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Post-Secondary Attendance by Parental Income: Comparing the U.S. and Canada*

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Abstract

This paper makes three contributions to the literature on educational attainment gaps by family income. First, we conduct a parallel empirical analysis of the effects of parental income on post-secondary (PS) attendance for recent high school cohorts in both the U.S. and Canada using data from the 1997 Cohort of the National Longitudinal Survey of Youth and Youth in Transition Survey. We estimate substantially smaller PS attendance gaps by parental income in Canada relative to the U.S., even after controlling for family background and adolescent cognitive achievement. Second, we develop an intergenerational schooling choice model that sheds light on the role of four potentially important determinants of the family income – PS attendance gap: (i) borrowing constraints, (ii) a 'consumption value' of attending PS school, (iii) the earnings structure, and (iv) tuition policies and the structure of financial aid. Third, we document Canada – U.S. differences in financial returns to PS schooling, tuition policy, and financial aid, discussing the extent to which these differences contribute to the stronger family income – attendance relationship in the U.S. Most notably, we document the dependence of both non-repayable financial aid and government student loan access on parental income in both countries.

1 Introduction

A number of studies document important gaps in post-secondary (PS) attendance by family income and adolescent cognitive achievement in the U.S. (Manski and Wise 1983, Cameron and Heckman 1998, 2001, Ellwood and Kane 2000, Carneiro and Heckman 2002, Belley and Lochner 2007). Frenette (2007) documents similar, though smaller, gaps by income in Canada.[1] What explains these gaps and why do they differ across countries?

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[1]Frenette (2005) empirically examined U.S. – Canada differences in PS attendance by parental income; however, it did not account for the effects of cognitive achievement in both countries. Dearden, McGranahan, and Sianesi (2004) document income gaps in post-secondary attendance in the United Kingdom.

This paper contributes to the literature on educational attainment gaps by family income in three ways. First, we conduct a parallel empirical analysis of the effects of parental income on PS attendance for recent high school cohorts in both the U.S. and Canada using data from the 1997 Cohort of the National Longitudinal Survey of Youth (NLSY97) and Youth in Transition Survey (YITS). Despite the similarities in demographic characteristics and educational attainment levels for the U.S. and Canada, we estimate substantially smaller PS attendance gaps by parental income in Canada relative to the U.S., even after controlling for family background and adolescent cognitive achievement. Interestingly, the large difference in income – attendance gaps between Canada and the U.S. is focused on the top half of the income distribution; among youth from very low to middle income families, there is little relationship between family income and PS attendance in either country (after conditioning on family background and adolescent achievement).

Second, we develop an intergenerational schooling choice model that sheds light on the role of four potentially important determinants of the family income – PS attendance gap (conditional on child ability): (1) Borrowing constraints may make it difficult for economically disadvantaged youth to afford college or university. (2) Many individuals may simply enjoy school, deriving a 'consumption value' from attending. It is commonly argued that this may lead wealthier students to 'purchase' more schooling than their lower income counterparts. (3) The earnings structure (especially the return to schooling) may also affect schooling choices differently depending on family resources when individuals derive a consumption value from school and/or credit constraints are important. (4) Financial aid formulas themselves may generate different PS attendance decisions by family income, since they create different implicit tuition costs based on family resources. We also recognize that peers, social networks, and information about the costs and benefits of school may differ by socio-economic status resulting in differential PS attendance rates. While we do not explicitly model these additional factors, we offer some limited evidence from the NLSY97 and YITS regarding their potential importance.

Third, we document Canada – U.S. differences in financial returns to PS schooling, tuition policy, and financial aid, discussing the extent to which these differences contribute to the stronger family income – PS attendance relationship in the U.S. Most notably, we document the dependence of both non-repayable financial aid (e.g. grants, scholarships, bursaries, and tax credits) and government student loan access on parental income in both countries, focusing on aid offered to students attending four-year public institutions.

Key factors highlighted by our model suggest that we should observe a stronger family income – attendance relationship in Canada at the bottom of the income distribution where U.S. financial

aid is, on average, generous but sharply decreasing in parental resources. This contrasts with our empirical findings that income – attendance gradients are equally weak at the bottom of the income distribution for both countries. At higher income levels, the stronger income – attendance gradient in the U.S. relative to Canada can be explained by the universal Stafford Loan Program in the U.S. and the sharp drop in Canadian financial aid (both grants and loans) that occurs as parental income rises above the median. We discuss the empirical importance of a few other factors that may shape the family income – PS attendance relationship as well; however, there is little evidence to suggest that they are important contributors the sizeable Canada – U.S. difference.

This paper proceeds as follows. The next section briefly reviews the related literature on borrowing constraints and educational attainment. We describe the YITS and NLSY97 data in Section 3, presenting evidence on PS attendance by parental income in Section 4. Section 5 develops an intergenerational model of PS attendance decisions that incorporates borrowing constraints, tastes for school, financial returns to school, and a general structure for need-based student aid. Section 6 compares Canada and the U.S. in terms of their PS institutional structure, tuition levels, financial aid policies, and financial returns to schooling. We interpret the empirical evidence on PS attendance patterns in light of the economic environments of both countries in Section 7 and conclude in Section 8.

2 Related Literature on Borrowing Constraints and Schooling

Previous studies of the relationship between schooling, ability, and family income have primarily focused on the potential role played by borrowing constraints in determining PS attendance. These studies have generally recognized the strong correlation between cognitive ability and family income, so most researchers have attempted to simultaneously control for adolescent achievement and family income as well as other family background characteristics that might affect schooling decisions. Doing so substantially reduces the role of family income in most studies but does not generally eliminate it.

Studies using U.S. data from the 1979 Cohort of the National Longitudinal Survey of Youth (NLSY79) generally conclude that borrowing constraints played little role in PS attendance decisions in the U.S. during the early 1980s. Cameron and Heckman (1998, 2001) find that after controlling for family background, scores on the Armed Forces Qualifying Test (AFQT), and unobserved heterogeneity, family income has little effect on PS enrollment rates.[2] Carneiro and Heckman (2002) also estimate small differences in PS enrollment rates and other higher education outcomes by family income after

[2]AFQT test scores are widely used as a measure of cognitive achievement by social scientists using the NLSY79 or NLSY97 data. They are strongly correlated with positive outcomes like education and post-school earnings. See, e.g., Blackburn and Neumark (1993), Murnane, Willett, and Levy (1995), and Cawley, et al. (2000). We discuss the composition of this test further below.

accounting for differences in family background and AFQT. Cameron and Taber (2004) find little evidence of differential returns to school that would be consistent with borrowing constraints. Keane and Wolpin (2001) estimate a structural model of schooling and work that incorporates constraints on borrowing and parental transfers that may depend on child schooling decisions. While they estimate very tight borrowing limits (much more stringent than federal student loan limits), they find little effect of borrowing constraints on educational attainment.

Belley and Lochner (2007) and Lochner and Monge-Naranjo (2010) argue that the rising costs of and returns to PS education in the U.S. since the early 1980s, combined with relatively stable real government student loan limits, have likely increased the salience of borrowing constraints for American youth.[3] Indeed, the fraction of undergraduate borrowers that borrowed the maximum limit from the federal Stafford Student Loan Program nearly tripled to 52% between 1990 and 2000 (Berkner 2000 and Titus 2002). Furthermore, Belley and Lochner (2008) estimate that the effects of family income on PS attendance (conditional on family background and AFQT scores) roughly doubled between the early 1980s and 2000s (based on data from the NLSY79 and NLSY97, respectively).

In Canada, a lack of appropriate data has limited serious examination of the issue until very recently. Frenette (2007) examines the gap in attendance at four-year PS institutions between youth from families in the top and the bottom quartiles of family income.[4] Using a Blinder-Oaxaca decomposition, he finds that 84% of the total gap in attendance between youth from the top and bottom income quartiles can be accounted for by long-term ability and family differences like age 15 achievement and grades, parental influences, and high school quality.

Differences in approach and specifications across previous U.S. and Canadian studies make cross-country comparisons of the relationship between family income and PS attendance difficult. This paper carefully explores this relationship for Canadian and American youth from roughly the same age cohort using similar measures of family background, parental income, and adolescent cognitive achievement. This not only provides a useful cross-country comparison, but it also enables us to explore various mechanisms that may shape this relationship.

3 Data

Our main empirical analysis uses data from the NLSY97 and YITS, focusing on educational attainment as of age 21. The NLSY97 samples American youth ages 12-16 at the beginning of 1997, while YITS

[3] See Katz and Autor (1999) or Heckman, Lochner, and Todd (2008) for evidence on rising returns to school and College Board (2004) for evidence on rising tuition costs.

[4] See Christofides, Cirello, and Hoy (2001) and Corak, Lipps, and Zhao (2003) for other recent studies.

surveys Canadian youth age 15 at the start of 2000.[5] Youth in both samples made their PS attendance decisions in the early to mid-2000s. Most importantly, NSLY97 and YITS contain comparable measures of adolescent cognitive achievement, parental income during adolescence, and rich measures of family background.

In 1997, NLSY97 respondents took a large battery of tests known as the Armed Forces Vocational Aptitude Battery (ASVAB).[6] In 2000, YITS respondents took math, reading, and science tests from the Programme for International Student Assessment (PISA). All respondents took the reading assessment, but only half the respondents took the math assessment while the other half (both randomly assigned) took the science assessment. We focus on the half taking both the reading and mathematics assessments. Our analysis uses a combined math-reading achievement measure, which is simply the average of normalized math and reading assessment scores. For comparability in the NLSY97, we create a combined math-reading achievement measure from four ASVAB assessments (arithmetic reasoning, mathematics knowledge, paragraph comprehension, and word knowledge). Finally, we categorize individuals according to their normalized test score quartiles.[7]

The NLSY97 measures income for all household members (received in 1996), while YITS only contains measures of *parental income* (received in 1999). For comparability, we use total *parental income* (excluding income from other household or family members) in both samples for our analysis.[8] Parental income is measured when youth are age 15 in YITS and ages 12-16 in the NLSY97; however, this discrepancy does not play an important role in our findings. We denominate income in year 1999 dollars, using the U.S. Consumer Price Index for all urban consumers (CPI-U) to adjust for inflation in the NLSY97. We also consider income adjustments to account for differences in the Canada–U.S. currency exchange rate or the purchasing power parity (PPP) index.[9]

[5] In the NLSY97, we exclude youths that are part of the minority and poor white over-samples, using only the full random samples in our analysis.

[6] Four ASVAB subtests are combined to create the AFQT scores discussed earlier. The full set of subtests includes arithmetic reasoning, assembling objects, auto information, coding speed, electronics information, general science, mathematics knowledge, mechanical comprehension, numerical operations, paragraph comprehension, shop information, and word knowledge.

[7] For both data sources, we first normalize individual test scores by subtracting the mean score and dividing by its standard deviation. This generates normalized scores for all tests with a mean of zero and standard deviation of one. In the NLSY97, we normalize within each age group (in years). In YITS, our math-reading achievement measure is the simple average of the normalized math and reading scores. In the NLSY97, we first create a math (reading) score by taking an average of normalized scores for arithmetic reasoning and mathematics knowledge (paragraph comprehension and word knowledge). We normalize these scores and then take their average as our math-reading achievement measure — its correlation with AFQT percentile is over 0.97 in our sample.

[8] The correlation between total parental income and total household income (used by Belley and Lochner (2007)) is 0.96 in the NLSY97.

[9] In 1999, the average nominal exchange rate was 1.49 while the PPP was 1.19. That is, the U.S. dollar was worth 1.49 (or 1.19 using PPP) Canadian dollars.

Our analysis focuses primarily on PS attendance as of age 21.[10] Individuals in the NLSY97 are considered to have attended a PS institution if they *attended* at least 13 years of regular school. This includes traditional two- and four-year colleges and universities but would generally exclude participation in shorter training or vocational programs. In YITS, our measure of PS attendance is based on reported attendance by age 21 in a qualifying PS program or institution, including 'colleges' (two-year institutions), 'universities' (four-year institutions), or Quebec's CEGEP ('College d'enseignement general et professionnel', meaning College of General and Vocational Education) program. Consistent with our NLSY97 measure, we exclude participation in shorter vocational, training, licensing, or apprenticeship programs. In some cases, we also consider whether youth ever reported attending a four-year PS institution by age 21.

Our multivariate analysis controls for a rich set of family background measures. We control for maternal education by categorizing mothers as high school dropouts, those who completed high school or more, and those who completed at least one year of PS schooling. We also account for family structure by controlling for the number of household members under the age of 18 as of the first survey date. Additional family structure information is provided by an indicator variable for whether both biological parents are present in the home at the time of the initial survey. We include controls for whether the youth is an immigrant and whether at least one parent is an immigrant. We account for family residence in a metropolitan area at age 15.[11] We control for the mother's age at the time of the respondent's birth as well as gender in both surveys. Finally, we control for race (blacks, hispanics, other non-whites, and whites) and year of birth in the NLSY97.

Descriptive statistics for these variables are provided in Table 1 for both surveys.[12] Comparisons across samples suggest that schooling attainment is higher in Canada, except at the top end. Both high school and PS attendance rates are about 10% higher in Canada than the U.S. (93% vs. 83% for PS attendance and 71% vs. 63% for high school completion).[13] By contrast, 42% of youth attended a 4-year PS school in both countries. Educational attainment is also higher among Canadian mothers. Nearly 10% of all Canadian youth in our sample are immigrants, and one-fourth of all youth have at least one parent who is foreign born. Both of these figures are considerably smaller in the U.S.

[10] Schooling attainment at age 22 is used in the NLSY97 if it is missing or unavailable at age 21 (fewer than 10% of all respondents).

[11] In the NLSY97, 'metropolitan residence' reflects residence in a U.S. Metropolitan Statistical Area (MSA) at age 15 if available; otherwise, residence at 16 or 17 (if unavailable at ages 15 and 16) is used. An analogous Canadian measure was created for YITS using an indicator for whether the respondent's Census Metropolitan Area (CMA) or Census Agglomeration Area (CA) had a population of greater than 50,000.

[12] These samples are restricted to individuals for whom we observe both math-reading scores and parental income.

[13] In the NLSY97, respondents are assumed to have completed high school if they *completed* 12 or more years of school. In YITS, high school completion is self-reported as of age 21

Canadian youth also tend to have slightly older mothers and are more likely to have both biological parents present in the household during adolescence. Fewer Canadian youth grow up in metropolitan areas. The table reports average parental income and average income within each of the four quartiles for Canada and the U.S. (denominated in year 1999 dollars). For comparability, the table shows U.S. income levels after adjusting for differences in PPP, a factor of 1.19. After adjusting for PPP, American parents average about $7,500 less in income than Canadian parents each year.[14] Income is more dispersed in the U.S. Most notably, parents in the lowest income quartile in the U.S. report annual income averaging $15,600 while Canadian parents in the bottom quartile reported incomes averaging $28,100. In the top quartile, American and Canadian parental incomes differ by less than $1,000, both averaging around $125,000.

Appendix Table A1 shows the joint distribution of math-reading achievement quartiles and parental income quartiles in both YITS and the NLSY97. While parental income and achievement are positively correlated in both samples, this correlation is weaker in Canada. Roughly 35% of American youth lie along the diagonal in Table A1 (i.e. they are in the same achievement and family income quartiles), compared to only 30% of Canadian youth.

4 Achievement, Parental Income and Educational Attainment

Figure 1 reports PS attendance rates by parental income quartile in Canada and the U.S. Education and parental income are positively correlated in both countries, but the correlation is substantially stronger in the U.S. Canadian youth with parents in the highest income quartile are nearly twenty percentage points more likely to attend a PS institution than are youth from the lowest income quartile. In the U.S., this difference is about 45 percentage points. High income youth from both countries have similar PS attendance rates, but low income youth in the U.S. have much worse educational outcomes than their Canadian counterparts.

Figure 2 shows PS attendance rates by parental income and math-reading achievement quartiles in YITS and the NLSY97. Not surprisingly, math and reading skills play an important role in determining educational attainment. Both achievement and parental income are more important determinants of PS attendance in the U.S. than in Canada. In Canada, income has much greater effects on PS attendance for the least able than for all other math-reading achievement quartiles. Among the least able, youth from the highest income quartile appear to be outliers with attendance rates that are 13-20 percentage points higher than all other income groups. Other achievement groups show

[14] Using the official currency exchange rate of 1.49, average parental income in the U.S. ($80,000) was almost $9,000 higher than in Canada.

an attendance gap of 8-12 percentage points between the highest and lowest income quartiles. The picture for the U.S. is quite different. In the NLSY97 data, differences in attendance between the highest and lowest income quartiles range from 20-30 percentage points for all achievement groups.

To further explore these relationships, we employ a similar methodology to that used in Ellwood and Kane (2000), Carneiro and Heckman (2002) and Belley and Lochner (2007), who analyze the effects of family income and achievement on schooling decisions in the U.S. after controlling for other family background characteristics. Since we are mainly interested in how parental income – educational attainment relationships compare between Canada and the U.S., we employ very similar estimation specifications for both YITS and the NLSY97. Specifically, we regress educational outcomes on parental income quartiles during the respondent's late teenage years, math-reading achievement quartiles, and nearly identical family background measures (as discussed earlier). We primarily use parental income and achievement quartiles to allow for non-linear relationships; however, we consider alternative assumptions about the role of parental income below.

Table 2 reports estimates of our main specifications for the YITS and NLSY97 data. First, consider the determinants of PS attendance in Canada and the U.S. reported in the first two columns. There is general agreement between both countries regarding the role played by family background. Immigration status (of the youth and his or her parents) and maternal education have fairly strong positive effects on PS attendance rates in both countries. Youth born to older mothers, youth living in metropolitan areas, and youth living in intact families (both biological parents present) during adolescence are more likely to have attended a PS institution by age 21. The magnitudes of these effects are modest and similar across the two countries. As observed in Figure 2, math-reading achievement and parental income are both substantially more important determinants of PS attendance in the U.S. compared to Canada. In Canada, the most able are 37 percentage points more likely to attend college relative to the least able; this gap is more than 50 percentage points in the U.S. The difference in attendance rates between the highest and lowest income quartiles is about 7 percentage points in Canada and more than twice as large in the U.S.[15]

The final two columns of Table 2 examine identical specifications for attendance at four-year PS institutions. Interestingly, achievement appears to have similar effects on attendance at four-year schools in Canada and the U.S., despite the weaker effects of achievement on attendance at any PS institution in Canada. While the effects of parental income in Canada are slightly stronger for

[15] We control for a very similar set of family background characteristics to those of Belley and Lochner (2007), who explore the changing effects of family income on educational attainment using the NLSY79 and NLSY97. Our estimates for the NLSY97 are very similar to theirs, despite using slightly different measures of achievement and parental income.

attendance at four-year PS institutions than at any PS institution, the effects in the U.S. are still twice as large as in Canada.

We have also explored PS attendance specifications that include separate measures for math and reading achievement rather than a single combined measure. These estimates suggest that math is more important than reading in the U.S., while the opposite appears to be true in Canada. Reading has very similar effects in both countries, but math is much more important in the U.S.[16] Most importantly, the estimated effects of parental income are nearly identical to those reported in Table 2. Since we are primarily interested in the effects of parental income on educational attainment, controlling for our combined math-reading achievement measure does just as well as controlling for each score separately.

An important concern with using family income quartiles to account for a non-linear relationship between income and schooling is the difference in income distributions between the U.S. and Canada. As is evident from Table 1, income is more dispersed in the U.S., so the gap between high and low income families is greater in the U.S. To see whether this explains the larger educational attainment gaps by parental income quartiles, we estimate specifications analogous to those of Table 2 using linear splines.[17] This enables us to compare the effects of parental income across countries at any level of income. Figures 3a and 3b plot the estimated effects of income for PS attendance and attendance at a 4-year institution as a function of parental income, normalizing all lines to zero at an income level of $10,000. These figures are consistent with Table 2 and show that parental income matters much more in the U.S., whether we use the PPP index or official exchange rates to adjust for currency differences. Furthermore, they show that the effects of income on attendance are focused in the income range of $30-80,000, with the effects much stronger in the U.S. in this region.

We look more closely at the joint role of achievement and parental income in Table 3, which reports the estimated effects of parental income (using quartile indicators) on attendance at any PS institution and at a 4-year PS institution within each math-reading achievement quartile. These specifications control for the same background characteristics as in Table 2. Among Canadian youth, parental income has modest effects on PS schooling for low-achievement youth but smaller effects on those from higher achievement quartiles. The NLSY97 results show sizeable and statistically significant effects of family income in the U.S. for all achievement groups. Among all but the top achievement quartile, moving

[16] Results available upon request. If *ability* is measured equally well by the ASVAB and PISA tests, then Canada – U.S. differences in the effects of achievement can be attributed to differences in the importance of ability. However, if PISA provides a noisier measure of ability than the ASVAB tests, then we would expect to estimate a weaker relationship between achievement and PS attendance in Canada. Assuming a strong positive correlation between ability and parental income, this would likely lead to a small upward bias in the estimated effect of parental income in Canada relative to the U.S.

[17] For comparison with our NPSAS04 analysis of financial aid schedules below, we include spline 'knots' every $10,000 from $20,000 to $100,000, where all amounts are denominated in Canadian dollars.

from the lowest to highest family income quartile raises PS attendance rates by at least 20 percentage points.

Alternative Specifications

We next explore a number of alternative specifications that shed light on the robustness of our findings and offer additional insights regarding the role of parental income.

