The Effect of Financial Aid on the Persistence of University and College Students in Canada

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MESAMEASURING THE EFFECTIVENESS OF STUDENT AID

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- After graduating from high school, teenagers coming from low-income backgrounds face a choice as to attend college or university, or not. For those who did attend, how do they compare to those who did not?
- Does providing more funding in a student's first few years of further education attract more low-income students to post-secondary education?
- Does providing more funding in a student's first few years of further education make it more likely for low-income students to stay in and graduate?
- Are low-income students different across Canada?

This paper is part of a series of research papers solicited from some of the leading Canadian researchers in the field of post-secondary education; the researchers were asked to write about issues of access and persistence in post-secondary education in Canada. The requirements for the papers were that the researchers use one of several currently-existing Statistics Canada databases or another source of Canadian data. Each of the papers commissioned during this project is available for downloading from the MESA Project website at www.mesa-project.org.

The findings and conclusions expressed in this paper are those of the authors and do not necessarily represent those of the MESA Project or its partners.

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The **Canada Millennium Scholarship Foundation** is a private, independent organization created by an act of Parliament in 1998. It encourages Canadian students to strive for excellence and pursue their post-secondary studies. The Foundation distributes $325 million in the form of bursaries and scholarships each year throughout Canada. Its objectives are to improve access to post-secondary education for all Canadians, especially those facing economic or social barriers; to encourage a high level of student achievement and engagement in Canadian society; and to build a national alliance of organizations and individuals around a shared post-secondary agenda. The Foundation is funding the MESA Project overall, and has negotiated access to its student administrative lists with each of the provinces on the project's behalf.

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Abstract

This paper examines the relationship between post-secondary persistence and financial aid in Canada by analysing data from Cohort B of the Youth in Transition Survey. The analysis focuses on a sample of 2,936 Canadian high school graduates who entered a post-secondary program in August or September of 1999. Financial aid is divided into three categories – scholarships and awards, grants and bursaries, and government-sponsored student loans – and persistence is defined as having graduated or continued post-secondary studies as of December 31, 2001. Although cross-tabulations and probit estimates of models of persistence find a positive correlation between persistence and financial aid, the estimated effect of financial aid on persistence is small. When instrumental variables probit estimation is used to control for the potential endogeneity of financial aid, the results suggest that the correlation between financial aid and persistence is instead negative; however, tests of the reliability of the instruments for financial aid suggest that they are weak, casting doubt on the reliability of the instrumental variables probit estimates. Despite important provincial differences in tuition fees, neither set of results suggests that there are statistically significant provincial differences in persistence, nor do many personal characteristics influence persistence. Overall, the results suggest that a student's overall high-school average, marital status, and parental attitudes toward post-secondary education have a much larger impact on post-secondary persistence than does financial aid.

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Introduction

Since the publication of Mankiw, Romer, and Weil's (1992) pioneering paper on the role of human capital in economic growth, it has become an accepted fact that a country's economic growth depends on its stock of human capital. Furthermore, at the individual level, higher levels of education are believed to be associated with higher levels of human capital. Consequently, governments in developed and developing countries alike feel compelled to focus a great deal of attention on human capital acquisition in general, and post-secondary education in particular. In Canada, spending on education accounted for 24 percent of consolidated government spending during the fiscal year ending March 31 2007; of that amount, $36,128 million, or 48.6 percent of total government spending on education, was devoted to post-secondary education.[1]

Given the magnitude of their financial investment in post-secondary education, it is not surprising that Canadian governments are also concerned about student persistence. Although the share of tuition fees in post-secondary financing has been rising, the public sector still bears the lion's share of the cost of post-secondary education in Canada. When students do not complete a publicly-financed post-secondary program, society may be losing out, either because funds were wasted on unsuitable candidates for post-secondary education, or because future returns in the form of greater productivity will never be realized. Of particular interest is the impact of financial aid on post-secondary persistence, since its primary objective is to encourage students to enrol in and complete post-secondary training. Yet there have been few empirical studies of post-secondary persistence in Canada, and even fewer studies that examine the role of financial aid in influencing persistence. While Montmarquette, Mahseredjian, and Houle (2001) may be the first econometric analysis of post-secondary persistence that relies on Canadian data, their administrative data from the University of Montréal do not include any information about the financial aid received by students. McElroy (2005), who based her study on administrative data from six Canadian universities, does have data on financial aid, but her data set does not provide much information about individual characteristics, family background, or measures of ability. There is thus a need for more studies of this issue using other Canadian data sources.

This paper uses data from Cohort B of Statistics Canada's *Youth in Transition Survey* (YITS-B). This longitudinal survey was specifically intended to examine the post-high school experiences of Canadian youth. Cycle 1 of the survey, conducted in 2000, collected information relating to 1999, with follow-up questionnaires administered every two years thereafter. Since a reasonable proportion of the 18-20 year olds originally interviewed in Cycle 1 were just beginning post-secondary education, it is a useful source of data for analyses of post-secondary persistence. In addition to information on individual characteristics, family background, and high school experiences, the YITS includes questions relating to the financing of post-secondary education, making it ideal for examining the im-

1 See CANSIM table 385-0001, last updated July 16, 2007.

pact of financial aid on post-secondary education.

In the next section of the paper, the YITS-B data are examined to see what factors are correlated with persistence over the period from August 1999 to January 2001. In keeping with the approach of a number of previous studies, the paper focuses on a cohort of students who began post-secondary education at a particular point in time, in this case August or September of 1999. Probit analysis is used to examine which factors are the most highly correlated with persistence. The third section of the paper discusses the theoretical and empirical challenges that must be faced in attempting to estimate the causal effect of financial aid on persistence, and presents instrumental variables probit estimates of a simultaneous model of persistence. The final section concludes the paper by summarizing the findings, and discusses the policy implications of the results.

Post-secondary Persistence and Financial Aid in Canada: A Descriptive Analysis

To date, there have been relatively few studies of post-secondary persistence in Canada, and very few of those studies have examined the relationship between persistence and financial aid. A recent exception is McElroy (2005). McElroy uses administrative data obtained from six Canadian universities to examine the impact of financial aid on persistence over a five-year period. She divides financial aid into two categories: repayable aid (i.e., loans), and non-repayable aid (referred to as grants in the study). Because students in her data set may have spent different lengths of time studying, she constructs annualized aid measures equal to the annual average amount of aid received by students in the sample. Using both logit models of completion during the five-year interval, and linear regression models of the proportion of required credits completed, she finds that persistence decreases with the amount of annualized aid received, and hypothesizes that this may be due to attempts on the part of students to avoid incurring more debt.

As will be discussed in the next section of the paper, designing and estimating a structural model of the relationship between persistence and financial aid is a difficult task. Instead, this section will focus on the simpler task of exploring the data and trying to identify the factors that are correlated with persistence. In so doing, like many previous studies of post-secondary persistence this one will focus on a particular cohort of entering students. Although it may restrict sample size, the advantage of doing so is that it ensures that the general economic conditions faced by all individuals in the data set are the same, and that comparable data on individual characteristics are available for all individuals. The cohort examined consists of Canadian high-school graduates who began their post-secondary education in the fall (i.e., August or September) of 1999. The data are drawn from the microdata files of Statistics Canada's Youth in Transition Survey, Cohort B. The survey provides a wealth of information on individuals' high school experiences and post-secondary life, including work, post-secondary programs and institutions attended, and financing of post-secondary education. Unfortunately, the attrition rate was

high, with the initial sample of 22,378 individuals in 2000 dropping to 18,779 in 2002.[2]

In total, 4,209 of the young people surveyed in Cycle 1 were high-school graduates who began a post-secondary program in either August or September of 1999. However, due to attrition, only 3,700 of these individuals remained in the sample in Cycle 2. The sample available for analysis was further reduced to 2,970 individuals because some individuals had to be deleted due to their failure to provide answers to some of the questions relevant to this analysis. Finally, it was decided to eliminate from the sample the small number (34) of individuals who were studying outside Canada, resulting in an initial sample size of 2,936, representing a total population of 179,875.

The most important variables in the analysis are those measuring persistence and financial aid. Although YITS-B provides information on the dollar amounts of three types of financial aid – scholarships and awards, grants and bursaries, and student loans – it does not provide this information on an annual basis. In Cycle 1, respondents are asked to report the total amount of each type of aid received up to December 1999. In Cycle 2, they are asked to report the total amount of each type of aid received between January 2000 and December 2001. Since it is impossible to allocate aid to individual years or semesters, it is impossible to use the YITS-B data to examine how financial aid influences year-to-year decisions about persistence. Therefore, this analysis examines persistence over the period between the fall of 1999 and the end of 2001 – a period of roughly two and a half years. Persistence is defined broadly to include graduation during this time period, or continued study, both of which are positive outcomes. The continued study may be at a different institution or in a different program than the one in which the individual was originally enrolled. At the university level few students are likely to have graduated within this time period, but some students may have graduated from programs at other types of institutions. This broad measure of overall persistence is defined to equal 1 in the case of a positive outcome (persistence) and zero otherwise.

In the discussion that follows, the relationship between persistence and a variety of other variables besides financial aid is examined. The additional variables include various personal characteristics and indicators of academic performance. The next subsection provides a general overview of the study population, while the second subsection uses probit analysis to help identify the separate effects of different factors underlying post-secondary persistence in Canada.

A Profile of the Fall 1999 Entering Class

Since this is a study of student persistence, it is of particular interest to examine the persistence behaviour of the population under investigation.[3] Table 1 provides estimates of the number of individuals in the Fall

2 For further information on the *Youth in Transition Survey*, visit Statistics Canada's website. Both code books and user's guides for each cycle of the survey are available on-line.

3 All statistics presented in this subsection are weighted estimates of population totals constructed using the sample data and Cycle 2 sampling weights.

1999 entering class who had left their post-secondary program without completing it by December 2001, when the Cycle 2 questionnaire was administered, classified by type of institution. For the purposes of this study, "persistence" is broadly defined to include both graduating from the program in which one had enrolled in 1999, and continuing that program. Institutions are classified into three types: universities, colleges, and all other institutions.[4] According to Table 1, universities were the most popular destination for students entering post-secondary programs in the fall of 1999, with colleges following as a close second. In total, these two types of institutions welcomed over 83 percent of the new post-secondary students.

Table 1 also shows that after approximately two years, most students had either graduated, or were continuing their education. In total, 150,494 students, or 83.7 percent, were classified as persistent. Not surprisingly, at the university level, only a small proportion – 4.2 percent – of these students had graduated after two years. At the college level, where programs tend to be shorter, 38.7 percent of the students had completed their programs. The dropout rate also varied by type of institution, ranging from a low of 12.5 percent for university students to a high of 27.8 percent for college students. The relatively high dropout rate for college students is somewhat surprising, given that college programs are typically shorter than university degree programs.

Table 2 provides an overview of some of the characteristics of the student population, classified by type of institution. The table confirms that women now make up the majority of students at all types of post-secondary institutions; interestingly, the population share of women is higher at universities than at other types of institutions. Visible minorities also account for a higher share of university students, 18.8 percent, than they do of students at other types of institutions. In fact, visible minorities account for only 7.8 percent of students starting college in 1999. Not surprisingly, English is the most common mother tongue of students at all types of institutions; 77.9 percent of university students, 61.2 percent of college students, and 82.2 percent of students at other institutions were native English speakers. However, students enrolled in colleges were more likely to speak French as their mother tongue than students at other institutions. In fact, the proportion of French speakers attending college, 29.5 percent, was more than five times the proportion of university students whose mother tongue was French. This discrepancy likely reflects the important role of the CEGEP system in the province of Quebec.

