Post-Secondary Attendance by Parental Income: A Canada – U.S. Comparison*

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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?

This paper contributes to the literature on educational attainment gaps by family income and the importance of borrowing constraints 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.

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

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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.

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. We make four important observations about the structure of financial aid. First, the U.S. and Quebec are quite generous, on average, relative to other Canadian provinces in terms of grant and bursary aid to students from very low income families. Second, students from middle income families in the U.S. and Quebec receive much less financial aid than students from low income families, but this is not the case in other Canadian provinces. The reverse is true when comparing students from middle and high income families: those from high income families receive much less aid than those from middle income families in most Canadian provinces but not in Quebec or the U.S. Third, Stafford loans in the U.S. provide modest amounts of credit to students from all financial backgrounds, whereas the vast majority of financial aid in Canada, including government student loans, is need-based and generally unavailable to students from higher income families. Fourth, there is considerable heterogeneity in tuition and financial aid across institutions and states in the U.S. As a result, many American students appear to receive much less generous financial aid offers than the average.

As we discuss below, it is not easy to reconcile the differences in PS attendance gaps by family income in Canada and the U.S. with their differences in tuition costs and financial aid policies. Key factors highlighted by our model suggest that we should observe a stronger family income – attendance

relationship in Canada, especially at the bottom of the income distribution where U.S. financial aid is, on average, generous but sharply decreasing in parental resources. Of course, if the effects of financial aid on attendance are declining in family income (e.g. due to borrowing constraints), then the heterogeneity in aid across American states may contribute to a stronger income – attendance gradient for disadvantaged youth than would be expected based on average financial aid schedules.[2] The stronger income – attendance gradient in the U.S. relative to Canada is more easily explained at higher income levels 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 our main empirical results 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 ability 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.

Empirical 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

[2]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.

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.[3] Carneiro and Heckman (2002) also estimate small differences in PS enrollment rates and other higher education outcomes by family income after 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.

Much has changed in the U.S. since the early 1980s, when the NLSY79 respondents made their PS attendance decisions. Financial returns to schooling have risen dramatically (Katz and Autor 1999, Heckman, Lochner, and Todd 2008) as have the costs of tuition, fees, room, and board at U.S. colleges and universities (College Board 2004). At the same time, real borrowing limits associated with government student loan programs remained stable or declined. As a result, the fraction of all undergraduate borrowers that borrowed the maximum limit from the federal Stafford Student Loan Program went up from only 18% in 1989-90 to 52% in 1999-2000 (Berkner 2000 and Titus 2002).

Consistent with an increased importance of borrowing constraints in the U.S., Belley and Lochner (2007) show that family income has become a much more important determinant of PS attendance for youth finishing high school in the early 2000s.[4] Youth from high income families in the NLSY97 are sixteen percentage points more likely to attend a post-secondary institution than are youth from low income families, conditional on AFQT scores, family composition, parental age and education, race/ethnicity, and urban/rural residence. This is nearly twice the effect observed in the NLSY79. The combined effects of family income and wealth are even more dramatic in the NLSY97. Comparing

[3] 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.

[4] Ellwood and Kane (2000) argue that PS attendance differences by family income were already growing by the early 1990s. Using data on youth of PS school-ages in the 1970s, 1980s, and 1990s (from the U.S. Health and Retirement Survey), Brown, Seshadri, and Scholz (2007) estimate that borrowing constraints limit college-going; however, they do not examine whether constraints have become more limiting in recent years. While Stinebrickner and Stinebrickner (2007) find little effect of borrowing constraints (defined by the self-reported desire to borrow more for school) on overall PS dropout rates for a recent cohort of students at Berea College in Kentucky, they find substantial differences in dropout rates between those who are constrained and those who are not. They do not study the effects of borrowing constraints on attendance.

youth from the highest family income and wealth quartiles to those from the lowest quartiles yields an estimated difference in PS attendance rates of nearly 30 percentage points after controlling for ability and family background.

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 income.[5] Using a Blinder-Oaxaca decomposition, he finds that 96% of the total gap in attendance between youth from the top and bottom income quartiles can be accounted for by differences in observable characteristics. Differences in long-term factors such as standardized test scores in reading obtained at age 15, school marks reported at age 15, parental influences, and high school quality account for 84% of the gap. In contrast, only 12% of the gap is related to financial constraints (as reported by youth).

Because of the different approaches and specifications across previous U.S. and Canadian studies, any cross-country comparison of the relationship between family income, ability, and schooling is limited. 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. The former samples youth in the U.S. ages 12-16 at the beginning of 1997, while the latter surveys youth age 15 at the start of 2000.[6] Because we focus on educational attainment as of age 21, we limit our NLSY97 sample to those who have reached that age by the last year of currently available data, 2005. Youth in both surveys are roughly the same ages and made their post-secondary attendance decisions in the early to mid-2000s. Most importantly, these data contain comparable measures of adolescent cognitive achievement, parental income during adolescence, and rich measures of family background.

Both data sources contain measures of cognitive achievement during middle adolescence. In 1997, NLSY97 respondents took a large battery of tests known as the Armed Forces Vocational Aptitude Bat-

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

[6] 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.

tery (ASVAB).[7] In 2000, YITS respondents took math, reading, and science tests from the Programme for International Student Assessment (PISA). While all respondents took the reading assessment, 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 the their normalized test score quartiles.[8]

The NLSY97 measures household income received in 1996 in the 1997 survey. Since YITS contains measures of *parental income* (reported in 2000 but received in 1999), we calculate total *parental income* (excluding income from other household or family members) in the NLSY97 and use this in our main analysis. While parental income is measured when youth are age 15 in YITS, it is measured at ages 12-16 for NLSY97 respondents. This discrepancy does not play an important role in our findings. In both samples, 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 PPP index.[9]

Our analysis focuses primarily on the effects of family income on post-secondary attendance as of age 21. Individuals in the NLSY97 are considered to have attended college 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. 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). In YITS, our measure of PS attendance is based on reported attendance by age 21 in a qualifying PS program or institution. Consistent with the NLSY97 measures, we exclude participation in shorter

[7] 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.

[8] 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.

[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.

vocational, training, licensing, or apprenticeship programs. PS attendance in Canada is determined by past or present enrollment in 'colleges' (two-year institutions), 'universities' (four-year institutions), or Quebec's CEGEP program.

We also consider whether youth ever attended a four-year institution by age 21. In the NLSY97, we use the institution type measures for all post-secondary institutions the youth reported attending to create this variable. In YITS, youth are asked to report all education institutions they have attended. This question allows respondents to distinguish between attendance at four-year 'universities', two-year 'colleges', and the different CEGEP programs (as well as other shorter training and apprenticeship institutes).

Our multivariate analysis controls for a host of family background variables. For both data sources, 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.[10] 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.[11] 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).[12] By contrast, 42% of youth attended a 4-year PS school in both countries. We observe higher educational attainment 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. Canadian youth also tend to have slightly older mothers and are more likely to have both

[10] 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.

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

[12] 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

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. The table reveals that, after adjusting for PPP, American parents average about $7,500 less in income than Canadian parents each year.[13] 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 — nearly $13,000 more. In the top quartile, American and Canadian parental incomes differ by less than $1,000, both averaging around $125,000. Inequality in the U.S. is even more dramatic when the currency exchange rate (a factor of 1.49) is used.

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. More youth are classified as low achievement – low income and high achievement – high income in the NLSY97 compared with YITS. And, while 4.5% of YITS respondents lie in the highest achievement – lowest income quartiles, only 2.2% of NLSY97 respondents do. At the opposite extreme, 4.0% of YITS respondents lie in the lowest achievement – highest income quartiles, compared to only 2.1% of NLSY97 respondents.

4 Achievement, Parental Income and Educational Attainment

Figure 1 reports PS attendance rates by parental income quartile in Canada and the U.S. Parental income is strongly correlated with PS attendance in both countries; although income has substantially greater effects 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. Interestingly, 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. More interestingly, both achievement and parental income are more important

[13] 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.

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 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, parental income has sizeable effects on PS attendance rates for all achievement groups, with differences in attendance between the highest and lowest income quartiles ranging from 20-30 percentage points.

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. We primarily use parental income and achievement quartiles to allow for general non-linear relationships; however, we consider alternative assumptions about the role of parental income below. For comparability, 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 and ability on educational attainment from the early 1980s to early 2000s using the 1979 and 1997 Cohorts of the NLSY.[14] These include measures of maternal education, whether the family is intact during adolescence, residence in a metropolitan area during adolescence, and the number of children under age 18 in the household. We also control for gender in both data sources as well as race/hispanic ethnicity in the NLSY97. Unlike Belley and Lochner (2007), we further control for the youth's immigration status and whether at least one of the youth's parents is foreign born, since immigration rates are quite high in Canada.[15]

An important advantage of closely matching the specifications of Belley and Lochner (2007) is that

[14]Carneiro and Heckman (2002) perform a similar analysis of PS attendance to Belley and Lochner (2007) for the NLSY79, only they focus on white men and measure schooling attainment when respondents are in their early 30s rather than as of age 21. Both studies reach similar conclusions about the importance of ability and relative unimportance of family income in the NLSY79.

[15]These additional immigration controls have negligible effects on the estimated role played by achievement and parental income in the U.S.; however, their inclusion tends to increase the estimated effects of parental income in Canada.

the two studies combined offer comparable observations on the relationship between family income, ability, and educational attainment in three different economic and policy environments: the U.S. in the early 1980s, the U.S. in the early 2000s, and Canada in the early 2000s. This proves useful in our interpretation of the evidence below. Since our emphasis in this paper is on the Canada – U.S. comparison using YITS and NLSY97 data, we use slightly different measures of achievement and parental income from those of Belley and Lochner (2007). Specifically, Belley and Lochner (2007) use AFQT scores rather than our combined math-reading achievement score.[16] Belley and Lochner (2007) use a measure of total household income, which includes income from all family and non-family members living in the home. Since YITS only records income from the respondents' parents, we use this more limited *parental* income measure in the NLSY97 as well. The two measures of income have a correlation of over 0.96 in our NLSY97 sample. Not surprisingly, the main results discussed below for the NLSY97 are very similar to those reported in Belley and Lochner (2007).

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.

The final two columns of Table 2 examine attendance at four-year PS institutions. These estimates are similar to those for attendance at any PS institution reported in columns 1 and 2, so we only comment on the effects of achievement and parental income. Interestingly, achievement appears to

[16] These achievement measures share three ASVAB subtest components: arithmetic reasoning, word knowledge, and paragraph comprehension. The AFQT composite also includes the respondent's score on the ASVAB numerical operations test but excludes the ASVAB score on mathematical knowledge used in our achievement measure. The AFQT composite and our math-reading achievement measure have a correlation of 0.97 in our NLSY97 sample.

