

Online Appendix for “Post-Secondary Attendance by Parental Income in the U.S. and Canada: Do Financial Aid Policies Explain the Differences?”

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This is a companion (online) appendix to “Post-Secondary Attendance by Parental Income in the U.S. and Canada: Do Financial Aid Policies Explain the Differences?” by Philippe Belley, Marc Frenette, and Lance Lochner.

Part I provides a number of additional results and robustness checks related to our empirical analysis of the relationship between post-secondary schooling and family income using the NLSY97 and YITS data. Part II reports a detailed discussion of our non-repayable aid calculations for the U.S. using the NPSAS04, while Part III provides details on our financial aid calculations for Canada. Part IV considers a few alternative measures of net tuition and out-of-pocket expenditures, while Part V presents net-tuition and out-of-pocket expenditures for two-year institutions. Part VI discusses details regarding the counterfactual aid calculations presented in Section 6 of the paper.

I Additional Empirical Results from the NLSY97 and YITS

In this section, we provide a number of additional results and robustness checks related to key specifications presented in the paper.

Appendix Table 1 reports summary statistics for key demographic characteristics in the U.S. (NLSY97) and Canada (YITS) by family income category. As expected, higher earning families have higher educational achievement for both the mother and the youth; they are also more likely to be white and come from intact families. The largest discrepancies between the U.S. and Canadian sample are found at the bottom of the income distribution. For example, the proportion of intact families is much lower for poor American families relative to their Canadian counterparts. The same phenomenon is observed for mothers having completed at least some post-secondary schooling.

Appendix Table 2 reports results from two specification checks analogous to NLSY97 results reported in Table 3 of the paper. These results are based on regressions of post-secondary attendance or attendance at a four-year institution on family income, math-reading achievement, and family background. We first examine the role of missing variables in the NLSY97. Among youth with

observed educational outcomes, roughly 5% are missing our parental income measure and 15% are missing the math and reading ASVAB scores needed to create our achievement measure. Our main analysis reported in the paper drops all observations that are missing any of the variables used in the specification. The first two columns of Appendix Table 2 report results when imputing these missing values for achievement and parental income using multivariate imputation by chained equations (MICE) as described in van Buuren, Boshuizen and Knook (1999). This approach uses iterative Markov chain Monte Carlo methods for the imputation.¹ The imputation model is based on ordered logistic specifications for achievement and parental income categories as functions of the educational outcomes of interest, all independent variables used in the regression models, and their interactions. This estimation approach is preferred to the ‘complete cases’ approach in the paper if the likelihood of missing achievement or income measures depends on observed post-secondary attendance outcomes (conditional on all other observed regressors). In practice, estimates from these specifications are very similar to their counterparts in Table 3 of the paper. We next re-do our main analysis including the NLSY97 minority over-samples (using the appropriate sample weights), as reported in Columns 3 and 4 of Appendix Table 2. This increases sample sizes by about one thousand observations; however, estimates for these specifications are very similar to those reported in Table 3 of the paper.

Appendix Table 3 adds father’s educational attainment to the list of family background controls in our main specifications of Table 3 in the paper. To account for the fact that this variable is missing for many respondents, we also include an indicator variable for missing father’s education. Not surprisingly, the estimated coefficients on father’s education are generally positive; however, including father’s education has little effect on other estimated coefficients as reported in Table 3.

II Details on Non-Repayable Aid for the US

Non-repayable aid in the U.S. is distributed by the federal government (mostly as Pell grants and the Supplemental Educational Opportunity Grant), state governments, and institutions themselves. Education tax credits (and deductions) are an additional source of non-repayable aid to students. The NPSAS04 imputes federal Hope and Lifetime Learning tax credits as well as any education deductions based on reported parental income and documents by the Internal Revenue Service reporting education tax credits claimed by income.² For students living away from home, Appendix Figure 1 shows averages for each of these sources of non-repayable aid by parental income for the NPSAS04 sample used in the paper.

¹Twenty-five iterative cycles are used in the Gibbs sampling algorithm, and one hundred imputation samples are generated.

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

II.A NPSAS Online Data Extraction and Aid Schedules Preparation

All our NPSAS04 financial aid figures were obtained online using the table creation tool of the National Center for Education Statistics Data Analysis System.³ We restrict our sample to students ages 18 to 24 years old, who are dependent on their parents during the academic year 2003-04. Our sample only includes students enrolled in four-year public institutions who were paying the regular “in-jurisdiction” tuition fees. We restrict our sample to students who were enrolled nine or more months full-time during the 2003-04 academic year at a single institution. Finally, we only consider students who had submitted a federal financial aid application and had a record in the Central Processing Service computer system that analyzes FAFSA applications; this ensures access to administrative data on parental income and financial aid packages.

The NPSAS04 data on parental income and expected family contributions (EFC) come from financial aid administrative records. As noted in the paper, we adjust parental income by the PPP index (1.19) before obtaining equivalent categories in U.S. dollars for use in the online table creation tool. To compute non-repayable aid, we sum total grants from all sources and estimated education tax credits. Total loans are the sum of federal, state, and institutional loans, where we replace actual Stafford loan amounts by the Stafford loan limits (averaged over a four-year degree).

III Details on Canada Financial Aid Calculations

We disaggregate non-repayable aid in Canada differently, since federal aid is exclusively in the form of loans and we do not have measures of institutional support. Appendix Figure 2 reports separate amounts (by parental income) for the following categories of non-repayable aid in British Columbia, Ontario, and Quebec: (i) Millennium and provincial grants and bursaries, (ii) loan remissions, and (iii) tax credits. Federal and provincial rules are used to calculate all aid figures are discussed in detail below. To the extent that some Canadians do not take advantage of all available tax credits, these figures may be slightly inflated. Because British Columbia does not use loan remissions, the figure only reports remissions for Ontario and Quebec.

The rest of this section provides a detailed description of Canadian financial aid rules and key assumptions used in calculating financial aid-related measures for Canada in the paper.

III.A General Structure of Student Financial Aid Determination

We use provincial and Canada Student Loan Program (CSLP) rules in 2003-04 to determine financial aid availability for students from different backgrounds. We specifically consider detailed rules in the three largest provinces – Quebec (QC), Ontario (ON), and British Columbia (BC) – and actual

³This website can be found at the following address: <http://nces.ed.gov/dasol/>.

Millennium Foundation awards to determine financial aid as a function of parental income in these provinces.⁴ Financial aid in most other provinces is similar in nature to that of BC and ON.

In general, financial aid is awarded to students who have financial need $FN = TEC - EFC$, where TEC is total estimated cost of schooling and EFC is the expected family contribution. Students receive loans and/or non-repayable aid if financial need is positive. The exact formulas that determine TEC and EFC, as well as the allocation between loan and non-repayable aid, vary across jurisdictions.

In all Canadian provinces except Quebec, financial aid is awarded by both federal and provincial governments. Subject to upper limits, the CSLP provides 60% of aid in the form of loans while provinces cover the remaining 40% with both loans and non-repayable aid. Rules at the federal level are set by the CSLP, while provinces set their own similar rules. Each province offers different grant and scholarship programs, and each uses different allocation rules for Millennium Foundation awards.

Students in Quebec receive financial aid governed exclusively by provincial rules that differ significantly from those of the CSLP and other provinces. Broadly speaking, Quebec puts relatively more emphasis on non-repayable aid rather than loans compared to the rest of Canada.

TEC and EFC calculations depend on a number of family-specific factors. Our calculations make the following assumptions to best reflect a ‘typical’ university student in Canada. First, we assume that students register for a full-time academic year of 34 weeks (i.e. a two-term program). Second, we assume that students are dependent on their parents.⁵ Third, we assume that students live with both parents and have a younger sibling that is not of PS age. Fourth, we assume that both parents work with a 60%-40% income split between them. Finally, whether a student lives with his parents or away from home has important implications for the computation of financial aid, so we consider both types of students.

III.B Total Estimated Cost

The total estimated cost (TEC) of school is the sum of both education and living costs. This includes (i) tuition and compulsory fees; (ii) books, supplies and equipment; (iii) living allowances; and (iv) return transportation for students living away from home. In some cases, CSLP and province-specific aid rules impose different upper limits on costs in computing TEC. We describe each cost component in detail below, specifying assumptions used for our aid calculations in the paper.

⁴Rules for QC can be found in “Regulation respecting financial assistance for education expenses”, O.C. 844-90, as posted between May 30th 2003 and February 10th 2004. ON rules are found in the OSAP 2003-2004 Student Eligibility and Financial Need Assessment Manual. BC rules are found in the BC Student Assistance Program Policy and Procedures Manual 2003-2004.

⁵A 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. A student may also be considered independent in a few other more specific situations (e.g. foster children, an individual with deceased parents).