Since Quebec differs from other Canadian provinces in many ways (e.g. Quebec's francophone population, CEGEP system, differing financial aid schedules and emphasis on grants over loans), we estimate specifications identical to our baseline results in Table 2 separately for Quebec and for all other provinces. These results are presented in Table 4. Interestingly, the effects of achievement on PS attendance are much stronger in Quebec than in the rest of Canada (and even a little stronger than in the U.S.), while the effects of income are quite similar between Quebec and other provinces. In Quebec, the effects of parental income are quite small for PS attendance, while they are modest for university attendance. The effects of income on PS attendance are slightly larger in other provinces relative to Quebec (very similar to estimates for all of Canada in Table 2) but still much smaller than those of the U.S. The effects of parental income on four-year school attendance outside Quebec are slightly weaker than in Quebec and our baseline estimates. While not shown, estimates for youth whose first language is French are quite similar to those for the Quebec sample.

Given the importance of immigration status in determining PS attendance and the possibility that immigrants may differ in many ways from the native population, we explore separate PS attendance specifications by immigration status in Table 5. These specifications are otherwise identical to those of Table 2. The first two columns explore the effects of achievement and parental income on youth with at least one foreign-born parent. While achievement is strongly related to PS attendance for the children of immigrants, parental income is not (in either country). Of course, immigrants are a select group. Many immigrants may move to the U.S. or Canada to improve educational opportunities for their children, and it is possible that lower income migrants possess the strongest desire to educate their children. While difficult to verify, this hypothesis is consistent with the fact that income matters much more for youth with native parents (especially in the U.S.) as seen in the second set of columns in Table 5. Comparing the children of natives in the U.S. and Canada, we see that income and achievement are more important in the U.S. as was the case for the full populations in Table 2. Finally, the last set of results restricts the sample further to white native youth with native parents. We also restrict the Canadian sample to those with English as their native tongue to best generate a similar ethnic, racial, and cultural sample across the two countries. These additional restrictions have

only minor effects on our estimates.

Appendix Tables A2 (for Canada, YITS) and A3 (for the U.S., NLSY97) explore the robustness of our findings to alternative PS schooling specifications. Columns (i)-(iii) of these tables are the same for both countries. In column (i), we use an alternative measure of family income which makes an adjustment for family size. Specifically, we divide parental income by the square root of family size before deriving income quartiles. These new income quartiles are used in place of the original measures in estimating the effects of achievement, parental income, and family background on PS attendance. Comparing column (i) of Tables A2 and A3 with their counterparts in Table 2 reveals that this income adjustment has little effect on the estimated importance of achievement or parental income.

Column (ii) of Tables A2 and A3 conditions our sample on those who have completed high school. While this does not change the estimated effects of achievement and parental income in Canada, these effects are noticeably weaker in the U.S. when compared with Table 2. Given the higher high school completion rates in Canada relative to the U.S., it is not surprising that this has a greater impact on our U.S. results. Furthermore, Table A4 reveals that family income has a larger impact on high school completion rates in the U.S. relative to Canada, especially for lower achievement quartiles. The estimated effects of income and achievement in column (ii) of Table A3 are roughly half-way between the U.S. and Canada estimates in Table 2, suggesting that about half of the Canada–U.S. differences in the effects of achievement and parental income on PS attendance can be traced back to the differential effects of achievement and income on high school completion.

Column (iii) of Tables A2 and A3 provides estimates of the effects of achievement and parental income on attendance at a four-year school conditional on attendance at any PS school. For both countries, achievement has strong positive effects on the likelihood of choosing a four-year institution over a two-year institution, while income has a small effect in Canada and a modest effect in the U.S.

Column (iv) in Table A2 controls for school (at age 15) fixed effects in Canada.[18] The estimated effects of achievement are remarkably similar to those of Table 2 and the effects of income are only slightly smaller than our baseline estimates. The NLSY97 sampling scheme stratified by geographic area rather than school, so it is not possible to estimate models with school fixed effects. Column (iv) of Table A3 instead estimates our baseline model with fixed effects for county $\times$ MSA residential status at age 15 (not in MSA, in MSA but not central city, in MSA and central city). These estimates are also remarkably similar to their counterparts in Table 2. This is, perhaps, more surprising given the dramatic differences in schools, local crime rates, and local labor market conditions across U.S.

[18] Due to the YITS sampling scheme, which is stratified by schools, our data contain about 30 students on average in each school.

counties (and metropolitan status within counties). These estimates also account for differences in local access to a PS institution across individuals. We find that the presence of a public PS institution in an individual's county of residence at age 15 has no significant effects on PS attendance rates or the estimated effects of parental income on PS attendance.[19]

Column (v) of Table A2 takes advantage of some unique data collected in YITS related to respondents' perceived returns to schooling and their peers' education plans. The survey asks respondents the extent to which they agree that getting a good job later in life depends on success in school. They are also asked how many of their peers plan to pursue education after high school. Column (v) reveals that including responses to these questions in our baseline specifications for PS attendance has negligible effects on the estimated achievement and parental income coefficients (compared to Table 2). This is not because perceived returns and peers have no affect on schooling decisions. Our estimates imply that youth who strongly agree that schooling is important for getting a good job in the future are about 8 percentage points more likely to attend PS school than those who strongly disagree with that statement. Furthermore, youth who report that 'all' their peers will attend PS school are about 14 percentage points more likely to attend themselves. While the latter result is not easily interpreted due to concerns about endogeneity bias and correlated unobserved tastes, these findings suggest that our estimated effects of parental income (or achievement) are not driven by differences in peers or views about the returns to education.

5 Intergenerational Schooling Decision Model

We now develop a simple intergenerational schooling model with altruistic parents and children. We focus attention on the following factors likely to affect PS attendance differences by family income: constraints on borrowing and intergenerational transfers, tastes for schooling, earnings as a function of schooling, and the structure of financial aid programs.

We assume that parents live for only one period. They have wealth/income $W > 0$ and must decide how much to transfer their children, $\tau \geq 0$, and consume themselves, $c^p = W - \tau$. Children live for two periods (overlapping with their parents for the first), potentially going to school ($s \in \{0, 1\}$) the first and working the second. Youth of ability θ who do not attend school earn $y_0(\theta)$ during both periods. Those who attend school receive a fixed exogenous 'income' of x and earn $y_1(\theta)$ after school,

[19] Available upon request, these results are based on a specification like that of Table 2 with the inclusion of an indicator for 'public PS school in county of residence at age 15' and interactions of that variable with parental income. (We thank Janet Currie and Enrico Moretti for providing their data on PS institutions by county. See Currie and Moretti (2003) for further details on these data.) Separate estimates of our baseline specifications for those with and without a PS school in the county of residence at age 15 also reveal very similar effects of income.

but they must pay tuition T during the schooling period. We assume that $y_0'(\theta) > 0$, $y_1'(\theta) > 0$, and $y_0(\theta) < y_1(\theta)$, so schooling and ability strictly increase earnings. We also assume that youth place the utility value ξ on college attendance in addition to any financial rewards. Parents discount their child's utility by the factor $\rho > 0$.

Much of our focus is on the importance of financial aid structure, since this is typically neglected in studies of the family income – PS attendance relationship. Youth enrolled in PS school are assumed to receive grants $G(W, x)$ which depend on parental wealth and the amount of in-school income. They may also borrow against future income, b, subject to an upper loan limit which depends on parental wealth and in-school income: $\bar{b}(W, x)$. The need-based nature of financial aid programs implies that both grants and loan limits are weakly decreasing functions of both W and x. Loans must be repaid with gross interest rate $R > 1$. To simplify some of the expressions, we define tuition net of in-school income and grants: $\tilde{T}(W, x) \equiv T - x - G(W, x)$. We assume youth who do not attend PS school can borrow freely, since we are mainly interested in the role of financial aid for those who attend. Borrowing constraints are likely to be much less of a concern for non-attendees, since their income profiles are relatively flat.

We assume parents can perfectly dictate the youth's behavior through tied transfers subject to the caveat that they cannot 'take' from their child via negative transfers.[20] This effectively implies that we can solve the model as though there is a single decisionmaker subject to a constraint on cross-generation transfers.

Assuming utility $u(c)$ is a strictly increasing and concave function of consumption c, and families discount the future at rate $\beta > 0$, the family decision problem can be written as follows:[21]

$$\max\{V_0(\theta, W), V_1(\theta, W) + \rho\xi\},$$

where the family utility from consumption associated with PS attendance is given by

$$V_1(\theta, W) = \max_{b^1, \tau^1} u(c^{p1}) + \rho[u(c_1^1) + \beta u(c_2^1)],$$

subject to parental consumption $c^{p1} = W - \tau^1$, youth consumption during and after school ($c_1^1 = \tau^1 - \tilde{T}(W, x) + b^1$ and $c_2^1 = y_1(\theta) - Rb^1$, respectively), the borrowing constraint $b^1 \leq \bar{b}(W, x)$, and the

[20] See Brown, Scholz, and Seshadri (2009) for an interesting analysis in which parents cannot dictate children's schooling and consumption choices; however, parents can provide transfers that are unrestricted or 'tied' to education decisions.

[21] When $\rho = 0$, parents will always transfer zero to their children and are indifferent to their children's borrowing and schooling. In this case, it is natural to study the schooling and borrowing decisions of youth on their own given zero transfers. This is easily characterized and equivalent to our analysis below when the non-negative transfer constraint binds.

non-negative transfer constraint $\tau^1 \geq 0$. The family utility of not attending PS school is given by

$$V_0(\theta, W) = \max_{b^0, \tau^0} u(c^{p0}) + \rho[u(c_1^0) + \beta u(c_2^0)],$$

subject to parental consumption $c^{p0} = W - \tau^0$, youth consumption $c_1^0 = \tau^0 + y_0(\theta) + b^0$ and $c_2^0 = y_0(\theta) - Rb^0$, and the non-negative transfer constraint $\tau^0 \geq 0$.

We assume that $\xi_i = \phi(W_i) + \eta_i$, where η_i varies in the population with density function $F_\eta(\eta)$ (and associated probability density function $f_\eta(\eta)$). We further assume that $\eta \perp\!\!\!\perp (\theta, W)$ and any other policy or preference parameters. In general, we cannot observe ξ for any particular individual; however, we can often observe W and θ (or, at least, proxies of each). We, therefore, define the PS – non-PS difference in the marginal value of wealth, $\Delta(\theta, W) \equiv V_1(\theta, W) - V_0(\theta, W)$, and consider the probability that a child of ability θ and parental resources W attends PS school:

$$Pr(Coll|\theta, W) = 1 - F_\eta\left(-\left[\frac{\Delta(\theta, W)}{\rho} + \phi(W)\right]\right).$$

From this, we can determine the family income – PS attendance gradient:

$$\frac{\partial Pr(Coll|\theta, W)}{\partial W} = \left(\frac{1}{\rho}\frac{\partial \Delta}{\partial W} + \phi'(W)\right) f_\eta\left(-\left[\frac{\Delta(\theta, W)}{\rho} + \phi(W)\right]\right). \quad (1)$$

As one would expect, the effect of family resources on the probability of college attendance depends positively on the PS vs. non-PS marginal value of wealth ($\frac{\partial \Delta}{\partial W}$) as well as the relationship between wealth and tastes for college ($\phi'(W)$).

For simplicity, we assume that $\beta = R^{-1}$, so youth desire constant consumption over their lives. We are primarily interested in understanding how the marginal value of wealth (MVW) for PS vs. non-PS, $\frac{\partial \Delta}{\partial W}$, is affected by such things as the earnings structure ($y_0(\theta)$ and $y_1(\theta)$), tuition levels T, grant policies $G(W, x)$, and loan limits $\bar{b}(W, x)$. This will, in turn, determine the relationship between family resources and PS attendance rates observed in the data (conditional on youth ability). We relegate most technical details to Appendix B.

5.1 Positive Parental Transfers

We first discuss the decision problem when the non-negative transfer constraints do not bind (or are ignored). In this case, the non-PS consumption allocation problem is quite simple. Given $\beta = R^{-1}$, consumption of the child will be constant over time and increasing in total lifetime family resources $I^0 \equiv W + (1 + R^{-1})y_0(\theta)$. We denote this level of consumption by $c^{0u}(I^0)$; although, the dependence of consumption on I^0 is often implicit below.[22]

[22] We use a 0 or 1 superscript to refer to the PS attendance decision. The u superscript denotes the unconstrained problem. We employ similar notation below to distinguish between the case when individuals are borrowing constrained (superscript c), and transfer constrained (superscript τ). Subscripts denote time periods.

PS consumption allocations depend on whether the family is borrowing constrained.[23] As with the non-PS choice, optimal unconstrained child consumption for PS attendees $c^{1u}(I^1)$ is constant over time and increasing in lifetime family resources $I^1 \equiv W - \tilde{T}(W,x) + R^{-1}y_1(\theta)$. When the borrowing constraint binds, consumption during school is relatively low $c_1^{1c} < c^{1u}(I^1)$, while consumption after school is high, $c_2^{1c} > c^{1u}(I^1)$. This implication of borrowing constraints drives all of our results below that link liquidity problems to the family income – PS attendance relationship.

When parental transfers are unconstrained, we can generally write the difference in the MVW for PS vs. non-PS attendance as:

$$\frac{\partial \Delta}{\partial W} = \rho\left[u'(c^{1u}) - u'(c^{0u})\right] + \rho u'(c_2^1)\frac{\partial G}{\partial W} + \rho\left[u'(c_1^1) - u'(c^{1u})\right] + \rho\left[u'(c_1^1) - u'(c_2^1)\right]\frac{\partial (G+\bar{b})}{\partial W}. \quad (2)$$

The first term represents a pure wealth effect of PS attendance in the absence of any borrowing constraints. This may be positive or negative depending on whether the net financial return to PS school

$$NFR(\theta, W) \equiv \{-\tilde{T}(W,x) + R^{-1}y_1(\theta)\} - (1+R^{-1})y_0(\theta)$$

is positive or negative. To understand why, note that unconstrained consumption levels are increasing in net lifetime income. As a result, if PS attendance increases net lifetime income, then $c^{1u} > c^{0u}$ and the first term in equation (2) is negative due to the diminishing marginal utility of consumption. Intuitively, if PS attendance has a positive NFR, then a marginal increase in family resources improves family welfare less in the case of PS attendance than non-attendance. The opposite is true when the NFR is negative (e.g. low ability youth).[24] As a corollary, anything that increases the NFR to PS school (e.g. a rising skill premium in the labor market) will cause this wealth effect to become more negative. Cross-sectionally, we would expect the NFR to increase with ability (i.e. $y_1'(\theta) > y_0'(\theta)$), in which case the pure wealth effect would tend result in a more positive income – attendance relationship for youth of lower ability. Indeed, this prediction is roughly consistent with our findings for PS attendance reported in Table 3.

The second term in equation (2) is non-positive and reflects pure 'price effects' associated with implicit taxes on family income associated with PS grant aid. Because grant aid is generally decreasing in family resources, youth from higher income families must pay a higher net price for PS schooling

[23] Because income is monotonically increasing in ability, there exists a cutoff level of ability $\hat{\theta}_1(W,x)$ above which youth attending PS school are borrowing constrained and below which they are unconstrained. See Appendix B.

[24] When the NFR is negative, PS attendance is costly and families will only send their children to PS school if it provides a positive 'consumption value'. In this case, wealthier families are more willing to pay the cost (i.e. lower lifetime income) to obtain this 'consumption value'. When the NFR is positive, PS school provides a financial return, so families would only choose not to send their child to school (absent borrowing constraints) if they put a negative 'consumption value' on schooling. In this case, wealthier families that do not value school can better afford to give up its financial returns.

than those from lower income families. This unambiguously discourages PS schooling among children from higher income families.

The last two terms in equation (2) reflect the liquidity effects of extra family wealth on PS attendance decisions when families are borrowing constrained (i.e. $c_1^1 < c^{1u} < c_2^1$). The third term is non-negative and reflects the fact that the marginal utility of consumption during PS school is relatively high for constrained families, since in-school consumption is low. This is the force most often referenced in analyses emphasizing the role of borrowing constraints. The fourth term is non-positive and incorporates the fact that total financial aid is declining in family resources. This offsets any benefits of increased family wealth on available resources for consumption while in school.

For unconstrained families, $c_1^1 = c_2^1 = c^{1u}$ and Terms 3 and 4 disappear. The difference in the unconstrained MVW between those attending and not attending PS school can be simply written as

$$\frac{\partial \Delta^u}{\partial W} = \rho \left[u'(c^{1u}) - u'(c^{0u}) \right] + \rho u'(c^{1u}) \frac{\partial G}{\partial W}. \tag{3}$$

In the absence of need-based grant aid, $sign\left\{\frac{\partial \Delta^u}{\partial W}\right\} = -sign\{NFR\}$. More generally, if the net financial returns to PS attendance is positive and grants are need-based (i.e. $\frac{\partial G}{\partial W} < 0$), then the MVW is greater for non-PS than it is for PS (i.e. $\frac{\partial \Delta^u}{\partial W} < 0$). This highlights two forces that may contribute to a *negative* PS attendance – family income relationship: (i) if the financial returns to PS school are positive, then a marginal increase in family resources improves family welfare less in the case of PS attendance than for non-attendance; and (ii) if grant aid is need-based, then the net price of PS education is increasing in family wealth.

When the borrowing constraint binds for PS attendees, $c_1^{1c} < c^{1u} < c_2^{1c}$.[25] Re-arranging terms in equation (2) and using equation (3), we obtain the following relationship for the relative MVW when families are borrowing constrained:

$$\frac{\partial \Delta^c}{\partial W} = \frac{\partial \Delta^u}{\partial W} + \rho \left[u'(c_2^{1c}) - u'(c^{1u}) \right] \left(1 + \frac{\partial G}{\partial W} \right) + \rho \left[u'(c_1^{1c}) - u'(c_2^{1c}) \right] \frac{\partial \bar{b}}{\partial W}.$$

If grant aid declines less than one-for-one with increases in family resources and student loan limits are not need-based, then $\frac{\partial \Delta^c}{\partial W} > \frac{\partial \Delta^u}{\partial W}$. In this case, borrowing constraints unambiguously raise the MVW for PS attendance relative to non-attendance and facilitate a positive family income – attendance relationship.[26] Even with positive net financial returns to college, PS attendance may have a higher MVW than non-attendance for those who are constrained. Still, the income – attendance correlation

[25] See Appendix B for conditions on ability that imply binding borrowing constraints.

[26] However, if both loan and grant aid are very strongly decreasing in family resources, it is theoretically possible for family income – PS attendance relationships to be weaker (or more negative) for constrained relative to unconstrained families.

may be weak (or negative) even when credit constraints bind due to the wealth and price effects discussed earlier.

This discussion highlights the important roles of the NFR to education and the extent to which financial aid is need-based. Factors that increase the net return to schooling or an increase in implicit financial aid taxes on income will tend to weaken (or make more negative) the income – attendance relationship. That is, under fairly weak assumptions (e.g. , $\frac{\partial G}{\partial W} < 0$, $\frac{\partial \bar{b}}{\partial W} \leq 0$, and $-\frac{\partial(G+\bar{b})}{\partial W} < 1$), higher non-PS earnings, lower PS earnings, and higher tuition all lead to a more positive family income – PS attendance relationship when parental transfers are unconstrained. Any increase in the implicit taxes on family resources associated with financial aid also reduces the income – attendance correlation. Because grant aid affects both the net price of attendance and liquidity while loan limits only affect the latter, the need-based nature of grant aid will have a greater influence on income – attendance relationships than does the need-based nature of student loans. Finally, we note that relaxing the borrowing constraint by broadly expanding loan limits is likely to reduce the income – attendance correlation. Assuming $\bar{b}(W,x) = \bar{b}$ is constant for all (W,x), one can show that $\frac{\partial \Delta}{\partial W}$ is strictly decreasing in $\bar{b}$ if and only if $-\frac{\partial G}{\partial W} < 1$. See Appendix B for details.

5.2 Zero Parental Transfers

When parental transfers are constrained at zero, the problem reduces to that of the youth alone, who must choose whether or not to attend PS school and how to smooth consumption over time (subject to potential limits on borrowing). Increases in parental wealth provide no benefit to youth in the absence of parental transfers. Instead, children of wealthier parents may receive less financial aid. These forces contribute to a negative family income – PS attendance relationship as observed from the difference in MVW between PS attendance and non-attendance:

$$\frac{\partial \Delta^{\tau}}{\partial W} = \rho u'(c_2^1)\frac{\partial G}{\partial W} + \rho\left[u'(c_1^1) - u'(c_2^1)\right]\frac{\partial (G+\bar{b})}{\partial W} \leq 0. \tag{4}$$

If parental transfers are zero (for both PS and non-PS choices) but youth are not borrowing constrained (i.e. $c_1^1 = c_2^1$), then $\frac{\partial \Delta^{\tau}}{\partial W} = \rho u'\left(\frac{y_1(\theta) - R\tilde{T}(W,x)}{1+R}\right)\frac{\partial G}{\partial W}$ and implicit 'taxes' on grant aid drive the income – attendance relationship.[27] For $\frac{\partial G}{\partial W} < 0$, increases in PS earnings or reductions in tuition reduce the marginal utility of consumption for PS attendees and attenuate the perverse effect of family resources on the attendance decision, leading to a more positive income – attendance relationship. This contrasts sharply with the case of positive parental transfers. Not surprisingly, an increase in

[27] While ρ affects $\frac{\partial \Delta^{\tau}}{\partial W}$, ρ does not affect the family income – PS attendance gradient. To see why, note that in equation (1), $\frac{\partial \Delta}{\partial W}$ and Δ are both multiplied by $1/\rho$. Thus, among parents who do not make any transfers to their children, their degree of altruism ρ affects their PS vs. non-PS relative MVW, but it does not affect their child's PS attendance choice.

the implicit tax on parental income used to determine grant aid facilitates a more negative income – attendance correlation.