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 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.[17] Most importantly, the estimated effects of parental income are nearly identical to those reported in Table 2. To the extent that 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 a fifth order polynomial in parental income rather than income quartile indicators. This also allows for a very general income – schooling relationship and enables us to compare the effects of parental income across countries at any level of income. Figure 3 plots the estimated polynomials for PS attendance as a function of parental income (ranging from $5,000 to $120,000). This figure clearly shows that the effects reported in Table 2 are not entirely (or even mostly) driven by differences in the distribution of family income.[18] Parental income matters much more in the U.S., whether we use the PPP or official exchange rates to adjust for currency differences.

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

[17] 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.

[18] Joint F-tests of whether all income polynomial coefficients equal zero yield p-values (5 degrees of freedom) of 0.0021 for Canada and less than 0.0001 for the U.S.

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 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 on 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), it is natural to ask whether the effects of parental income differ within Canada. Table 4 estimates specifications identical to our baseline results in Table 2 separately for Quebec and for all other provinces. Interestingly, the effects of achievement on PS attendance appear to be much stronger in Quebec than in the rest of Canada (and even a little stronger than in the U.S.). In Quebec, the effects of parental income are quite small for PS attendance, while they are relatively modest for university attendance. The effects of income on PS attendance are slightly larger in other provinces relative to Quebec (very similar to our 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 (with slightly larger effects of parental income on PS and four-year university attendance).

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 (except for the exclusion of immigrant indicators from the regressions). 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 these children of immigrants (many of which are immigrants themselves), parental income is not. For neither the U.S. nor Canada do we observe

any significant effects of parental income among children of immigrants. It is quite possible that many immigrants choose to move to the U.S. or Canada to improve the educational opportunities for their children. This is certainly consistent with their children's higher levels of educational attainment. Whether or not those with lower incomes who choose to migrate possess an even stronger desire to educate their children is more difficult to verify; although, it appears to be consistent with the fact that income matters substantially more for youth with native parents as seen in the second set of columns in Table 5. The second set of results shows that among youth with native parents, both achievement and parental income play an important role. Parental income is more important than in the overall population results shown in Table 2. Furthermore, income and achievement are more important in the U.S. than in Canada among children of natives. 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.

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 our estimated effects of achievement or parental income quartiles.

Column (ii) of Tables A2 and A3 conditions our sample on those who have completed high school. While this has little effect on 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 fairly small effects.

Column (iv) in Table A2 controls for school (at age 15) fixed effects in Canada.[19] 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. 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.[20]

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

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

[20] 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.

due to concerns about endogeneity bias and correlated unobserved tastes, these findings suggest that our estimated effects of parental income (or achievement) are not being driven by differences in peers or views about the returns to education.

5 Intergenerational Schooling Decision Model

In this section, we 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, 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 $\rho \in (0, 1]$.

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 school can borrow freely, since we are mainly interested in the role of financial aid for those who attend college. Borrowing constraints are likely to be much less of a concern with youth who do not attend college, 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.[21] 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:[22]

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

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

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

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

$$b \leq \bar{b}(W, x), \tag{1}$$

and the non-negative transfer constraint

$$\tau \geq 0. \tag{2}$$

The utility of not attending PS school is given by

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

subject to parental consumption $c^{p0} = W - \tau$, youth consumption $c_1^0 = \tau + y_0(\theta) + b$ and $c_2^0 = y_0(\theta) - Rb$, and the non-negative transfer constraint (2). For simplicity, we abstract from borrowing constraints when individuals do not attend PS school.

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 –

[21] 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.

[22] 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-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:

$$\frac{\partial Pr(Coll|\theta, W)}{\partial W} = \left(\frac{1}{\rho} \frac{\partial \Delta}{\partial W} + \phi'(W) \right) f_\eta \left(- \left[\frac{\Delta(\theta, W)}{\rho} + \phi(W) \right] \right). \tag{3}$$

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.[23] We are primarily interested in understanding how the marginal value of wealth 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 many of the details to Appendix B, focusing the discussion in the text largely on the difference in the marginal value of wealth between PS attendees and non-attendees.

5.1 Positive Transfers

We first discuss the decision problem when the non-negative transfer constraint (equation 2) does not bind (or is ignored). In this case, the non-PS consumption allocation problem is quite simple. Given our assumption that $\beta = R^{-1}$, consumption of the child will be constant over time and proportional to total lifetime family resources as determined by θ and W. We denote this level of consumption by $c^{0u}(\theta, W)$; although, the dependence of consumption on (θ, W) is generally implicit below.[24]

PS consumption allocations will depend on whether the family is borrowing constrained.[25] As with the non-PS choice, optimal unconstrained child consumption for PS attendees is constant over

[23] Our main conclusions should generalize to $\beta \neq R$; however, this assumption simplifies the discussion. In Appendix B, we derive closed form expressions for consumption allocations and transfers assuming preferences are characterized by the constant intertemporal elasticity of substitution (CIES) form: $u(c) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$ with $\sigma > 0$.

[24] 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 employed below denote time periods.

[25] Because income is monotonically increasing in ability, there exists a cutoff level of ability $\hat{\theta}_1(W, x) > 0$ above which youth attending PS school are borrowing constrained and below which they are unconstrained. Appendix B derives this and other ability thresholds under CIES preferences.

time and denoted by $c^{1u}(\theta, W)$. When the borrowing constraint binds, consumption during school is relatively low $c_1^{1c}(\theta, W) < c^{1u}(\theta, W)$, while consumption after school is high, $c_2^{1c}(\theta, W) > c^{1u}(\theta, W)$. This implication of borrowing constraints drives all of our results below that link liquidity problems to the family income – PS attendance relationship.

We can generally write the difference in the marginal value of wealth (MVW) for PS vs. non-PS attendance as:

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

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 proportional to net lifetime income. As a result, if PS attendance increases net lifetime income, then $c^{1u} > c^{0u}$ and the first term in equation (4) is negative due to the diminishing marginal utility of consumption. Put another way, if PS attendance has a positive net financial return, then a marginal increase in family resources improves family welfare less in the case of PS attendance than non-attendance.

The second term in equation (4) is non-negative and reflects the 'price effects' associated with implicit taxes on family income associated with PS grant aid. Because financial aid is generally decreasing in family resources, youth from higher income families must pay a higher net price for PS schooling than those from lower income families. This reduces the MVW for PS attendance relative to non-attendance and discourages PS schooling among children from higher income families.

The last two terms in equation (4) both reflect the liquidity benefits 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 captures the fact that the MVW associated with PS attendance is greater for constrained families, since consumption during school is limited. The fourth term is non-positive and reflects the fact that financial aid is declining in family resources. For constrained families, this reduces liquidity and limits available consumption during school more for wealthier families.

For unconstrained families, $c_1^1 = c_2^1 = c^{1u}$ and Terms 3 and 4 disappear.[26] The difference in the

[26]This requires $\theta \leq \hat{\theta}_1(W, x)$, so the borrowing constraint does not bind. Generally, this also requires that optimal unconstrained transfers are non-negative. See Appendix B.

MVW between those attending and not attending PS school can be simply written as

$$\frac{\partial \Delta^u}{\partial W} = \rho \left[u'(c^{1u}) - u'(c^{0u}) \right] + \rho u'(c^{1u}) \frac{\partial G}{\partial W}. \tag{5}$$

In the absence of need-based aid, $sign\left\{\frac{\partial \Delta}{\partial W}\right\} = -sign\{NFR\}$. 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. $\frac{\partial \Delta}{\partial W} < 0$). 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-PS; 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, $c_1^{1c} < c^{1u} < c_2^{1c}$.[27] Re-arranging terms in equation (4) and using equation (5), 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 (implicitly assumed in most discussions of borrowing constraints and schooling), borrowing constraints unambiguously raise the MVW for PS attendance relative to non-attendance and facilitate a positive family income – attendance relationship. Even with positive net financial returns to college, PS attendance may have a higher MVW than non-attendance for those who are constrained. 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.

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. Specifically, increases in $y_0(\theta)$ unambiguously increase $\frac{\partial \Delta}{\partial W}$ by lowering the non-PS MVW. If grant aid decreases less than one-for-one with family wealth, an increase in PS earnings $y_1(\theta)$ reduces $\frac{\partial \Delta^u}{\partial W}$ while an increase in tuition has the opposite effect among unconstrained families. Among constrained families, an increase in PS earnings reduces $\frac{\partial \Delta^c}{\partial W}$ as long as loan limits are need-based

[27] This requires $\theta > \hat{\theta}_1(W, x)$, so the borrowing constraint binds. It also requires that optimal transfers for borrowing-constrained parents are non-negative. See Appendix B.

(otherwise, PS earnings do not affect the MVW). An increase in tuition increases $\frac{\partial \Delta^c}{\partial W}$ as long as total financial aid $(G + \bar{b})$ decreases less than one-for-one with family resources. Under fairly weak assumptions, 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 $\frac{\partial \Delta}{\partial W}$ and the income – attendance correlation. Finally, we note that relaxing the borrowing constraint by broadly expanding loan limits is likely to reduce the income – attendance correlation as long as aid is not too strongly based on need. Assuming $\bar{b}(W, x) = \bar{b}$ is constant for all (W, x), one can show that $\frac{\partial \Delta}{\partial W}$ is decreasing in $\bar{b}$ if and only if $-\frac{\partial G}{\partial W} \leq 1$.

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 in order to attend college. These forces contribute to a negative family income – PS attendance relationship as observed from the difference in MVW between PS attendance and non-attendance:

$$\frac{\partial \Delta^\tau}{\partial W} = \rho u'(c_2^1) \frac{\partial G}{\partial W} + \rho \left[u'(c_1^1) - u'(c_2^1) \right] \frac{\partial (G + \bar{b})}{\partial W} \leq 0. \tag{6}$$

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.[28] 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 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

[28] This requires that optimal unconstrained transfers are negative for both schooling choices and that $\frac{y_1(\theta) + \tilde{T}(W,x)}{1+R} < \bar{b}(W, x)$. While ρ affects $\frac{\partial \Delta^\tau}{\partial W}$, it will not affect the family income – PS attendance gradient. To see why, note that in equation (3), $\frac{\partial \Delta}{\partial W}$ 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.

relationship more negative) as seen in equation (6). 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.

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. 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) generally weaken an otherwise positive income – attendance gradient for youth receiving parental transfers. Among youth receiving no transfers, a change in non-PS earnings does not affect the income – attendance gradient. An increase in PS earnings weakens the gradient by lowering the marginal utility of PS consumption if youth are borrowing constrained and borrowing limits are need-based. However, if youth on their own are not borrowing constrained, an increase in PS earnings strengthens the gradient.

6 Higher Education in Canada and the U.S.

There are many reasons family income – PS attendance patterns may differ across countries or over time. 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 that may be important. Then, we discuss each country's educational institutions, post-secondary tuition levels, government post-secondary financing through grants and

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 $-\frac{\partial (G+\bar{b})}{\partial W} < 1$.

student loans, and the estimated returns to schooling. Although, both countries are similar in many respects, there are a few important differences.

6.1 Demographics

Both Canada and the U.S. are demographically quite similar – largely white, English-speaking populations.[29] 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.

A second important difference between Canada and the U.S. is the result of different immigration policies. In 2000, 11% of the U.S. population was foreign born, with about half of all foreign-born coming from Latin America and one-quarter from Asia. 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.

