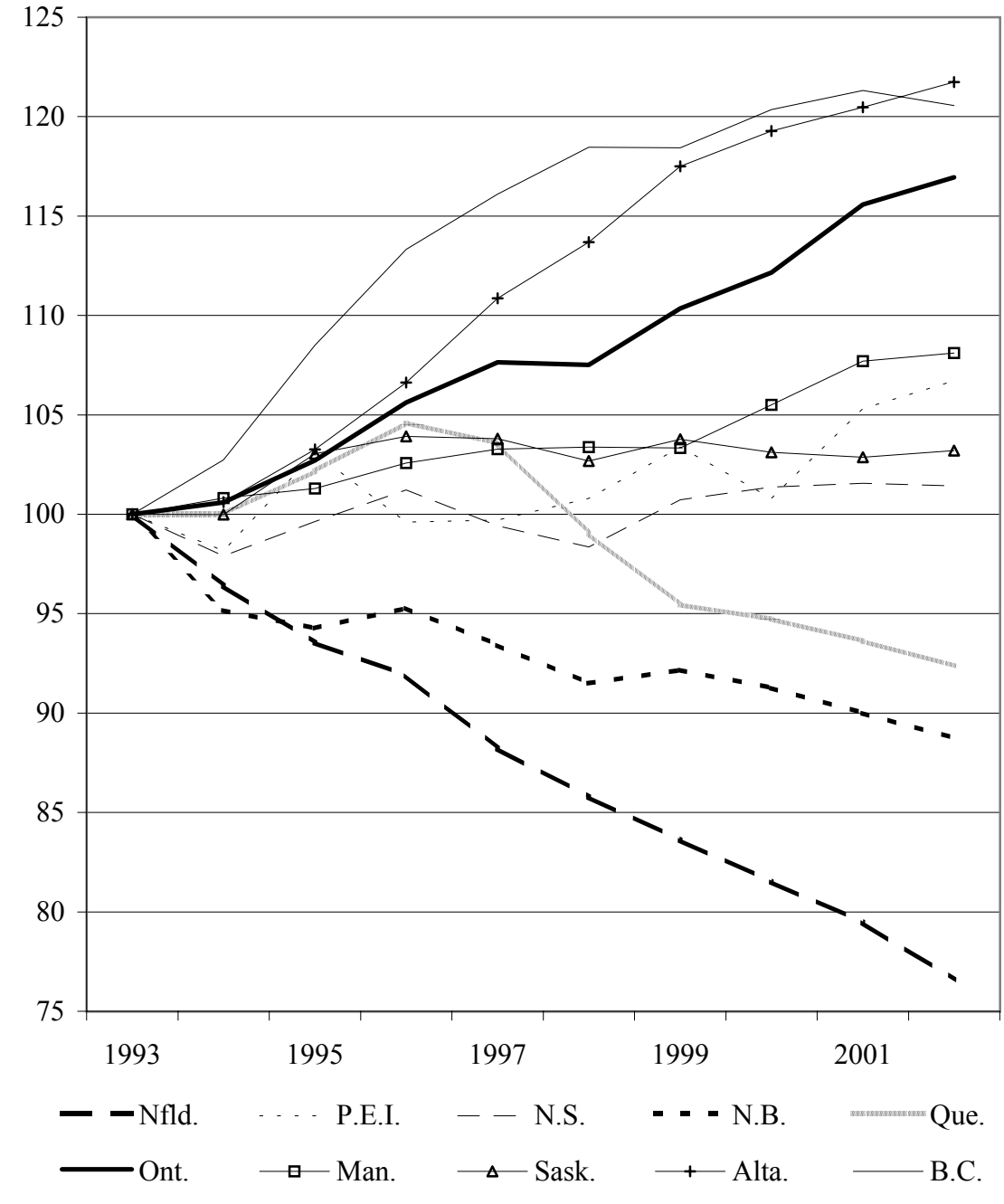

Figure Five

University-provided Student Financial Aid

2000/01 dollars per full-time student