Appendix Table 4: Living Allowances for a Full Academic in Canada

Residential Status	BC	ON	QC
Living With Parents	\$3,048	\$3,092	\$2,006
Living Away From Parents	\$7,402	\$7,409	\$5,610

Notes: Figures taken from the BC Student Assistance Program Policy and Procedures Manual 2003-2004 for BC, the OSAP 2003-2004 Student Eligibility and Financial Need Assessment Manual for ON, and the "Regulation respecting financial assistance for education expenses O.C. 844-90 for QC."

III.B.1 Tuition and Compulsory Fees

The CSLP uses the full value of tuition and compulsory fees to compute TEC. When computing the Ontario provincial portion of financial aid, the TEC limits tuition and fees to \$2,250 per term. In Quebec, tuition and compulsory fees are capped at \$6,000 per term in computing TEC. Based on average tuition and fees across provinces reported in Junor and Usher (2004), we set tuition and fees for an academic year to \$4,800 in BC, \$5,600 in ON, and \$2,500 in QC.⁶

III.B.2 Books and Supplies

We assume that students in BC and ON claim \$760 per academic year for books and supplies. This figure is obtained by taking the average of maximum allowable costs for books in a general arts and science program (\$390) and an applied science and engineering program (\$440) plus the maximum allowable amount of \$345 for expendable supplies in a non-fine arts program.⁷ We assume that students in QC claim the maximum of \$650.

III.B.3 Living Allowances

Living allowances vary within provinces based on program length and whether students live with their parents or not. We use values specified by student aid rule manuals as reported in Appendix Table 4.

III.B.4 Transportation Costs

In BC (ON), we assume that students living away from their parents claim the maximum allowable amount for return transportation of \$1,800 (\$1,200). In QC, we assume students claim \$476 (\$14 per week) to pay for transportation costs, regardless of their residential status.

III.C Expected Family Contribution

For dependent students, the expected family contribution (EFC) is the sum of the (i) expected student contribution and (ii) expected parental contribution. In theory, both student and parental contribu-

⁶See Figure 4.III.3 of Junor and Usher (2004).

⁷Programs that require more material (e.g. dentistry) are allowed higher ceilings.

tions depend on assets; however, we ignore assets in our aid calculations, since students generally have few assets and parental asset exemption levels are quite high.⁸ We focus on the relationship between income on expected contributions. In some cases, expected contributions differ for CSLP and province-specific aid calculations as noted.

III.C.1 Student Contribution

Students are expected to make a minimum contribution in all provinces. In BC and ON, the student contribution is computed separately for income earned during the “pre-study” period and in the “study” period. The student’s contribution in QC is based on income earned during the calendar year that ends during the current academic year. We first describe contributions coming from pre-study income and study income in BC and ON, followed by a discussion of student contributions in QC.

In BC and ON, the pre-study period is defined as the period that precedes the beginning of the current academic year. In BC, this period is fixed at 18 weeks, while in ON, this period starts at the end of the previous academic year and is capped at 16 weeks. For ON, we assume an 8-week pre-study period for first-year students, since the high school academic year typically ends in June. The ON pre-study period is set to 16 weeks for students in other years, since the PS academic year typically ends in April.

The pre-study period minimum student contribution in BC and ON depends on the student’s residential status during that time. We assume that all students live with their parents during the pre-study period, even those living away from their parents during the academic year. In BC, the pre-study student contribution is the minimum of \$2,826 or 80% of “disposable income” (i.e. net income minus a living allowance of \$90 per week). Students must earn more than \$314 per week (pre-tax) to contribute more than the minimum. In ON, the minimum pre-study contribution is \$1,028 for first year students, and \$2,057 for those in upper years. Students must earn more than \$267 per week (pre-tax) to contribute more than this minimum. In our calculations, we assume that students from BC and ON earn just enough pre-tax income during the pre-study period to pay the minimum contribution.⁹

In BC and ON, students must make additional contributions if they earn income during the study period. In BC (ON), students are expected to contribute 80% (100%) of their after-tax study period income minus a \$90 weekly living allowance.¹⁰ Our calculations assume that BC and ON students do

⁸Students in BC and ON are expected to contribute the value of their assets, with the exception of a \$5,000 exemption on vehicles and a limited exemption on Registered Retirement Savings Plans. The student contribution does not depend on assets in QC. In computing the parental contribution, principal residence, motor vehicles, business and farm assets are fully exempt in BC; 1% of the value of all other assets in excess of \$150,000 must be contributed. The parental contribution in ON does not depend on parental assets. For the purpose of computing grant aid in QC, parents must contribute 2% of the total value of their assets net of \$90,000, or net of \$250,000 if parents are farmers or fishermen. The parental contribution for computing loan aid in QC is independent of parental assets.

⁹This is important later on for determining how much students benefit from PS education-related tax credits.

¹⁰The study period income contribution in ON can be reduced by the amount by which actual tuition and fees exceed

not earn any income during their study period.

In QC, the student contribution is independent of residential status, but it depends on schooling status (high school student, CEGEP student, university student, or not a student) the winter preceding the beginning of the current academic year. As is standard, we assume that first year university students were attending CEGEP during the previous winter. QC computes different student contributions in determining loans and grant aid. In determining loans, first year students are expected to contribute \$2,805, while upper year students are expected to contribute \$4,425. In determining grants, first year students are expected to contribute \$940 plus 50% of pre-tax income above that amount, while others are expected to contribute \$1,280 plus 50% of pre-tax income above that amount. In our calculations, we assume that first year QC students earn \$2,805 (pre-tax) and are expected to contribute \$2,805 towards loans and \$1,873 towards grants. For those in higher years, we assume pre-tax income of \$4,425 and expected contributions of \$4,425 for loans and \$2,853 for grants.

III.C.2 Parental Contribution

Parental contributions in all provinces depend on family size, family composition, and parental income. As noted earlier, our calculations assume that students live with both parents and a younger sibling not of PS school age. We also assume that both parents work with a 60%-40% income split between them.

In BC, the expected parental contribution is based on Annual Discretionary Income (ADI): after-tax income minus Employment Insurance contributions, Canada Pension Plan contributions, and a Moderate Standard of Living (MSOL).¹¹ The MSOL is determined by family size according to CSLP rules and is meant to incorporate living costs associated with shelter, food, household supplies and furnishing, clothing, child care, transportation, etc. Given our assumptions on family structure, this MSOL is \$46,815, which implies zero parental contribution as long as after-tax income is less than \$46,815 (roughly \$60,000 pre-tax). The first \$3,000 of ADI (net income above the MSOL) must be contributed at a 45% rate. The next \$3,000 of ADI is contributed at a 60% rate. Any additional ADI is contributed at a 75% rate. The total contribution is then divided by 52 weeks and multiplied by the program length in weeks (assumed to be 34) to obtain the parental contribution.

In ON, the parental contribution is computed differently in calculating CSLP aid and provincial aid. The CSLP calculation follows the same rules as in BC, with the same contribution rates and an MSOL of \$42,888 for a family of four. For the Ontario calculation, there is no parental contribution if pre-tax parental income is less than \$40,000. If pre-tax parental income is between \$40,000 and less than \$53,000, the expected parental contribution is \$153 plus 7.6% of pre-tax income above \$40,000

the imposed ceiling of \$2,250 when computing the provincial portion of aid.

¹¹To compute after-tax income, we use the Canadian Tax and Credit Simulator for the fiscal year 2002 [Milligan, K. (2008), *Canadian Tax and Credit Simulator*. Database, software and documentation, Version 2008-1.]. Our measures of taxes, Canadian-Quebec Pension Plan (CPP) contributions, and Employment Insurance (EI) contributions are based on the variables “*tottax*”, “*cpp*”, “*ui*”, “*sptottax*”, “*spcpp*”, and “*spui*” in the simulator.

all multiplied by 34/52. If pre-tax parental income is \$53,000 or more, the parental contribution is the same as the CSLP portion plus 3% of after-tax parental income multiplied by 34/52.

In QC, the parental contribution is based on pre-tax income net of a base exemption level. This base exemption level is \$13,385 (for two parent households) plus \$2,660 for the student plus another \$2,400 for a younger sibling. Since we assume that both parents work, the lesser of \$2,100 or 14% of net income is also added to the base exemption level.¹² EFC formulas also effectively add another \$8,000 to the exemption level for all families. Parents with income below this effective exemption level are not expected to contribute in Quebec. Expected contributions rise at a 19% rate for the first \$36,000 above the effective exemption level; a 29% rate for the next \$10,000 in income; a 39% rate for the next \$10,000; and a 49% rate for all additional income.

III.D Need and Financial Aid

To determine need, we subtract EFC from TEC. If need is zero or negative, the student receives no aid; otherwise, the student receives some aid subject to an upper limit. In all provinces, the first dollars of need are covered by loans, then by non-repayable aid if need is high enough. CSLP aid is exclusively in the form of student loans (generally accounting for 60% of all aid), while provincial aid is generally a mix of bursaries/grants (including loan remissions and Millennium Foundation awards) and loans. We report all annual amounts assuming a typical 34-week PS education program.