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

[29] 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*).

notably different from other provinces as we discuss below. As discussed above, this does not appear to play an important role in explaining U.S. – Canada differences in PS education patterns.

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

The earnings structure, especially the financial returns to PS attendance, are likely to affect the income – attendance gradient. 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 attempt to 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. As discussed in Section 5, this implies that the income – PS attendance relationship should be weaker, not stronger, 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).[30] The province of Quebec differs, however. Students in Quebec normally graduate with a high school diploma after completing 11 years of schooling. Students that want to attend university must first complete a two-year college program at CEGEP ('College d'enseignement general et professionnel', meaning College of General and Vocational Education). 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) must complete a three-year CEGEP program. For the cohort examined in this study, the system also differed in Ontario. Prior to 1999, university attendance in Ontario required

[30] 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).

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. In the vast majority of cases, one additional year of high school was required.[31]

In the U.S., high school completion typically requires 12 years of primary and secondary schooling. In some states, a state-wide test must also be passed to receive a high school diploma. Students that do not graduate from high school may take the General Educational Development (GED) test at any time, 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.[32]

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 which are 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.[33] 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.[34] 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

[31] The Ontario system has since been reformed. For students beginning high school in 1999 or later, the university-bound curriculum has been compressed from five years to four, meaning that students become eligible for university entry after grade 12, although many students still need an additional year to obtain the advanced credits (King, et al., 2005).

[32] Rather than focus on the receipt of a diploma or GED, we consider whether individuals complete twelve or more years of schooling as our 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.

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

[34] 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).

students. Because Quebec differs in important ways from other Canadian provinces in the tuition it charges and the way it administers financial aid, we consider it separately in addition to the U.S. and other Canadian provinces covered by the Canada Student Loan Program (CSLP).

We consider costs and aid for the 2003-04 academic year unless otherwise noted, since most of the youth in our U.S. and Canadian data sources would typically be enrolled in PS schools during that year and 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 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. Financial aid in most other provinces is similar in nature to that of British Columbia and Ontario. Appendix C discusses the details of financial aid determination in the U.S. and Canada.

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

[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.

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 purchasing power parity (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, so comparing average tuition levels can be somewhat misleading as we discuss below.

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.

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

[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 a 4-year public or private institution in 2003-04 (based on NPSAS04).

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 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 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

[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.

[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.

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 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, Quebec, and the U.S.[42] (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., beginning at fairly low income levels; it over-takes 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

[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.

[42] These EFC calculations also assume that only one child is currently attending PS school, both parents work, students have no savings, parental savings are entirely exempt, and that Canadian students make the minimum contribution from summer employment. EFC schedules in other Canadian provinces are similar to those of British Columbia and Ontario. See Appendix C for additional details.

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.

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 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 (especially, those whose parents are unwilling to cover their expected contribution) than is the Canadian system. Canada does not offer government student loans irrespective of need, so those students with parents unwilling to make their full expected contribution may have difficulties making ends meet.

Figures 5 and 6 report total grants/scholarships/bursaries and loans, respectively, in the U.S. and the three largest Canadian provinces. Figures for the U.S. come from the NPSAS04 and are based on 18-24 year-old dependent students that are enrolled in a public four-year PS institution and applied for federal financial aid.[44] Canadian figures are based on the CSLP and provincial rules (including

[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 computed average aid for parental income categories (adjusted for PPP) zero to ten thousand dollars, then by every ten thousand dollars up to one hundred thousand dollars, and for one hundred thousand dollars and above.

Millennium and provincial grants and bursaries), using province-specific information about average university costs and student residential status (living with at home with parents or away from home).[45] Aid figures are reported separately for students living at home and those living away from their parents. See Appendix C for further details on all aid calculations.

Total grants, scholarships, and bursaries reported in Figure 5 are disaggregated by source for the U.S., revealing the importance of both state and institutional aid relative to federal aid. Combining these amounts, students with parental income below $20,000 received about $8,000 in total grant and scholarship aid. Surprisingly, total grant amounts were not substantially different by student residential status in the U.S. despite the higher living expenses associated with living away from one's parents. Total grant aid in Canadian provinces 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 income level, below which students receive Millennium or provincial bursaries/grants and above which they do not.[46]

Figure 6 reports total available government loans in the U.S. and three largest Canadian provinces. The U.S. figure assumes all students are able to access Stafford Loans up to the maximum limits; it also includes 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. In Quebec, loans phase-out a bit later than grant aid but at relatively low income levels. The reverse is true in Ontario and British Columbia, where loans begin to phase-out slightly before grant aid does. In Ontario and British Columbia, both grants and loans are available up to fairly high income levels (roughly median family income in Canada), then phase-out very quickly. There is virtually no phase-out of loans in the U.S., but there is a steady decline in grants with parental income over the bottom half of the distribution.

Tax credits (federal and provincial/state) are an additional source of non-repayable aid to students in both Canada and the U.S. For the U.S., these credits are imputed by the NPSAS04 based on reported parental income and documents by the Internal Revenue Service reporting education tax credits claimed by income. Again, we use federal and state rules to impute tax credits in Canada. To the extent that some Canadians do not take advantage of all available credits, our Canadian tax credits

[45] We include loan remissions as grants in our calculations.

[46] Through loan remissions, Ontario effectively limits loans to $7,000 and provides all aid above that amount in the form of grants.

are slightly inflated. Figure 7 adds these tax credits to the non-repayable aid reported in Figure 5 and reports total non-repayable aid from tax credits, grants, scholarships, and bursaries in the U.S. and Canada (i.e. $G(W, x)$ in the model of Section 5). Here, we disaggregate U.S. non-repayable aid based on whether the student pays more or less than the median level of tuition ($4,700) in the U.S. We note that average tuition among the bottom half is $3,400, while it is $7,600 for the top half.

Figure 8 subtracts total grants, bursaries, scholarships, and tax credits from tuition and fees to obtain a measure of 'net tuition' at public four-year institutions. It is important to recognize that this measure does not account for living expenses, which are typically around $6-7,000 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 tends to be lower. As in the previous figure, we report net tuition levels in the U.S. depending on whether tuition itself is high or low. Net tuition figures for the U.S. are not that different for students living at home vs. away from home, so we do not distinguish between them.

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 financial aid 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 (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 $65,000, at which point it jumps up noticeably.[47] 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. Thus, it is highly unlikely that net tuition rises as steeply with income in these provinces as it does in either the U.S. or Quebec. Third, net tuition can differ substantially across the U.S. depending on state-determined tuition levels. This is further examined in Figure 9, which reports the distribution of net tuition levels 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

[47] The slight decline in net tuition with income at the low end in Canada reflects the inability of very low income families to take advantage of otherwise broad-based tax credits.

financing their studies. Although roughly 75% of all students from families earning less than $20,000 have negative net tuition levels in the U.S., 9% pay more than $3,000 in net tuition. Finally, it is important to recognize that all of our 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 institutional support never enroll in the first place, so our total grant figures are likely to be biased upwards and net tuition figures downwards compared to the amount a random *potential* student might face.

In addition to the net price of attendance, out-of-pocket costs will be an important determinant of PS attendance for youth who have limited access to credit. Figure 10 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 of money students are expected to raise on their own (or from parents or other relatives) each year to finance their schooling. 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 low tuition U.S. states. Out-of-pocket expenses in Ontario and British 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 higher income students is evident in the low out-of-pocket expenditures required relative to Canada.

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.[48]

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

In this Section, we consider different potential explanations for the stronger relationship between family income and PS attendance in Canada relative to the U.S. 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

[48] 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).

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 factors correlated with both parental income and educational tastes, costs, or returns drive the correlation between parental income and educational attainment. However, we control for a number of obvious factors that might play such a confounding role: parental education and age, family structure, youth achievement during adolescence for example. Controlling for these factors, we still find a much stronger relationship between parental income and PS attendance in the U.S. In the end, 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. One common concern is unmeasured student ability and the possibility that youth from higher income families are more able. Controlling for math and reading achievement during adolescence greatly alleviates this concern. 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. Therefore, we are fairly confident that the much higher income – attendance gradient in the U.S. cannot be explained by unobserved differences between youth from high and low income families.

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 the U.S., these factors could contribute to a stronger income – attendance relationship there. The school-level (YITS) and county $\times$ 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 the reason this relationship differs across these countries).[49]

We next consider the role of borrowing constraints and the structure of student financial aid in both countries.[50] These factors are inter-related and not easily separated. However, in discussing financial aid programs, it is worth distinguishing between their effects on net tuition prices and on cash-flow problems due to credit constraints. Grants and scholarships impact schooling decisions in two ways: they lower the actual price of education, and they help alleviate any cash-flow problems while in school due to an inability to borrow. The first encourages schooling whether or not students can borrow freely, while the second only operates when youth face limited borrowing opportunities. In principle, government student loans help alleviate borrowing difficulties in the private market but they do not affect the net price of attendance. In practice, however, 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 here.

We first discuss the effects of financial aid on the 'net price' of PS attendance (total costs less grant aid), focusing on the way in which governments link grants (and, therefore, the net price of PS attendance) to parental resources. Based on Figure 8, 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 would suggest that family income – PS attendance gradients should be weakest in the U.S. and Quebec among lower income families. While Quebec has the weakest income – attendance gradient, the gradient is strongest in the U.S. When looking 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, this suggests that income – attendance gradients should be stronger in the U.S. and Quebec relative to other Canadian provinces

[49] Unfortunately, we are not able to control for factors at the school or neighborhood level in the U.S. to see the extent to which they may explain our findings. It is possible that differences across schools or neighborhoods within central city, suburban, or non-metropolitan areas of counties plays an important role.

[50] Belley and Lochner (2007) argue that these factors are likely to be important factors in explaining the increased importance of family income in the U.S. since the early 1980s.

at the top of the income distribution.

Financial aid also helps alleviate cash-flow problems that may arise from imperfect credit markets. Both grants and loans play a role in addressing this problem. Much of the literature (as well as aid programs themselves) has focused on whether youth can finance a 'minimal standard of living' while enrolled in school; however, this does not necessarily ensure efficient investment behavior. For example, some youth may prefer the lifestyle of a high school graduate to a meager living standard while attending college followed by a much better living standard thereafter, even though they might prefer attending college if they could raise their in-school standard of living by borrowing against their 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.[51]

Figure 10 reveals that, on average, very low income American students in low tuition states receive considerable financial help enabling them to cover roughly $7,500 in living expenses without having to dip into their own pockets. The same student from an average high tuition state would have about $2,000 less to live with. Of course, Figure 9 implies that a non-trivial share of American students fare considerably worse than this. Very low income Canadian students fare a bit worse than the typical American student from a high tuition state. The high implicit tax on total aid for lower and middle income families in the U.S. suggests that youth from middle income families may find cash-flow problems most severe. Middle income students from Ontario and British Columbia appear to be able to finance most of their university expenses with little help from their parents. The availability of Stafford Loans enables wealthier American students to attend most public four-year schools with only modest help from their parents. In contrast, it is difficult to see how higher income Canadian youth could attend university without substantial support from their parents. To the extent that students are constrained in their borrowing from non-governmental sources, Figure 10 suggests that the income – PS attendance gradient should be weak in 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 wealthy Canadian parents fail to contribute more than a few thousand dollars towards their children's education). Looking at Table 2, attendance gaps between the first and second income quartiles are quite similar across the U.S. and Canada, but they are noticeably larger in the U.S. for higher income

[51] 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.

quartiles. Thus, the differential treatment of student loans may be playing an important role in determining PS attendance among middle and upper income families.