Table 2 also shows that, consistent with popular beliefs regarding the need for high grades in order to get into university, universities have a higher proportion of students with very high grades than other post-secondary institutions. Over 16 percent of the students registered in universities had a high-school average of A+, while another 52.2 percent had a high-school average of 80 to 89 percent. At the college level, only 3.3 percent of entering students had a high-school average of 90 to 100 percent; the majority of col-

4 Institution type was determined by the Cycle 1 variable H8a. The category "Other institutions" includes university colleges, private business schools, trade and vocational institutions, and a few other types of institutions. University college students were excluded from both the university and college categories. Note that an alternative way of classifying students would have been to use a variable which identifies the level of the program in which the student had registered. CEGEP students in Québec are included in the college category.

lege students had averages from 70 to 79 percent. Interestingly, other post-secondary institutions appeared to attract a higher proportion of very good students from high school than did colleges – over 9 percent of their students had an average grade of 90 to 100 percent in high school.

The provincial breakdown of the Fall 1999 post-secondary entering cohort, also shown in Table 2, generally reflects the distribution of the Canadian population as a whole. Over 50 percent of university and college students attended institutions in Ontario, with the remaining provinces excluding Quebec each accounting for less than 10 percent. Colleges in Quebec represent an anomaly: 27.7 percent of college students attended institutions in Quebec in 1999. Again, this high proportion, which is accompanied by an unexpectedly low proportion – just 3 percent – of university students studying in Quebec, reflects the unusual structure of Quebec's post-secondary system. In contrast to the system in most other provinces, in Quebec university-bound students begin their studies in the CEGEP or college system.

Because the focus of this study is on the role of financial aid, the percentage of students receiving financial aid and the amount of aid received are of particular interest. YITS-B provides information on three types of financial aid: scholarships and awards, grants and bursaries, and student loans. Table 3 shows the proportion of students who *did not receive* each type of aid, or any aid at all, between the fall of 1999 and December 2002, classified by institution type and persistence. In this and subsequent tables, "Aid" refers to the total received from all three sources. Overall, only 38.4 percent of the Fall 1999 entering class received no aid at all. The least common form of financial aid was grants and bursaries, with 72.6 percent of students reporting that they did not receive any. About 40 percent of students received scholarships, while about 30 percent received student loans.

This picture changes a bit when the data are examined at the institutional level. Table 3 shows that scholarships are the most common form of aid received at universities and other post-secondary institutions, but the least common form of aid received at colleges. Only 40.9 percent of university students in the fall 1999 entering class did not receive a scholarship, implying that almost 60 percent of university students did receive some kind of scholarship. However, 80.9 percent of college students report that they did not receive a scholarship. In fact, the only form of financial aid which is more common at the college level than at the university level is student loans – according to the table, 33 percent of college students and 31.8 percent of university students received student loans to help finance their education. Interestingly, although students outside universities and colleges were less likely to receive student loans, they were more likely to receive scholarships and awards or grants and bursaries than were college students.

The data in Table 3 do tend to support the hypothesis that receipt of financial aid lowers dropout rates. In all but one case, students who dropped out are more likely to report non-receipt of financial aid than are graduates or continuers. It is at the college level that the difference is the most striking: 16.6 percentage points, as compared to just 12.2 percentage points for university students.

Table 4 takes a closer look at the types of financial aid received by students, and shows that although most students in the Fall 1999 entering cohort who received aid rely on only one type of aid, a surprising number of students actually received more than one type of aid. Among university students, 12.5 percent received all three types of financial aid, while a total of 13.7 percent received a student loan in addition to a scholarship or grant. Similarly, 9 percent of college students received all three types of aid, while a further 10.2 percent received either a scholarship or a grant in combination with a student loan. At the university level, scholarships were the sole source of financial aid for almost a third of students, but at the college level the most important sole source of aid was student loans. Students in other post-secondary institutions, like university students, were more likely to rely on scholarships as their sole source of aid.

Finally, Table 5 presents the average dollar amount of aid received by aid recipients over the period from August/September 1999 to December 2001, classified by type of institution and persistence. Overall, the average amount of aid received was $7,367. Average aid was highest for university students at $8,270, and lowest for college students at $6,108. University students received the highest average scholarships and student loans, but average grants were highest for students outside colleges and universities.

Although Table 3 implied that scholarships were the most commonly-received form of aid, Table 5 indicates that in terms of average dollar amounts, student loans constituted the most important category of aid. On average, university student loan recipients received $11,413, while college students received only $7,332. Even students studying in other institutions received larger average student loans than college students, with the difference being over $1,700. The determinants of the surprisingly large discrepancy between average student loans received by university and college students deserves further study; both differences in tuition fees and the relatively short length of some college programs are possible explanations.[5]

Turning now to the relationship between average aid and persistence, average aid received also seems to be higher for graduates and continuers than for leavers. For example, at the university level, graduates/continuers who received student loans received $11,957 on average, as opposed to only $7,818 for leavers (34.6 percent less). Similarly, university graduates/continuers received on average $3,454 in scholarships, while leavers received only $2,228 (35.5 percent less). The one exception to this general finding is that graduating/continuing college students who received scholarships actually received $265 less on average than college leavers.

Aside from a couple of anomalies, then, Tables 3 and 5 suggest a positive correlation between financial aid received and post-secondary persistence. The empirical analysis of the next subsection will attempt to determine whether this positive relationship persists when other potential determinants of student success are held constant.

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5 Because the questions related to financing of post-secondary education in YITS-B ask only about the total amounts received during a particular time interval – a two-year period in the case of the Cycle 2 questionnaire – it is impossible to allocate aid received to individual years.

Probit Analysis of the Factors Influencing Persistence

Although the data in Tables 1 to 5 suggest a positive relationship between financial aid and post-secondary persistence, each table holds constant only a few of the factors that might influence persistence. To get a better idea of the relationship between persistence and financial aid, a more complex analysis that takes into account the influence of more factors is required.

Econometric modelling of persistence decisions generally involves some sort of discrete choice model. Bettinger (2004) estimates linear probability models of persistence after one year of university, while Alon (2005) estimates probit models of the probability of completing a university degree in six years. McElroy (2005) uses a logit model to examine the probability of degree completion in Canada. Also using Canadian data, Montmarquette, Mahseredjian, and Houle (2001) estimate a bivariate probit model of the decision to undertake two consecutive terms of study, using administrative data from the University of Montréal. In their model, students who after the first semester chose to continue their studies for one more term must again choose whether or not to continue on further after their second semester.

While the bivariate probit approach used by Montmarquette et al. could in principle be extended to more than two periods, in practice it would be difficult to estimate such a model. In a series of papers, DesJardins et al. (1999, 2002) adopt a different approach – an event history model, which can be viewed as the discrete-time equivalent of a duration model. Their approach allows them to examine the complete history of a student's experience in a post-secondary program, including temporary "stopouts" as well as dropout behaviour. However, the information requirements of this type of model are enormous – one needs year-by-year or semester-by-semester information about a student's decision in order to implement it. In contrast, the simple discrete choice approach of Bettinger (2004) and Alon (2005) requires less information, and is easily adapted to different time intervals, depending on the available data.

Because the financial aid data in YITS-B are not available on a semester-by-semester basis, a simple binary choice model similar to those used by Bettinger (2004), Alon (2005), and McElroy (2005) seemed the most appropriate for this paper. The model can be expressed a follows:

$$y_i^* = X_i' \beta + \varepsilon_i , \qquad (1)$$

$$y_i = \begin{cases} 1 & y_i^* > 0 \\ 0 & otherwise \end{cases}, \qquad (2)$$

where y_i^* is an unobservable latent variable that can be viewed as an index of the benefit to individual *i* of persistence, X_i is a vector of factors related to persistence for individual *i*, β is a vector of parameters to be estimated, and ε_i is a random error term. Under the assumption that ε_i is a standard normal random variable, a probit model of persistence is obtained, and individual *i's* predicted probability of persistence will be given by $\Phi(X_i \hat{\beta})$, where $\Phi(\cdot)$ is the standard normal cumulative distribution function and $\hat{\beta}$ is the maximum likelihood estimate of β.

Details regarding the construction of the sample and the variables used in the analysis have been relegated to an appendix that is available from the author upon request. This section will discuss the definitions of only the most important variables, as well as identify-

ing all the variables included in the estimating equations. Table 6 lists the definitions of all explanatory variables included in the persistence equations.

While most of the empirical analysis is based on the broad definition of persistence discussed in the previous subsection, a few equations are estimated using slightly different measures of persistence. The first can be thought of as institutional persistence: did the individual remain in or graduate from the institution in which he or she was originally enrolled, or not? In this case, non-persistence includes changing institutions as well as completely dropping out of post-secondary education. The second alternative measure can be thought of as program persistence: did the individual remain in or graduate from the program in which he or she was originally enrolled, or not? In this case, non-persistence is defined as a change from the original program of study or completely dropping out. Like overall persistence, both institutional persistence and program persistence are represented by variables that are equal to 1 in the case of persistence and zero otherwise.

Because the construction of the institutional persistence and program persistence variables required variables from the institution and program rosters of Cycle 2, the sample sizes for models estimated using these variables is slightly smaller than for those estimated using the more general definition of persistence. The difference in sample sizes arises from the fact that in some cases, the program in which the individual claimed to be registered in Cycle 1 was declared an ineligible post-secondary program as of Cycle 2. Hence information about the individual's status in the program was lost. While some of these individuals could be returned to the sample using internal Statistics Canada information, not all of them could be, resulting in smaller sample sizes.

As for explanatory variables, previous studies of post-secondary persistence in the United States methods have identified quite a number of factors that seem to be correlated with persistence, such as age, race, student academic performance, family background, and in some cases, financial aid.[6] For Canada, Montmarquette, Mahseredjian, and Houle (2001) found that age, grade point average, and choice of program were related to the persistence of students at the University of Montréal, while McElroy (2005) included financial aid as well as age and gender in her analysis of the factors influencing the persistence of students at six Canadian universities.

Because YITS-B is a much richer data set than the administrative data used by Montmarquette et al. (2001) and McElroy (2005), it allows one to include far more factors that might potentially influence persistence than those studies were able to. In the probit models of persistence, persistence is assumed to depend on individual characteristics, province of study, ability, and financial aid. Among the individual characteristics included are age, sex, mother tongue, marital status, number of dependent children, visible minority status, years since immigration to Canada, and an indicator of whether or not the individual moved in order to begin post-secondary education. Age is expected to have a positive effect on persistence, since older

6 For example, see DesJardins, Ahlburg, and McCall (1999), Bettinger (2004), and Ishitani (2006). Mueller (2008) provides a more comprehensive survey of the literature on persistence.

students are likely to be more mature and better able to adapt to a post-secondary environment.[7] Having dependent children will most likely have a negative effect on persistence; in particular, the demands of looking after young children will greatly reduce the amount of time an individual has available to study, and thus may affect the quality of the student's work. Being married, on the other hand, may have positive or negative effects, depending on the contribution of the spouse to financing the student's education and maintaining the family household.

The effects of the other personal characteristics that have been included are harder to predict, however. While women now make up the majority of students at the post-secondary level, there is no particular reason to believe that they will perform better than men once admitted. Nor is there any particular reason to expect members of visible minorities to perform less well, unless perhaps there is some discrimination occurring in post-secondary institutions. Recent immigrants, however, may be less accustomed to Canadian institutions, and hence may find it more difficult to adapt to post-secondary studies than the Canadian-born or those who have been in Canada longer. An indicator of the importance the student's parent places on post-secondary education is also included, in case students who are under greater parental pressure to succeed indeed work harder. Finally, a dummy variable is included to indicate inter-city or inter-provincial moves in order to account for the possibility that some students may find post-secondary life harder if they are simultaneously adapting to having left friends and family behind.

