Come and Stay a While: Does Financial Aid Effect Enrollment and Retention at a Large Public University?*

by

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Abstract

Few studies have examined whether financial aid affects college retention. This paper models the decision to enroll and re-enroll in college, which yields a bivariate probit model that is estimated using detailed individual data from a large public university. The analysis uses the unique detail of institution-specific data to examine the effect of financial aid on the re-enrollment decision, and exploits the sequential college completion process to condition the re-enrollment probabilities for college selection such that the implications are broader than is typical of a single-institution study. Overall, the results indicate that some types of need-based aid improve retention, but that merit-based aid has the largest retention effects (particularly for well-to-do enrollees).

I. Introduction

In 2000, federal and state governments spent nearly $55 billion in need-based financial aid and individual higher-education institutions spent almost $20 billion in university-specific grants. This significant public investment in higher education has generated considerable interest in the effect of need-based aid on both the decision to attend college (McPherson and Schapiro, 1991) and the choice among alternative offers of admission (e.g., Ehrenberg and Sherman, 1984). Nonetheless, although completing some college has been found to raise wages (e.g., Light, 1995), the ultimate goal of U.S. financial aid policy is to insure that academically capable students are able to earn a college degree independent of financial considerations (e.g., Duffy and Goldberg, 1998). Thus, the issue of whether need-based aid reduces attrition from college is important, particularly since prior work suggests that dropping out of school is largely a "once-in-for-all decision" (Card and Lemieux , 2000).

Even so, few studies have examined whether financial aid improves retention once a student has entered college, even though descriptive evidence suggests that it is those who are financially constrained that are most likely to drop out (e.g., Tinto, 1993). Moreover, higher education, as a whole, has become increasingly dependent on tuition revenue due to reductions in federal and state support that have not kept pace with tuition increases over the last two decades (e.g., McPherson and Schapiro, 1998). This has lead budget-strapped universities to direct more resources towards merit-based aid either to coax an applicant to enroll or to coax an enrollee to re-enroll (e.g., Marcus, 1989). Given that non-need-based aid has been found to

disproportionally benefit well-to-do students (e.g., Singell and Stone, 2001), the extend to which the overall financial aid package affects enrollment and retention could have significant direct and indirect effects on the distribution of income in the United States.

In this paper, an empirical model of the sequential enrollment and re-enrollment decision is developed for freshmen at a large public university, which is estimated using four years of uniquely detailed data for students at the University of Oregon. In particular, the empirical analysis examines how various types of need- and merit-based aid affect the enrollment and re-enrollment decision, controlling for personal attributes, ability, and background of the student. The empirical results provide some of the first formal evidence that financial aid improves retention, even after netting out the observed self-selection of enrollees who are naturally more likely to remain in college than a random applicant. Nonetheless, the findings also indicate that the most needy students are less likely to enroll and re-enroll controlling for the level of aid, and that the retention effects of merit-based aid are smaller for needy students even after controlling for ability. Thus, the findings suggest that financial aid has not created equal access or degree progress even at a large public university.

II. Background

Direct public aid for college attendance in the United States has traditionally focused on low-income students rather than merit, although subsidized tuition at public universities is a significant *indirect* form of (non-need-based) aid. For example, ninety percent of student participants in the two largest federal aid programs, the Stafford Loan and the Pell Grant, have family incomes below $40,000 (National Center for

Education Statistics, Table 314, 1998). However, most higher education literature has focused on the general effects of aid on college attendance. For example, Leslie and Brinkman (1987) survey early enrollment studies that use aggregate time series data on enrollment and the net tuition price (i.e., tuition minus financial aid) and find that the enrollment demand is inelastic. Collectively, these studies suggest that there is a small, but positive, enrollment response to financial aid (e.g., Becker,1990).

More recent work relies on individual variation in college aid to study college enrollment. For example, Angrist (1994) uses survey responses of military veterans to the veteran benefits program for college, Kane (1994) uses panel data for 18-19 year-old black youths drawn from the Current Population Survey, and Dynarski (1999) uses data from the Social Security Benefit Program. Broadly, these studies find that a $1000 of aid increases the likelihood of college attendance by roughly 4 to 5 percent. This study extends prior work by showing that financial aid increases both the enrollment and re-enrollment rate.