So, how important are borrowing constraints and the structure of financial aid in determining family income – PS attendance gradients? While the low net tuition and high implicit tax rates on grant aid correctly suggest that Quebec should have a relatively weak gradient, they incorrectly suggest that the U.S. should as well. The out-of-pocket expenditure schedules suggest that the U.S. should have a relatively flat income – attendance gradient at the low end of the income distribution and steeper gradient at the high end. Our empirical findings are only roughly consistent with this prediction.

A few caveats make these comparisons difficult. 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 (especially at the low end of the income distribution where youth who do not receive institutional aid are most likely to be discouraged from attending). Adjusting for this student selection would tend to bring the U.S. net tuition and out-of-pocket figures closer to those of Ontario and British Columbia for lower income families; however, the differential treatment of student income by EFC calculations is likely to leave some gap between poor American and Canadian students. Any adjustment for student selection is unlikely to affect the relatively low out-of-pocket expenses for American youth from higher income families, since the Stafford Loan program plays an important role for these youth. Second, there is a lot of variation within the U.S. The fact that nearly 10 percent of (enrolled) low-income youth face net tuition levels in excess of $3,000 may have a large effect on attendance rates for this group even if it only has a minor effect on their average net tuition levels. 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. However, 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 serious 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 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.[52] Furthermore, it is difficult to understand why this should generate a stronger relationship between parental income and high school completion in the U.S. than in Canada.

8 Conclusions

Among recent cohorts of American and Canadian students, we find that PS attendance (and attendance at four-year PS institutions) is strongly positively related to parental income in the U.S., even after controlling for similar measures of family background and adolescent cognitive achievement. The parental income – PS attendance relationship in Canada is also positive, but substantially weaker.

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 systems can explain Canada – U.S. attendance patterns. We find mixed evidence in this regard.

First, differences in average net tuition schedules cannot explain the steeper income – attendance gradient in the U.S. relative to Canada at the bottom half of the income distribution. Net tuition is relatively quite low in the U.S. for very low income families, and grant aid is quickly taxed away as family income rises toward the median. Both of these suggest that the U.S. should have a relatively weak relationship between family income and PS attendance.[53] For the top half of the income distribution, a strong income – attendance relationship in the U.S. relative to Canada is largely consistent with the sharp declines in grant/bursary aid that occur as income begins to rise above the median for families in provinces like Ontario and British Columbia. In contrast, financial aid and net tuition are very similar for middle and high income American families.

Second, out-of-pocket expenditure schedules also fail to explain the steeper income – attendance gradient at the bottom of the income distribution in the U.S. relative to Canada; however, they are more consistent with attendance patterns at the top of the income distribution. It is quite possible that

[52] 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%.

[53] Quebec has similar net tuition to low tuition U.S. states, suggesting they should have similar income – attendance relationships.

many middle income American families have a difficult time covering required out-of-pocket expenses for their children's PS schooling, while the schooling of children from most lower income families is nearly fully supported by grants and loans. In Canada, both low and middle income families receive the same support, though middle income families can presumably better afford to help their children. This implies a weaker gradient in the U.S. relative to Canada at the bottom of the income distribution. At the top end, the Stafford Loan program in the U.S. ensures that all higher income youth have access to at least modest levels of financing, while Canada sharply scales back all loans and grants for families earning over $55,000. Thus, the income – attendance gradient should be stronger in the U.S. at the top end of the income distribution. This is roughly borne out in the data.

Third, 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 the 10-20 percent of youth from higher tuition states who receive the least financial aid. In principle, future research on the U.S. alone could shed light on this issue.

Fourth, many students and families are likely to be ill-informed about the costs and financial aid associated with PS school. This seems likely to be more of a 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 a more serious problem for the most disadvantaged. Interestingly, these two 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 is likely to 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 educational decision. Although peer effects, social networks, and other neighborhood or school-level factors do not appear to 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 a narrow geographic or the 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 so 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 in Canada today).

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

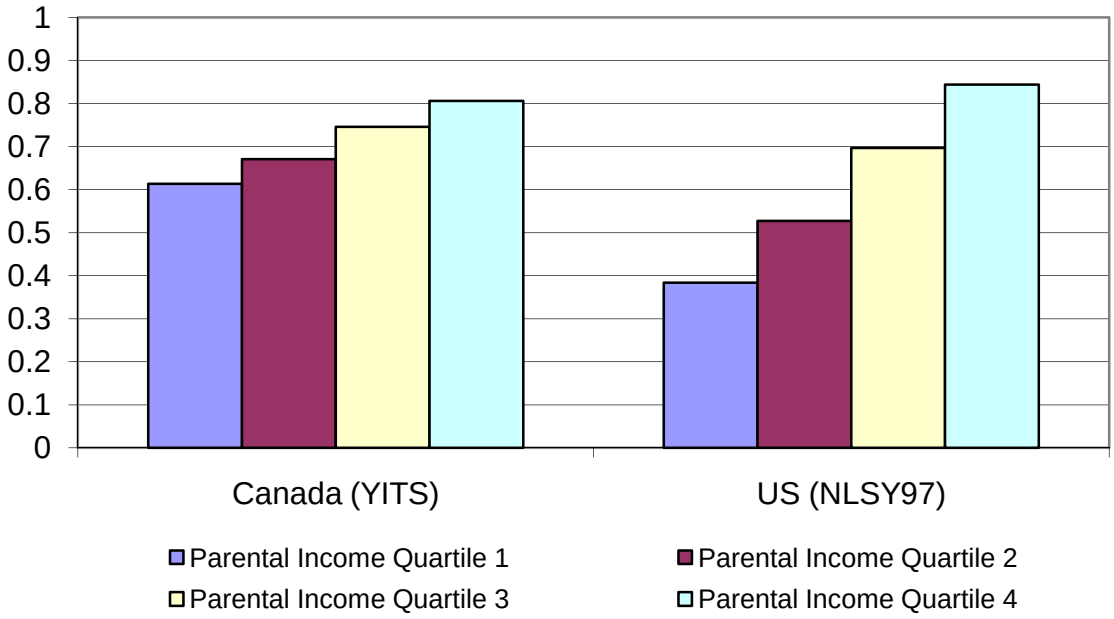

Figure 2a: Post-Secondary Attendance by Math-Reading Ability and Parental Income Quartiles in Canada (YITS)

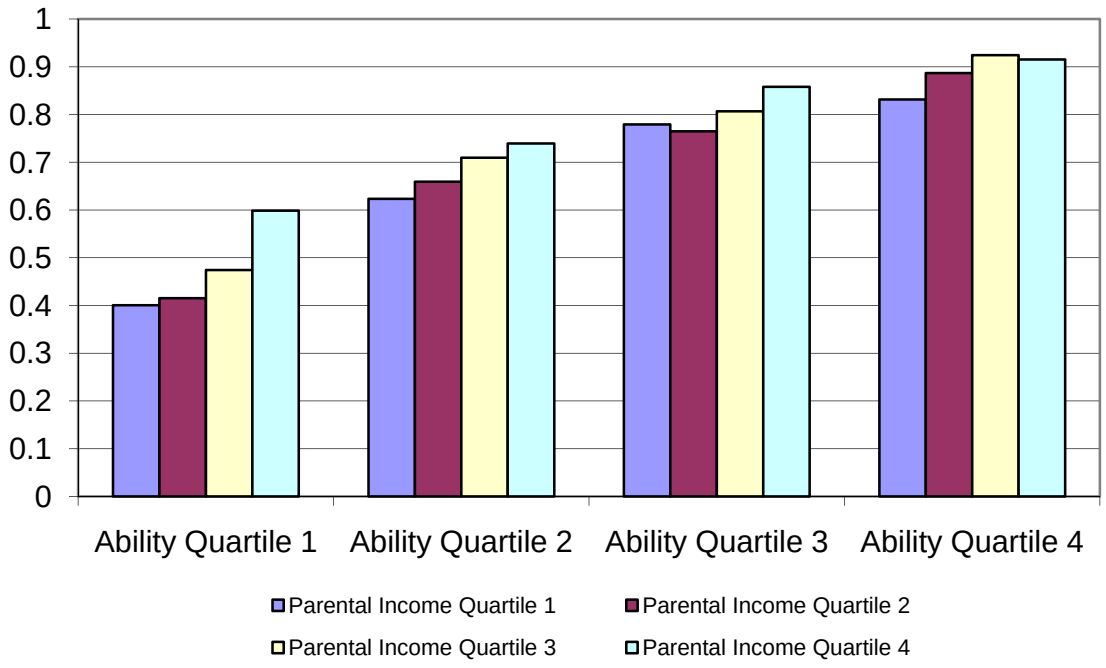

Figure 2b: Post-Secondary Attendance by Math-Reading Ability and Parental Income Quartiles in the US (NLSY97)

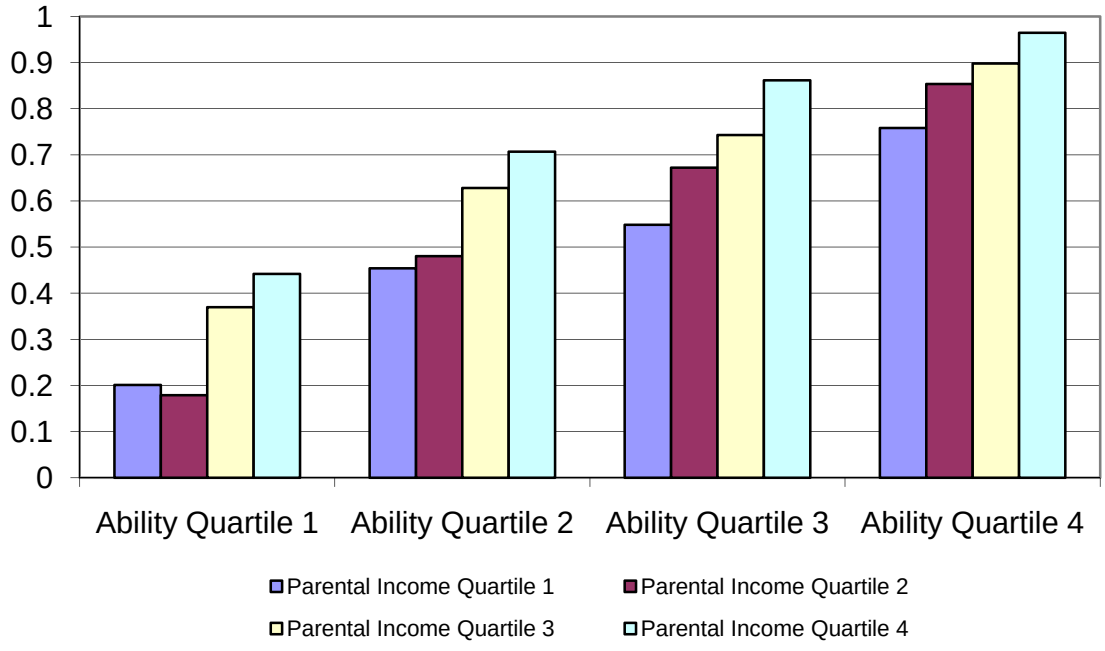

Figure 3: Estimated Effects of Parental Income on Post-Secondary Attendance

(Polynomial Estimates)