Unfortunately YITS-B does not include any objective indicators of ability such as standardized test results. However, it does include information about high school grades. For the purposes of this paper, the student's overall high school grade average is used as the measure of ability. Individuals are divided into four ability categories: 90 to 100 percent, 80 to 89 percent, 70 to 79 percent, and less than 70 percent. It is expected that the higher the individual's ability as measured by his or her overall high school average, the more likely it is that they will persist.

For the purposes of this study, the most important explanatory variables are the financial aid variables. Since YITS-B provides information about three types of external financial aid – scholarships and awards, grants and bursaries, and student loans, three types of aid have been included in some of the models of persistence.[8] However, in others only total aid received is included. For scholarships and grants, the amount included is the sum of the amounts reported by the student in Cycles 1 and 2. In the case of student loans, the amount included is that reported by students in Cycle 2 in response to the question, "what is the total amount you have borrowed in the form of student loans up to December 2001?" Holding all else constant,

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7 Recall that individuals included in Cohort B of YITS ranged in age from 18 to 20 at the time the survey began, so the range of this variable is quite small.

8 It should be noted that although it is possible to estimate the amount received in the form of loans from family members, bank loans, and lines of credit, this amount has not been included in the models, because it is not financial aid from external agencies. An additional problem is that the amount reported for total loans may not be completely consistent with the amount reported for student loans, since for student loans the amount *borrowed* is used in this study, while the amount reported for total loans is the amount *owed*.

financial aid is expected to be positively correlated with the probability of persistence. [9]

It should be noted that the measure of financial aid used in this paper differs somewhat from that used by McElroy (2005). McElroy's measure of persistence is whether or not a university program was completed within a five-year period; thus her financial aid data cover a period that is more than twice as long as that examined here. For this reason, she uses an annualized financial aid measure that is computed by multiplying total aid received by the proportion of required credits that have been completed, in an attempt to control for the fact that students who spend more time in school can potentially receive more aid. Although the same problem may arise in this study, no such correction has been made, as the proportion of credits completed cannot be determined using YITS-B. Although students who leave their program early in the two-year period examined will no doubt receive less aid than those who continue, the problem is likely to be less severe due to the shorter time period being examined. Furthermore, to the extent that such an effect exists, it should tend to bias the results toward magnifying the effect of financial aid on persistence.

Turning now to the results of the probit analysis, models of overall persistence, institutional persistence, and program persistence were estimated for the complete sample of post-secondary students, and for subsamples consisting of university and college students. All equations were estimated using the Cycle 2 sampling weights. For ease of interpretation, all results are reported in the form of marginal effects, rather than the parameter estimates themselves. For dummy variables, the marginal effect represents the effect of a change in the value of the variable from 0 to 1. For continuous variables (such as age, income, and financial aid), the marginal effect is a derivative. For all equations, the reference individual or base case is assumed to be an individual for whom all dummy variables take on the value zero. In other words, the reference individual is a male who lives in Ontario, with English as his mother tongue, who is not a member of a visible minority, whose average grade in high school was below 70 percent, whose parents do not consider post-secondary education to be very important, who is unmarried and has no dependent children, and still lives at home in the same city with two biological parents. In addition, the reference individual is assumed to be Canadian born, to have no siblings, and parents who did not finish high school. Finally, the reference individual is assumed to be of average age, with average income but no financial aid. All the reported marginal effects are to be interpreted relative to this reference individual.

Table 7 presents the marginal effects for models of overall post-secondary persistence between August/September 1999 and December 2001. The first three columns of the table present the results when total aid received is the financial aid variable; in the last three columns of the table, aid is disaggregated into its three components. Although the null hypothesis that the slope coefficients of the persistence equation are jointly zero is strongly rejected at the 1 percent level of significance in all the equations, surprisingly few of the marginal effects are statistically signifi-

9 No adjustments have been made for inflation over the 1999-2001 period, since it is impossible to accurately allocate amounts received to particular years.

cant at the 10 percent or lower levels. Only two personal characteristics consistently have an effect on persistence: one is marital status, while the other is the importance of post-secondary education to the parents. Marriage lowers the probability of persistence by almost 40 percentage points. Since the predicted probability of persistence of the reference individual ranges from 0.785 for all students to 0.595 for college students, depending on the equation, this represents a decrease of more than 50 percent for the reference individual. However, if one's parents place a high importance on post-secondary education the probability of persistence increases, although the effect is not statistically significant for university students. For college students, the increase in the probability of persistence associated with parental expectations is at least sixteen percentage points.

The fact that few individual characteristics have a significant impact on post-secondary persistence can actually be viewed as a positive result, because it implies that once students are admitted to a post-secondary program, such factors as gender, language, and belonging to a visible minority are not associated with student success. In other words, there is no evidence of problems related to belonging to particular population subgroups. Although such factors may be related to access to post-secondary education, it would appear that in Canada they do not affect the probability of success once a student has been admitted to a post-secondary program. In contrast, numerous studies of persistence in the United States, including DesJardins et al. (1999) and Ishitani (2006) have found that race has some impact on persistence and rates of degree completion.

Similarly, the fact that there are no statistically significant provincial marginal effects in Table 7 can also be regarded as a positive, although surprising, result. This finding implies that despite provincial differences in tuition fees and the design of the post-secondary system, post-secondary persistence in all provinces is quite similar.

Not surprisingly, ability as measured by one's overall high school average has a relatively large and statistically significant impact on persistence. Students whose high school average was over 90 percent are far more likely to continue their studies than those with lower averages; for the reference individual, the increase in the probability of persistence is over 20 percentage points for university students, and over 30 percentage points for college students. For all students, the increase is only 15-16 percentage points, suggesting that a high average in high school has less of an impact for students attending institutions other than colleges and universities. Students with high school averages in the 80 to 89 percent range are also more likely to continue their studies, although the effect is smaller than that associated with an average of 90 percent of better.

Finally, the results suggest that financial aid has the expected positive effect on post-secondary persistence. Total aid has a positive and statistically significant effect for all students, as well as university and college students separately. However, the effect on the probability of persistence is small. The marginal effects in Table 7 imply that if total aid increases by $1000, the probability of persistence will increase by less than one percentage point for university students, and by about 2 percentage points for college students. Since average aid is about $7367 (see

Table 5), this is an increase of about 14 percent of the population mean amount of aid. Smaller increases in aid would of course have smaller effects. Based on these parameter estimates, total aid would have to increase by over $20,000 to have an impact on persistence close to that of a high school average of at least 90 percent.

When aid is disaggregated into three categories, the results become a little less clear. Scholarship income appears to have no significant effect on persistence, while grants and student loans have a statistically significant effect only for college students.[10] In most cases the magnitude of the effect remains small, although the marginal effect of grants and bursaries for college students is considerably higher than the effect of total aid. According to the last column of Table 7, a $1000 increase in grants will increase the probability of persistence for college students by almost ten percentage points. These unexpected results may be partially due to correlations between the different types of aid; as was demonstrated earlier, some students receive more than one type of aid, and students who do receive other types of aid will find their eligibility for student loans reduced accordingly. As a result, it may be difficult to disentangle the separate effects of different types of aid.

Table 8 presents the marginal effects of changes in the explanatory variables on institutional and program persistence. In these equations, financial aid is divided into three categories. The results are in many ways similar to those in Table 7. Again, none of the three types of financial aid appear to have a significant effect on the persistence of university students, and again grants are the type of financial aid that appear to have the greatest impact on the persistence of college students and post-secondary students as a whole. According to the table, a $1000 increase in grants will increase the institutional persistence of college students by almost ten percentage points. The impact on program persistence is even greater – a $1000 increase in grants will increase the program persistence of college students by over twelve percentage points. As in the case of overall persistence, being married has a significant negative impact on both program persistence and institutional persistence, although the magnitude of the effect appears to be smaller than for overall persistence. For university students, for example, being married reduces the institutional persistence of the reference individual by over 27 percentage points, and reduces program persistence by over 20 percentage points. For college students, being married has an even larger negative effect on both institutional and program persistence. For all students, including the university and college subsets, institutional persistence is more greatly affected by being married than is program persistence. This result is surprising, since changes in institution are more likely to result in a change in location than are changes in program. Married students are likely to be less mobile than single students, and hence one would expect them to be less likely to change institution. Having parents who think post-secondary education is important again seems to have a significant positive impact on the persistence of college students.

10 Although the estimated marginal effects of total aid are almost identical for the weighted and unweighted estimates, they are not for the separate components of aid.

Interestingly, for university students, high-school academic performance as measured by overall average has a bigger effect on both institutional and program persistence than it does on overall persistence. According to Table 8, a grade of 70 percent or better increases the institutional and program persistence of university students, with the magnitude of the effect increasing with the student's high school average. For the reference university student, the predicted probability of institutional persistence is 0.428; having a high school average of 90 percent or better more than doubles the persistence rate to 0.888. Having an average of 80 to 89 percent raises the predicted institutional persistence rate to 0.791; while having an average between 70 and 79 percent raises it to 0.652, which is also a substantial increase. The changes in the rate of program persistence for university students are similar in magnitude. For college students, however, only institutional persistence is significantly affected by high school grades, and only in the case of a grade of 90 percent or better. Moreover, the effect is smaller than for university students – an increase of 27.4 percentage points.

Finally, like overall persistence, neither institutional persistence nor program persistence seem to suffer greatly from provincial effects. For college students, institutional persistence seems to be somewhat higher in New Brunswick, but the effect is statistically significant only at the 10 percent level of significance. There are no significant provincial effects for university students.

Thus overall, the results suggest that financial aid is positively correlated with persistence. However, the effect is small relative to the impact of ability as measured by high school average, being married, and having parents who think post-secondary education is important. Furthermore, when aid is disaggregated into three categories it is harder to detect a statistically significant impact of aid, especially for university students. Surprisingly, for college students grants are the type of aid that has the largest impact on all measures of persistence examined, and student loans have a significant impact only on overall persistence and program persistence.

Persistence and Financial Aid: Identifying a Causal Relationship

From a policy-maker's point of view, it would be desirable to be able to predict the effect on rates of persistence of a change in student financial aid policies. The marginal effects of financial aid discussed in the previous section, if given a causal interpretation, would suggest that increases in financial aid have only a small effect on post-secondary persistence. However, there are at least a couple of reasons why one should be careful about attaching such a causal interpretation to these estimates. First of all, the economic theory of investment in human capital suggests that small changes in financial aid will have an impact on the persistence decisions of only those students for whom the benefits and costs of further investment in post-secondary education are exactly equal. For inframarginal students, for whom the expected benefits may far exceed the costs, only very large changes in financial aid would be likely to have any effect.[11] Furthermore, the marginal effects presented are valid only for relatively small changes in financial aid. Thus the small magnitude of the estimated marginal effects

11 This point was raised by several participants at the MESA conference entitled *All in the Family? Evidence from the YITS on PSE Access and Persistence*, October 19, 2007.

may simply reflect the fact that for most individuals in the sample, changes in financial aid are not big enough to have a major impact on the persistence decision.

Second, as Bettinger (2004) and Alon (2005) have pointed out, if receipt of financial aid depends on the same unobservable factors as persistence, then estimates of a simple probit model will be biased and inconsistent. Dealing with this problem requires both the use of more sophisticated econometric methods and a structural model of the determinants of persistence.

In the next subsection, both the theoretical and econometric issues that arise in attempting to model the causal relationship between persistence and financial aid will be discussed. However, the primary focus will be on the construction of an empirical model of this relationship, rather than on the development of a complete theoretical model. This discussion of modelling issues will be followed by an examination of the parameter estimates of a simultaneous model of persistence and financial aid.