III.D.1 Financial Aid in BC

For the academic year 2003-2004, no non-repayable aid was available to BC students in their first year of university. Need is, therefore, covered by loans up to \$9,350 for a 34-week program with 60% coming from the CSLP (capped at \$5,304) and the rest from the BC provincial government.

Non-repayable aid is available to students in their second year and above who have at least \$4,250 in need. 60% of this need is covered by a CSLP loan (capped at \$5,304). The rest is covered by non-repayable aid from BC Grants and/or Millennium Bursary. The total aid package is capped at \$9,350 for the academic year.

III.D.2 Financial Aid in ON

60% of aid in ON is provided by CSLP loans (up to \$5,610) and the remaining 40% is provided by the province (up to \$3,740). Provincial aid is initially provided in the form of loans; however, loan remissions are available for full-time students that complete their academic year. These students are reimbursed any loan value above \$7,000 in the form of an Ontario Student Opportunity Grant. Students in their second year or above can also receive the Millennium Bursary (MB) worth \$3,000

¹²Families with net income of \$15,000 or more have \$2,100 added to their exemption level. Our measure of “net income” includes income net of all taxes, Employment Insurance contributions, and Quebec Pension Plan contributions.

if total need for the academic year is at least \$8,844. In our aid calculations, we assume that loan awards are reduced by the value of any loan remission or MB received by students.

III.D.3 Financial Aid in QC

In QC, loan awards are capped at \$2,400 for a full academic year at the university level, while grants are capped at \$13,463 plus \$1,370 for tuition.¹³

QC students can also receive loan remissions worth 15% of all loans awarded if they complete their program of study and if they received grant awards in every year of their program. In this case, our calculations reduce loan awards by 15% and increase grants by the same amount.

III.D.4 Non-Repayable Aid from Tax Benefits

Tax credits (federal and provincial) are an additional source of non-repayable aid to students, and we use federal and provincial rules to impute tax credits in Canada. To the extent that some families do not take advantage of all available credits, these amounts will be slightly inflated.

There are two main PS education tax benefits in Canada. The Tuition Tax Credit (TTC) provides a credit equal to total tuition and fees multiplied by the lowest marginal tax rate (federal and provincial).¹⁴ The Education Tax Credit (ETC) provides a fixed monthly credit for PS enrolment. A full-time student enrolled for eight months can qualify for a federal ETC of up to \$3,200 times the lowest federal marginal tax rate. The maximum provincial amount for BC (ON) is \$1,600 (\$3,368) times the lowest provincial tax rate. There is no provincial ETC in QC. Neither of these tax credits is refundable, so they can only be used to offset tax obligations. Any credit amount unused by the student can be transferred to a parent (subject to a specified upper limit).¹⁵

IV Alternative Measures of Net Tuition and Out-of-Pocket Expenditures

In this section, we consider a number of alternative assumptions in computing net tuition and out-of-pocket expenditures. We first consider the extent to which these cost measures depend on whether a student has a sibling enrolled in post-secondary school at the same time. We next consider the

¹³Since the student contribution differs for loan vs. grant calculations, we compute each separately. We assume individuals receive any calculated loan awards (up to the maximum) and subtract these amounts from our calculated grant aid.

¹⁴These tax rates are 16% for federal taxes, 6.05% for provincial taxes in BC and ON, and 16% for provincial taxes in QC.

¹⁵For the federal credit, the maximum transfer to parents (for both credits combined) is \$5,000 less the amount claimed by the student. All provinces except Ontario follow the same transfer rule, while Ontario limits transfers to \$5,405 less the amount claimed by the student. Students can also transfer education credits to future years; however, we ignore these potential transfers in our calculations. Given our assumptions on student income, our calculations are based on credits given to parents and are, therefore, subject to these upper limits.

implications of differences in student residential status for average net tuition and out-of-pocket expenditures in Canada and the U.S. Finally, we calculate bounds on these potential costs in the U.S. to account for the possibility that students who do not choose to enroll in higher education may receive less institutional or state-based financial aid.

IV.A Accounting for Enrolled Siblings

In both Canada and the U.S., the expected parental contribution is equally divided across all children currently enrolled, so parents with the same resources and two children in PS schooling are expected to contribute one-half their expected contribution towards each child. Figures 3 to 7 in the paper assume that Canadian students have no siblings enrolled in post-secondary schooling; however, numbers for the U.S. are averages across actual students with and without siblings. Appendix Figures 3 and 4 present net tuition and out-of-pocket expenses for students with and without any siblings that are also enrolled at a PS institution. Our calculations for Canada assume that students have zero or one sibling and can transfer their education and tuition tax credits to the parent with higher earnings. Education and tuition tax credits for a student can only be transferred to a single parent, while a parent cannot claim tax credits for more than one child. For the U.S., we calculate average net tuition and out-of-pocket costs separately for students with and without at least one enrolled sibling.

As the figures show, net tuition and out-of-pocket expenditures schedules depend surprisingly little on whether a student has a fellow sibling in school at the same time. This is especially true over the lower half of the income distribution in Ontario and British Columbia, since expected family contributions are zero regardless of family composition.

IV.B Accounting for the Higher Cost of Living Away From the Parental Home

Net tuition and out-of-pocket expenditure schedules presented in the paper do not account for the larger proportion of Canadian students living with their parents. In Appendix Figures 5 and 6, we average net tuition and out-of-pocket costs across those living at home with their parents and those living away from their parents separately in each province and in the U.S. (assuming, as reported in the paper, that 35% of Canadians and 22% of Americans live with their parents). In calculating costs for students living away from home, we include \$6,000 in additional living expenses. The basic differences between Canada and the U.S. discussed in the paper remain.

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

We have used the NPSAS04 to calculate average tuition T , financial aid F , and net tuition $NT = T - F$ by parental income I conditional on college enrollment; however, we would like unconditional averages for the full population. Here, we calculate bounds on unconditional averages based on assumptions about non-repayable institutional and state aid.

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

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

where $\Delta T(I) \equiv E(T|I, C = 1) - E(T|I, C = 0)$. In the text, we report estimates of $E(NT|I, C = 1)$ and $E(F|I, C = 1)$ using the NPSAS04. Using the NLSY97, it is straightforward to estimate both $\pi(I)$ and $\Delta T(I)$.¹⁶

It is not possible to determine $E(F|I, C = 0)$ from either the NLSY97 or NPSAS04; however, we can bound $E(F|I, C = 1) - E(F|I, C = 0)$ using data from NPSAS04. In general, federal student aid offers should be independent of enrolment choices conditional on family income.¹⁷ In this case, a conservative upper bound on financial aid differences by enrollment status assumes that students who do not enroll in college receive zero state and institutional aid offers. This implies a conservative upper bound (Bound 1) for average net tuition by parental income:

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

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

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

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

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

Appendix Figures 7 and 8 show these bounds for net tuition and out-of-pocket costs for students living away from home. Given the important role of state-based financial aid, especially in high tuition states, Bound 1 is extremely conservative. Average net tuition and out-of-pocket expenditures almost certainly lie in the narrow region between Bound 2 and the values reported in the text.

¹⁶Ignoring any within state variation in in-state tuition at public four-year institutions, $E(T|I, C)$ can be estimated with the NLSY97 by assigning average in-state tuition levels to individuals according to their state of residence during adolescence.

¹⁷To the extent that tuition levels differ across states, it is possible that student need and federal aid differ across states. Given different enrollment rates across states, this could lead to differences in average federal aid by enrollment status. However, since federal aid rarely covers total schooling costs for those eligible, any differences across states (and, therefore, enrollment status) are likely to be very small.

V Net Tuition and Out-of-Pocket Expenditures at Public Two-Year Institutions

The rules determining financial aid for students of two-year and four-year public PS institutions are essentially the same. As such, patterns for net tuition and out-of-pocket costs for two-year schools are similar to those shown in Figures 5 and 7 for four-year institutions. Appendix Figure 9 shows net tuition for both four-year and two-year public PS institutions.¹⁸ For Canada, both schedules are roughly parallel with a lower level for two-year schools. In the U.S., net tuition paid by students from high-income families is lower at two-year institutions than four-year schools; however, this is not the case for students from low-income families. Due to need-based aid, low-income students pay similar net tuition regardless of the type of institution they attend. As a result, net tuition schedules in the U.S. are flatter for two-year institutions than four-year institutions; however, they are still much steeper than in Canada. Appendix Figure 10 presents out-of-pocket expenditures by parental income, which are quite similar for two- and four-year institutions.

VI Counterfactual Non-Repayable Aid Calculations

In simulating the effects of removing aid and eliminating conditional family income – PS attendance gaps, we disaggregate the population into income categories corresponding to those used in both our spline estimates (see Figures 2a and 2b) and in our financial aid analysis (Figures 3-7). We aggregate over the entire U.S. and over British Columbia, Ontario, and Quebec in Canada.