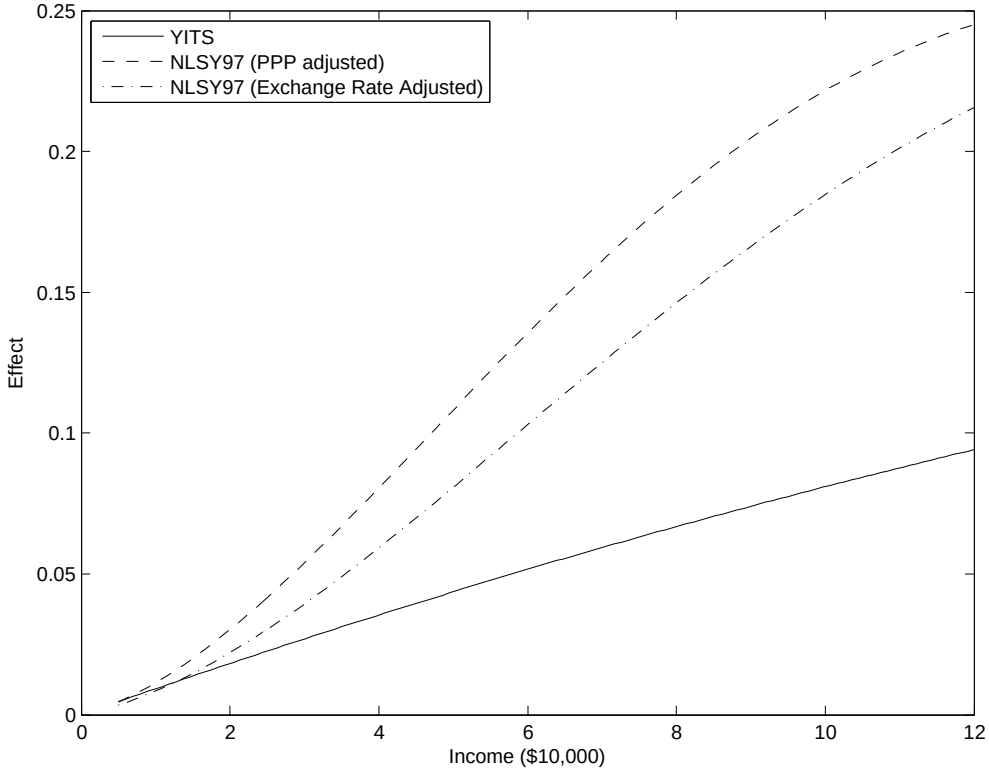

Figure 4: Expected Financial Contribution

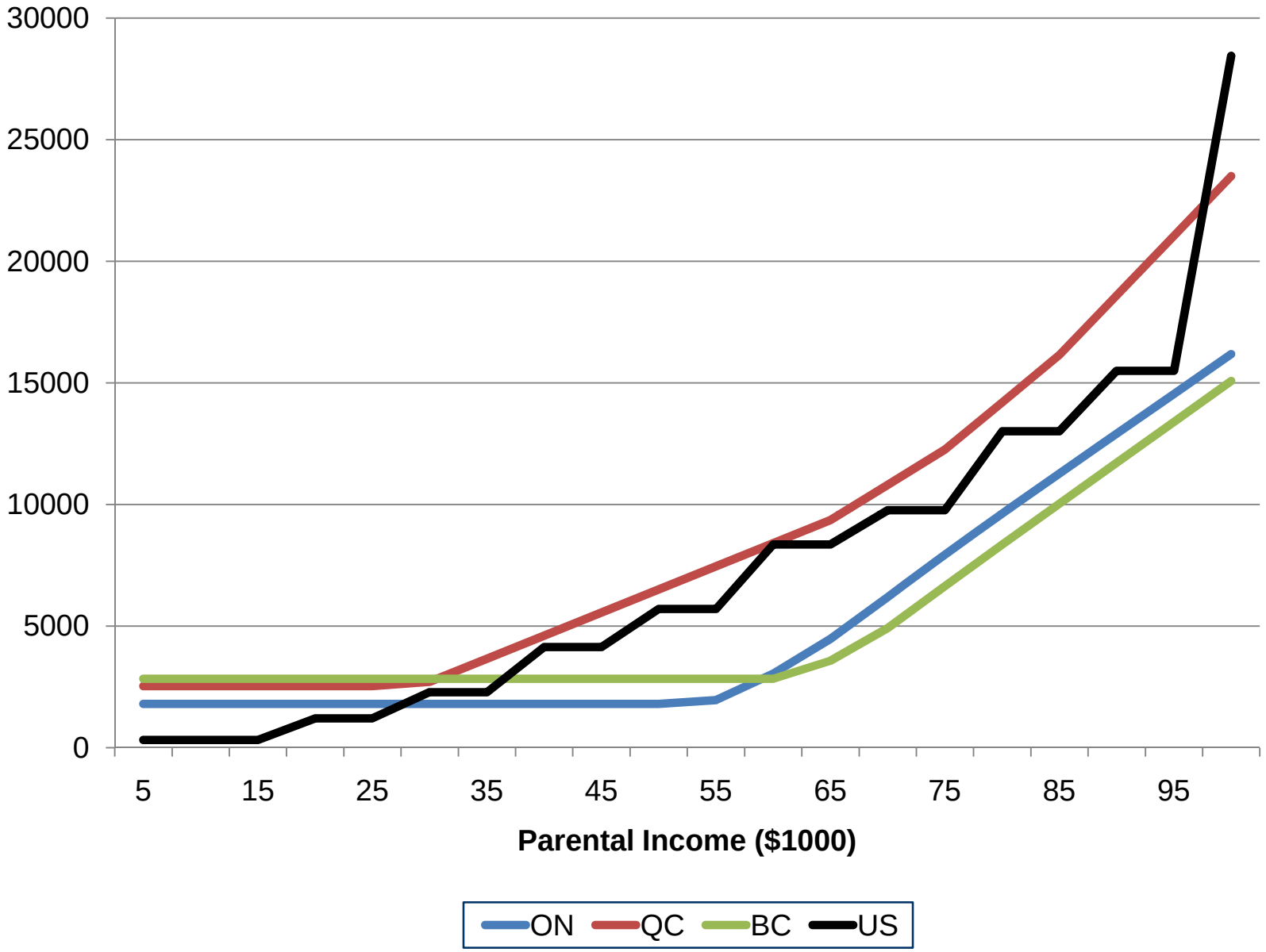

Figure 5: Total Grants, Scholarships & Bursaries

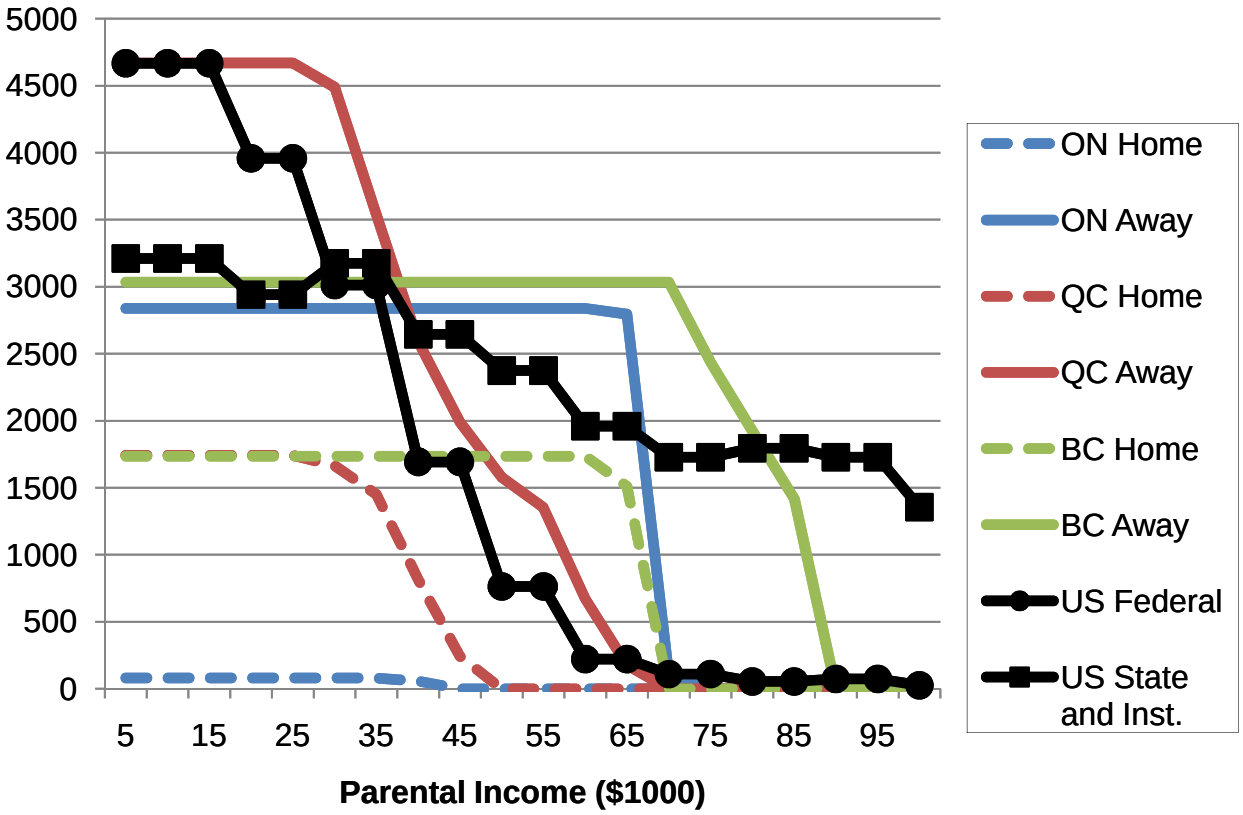