When transfers are zero and youth attending PS school are borrowing constrained (so $c_1^1 < c_2^1$), need-based loan support further weakens any positive income – attendance relationship (or makes the relationship more negative) as seen in equation (4). An increase in PS earnings reduces the MVW for PS attendance when loan limits are need-based, while increases in tuition reduce the parental income – attendance correlation if either grants or loans are need-based. When $\bar{b}(W, x) = \bar{b}$ is independent of family resources, a reduction in the borrowing limit $\bar{b}$ has a qualitatively similar effect. Of course, if financial aid does not depend on parental resources, then none of these factors affect the income – attendance relationship for youth on their own. In this case, the relationship between parental income and PS attendance would be driven exclusively by the relationship between tastes for schooling and parental income. See Appendix B for detailed derivations of these results.

5.3 Summary

Table 6 summarizes the effects of the earnings structure, tuition, and financial aid policies on the PS – non-PS difference in the MVW under the assumptions that financial aid is need-based but does not fully offset differences in parental resources: $\frac{\partial G}{\partial W} < 0$, $\frac{\partial \bar{b}}{\partial W} \leq 0$, and $-\frac{\partial (G+\bar{b})}{\partial W} < 1$. In all cases discussed, the more financial aid 'taxes' parental resources, the weaker or more negative will be the family income – PS attendance relationship. In general, implicit income taxes affecting grant aid exert more powerful effects than taxes associated with loan aid. By increasing the marginal utility of consumption associated with PS attendance, an increase in tuition strengthens the income – attendance relationship when youth receive transfers from their parents. However, it has the opposite effect when youth are on their own financially since a higher marginal utility of consumption exacerbates the disincentive effects of need-based financial aid formulas. When borrowing constraints are binding, a reduction in borrowing limits produces qualitatively similar effects. Factors that increase the return to PS attendance (either from an increase in PS earnings or decline in non-PS earnings) typically weaken an otherwise positive income – attendance gradient for youth receiving parental transfers. However, if youth on their own are not borrowing constrained (an unlikely combination), an increase in PS earnings strengthens the gradient.

Table 6: Effects of Earnings Structure, Tuition, and Financial Aid on $\frac{\partial \Delta}{\partial W}$

Family Circumstances	$y_0(\theta)$	$y_1(\theta)$	T	$-\frac{\partial G}{\partial W}$	$\bar{b}$ $(\frac{\partial \bar{b}}{\partial W} = 0)$	$-\frac{\partial \bar{b}}{\partial W}$
Positive Parental Transfers						
Unconstrained	> 0	< 0	> 0	< 0	0	0
Borrowing Constrained	> 0	≤ 0	> 0	< 0	< 0	< 0
Zero Parental Transfers						
Not Borrowing Constrained	0	> 0	< 0	< 0	0	0
Borrowing Constrained	0	≤ 0	< 0	< 0	> 0	< 0

Note: Results in table assume $\frac{\partial G}{\partial W} < 0$, $\frac{\partial \bar{b}}{\partial W} \leq 0$, and $-\frac{\partial (G+\bar{b})}{\partial W} < 1$.

6 Higher Education in Canada and the U.S.

In this section, we describe key features of the environments in which recent cohorts of Canadian and American youth have made their schooling decisions. We begin with a brief discussion of a few demographic differences between Canada and the U.S., followed by a summary of estimated financial returns to PS education in both countries. Then, we discuss each country's educational institutions, PS tuition levels, and PS financial aid policies.

In the following section, we discuss the extent to which these factors can explain the parental income – PS attendance patterns estimated for Canada and the U.S. in light of the model developed in Section 5.

6.1 Demographics

Both Canada and the U.S. are demographically quite similar – mostly white and English-speaking populations.[28] However, both countries have somewhat different mixes of ethnic and racial minorities. In the U.S., hispanic and African Americans are both sizeable minorities, each representing 10-15% of the population. Asians represent fewer than 5%. In Canada, blacks and hispanics make up less than 1% of the population, while Asians represent nearly 10% of the population.

Recent immigration has been substantially greater in Canada with 18% of all Canadians foreign-born in 2001. Roughly 40% of the foreign-born come from Europe and another third from Asia. By

[28] The figures reported in this subsection come from the 2000 U.S. Census (as reported by the Census Bureau in various Census 2000 Briefs at *http://www.census.gov/population/www/cen2000/briefs.html*) and the 2001 Canadian Census (as reported by Statistics Canada at *http://www40.statcan.ca/l01/ind01/l3_3867_3433.htm?hili_none*).

comparison, 11% of the U.S. population in 2000 was foreign born, with about half of all foreign-born coming from Latin America and one-quarter from Asia.

Finally, Canada differs in that it contains a sizeable francophone population with about one-fifth of the population speaking French at home. (French, as well as English, is an official language of Canada.) The vast majority of Canadian francophones live in Quebec, where the education system is notably different from other provinces. Given our findings reported in Tables 4 and 5, these demographic differences do not appear to play an important role in explaining overall U.S. – Canada differences in PS education patterns.

6.2 Rates of Return to High School and Post-Secondary Schooling

It is well-known that returns to PS education rose considerably in the U.S. during the 1980s and 1990s (see, e.g., Katz and Autor 1999, Heckman, Lochner and Todd 2008). Increases appear to have been much more muted in Canada (Burbidge, Magee, and Robb 2002, Boudarbat, Lemieux, and Riddell 2006). In their Canada – U.S. comparison of weekly wages by education, Burbidge, Magee, and Robb (2002) find that in 1999 a PS certificate or degree (relative to high school completion) yielded a 27% increase in weekly wages in the U.S. and a 13% increase in Canada. A baccalaureate degree yielded 77% and 42% increases in weekly wages (relative to high school completion) in the U.S. and Canada, respectively. While few other studies estimate the returns to schooling for both Canada and the U.S., a comparison of country-specific studies suggests substantially higher returns in the U.S. relative to Canada during recent years. The model developed in Section 5 suggests that this should lead to a weaker, not stronger, income – PS attendance correlation in the U.S.

6.3 Institutional Environment

In most Canadian provinces, students obtain a high school diploma after completing 12 years of elementary and secondary schooling. At that point, youth are eligible to begin 'college' (usually a two- or three-year program) or 'university' (usually lasting four years for an undergraduate degree).[29] The province of Quebec differs, however. Students in Quebec normally graduate with a high school diploma after completing 11 years of schooling. Those that want to attend university must first complete a two-year college program at CEGEP. Because of the additional year of schooling prior to entering university, Quebec students normally only require three more years to complete an undergraduate university degree. Those wishing to obtain a terminal college diploma (rather than attend university)

[29] Some students may be eligible to begin PS studies without a high school diploma if they are deemed to be 'mature students' (typically 21 years old or older).

must complete a three-year CEGEP program. For the cohort examined in this study, the system also differed in Ontario where most students attending university would have attended 13 years of elementary and secondary schooling.[30]

In the U.S., high school completion typically requires 12 years of primary and secondary schooling; however, a state-wide test must also be passed to receive a high school diploma in some states.[31]

With the exception of a small number of private career colleges, as well as some elite professional programs at the university level, most PS institutions in Canada are heavily funded by the government and are effectively 'public' schools. In the U.S., there are over 4,000 accredited degree granting post-secondary institutions, about 40% of them private. About 60% of American PS students attend four-year institutions. About two-thirds of students in four-year institutions attend public schools, whereas nearly all students enrolled in two-year schools do. Overall, roughly three-quarters of all American post-secondary students enrolled in 2003 were enrolled in a public institution.[32] These distinctions are important, since tuition costs differ substantially between public and private colleges and universities in the U.S.

6.4 Post-Secondary Education Finance

We now discuss the costs of PS attendance and the structure of financial aid programs in Canada and the U.S.[33] We focus on the following factors determining the financial situation of students in both countries: (i) tuition, fees, and other costs; (ii) expected family contributions (EFC) towards PS schooling; (iii) grants and other non-repayable aid like tax credits; and (iv) student loans. These factors determine both the net price of PS attendance as well as the out-of-pocket expenditures required of students.

We consider costs and aid for the 2003-04 academic year unless otherwise noted, since most of the youth in the NLSY97 and YITS would typically be enrolled in PS school during that year and

[30] Prior to 1999, university attendance in Ontario required a regular high school diploma (12 years) plus several courses at the OAC (Ontario Academic Credit) level. Although it was possible to complete the OAC requirements by the end of grade 12, very few students did. The Ontario system has since been reformed, such that students beginning in high school in 1999 or later are eligible for university entry after grade 12; however, many students still require an additional year to obtain the advanced credits (King, et al., 2005).

[31] Students that do not graduate from high school may take the General Educational Development (GED), which is meant to substitute for a high school diploma; however, Cameron and Heckman (1993) show that the earnings for individuals with a GED are the same as the earnings of high school dropouts with the same amount of schooling. Rather than focus on the receipt of a diploma or GED, our empirical analysis considers whether individuals complete twelve or more years of schooling as a measure of high school completion in the U.S. Belley and Lochner (2007) find that treating those obtaining a GED as dropouts does not affect the importance of family income in the U.S.

[32] These institutional and enrollment statistics are taken from Tables 168 and 243 of the *Digest of Education Statistics, 2005*.

[33] Although foregone earnings (i.e. the expected earnings one could receive if not enrolled in school) are an important component of costs, they are roughly similar in Canada and the U.S. (Burbidge, Magee, and Robb 2002).

because we can obtain detailed information about PS financial aid and costs for the U.S. that year from the 2004 National Post-Secondary Aid Survey (NPSAS04). Although comparable individual-specific information about financial aid for students in Canada is not available, the vast majority of aid in Canada is distributed by the federal or provincial governments subject to known rules. We, therefore, use provincial and Canada Student Loan Program (CSLP) rules in 2003-04 to determine financial aid availability for students from different backgrounds. We specifically consider detailed rules in the three largest provinces (Quebec, Ontario, and British Columbia) and actual Millennium Foundation awards to determine financial aid (grants and loans) as a function of parental income in those provinces.[34] Financial aid in most other provinces is similar in nature to that of British Columbia and Ontario.

6.4.1 Costs

In 2003-04, average tuition at Canadian universities was $4,025. Adding expenses for books, supplies, housing, and transportation, typically implied total costs to students of more than $10,000 per year. Tuition levels at two-year colleges are roughly half that of university levels (except in Quebec), and more youth have local access to colleges than universities, reducing additional costs associated with housing and transportation. Variability in tuition is quite small in Canada relative to the U.S. At the college level, tuition is remarkably similar across programs and most provinces; although, Quebec is a clear exception, where in-province CEGEP students pay only nominal registration fees. At the university level, tuition varies somewhat from about $2,500 in Quebec to $4,800 in British Columbia to $5,600 in Ontario.[35]

Average tuition levels are much higher in the U.S. than in Canada due to the sizeable share of private PS institutions in the U.S. Differences between Canadian and U.S. public school tuition levels are more modest. In the 2003-04 academic year, average tuition and fees for undergraduates in the U.S. amounted to $1,900 at two-year public schools, $4,600 at four-year public schools, and $19,000 at four-year private schools (College Board 2004). Before comparing these figures with their Canadian counterparts, it is important to adjust for the difference in currency values. Adjusting for the relevant PPP inflates the U.S. costs by about 20%.[36] American students who choose in-state public PS schools typically face only slightly higher costs when compared with their Canadian counterparts. It is worth noting, however, that tuition and fees varied substantially across U.S. states as we discuss below.

[34] Roughly 75% of the Canadian population resides in Quebec, Ontario, or British Columbia.

[35] Within provinces, tuition is fairly similar across programs and institutions, except for a few recently de-regulated elite professional programs (especially in Ontario). See Junor and Usher (2004) for a detailed description of PS costs and financial aid in Canada. Also, see http://www.statcan.ca/Daily/English/040902/d040902a.htm for details on tuition costs in Canada.

[36] Using official exchange rates at the time would inflate the U.S. figures by about 50%.

Among students living away from home, room and board charges added another $5,900 to four-year public school costs and $7,100 to four-year private school costs in the U.S. These costs are comparable in Canada (Usher and Steele 2006). Of course, living at home can save considerably on these costs. In this regard, an important difference between the U.S. and Canada is access to a local college or university. Do (2004) notes that about half of U.S. high school graduates do not have local access to a state-funded PS institution. In contrast, Frenette (2004) finds that only one-in-six Canadian students do not have access to a local university, while nearly all Canadian students have local access to a two-year college. These differences are important, since 35% of recent dependent university students who received CSLP aid in Canada lived with their parents while only 20% of their American counterparts did.[37]

It is not surprising that university attendance rates have traditionally been lower among 'distant' students, especially those from disadvantaged families (Card 1995, Kling 2001, Frenette 2004). However, Kling (2001) and Cameron and Taber (2004) suggest that living near a post-secondary school was less important in the U.S. during the early 1980s than it was twenty years earlier. We find no difference in family income – PS attendance gaps in the NLSY97 for students with or without a public PS institution in their county of residence at age 15.

6.4.2 Financial Aid

Both Canada and the U.S. provide considerable aid in the form of grants (including loan remissions in Canada), tax credits, and loans. In both countries, the vast majority of financial aid is need-based; although, merit-based aid has grown recently in the U.S.[38] We focus on need-based aid in Canada and the U.S., since we are primarily interested in understanding PS attendance gaps by family income conditional on adolescent student achievement.

Throughout most of Canada, student grants and loans are administered through (or in concert with) the Canada Student Loan Program (CSLP) with the federal government providing 60% of

[37] Canadian residential status figures are based on dependent students receiving some form of aid from the CSLP (excludes Quebec) in 2004-05. (We thank Leesha Lin from the CSLP for providing us with these statistics from the Provincial Need Assessment Data.) Among 19-year old Canadians surveyed (by YITS) in 2004, 48% of those who had attended university reported living with their parents in December 2003; this figure drops to 42% for those in university four years later at age 23. These figures are likely higher than that for all CSLP aid recipients, since students living with their parents are less likely to qualify for financial aid. The U.S. figure is based on all full time/full-year dependent students ages 18-24 who applied for federal aid and attended an in-state 4-year public institution in 2003-04 (based on NPSAS04).

[38] In Canada, roughly $200 million is provided annually in the form of merit aid, compared with over $6 billion in federal and provincial aid (Berger, Motte, and Parkin 2007). Some U.S. states have introduced scholarships and grants for students who perform well in high school and attend PS school in-state (many based on the success of Georgia's Hope Scholarship Program). PS institutions themselves exercise flexibility in their financial aid packages, sometimes using generous offers to attract top students. This is most common in the most expensive private schools and less common in public institutions.

student assessed need and provincial governments the rest. (Quebec is an exception with its own student financial aid system.) The Millennium Foundation also provided considerable grant and bursary aid in 2003-04, which we account for in our figures below. While the details of provincial aid programs differ, all provide some combination of loans and grants based on student need. In the U.S., federal rules determine federal grants and loans as a function of student need. Most states and institutions use a similar need calculation in determining their support.

Generally, determined 'need' simply equals total estimated costs (including tuition, fees, living expenses, books and equipment, and travel expenses) less an expected family contribution (EFC). While actual EFCs differ between Canada and the U.S., they are based on similar information.

EFCs depend on a student's own savings and income, as well as that of his parents (dependent students) or spouse (married students).[39] Canadian students in provinces other than Quebec are expected to contribute all of their savings towards post-secondary schooling, while student savings are fully exempt in Quebec. American students are expected to contribute 35% of any savings. Because most traditional students accumulate little savings, these differences are relatively unimportant. More importantly, Canada and the U.S. differ substantially in the way they treat student income in calculating the EFC. In Canada, students are expected to contribute a minimum amount each year from summer employment, with any additional income above a modest living amount taxed at rates typically above 80%. Minimum contribution rates can be sizeable, ranging between two and three thousand dollars in most provinces.[40] In contrast, the U.S. imposes no minimum contribution from students, instead allowing them to earn $2,380 before 'taxing' them at a 50% rate. This differential treatment of student income plays an important role in determining EFCs and financial aid at the low end of the parental income distribution in the U.S. and Canada.

Expected parental contributions depend primarily on parental income in both countries, with assets playing only a minor role.[41] Generally, parents with income below an exemption amount are

[39] Parental resources are not considered for independent students. In Canada, a student must typically be married, have children, been in the workforce for at least 2 years, or been out of secondary school for at least 4 years (5 years in Ontario, out of full-time studies for 7 years in Quebec) in order to be considered independent. In the U.S., independent students must be over age 24, married, or with children.

[40] Students in Quebec and BC are expected to contribute between $2,500 and $3,000 each year, while students from Ontario are only expected to contribute $1,800 annually. In some cases, students may be given an exemption from the minimum contribution if they are unable to find summer employment. Exemption rates vary from year to year, but for 2004-05, 23% of dependent university students from British Columbia and 5% of students from Ontario received an exemption. (We thank Leesha Lin from the CSLP for providing us with these exemption rates from the Provincial Need Assessment Data.)

[41] Parental assets are generally exempt throughout Canada, except in Quebec where expected parental contributions increase by 2% for assets above $90,000 ($250,000 for farmers and fishermen). In the U.S., all housing assets are exempt, along with any assets below the appropriate exemption amount (e.g. $37,300 for a two-parent family with the older parent 40 years old). Above the exemption amount, assets are multiplied by 0.12 and then added to parental income in determining expected parental contributions.

not expected to contribute to their children's PS education. Exemption levels are relatively low in the U.S. and Quebec compared to other Canadian provinces. Parents earning above the exemption level are effectively taxed by financial aid formulas as their expected contribution rises with income.

Figure 4 shows EFCs as a function of pre-tax parental income for students from two-parent/two-child families in British Columbia, Ontario, and Quebec.[42] The figure also reports average EFC amounts by parental income for dependent undergraduate students in the U.S. from the NPSAS04. (Note that U.S. dollars in this and other figures of this section have been inflated by 20% reflecting the PPP difference between Canada and the U.S.) The differential treatment of student contributions from summer work is evident at the low end of the income scale, where the U.S. expects much less from disadvantaged families. However, the EFC increases quickly in the U.S., overtaking the EFCs in Ontario and British Columbia at around $30-35,000. Implicit tax rates on parental income above the exemption level are modest but cover a broad range of incomes for the U.S. and Quebec, whereas in other Canadian provinces, implicit tax rates on non-exempt income are higher but only apply to families earning above $55,000 (slightly below the median family income for our YITS sample).

In Canada, government student aid is offered to cover the difference between costs and the EFC, subject to a generous upper limit. (Institutions themselves sometimes provide additional aid to help meet any need that has not been satisfied by federal and provincial sources; however, institutional aid plays a minor role in Canada relative to the U.S.) In most provinces, total government aid (loans plus grants) is limited to no more than $275 per week ($9,350 for a typical 34-week academic year) for single dependent students. While a few provinces offer slightly higher limits, Quebec sets much higher annual limits of $14,792 (CEGEP) and $17,293 (university undergraduates). Generally, government loans are the first form of aid provided, with grants reserved for those with the greatest need. The mix between grants and loans is largely a provincial decision. Again, Quebec differs substantially from the rest of Canada in favoring grants heavily over loans. Quebec limits loan amounts to about $2,500 per year for university undergraduates ($2,000/yr for CEGEP students), providing all other aid in the form of grants. Other provinces typically offer more of their assistance in the form of loans. See Appendix D (available online) for further details.

Most federal grant aid in the U.S. is distributed in the form of Pell grants, targeted to very low income families. (In 2003-04, the maximum Pell grant award was $4,050, while the maximum Supplemental Educational Opportunity Grant was $4,000.) States and institutions are also an important source of grant aid, especially for students from middle and higher income families. The Stafford

[42] See Appendix D (available online) for a detailed discussion of EFC and aid calculations in Canada.

Loan Program offers loans to all students (regardless of need) of up to $2,625 for the first year of PS schooling, $3,500 for the second year, and $5,500 for each of the next three years.[43] The total amount of federal grants and subsidized loans cannot exceed the total cost of tuition, fees, room and board (TFRB) less the EFC. However, all students can take out unsubsidized Stafford loans up to maximum loan limits or the total cost of schooling (less any subsidized loan amounts) regardless of calculated need. In this respect, the U.S. federal aid system is more generous to youth from higher income families compared to the Canadian system. Canada does not offer government student loans irrespective of need, so students with parents providing little financial support may have difficulties making ends meet.

In Figures 5-9, we show how financial aid, net tuition, and out-of-pocket schooling costs for PS students attending four-year institutions in Canada and the U.S. depend on parental income. Canadian figures are based on the CSLP and provincial rules (including Millennium and provincial grants and bursaries), using province-specific information about average university costs and student residential status. We focus on the three largest Canadian provinces (British Columbia, Ontario, and Quebec); however, patterns for other provinces are governed by similar rules to those of British Columbia and Ontario (see, e.g., Junor and Usher, 2004). Figures for the U.S. are calculated from the NPSAS04 and are based on 18-24 year-old dependent students that are enrolled in-state in a public four-year PS institution and applied for federal financial aid.[44] We separately consider students attending high and low tuition institutions in the U.S. based on whether the student pays more or less than the median level of tuition ($4,350).[45] Average tuition for the bottom half is $3,300, while it is $6,000 for the top half. Aid figures for Canada are reported separately for students living at 'home' with their parents and those living 'away' from their parents. Surprisingly, average aid amounts differ very little by student residential status in the U.S. We, therefore, show averages for American students regardless of residential status.