Recently, federal and state governments have moved toward greater reliance on non-need- or merit-based aid programs. For example, a new federal Education IRA program permits families to save after-tax dollars for college that earn tax-free interest and the Hope Scholarships provide a federal tax credit up to $1500 a year for college. Many states have similar programs including recently adopted IRA programs in New York and New Hampshire (Selingo, 1999). The benefits of these new federal and state aid programs are directed at upper and middle-income families who pay the highest marginal tax rates and more frequently send their children to college (e.g., Ellwood and

Kane, 1999). At the same time, because the growth in federally-subsidized, need-based aid has not kept pace with tuition increases over the last two decades, the relative share of need-based, non-subsidized loans has increased in the financial aid package (e.g., McPherson and Schapiro, 1994). Nonetheless, despite a documented shift in policy away from subsidized need-based aid, relatively few enrollment studies have distinguished between merit-based aid, grants, and need-based subsidized and unsubsidized loans, which a central issue in this paper.

A recent study by Dynarski (2000) does examine the effects of merit-based aid in the form of Georgia's HOPE Scholarship program. The scholarship is found to have a strong enrollment response for middle- and high-income youth, but yields relatively little benefit to low income students (in part, because the benefit was reduced dollar for dollar with Pell grants). Thus, the program appears to widened the college enrollment gap between blacks and whites and between those from low- and high-income families. However, her data do not permit a match between the actual aid or scholarship received and the individual's choice to attend college and they do not include controls individual ability, academic performance, and other sources of aid available to individual students. This paper examines whether the enrollment and re-enrollment response to non-need-based aid varies with need, controlling for a both detailed set of individual attributes and other forms of aid.

Although enrollment studies find that the provision of financial aid significantly increases enrollment, most retention studies do not include controls for need- or merit-based aid. Instead, recent work shows that non-financial factors are important for

retention, including the gender composition of the faculty (Robst, et al., 1998), teaching effectiveness (Langbein and Snider, 1999), and the quality of the match between the student and university (Light and Strayer, 2000), can improve retention. However, a recent study by Wetzel et al. (1999) does examine the effect of financial aid on student retention. Specifically, a logit model is estimated for whether an enrollee is retained or not using student-level data from Virginia Commonwealth University. The empirical results suggest that net costs (i.e., tuition minus grants) and loans significantly reduce the probability that a student is retained, but also indicate that their effect on retention is small in comparison to a student's commitment to either the institution or to the goal of a college degree.

Overall, the re-enrollment findings are consistent with evidence in Venti and Wise (1983), which uses data from the National Longitudinal Study of the Class of 1972 to show that the unmeasured attributes of enrollees yield a systematically greater commitment to college than for those applicants who elect not to attend. Nonetheless, prior retention studies have not explicitly modeled how the self-selection of enrollees may affect the re-enrollment decision. For example, enrollees may have unmeasured attributes that yield a higher return to schooling than for non-enrollees, which increases their relative willingness to pay for college. This paper extends prior work by using the unique detail of institution-specific data to examine the effect of financial aid on the re-enrollment decision, but also exploits the sequential college completion process to condition the re-enrollment probabilities for college selection such that the implications for retention are broader than is typical of a single-institution study.

III. Empirical Model

The matriculation process can be modeled as a sequential series of enrollment decisions. Specifically, potential students must initially choose whether or not to enroll in a specific university as freshman, and then subsequently decide whether or not to re-enroll for their sophomore, junior, and senior years. For simplicity, the empirical model focuses on the discrete enrollment decision of college freshmen and their subsequent re-enrollment decision, which is the period of the greatest attrition from college.[1] These two decisions are likely to be correlated because they depend on many of the same observed and unobserved attributes of the individual and the university. In addition, the re-enrollment decision is observed for only a select pool of students who initially choose to enroll (e.g., Manski and Wise, 1983). A bivariate probit model with sample selection is used to describe the correlated qualitative decisions to enroll and re-enroll, where the re-enrollment decision is censored.

As a point of departure, a random utility approach is adopted where an individual *i* enrolls and/or re-enrolls at university *j* if the utility of the decision exceeds the utility of the next best opportunity. Although the net utility from the enrollment and re-enrollment decisions for person *i* at university *j* is not observed, the decisions to enroll (*E*) and re-enroll (*R*) are observed and are modeled as linear index functions:

$$E_{ij} = a Z_{ij}^{E} + e_{ij}^{E} \qquad E_{ij} = \begin{cases} 1 & \text{if enrolled} \\ 0 & \text{if not} \end{cases} \qquad \textbf{(1.1)}$$

[1]For example, the 1999-2000 annual report of the Consortium for Student Retention Data (CSRDE) finds that in 294 U.S. colleges and universities, 40 percent of students drop of school over a six-year period with approximately half the overall attrition occurring in the freshman year.

$$R_{ij} = bX_{ij}^{R} + e_{ij}^{R} \qquad R_{ij} = \begin{cases} 1 & \text{if re-enrolled and } E_i = 1 \\ 0 & \text{if not and } E_i = 1 \end{cases} \qquad \textbf{(1.2)}$$

where the net utility of selecting university *j* by person *i* depends on observed individual and university attributes, Z_{ij} and X_{ij}, and unobservables, e_{ij}^{E} and e_{ij}^{R}, that are assumed to be distributed bivariate normal, [0,0,1,1,ñ].