Modelling the Relationship between Persistence and Financial Aid

Although a number of authors make reference to the role of individual utility in student decisions about post-secondary persistence, few authors have explicitly tried to develop a theoretical model of the determinants of persistence. This gap in the literature is likely due to the complexity of the problem. A complete model of post-secondary participation and persistence would have to explain not only the persistence decision itself, but also the amount of time or effort the student puts into his or her studies once admitted to a post-secondary program, since effort has an important impact on student success. Furthermore, as Bettinger (2004) points out, students may have imperfect information about their own ability, which suggests that models of persistence should allow for changes in students' expectations regarding their ability to successfully complete their chosen program. Yet another relevant factor is family background. For example, Ishitani (2006) notes that previous studies have found that students whose parents did not attend college are less likely to complete a college program. Specifying the mechanisms through which all of these factors influence persistence would be an extremely difficult task.

One author who does to try to develop an economic model of persistence is Bettinger (2004), who proposes a multi-stage version of the human capital model as a basis for his empirical analysis. In his model, students will choose to invest in an additional year of schooling as long as the expected increase in wages that would result from that additional year of schooling exceeds the expected cost. For example, at Time 0 they will choose to attend a post-secondary program for one year if

$$E_0\left\{\sum_{s=2}^{T} R^{s-1}\left[w_s(y=1,a)-w_s(y=0,a)\right]\right\} > E_0\left\{w_s(y=0,a)+F_1-g(I_0,n)-h(a)\right\} \quad (3)$$

where $E_t\{\}$ denotes expectations at period t; R is the discount factor; w_s is the wage in period s, which is assumed to be a function of both the number of years of post-secondary education attended (y) and the individual's ability (a); F_t is the tuition fee for year t; $g(\cdot)$ is needs-based financial aid received by the individual, which is assumed to be a function of the individual's initial wealth (I_0) and the number of siblings attending college at the same time (n); and $h(\cdot)$ is merit-based financial aid, which is assumed to depend on ability. At Time 0 the student may even have the intention of remaining in the program for more than one year, as long as the expected return in future years is greater than the expected cost, given the information available at Time 0.

Bettinger's model identifies a number of factors that might cause a student to change his or her plans after one or more years of study. First of all, at Time 0 the student is assumed to have imperfect information about his or her abilities, and each year of schooling improves the individual's estimate of his or her own ability. A downward revision of estimated ability will reduce the expected returns to further education, and cause the individual to quit before completing the program in which he or she is enrolled. Similarly, unanticipated changes in tuition fees or financial aid could also lead the individual to change his or her plans regarding post-secondary education in mid-stream. Increases in financial aid, by lowering the expected cost of another year of post-secondary education, will increase the expected net benefits of the additional year of education, and hence increase the probability of persistence.

An interesting feature of this multi-stage model is that as Bettinger points out, some individuals may have no intention of completing a degree or diploma in the first place. For these individuals, one year of study may raise future earnings enough to make it worthwhile investing in one year of schooling, but the return to the second year may be negative. Hence for such individuals, it is perfectly rational to attend one year of post-secondary education and then quit.

One limitation of Bettinger's model is that it does not include student loans. Both types of financial aid incorporated in the model are non-repayable; they differ only in the criteria by which they are allocated. The net impact of a given dollar amount of student loans on persistence is likely to be less than the same dollar amount in the form of a non-repayable grant or scholarship, since the loan repayments will reduce the net wage gain once the student graduates and begins to work. Thus one would expect a dollar of scholarships or grants to have a larger positive effect on persistence than one dollar in student loans. Other factors that are not included in Bettinger's model are family background and the student's allocation of time between studying and other activities. However, the model does suggest some factors that influence the amount of aid received – ability, and, in the case of needs-based aid, the number of siblings.

Since an individual's level of ability is not directly observable in most cases, but is a determinant of both future earnings and the amount of aid received, Bettinger's theoretical model implies that financial aid is likely to be correlated with the error term in a discrete choice model of persistence. In his empirical work Bettinger takes the potential endogeneity of financial aid into account by carrying out instrumental variables estimation of a linear probability model. In his study, in which he examines the effect of Pell grants on persistence after one year of study in Ohio universities, he uses as instruments for financial aid variables related to the size of the student's family, family income, and family wealth.[12] He finds some evidence that "stopout" behaviour is negatively related to the size of the grant received, but this finding is not robust to different model specifications.

Like Bettinger, Alon (2005) takes a discrete choice approach to the modelling of persistence, but estimates probit models of persistence rather than linear probability models using data from the College and Beyond database for the United States. To deal with the endogeneity problem, Alon uses the two-step estimator recommended by Newey (1987), also known as the Amemiya Generalized Least Squares Estimator (AGLS) or instrumen-

12 Pell grants are a form of needs-based financial aid available to college/university students in the United States.

tal variables probit estimator. Alon examines the effects of different types of aid, such as grants, loans, and work-study, as well as part-time work, and finds that when the AGLS estimator is used, the coefficient of each aid variable becomes positive, whereas in probit models that ignored endogeneity the coefficients were negative. However, rather than including several types of aid in the same equation, Alon repeatedly estimates the same persistence equation, each time changing the definition of the financial aid variable.[13]

Another study which explicitly takes into account the potential endogeneity of financial aid is that of Dynarski (2003). Her approach is somewhat different, however; rather than using an instrumental variables estimator, she takes advantage of a natural experiment created by the elimination of the Social Security Student Benefit Program in the United States. Prior to its elimination in 1982, the program had provided financial aid to children of deceased, disabled, and retired Social Security beneficiaries who were attending college full-time. Using a differences in differences estimator and data from the National Longitudinal Survey of Youth from 1979-1983, she found that the elimination of the program significantly reduced persistence.

Since a natural experiment of the type exploited by Dynarski is not available in the YITS-B data set, the most fruitful approach to building a structural model of the effect of aid on persistence using these data would seem to be to specify a multi-equation model of persistence and financial aid that can be estimated jointly or using instrumental variables methods. Econometrically, the model can be expressed as follows:

$$y_{1i}^{*} = X_{1i}'\beta_1 + \gamma\, y_{2i} + \varepsilon_{2i}\,, \qquad (4)$$

$$y_{1i} = \begin{cases} 1 & y_{1i}^{*} > 0 \\ 0 & otherwise \end{cases}, \qquad (5)$$

$$y_{2i} = X_{2i}'\beta_2 + \varepsilon_{2i}\,, \qquad (6)$$

where y_{1i}^{*} is an unobservable latent variable reflecting individual *i*'s estimate of the net benefits of persistence in his or her post-secondary program, X_{1i} is a vector of variables that influence the net benefits of persistence, y_{2i} is the amount of financial aid received, y_{1i} is an observed binary indicator of persistence defined to be equal to 1 if the individual decides to persist, and X_{2i} is a vector of variables that influence the amount of financial aid received. ε_{1i} and ε_{2i} are assumed to be jointly normally distributed with zero means; as is typical in probit models the variance of ε_{1i} is normalized to equal one in order to identify the parameter estimates of equation (4). As demonstrated by Wooldridge (2002, 473), this normalization also ensures that the estimated marginal effects of changes in the explanatory variables can be interpreted as average partial effects.[14] Note that the model is assumed to be recursive, in that financial aid affects persistence, but persistence does not affect the level of financial aid. The parameters of equation (4) will be identified as long as the vector X_{2i} contains at least one variable that is not in X_{1i}.

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13 Alon's paper does not seem to indicate what variables were used as instruments for financial aid, nor are the results of tests for the exogeneity of financial aid reported.

14 The average partial effect of a change in an explanatory variable is the partial derivative of the expectation of the random variable *y* (the dependent variable) with respect to the explanatory variable *x*, averaged over the population distribution of an unobserved random variable that also influences *y*. This unobserved random variable is usually referred to as unobserved heterogeneity. When *x* is a dummy variable indicating whether or not the individual participated in a particular program, the average partial effect is generally referred to as an average treatment effect. See Wooldridge (2002, 2005) and Heckman et al. (1999) for further discussion of average partial effects and average treatment effects.

Under the assumption that ε_{1i} and ε_{2i} are jointly normally distributed, a likelihood function for this model can be specified and the two equations can be jointly estimated. A test for the exogeneity of y_{2i} can be carried out by testing the null hypothesis that the coefficient of correlation between ε_{1i} and ε_{2i} is zero. Two-step estimators for this model and an alternative test for exogeneity have also been proposed by Rivers and Vuong (1988) and Newey (1987). Finally, the model can be extended to the case of more than one endogenous variable.

Although this econometric model of persistence has been used elsewhere, for example by Alon (2005), it has one limitation with respect to its application to financial aid: it does not take into account the fact that financial aid is a censored variable. In any given sample of individual data, there are likely to be a substantial number of students who do not receive any aid of a given type. Yet the model outlined above is based on the assumption that the endogenous variable – financial aid – is continuous. In fact, as shown in Table 4, 38.4 percent of students who entered PSE in the fall of 1999 had no financial aid. Cameron and Trivedi (2005) note that the estimation of probit models with endogenous explanatory variables that are themselves limited dependent variables is relatively straightforward only if it is the latent variable, not the observed variable, that enters the probit equation. The estimation problem becomes much more complicated when the observed limited dependent variable is assumed to enter the choice equation.

In the case of financial aid for students, it seems more reasonable to assume that it is actual aid received, not some unobserved latent variable reflecting eligibility for aid, that appears in the persistence equation. An alternative model that could be used is the simultaneous probit-tobit model of Chappell (1982). In his model, voting behaviour is measured by a binary variable, while campaign contributions are a censored variable. Chappell derives the appropriate likelihood function and estimates his model using the method of maximum likelihood.[15] Unfortunately, the model is not always easy to estimate and proved not to be feasible in this study. Hence the estimates reported below are for the model described by equations (4) to (6), and ignore the fact that financial aid is not in fact a continuous variable.

Before discussing the parameter estimates themselves, it is important to discuss the choice of variables to include in X_{1i} and X_{2i}. The exact definitions of all of the explanatory variables are provided in Table 6. X_{1i} is assumed to include all the non-aid variables that were included in the probit equations discussed in the previous section. In short, it includes variables reflecting individual characteristics, ability, and province of study. The amount of effort supplied by students is implicitly assumed to be a function of their personal characteristics. The ability measure, overall high school average grade, is imperfect since schools may differ in their grading systems, but is the only measure available in the data set. Ability is an important determinant of both the probability of success in the chosen program of study, and future wages. Finally, provincial dummy variables are included to control for excluded factors, such as tuition fees, that may differ across provinces.

The vector of determinants of financial aid, X_{2i}, is assumed to include all the variables in

15 Although Chappell's model has been used in many other studies of voting and campaign contributions, it has received almost no attention from econometricians. This is somewhat surprising given the amount of effort that has been devoted to the development of estimators for the simpler case where the endogenous explanatory variable is a continuous variable.

X_{1i}, plus a number of variables that are assumed to affect only financial aid and thus serve as instruments for aid. However, it is not easy to identify such variables. The level of financial aid received is itself the outcome of a complex process in which first students decide whether or not to apply for aid, and then an external agency decides whether or not to grant the aid.[16] While some variables may affect both steps in the process, others may be more relevant to one than the other.

The development of a complete model of financial aid was not attempted in this paper. Instead, the list of variables available in YITS-B was examined carefully for variables that might enter into such a model, but not influence the persistence decision. It is particularly difficult to think of possible instruments for scholarships that might be available in YITS-B, since scholarships are supposed to be awarded primarily on the basis of academic performance in high school, and the available measure of academic performance in high school (high school overall average grade) is also an important explanatory variable in the persistence equations. However, for grants and student loans, both of which are awarded at least partly on the basis of need, the YITS-B data set does include some potential instrumental variables. These are variables related to family structure, such as whether or not the student lives at home, the number of siblings, and whether or not the individual lives with two biological parents, and variables indicating the parent/guardian's level of education. The latter variables serve as a proxy for the parent/guardian's level of income, which is not reported in YITS-B. Most of these variables are clearly related to the amount of student loans that the individual might be eligible to receive, as the applicants are required to supply information about family size, parental income, whether the student still lives at home, and the student's own income.[17] In their study of student loans in Canada, Finnie and Schwartz (1996) found evidence that parental education and whether or not students moved to study, in addition to regional dummies and characteristics of the program of study, do indeed influence the amount of money borrowed through student loans. In addition, the student's own income in 1999 is also included, since the higher the student's income, the smaller the loan to which he or she will be entitled. Only 1999 income is included, since that is the income associated with the beginning of post-secondary education, and because no data are available on income in 2000. To the extent that a student's income in subsequent years is proportional to income in 1999, 1999 income will serve as a good proxy for the income earned during the entire 1999-2001 period.