Figure 6: Total Available Government Loans

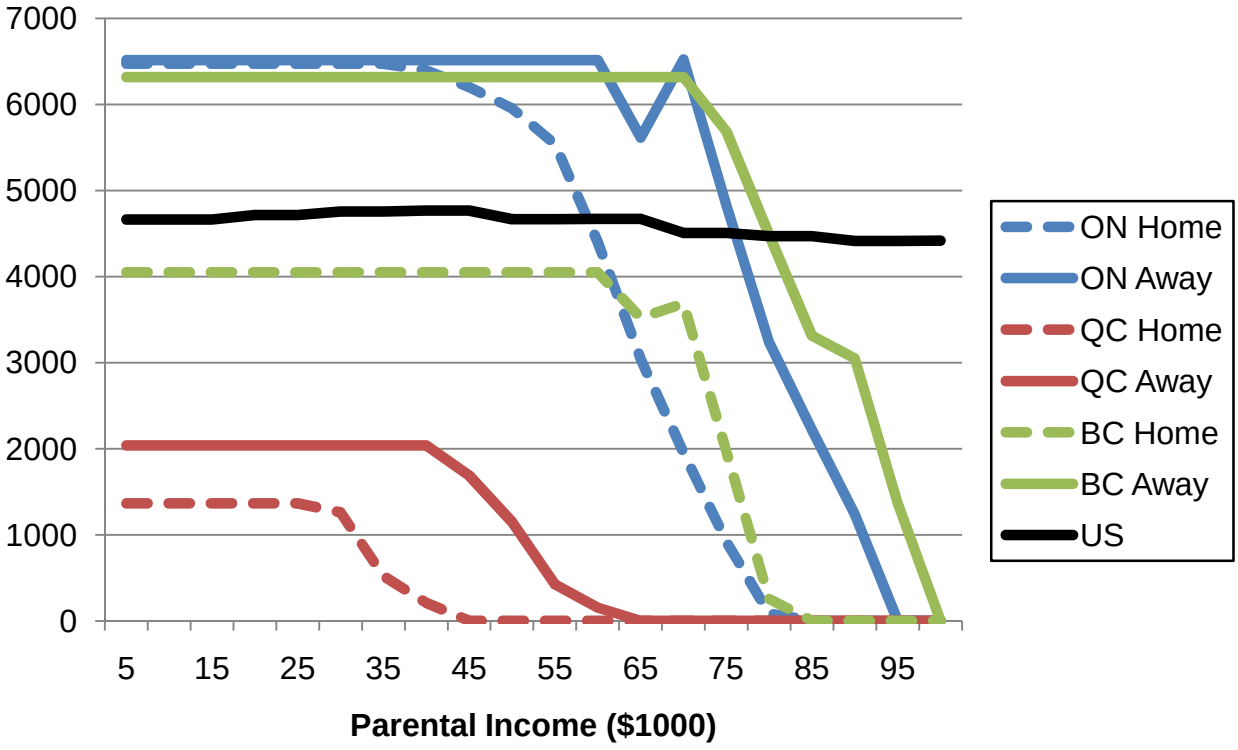

Figure 7: Total Tax Credits, Grants, Scholarships & Bursaries

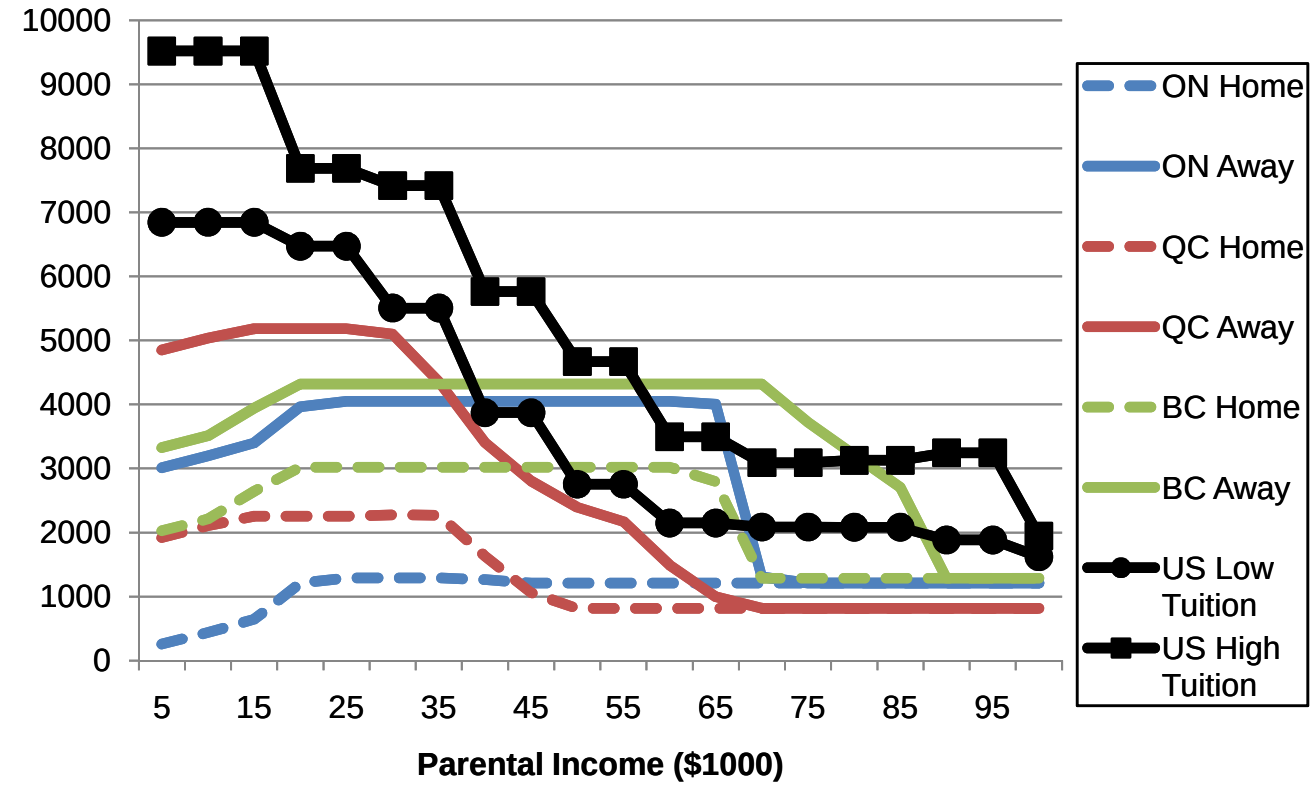

Figure 8: Net Tuition (Tuition less Non-Repayable Aid)