Our calculations assume that each additional \$1,000 in grant aid increases PS attendance by .03 or .05 for the affected groups. In calculating the effects of eliminating ‘conditional’ income – attendance gaps, we use the gaps from our spline estimates (see Figures 2a and 2b).

To calculate the effect of removing need-based aid, we multiply the difference in non-repayable aid between each income group and the highest income group (family income over \$100,000), by the effect of non-repayable aid on PS attendance. Letting E_j reflect the initial non-repayable aid and A_j the initial attendance rate for income group j , we compute the counterfactual attendance rate $A'_j = A_j - \gamma(E_j - E_{top})/1000$, where E_{top} is the aid given to the top income group and γ is 0.03 or 0.05.

In calculating the additional aid required to eliminate conditional attendance gaps, let A_j reflect the current attendance rate for youth in income category j and A'_j the counterfactual attendance rate associated with no conditional income – attendance gap (determined from the spline estimates

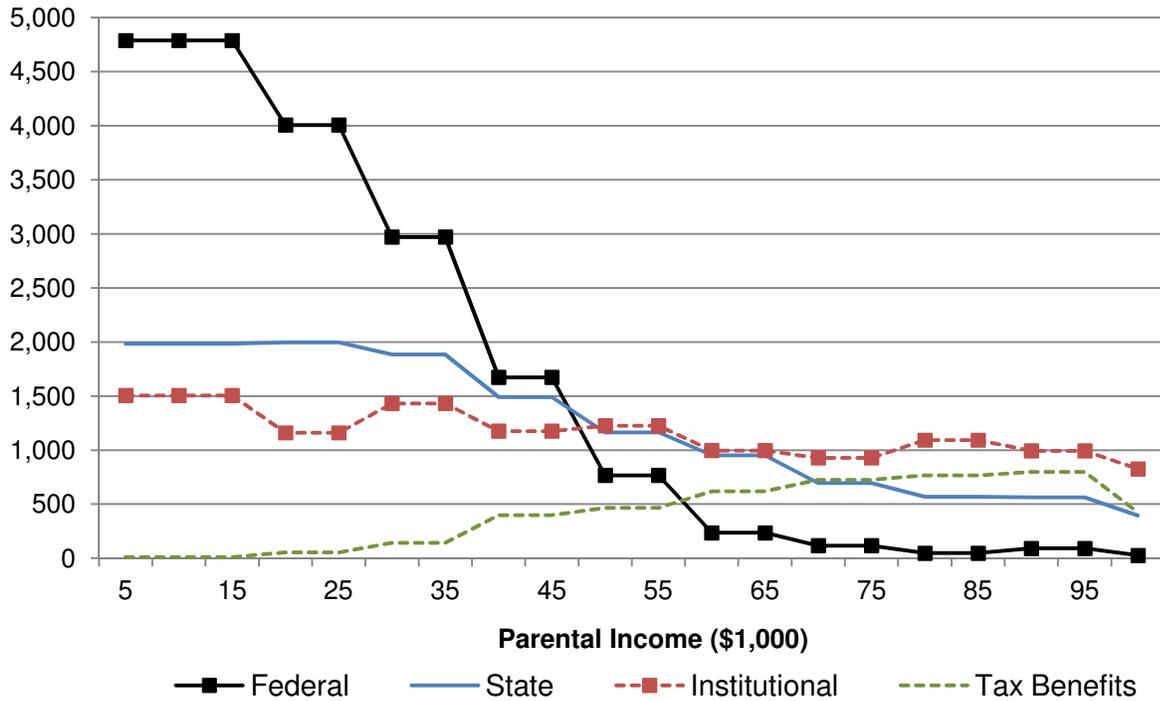
¹⁸Average tuition at two-year institutions is \$2,300 (adjusted for PPP) in the U.S., \$2,700 in British Columbia, \$1,900 in Ontario, and \$200 in Quebec. Canadian financial aid schedules are first calculated separately for British Columbia, Ontario, and Quebec, then aggregated using weights based on their population shares in YITS. Within each province, we aggregate aid figures for students living at home with their parents and those living away from home assuming that 35% of students live with their parents.

shown in Figures 2a and 2b). Letting E_j reflect current non-repayable aid amount, the counterfactual required aid amount is $E'_j = E_j + 1000 \times (A'_j - A_j)/\gamma$ where γ is 0.03 or 0.05.

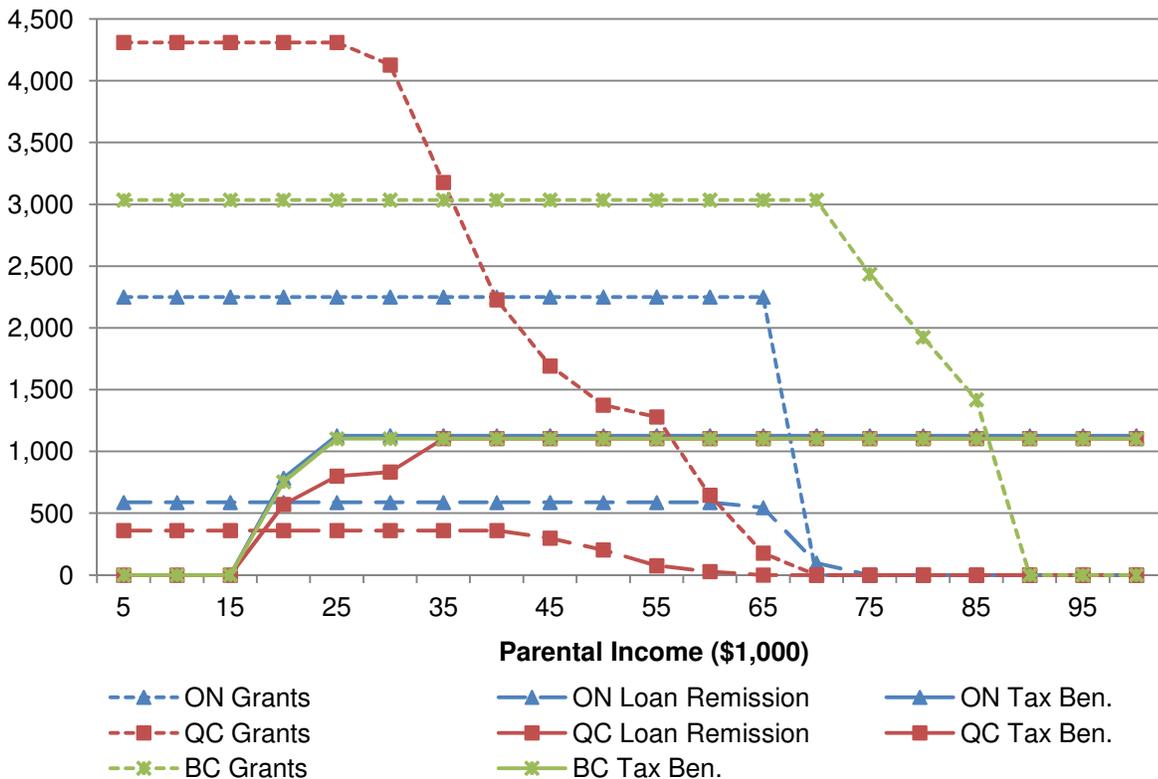
References not in the Paper

van Buuren, S., H.C. Boshuizen, and D. L. Knook (1999), “Multiple Imputation of Missing Blood Pressure Covariates in Survival Analysis”, *Statistics in Medicine*, 18(6), 681–694.