An important issue that needs to be addressed before examining the IV probit parameter estimates is whether it is reasonable to assume that the variables selected as instruments for financial aid have no independent impact on persistence. One potential problem is that parental financial support, which has not been explicitly included in the model, may also depend on family structure. A second potential problem is that parental education may influence persistence through other channels besides its effect on the amount of aid received. For example, university-educated parents may place more pressure on their children to attend university and perform well, and may be better informed about potential sources of aid, resulting in a greater probability that their children

16 In the case of many scholarships for undergraduates, students are considered automatically upon applying to a university. Hence they do not in fact have to apply separately for such scholarships.

17 See the Canada Student Loans program website, maintained by Human Resources and Social Development Canada, for information about current eligibility requirements for student loans and grants offered by the program - http://www.hrsdc.gc.ca/en/learning/canada_student_loan/index.shtml#loans

will actually apply for aid. However, this latter effect may already be captured in the indicator of the importance of post-secondary education to the student's parents that is included in the probit models of persistence. Similarly, parental decisions regarding the amount of financial support they will provide may be made prior to admission to university, in which case family structure variables would be more likely to directly influence the initial decision to attend a post-secondary institution, not the decision to continue once admitted. Finally, it is worth noting that Bettinger (2004) also uses family income and family size, in addition to family assets and the number of children in the family attending college, to construct an instrument for financial aid. Thus the choice of instruments in this paper is at least consistent with current practice in the literature.

Instrumental Variables Estimation Results

In this section, instrumental variables probit estimates of the effect of financial aid are presented. Table 9 presents marginal effects based on weighted estimates of models that include only total financial aid. In all equations discussed, the dependent variable is the broad measure of persistence, not institutional or program persistence.

The estimated marginal effects in Table 9 are based on maximum likelihood estimates of a probit model with one endogenous variable, where the endogenous variable is assumed to be continuous, not censored. The first thing to note about these results is that some of the results are quite similar to those in Table 7. For example, being married again has a negative effect on persistence for all students and college students, although the magnitude of the effect is a little smaller – about 27 percentage points, as opposed to 40 in Table 7. In addition, once again having parents who believe post-secondary education is important or having a high average in high school both have a positive effect on persistence. Interestingly, the estimated impact of the high school average is higher than before, for all students and for college students. However, although the estimated parameters of a 90 to 100 percent and an 80 to 89 percent average are statistically significant for university students, the marginal effects for these variables are not significantly different from zero. Having a high school average of 90 percent or better now increases the probability of persistence by 0.310 as opposed to 0.163 for all students, and by 0.358 as opposed to 0.301 for college students.[18] Finally, there are few significant provincial effects and most other individual characteristics still have no significant impact on persistence.

Although there are many similarities between the two sets of results, the change in model and estimation method results in a big difference in the results with respect to financial aid. As the final row of Table 9 indicates, for all students as a whole, total financial aid still has a significant impact on persistence at the 5 percent level of significance, but the effect is now negative. It implies that an increase of $1000 in total financial aid will reduce the probability of overall persistence by 4.3 percentage points. Moreover, the test of exogeneity based on the coefficient of correlation between financial aid and persistence, shown in the final row of the table, indicates that the null hypothesis that the correlation coefficient is zero must be rejected at the 1 percent level of significance. This result implies that total aid is indeed endogenous, and that the marginal effect estimates of Table 7 for all students are biased.

However, for the university and college student subsamples, the null hypothesis of endogeneity cannot be rejected, implying that the results in Table 7 are in fact appropriate.

18 It should be noted that the predicted probability of persistence for the reference individual is a little lower for these estimates.

This result is surprising, since together university and college students account for about 85 percent of the sample. For these subsamples financial aid also has no significant impact on persistence at all.

One possible explanation for the striking difference between these estimates and those in Table 7 regarding the effect of financial aid on persistence is that there may be heterogeneity in the sample in terms of individual responses to the chosen instruments. If so, the estimated IV marginal effects may in fact measure the average partial effect for only the subset of the population that is responsive to the instruments.[19] For example, instrumental variables such as the number of siblings may be irrelevant to students who are academically strong and rely primarily on scholarships as a source of financial aid. The estimated marginal effects in Table 9 would in this case be inapplicable to these students.

Another potential explanation for the differences between the IV and standard probit results is that the instruments used may simply not be strong enough. Even if they are uncorrelated with the error term in the probit equations, they may be too weak to be adequate, resulting in a substantial bias in the IV parameter estimates. This possibility can be investigated by examining the OLS estimates of the first-stage equations, which are presented in Table 10, in which the dependent variable is total financial aid. An examination of these equations reveals that for all students, the variables indicating whether or not the student lived at home, the number of siblings, and four of the five levels of parental education all have statistically significant coefficients at the 10 percent or lower level of significance. For university students, having a single parent or a parent with a university education are the only instruments that have a significant impact on financial aid, while for college students, having a parent with a university education, the number of siblings, and especially the student's income in 1999 have a statistically significant impact. However, for all three samples the explanatory power of the first-stage equations, as measured by R^2, is low, ranging from 0.1667 for university students to 0.2432 for college students. Further evidence that the instruments have some relevance is provided by Tobit estimates for each of the three types of aid, which are provided in the appendix.[20] However, for these equations too the pseudo-R^2 values suggest that the explanatory power of the equations is weak, even allowing for the fact that cross-section microdata are being used.

Recently Stock and Yogo (2005) have proposed a number of tests for weak instruments. Although their tests were developed in the context of linear models, they may be relevant here because the first-stage equations for financial aid are linear in parameters.[21] The tests are easily applied in the case of a single financial aid variable, as in this case the test statistic is simply the F-statistic of the first-stage regression. As indicated in Table 10, the F-statistics of the first-stage regressions are 10.94, 4.85, and 6.30 for all students, university students, and college students respectively. Applying the 5 percent critical values for the two-stage least squares (2SLS) bias test proposed by Stock and Yogo (2005) with 30 regressors in the first-stage equations, these values imply that

19 In the context of average treatment effects, the resulting marginal effect is called a local average treatment effect.

20 Note that tests of significance based on the OLS estimates of the first-stage equations are likely to be unreliable due to the censored nature of the aid variable. It is for this reason that the Tobit estimates are provided in the appendix.

21 Note that the tests would be directly applicable to the estimation of a linear probability model using instrumental variables estimation.

for all students and college students, one cannot reject the null hypothesis that the relative bias of the 2SLS estimator would be less than or equal to 20 percent (relative to the OLS estimator).[22] However, the null hypothesis that the relative bias is less than or equal to 10 percent is rejected. For university students, the lowest level of relative bias for which the null hypothesis cannot be rejected is 30 percent. When Stock and Yogo's second test for weak instruments, which is based on the size distortion resulting from the use of weak instruments of a Wald test of the overall significance of the coefficients of the second stage equation, is applied, the results are even less favourable: the null hypothesis that the instruments are weak cannot be rejected for any of the models. To be more specific, one cannot reject the null hypothesis that for a test carried out at a level of significance of 5 percent, the true size is actually 25 percent.

Taken together, these test results lead to the conclusion that although the first-stage equations do have some explanatory power, the chosen instruments do not do a good enough job of explaining financial aid. Consequently, there is likely to be considerable bias in the marginal effects presented in Table 8, especially those for university and college students. This bias may well be exacerbated by the fact that the estimation method does not take into account the fact that financial aid is not a continuous variable. As a result of the bias and size distortions caused by weak instruments, hypothesis tests based on the IV probit estimates are unlikely to be reliable.[23]

Since the instrumental variables estimates of the effect of aid on persistence may not be reliable, one last experiment was carried out in an attempt to shed further light on the impact of financial aid. Students were divided into two subsamples: those who had received aid prior to January 1999, and those who had not received aid prior to January 1999.[24] The first subsample constitutes students who were already dependent on aid when they started post-secondary education, while the second subsample consists of students who began their post-secondary education despite not having received any financial aid. Of these two groups, one would expect that the first would be more likely to be sensitive to the level of financial aid received. An exercise of this sort is perhaps the closest one can come to a natural experiment using the YITS-B data.

Table 11 presents the estimated marginal effects of total aid in standard probit models of persistence, using overall persistence as the dependent variable.[25] The table shows that the marginal effect of aid is indeed statistically significant for students who received aid prior to January 2000. Moreover, the estimated marginal effect for all students, university students, and college students is higher than in Table 7. This result makes sense because these students are the most likely to be on the margin between continuing and not continuing. For the students who did not receive aid prior to January 2001, however, the effect of aid on persistence is not statistically significant, except in the case of college students. For college students, the effect of financial aid is positive and signifi-

22 Although there are actually 33 regressors in the first-stage equations, Stock and Yogo provide critical values only for up to 30 instruments. However, the F-statistics for the first-stage equations are sufficiently far away from the critical values for the case of 30 instruments that it is unlikely that the results would be more favourable if the exact critical value had been used.

23 In an attempt to cast further light on the weaknesses of the instruments, separate OLS regressions were also carried out for the three types of aid. Somewhat surprisingly, the F-statistics from these regressions were highest for scholarships. The F-statistic for the grants equation was lowest. But in all three cases the F-statistics were lower than the level required to reject the null hypothesis that the maximum bias was more than 10 percent. Thus the chosen instruments do an equally bad job of explaining all three types of aid.

24 I am grateful to Hans Vossenteyn for suggesting this exercise.

25 A complete set of estimates is available from the author upon request.

cant at the 10 percent level of significance, and in fact is larger in magnitude than for students who had previously received aid. Thus in both subsamples the estimated marginal effect of total aid is found to be largest for college students.

These supplementary results confirm that the effect of aid on persistence differs for different groups of students. On the one hand, this means that it is indeed likely that the effect of instruments for aid will be heterogeneous; on the other hand, it confirms that there are additional determinants of persistence that are missing from the model. Exactly what those determinants are remains to be discovered.

Conclusion

Despite this study's attempt to illuminate the relationship between post-secondary persistence and financial aid, the exact nature of the relationship between aid and persistence in Canada remains unclear. Although the probit estimates in Table 7 indicate that a positive correlation between total financial aid and persistence remains even after controlling for provincial effects, ability as measured by academic performance in high school, and various personal characteristics, it appears to be difficult to disentangle the separate effects of the components from each other. Furthermore, attempts to control for the potential endogeneity of financial aid caused the estimated coefficient of total aid to change sign, from positive to negative. These negative coefficients for total aid are counter-intuitive and hard to believe in the face of the constant calls from student advocacy groups for more generous financial aid.[26]

Similar inconsistencies between IV and standard probit or least squares estimates of discrete choices models of persistence have been observed by other studies as well. For example, Alon (2005) obtains a positive estimated coefficient for financial aid only after doing instrumental variables probit estimation; Bettinger (2004) also finds that different estimation methods produce inconsistent results regarding the effects of financial aid. As the discussion of the previous section suggests, one of the reasons for these inconsistencies may be the difficulty of finding instruments for financial aid that are strongly correlated with financial aid, yet uncorrelated with the persistence decision. As a result, the instrumental variables estimates of the impact of financial aid may actually be less reliable than estimates which treat aid as exogenous. The weak instrument problem, coupled with the fact that the censored nature of the financial aid variables is not taken into account, means that the instrumental variables probit estimates of this paper are likely to suffer from an unknown, but possibly high, degree of bias.