In this case, the re-enrollment decision, R_{ij}, is observed only if the person enrolls, E_{ij}=1. The likelihood function for N applicants specified by Meng and Schmidt (1985) is:

$$\begin{aligned} \ln L(a, b, r) = \sum_{i=1}^{N} & E_{ij} R_{ij} \ln \Phi(aZ_{ij}, bX_{ij}; r) \\ & + E_{ij}(1 - R_{ij}) \ln[F(aZ_{ij}) - \Phi(aZ_{ij}, bX_{ij}; r)] \\ & + (1 - E_{ij}) \ln[1 - F(aZ_{ij})], \end{aligned} \qquad \textbf{(2)}$$

where Ö and F, respectively, denote the bivariate standard normal cumulative density function and the univariate standard normal cumulative density function for the errors in (1.1) and (1.2). Estimating the re-enrollment decision conditioned on enrollment decision offers two advantages over estimating (1.1) and (1.2) separately. First, the joint approach offers efficiency gains that improve the standard error estimates of both the enrollment and re-enrollment model relative to separate estimates of (1.1) and (1.2), because it accounts for the potential correlation between the two decision processes, *ñ*. Second, (2) corrects for potential sample selection that could bias the predicted effect of financial aid and other variables on re-enrollment, which are crucial with respect to forming a retention policy. Identification is achieved through the non-linearity of equation (2) and because the sequential nature of the two choices leads

elements of Z_{ij} and X_{ij} to differ. The explanatory variables that are included in Z_{ij} and X_{ij} are discussed in the data section.

IV. Data and Empirical Specification

Equation (2) is estimated using data from the UO admissions office for 10,647 in-state and out-of-state Fall-term freshman applicants for two academic years,1997-98 and 1998-99. The analysis is restricted to Fall-term freshman applicants because these students make up the vast majority of potential enrollees and because applicants from Winter and Spring terms tend to be nontraditional/transfer students who differ distinctly from new students. The dependent variables for equation (2) are binary variables that equal one if a student enrolls in either the 1997-1998 or 1998-1999 academic year and if the student re-enrolls in the subsequent 1998-1999 or 1999-2000 academic year. Following prior work, the explanatory variables include personal attributes, attributes of the student's high-school and peers, academic ability measures, and financial aid information (Ehrenberg and Sherman, 1984; Cur and Singell, 2001).

Personal attributes include race and gender dummies because the response of female and nonwhite students to the UO, which is located in a largely white, moderately sized city, may be different than for white men. The age an applicant first contacts the UO is used as a measure of initial interest. The median household income for the ZIP code of the recruit's parents drawn from the 1990 Census is used as a proxy for peer income. In addition, a binary variable that equals one if the student is from the state of Oregon is included in the model, because in-state students are likely to have a relatively greater direct interest in the flagship university of their home state.

Academic aptitude is measured by the cumulative math and verbal SAT score, along with the high-school and college grade point averages (GPA). Following prior work, a quadratic specification is used for the cumulative SAT scores (Curs and Singell, 2001). However, the GPA measures are specified in levels, because specifications that included quadratic terms (not presented) generally yield only a significant linear effect for high-school and college GPA. Although high-school GPA is included in both the enrollment and re-enrollment model, college GPA is included only in the re-enrollment model since freshman applicants to the UO have yet to attend college and obtain a college GPA. This natural exclusion restriction helps identify the bivariate probit model.

Attributes of the student's high school may also affect the application and enrollment decision. The number of advanced placement (AP) courses provides a measure of the academic opportunities available in high school and may signal the relative ability of the high school to prepare its students for college. In addition, the number of Scholastic Aptitude Tests (SATs) sent to the UO by the graduating class is included in both models because it provides a measure of potential reputation effects and the size of a high-school support group on campus. Binary variables for private secular and religious high schools are included to control for possible differences in preparation, ability, and background between high-school students who attend public versus private schools.