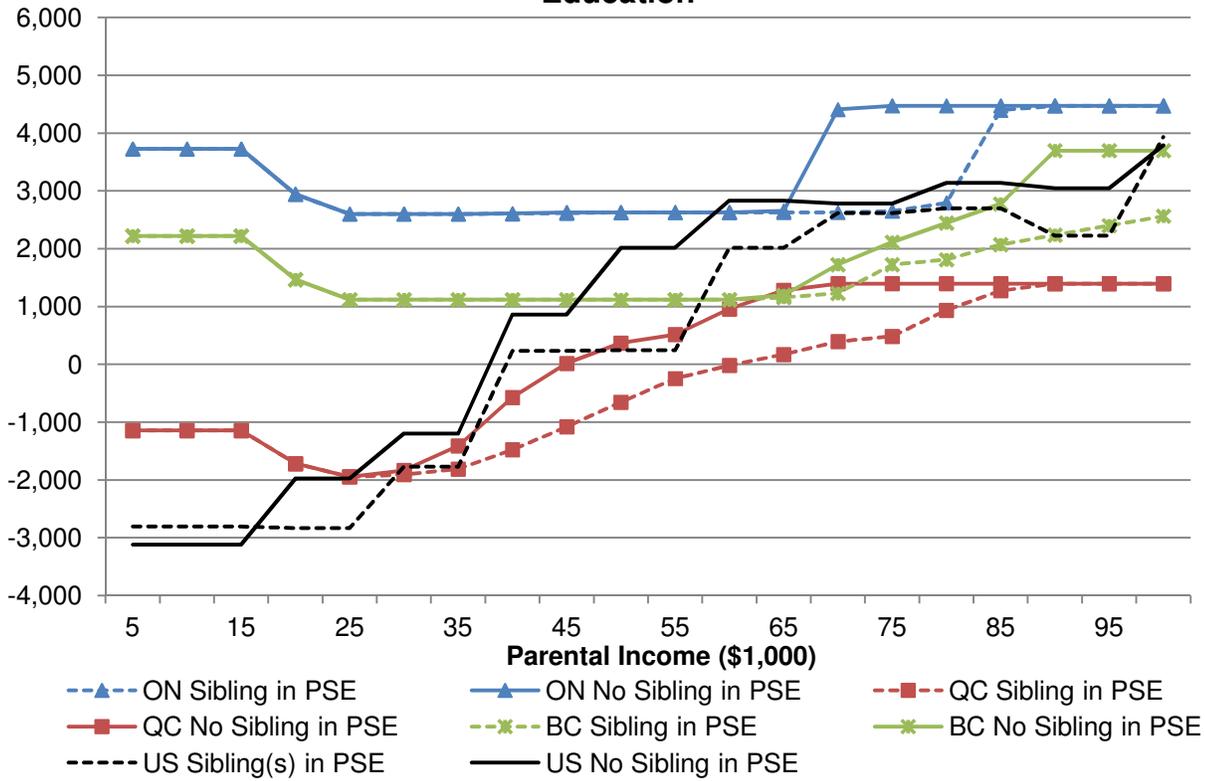
**Appendix Figure 1: Non-Repayable Aid by Source in the US
(Students Living Away from Parents)**



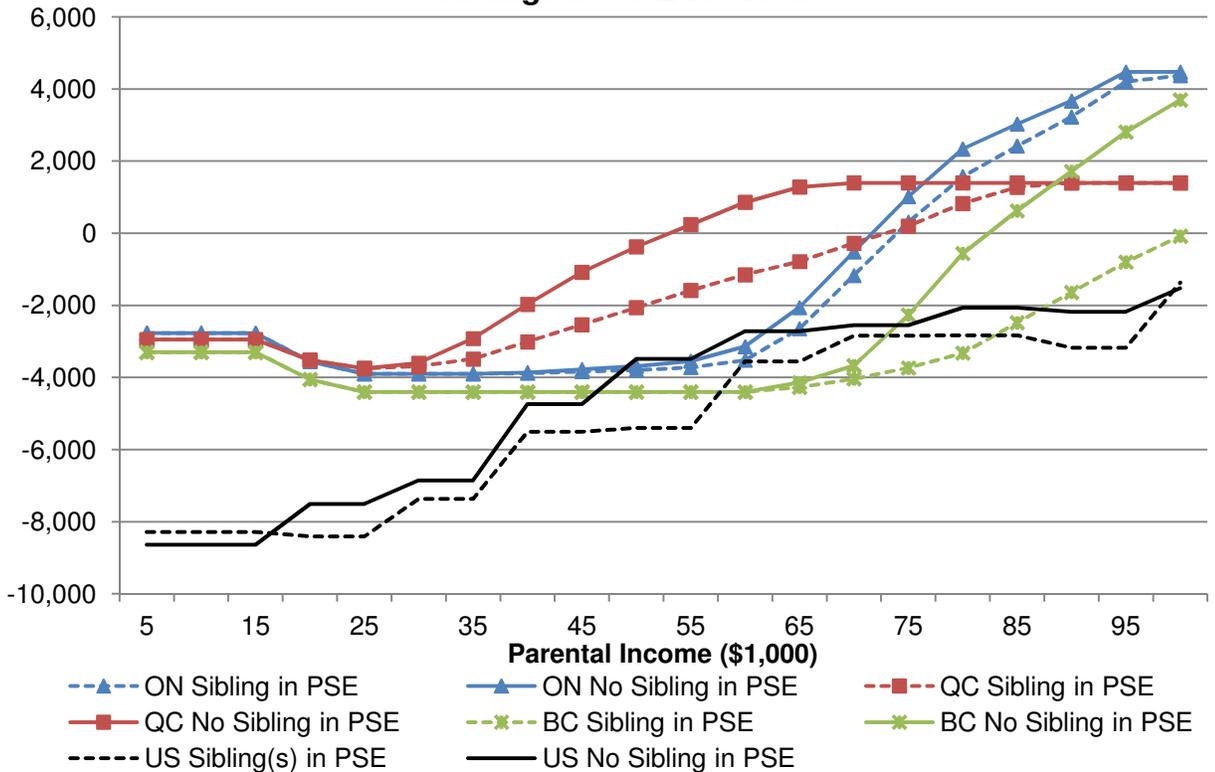
**Appendix Figure 2: Non-Repayable Aid by Source in Canada
(Students Living Away from Parents)**



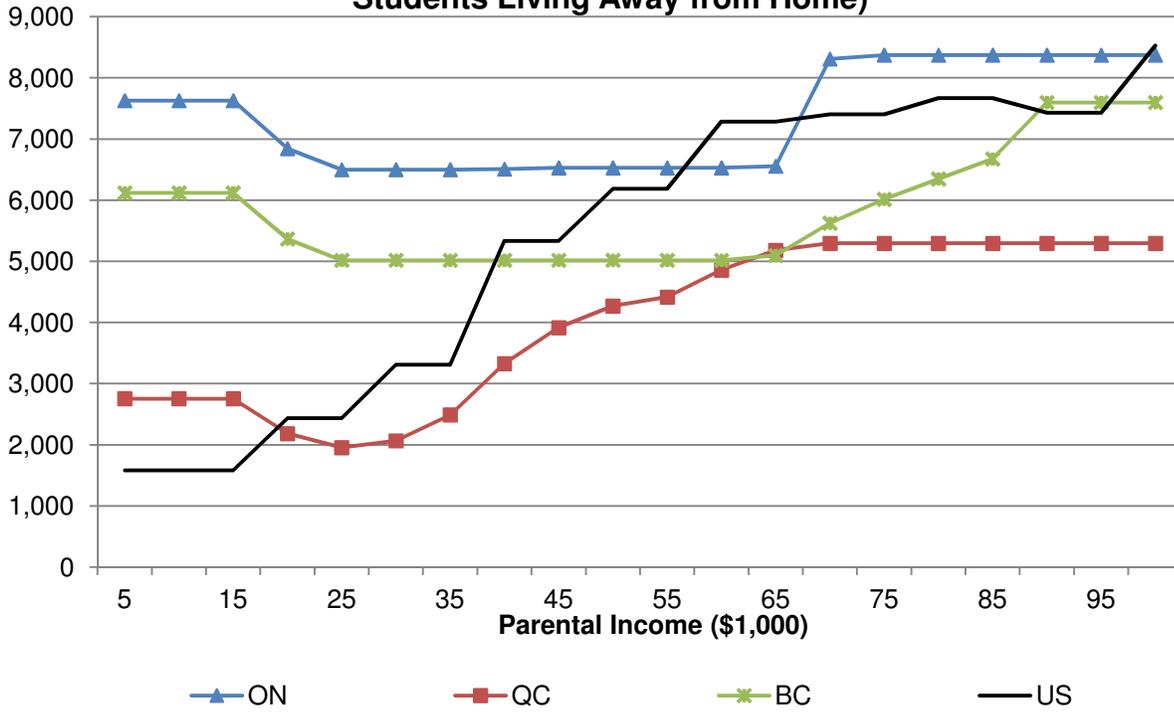
Appendix Figure 3: Net Tuition With and Without Siblings in PS Education