In light of these limitations of the instrumental variables estimates, the probit estimates in Table 7 probably provide a more accurate picture of the nature of the relationship between financial aid and persistence. However, these results should be viewed as being more informative about the general direction of the relationship – positive – than about its magnitude. The small size of the estimated marginal effect of changes in financial aid obscures the fact that for some individuals, the effects are likely to be much larger. Unfortunately the study has not succeeded in identifying who those marginal individuals are.

Although this study may not have succeeded in accurately measuring the effect of financial aid on post-secondary persistence, it has succeeded in identifying other factors that have a strong influence on persistence. These are academic performance in high school and

26 For example, see Canadian Federation of Students (2007).

being married. Being married has a strong negative effect on persistence in almost all the equations estimated, which suggest that policies directed towards married students might have a positive impact on persistence. However, two caveats accompany this conclusion: first, it is not clear exactly why marriage has such a negative effect on persistence, especially since the number of dependent children was included as a separate explanatory variable; and second, students who are married or living with a partner constitute only 2 percent of the population studied. Thus only a small proportion of students would benefit from such policies, and they would not be likely to have a large effect on the overall persistence rate.

That leaves one other variable which was found to have an important impact on persistence: academic performance in high school. The results imply that if the quality of high school graduates could be increased, so that the proportion of entering students with high averages increased, then rates of post-secondary persistence would increase substantially. For such policies to work, however, the increase in student quality would have to be real, rather than just grade inflation. Furthermore, such increases in student quality could only be achieved by making changes at the elementary and/or secondary levels, rather than spending more on aid for post-secondary students. Alternatively, persistence rates could be increased by raising university admission standards, so that fewer high school students who are at risk of failure were admitted. Although such a policy would not increase the number of graduates from post-secondary programs, it would likely reduce the variance in returns to post-secondary education, and possibly the average return as well. Whether such a policy directed towards increasing the average quality, rather than the quantity, of post-secondary graduates would be beneficial for the economy as a whole is a question that deserves further study.

Finally, although this study does not provide clear-cut answers regarding the role that financial aid plays in determining persistence, the results do suggest that in some respects the post-secondary system in Canada is working well. There is no evidence that once admitted, students from particular population subgroups are any more or less likely to succeed. There also is no evidence of important provincial differences in persistence rates, after other factors have been taken into account. To the extent that high school grades reflect ability, students with higher ability do tend to perform better once admitted to a post-secondary program. However, it is also clear that the estimated models could do a better job of explaining persistence. Perhaps other studies will succeed in identifying factors that play a greater role in predicting persistence than those examined here.

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Appendix

Table 1. Persistence by Type of Institution, Fall 1999 Entering Class

	University Students	College Students	Other Students	Total
Leaver	8609	15797	4975	29381
Graduate/Continuer	68933	56758	24803	150494
Graduate – Continuing	1597	7259	1749	10605
Graduate – Not continuing	1268	14699	7792	23759
Not yet graduated	66068	34800	15262	116130
Total	77542	72555	29778	179875

Table 2. Characteristics of Fall 1999 Entering Class (percentage share unless otherwise indicated)

Characteristic	University Students	College Students	Other Students	Total
Average age (years)	18.8	18.8	18.7	18.8
Female	56.2	53.8	52.7	54.6
Mother tongue				
French	4.5	29.5	10.5	15.6
English	77.9	61.2	82.2	71.9
Other language	17.7	9.5	7.2	12.6
Visible minority	18.8	7.8	8.9	12.8
Average income, 1999 ($)	9921	8074	10804	9322
High school average:				
90-100 percent	16.2	3.3	9.3	9.8
80-89 percent	52.2	25.8	23.8	36.9
70-79 percent	28.9	53.9	47.2	42
< 70 percent	2.7	16.9	19.7	11.3
Province of study				
NFLD	3.2	1	2.3	2.2
PEI	0.5	0.6	0.4	0.5
NS	5.6	2.4	3.4	3.9
NB	4.2	2.1	1.8	3
QUE	3.3	27.7	9.9	14.2
ONT	57.1	50.7	24.6	49.2
MAN	4.1	1.6	1.9	2.7
SASK	4.2	0.8	6.3	3.2
ALTA	8.4	6.6	18.2	9.3
BC	9.6	6.4	31.2	11.9

Table 3. Percentage of Students with No Financial Aid, by Type of Institution and Persistence

	Leaver	Graduate/Continuer	Total
University			
Scholarship	57.7	38.8	40.9
Grants	73.7	65.4	66.3
Student loans	61.4	68.2	67.4
Aid	33.6	21.4	22.8
College			
Scholarship	85.7	79.6	80.9
Grants	91.4	75.0	78.5
Student loans	80.1	67.0	69.9
Aid	66.4	49.8	53.4
Other			
Scholarship	68.6	54.1	56.5
Grants	84.0	72.8	74.6
Student loans	83.3	73.7	75.3
Aid	51.8	40.9	42.7
Total			
Scholarship	74.6	56.7	59.6
Grants	84.9	70.2	72.6
Student loans	75.2	68.6	69.7
Aid	54.3	35.3	38.4

Table 4. Percentage of Students Receiving Each Aid Combination

	University	College	Other	Total
Scholarships only	31.1	7.3	19.5	19.6
Grants only	4.0	5.7	3.7	4.6
Student loans only	6.4	14.7	6.9	9.8
Scholarships + Grants	9.5	3.5	9.4	7.0
Scholarships + Student loans	6.0	3.1	5.5	4.7
Grants + Student loans	7.7	7.1	3.1	6.7
All types of aid	12.5	9.0	4.7	6.7

Table 5. Average Amount of Aid received by Aid Recipients, by Type of Institution and Persistence

	Leaver	Graduate/Continuer	Total
Scholarships			
University	2228	3454	3356
College	1506	1241	1285
Other	2200	2314	2300
All students	2004	2862	2773
Grants			
University	1633	2060	2023
College	1292	1880	1829
Other	2090	2373	2343
All students	1610	2050	2011
Student Loans			
University	7818	11957	11413
College	5913	7571	7332
Other	7546	9264	9070
All students	6966	9846	9460
Total Aid			
University	6618	8445	8270
College	4475	6412	6108
Other	4736	7013	6692
All students	5434	7634	7367

Table 6. Definitions of Explanatory Variables

Variable name	Definition
Age	age of individual as of December 1999
Female	dummy variable equal to 1 if individual is female, 0 otherwise
French	dummy variable equal to 1 if mother tongue is French, 0 otherwise
Other language	dummy variable equal to 1 if mother tongue is neither English nor French, 0 otherwise
Married	dummy variable equal to 1 if individual is legally married or living with a partner, 0 otherwise
No. of children	number of dependent children that individual has
Visible minority	dummy variable equal to 1 if individual belongs to a visible minority, 0 otherwise
Years since immigration	for immigrants, equal to years since arriving in Canada; equal to 0 for the Canadian-born
Moved to study	dummy variable equal to 1 if individual changed province or city to start post-secondary education, 0 otherwise
PSE important to parents	dummy variable equal to 1 if it is very important to the parents that the individual get some post-secondary education, 0 otherwise
90-100 percent	dummy variable equal to 1 if individual's overall high-school grade average is 90-100 percent, 0 otherwise
80-89 percent	dummy variable equal to 1 if individual's overall high-school grade average is 80-89 percent, 0 otherwise
70-79 percent	dummy variable equal to 1 if individual's overall high-school grade average is 70-79 percent, 0 otherwise
NFLD, …, BC	dummy variables equal to 1 if the individual's province of study in 1999 was province *j*, 0 otherwise
Scholarships	total amount of scholarships and awards received up to December 2001 ($)
Grants	total amount of grants and bursaries received up to December 2001 ($)
Student loans	total amount borrowed through student loans up to December 2001 ($)
Total aid	sum of scholarships, grants, and student loans
Income in 1999	Total income in 1999, including scholarships and grants ($)
Not living at home	dummy variable equal to zero if individual no longer lives with parent or guardian, 0 otherwise
No. of siblings	number of older and younger siblings of the individual
Two parents	dummy variable equal to one if individual has two parents or guardians, no more than one of whom is a biological parent, 0 otherwise
Single parent	dummy variable equal to one if individual has a single parent or guardian, 0 otherwise
Other family	dummy variable equal to one if individual's parents have split custody, or if individual lives without parents or in an institution, 0 otherwise
High school	dummy variable equal to one if at least one parent/guardian has completed high school and neither parent has any post-secondary education, 0 otherwise
College	dummy variable equal to one if at least one parent/guardian has a college diploma but neither parent has any university training, 0 otherwise
Some PSE	dummy variable equal to one if at least one parent/guardian has some college or university education, but neither parent has a degree or diploma, 0 otherwise
University	dummy variable equal to one if at least one parent/guardian has a university degree, 0 otherwise
Other	dummy variable equal to one if at least one parent/guardian has some other post-secondary qualification other than a degree or a diploma, 0 otherwise

Table 7. Marginal Effects for Probit Models of Overall Persistence (weighted estimates)

Variable	All Students	University Students	College Students	All Students	University Students	College Students
Age	0	0.05	-0.01	0	0.05	-0.02
Female	0	0	0.06	0	0.01	0.07
French	-0.09	-0.272*	-0.05	-0.09	-0.269*	-0.05
Other language	0.01	0.08	0.11	0.01	0.07	0.1
Married	-0.396***	-0.390**	-0.403***	-0.4	-0.405**	-0.417***
No. of children	-0.03	-0.13	0.16	-0.04	-0.12	0.18
Visible minority	-0.07	-0.07	-0.04	-0.06	-0.05	-0.04
Years since immigration	0	-0.01	-0.01	0	-0.01	0
Moved to study	0	0.01	0	0	0.02	-0.01
PSE important to parents	0.075***	0.05	0.163***	0.073**	0.05	0.169***
High school average:						
90-100 percent	0.163***	0.226**	0.301***	0.154***	0.206*	0.312***
80-89 percent	0.075*	0.175**	0.123*	0.072*	0.17	0.129*
70-79 percent	-0.03	0.07	0.03	-0.03	0.07	0.03
Province of study						
NFLD	-0.03	-0.01	-0.01	-0.02	0.02	0.01
PEI	-0.01	-0.09	0.12	0	-0.06	0.11
NS	-0.05	-0.04	-0.08	-0.04	-0.02	-0.08
NB	0.02	0.03	0.07	0.03	0.04	0.09
QUE	0.05	-0.15	0.13	0.04	-0.15	0.12
MAN	-0.01	-0.01	0.05	-0.01	0	0.06
SASK	0.01	-0.08	0.04	0.01	-0.07	0.06
ALTA	-0.04	-0.01	-0.15	-0.04	-0.02	-0.12
BC	-0.02	0.08	-0.06	-0.03	0.07	-0.08
Financial aid						
Total aid	0.010***	0.006**	0.021***			
Scholarships				0.01	0.02	-0.01
Grants				0.028**	0.02	0.096**
Student loans				0.006**	0	0.016**
Base case probability	0.78	0.73	0.6	0.79	0.74	0.6
Sample size	2936	1382	1101	2936	1382	1101
Log-likelihood	-1208.9	-436.47	-524.54	-1205.95	-434.45	-519.64
Wald χ^2	111.52***	69.06***	62.83***	110.99***	65.48***	68.68

Note: For Age and financial aid variables, marginal effects are the derivative of the probability of persisting. For all other variables, the marginal effects reflect the effect on the probability of persisting of a change in value from 0 to 1. The base case probability is the probability that the reference individual will be persistent. Finally, * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Table 8. Marginal Effects for Probit Models of Institutional and Program Persistence (weighted estimates)