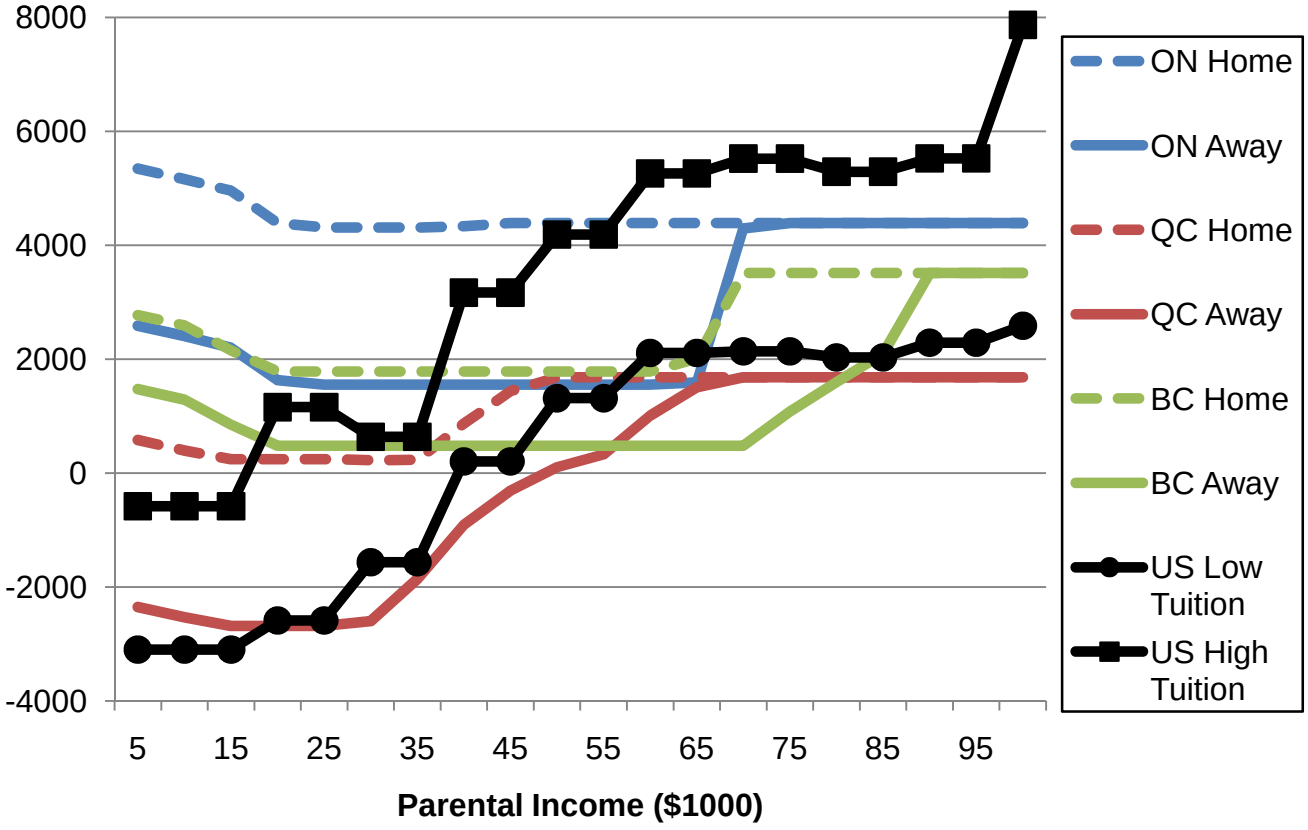

Figure 9: Distribution of Net Tuition by Parental Income in the US

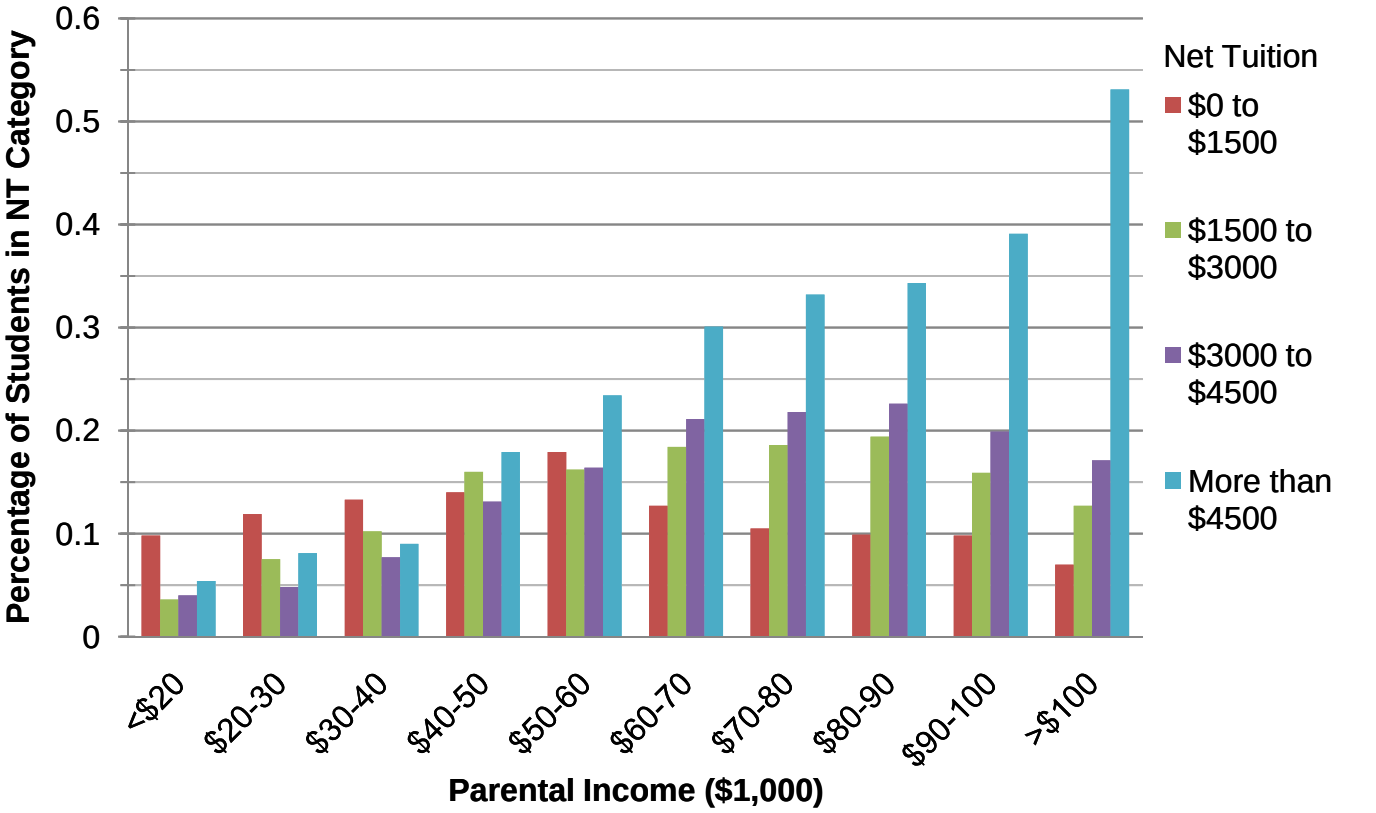

Figure 10: Out-of-Pocket Costs

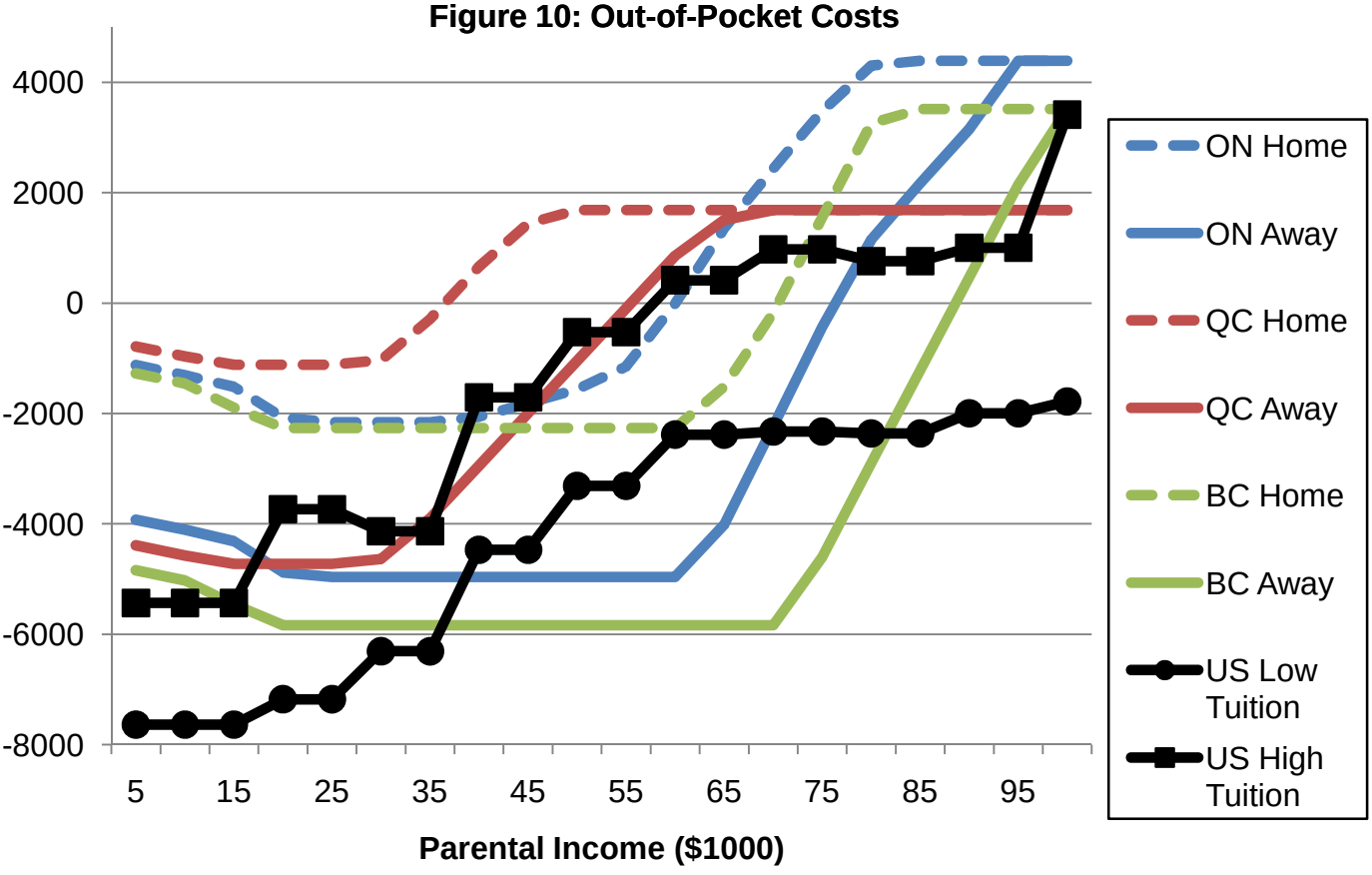

Table 1: Sample Descriptive Statistics

	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) 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 School Fixed Effects	(v) Controls for Perceived Returns to School & Peers' PS Plans
Math-Reading Achievement Quarti	0.1991	0.1626	0.1849	0.2080	0.1813
	(0.0121)	(0.0125)	(0.0178)	(0.0209)	(0.0121)
Math-Reading Achievement Quarti	0.2978	0.2412	0.3117	0.3079	0.2729
	(0.0123)	(0.0126)	(0.0173)	(0.0202)	(0.0124)
Math-Reading Achievement Quarti	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 Quarti	0.2502	0.2202	0.1038	0.2546
	(0.0198)	(0.0227)	(0.0359)	(0.0207)
Math-Reading Achievement Quarti	0.3933	0.3468	0.2801	0.3935
	(0.0204)	(0.0227)	(0.0354)	(0.0214)
Math-Reading Achievement Quarti	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-val	<.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-val	<.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

In this appendix, we derive closed form expressions for consumption allocations and transfers assuming preferences are characterized by the constant intertemporal elasticity of substitution form: $u(c) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}$ with $\sigma > 0$. We also derive other results discussed in the paper.

B.1 PS Attendance

Here, we characterize the consumption allocation problem which determines $V_1(\theta, W)$.

First, define parental consumption $c^p = W - \tau$ and youth consumption during and after school $c_1^1 = \tau - \tilde{T}(W, x) + b$ and $c_2^1 = y_1(\theta) - Rb$. Consider the FOC for τ, b:

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

where the inequalities are strict if the corresponding constraint on τ or b binds; otherwise, equalities hold.

B.1.1 Unconstrained Problem

We first study the fully unconstrained problem, then characterize when the different constraints will bind.

If the FOC hold with equality (agents are unconstrained), it is clear that $c_1^1 = c_2^1 = \rho^\sigma c^p$ given the CIES utility function and $R = \beta^{-1}$. With no restrictions on transfers or borrowing/saving, the present value of family consumption must equal the present value of family resources: $c^p[1 + \rho^\sigma(1 + R^{-1})] = W - \tilde{T} + R^{-1}y_1$. This immediately implies that unconstrained optimal parental consumption, $c^{p1u}(\theta, W)$, youth consumption in both periods $c^{1u}(\theta, W)$, parental transfers $\tau^{1u}(\theta, W)$, and youth borrowing $b^{1u}(\theta, W)$ are given by:

$$\begin{aligned} c^{p1u}(\theta, W) &= \chi(\rho)\left[y_1(\theta) + R(W - \tilde{T}(W, x))\right] \\ c^{1u}(\theta, W) &= \chi(\rho)\rho^\sigma\left[y_1(\theta) + R(W - \tilde{T}(W, x))\right] \\ \tau^{1u}(\theta, W) &= \chi(\rho)\left[(1 + R)\rho^\sigma W - y_1(\theta) + R\tilde{T}(W, x)\right] \\ b^{1u}(\theta, W) &= \chi(\rho)\left[(1 + \rho^\sigma)y_1(\theta) - \rho^\sigma(W - \tilde{T}(W, x))\right], \end{aligned}$$

where we define the constant $\chi(\rho) \equiv \frac{1}{R+(1+R)\rho^\sigma} \in (0, R^{-1}]$.

Given the consumption allocations, we can calculate family utility when the youth goes to college and no constraints bind as:

$$V_1^u(\theta, W) = \left[\frac{\chi(\rho)^{-\frac{1}{\sigma}}}{R(1 - \frac{1}{\sigma})}\right][y_1(\theta) + R(W - \tilde{T}(W, x))]^{1-\frac{1}{\sigma}}. \tag{7}$$

When the transfer constraint does not bind, constraint (1) does not bind if and only if

$$y_1(\theta) \leq \left[\frac{R+(1+R)\rho^\sigma}{1+\rho^\sigma}\right]\bar{b}(W,x) + \frac{\rho^\sigma}{1+\rho^\sigma}\left[W - \tilde{T}(W,x)\right]. \tag{8}$$

Since $y_1(\theta)$ is increasing in θ, this implies a cutoff level of ability

$$\hat{\theta}_1(W,x) \equiv y_1^{-1}\left(\left[\frac{1}{\chi(\rho)(1+\rho^\sigma)}\right]\bar{b}(W,x) + \rho^\sigma\left[W - \tilde{T}(W,x)\right]\right)$$

above which youth are borrowing constrained and below which they are unconstrained.