Figure 5 reports total non-repayable aid, including tax credits, grants, scholarships and bursaries, by parental income.[46] (See Appendix C for a discussion of non-repayable aid disaggregated by source.) American students with parental income below $20,000 received roughly $10,000 in non-repayable aid

[43] These limits have increased since 2003-04. Low-income students may receive subsidized Stafford Loans, for which the government pays the interest while the student is enrolled in a PS school, as well as Perkins Student Loans. Higher income students can take out unsubsidized Stafford Loans.

[44] Using the NPSAS04, we calculate average aid for parental income categories (adjusted for PPP) zero to twenty thousand dollars, then by every ten thousand dollars up to one hundred thousand dollars, and for one hundred thousand dollars and above.

[45] This distinction is largely synonymous with living in high or low tuition states, since variation in in-state tuition across four-year institutions within states is quite small.

[46] We also include loan remissions in total non-repayable aid for Ontario and Quebec.

from high tuition states and approximately $7,000 from low tuition states. This difference nearly compensates for the difference in tuition. The figure also shows how non-repayable aid (in particular, grant and scholarship aid) declines sharply and continuously with income in the U.S. for families earning less than $60,000. Total non-repayable aid (especially grants and bursaries) in Canada is generally much lower and varies considerably by student residential status, reflecting the difference in costs. As noted earlier, Quebec provides all aid in the form of grants above $2,500; however, Ontario and British Columbia simply have a cutoff need level, above which students receive Millennium or provincial bursaries/grants and below which they do not.[47] Non-repayable aid for Quebec follows a similar pattern to that of the U.S., phasing out continuously over the bottom half of the income distribution. By contrast, non-repayable aid in British Columbia and Ontario phases out quite quickly but at much higher income levels.

Figure 6 reports available government loans in the U.S. and Canada. U.S. amounts assume all students can access Stafford Loans up to the maximum limits; they also include any need-based loans (e.g. Perkins loans) as reported by the NPSAS04. Government student loan access is largely independent of parental income in the U.S. This is not true in Canada, where loans phase-out over a similar income range as does grant aid. In Ontario and British Columbia, both grants and loans are available up to fairly high income levels (roughly $70,000 for students living away from home), then phase-out very quickly.

Figure 7 subtracts total non-repayable aid from tuition and fees to obtain a measure of 'net tuition' at public four-year institutions. This measure does not account for living expenses, which are typically estimated at $6-7 thousand for students living away from home. So, while net tuition appears to be higher for Canadian students living at home, the total net cost of university may be lower. Because financial aid and net tuition figures for the U.S. differ little by residential status, total net costs are noticeably higher for American students living on their own.

A few general comments about net tuition are in order. First, the U.S. is, on average, relatively generous at the low end of the income distribution, even among high tuition states. The Canada – U.S. difference in net tuition for very low income families largely reflects the differential treatment of student income by EFC formulas: Canada expects all students to pay $2-3 thousand towards their own education while the U.S. does not. Quebec is also quite generous due to its emphasis on grants over loans. Indeed, net tuition as a function of family income is remarkably similar for Quebec

[47] Through loan remissions, Ontario effectively limits loans to $7,000 and provides all aid above that amount in the form of grants. The modest increases in aid at very low income levels in Canada are due to the inability of very low income families to fully benefit from education tax credits.

(students living away from their parents) and low tuition states in the U.S. Second, net tuition increases substantially with income over the bottom half of the distribution (up to around $60,000) in the U.S. and Quebec. In Ontario and British Columbia, net tuition is largely independent of family income until it reaches about $65-75,000, at which point it jumps up $2-3 thousand. In practice, net tuition is likely to increase more smoothly than reflected in the figure for Ontario and British Columbia due to institutional grants and scholarships not considered here; however, institutional aid does not play a major role in Canada.[48] Thus, it is highly unlikely that net tuition rises as much with income in these provinces as it does in either the U.S. or Quebec. Third, net tuition differs substantially across the U.S. depending on state-determined tuition levels. This is further shown in Figure 8, which reports the distribution of net tuition in the U.S. within each of our parental income categories. The figure only reports those with positive net tuition to focus on those who may have difficulties financing their studies. Although roughly 80% of all in-state students from families earning less than $20,000 have negative net tuition levels in the U.S., 8% pay more than $1,500 in net tuition. Finally, it is important to recognize that all NPSAS04 figures for the U.S. are based on students choosing to enroll in a four-year public institution. It is possible that students receiving less generous financial aid offers never enroll in the first place, so our total grant figures may be biased upwards and net tuition figures downwards compared to the amounts a typical *potential* student might face. In Appendix C, we consider bounds on net tuition and out-of-pocket costs (by parental income) to account for this self-selection. As Figures C3 and C4 show, assuming that youth who do not attend PS school would have received zero institutional grant aid produces qualitatively similar conclusions.[49]

In addition to the net price of attendance, out-of-pocket costs may be an important determinant of PS attendance for youth who have limited access to credit. Figure 9 shows out-of-pocket expenses, defined as net tuition less available government loans, for Canada and the U.S. This reflects the total amount of money students are expected to raise on their own (or from parents or other relatives) each year to finance tuition costs. On average, the U.S. is relatively generous at the low end of the income distribution; however, total available aid (repayable and non-repayable) is more generous in British Columbia and Ontario for middle income families. While Quebec is generous in terms of grant aid, it is not in terms of total aid. As a result, out-of-pocket expenses are relatively high in Quebec compared to other Canadian provinces and the U.S. Out-of-pocket expenses in Ontario and British

[48] Differences in family assets, youth earnings, and calculated living/travelling costs across individuals would also tend to smooth out financial aid as a function of income in Canada.

[49] Average net tuition for very low income youth is noticeably higher in high tuition states if we assume non-attendees would not have received any institutional or state aid; however, this bound is extremely conservative given the amount of state aid that is disbursed.

Columbia do not depend much on parental income for lower and middle income families; however, they rise considerably with income among higher income families. The value of the Stafford Loan program in the U.S. for students from high-income families is evident in their low out-of-pocket expenditures relative to their Canadian counterparts.

Private loans are also a growing source of financing for undergraduate students in both the U.S. and Canada. Unfortunately, we are unable to compare Canada and the U.S. with respect to private student credit by parental income; however, overall private student borrowing amounts appear to be roughly similar.[50]

7 What Explains the Stronger Role of Parental Income in the U.S.?

In this Section, we consider potential explanations for the stronger relationship between family income and PS attendance in the U.S. relative to Canada. As noted earlier, the higher returns to schooling in the U.S. (incorrectly) predict that income should have a weaker effect on PS attendance in the U.S. We also argue that differences in unobserved factors or peers and social networks are unlikely to explain the cross-national differences in attendance patterns. We focus more on the extent to which these patterns can be explained by the differences in tuition and financial aid policies documented in Section 6.

It is impossible to fully rule out the possibility that unobserved family- or youth-specific factors correlated with both parental income and education tastes, costs, or returns drive the correlation between parental income and educational attainment. However, we control for obvious factors that might play such a confounding role (parental education and age, family structure, youth achievement during adolescence) and still find a much stronger correlation in the U.S.[51] It is difficult to think of unobserved family or youth characteristics that would be strongly correlated with income and schooling in the U.S. but not in Canada.

It is possible that the primary and secondary schools attended by youth from higher income families are simply 'better' than those attended by more disadvantaged youth. This may affect the financial returns to or costs of additional schooling, the social networks and peers of youth, or information about colleges and universities acquired by youth. With greater residential segregation by income in

[50] In the U.S., private student loans represented 16% of all student loan dollars taken out in 2003-04 (College Board 2009). Junor and Usher (2004) report that roughly 15% of Canadian students reported taking out a private student loan in 2001-02 (with average annual loan amounts of $5,600).

[51] As Belley and Lochner (2007) show, controlling for a battery of ten different tests (ranging from knowledge about electronics to auto mechanics to reading comprehension and math) as well as various measures of non-cognitive skills in addition to the controls we have included here has little impact on the estimated parental income – PS attendance relationship in either the NLSY79 or NLSY97 data.

the U.S., these factors could contribute to a stronger income – attendance relationship there. The school-level (YITS) and county × MSA residential status (NLSY97) fixed effects estimates suggest that income plays an important role even within schools or local geographic areas. Of course, peers and social networks may operate on a much more micro level within schools and neighborhoods that may not be picked up by school or local fixed effects. Our findings from YITS regarding peers plans for PS schooling and youths' own perceptions about the value of an education suggest that these factors are important determinants of PS choices, but they do not explain the observed correlation between parental income and PS attendance (after controlling for achievement and family background). However important peers and social networks are, we find no evidence that they explain the parental income – educational attainment relationships we find in the U.S. and Canada (or why this relationship differs across these countries).

We next consider the role of borrowing constraints and the structure of student financial aid in both countries. It is important to distinguish between the effects of financial aid on net tuition prices and on cash-flow problems due to credit constraints. Grants and scholarships lower the actual price of education and help alleviate any cash-flow problems while in school due to an inability to borrow. The first encourages schooling regardless of borrowing opportunities, while the second only operates when youth are borrowing constrained. In principle, government student loans help alleviate borrowing difficulties in the private market, but they do not affect the net price of attendance.[52]

We first discuss the effects of financial aid on the 'net price' of PS attendance (total costs less non-repayable aid), focusing on the way in which governments link grant aid to parental resources. Based on Figure 7, net tuition begins very low but rises quickly with family income in the U.S. and Quebec throughout the bottom half of the income distribution, while net tuition is virtually identical for low and middle income youth in other Canadian provinces. This suggests that family income – PS attendance gradients should be weakest in the U.S. and Quebec among lower income families. Empirically, income attendance gaps are equally weak for the U.S. and Canada (both in Quebec and other provinces) at the bottom of the income distribution as observed in Tables 2 and 4 and Figure 3. At the top half of the income distribution, net tuition is relatively flat in the U.S. and Quebec, while it is increasing sharply with income in British Columbia and Ontario. Consistent with evidence presented in Table 2 and Figure 3, this suggests that income – attendance gradients should be stronger in the

[52]In practice, both Canada and the U.S. offer student loans at interest rates below market value and cover interest payments to students while they are enrolled in school (the latter is not true for unsubsidized Stafford Loans to students or loans offered to their parents through the PLUS Parental Loan program), thus blurring the distinction between grants and loans. As such, government student loans typically have a small subsidy component, which we ignore in our discussion.

U.S. relative to English-speaking Canadian provinces at the top of the income distribution. We should also expect a stronger income – attendance gradient in Quebec, but this is not the case.

Financial aid also helps alleviate cash-flow problems that may arise from imperfect credit markets. Much of the literature (as well as aid programs themselves) focuses on whether youth can finance a 'minimal standard of living' while enrolled in school; however, this does not necessarily ensure efficient schooling decisions. Many youth may prefer the modest lifestyle of a high school graduate to a very low living standard while attending university followed by a much better living standard thereafter, even though they might prefer attending university if they could raise their in-school living standard by borrowing against future earnings. In theory, only unrestricted borrowing opportunities that allow for complete consumption-smoothing ensure efficient educational outcomes. In practice, this is a complicated issue, since students have little collateral to secure educational loans and re-payment is far from certain.[53]

Figure 9 reveals that, on average, very low income American students receive considerable financial help enabling them to cover more than $7,000 in living expenses without dipping into their own pockets. (Figure 8 shows that a non-trivial share of American students fare considerably worse than this.) Low income Canadian students are a bit worse-off than their American counterparts from high tuition states. Even if students have $5-8 thousand at their disposal while in school, this is almost certainly much lower than they can expect to earn and consume after completing their PS program.[54] This suggests that many disadvantaged youth may be unable to fully smooth consumption during and after school (the definition of 'borrowing constrained'). The high implicit tax on total aid for lower and middle income families in the U.S. suggests that some youth from middle income families (especially those in high tuition states) may also face severe cash-flow problems. Without help from their parents, they cannot even finance a minimal living standard. In contrast, middle income students from Ontario and British Columbia can, at least, finance educational expenses and a meager lifestyle without much help from their parents. The availability of Stafford Loans enables wealthier American students to attend most public four-year schools with modest parental aid or a summer job. In contrast, it is difficult to see how higher income Canadian youth could attend university without substantial family support or delaying attendance to work a few years. To the extent that students are constrained in their borrowing, Figure 9 suggests that the income – PS attendance gradient should be weak in

[53] Efficient investment behavior depends crucially on a balance of access to credit and enforcement of loan re-payment. See Lochner and Monge-Naranjo (2010) for a discussion of how different forms of credit markets affect educational investment decisions.

[54] For an interesting point of reference, the official 2003 U.S. poverty threshold for a single person under age 65 was over $11,000 (after adjusting for PPP).

the U.S. relative to Canada at the low end of the income distribution; however, the opposite should be true at the high end (especially if many mid- to high-income parents are unwilling to contribute much towards their children's education). The first prediction is not borne out in the data (income – attendance gaps are similar for Canada and the U.S. at the bottom of the income distribution), but the second is consistent with Table 2 and Figure 3. The differential treatment of student loans may be playing an important role in determining PS attendance among middle and upper income families.

A few caveats complicate any interpretation of the evidence. First, the U.S. financial aid figures are based on students choosing to enroll, so net tuition and out-of-pocket expenses are likely to be worse than reported; however, efforts to account for this selection (see Tables C3 and C4) suggest that this is not a major concern. Second, there is considerable variation in costs and aid within the U.S. If the effects of financial aid on attendance are declining in family income (e.g. due to borrowing constraints), then the substantial heterogeneity in net costs across American states may contribute to a stronger income – attendance gradient for disadvantaged youth than would be expected based on average financial aid schedules.[55] Third, our analysis implicitly assumes students are well-informed about the costs of PS school and the financial aid amounts they are likely to receive. A number of studies raise serious questions about this assumption (e.g. Ikenberry and Hartle 1998, Prairie Research Associates 2005, Usher 2005, Oreopoulos and Dunn 2003). Others have noted important barriers to filling out complicated financial aid forms in the U.S. (Dynarski and Scott-Clayton 2006). Using a randomized experiment, Bettinger, et al. (2009) show that both providing information about financial aid and helping families fill out required financial aid forms significantly increases PS attendance rates among aid-eligible youth in the U.S.

Finally, it is worth pointing out that parental income has modest effects on high school completion in the U.S. (with fairly strong effects among the least able) and weaker effects in Canada. While it is possible that borrowing constraints encourage lower ability youth to drop out of high school in order to find a job, this explanation is not particularly convincing given the high non-employment rates among young high school dropouts in the U.S.[56]

[55] Previous empirical studies are mixed on the relative effects of tuition on PS attendance by family income. See Carneiro and Heckman (2002) or Kane (2006) for reviews of this literature.

[56] For example, among those dropping out of high school between October 2001 and October 2002, only two-thirds were in the labor force in October 2002 with an unemployment rate of 29.8% (U.S. Department of Labor 2003). This implies an employment rate of less than 50%.

8 Conclusions

Among recent cohorts, we estimate that PS attendance rates are more strongly related to parental income in the U.S. than in Canada, even after controlling for similar measures of family background and adolescent cognitive achievement. The largest difference in the effects of income on attendance are observed for youth from middle- to high-income families. In the U.S., PS attendance is strongly increasing in parental income over the range of $30-80 thousand.

We argue that the greater importance of parental income in the U.S. is unlikely to be caused by unobserved educational determinants (including cognitive ability) that are correlated with parental income, differences in neighborhoods, peers or social networks for youth by family income. We, therefore, explore the extent to which limited borrowing opportunities and the structure of Canadian and American financial aid programs can explain Canada – U.S. attendance patterns.

At the bottom of the income distribution, the U.S. provides more aid than Canada, but quickly 'taxes' that aid away as parental income rises toward the median. Canada provides similar aid to low- and middle-income families, 'taxing' it away quickly for families above the median. While youth from high income families receive little or no financial aid in Canada, they are eligible for unsubsidized Stafford loans in the U.S. Overall, the U.S. is relatively more generous at the low and high ends of the income distribution, but Canada is more generous in the middle. These differences (incorrectly) predict a weaker income – attendance correlation in the U.S. relative to Canada at the bottom of the income distribution, but they correctly predict a stronger correlation in the U.S. at the top of the distribution. Although, evidence on the importance of financial aid policies for the income – attendance gradient is mixed, we think future research on PS education decisions would benefit from more carefully considering the structure of need-based financial aid.

Heterogeneity in PS costs and aid is much greater in the U.S. due to differences across states and institutions. So, while average grant and loan aid is fairly generous at the low end of the income distribution, there is still a sizeable share of low income individuals facing relatively high net tuition costs. Their Canadian counterparts tend to receive less aid, on average, but most receive very similar amounts. Relatively low PS attendance rates among low-income Americans may be driven largely by youth from high tuition states who receive poor financial aid offers. In principle, future research on the U.S. alone could shed light on this issue.

Many students and families may be ill-informed about the costs and financial aid associated with PS school. This is likely to be a greater problem in the U.S. for two reasons: (i) there is considerable heterogeneity in tuition levels across states and institutions, with the popular press emphasizing the

skyrocketing costs of elite private institutions and (ii) a large share of financial aid is institution-specific, making it more difficult to determine up front the actual amount any student would receive. The latter, especially, may contribute to a steeper income – attendance gradient in the U.S., since poor information and uncertainty about financial aid is more detrimental to the most disadvantaged. Interestingly, these information problems might also help explain the rising income – attendance gradient in the U.S. over the past few decades as discussed in Belley and Lochner (2007). Even if financial aid had risen at the same rate as tuition (it rose at a slower pace), uncertainty or poor information about financial aid would deter some additional lower income youth from attending PS school today.

Although, we have focused largely on PS attendance decisions, we also estimate modest effects of parental income on high school completion in the U.S. (especially among the bottom half of the achievement distribution) and much smaller effects in Canada. These patterns are more difficult to explain, since borrowing constraints and PS financial aid programs are unlikely to play important roles in this education decision. Although peer effects, social networks, and other neighborhood or school-level factors do not explain the effects of income on PS attendance (or high school completion) in Canada, it is possible that these factors are more important in the U.S. due to greater residential segregation and neighborhood/school quality differences by family income. Unfortunately, we are unable to account for these effects at the neighborhood or school level with the NLSY97 data.

In the end, it is always possible that family income is more strongly correlated with tastes for schooling in the U.S. than it is in Canada; however, this is not a particularly satisfying explanation by itself. A serious treatment of this hypothesis should not only explain why the distribution of tastes differs between the U.S. and Canada, but it should also explain why tastes for schooling have become much more strongly correlated with income in the U.S. since the early 1980s (when family income – PS attendance gaps were as weak as they are today in Canada).

References

Barr-Telford, L., F. Cartwright, S. Prasil, and K. Shimmons (2003), *Access, Persistence and Financing: First Results from the Postsecondary Education Participation Survey (PEPS)*, Culture, Tourism and the Centre for Education Statistics Research Papers. Catalogue no. 81-595-MIE2003007. Ottawa: Statistics Canada.

Becker, G. (1975), *Human Capital*, 2nd Ed., New York, NY: Columbia University Press.

Belley, P., and L. Lochner (2007), "The Changing Role of Family Income and Ability in Determining Educational Achievement", *Journal of Human Capital*, 1(1), 37–90.

Berkner, L. (2000), *Trends in Undergraduate Borrowing: Federal Student Loans in 1989-90, 1992-93, and 1995-96*, Washington DC: National Center for Education Statistics Report 2000–151.

Berger, J. A. Motte, and A. Parkin (2007), *The Price of Knowledge: Access and Student Finance in Canada*, Montreal: Canada Millenium Scholarship Foundation.

Blackburn, M., and D. Neumark (1993), "Omitted-Ability Bias and the Increase in the Return to Schooling", *Journal of Labor Economics*, 11, 521–44.

Boudarbat, B., T. Lemieux, and W.C. Riddell (2006), "Recent Trends in Wage Inequality and the Wage Structure in Canada," in D. Green and J. Kesselman (eds.), *Dimensions of Inequality in Canada*, Vancouver: University of British Columbia Press.

Burbidge, J.B, L. Magee, and A.L. Robb (2002), "The Education Premium in Canada and the United States", *Canadian Public Policy*, 28(2), 203–27.

Brown, M., J.K. Scholz, and A. Seshadri, (2007) "A New test of Borrowing Constraints for Education," Working paper.

Cameron, S., and C. Taber (2004), "Estimation of Educational Borrowing Constraints Using Returns to Schooling", *Journal of Political Economy*, 112, 132–82.

Cameron, S., and J.J. Heckman (1993),"Nonequivalence of High School Equivalents", *Journal of Labor Economics*, 11(1), 1–47.

Cameron, S., and J.J. Heckman (1998),"Life Cycle Schooling and Dynamic Selection Bias: Models and Evidence for Five Cohorts of American Males ", *Journal of Political Economy*, 106, 262–333.

Cameron, S., and J.J. Heckman (2001),"The Dynamics of Educational Attainment for Black, Hispanic and White Males", *Journal of Political Economy*, 109, 455–99.

Card, D. (1995), "Using Geographic Variation in College Proximity to Estimate the Returns to Schooling", in L.N. Christofides et al. (eds.), *Aspects of Labour Market Behaviour: Essays in Honor of John Vanderkamp*, Toronto: University of Toronto Press, 201–21.