Variable	All Students	University Students	College Students	All Students	University Students	College Students
Age	0.04	0.078**	0.03	0.051**	0.05	0.05
Female	-0.01	0.02	0	0	0.05	0
French	-0.08	-0.17	-0.05	-0.07	-0.164*	-0.02
Other language	-0.06	0.07	-0.19	-0.07	0.03	-0.18
Married	-0.240***	-0.274**	-0.334***	-0.179**	-0.201*	-0.269***
No. of children	-0.08	-0.65	0.19	-0.05		0.31
Visible minority	0.07	0.11	0.07	0.03	0.06	0.04
Years since immigration	0	-0.018***	0.02	0	-0.01	0.02
Moved to study	0.01	0.02	-0.03	0	0	-0.02
PSE important to parents	0.087**	0.03	0.152***	0.090**	0.01	0.187***
High school average:						
90-100 percent	0.220***	0.460***	0.274***	0.125***	0.430***	0.14
80-89 percent	0.124**	0.363***	0.09	0.082***	0.378***	0.1
70-79 percent	0.03	0.224**	0.02	-0.009***	0.272***	0.01
Province of study						
NFLD	-0.132**	-0.1	-0.15	-0.116*	-0.1	-0.05
PEI	0.07	-0.02	0.18	0.08	0	0.12
NS	-0.01	0.01	-0.01	0.01	0.01	0.02
NB	0.06	0	0.194*	0.04	-0.03	0.19
QUE	0.1	-0.16	0.11	0.11	-0.07	0.09
MAN	-0.093*	-0.06	-0.1	-0.05	-0.04	-0.03
SASK	0.02	-0.05	-0.02	0.03	-0.06	-0.04
ALTA	-0.02	0.01	-0.06	0.01	0.02	-0.02
BC	-0.04	0.12	-0.13	0.04	0.12	-0.06
Financial aid						
Scholarships	0.01	0.01	-0.02	0.013*	0.01	-0.02
Grants	0.025**	0.02	0.095***	0.026**	0.02	0.124***
Student loans	0	0	0.011*	0.005*	0	0.01
Base case probability	0.61	0.43	0.55	0.56	0.34	0.6
Sample size	2858	1363	1065	2686	1267	1006
Log-likelihood	-1588.22	-650.32	-623.68	-1643.55	-718.26	-619.73
Wald χ^2	68.25***	87.49***	66.05***	50.11***	53.74***	55.60***

Note: For Age and the financial aid variables, marginal effects are the derivative of the probability of persisting. For all other variables, the marginal effects measure the effect on the probability of persisting of a change in value from 0 to 1. The base case probability is the probability that the reference individual will be persistent. Finally, * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Table 9. Marginal Effects for Instrumental Variables Probit Models of Overall Persistence (weighted estimates)

Variable	All Students	University Students	College Students
Age	0.02	0.06	-0.02
Female	0.02	0.01	0.087*
French	-0.07	-0.26	-0.03
Other language	0.05	0.09	0.12
Married	-0.268**	-0.33	-0.314**
No. of children	0.22	-0.15	0.542*
Visible minority	0.02	-0.05	0
Years since immigration	0	-0.01	-0.01
Moved to study	0.139**	0.04	0.13
PSE important to parents	0.064*	0.05	0.120*
High school average:			
90-100 percent	0.310***	0.26	0.358***
80-89 percent	0.147***	0.2	0.136**
70-79 percent	-0.01	0.09	0.01
Province of study			
NFLD	0.057	0.02	0.072
PEI	0.214**	-0.05	0.387*
NS	0.02	-0.03	-0.04
NB	0.146**	0.05	0.2
QUE	0.01	-0.14	0.05
MAN	-0.03	-0.02	0.05
SASK	-0.03	-0.09	-0.05
ALTA	0	0.01	-0.154*
BC	-0.01	0.08	-0.04
Financial aid			
Total aid	-0.028**	0	-0.03
Base case probability	0.6	0.7	0.54
Sample size	2936	1382	1101
Log-likelihood	-64438.9	-292453.6	-246399.5
Wald χ2	143.60***	64.07***	64.27***
Exogeneity test	6.80***	0.06	1.94

Note: For Age and the financial aid variables, marginal effects are the derivative of the probability of persisting. For all other variables, the marginal effects measure the effect on the probability of persisting of a change in value from 0 to 1. The base case probability is the probability that the reference individual will be persistent. Finally, * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Table 10. OLS Estimates of First-Stage Equations (weighted estimates)

	All Students		University Students		College Students	
	Estimated Coefficient	p-value	Estimated Coefficient	p-value	Estimated Coefficient	p-value
Age	0.65	0.03	1.2	0.05	-0.03	0.91
Female	0.25	0.47	-0.17	0.77	0.49	0.21
French	0.16	0.84	1.5	0.21	0.36	0.54
Other language	0.56	0.5	0.44	0.72	0.5	0.67
Married	0.46	0.74	7.79	0.17	-0.22	0.85
No. of children	6.1	0.07	-2.61	0.19	7.58	0.08
Visible minority	2.14	0.02	3.54	0.01	0.27	0.76
Years since immigration	-0.04	0.62	-0.01	0.89	-0.12	0.36
Moved to study	3.61	0	3.56	0	2.66	0
PSE important to parents	-0.24	0.57	-0.77	0.34	-0.3	0.58
Income in 1999	-0.05	0.18	0.01	0.89	-0.09	0.02
High school average:						
90-100 percent	5.19	0	5.79	0	2.39	0.04
80-89 percent	2.15	0	2.31	0.06	0.83	0.18
70-79 percent	0.43	0.4	1.05	0.39	-0.16	0.78
Family Structure						
Not living at home	1.4	0.03	1.17	0.25	1.34	0.13
No. of siblings	0.23	0.07	0.28	0.26	0.27	0.09
Two parents	-0.55	0.42	-0.57	0.65	-0.24	0.81
Single parent	1.28	0.11	3.06	0.08	0.96	0.23
Other family	3.09	0.17	1.65	0.44	5.68	0.16
Parental education						
High school	-2.23	0.07	-1.94	0.41	-2.29	0.13
College	-2.02	0.09	-2.02	0.38	-2.07	0.16
Some PSE	-2.36	0.07	-3.35	0.18	-2.07	0.2
University	-2.78	0.02	-3.83	0.09	-2.69	0.07
Other	-1.92	0.15	-1.92	0.45	-2.46	0.12
Province of study						
NFLD	2.18	0.02	2.71	0.06	1.65	0.11
PEI	6.72	0	5.02	0	9.67	0
NS	1.56	0.02	2.03	0.06	0.2	0.85
NB	3.56	0	2.18	0.09	3.18	0.01
QUE	-0.95	0.35	1.72	0.51	-1.47	0.03
MAN	-0.27	0.65	-1.07	0.17	0.21	0.83
SASK	-0.81	0.16	-0.53	0.54	-0.7	0.51
ALTA	1.16	0.07	2.88	0.02	0.01	0.99
BC	0.22	0.73	-0.18	0.87	0.88	0.42
Constant	-9.4	0.11	-19.4	0.1	4.52	0.43
R^2	0.19		0.17		0.24	
F-statistic (p-value)	10.94 (0.000)		4.85 (0.000)		6.30 (0.000)	
No. of observations	2936		1382		1101	

Table 11. Marginal Effect of Total Aid on Probability of Persistence (weighted estimates)

	Students who received aid prior to January 2000	Students who did not receive aid prior to January 2000
Probit models		
All students	0.013***	0.016
University students	0.008**	0.003
College students	0.032***	0.058*
IV probit models		
All students	-0.026**	-0.062
University students	-0.017	-0.019
College students	-0.093*	-0.139***

Note: * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Appendix A: Determinants of Financial Aid

Tables A1, A2, and A3 contain estimates of the marginal effects of changes in the determinants of the three types of financial aid. In all the equations, financial aid and income are measured in thousands of dollars. The first three columns of each table present the marginal effect on the probability of receiving the type of aid in question, while the last three columns provide the marginal effect of a change in the specified variable on the amount of aid received, given that a positive amount is received. Summary statistics for the associated estimating equation, including the sample size, the value of the log-likelihood function, and a Wald χ^2 statistic for a test of the null hypothesis that the slope coefficients are jointly zero. For all the Tobit equations, the null hypothesis of no explanatory power can be rejected at the 1 percent level of significance.

Since no attempt was made to build models of the receipt of financial aid in this paper, the results reported in Tables A1-A3 are best thought of as reflecting the characteristics of recipients of financial aid. They can perhaps also be thought of as reflecting the preferences of the institutions or agencies that allocate financial aid. Of course, since the choice of explanatory variables was constrained by the information available in YITS-B, the equations may not include all factors that those who allocate aid actually take into account.

Since scholarships and awards are awarded primarily on the basis of academic merit, no explanatory variables related to financial need were included in these equations. Since scholarships may sometimes be targeted towards particular population subgroups such as women or visible minorities, variables reflecting these and a few other individual characteristics were included. Instead, the focus is on the variables measuring the student's average grade in high school. As expected, high grades have a big impact on whether or not a student receives a scholarship. In the case of universities, the predicted probability that the reference individual will receive a scholarship is only 0.274. However, that probability jumps to 0.889 if the individual's high school average was at least 90 percent, a change that is significant at the 1 percent level. In addition, the amount of aid the student can expect to receive, holding all else constant, jumps up by $4,303, from $3,232 for the reference individual with a high school average of less than 70 percent. Individuals with a high school average of 80 to 89 percent also enjoy statistically significant increases in the probability of receiving aid (an increase of 0.319, or 31.9 percentage points) and the amount of aid received (an increase of $1,446), but the effects are considerably smaller. There is no statistically significant difference between the reference individual and an individual with a high school average between 70 percent and 79 percent.

While college students also benefit financially from a high average grade in high school, the return in terms of more scholarship income are much smaller than for university students. While for A+ students the corresponding increase in the probability of receiving a scholarship or award is slightly more than half that of A+ university students, the increase in average aid received is far less – only $791. The same is true for college students with high school averages in the 80 to 89 percent range. Clearly scholarships are neither as abundant nor as generous at the college level as they are at the university level.

Although the results in Table A1 suggest that most of the included individual characteristics do not have a statistically significant impact on scholarships received, there are a few interesting exceptions. First of all, for university students age appears to have a significant (at the 5 percent level) effect on both the probability of receiving a scholarship or award, and the amount received. An increase in age of one year will reduce the probability of receiving a scholarship by about 6 percent, while the amount received decreases by about $237, holding all else constant. For college students, an increase in age doesn't appear

to significantly affect the probability of receiving a scholarship, but does have a slight effect on the amount received. An increase of one year in age reduces the amount of college scholarships by about $72, at the 10 percent level of significance. Somewhat curiously, having a mother tongue other than English or French significantly reduces both the probability of receiving a scholarship and the amount received, for college students only. Contrary to expectations, for university students, belonging to a visible minority significantly reduces the probability of receiving a scholarship by about nine percentage points, and reduces the amount received by $362. Possibly students belonging to visible minorities are for some reason less likely to apply for scholarships. It is also difficult to explain why having parents who consider post-secondary education to be important has a significant negative impact on university scholarships; the magnitude of the effect is slightly smaller than that of belonging to a visible minority.

The coefficients of the provincial dummies in the scholarship equation show that there are some statistically significant differences in the generosity of scholarships. At the university level, scholarships appear to be significantly less generous in Newfoundland and Labrador, Nova Scotia, Manitoba, and Saskatchewan than in Ontario. Students in these provinces are less likely to receive scholarships, and receive less money if they do receive them, holding all else constant. In Alberta, on the other hand, the probability of receiving a scholarship is 20 percentage points higher than in Ontario, and recipients receive on average about $863 more.