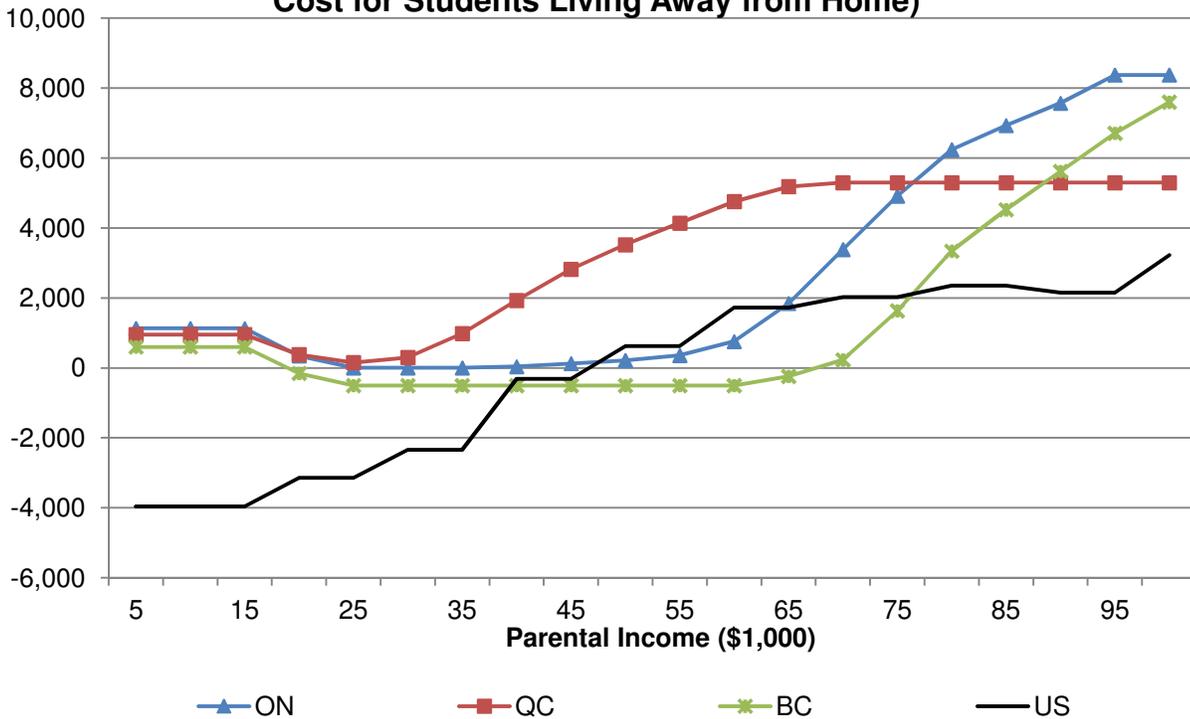
Appendix Figure 4: Out-of-Pocket Cost With and Without Siblings in PS Education



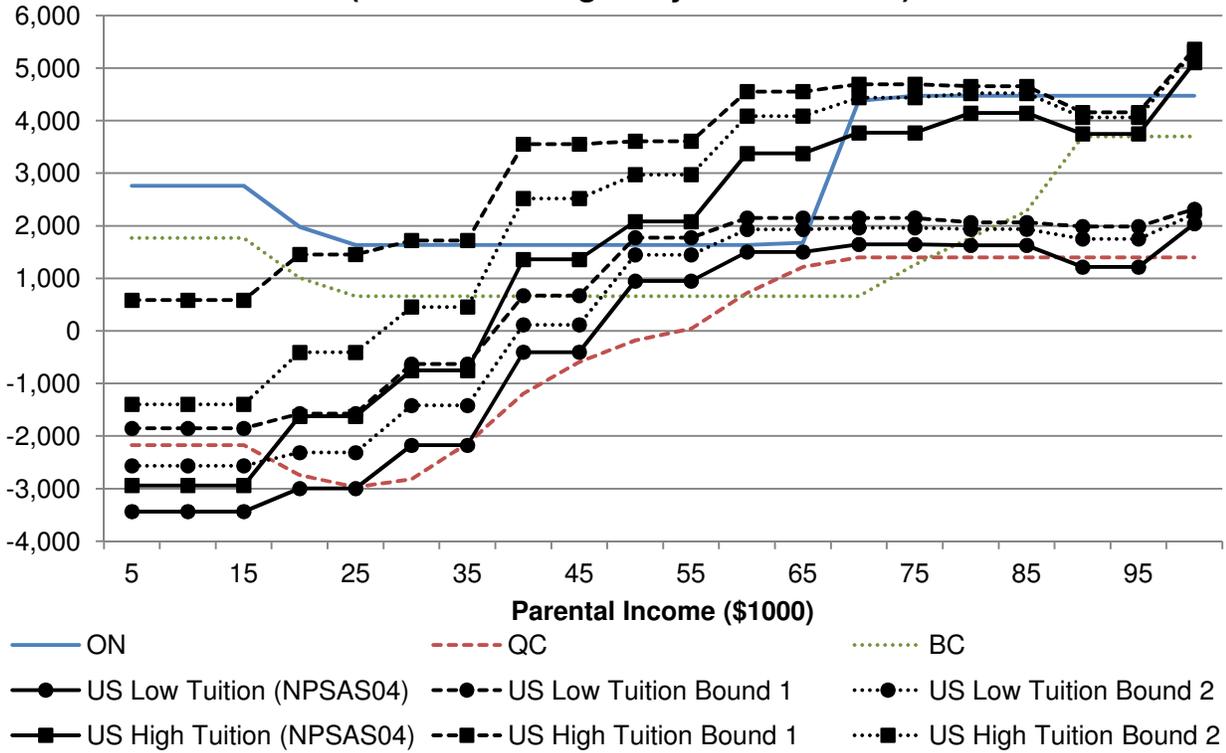
Appendix Figure 5: Net Tuition Averaged Across Students Living at Home and Away (Including \$6,000 Living Cost for Students Living Away from Home)



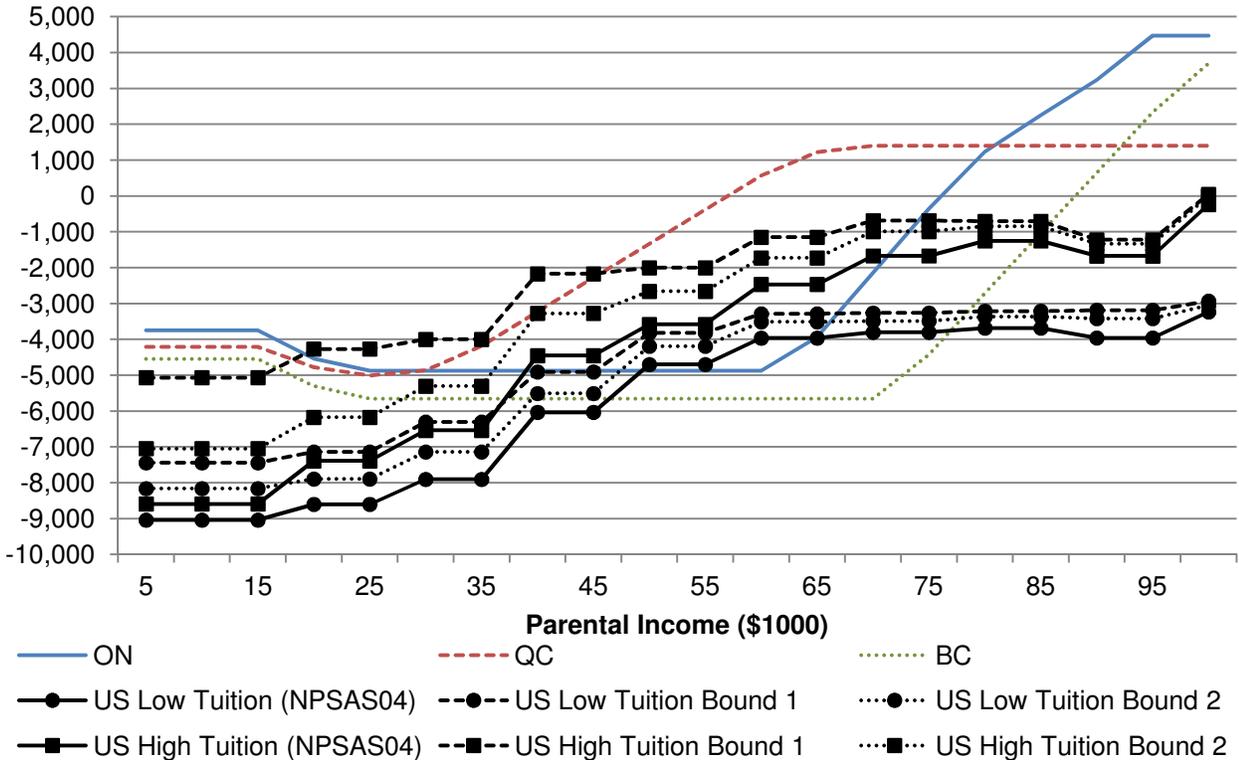
Appendix Figure 6: Out-of-Pocket Cost Averaged Across Students Living at Home and Away (Including \$6,000 Living Cost for Students Living Away from Home)