Card, D., and T. Lemieux (2001), "Can Falling Supply Explain the Rising Return to College for Younger Men? A Cohort-Based Analysis", *Quarterly Journal of Economics*, 116, p.705–46.

Carneiro, P., and J.J. Heckman (2002), "The Evidence on Credit Constraints in Post-Secondary Schooling", *Economic Journal*, 112, 989–1018.

Cawley, J., J.J. Heckman, L. Lochner and E. Vytlacil (2000), "Understanding the Role of Cognitive Ability in Accounting for the Recent Rise in the Economic Return to Education", in K.J. Arrow, S. Bowles and S. Durlauf (eds.), *Meritocracy and Economic Inequality*, Princeton, NJ: Princeton University Press.

Christofides, L., J. Cirello, and M. Hoy (2001), "Family Income and Postsecondary Education in Canada", *The Canadian Journal of Higher Education*, 31(1), 177–208.

Corak, M., G. Lipps, and J. Zhao (2003), *Family Income and Participation in Post-Secondary Education*, Analytical Studies Branch Research Paper Series. Catalogue no 11F0019MIE2003210. Ottawa: Statistics Canada.

College Board (2004), *Trends in College Pricing 2004*, Washington DC: College Board.

College Board (2006), *Trends in Student Aid 2006*, Washington DC: College Board.

Currie, J., and E. Moretti (2003), "Mother's Education and the Intergenerational Transmission of Human Capital: Evidence from College Openings", *Quarterly Journal of Economics*, 118(4), 1495-1532.

Dearden, L., L. McGranahan, and B. Sianesi (2004), "The Role of Credit Constraints in Educational Choices: Evidence from the NCDS and BCS70", CEEE Discussion Paper No. 0048.

Do, C. (2004), "The effects of local colleges on the quality of college attended", *Economics of Education Review*, 23(3), 249–57.

Ellwood, D., and T. Kane (2000), "Who Is Getting a College Education? Family Background and the Growing Gaps in Enrollment", in S. Danziger and J. Waldfogel (eds.), *Securing the Future: Investing in Children from Birth to College*, Russell Sage Foundation.

Feenberg, D., and E. Coutts (2003), "An Introduction to the TAXSIM Model" *Journal of Policy Analysis and Management*, 12(1), 189–94.

Frenette, M. (2004), "Access to College and University: Does Distance Matter?" *Canadian Public Policy*, 30(4), 427–43.

Frenette, M. (2005), "Is Post-Secondary Access More Equitable in Canada or the United States?" Statistics Canada, Analytical Studies Branch Research Paper No. 244.

Frenette, M. (2007), "Why are Youth from Lower-Income Families Less Likely to Attend University? Evidence from Academic Abilities, Parental Influences, and Financial Constraints", Statistics Canada, Analytical Studies Branch Research Paper No. 295.

Heckman, J.J., L. Lochner, and P. Todd (2008), "Earnings Functions and Rates of Return", *Journal of Human Capital*, 2(1), 1–31.

Junor, S., and A. Usher (2004), *The Price of Knowledge: Access and Student Finance in Canada*, Montreal: Canada Millenium Scholarship Foundation.

Kane, T. (2006), "Public Intervention in Post-Secondary Education," in E. Hanushek and F. Welch (eds.), *Handbook of the Economics of Education*, Vol. 2, Ch. 23, Amsterdam: Elsevier Science.

Katz, L., and D. Autor (1999), "Changes in the Wage Structure and Earnings Inequality," in O. Ashenfelter and D. Card (eds.), *Handbook of Labor Economics*, Vol. 3A, Amsterdam: Elsevier Science.

Keane, M., and K. Wolpin (2001), "The Effect of Parental Transfers and Borrowing Constraints on Educational Attainment", *International Economic Review*, 42, 1051–1103.

King, A.J., W.K. Warren, J.C. Boyer, and P. Chin (2005), *Double Cohort Study: Phase 4*, Queen's University: Social Program Evaluation Group. Report submitted to the Ontario Ministry of Education.

Kling, J. (2001), "Interpreting Instrumental Variables Estimates of the Returns to Schooling", *Journal of Business & Economic Statistics*, 19(3), 358–64.

Lochner, L., and A. Monge-Naranjo (2010), "The Nature of Credit Constraints and Human Capital", Working Paper.

Manski, C., and D. Wise (1983), *College Choice in America*, Cambridge, MA: Harvard University Press.

McPherson, M., and M. Schapiro (1998), *The Student Aid Game: Meeting Need and Rewarding Talent in American Higher Education*, Princeton, NJ: Princeton University Press.

Milligan, K. (2002), "Tax preferences for Education Savings Plans: Are RESPs Effective?" Ottawa: C.D. Howe Institute.

Murnane, R., J. Willett, and F. Levy (1995), "The Growing Importance of Cognitive Skills in Wage Determination", *Review of Economics and Statistics*, 77, 251-266.

Neill (2007), *Canada's Tuition and Education Tax Credits*, Montreal: Canada Millenium Scholarship Foundation.

Stinebrickner, T., and R. Stinebrickner (2007), "The Effect of Credit Constraints on the College Drop-Out Decision: A Direct Approach Using a New Panel Study", Working Paper.

Titus, M. (2002), *Supplemental Table Update for Trends in Undergraduate Borrowing: Federal Student Loans in 1989-90, 1992-93, and 1995-96*, http://nces.ed.gov/pubs2000/2000151update.pdf.

U.S. Department of Education, National Center for Education Statistics (2003), *How Families of Low- and Middle-Income Undergraduates Pay for College: Full-Time Dependent Students in 1999-2000*, NCES 2003-162, by S. Choy and A.M. Berker. Project Officer C.D. Carroll, Washington DC.

U.S. Department of Labor (2003), *College Enrollment and Work Activity of 2002 High School Graduates*, News Release USDL 03-330, Washington DC.

Usher, A., and K. Steele (2006), *The State of Student Aid in Canada*, Toronto: Educational Policy Institute.

Figure 1: PSE Attendance by Parental Income Quartiles in Canada (YITS) and the US (NLSY97)

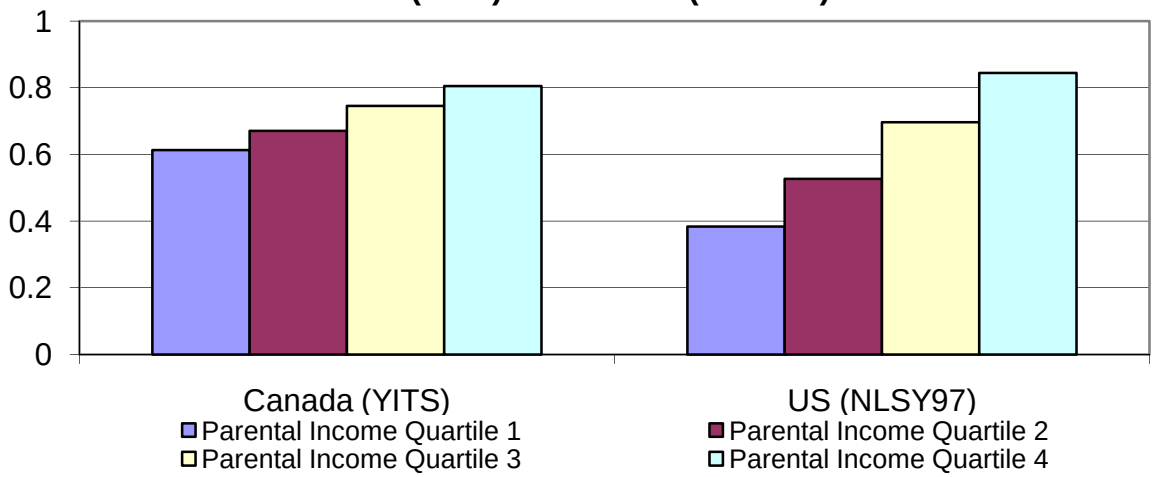

Figure 2a: Post-Secondary Attendance by Math-Reading Ability and Parental Income Quartiles in Canada (YITS)

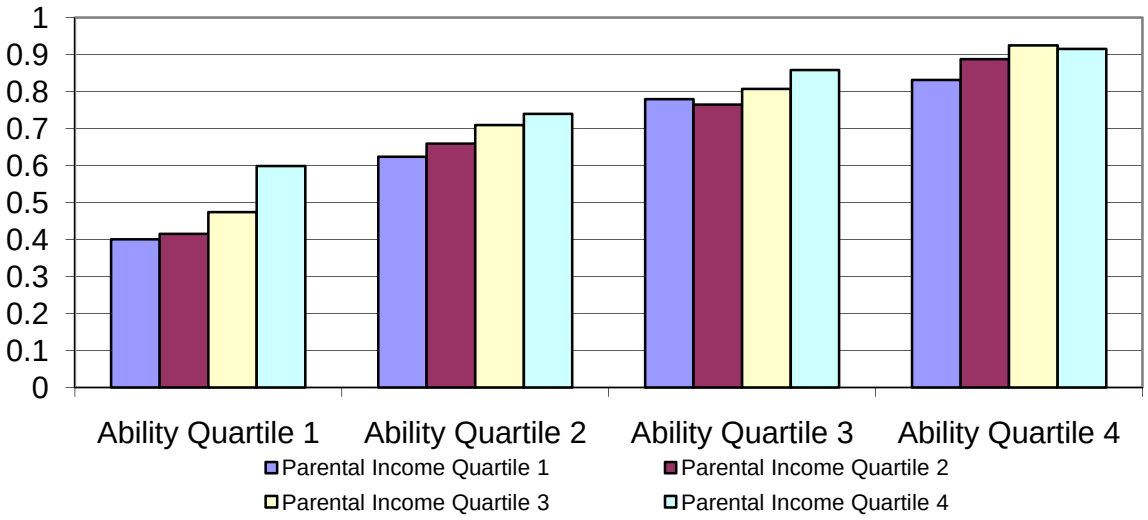

Figure 2b: Post-Secondary Attendance by Math-Reading Ability and Parental Income Quartiles in the US (NLSY97)

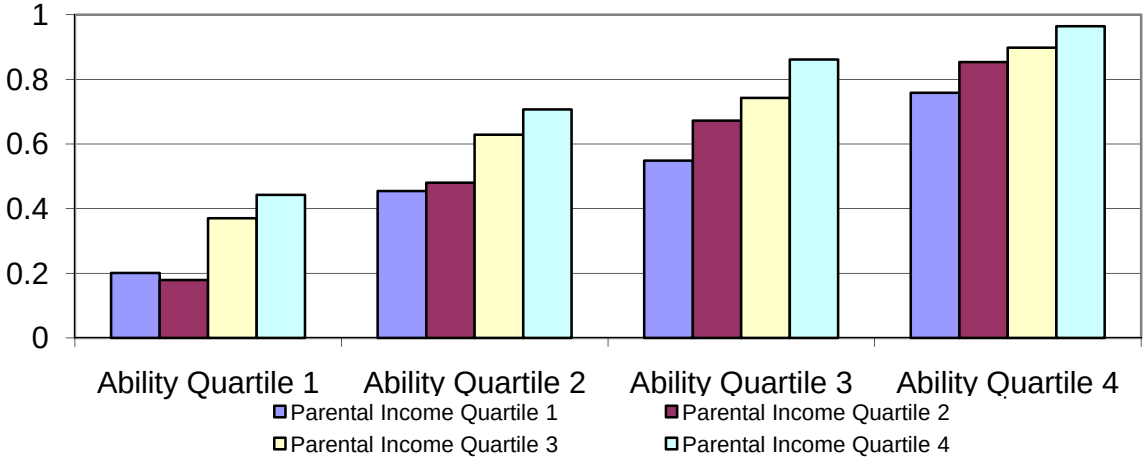

Figure 3a: Estimated Effects of Parental Income on Post-Secondary Attendance (Spline Function Estimates)

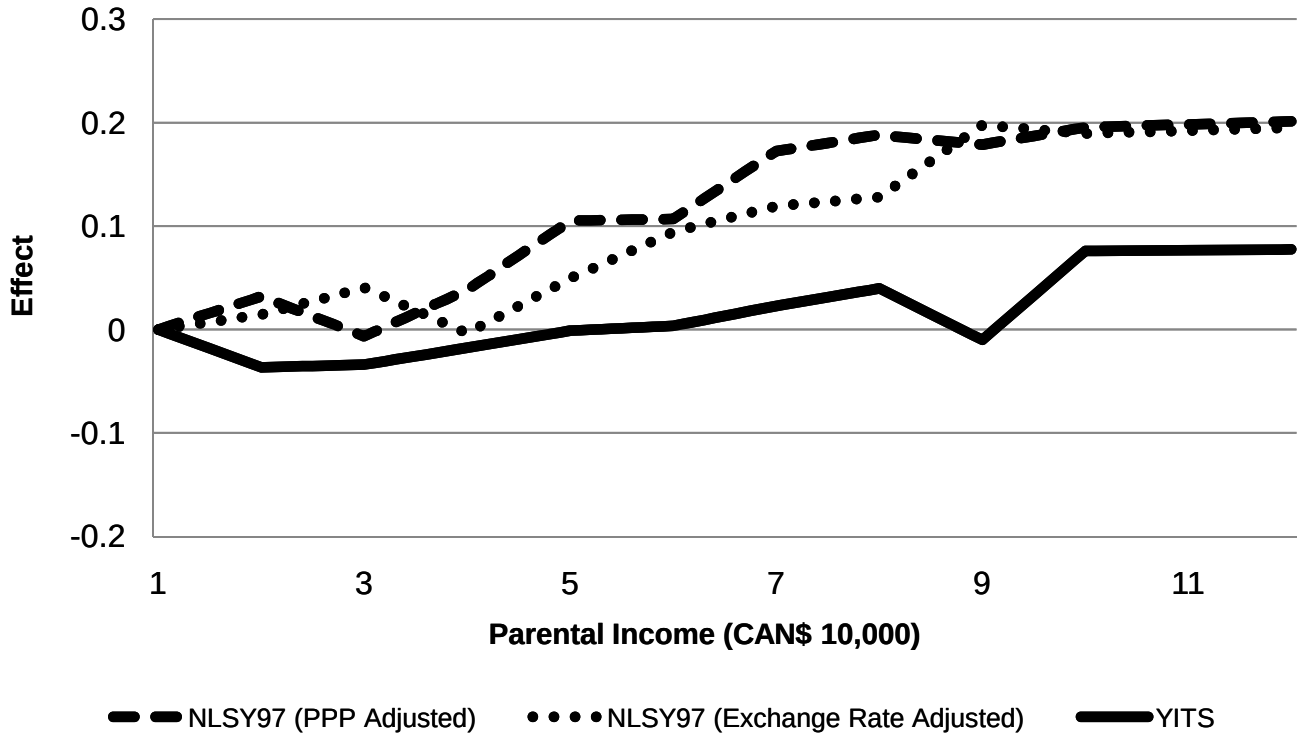

Figure 3b: Estimated Effects of Parental Income on Attendance at a Four-Year PS Institution (Spline Function Estimates)