Turning now to grants and bursaries (Table A2), which are awarded both on the basis of academic merit and financial need, it appears that being married and having a high-school average of 90 percent or above are the primary determinants of both the probability of receiving money and the amount received. Both tend to increase the amount received. However, having at least one parent with a university education does have a small significant effect on the amount of money received by the reference individual, leading to a reduction in grants of about $327 on average. This result suggests that parental income does indeed affect the allocation of grants and bursaries.

For college students, grants appear to be more closely tied to financial need. Having an additional dependent child raises the probability of receiving a grant by 44.8 percentage points, and raises the size of the grant by $1,194 dollars. This represents an increase of more than 50 percent relative to the grant received by the reference person. Not living at home with one's parents also has a significant positive impact on the probability of receiving a grant and the amount received; an increase of $1,000 in income also decreases the amount of grant received, but only by $19.

For both college and university students, provincial differences in the amount of grants received and the probability of receiving a grant are roughly similar to those for scholarships. Grants are lower in Newfoundland and Labrador, Manitoba, and Saskatchewan than in Ontario. There is some evidence that for all post-secondary students, grants are higher in British Columbia than in Ontario, but the effect does not seem to be present in the university and college subsamples.

Finally, the student loan models in Table A3 show the strongest relationships yet between needs-related variables and the amount of aid received. This is what one would expect, since student loans in Canada are explicitly tied to financial need. The higher the student's income in 1999, the lower the amount of aid received and the lower the probability of receiving aid for both university and college students, although the effect is not large. Not living at home has a large positive impact on both the probability of receiving aid and the amount of aid received for both university and college students: on average, the amount of aid received rises by $1767 for university students, and $1706 dollars for college students. Student loans are also significantly positively related to the number of siblings a student has. Having a

family structure in the “other” category, which includes living in an institution or on one’s own, has a particularly large impact on grants received by college students: grants increase by $5012 on average. However, this variable does not have a statistically significant impact on grants received by university students.

One of the most important determinants of student loans is having parents with a university education. A university student whose parents do not have a university education will see his or her loan rise by over $2500. College students whose parents do not have a university degree also benefit in terms of increased loans, to the tune of $1602. But it is the provincial effects that are the largest of all. Students in Newfoundland and Labrador, Prince Edward Island, and New Brunswick receive far more generous student loans than students in other provinces. The difference between Ontario and Prince Edward Island in terms of the amount received by loan recipients is $4103 for university students and $6175 for college students. For college students, this constitutes almost a 100 percent increase relative to the amount received by the reference person.

Although student loans may not be as directly related to academic performance as other types of financial aid, Table A3 shows that for college students at least, a high school average in the 80 to 89 percent range has a significant positive impact on loans received. It is also interesting to note that for university students, being a member of a visible minority significantly increases both the probability of receiving a loan and the amount received. However, these results may not reflect any favouritism towards visible minorities on the part of the student loan system. Instead, it may simply be the case that visible minorities are more likely to apply for student loans. This may in part be due to the fact that they seem to be somewhat less likely to receive scholarships. Similarly, students with averages in the 80 to 89 percent range may be more likely to apply for student loans, because they receive smaller scholarships than students with a higher high school average. It is, however, somewhat surprising that students with high school averages of 70 to 79 percent do not receive more student loans, since they receive even less in the form of scholarships and grants than students with better academic records in high school.

Table A1. Marginal Effects of the Determinants of Scholarships and Awards (weighted estimates)

	Probability of Receiving Aid			Amount of Aid Received		
Variable	**All Students**	**University Students**	**College Students**	**All Students**	**University Students**	**College Students**
Age	-0.027**	-0.059**	-0.03	-0.110**	-0.237**	-0.072*
Female	0.018	0.01	0.064**	0.073	0.042	0.144**
French	0.003	0.047	0.066	0.011	0.186	0.148
Other language	0.039	0.118*	-0.094***	0.155	0.481	-0.304***
Visible minority	-0.013	-0.089**	0.075	-0.055	-0.362*	0.168
PSE important to parents	-0.02	-0.085**	-0.038	-0.087	-0.343**	-0.098
High school average:						
90-100 percent	0.631***	0.615***	0.368***	3.081***	4.303***	0.791***
80-89 percent	0.285***	0.319***	0.140***	1.095***	1.446***	0.301**
70-79 percent	0.090***	0.116	0.015	0.349***	0.47	0.036
Province of study						
NFLD	-0.069***	-0.164***	0.01	-0.322***	-0.693***	0.024
PEI	-0.006	-0.062	0.099	-0.025	-0.248	0.218
NS	-0.013	-0.087**	-0.027	-0.054	-0.352**	-0.069
NB	-0.091	-0.042	0.106	0.356	-0.169	0.231
QUE	-0.099***	-0.105	-0.085**	-0.501***	-0.429	-0.261***
MAN	-0.013	-0.085**	0.031	-0.055	-0.345**	0.071
SASK	-0.017	-0.127***	0.071	-0.071	-0.521***	0.158
ALTA	0.164***	0.205***	0.165**	0.627***	0.863***	0.351**
BC	0.074**	0.059	0.173***	0.289**	0.237	0.369***
Base case	0.143	0.274	0.119	2.508	3.232	1.316
Sample size	2936	1382	1101	2936	1382	1101
Log-likelihood	-265354	-159117	-50372.1	-265354	-159117	-50372.1
Wald χ^2	115.02***	86.40***	46.26***	115.02***	86.40***	46.26***

Note: For Age and the financial aid variables, marginal effects are a derivative. For all other variables, the marginal effects measure the effect of a change in value from 0 to 1. The base case is the value for the reference individual. Finally, * indicates significance at the 10 percent level, ** significance at the 5 percent level, and *** significance at the 1 percent level.

Table A2. Marginal Effects of the Determinants of Grants and Bursaries (weighted estimates)

	Probability of Receiving Aid			Amount of Aid Received		
Variable	All Students	University Students	College Students	All Students	University Students	College Students
Age	0.002	-0.023	-0.029	0.006	-0.055	-0.078
Female	0.022	-0.01	0.035	0.06	-0.025	0.094
French	-0.047	-0.033	0.006	-0.133	-0.077	0.015
Other language	-0.051	-0.077	-0.007	-0.146	-0.184	-0.02
Married	0.082	0.457**	0.056	0.225	1.416	0.15
No. of children	0.289*	-0.017	0.448*	0.801*	-0.04	1.194*
Visible minority	0.095	0.152	0.113	0.259	0.37	0.308
PSE important to parents	0.032	0.070*	-0.05	0.088	0.167*	-0.136
Income in 1999	0	0.003	-0.007	0	0.006	-0.019**
High school average:						
90-100 percent	0.167***	0.166*	0.169	0.458***	0.407*	0.473
80-89 percent	0.126***	0.128	0.058	0.344***	0.308	0.156
70-79 percent	0.019	0.067	-0.026	0.052	0.159	-0.07
Family structure						
Not living at home	0.090***	0.071	0.141**	0.244***	0.168	0.390**
No. of siblings	0.010*	0.006	0.009	0.029*	0.015	0.023
Two parents	0.015	0.029	0.039	0.041	0.068	0.106
Single parent	0.011	0.04	-0.018	0.029	0.095	-0.048
Other family	-0.011	-0.034	-0.06	-0.03	-0.08	-0.162
Parental education						
High school	-0.09	-0.106	-0.061	-0.264*	-0.254	-0.166
College	-0.063	-0.105	-0.01	-0.18	-0.252	-0.026
Some PSE	-0.05	-0.069	-0.084	-0.143	-0.165	-0.23
University	-0.092*	-0.134	-0.139	-0.271*	-0.327*	-0.39
Other	-0.064	-0.047	-0.092	-0.183	-0.112	-0.25
Province of study						
NFLD	-0.125***	-0.183***	-0.199**	-0.384***	-0.465***	-0.594***
PEI	0.129**	0.064	0.149	0.351**	0.152	0.413
NS	-0.012	-0.065	-0.079	-0.033	-0.154	-0.214
NB	0.013	-0.047	-0.067	0.035	-0.111	-0.181
QUE	-0.029	0.081	-0.120*	-0.082	0.193	-0.330**
MAN	-0.095**	-0.166***	-0.168**	-0.280***	-0.414***	-0.480**
SASK	-0.121***	-0.167***	-0.187**	-0.369***	-0.418***	-0.549**
ALTA	-0.05	-0.042	-0.116*	-0.14	-0.099	-0.320*
BC	0.104**	0.024	0.164	0.283**	0.056	0.457
Base case	0.211	0.277	0.273	1.920	3.232	2.179
Sample size	2936	1382	1101	2936	1382	1101
Log-likelihood	-186749	-91828.2	-60943.5	-186749	-91828.2	-60943.5
Wald χ^2	110.67***	67.58***	57.04***	110.67***	67.58***	57.04***

See note for Table A1.

Table A3. Marginal Effects of the Determinants of Student Loans (weighted estimates)

	Probability of Receiving Aid			Amount of Aid Received		
Variable	All Students	University Students	College Students	All Students	University Students	College Students
Age	0.051***	0.088**	0.008	0.483***	0.937**	0.055
Female	-0.011	-0.046	0.018	-0.106	-0.482	0.134
French	-0.015	0.055	-0.006	-0.141	0.596	-0.046
Other language	-0.044	-0.094	-0.001	-0.425	-0.989	-0.005
Married	0.029	0.215	0.003	0.274	2.56	0.021
No. of children	0.089	-0.07	0.094	0.845	-0.751	0.682
Visible minority	0.181***	0.297***	-0.044	1.781**	3.793***	-0.314
PSE important to parents	-0.01	-0.008	-0.047	-0.098	-0.085	-0.341
Income in 1999	-0.008***	-.008**	-0.014***	-0.080***	-.085*	-0.105***
High school average:						
90-100 percent	0.141**	0.097	0.224*	1.371**	1.073	1.859
80-89 percent	0.180***	0.148	0.143**	1.774***	1.68	1.119**
70-79 percent	0.065	0.085	0.004	0.616	0.94	0.032
Family structure						
Not living at home	0.186***	0.154***	0.208***	1.832***	1.767**	1.706**
No. of siblings	0.021***	0.028*	0.037***	0.197***	0.298*	0.268***
Two parents	-0.013	0.007	0	-0.126	0.075	-0.003
Single parent	0.08	0.07	0.158*	0.768	0.762	1.244
Other family	0.229	0.088	0.452**	2.306	0.967	5.012**
Parental education						
High school	-0.091	-0.14	-0.139	-0.884	-1.486	-0.991
College	-0.095	-0.16	-0.125	-0.921	-1.695	-0.892
Some PSE	-0.093	-0.177	-0.112	-0.902	-1.886	-0.8
University	-0.159**	-0.234*	-0.221**	-1.619**	-2.568**	-1.602**
Other	-0.085	-0.101	-0.177	-0.822	-1.069	-1.264
Province of study						
NFLD	0.166***	0.187**	0.197**	1.626***	2.187*	1.600**
PEI	0.352**	0.315***	0.500***	3.858***	4.103**	6.175***
NS	0.108**	0.166***	0.039	1.041**	1.908**	0.287
NB	0.186***	0.141**	0.282***	1.832***	1.596*	2.472**
QUE	-0.063	0.121	-0.154**	-0.601	1.355	-1.096**
MAN	-0.082*	-0.130**	-0.003	-0.795*	-1.378**	-0.024
SASK	-0.01	0.021	0.118	-0.094	0.224	0.91
ALTA	-0.013	0.012	-0.007	-0.124	0.016	-0.054
BC	-0.094**	-0.113	-0.083	-0.918**	-1.196	-0.59
Base case	0.211	0.277	0.273	1.920	3.232	2.179
Sample size	2936	1382	1101	2936	1382	1101
Log-likelihood	-186749	-91828.2	-60943.5	-186749	-91828.2	-60943.5
Wald χ^2	110.67***	67.58***	57.04***	110.67***	67.58***	57.04***

See note for Table A1.