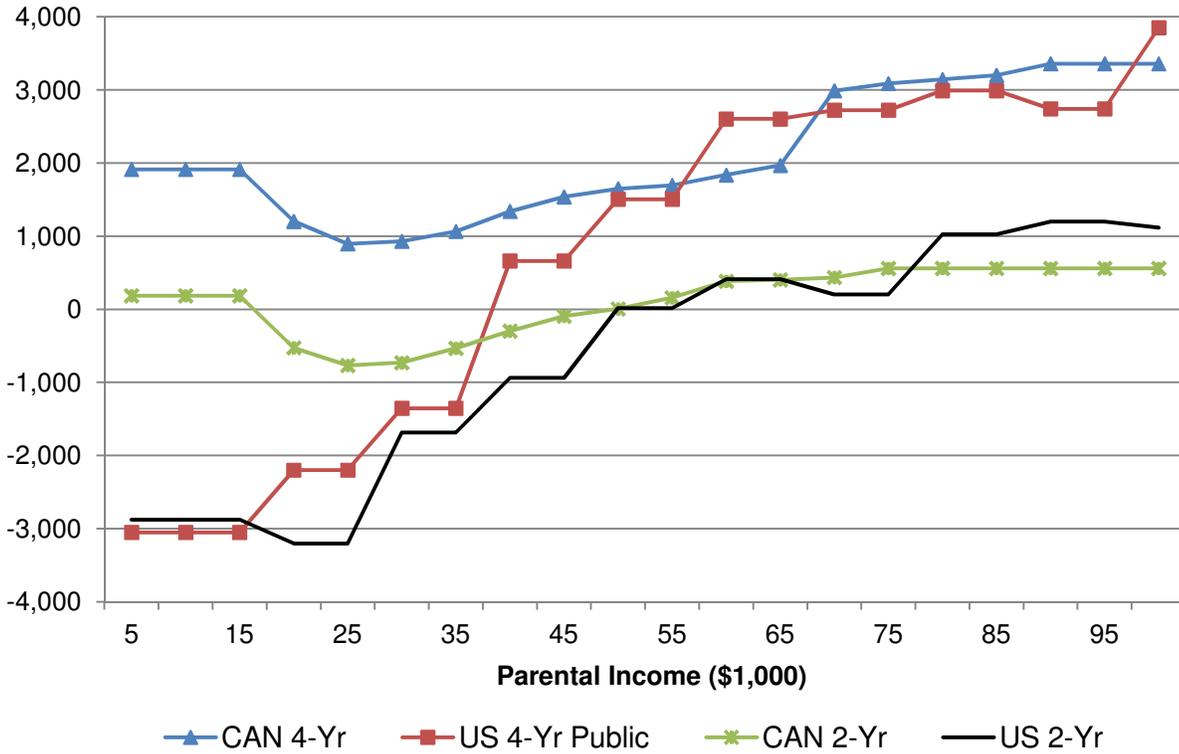
**Appendix Figure 7: Net Tuition with US Bounds
(Students Living Away From Parents)**



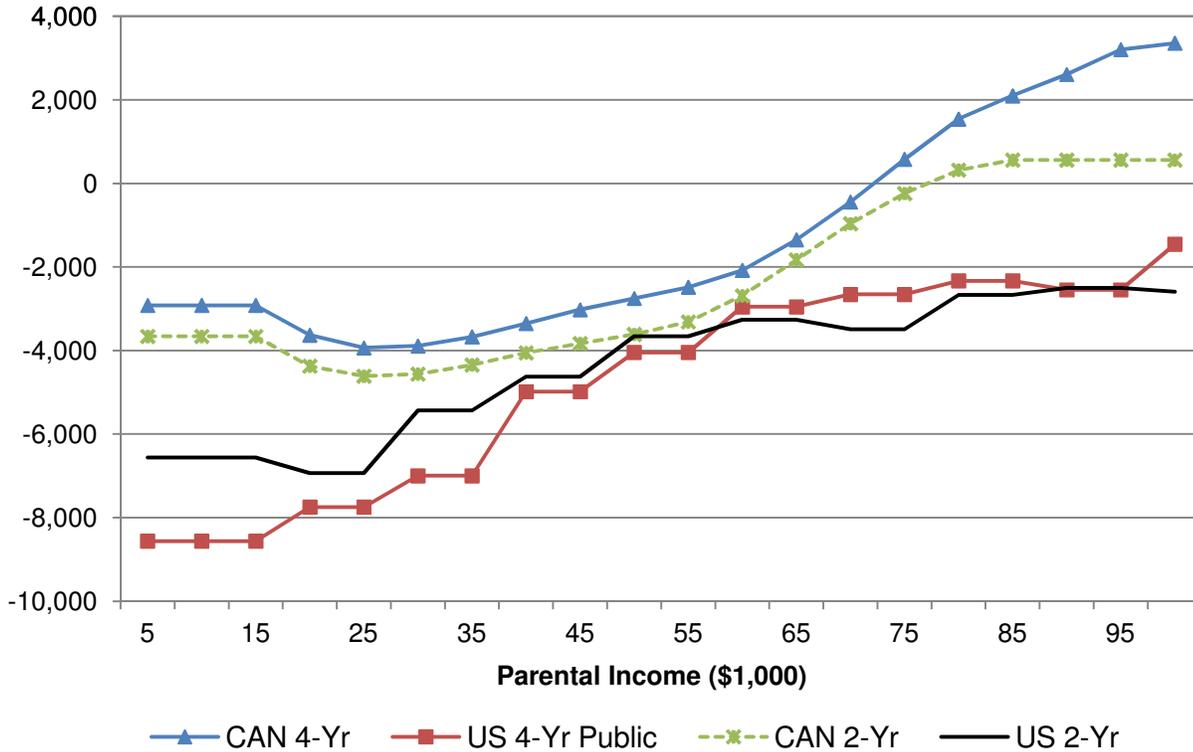
**Appendix Figure 8: Out-of-Pocket Costs with US Bounds
(Students Living Away From Parents)**



Appendix Figure 9: Net Tuition at Two-Year and Four-Year Public PS Institutions



Appendix Figure 10: Out-of-Pocket Costs at Four-Year and Two-Year Public PS Institutions



Appendix Table 1: Sample Descriptive Statistics by Parental Income Category

	Parental Income \$20,000 or Less		Parental Income \$20,000 to \$40,000		Parental Income \$40,000 to \$60,000		Parental Income \$60,000 to \$80,000		Parental Income \$80,000 to \$100,000		Parental Income \$100,000 or More	
	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)
Completed High School (as of age 21)	0.830 (0.376)	0.634 (0.482)	0.901 (0.299)	0.731 (0.444)	0.902 (0.297)	0.831 (0.375)	0.952 (0.214)	0.905 (0.294)	0.962 (0.191)	0.942 (0.233)	0.972 (0.165)	0.964 (0.185)
Post-Secondary Attendance (as of age 21)	0.596 (0.491)	0.362 (0.481)	0.613 (0.487)	0.459 (0.499)	0.650 (0.477)	0.592 (0.492)	0.738 (0.439)	0.723 (0.448)	0.757 (0.429)	0.771 (0.421)	0.845 (0.362)	0.889 (0.314)
Post-Secondary Attendance at 4-yr Institution (as of age 21)	0.338 (0.473)	0.205 (0.404)	0.307 (0.461)	0.254 (0.436)	0.359 (0.480)	0.364 (0.482)	0.422 (0.494)	0.483 (0.500)	0.496 (0.500)	0.544 (0.499)	0.589 (0.492)	0.739 (0.440)
Male	0.417 (0.493)	0.484 (0.500)	0.459 (0.498)	0.488 (0.500)	0.503 (0.500)	0.516 (0.500)	0.493 (0.500)	0.529 (0.500)	0.546 (0.498)	0.510 (0.500)	0.513 (0.500)	0.506 (0.500)
White	0.773 (0.419)	0.439 (0.497)	0.806 (0.396)	0.595 (0.491)	0.893 (0.310)	0.710 (0.454)	0.872 (0.334)	0.803 (0.398)	0.906 (0.292)	0.779 (0.416)	0.925 (0.263)	0.849 (0.358)
Immigrant	0.202 (0.401)	0.054 (0.225)	0.144 (0.351)	0.059 (0.236)	0.057 (0.232)	0.029 (0.169)	0.086 (0.281)	0.017 (0.128)	0.042 (0.201)	0.016 (0.125)	0.052 (0.221)	0.018 (0.132)
At Least One Parent an Immigrant	0.295 (0.456)	0.140 (0.348)	0.278 (0.448)	0.154 (0.361)	0.249 (0.433)	0.108 (0.311)	0.274 (0.446)	0.100 (0.300)	0.280 (0.449)	0.123 (0.328)	0.260 (0.439)	0.132 (0.338)
Mother's Age at Birth	28.017 (6.735)	24.799 (5.880)	27.233 (5.156)	24.613 (6.088)	27.683 (4.687)	25.482 (5.064)	28.096 (4.670)	26.117 (4.631)	28.664 (4.364)	26.824 (4.521)	29.505 (4.369)	28.513 (4.320)
Intact Family during Adolescence	0.387 (0.487)	0.172 (0.378)	0.552 (0.497)	0.393 (0.489)	0.762 (0.426)	0.574 (0.495)	0.838 (0.368)	0.731 (0.444)	0.839 (0.368)	0.741 (0.439)	0.865 (0.342)	0.790 (0.408)
Metropolitan Area during Adolescence	0.622 (0.485)	0.776 (0.417)	0.602 (0.489)	0.734 (0.442)	0.632 (0.482)	0.736 (0.441)	0.682 (0.466)	0.797 (0.403)	0.724 (0.447)	0.823 (0.382)	0.796 (0.403)	0.906 (0.292)
Number of Children in Household under 18	1.396 (0.503)	2.529 (1.378)	1.471 (0.510)	2.460 (1.245)	1.476 (0.507)	2.325 (1.103)	1.502 (0.509)	2.244 (1.003)	1.449 (0.506)	2.372 (1.214)	1.476 (0.506)	2.058 (0.846)
Mother High School Graduate	0.756 (0.429)	0.619 (0.486)	0.779 (0.415)	0.765 (0.424)	0.850 (0.357)	0.844 (0.363)	0.920 (0.271)	0.936 (0.244)	0.956 (0.204)	0.959 (0.199)	0.975 (0.156)	0.971 (0.169)
Mother at Least Some Post-Secondary Schooling	0.420 (0.494)	0.265 (0.442)	0.472 (0.499)	0.349 (0.477)	0.499 (0.500)	0.421 (0.494)	0.597 (0.490)	0.554 (0.497)	0.706 (0.456)	0.613 (0.488)	0.801 (0.399)	0.795 (0.404)
Parental Income (in \$10,000) during Late Adolescence	1.132 (0.673)	1.145 (0.562)	3.118 (0.550)	2.977 (0.575)	5.088 (0.596)	4.990 (0.567)	7.025 (0.612)	8.663 (0.710)	8.882 (0.568)	9.000 (0.577)	15.247 (10.008)	14.778 (4.785)
Sample Size	532	599	1,681	778	2,278	885	2,054	664	1,388	506	1,095	676