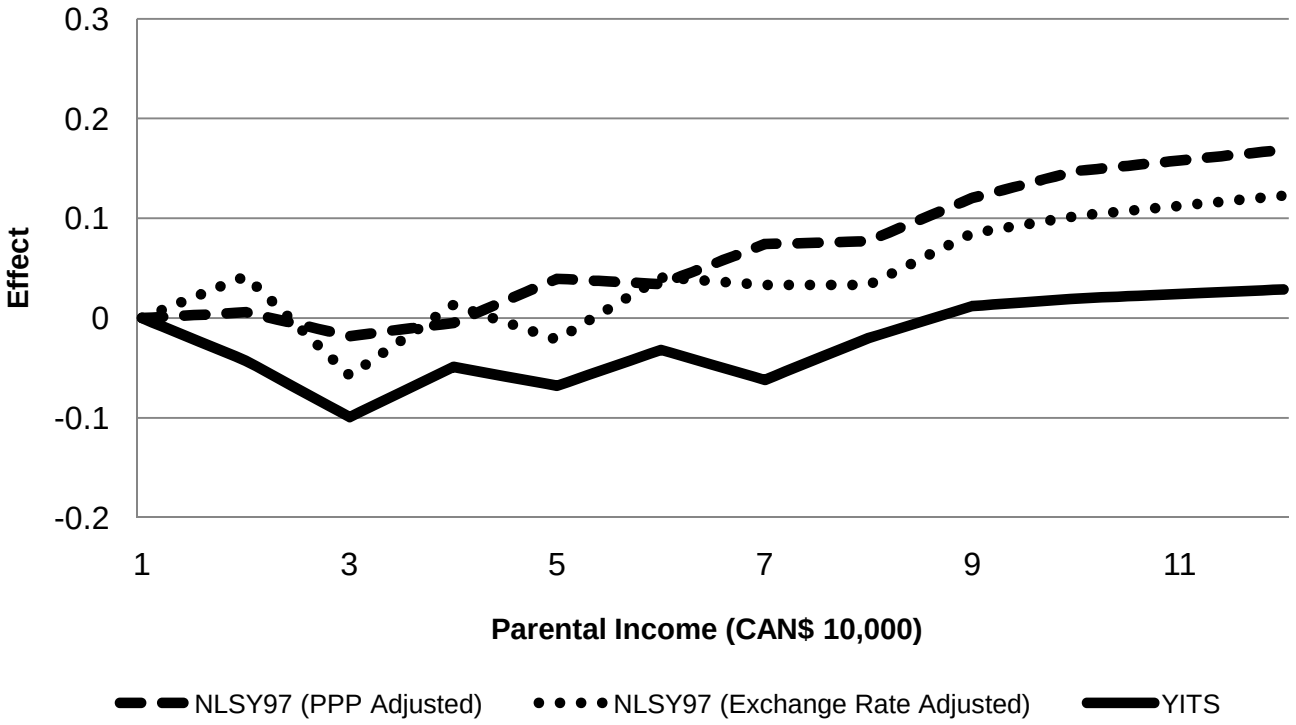

Figure 4: Expected Family Contribution

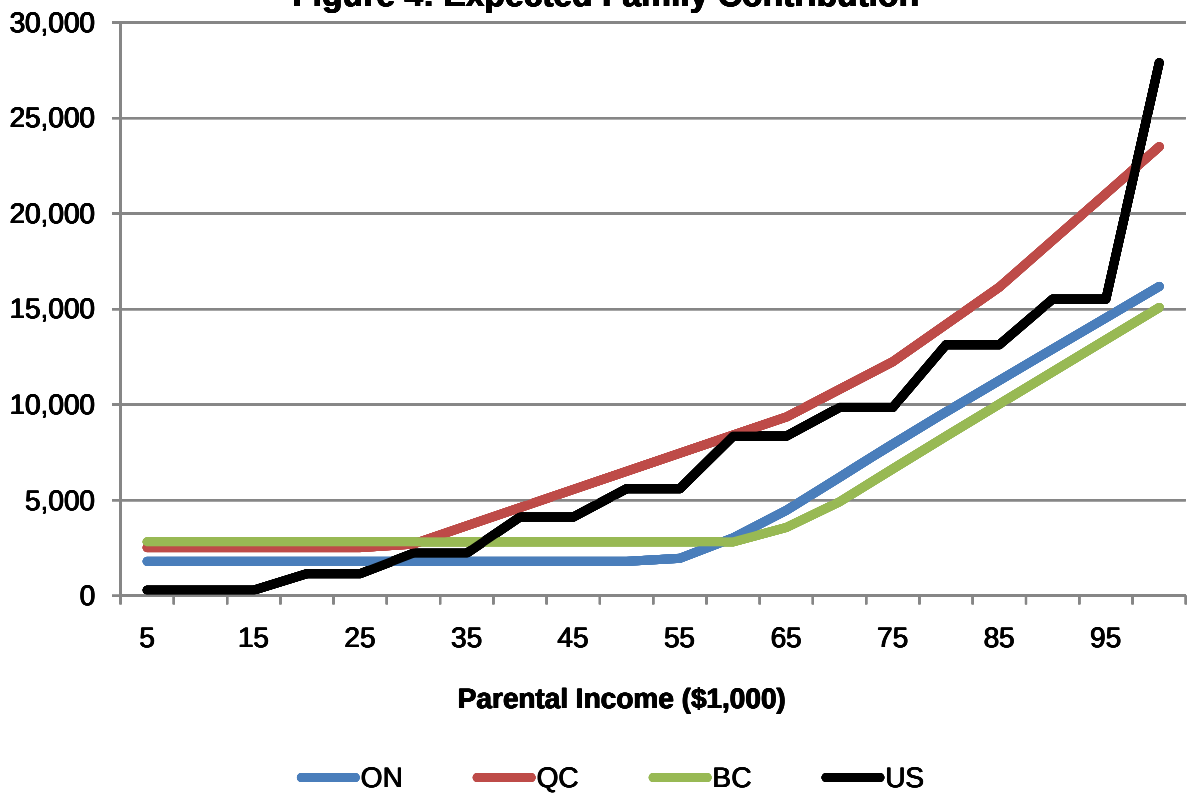

Figure 5: Total Non-Repayable Aid

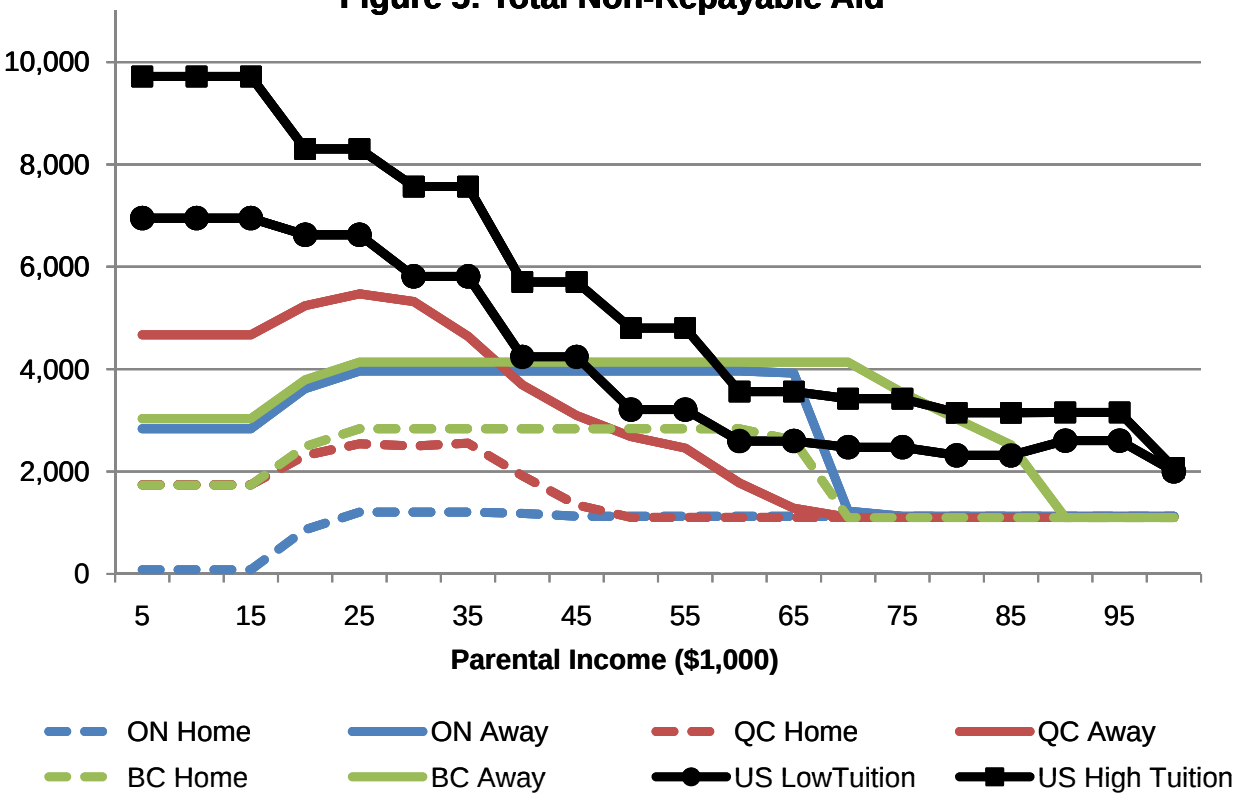

Figure 6: Total Available Government Loans

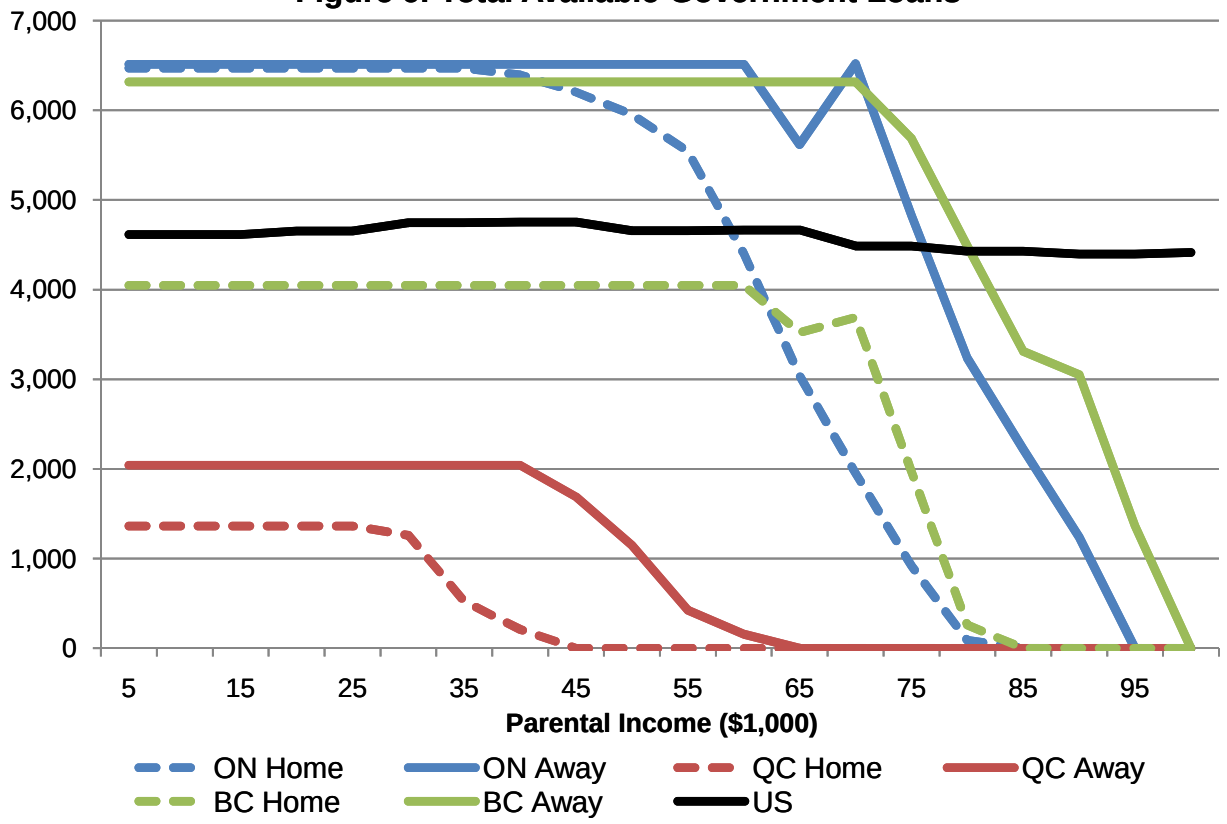

Figure 7: Net Tuition (Tuition less Non-Repayable Aid)

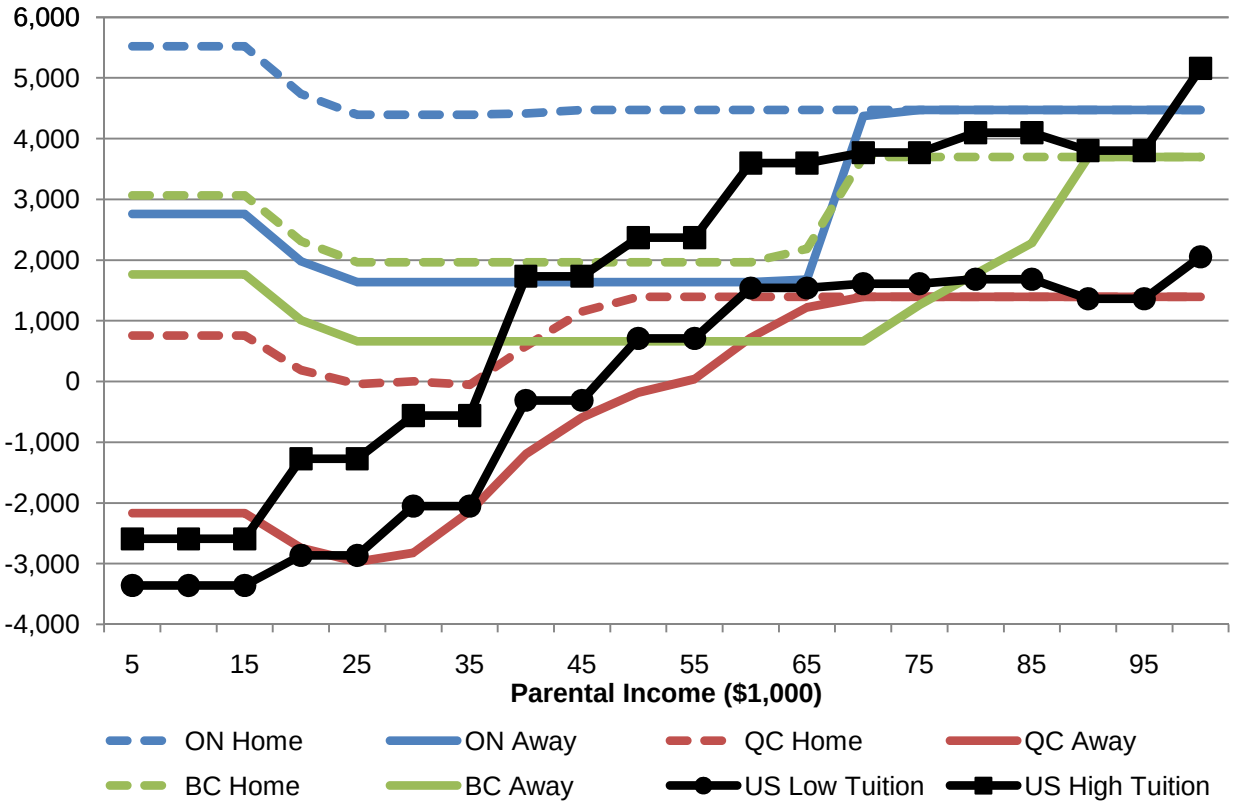

Figure 8: US Distribution of Net Tuition by Parental Income

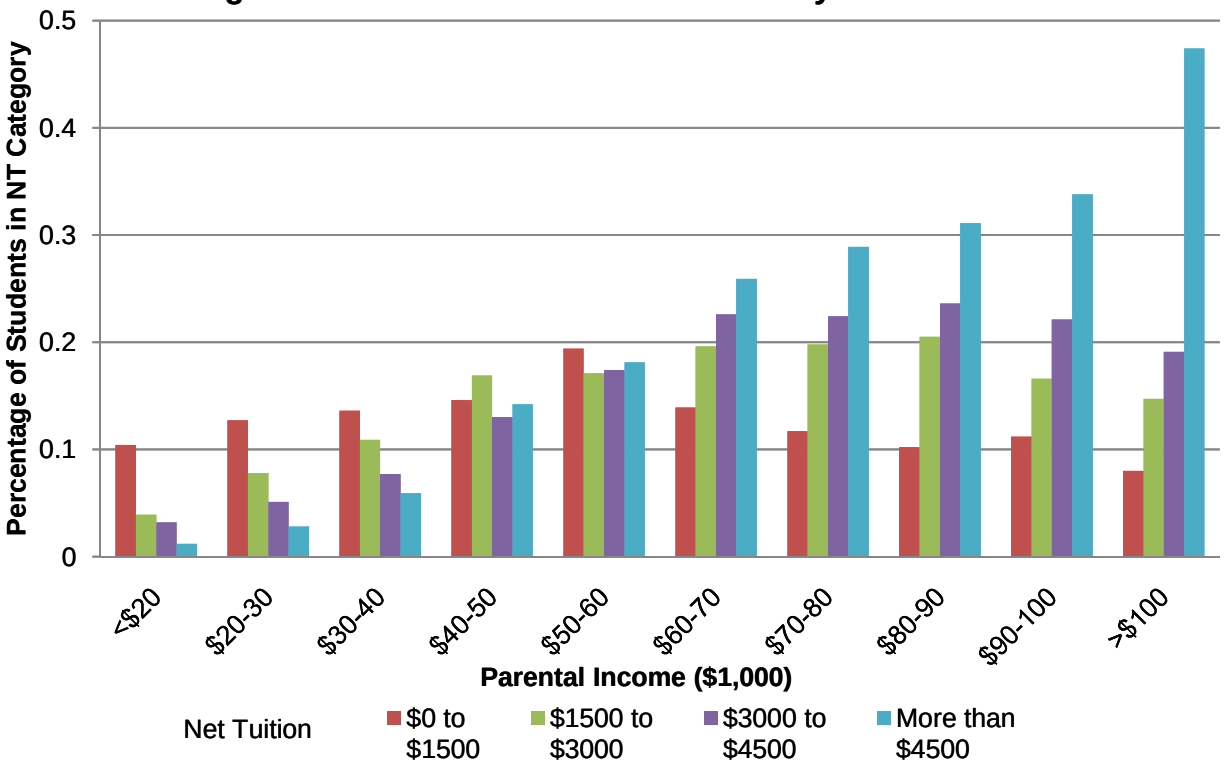

Figure 9: Out-of-Pocket Costs

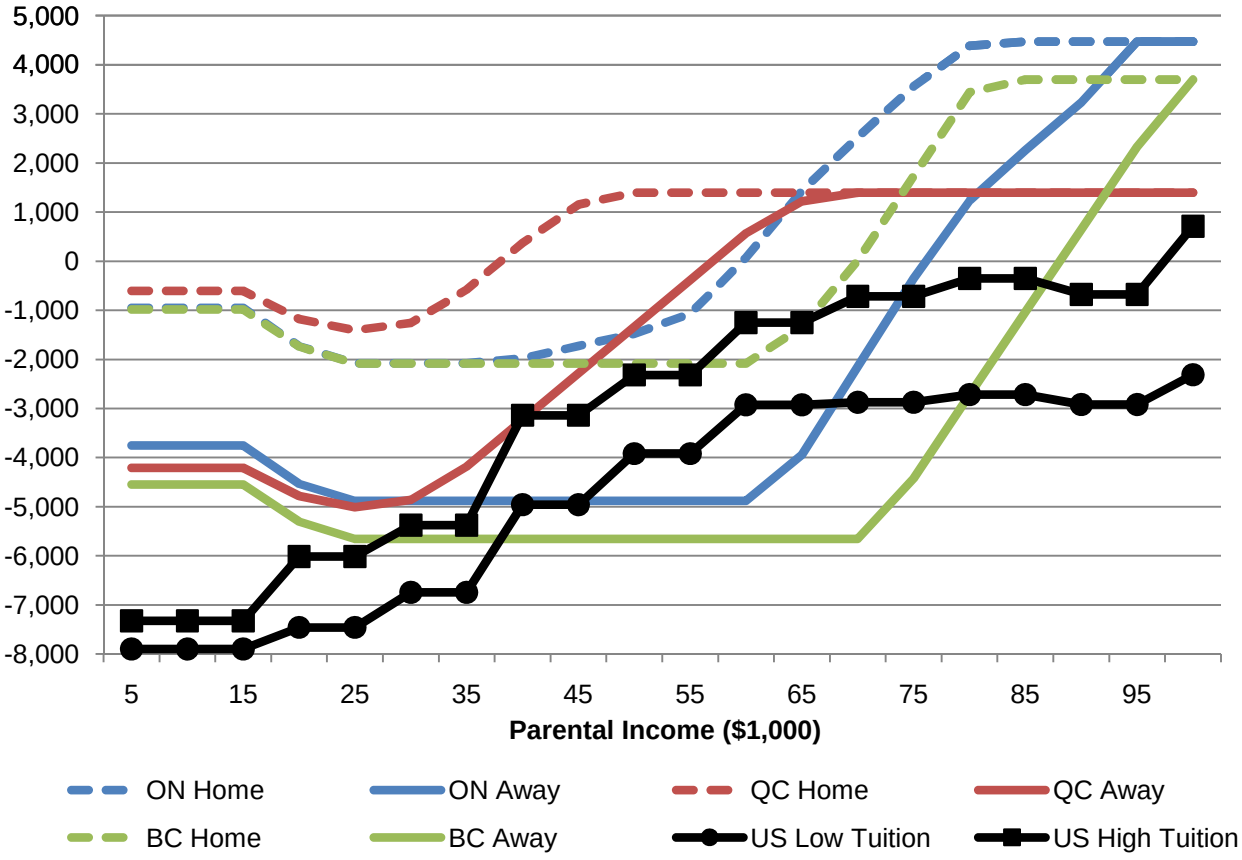

Table 1: Sample Descriptive Statistics

	Canada (YITS)	US (NLSY97)
Completed High School (as of age 21)	0.930	0.832
	(0.255)	(0.374)
Post-Secondary Attendance (as of age 21)	0.710	0.625
	(0.454)	(0.484)
Post-Secondary Attendance at 4-yr Institution (as of age 21)	0.423	0.420
	(0.494)	(0.494)
Male	0.498	0.506
	(0.500)	(0.500)
White	0.875	0.695
	(0.331)	(0.460)
Immigrant	0.082	0.033
	(0.275)	(0.178)
At Least One Parent an Immigrant	0.269	0.126
	(0.444)	(0.332)
Mother's Age at Birth	28.170	25.991
	(4.854)	(5.323)
Intact Family during Adolescence	0.754	0.563
	(0.431)	(0.496)
Metropolitan Area during Adolescence	0.679	0.790
	(0.467)	(0.407)
Number of Children in Household under 18	1.472	2.329
	(0.508)	(1.147)
Mother High School Graduate	0.887	0.847
	(0.316)	(0.360)
Mother at Least Some Post-Secondary Schooling	0.594	0.493
	(0.491)	(0.500)
Parental Income (in $10,000) during Late Adolescence	7.174	6.422
	(5.556)	(4.773)
Average Parental Income (in $10,000) in Quartile 1	2.814	1.561
	(1.137)	(0.749)
Average Parental Income (in $10,000) in Quartile 2	5.481	4.026
	(0.594)	(0.716)
Average Parental Income (in $10,000) in Quartile 3	7.552	6.609
	(0.625)	(0.889)
Average Parental Income (in $10,000) in Quartile 4	12.660	12.572
	(8.142)	(4.638)
Sample Size	9,031	4,108

Note: Table reports means with standard deviations in parentheses. YITS sample includes individuals with non-missing reading and mathematics scores and parental income. NLSY97 sample includes individuals with non-missing reading and mathematics scores and parental income measured in 1997 if they had reached age 21 by 2005. All dollar values denominated in year 1999 dollars. U.S. incomes adjusted by PPP = 1.19.

Table 2: Effects of Family Income, Math-Reading Achievement, and Family Background on Educa

	PS Attendance		Attendance at a Four-Year PS Institution	
	YITS	**NLSY97**	**YITS**	**NLSY97**
Male	-0.1272	-0.0927	-0.1478	-0.0895
	(0.0086)	(0.0130)	(0.0089)	(0.0134)
Immigrant	0.0812	0.1574	0.0938	0.1507
	(0.0179)	(0.0444)	(0.0186)	(0.0456)
At Least One Parent an Immigrant	0.0790	0.0521	0.1139	0.0178
	(0.0113)	(0.0242)	(0.0117)	(0.0248)
Mother's Age at Birth	0.0070	0.0031	0.0061	0.0039
	(0.0010)	(0.0014)	(0.0010)	(0.0014)
Intact Family during Adolescence	0.0538	0.0793	0.0560	0.0960
	(0.0106)	(0.0150)	(0.0110)	(0.0154)
Metropolitan Area during Adolescence	0.0339	0.0139	0.0351	0.0034
	(0.0097)	(0.0163)	(0.0101)	(0.0167)
Number of Children under 18	0.0227	-0.0089	0.0400	-0.0028
	(0.0089)	(0.0062)	(0.0093)	(0.0064)
Mother HS Graduate	0.1123	0.0898	0.0740	0.0222
	(0.0152)	(0.0209)	(0.0158)	(0.0214)
Mother at Least Some PSE	0.0578	0.0756	0.0774	0.1151
	(0.0100)	(0.0150)	(0.0104)	(0.0154)
Math-Reading Achievement Quartile 2	0.1997	0.2509	0.1671	0.1293
	(0.0122)	(0.0197)	(0.0126)	(0.0202)
Math-Reading Achievement Quartile 3	0.2988	0.3945	0.3139	0.3239
	(0.0124)	(0.0203)	(0.0128)	(0.0208)
Math-Reading Achievement Quartile 4	0.3714	0.5201	0.5215	0.5585
	(0.0126)	(0.0211)	(0.0131)	(0.0217)
Parental Income Quartile 2	0.0201	0.0290	-0.0005	0.0118
	(0.0126)	(0.0200)	(0.0131)	(0.0205)
Parental Income Quartile 3	0.0450	0.1232	0.0193	0.0547
	(0.0130)	(0.0213)	(0.0135)	(0.0218)
Parental Income Quartile 4	0.0693	0.1762	0.0794	0.1645
	(0.0132)	(0.0228)	(0.0138)	(0.0234)
Test of no Income Effects (P-value)	<.0001	<.0001	<.0001	<.0001
Sample Size	9,028	3,812	9,028	3,700

Notes: Education measured as of age 21. NLSY97 regressions also control for year of birth and race/hispanic ethnicity indicators. Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table 3: Effects of Parental Income on Educational Attainment at Age 21 by Math-Reading Ability Quartile