Define $\kappa(\theta,W,x) \equiv b^{1u}(\theta,W) - \bar{b}(W,x) \leq 0$, so constraint (1) binds if $\kappa > 0$. The following is useful for seeing how parental income/wealth affects who is constrained:

$$\frac{\partial\kappa}{\partial W} = -\chi(\rho)\rho^\sigma\left[1+\frac{\partial G}{\partial W}\right] - \frac{\partial\bar{b}}{\partial W}.$$

If grant and loan limits are unresponsive to parental resources, then $\frac{\partial\kappa}{\partial W} = -\chi(\rho)\rho^\sigma < 0$ and the least wealthy are constrained. However, if grant and loan limits are sharply decreasing in family resources (e.g. total government aid is reduced dollar-for-dollar with increases in parental resources), then wealthier youth may be constrained while more disadvantaged youth are not. That is, $\frac{\partial\kappa}{\partial W} \geq 0$ if $\frac{\partial(G+\bar{b})}{\partial W} \leq -1$, since $\chi(\rho)\rho^\sigma \in (0,1)$. While this is not a general feature of most financial aid systems, something like this may occur at 'jumps' in financial aid formulas where families below some income/wealth threshold qualify for aid but those above the threshold do not.

From $\tau^{1u}(\theta,W)$, it is straightforward to show that when the borrowing constraint does not bind, the non-negative transfer constraint does not bind if and only if

$$y_1(\theta) \leq (1+R)\rho^\sigma W + R\tilde{T}(W,x). \tag{9}$$

There will be a threshold level of ability, $\tilde{\theta}_1(W,x) \equiv y_1^{-1}\left((1+R)\rho^\sigma W + R\tilde{T}(W,x)\right)$ above which the transfer constraint binds and below which it does not. For $\bar{b}(W,x) = 0$, it is clear from (8) and (9) that $\tilde{\theta}_1(W,x) > \hat{\theta}_1(W,x)$ (assuming $\tilde{T}(W,x) \geq 0$), and the borrowing constraint would bind for some ability types that were not constrained by the non-negative transfer rule. For $\bar{b}(W,x)$ large enough, the reverse may be true. Finally, notice $\frac{\partial\tau^{1u}}{\partial W} = \chi(\rho)\left[(1+R)\rho^\sigma - R\frac{\partial G}{\partial W}\right] > 0$, so wealthy families are not constrained by the non-negative transfer rule.

B.1.2 Binding borrowing constraints with positive transfers

Now, consider the case where the borrowing constraint binds but optimal transfers are non-negative. This requires that $\theta \in \left(\hat{\theta}_1(W,x), \tilde{\theta}_1(W,x)\right)$.[54] In this case, $b^{1c}(\theta,W) = \bar{b}(W,x)$. The FOC for transfers is still satisfied with equality, so $c^p\rho^\sigma = c_1^1$; however, $c_1^1 > c_2^1$ due to the constraint on borrowing. At

[54] Note that this case is only relevant when $\tilde{\theta}_1(W,x) > \hat{\theta}_1(W,x)$, which requires that $\bar{b}(W,x) < (1+\rho^\sigma)\chi(\rho)\left[\rho^\sigma RW + (\rho^\sigma+R)\tilde{T}(W,x)\right]$.

an optimum, τ must satisfy $(W-\tau)\rho^\sigma = \tau - \tilde{T} + \bar{b}$. Therefore, we have the following borrowing constrained allocations:

$$\begin{aligned}
c^{p1c}(\theta, W) &= \chi_c(\rho)\left[W - \tilde{T}(W,x) + \bar{b}(W,x)\right] \\
c_1^{1c}(\theta, W) &= \chi_c(\rho)\rho^\sigma\left[W - \tilde{T}(W,x) + \bar{b}(W,x)\right] \\
c_2^{1c}(\theta, W) &= y_1(\theta) - R\bar{b}(W,x) \\
\tau^{1c}(\theta, W) &= \chi_c(\rho)\left[\rho^\sigma W + \tilde{T}(W,x) - \bar{b}(W,x)\right] \\
b^{1c}(\theta, W) &= \bar{b}(W,x),
\end{aligned}$$

where we define the constant $\chi_c(\rho) \equiv \frac{1}{1+\rho^\sigma} \in (0,1]$. Interestingly, ability only affects post-school consumption for youth; it has no effect on borrowing, transfers, in-school consumption, or parental consumption due to the borrowing constraint.

Given these allocations, we can determine family utility associated with college attendance when the borrowing constraint binds but the non-negative transfer constraint does not:

$$V_1^c(\theta, W) = \left[\frac{\chi_c(\rho)^{-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}\right]\left[W - \tilde{T}(W,x) + \bar{b}(W,x)\right]^{1-\frac{1}{\sigma}} + \left[\frac{\rho\beta}{1-\frac{1}{\sigma}}\right]\left[y_1(\theta) - R\bar{b}(W,x)\right]^{1-\frac{1}{\sigma}}. \tag{10}$$

Finally, notice that when youth are borrowing constrained, desired transfers will be non-negative as long as:

$$\bar{b}(W,x) \geq \rho^\sigma W + \tilde{T}(W,x); \tag{11}$$

otherwise, parental transfers will also be constrained.

B.1.3 Binding transfer constraint

Now, consider the case where the borrowing constraint does not bind but optimal unconstrained transfers are negative. For this to occur, it is necessary that $\theta \in \left(\tilde{\theta}_1(W,x), \hat{\theta}_1(W,x)\right)$.[55] In this case, $\tau^{1\tau}(W,x) = 0$. Since borrowing constraints are non-binding, youth still smooth consumption over time (consuming $c^{1\tau}(\theta, W)$ each period); however, consumption cannot be 'smoothed' optimally across generations. It is straightforward to show that:

$$\begin{aligned}
c^{p1\tau}(\theta, W) &= W \\
c^{1\tau}(\theta, W) &= \frac{y_1(\theta) - R\tilde{T}(W,x)}{1+R} \\
b^{1\tau}(\theta, W) &= \frac{y_1(\theta) + \tilde{T}(W,x)}{1+R}.
\end{aligned}$$

[55] Note that this case is only relevant when $\tilde{\theta}_1(W,x) < \hat{\theta}_1(W,x)$, which requires that $\bar{b}(W,x) > (1+\rho^\sigma)\chi(\rho)\left[\rho^\sigma RW + (\rho^\sigma + R)\tilde{T}(W,x)\right]$.

These allocations imply that utility for college families constrained by the non-negative transfer constraint is

$$V_1^{\tau}(\theta, W) = \frac{W^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \left[\frac{\rho\beta(1+R)^{1/\sigma}}{1-\frac{1}{\sigma}}\right]\left[y_1(\theta) - R\tilde{T}(W,x)\right]^{1-\frac{1}{\sigma}}. \tag{12}$$

Now, consider when youth receiving no parental transfers are unconstrained in their borrowing. These youth are unconstrained when $b^{1\tau}(\theta, W) \leq \bar{b}(W,x)$ or

$$y_1(\theta) \leq (1+R)\bar{b}(W,x) - \tilde{T}(W,x). \tag{13}$$

From this, it is clear that high θ youth and youth from high W families will be constrained.

B.1.4 Borrowing and non-negative transfer constraints bind

When both constraints bind simultaneously, we have $\tau = 0$ and $b = \bar{b}(W,x)$. In this case,

$$\begin{aligned} c^{p1c\tau}(\theta, W) &= W \\ c_1^{1c\tau}(\theta, W) &= -\tilde{T}(W,x) + \bar{b}(W,x) \\ c_2^{1c\tau}(\theta, W) &= y_1(\theta) - R\bar{b}(W,x), \end{aligned}$$

and

$$V_1^{c\tau}(\theta, W) = \frac{W^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \rho\left[\frac{[-\tilde{T}(W,x) + \bar{b}(W,x)]^{1-\frac{1}{\sigma}} + \beta\left(y_1(\theta) - R\bar{b}(W,x)\right)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}\right]. \tag{14}$$

B.1.5 Marginal values of wealth

It is straightforward to derive the MVW in the four different cases:

$$\begin{aligned} \frac{\partial V_1^u(\theta,W)}{\partial W} &= u'(c^{p1u})\left[1 + \frac{\partial G}{\partial W}\right] \\ \frac{\partial V_1^c(\theta,W)}{\partial W} &= u'(c^{p1c})\left[1 + \frac{\partial G}{\partial W}\right] + \left[u'(c^{p1c}) - \rho u'(c_2^{1c})\right]\frac{\partial \bar{b}}{\partial W} \\ \frac{\partial V_1^{\tau}(\theta,W)}{\partial W} &= u'(c^{p1\tau}) + \rho u'(c^{1\tau})\frac{\partial G}{\partial W} \\ \frac{\partial V_1^{c\tau}(\theta,W)}{\partial W} &= u'(c^{p1c\tau}) + \rho u'(c_1^{1c\tau})\frac{\partial G}{\partial W} + \rho\left[u'(c_1^{1c\tau}) - u'(c_2^{1c\tau})\right]\frac{\partial \bar{b}}{\partial W} \end{aligned}$$

B.2 Non-PS Attendance

We now study the consumption allocation problem for families in which the youth does not attend PS school. When no constraints bind:, $c^{p0}\rho^{\sigma} = c_1^0 = c_2^0$ at an optimum. Solving for unconstrained

allocations yields:

$$\begin{aligned} c^{p0u}(\theta, W) &= \chi(\rho)\left[RW + (1+R)y_0(\theta)\right] \\ c^{0u}(\theta, W) &= \chi(\rho)\rho^{\sigma}\left[RW + (1+R)y_0(\theta)\right] \\ \tau^{0u}(\theta, W) &= \chi(\rho)(1+R)\left[\rho^{\sigma}W - y_0(\theta)\right] \\ b^{0u}(\theta, W) &= \chi(\rho)\left[y_0(\theta) - \rho^{\sigma}W\right], \end{aligned}$$

and

$$V_0^u(\theta, W) = \left[\frac{\chi(\rho)^{-\frac{1}{\sigma}}}{R(1-\frac{1}{\sigma})}\right]\left[RW + (1+R)y_0(\theta)\right]^{1-\frac{1}{\sigma}}. \tag{15}$$

Notice that $\tau^{0u} \geq 0$ if and only if $y_0(\theta) \leq \rho^{\sigma}W$, so families with low ability children and wealthy parents (i.e. $\theta < \tilde{\theta}_0(W) \equiv y_0^{-1}(\rho^{\sigma}W)$) will make non-negative transfers from parents to children. Youth with $\theta > \tilde{\theta}_0(W)$ will be constrained to zero transfers, so $\tau^{0\tau} = 0$, $c^{p0\tau}(\theta, W) = W$, $c^{0\tau}(\theta, W) = y_0(\theta)$, $b^{0\tau}(\theta, W) = 0$, and

$$V_0^{\tau}(\theta, W) = \frac{W^{1-\frac{1}{\sigma}} + \rho(1+\beta)y_0(\theta)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}}. \tag{16}$$

The MVW in the two cases is

$$\begin{aligned} \frac{\partial V_0^u(\theta, W)}{\partial W} &= u'(c^{p0u}) \\ \frac{\partial V_0^{\tau}(\theta, W)}{\partial W} &= u'(c^{p0\tau}). \end{aligned}$$

Appendix C Post-Secondary Education Finance in Canada and the U.S. (To be updated)