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.

Appendix Table 2: Main NLSY97 Specifications Imputing Missing Values for Achievement and Parental income, and Including Minority Oversamples

	Imputing Missing Achievement Scores and Parental Income		Includes Minority Oversamples	
	PS	Attendance at a Four-Year PS Institution	PS	Attendance at a Four-Year PS Institution
	Attendance	Institution	Attendance	Institution
Male	-0.0859 (0.0119)	-0.0834 (0.0122)	-0.0962 (0.0115)	-0.0894 (0.0117)
Immigrant	0.0895 (0.0379)	0.1261 (0.0382)	0.1569 (0.0387)	0.1376 (0.0394)
At Least One Parent an Immigrant	0.0466 (0.0220)	0.0039 (0.0224)	0.0511 (0.0214)	0.0176 (0.0218)
Mother's Age at Birth	0.0035 (0.0013)	0.0042 (0.0013)	0.0033 (0.0012)	0.0044 (0.0012)
Intact Family during Adolescence	0.0688 (0.0139)	0.0967 (0.0142)	0.0727 (0.0133)	0.1062 (0.0135)
Metropolitan Area during Adolescence	0.0201 (0.0151)	-0.0034 (0.0153)	0.0056 (0.0145)	-0.0053 (0.0147)
Number of Children under 18	-0.0093 (0.0056)	-0.0007 (0.0057)	-0.0056 (0.0054)	-0.0020 (0.0055)
Mother HS Graduate	0.0819 (0.0190)	0.0276 (0.0192)	0.0778 (0.0186)	0.0145 (0.0188)
Mother at Least Some PSE	0.0836 (0.0140)	0.1099 (0.0142)	0.0808 (0.0133)	0.1133 (0.0136)
Math-Reading Achievement Quartile 2	0.2453 (0.0193)	0.1233 (0.0187)	0.2475 (0.0174)	0.1334 (0.0176)
Math-Reading Achievement Quartile 3	0.3918 (0.0200)	0.3123 (0.0195)	0.3787 (0.0181)	0.3261 (0.0183)
Math-Reading Achievement Quartile 4	0.5123 (0.0205)	0.5425 (0.0208)	0.5075 (0.0188)	0.5576 (0.0191)
Parental Income \$20,000 or Less	-0.2328 (0.0258)	-0.1990 (0.0266)	-0.2328 (0.0247)	-0.1963 (0.0251)
Parental Income \$20,000 to \$40,000	-0.1905 (0.0229)	-0.2163 (0.0235)	-0.1935 (0.0215)	-0.2052 (0.0219)
Parental Income \$40,000 to \$60,000	-0.1327 (0.0213)	-0.1694 (0.0220)	-0.1284 (0.0199)	-0.1757 (0.0203)
Parental Income \$60,000 to \$80,000	-0.0776 (0.0215)	-0.1537 (0.0224)	-0.0786 (0.0201)	-0.1532 (0.0206)
Parental Income \$80,000 to \$100,000	-0.0444 (0.0232)	-0.0855 (0.0245)	-0.0486 (0.0219)	-0.1008 (0.0226)
Test of no Income Effects (P-value)	<.0001	<.0001	<.0001	<.0001
Sample Size	4,654	4,518	4,879	4,742

Notes: Education measured as of age 21. Columns 1 and 2 impute missing values for parental income and math-reading achievement using multiple imputation methods. Columns 3 and 4 include minority oversamples in estimation, using custom NLSY97 weights for survey years 1997, and 2000 to 2005. Regressions also control for year of birth and race/hispanic ethnicity indicators. Test of no Income Effects is an F-test (5 d.o.f.) that all five coefficients on family income are zero. Standard errors are in parentheses.

Appendix Table 3: Main Specifications Controlling for Paternal Education

	PS Attendance		Attendance at a Four-Year PS Institution	
	Canada (YITS)	US (NLSY97)	Canada (YITS)	US (NLSY97)
Male	-0.1277 (0.0086)	-0.0925 (0.0129)	-0.1501 (0.0089)	-0.0890 (0.0133)
Immigrant	0.0733 (0.0180)	0.1579 (0.0443)	0.0792 (0.0186)	0.1464 (0.0453)
At Least One Parent an Immigrant	0.0805 (0.0112)	0.0535 (0.0241)	0.1136 (0.0116)	0.0192 (0.0247)
Mother's Age at Birth	0.0064 (0.0010)	0.0025 (0.0014)	0.0053 (0.0010)	0.0024 (0.0014)
Intact Family during Adolescence	0.0719 (0.0129)	0.0660 (0.0158)	0.0618 (0.0134)	0.0848 (0.0162)
Metropolitan Area during Adolescence	0.0260 (0.0097)	0.0079 (0.0163)	0.0273 (0.0101)	-0.0057 (0.0166)
Number of Children under 18	0.0215 (0.0089)	-0.0083 (0.0062)	0.0404 (0.0092)	-0.0035 (0.0063)
Mother HS Graduate	0.0909 (0.0156)	0.0706 (0.0214)	0.0608 (0.0162)	0.0151 (0.0218)
Mother at Least Some PSE	0.0442 (0.0103)	0.0594 (0.0155)	0.0523 (0.0106)	0.0850 (0.0159)
Father HS Graduate	0.0704 (0.0164)	0.0813 (0.0214)	0.0194 (0.0170)	0.0523 (0.0219)
Father at Least Some PSE	0.0274 (0.0118)	0.0382 (0.0168)	0.0932 (0.0122)	0.0947 (0.0172)
Father Education Missing	0.1174 (0.0199)	0.0510 (0.0274)	0.0847 (0.0207)	0.0631 (0.0280)
Math-Reading Achievement Quartile 2	0.1936 (0.0121)	0.2441 (0.0198)	0.1605 (0.0126)	0.1230 (0.0201)
Math-Reading Achievement Quartile 3	0.2916 (0.0124)	0.3817 (0.0204)	0.3074 (0.0128)	0.3115 (0.0207)
Math-Reading Achievement Quartile 4	0.3604 (0.0126)	0.4990 (0.0213)	0.5079 (0.0131)	0.5321 (0.0219)
Parental Income \$20,000 or Less	-0.0945 (0.0230)	-0.1885 (0.0282)	-0.0461 (0.0238)	-0.1513 (0.0288)
Parental Income \$20,000 to \$40,000	-0.0979 (0.0172)	-0.1731 (0.0245)	-0.1099 (0.0178)	-0.1921 (0.0252)
Parental Income \$40,000 to \$60,000	-0.0804 (0.0149)	-0.1121 (0.0226)	-0.0821 (0.0155)	-0.1502 (0.0233)
Parental Income \$60,000 to \$80,000	-0.0507 (0.0144)	-0.0639 (0.0228)	-0.0925 (0.0150)	-0.1373 (0.0235)
Parental Income \$80,000 to \$100,000	-0.0435 (0.0151)	-0.0410 (0.0244)	-0.0358 (0.0157)	-0.0880 (0.0253)
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 (5 d.o.f.) that all five coefficients on family income are zero. Standard errors are in parentheses.