	Post-Secondary Attendance:				Attendance at a 4-Year Post-Secondary Institution			
	Achieve. Quartile 1	Achieve. Quartile 2	Achieve. Quartile 3	Achieve. Quartile 4	Achieve. Quartile 1	Achieve. Quartile 2	Achieve. Quartile 3	Achieve. Quartile 4
a. YITS								
Parental Income Quartile 2	0.0132	0.0485	-0.0313	0.0471	0.0219	-0.0048	-0.0108	-0.0041
	(0.0269)	(0.0262)	(0.0251)	(0.0208)	(0.0189)	(0.0260)	(0.0310)	(0.0300)
Parental Income Quartile 3	0.0286	0.0777	-0.0055	0.0683	0.0163	0.0573	-0.0183	0.0276
	(0.0294)	(0.0272)	(0.0252)	(0.0205)	(0.0207)	(0.0270)	(0.0311)	(0.0295)
Parental Income Quartile 4	0.1462	0.0809	0.0283	0.0448	0.0960	0.0757	0.0799	0.0571
	(0.0315)	(0.0282)	(0.0253)	(0.0202)	(0.0221)	(0.0280)	(0.0313)	(0.0292)
Test of no Income Effects (P-value)	<.0001	0.0129	0.0838	0.0107	0.0001	0.0052	0.0014	0.0675
Sample Size	2,217	2,358	2,227	2,226	2,217	2,358	2,227	2,226
b. NLSY97								
Parental Income Quartile 2	-0.0556	0.0472	0.0888	0.0544	-0.0052	0.0541	0.0127	0.0386
	(0.0368)	(0.0450)	(0.0448)	(0.0371)	(0.0259)	(0.0408)	(0.0518)	(0.0519)
Parental Income Quartile 3	0.1631	0.1574	0.1030	0.0878	0.0442	0.1105	0.0174	0.0585
	(0.0437)	(0.0472)	(0.0456)	(0.0368)	(0.0308)	(0.0428)	(0.0528)	(0.0517)
Parental Income Quartile 4	0.2020	0.2004	0.2140	0.1294	0.1139	0.2288	0.1392	0.1528
	(0.0577)	(0.0515)	(0.0473)	(0.0371)	(0.0408)	(0.0471)	(0.0546)	(0.0520)
Test of no Income Effects (P-value)	<.0001	0.0001	<.0001	0.0014	0.0158	<.0001	0.0061	0.0010
Sample Size	845	933	973	1061	831	918	957	994

Notes: All regressions control for gender, race/ethnicity (NLSY97 only), immigrant status, whether at least one parent is an immigrant, mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, metropolitan area during adolescence, and year of birth (NLSY97 only). Education measured as of age 21. Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table 4: Educational Attainment in Canada: Quebec vs. Other Provinces (YITS)

	PS Attendance:		Attendance at a 4-Year PS Institution:	
	Quebec	**Other Provinces**	**Quebec**	**Other Provinces**
Math-Reading Achievement Quarti	0.3408	0.1739	0.0825	0.2009
	(0.0330)	(0.0130)	(0.0329)	(0.0135)
Math-Reading Achievement Quarti	0.4864	0.2578	0.2291	0.3555
	(0.0326)	(0.0134)	(0.0326)	(0.0139)
Math-Reading Achievement Quarti	0.5887	0.3214	0.5128	0.5424
	(0.0331)	(0.0136)	(0.0331)	(0.0142)
Parental Income Quartile 2	-0.0145	0.0268	-0.0129	0.0019
	(0.0293)	(0.0140)	(0.0293)	(0.0146)
Parental Income Quartile 3	0.0592	0.0358	0.0204	0.0063
	(0.0322)	(0.0142)	(0.0322)	(0.0148)
Parental Income Quartile 4	0.0314	0.0725	0.0982	0.0576
	(0.0341)	(0.0144)	(0.0341)	(0.0150)
Test of no Income Effects (P-value)	0.0946	<.0001	0.0049	<.0001
Sample Size	1,392	7,636	1,392	7,636

Notes: All regressions control for gender, immigrant status, whether at least one parent is an immigrant, mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, and metropolitan area during adolescence. Education measured as of age 21. Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table 5: Effects of Parental Income and Math-Reading Achievement on PS Attendance for Selected Population

	Youth with Immigrant Parents		Youth with Native Parents		White Native Youth with Native Parents	
	YITS	**NLSY97**	**YITS**	**NLSY97**	**YITS**	**NLSY97**
Math-Reading Achievement Quartile 2	0.1472	0.2267	0.2136	0.2526	0.1803	0.2550
	(0.0259)	(0.0566)	(0.0138)	(0.0212)	(0.0158)	(0.0256)
Math-Reading Achievement Quartile 3	0.2244	0.3065	0.3254	0.4050	0.2793	0.4037
	(0.0265)	(0.0580)	(0.0140)	(0.0218)	(0.0162)	(0.0254)
Math-Reading Achievement Quartile 4	0.2950	0.4316	0.4017	0.5344	0.3437	0.5429
	(0.0262)	(0.0616)	(0.0144)	(0.0226)	(0.0167)	(0.0256)
Parental Income Quartile 2	-0.0283	-0.0398	0.0316	0.0384	0.0566	0.0665
	(0.0265)	(0.0559)	(0.0143)	(0.0216)	(0.0172)	(0.0262)
Parental Income Quartile 3	-0.0432	-0.0480	0.0738	0.1440	0.0717	0.1632
	(0.0267)	(0.0638)	(0.0148)	(0.0227)	(0.0173)	(0.0266)
Parental Income Quartile 4	-0.0436	0.0019	0.1045	0.1979	0.1152	0.2178
	(0.0264)	(0.0626)	(0.0152)	(0.0246)	(0.0176)	(0.0282)
Test of no Income Effects (P-value)	0.3245	0.7238	<.0001	<.0001	<.0001	<.0001
Sample Size	1,614	456	7,410	3,351	5,635	2,537

Notes: All regressions control for gender, race/ethnicity (NLSY97 only), mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, metropolitan area during adolescence, and year of birth (NLSY97 only). Education measured as of age 21. In the final column for YITS, "White Native Youth with Native Parents", we also exclude youth whose mother tongue is not English. Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table A1: Distribution over Parental Income and Math-Reading Achievement Quartiles

	Math-Reading Achievement Quartile:			
	1	**2**	**3**	**4**
a. YITS				
Parental Income Quartile 1	8.63%	6.68%	5.16%	4.52%
Parental Income Quartile 2	6.92%	6.48%	6.02%	5.58%
Parental Income Quartile 3	5.40%	5.91%	6.46%	7.17%
Parental Income Quartile 4	4.03%	5.65%	6.84%	8.54%
b. NLSY97				
Parental Income Quartile 1	10.18%	5.79%	3.77%	2.22%
Parental Income Quartile 2	6.67%	6.74%	5.87%	5.48%
Parental Income Quartile 3	4.48%	6.74%	7.47%	7.86%
Parental Income Quartile 4	2.09%	5.06%	7.91%	11.66%

Notes: YITS sample contains 9,031 individuals. NLSY97 sample contains 4,108 individuals. See Table 1 for data sample description.

Table A2: Additional Specifications for Post-Secondary Attendance in Canada (YITS)

	(i)	(ii)	(iii)	(iv)	(v)
	Parental Income Adjusted for Family Size	**PS Attendance Conditional on Graduating HS**	**4-Yr School Attendance Conditional on PS Attendance**	**Controls for School Fixed Effects**	**Controls for Perceived Returns to School & Peers' PS Plans**
Math-Reading Achievement Quartile 2	0.1991	0.1626	0.1849	0.2080	0.1813
	(0.0121)	(0.0125)	(0.0178)	(0.0209)	(0.0121)
Math-Reading Achievement Quartile 3	0.2978	0.2412	0.3117	0.3079	0.2729
	(0.0123)	(0.0126)	(0.0173)	(0.0202)	(0.0124)
Math-Reading Achievement Quartile 4	0.3692	0.3078	0.4906	0.3874	0.3362
	(0.0126)	(0.0127)	(0.0172)	(0.0198)	(0.0128)
Parental Income Quartile 2	0.0230	0.0291	-0.0151	0.0232	0.0198
	(0.0124)	(0.0128)	(0.0170)	(0.0190)	(0.0125)
Parental Income Quartile 3	0.0579	0.0428	0.0008	0.0420	0.0408
	(0.0127)	(0.0130)	(0.0170)	(0.0196)	(0.0129)
Parental Income Quartile 4	0.0820	0.0655	0.0626	0.0456	0.0609
	(0.0132)	(0.0132)	(0.0172)	(0.0203)	(0.0131)
Test of no Income Effects (P-value)	<.0001	<.0001	<.0001	0.1081	<.0001
Sample Size	9,028	8,540	6,506	9,028	9,028

Notes: All regressions control for gender, immigrant status, whether at least one parent is an immigrant, mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, and metropolitan area during adolescence. Education measured as of age 21. The dependent variable for columns (i) and (ii) is PS attendance. Column (i) uses parental income divided by the square root of family size to generate income quartiles. Sample for column (ii) includes only those who completed high school. Sample for column (iii) includes only those who attended a PS institution; the dependent variable is attendance at a four-year PS institution. Column (iv) controls for school fixed effects. Column (v) controls for three indicators measuring level of perceived returns to education and two indicators for whether most or all peers plan to attend PS schooling (see text for details). Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table A3: Additional Specifications for Post-Secondary Attendance in the U.S. (NLSY97)

	(i) Parental Income Adjusted for Family Size	(ii) PS Attendance Conditional on Graduating HS	(iii) 4-Yr School Attendance Conditional on PS Attendance	(iv) Controls for County x MSA Residential Status Fixed Effects
Math-Reading Achievement Quartile 2	0.2502	0.2202	0.1038	0.2546
	(0.0198)	(0.0227)	(0.0359)	(0.0207)
Math-Reading Achievement Quartile 3	0.3933	0.3468	0.2801	0.3935
	(0.0204)	(0.0227)	(0.0354)	(0.0214)
Math-Reading Achievement Quartile 4	0.5169	0.4377	0.4528	0.5178
	(0.0212)	(0.0231)	(0.0356)	(0.0223)
Parental Income Quartile 2	0.0381	0.0226	0.0201	0.0302
	(0.0201)	(0.0228)	(0.0322)	(0.0218)
Parental Income Quartile 3	0.1230	0.0957	0.0338	0.1242
	(0.0214)	(0.0234)	(0.0321)	(0.0233)
Parental Income Quartile 4	0.1784	0.1290	0.1169	0.1731
	(0.0231)	(0.0245)	(0.0331)	(0.0253)
Test of no Income Effects (P-value)	<.0001	<.0001	<.0001	<.0001
Sample Size	3,812	3,180	2,332	3,797

Notes: All regressions control for gender, race/ethnicity, immigrant status, whether at least one parent is an immigrant, mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, metropolitan area during adolescence, and year of birth. Education measured as of age 21. The dependent variable for columns (i) and (ii) is PS attendance. Column (i) uses parental income divided by the square root of family size to generate income quartiles. Sample for column (ii) includes only those who completed high school. Sample for column (iii) includes only those who attended a PS institution; the dependent variable is attendance at a four-year PS institution. Column (iv) controls for county x MSA residential status at age 15 (see text for details). Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Table A4: Effects of Parental Income on High School Completion

		Math-Reading Achievement Category:			
	All	**Quartile 1**	**Quartile 2**	**Quartile 3**	**Quartile 4**
a. YITS					
Parental Income Quartile 2	-0.0119	-0.0220	-0.0153	-0.0200	0.0106
	(0.0075)	(0.0209)	(0.0147)	(0.0100)	(0.0067)
Parental Income Quartile 3	0.0187	0.0424	0.0224	0.0065	0.0072
	(0.0077)	(0.0228)	(0.0153)	(0.0100)	(0.0066)
Parental Income Quartile 4	0.0177	0.0750	0.0183	0.0069	0.0014
	(0.0079)	(0.0244)	(0.0158)	(0.0101)	(0.0066)
Test of no Income Effects (P-value)	<.0001	0.0002	0.0480	0.0128	0.2570
Sample Size	9,028	2,217	2,358	2,227	2,226
b. NLSY97					
Parental Income Quartile 2	0.0316	0.0406	0.0109	-0.0279	0.0312
	(0.0167)	(0.0420)	(0.0348)	(0.0312)	(0.0197)
Parental Income Quartile 3	0.0995	0.1698	0.0870	0.0355	0.0518
	(0.0177)	(0.0501)	(0.0366)	(0.0318)	(0.0195)
Parental Income Quartile 4	0.1130	0.2444	0.1394	0.0510	0.0614
	(0.0189)	(0.0657)	(0.0397)	(0.0329)	(0.0197)
Test of no Income Effects (P-value)	<.0001	0.0002	0.0007	0.0266	0.0095
Sample Size	3,785	832	924	968	1061

Notes: All regressions control for gender, race/ethnicity (NLSY97 only), immigrant status, whether at least one parent is an immigrant, mother's education (HS graduate, PS attendance), intact family during adolescence, number of children under 18, mother's age at child's birth, metropolitan area during adolescence, and year of birth (NLSY97 only). Specifications in the first column also control for math-reading achievement quartile indicators. Education measured as of age 21. Test of no Income Effects is an F-test (3 d.o.f.) that all three coefficients on family income are zero. Standard errors are in parentheses.

Appendix B Model Details

This appendix derives results discussed in the text regarding the marginal value of wealth (MVW) for constrained and unconstrained families. It also describes thresholds for ability that define which families are unconstrained as well as those that are constrained by borrowing constraints and/or parental transfer constraints.

As in the text, we assume utility $u(c)$ is strictly increasing and concave, parents discount their child's utility by factor $\rho > 0$, families discount the future at rate $\beta > 0$, and smooth consumption profiles are desired, $R\beta = 1$.

B.1 Determining the MVW

For PS attendance, the first order conditions (FOC) for τ^1 and b^1 are given by

$$\begin{aligned} u'(c^{p1}) &\geq \rho u'(c_1^1) && (5)\\ u'(c_1^1) &\geq R\beta u'(c_2^1), && (6) \end{aligned}$$

where the inequalities are strict if the corresponding constraint on τ^1 or b^1 binds; otherwise, equalities hold. Since $R\beta = 1$, equation (6) implies that $c_1^1 \leq c_2^1$, where the inequality is strict when the borrowing constraint binds.

In the non-PS case, we abstract from borrowing constraints, so τ^0 and b^0 satisfy:

$$\begin{aligned} u'(c^{p0}) &\geq \rho u'(c_1^0) && (7)\\ u'(c_1^0) &= R\beta u'(c_2^0), && (8) \end{aligned}$$

where the inequality in (7) is strict if the non-negative transfer constraint binds. Since $R\beta = 1$, child consumption profiles are flat: $c_1^0 = c_2^0$.

B.1.1 Unconstrained MVW

When unconstrained, $c_1^1 = c_2^1 = c^{1u}$, where c^{1u} and c^{1pu} satisfy the lifetime budget constraint:

$$c^{p1u} + (1 + R^{-1})c^{1u} = W - \tilde{T}(W, x) + R^{-1}y_1(\theta).$$

FOC (5) implies that both $c^{p1u}(I^1)$ and $c^{1u}(I^1)$ are strictly increasing functions of total lifetime income,

$$I^1 \equiv W - \tilde{T}(W, x) + R^{-1}y_1(\theta).$$

Furthermore, the budget constraint implies that $c^{p1u}(I^1) = I^1 - (1+R^{-1})c^{1u}(I^1)$ and $\frac{dc^{p1u}}{dI^1} = 1 - (1+R^{-1})\frac{dc^{1u}}{dI^1}$.

Unconstrained family lifetime utility for PS attendees is

$$V_1^u(\theta, W) = u(c^{p1u}(I^1)) + \rho(1 + \beta)u(c^{1u}(I^1))$$

and

$$\begin{aligned} \frac{\partial V_1^u(\theta, W)}{\partial W} &= \left[1 + \frac{\partial G}{\partial W}\right]\left[u'(c^{p1u}(I^1))\left(1 - (1 + R^{-1})\frac{dc^{1u}}{dI^1}\right) + \rho(1 + \beta)u'(c^{1u}(I^1))\frac{dc^{1u}}{dI^1}\right]\\ &= \left[1 + \frac{\partial G}{\partial W}\right]\rho u'(c^{1u}(I^1)), \end{aligned}$$

where the second equality holds, since equation (5) holds with equality and $R\beta = 1$.

Clearly, y_0 and $\bar{b}$ do not affect the MVW for unconstrained PS attendance; however, the unconstrained PS MVW is increasing in $\frac{\partial G}{\partial W}$. Furthermore,

$$\frac{\partial^2 V_1^u}{\partial W \partial T} = -\left[1+\frac{\partial G}{\partial W}\right]\left[u''(c^{p1u}(I^1))\left(1-(1+R^{-1})\frac{dc^{1u}}{dI^1}\right)^2+\rho(1+\beta)u''(c^{1u}(I^1))\left(\frac{dc^{1u}}{dI^1}\right)^2\right].$$

This is positive if and only if $\frac{\partial G}{\partial W} > -1$. Similarly, one can show that $\frac{\partial^2 V_1^u}{\partial W \partial y_1} = -R\frac{\partial^2 V_1^u}{\partial W \partial T}$, which is negative if and only if $\frac{\partial G}{\partial W} > -1$.

A parallel analysis for non-PS attendance yields $V_0^u(\theta, W) = u(c^{p0}(I^0)) + \rho(1+\beta)u(c^{0u}(I^0))$ and

$$\frac{\partial V_0^u(\theta, W)}{\partial W} = \rho u'(c^{0u}(I^0)),$$

since $c^{p0}(I^0) + (1+R^{-1})c^{0u}(I^0) = W + (1+R^{-1})y_0(\theta) \equiv I^0$. Both c^{p0} and c^{0u} are strictly increasing in I^0.

Clearly, y_1, $G(W,x)$, and $\bar{b}$ do not affect the MVW for non-PS attendance; however,

$$\frac{\partial^2 V_0^u}{\partial W \partial y_0} = \left[1+R^{-1}\right]\left[u''(c^{p0}(I^0))\left(1-(1+R^{-1})\frac{dc^{0u}}{dI^0}\right)^2+\rho(1+\beta)u''(c^{0u}(I^0))\left(\frac{dc^{0u}}{dI^0}\right)^2\right] < 0.$$

Define $\Delta^u = V_1^u - V_0^u$. If $\frac{\partial G}{\partial W} > -1$, these results imply that $\frac{\partial \Delta^u}{\partial W}$ is increasing in T, $\frac{\partial G}{\partial W}$, and y_0, and decreasing in y_1.

B.1.2 MVW when only the borrowing constraint binds for PS attendance

When only the borrowing constraint binds, FOC (5) holds with equality, parental and first period child consumption $c^{p1c}(I_1^1)$ and $c_1^{1c}(I_1^1)$ are strictly increasing functions of total available initial period resources, $I_1^1 \equiv W - \tilde{T}(W,x) + \bar{b}(W,x)$, and $c^{p1c} = I_1^1 - c_1^{1c}$. Furthermore, $c_1^{1c}(I_1^1) < c_2^{1c} = y_1(\theta) - R\bar{b}(W,x)$.

Borrowing constrained family lifetime utility for PS attendees is

$$V_1^c(\theta, W) = u(c^{p1c}(I_1^1)) + \rho u(c_1^{1c}(I_1^1)) + \rho\beta u(y_1(\theta) - R\bar{b}(W,x)),$$

and

$$\begin{aligned}\frac{\partial V_1^c(\theta,W)}{\partial W} &= \left[1+\frac{\partial G}{\partial W}+\frac{\partial \bar{b}}{\partial W}\right]\left[u'(c^{p1c}(I_1^1))\left(1-\frac{dc_1^{1c}}{dI_1^1}\right)+\rho u'(c_1^{1c}(I_1^1))\frac{dc_1^{1c}}{dI_1^1}\right]-\rho\beta R u'(y_1 - R\bar{b}(W,x))\frac{\partial \bar{b}}{\partial W}\\ &= \left[1+\frac{\partial G}{\partial W}+\frac{\partial \bar{b}}{\partial W}\right]\rho u'(c^{1c}(I_1^1)) - \rho u'(y_1 - R\bar{b}(W,x))\frac{\partial \bar{b}}{\partial W},\end{aligned}$$

where the second equality holds, since equation (5) holds with equality and $R\beta = 1$. This is clearly increasing in $\frac{\partial G}{\partial W}$. Note that $u'(c^{p1c}(I_1^1)) = \rho u'(c_1^{1c}) > \rho u'(c_2^{1c}) = \rho u'(y_1 - R\bar{b})$, because FOC (5) holds with equality and $c_1^{1c} < c_2^{1c}$ when the borrowing constraint binds. Thus, $u''(c) < 0$ implies that the MVW is also increasing in $\frac{\partial \bar{b}}{\partial W}$.

Clearly, y_0 and y_1 do not affect the MVW for borrowing constrained PS attendance; however, the borrowing constrained PS MVW is increasing in $\frac{\partial G}{\partial W}$. Furthermore,

$$\frac{\partial^2 V_1^c}{\partial W \partial T} = -\left[1+\frac{\partial G}{\partial W}+\frac{\partial \bar{b}}{\partial W}\right]\left[u''(c^{p1c}(I_1^1))\left(1-\frac{dc_1^{1c}}{dI_1^1}\right)^2+\rho u''(c_1^{1c}(I_1^1))\left(\frac{dc_1^{1c}}{dI_1^1}\right)^2\right],$$

which is positive if and only if $\frac{\partial G}{\partial W} + \frac{\partial \bar{b}}{\partial W} > -1$. Similarly, $\frac{\partial^2 V_1^c}{\partial W \partial y_1} = -\rho u''(y_1 - R\bar{b})\frac{\partial \bar{b}}{\partial W} \leq 0$, since $\frac{\partial \bar{b}}{\partial W} \leq 0$. Finally, if $\bar{b}(W,x) = \bar{b}$ is independent of wealth, then changes in the borrowing limit have the opposite effect on the borrowing constrained MVW as changes in tuition: $\frac{\partial^2 V_1^c}{\partial W \partial \bar{b}} = -\frac{\partial^2 V_1^c}{\partial W \partial T}$.

Define $\Delta^c = V_1^c - V_0^u$. If $\frac{\partial \bar{b}}{\partial W} \leq 0$ and $\frac{\partial G}{\partial W} + \frac{\partial \bar{b}}{\partial W} > -1$, then these results imply that $\frac{\partial \Delta^c}{\partial W}$ is increasing in T, $\frac{\partial G}{\partial W}$, $\frac{\partial \bar{b}}{\partial W}$, and y_0, and decreasing in y_1 (if $\frac{\partial \bar{b}}{\partial W} < 0$) and $\bar{b}$ (when $\frac{\partial \bar{b}}{\partial W} = 0$).

B.1.3 MVW when only parental transfer constraints bind

When the parental transfer constraint binds but the borrowing constraint does not, PS consumption allocations satisfy $c^{p1} = W$ and $c_1^1 = c_2^1 = \frac{y_1(\theta) - R\tilde{T}(W,x)}{1+R} \equiv c^{1\tau}(\theta, W)$ with $u'(W) > \rho u'(c^{1\tau})$.

Transfer constrained family lifetime utility for PS attendees is

$$V_1^\tau(\theta, W) = u(W) + \rho(1+\beta)u\left(c^{1\tau}(\theta, W)\right),$$

with

$$\frac{\partial V_1^\tau(\theta, W)}{\partial W} = u'(W) + \rho u'(c^{1\tau})\frac{\partial G}{\partial W}.$$

The PS attendance MVW for those with constrained parental transfers does not depend on y_0 or $\bar{b}$, but it is increasing in $\frac{\partial G}{\partial W}$ and

$$\begin{aligned}
\frac{\partial^2 V_1^\tau}{\partial W \partial T} &= -\rho\left(\frac{R}{1+R}\right)u''(c^{1\tau})\frac{\partial G}{\partial W} \leq 0 \\
\frac{\partial^2 V_1^\tau}{\partial W \partial y_1} &= \rho\left(\frac{1}{1+R}\right)u''(c^{1\tau})\frac{\partial G}{\partial W} \geq 0.
\end{aligned}$$

When the parental transfer constraint binds, non-PS consumption allocations satisfy $c^{p0} = W$ and $c_1^0 = c_2^0 = y_0(\theta)$ with $u'(W) > \rho u'(y_0(\theta))$. Non-PS family lifetime utility is $V_0^\tau(\theta, W) = u(W) + \rho(1+\beta)u\left(y_0(\theta)\right)$, with $\frac{\partial V_0^\tau(\theta,W)}{\partial W} = u'(W) > 0$. The latter clearly does not depend on any parameters of interest.

Define $\Delta^\tau = V_1^\tau - V_0^\tau$. If $\frac{\partial G}{\partial W} < 0$, then these results imply that $\frac{\partial \Delta^\tau}{\partial W}$ is independent of y_0 and $\bar{b}$, increasing in $\frac{\partial G}{\partial W}$ and y_1, and decreasing in T.

B.1.4 MVW when the parental transfer and borrowing constraints both bind

When the parental transfer and borrowing constraints both bind, PS consumption allocations satisfy $c^{p1} = W$, $c_1^1 = -\tilde{T}(W,x) + \bar{b}(W,x) < y_1(\theta) - R\bar{b}(W,x) = c_2^1$.

Borrowing and parental transfer constrained family lifetime utility for PS attendees is

$$V_1^\tau(\theta, W) = u(W) + \rho u\left(-\tilde{T}(W,x) + \bar{b}(W,x)\right) + \rho\beta u\left(y_1(\theta) - R\bar{b}(W,x)\right),$$

and

$$\frac{\partial V_1^{c\tau}(\theta, W)}{\partial W} = u'(W) + \rho u'(-\tilde{T}(W,x) + \bar{b}(W,x))\left[\frac{\partial G}{\partial W} + \frac{\partial \bar{b}}{\partial W}\right] - \rho u'(y_1(\theta) - R\bar{b}(W,x))\frac{\partial \bar{b}}{\partial W}.$$

When both constraints bind, the PS attendance MVW does not depend on y_0, but it is increasing in $\frac{\partial G}{\partial W}$ and $\frac{\partial \bar{b}}{\partial W}$ (the latter because $u''(c) < 0$ and $c_1^1 < c_1^2$ when the borrowing constraint binds). Furthermore,

$$\begin{aligned}
\frac{\partial^2 V_1^{c\tau}}{\partial W \partial T} &= -\rho u''(-\tilde{T}(W,x) + \bar{b}(W,x))\left[\frac{\partial G}{\partial W} + \frac{\partial \bar{b}}{\partial W}\right] \leq 0 \\
\frac{\partial^2 V_1^{c\tau}}{\partial W \partial y_1} &= -\rho u''(y_1(\theta) - R\bar{b})\frac{\partial \bar{b}}{\partial W} \leq 0.
\end{aligned}$$

If $\bar{b}(W,x) = \bar{b}$ is independent of wealth, then $\frac{\partial^2 V_1^{c\tau}}{\partial W \partial \bar{b}} = -\frac{\partial^2 V_1^{c\tau}}{\partial W \partial T} \geq 0$.

Define $\Delta^{c\tau} = V_1^{c\tau} - V_0^\tau$. If $\frac{\partial G}{\partial W} < 0$ and $\frac{\partial \bar{b}}{\partial W} \leq 0$, then these results imply that $\frac{\partial \Delta^{c\tau}}{\partial W}$ is independent of y_0, increasing in $\frac{\partial G}{\partial W}$, $\frac{\partial \bar{b}}{\partial W}$, and $\bar{b}$ (when $\frac{\partial \bar{b}}{\partial W} = 0$), and decreasing in T and y_1 (if $\frac{\partial \bar{b}}{\partial W} < 0$).

B.2 Ability Thresholds and Binding Constraints

For PS attendees, an increase in ability θ only increases second period income (i.e. $y_1'(\theta) > 0$). As a result, desired borrowing b^1 is increasing in ability while desired parental transfers τ^1 are decreasing in ability. This implies that for any level of parental wealth W and income while in school x, there is a threshold level of ability $\hat{\theta}_1(W, x)$ above which PS attendees are borrowing constrained and below which they are not. There also exists a threshold level of ability $\tilde{\theta}_1(W, x)$ above which parental transfers (for PS attendees) are constrained at zero and below which they are not. The income of children not attending PS school is also increasing in ability θ (i.e. $y_0'(\theta) > 0$), while parental resources are not. Consequently, there is a threshold level of ability $\tilde{\theta}_0(W)$ above which parental transfers (for non-attendees) are constrained at zero and below which they are not.

This paper considers the following cases: (1) Fully unconstrained persons satisfy $\theta \leq min\{\hat{\theta}_1, \tilde{\theta}_1, \tilde{\theta}_0\}$. (2) Families that are borrowing constrained (if attending PS school) but otherwise unconstrained: $\hat{\theta}_1 < \theta \leq min\{\tilde{\theta}_1, \tilde{\theta}_0\}$. (3) Families that are transfer constrained but not borrowing constrained: $max\{\tilde{\theta}_1, \tilde{\theta}_0\} < \theta \leq \hat{\theta}_1$. (4) Families that are both transfer and borrowing constrained (if attending PS school) and transfer constrained (if not attending): $\theta > max\{\hat{\theta}_1, \tilde{\theta}_1, \tilde{\theta}_0\}$. Clearly, for any level of wealth and school income (W, x), type (2) and type (3) families cannot both arise.

Appendix C Post-Secondary Education Finance

C.1 Non-Repayable Financial Aid in Canada and the U.S.

Non-repayable aid in the U.S. is distributed by the federal government (mostly as Pell grants and the Supplemental Educational Opportunity Grant), state governments, and institutions themselves. Education tax credits (and deductions) are an additional source of non-repayable aid to students. The NPSAS04 imputes federal Hope and Lifetime Learning tax credits as well as any education deductions based on reported parental income and documents by the Internal Revenue Service reporting education tax credits claimed by income.[57] For students living away from home, Figure C1 shows averages for each of these sources of non-repayable aid by parental income.[58]

We disaggregate non-repayable aid in Canada differently, since federal aid is exclusively in the form of loans and we do not have measures of institutional support. Figure C2 reports separate amounts (by parental income) for the following categories of non-repayable aid in British Columbia, Ontario, and Quebec: (i) Millennium and provincial grants and bursaries, (ii) loan remissions, and (iii) tax credits. Federal and provincial rules are used to calculate all aid figures as discussed in Appendix D (available online). To the extent that some Canadians do not take advantage of all available tax credits, these figures may be slightly inflated. Because British Columbia does not use loan remissions, the figure only reports remissions for Ontario and Quebec.

C.2 Bounding Net Tuition by Parental Income in the U.S.

We have used the NPSAS04 to calculate average tuition T, financial aid F, and net tuition $NT = T - F$ by parental income I conditional on college enrollment; however, we would like unconditional averages for the full

[57] In 2003-04, the federal Hope tax credit was available to first and second year students enrolled at least half-time; it provided full credit on the first $1,000 in tuition and fees and a 50% credit on the next $1,000 for a maximum credit of $1,500. The Federal Lifetime Learning tax credit, available to all students, provided a credit equal to 20% of tuition and fees up to a maximum credit of $2,000.

[58] We use the same NPSAS04 sample as used in the paper (i.e. 18-24 year-old dependent students that were enrolled in-state in a public four-year PS institution and applied for federal financial aid).

population. Here, we calculate bounds on unconditional averages based on assumptions about non-repayable institutional and state aid.

Define a college enrollment indicator, $C \in \{0, 1\}$, and $\pi(I)$ the probability someone with parental income I is enrolled in college. Then,

$$E(NT|I) = E(NT|I, C = 1) - \{\Delta T(I) - [E(F|I, C = 1) - E(F|I, C = 0)]\}[1 - \pi(I)],$$

where $\Delta T(I) \equiv E(T|I, C = 1) - E(T|I, C = 0)$. In the text, we report estimates of $E(NT|I, C = 1)$ and $E(F|I, C = 1)$ using the NPSAS04. Using the NLSY97, it is straightforward to estimate both $\pi(I)$ and $\Delta T(I)$.[59]

It is not possible to determine $E(F|I, C = 0)$ from either the NLSY97 or NPSAS04; however, we can bound $E(F|I, C = 1) - E(F|I, C = 0)$ using data from NPSAS04. In general, federal student aid offers should be independent of enrolment choices conditional on family income.[60] In this case, a conservative upper bound on financial aid differences by enrollment status assumes that students who do not enroll in college receive zero state and institutional aid offers. This implies a conservative upper bound (Bound 1) for average net tuition by parental income:

$$E(NT|I) \leq E(NT|I, C = 1) - \{\Delta T(I) - E(s + i|I, C = 1)\}[1 - \pi(I)],$$

where s denotes state-based financial aid and i denotes institutional financial aid. If we assume that both state and federal aid are independent of enrollment status (conditional on family income) and that youth not attending PS school receive zero institutional aid, we obtain a sharper upper bound (Bound 2):

$$E(NT|I) \leq E(NT|I, C = 1) - \{\Delta T(I) - E(i|I, C = 1)\}[1 - \pi(I)].$$

Estimates for $E(s|I, C = 1)$ and $E(i|I, C = 1)$ can be obtained from the NPSAS04.

Assuming youth choosing not to attend PS school do not receive above average financial aid offers, NPSAS04-based estimates of $E(NT|I, C = 1)$ reported in the paper provide a lower bound on net tuition.

Figures C3 and C4 show these bounds for net tuition and out-of-pocket costs for students living away from home. Given the important role of state-based financial aid, especially in high tuition states, Bound 1 is extremely conservative. Average net tuition and out-of-pocket expenditures almost certainly lie in the narrow region between Bound 2 and the values reported in the text.

[59] Ignoring any within state variation in in-state tuition at public four-year institutions, $E(T|I, C)$ can be estimated with the NLSY97 by assigning average in-state tuition levels to individuals according to their state of residence during adolescence.

[60] To the extent that tuition levels differ across states, it is possible that student need and federal aid differ across states. Given different enrollment rates across states, this could lead to differences in average federal aid by enrollment status. However, since federal aid rarely covers total schooling costs for those eligible, any differences across states (and, therefore, enrollment status) are likely to be very small.

Figure C1: Non-Repayable Aid by Source in the US
(Students Living Away from Parents)

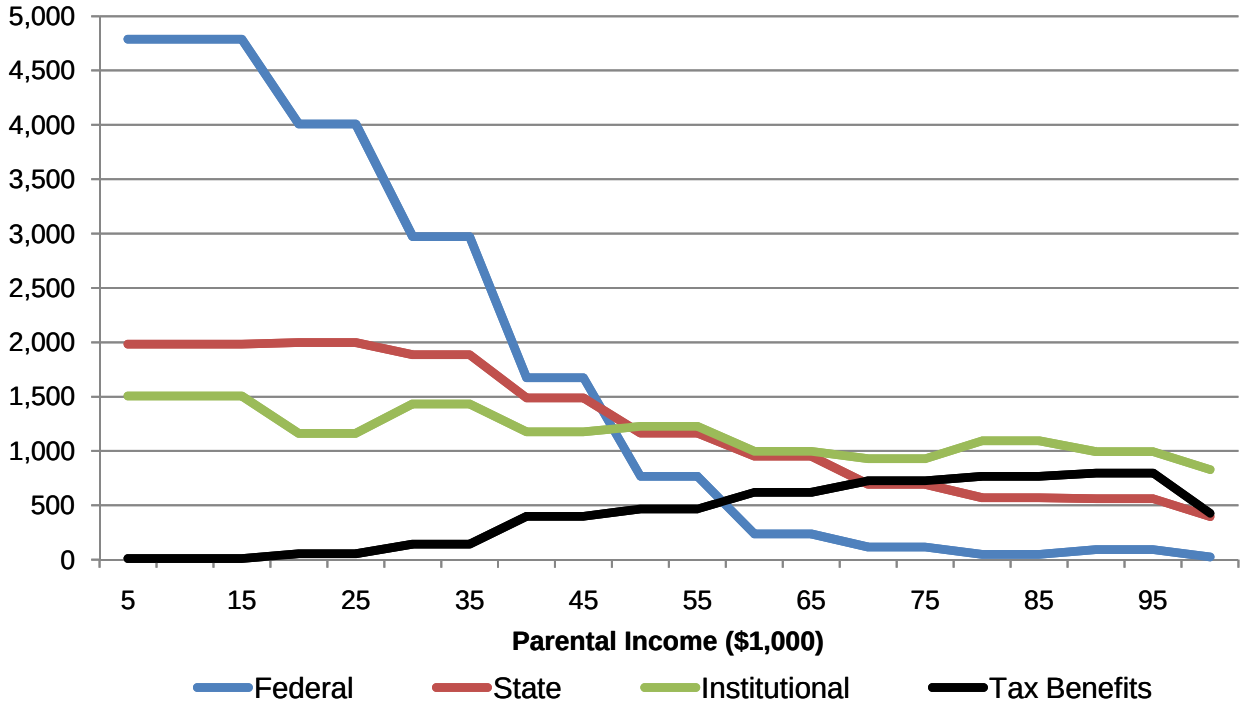

Figure C2: Non-Repayable Aid by Source in Canada
(Students Living Away from Parents)

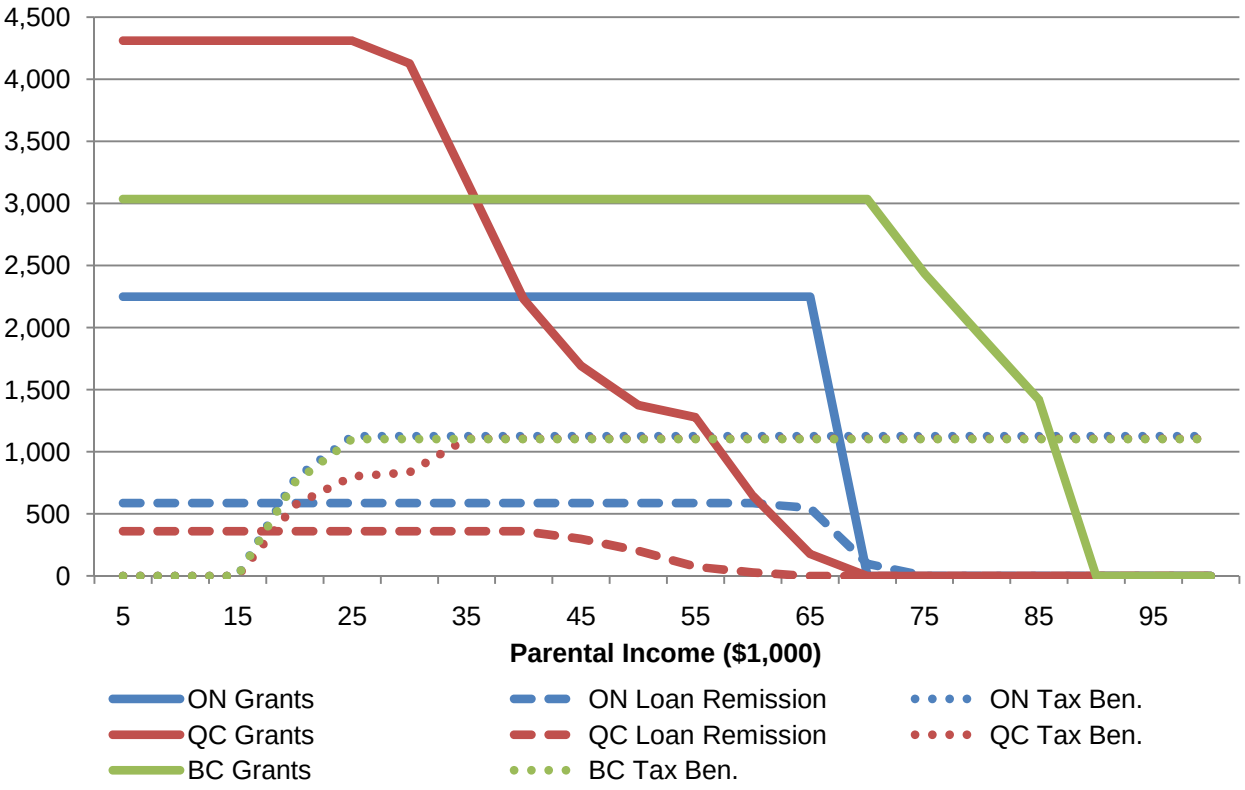

Figure C3: Net Tuition with US Bounds
(Students Living Away From Parents)

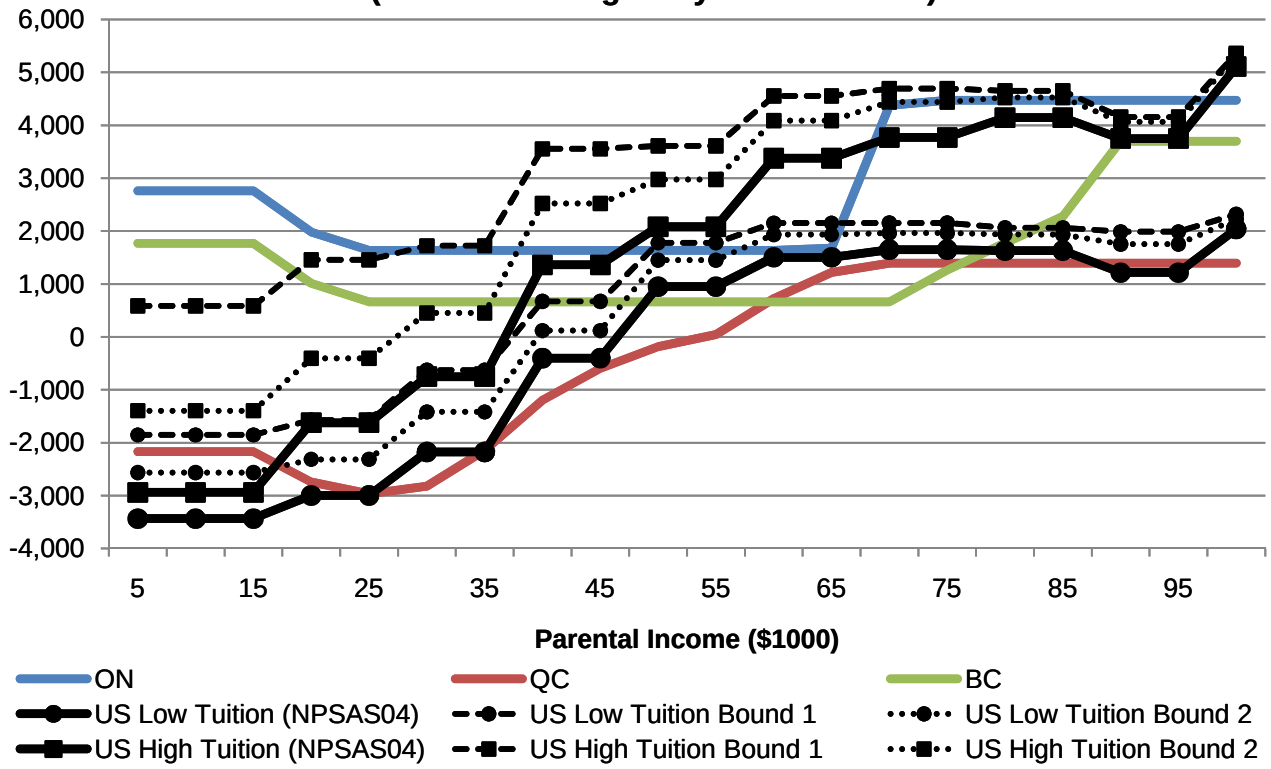

Figure C4: Out-of-Pocket Costs with US Bounds
(Students Living Away From Parents)