New applicants generally apply for financial aid around the time they apply for university admission, but before they enroll. Potential re-enrollees apply for a renewal

of their aid after January 1st of their freshman year (i.e., the date the federal government begins accepting financial-aid applications), but well-before they re-enroll the following Fall term. Students that apply for financial aid must submit the Free Application for Federal Student Aid form (FAFSA) giving detailed information on their parents' financial condition. The information permits a university's financial aid office to estimate the amount of aid a student requires to fully cover the costs of a attending the university. This university-specific estimate is based on College Board and federal guidelines and ranges from a negative number for students whose financial resources exceed the cost of college to a positive number that indicates the amount of financial assistance required to cover college costs. Thus, financial eligibility is a proxy for financial need for those students who complete the FAFSA.

The bivariate probit model includes binary variables that equal one if a potential enrollee or re-enrollee completes a FAFSA form. In addition, the model includes a variable that equals the level of financial eligibility for students who complete a FAFSA and have a positive calculated need (i.e., an aid-eligible student) and zero otherwise, and a variable that equals the level of financial eligibility for students who complete a FAFSA and have a negative calculated need (i.e., a non-aid-eligible student) and zero otherwise. Jointly, these variables allow the response for students who complete a FAFSA to differ based on the extent to which they are or are not eligible for financial aid in comparison with the excluded group of students who do not complete a FAFSA.

Variation in decision to complete a FAFSA form and the level of financial eligibility over time aids the identification of the bivariate probit model.[2]

The model includes three types of financial aid, need-based subsidized aid, unsubsidized loans, and merit-based scholarships, that are likely to yield different enrollment and re-enrollment responses. Specifically, students who have positive financial eligibility may receive need-based aid that provides some form of subsidy. The model includes the amount of several types of subsidized aid from its most to least generous form, starting with grants (i.e., Pell grants, state supplemental grants, UO need grants, and tuition surcharges), subsidized loans (i.e., Perkins loans, Direct deferred loans, and Direct non-deferred loans), and college work study. In addition, unsubsidized loans that are university-brokered loans from private lending sources and merit-based scholarships that are funded by the university are included in the model.[3] Finally, the scholarship amount is also interacted with high-school GPA and FAFSA, to examine if the scholarship response depends on merit and/or need, which has been found in prior work (Dynarski, 1999; Singell and Stone, 2001). The provision of these aid amounts differ over time, which helps to identify the bivariate probit model.

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[2]Singell (2001) suggests that the decision to complete a FAFSA depends on both merit and need and is determined simultaneously with the application decision. On the other hand, because all students have applied for financial aid prior to the start of the school year, the FAFSA decision is predetermined at the time of enrollment. In fact, a fully-informed enrollment decision must occur after the decision to apply for financial aid, because students do not know what their actual aid package will be until after they apply for aid and the university has time to determine their financial aid package.

[3]A small proportion of the merit-based aid is a diversity-building scholarship that is restricted to under-represented groups: These diversity-building, merit-based scholarships are not distinguished from other scholarships in the data.

Finally, the model includes a binary variable that equals one for the 1998 freshman cohort, because the relative attractiveness of the UO may vary over time due to changes in the list tuition price and other factors. The tuition price is not used directly because tuition exhibits insufficient variation over two years to identify a price effect. However, the tuition price is indirectly included in the model because it is an important determinant of financial eligibility.[4]

Descriptive statistics for applicants, enrollees, and re-enrollees are provided in Table 1. The means show that 36.5 percent of applicants enroll, and that 80 percent of enrollees re-enroll.[5] The descriptive evidence suggests that there are attribute differences between applicants and those students who actually enroll. For example, lower-income students from Oregon who have lower SAT scores and receive larger amounts of all forms of financial aid are more likely to enroll. However, other factors appear to affect the re-enrollment decision. Specifically, higher income students, with lower financial eligibility, and higher SAT scores are more likely to re-enroll. Thus, the

[4]Following Honenack and Weiler (1975), several specifications include the distance from the home state to the UO and/or tuition at competing universities, which are insignificant. Distance may not work in this case, because the UO has historically recruited students from Hawaii and Alaska that are close to the UO in comparison to other mainland universities but still distant in an absolute sense. Likewise, Hoenack and Weiler (1979) also find that the enrollment demand for a specific university is not significantly related to the tuition at competing universities, in part, because tuition is highly correlated across universities both over time and within a particular cross section.

[5]The 1999-2000 CSRDE report indicates that premier private universities can have retention rates above 90 percent, whereas some urban-based public universities can have retention rates as low as 70 percent. Nonetheless, similar to the UO, CSRDE finds that most large state universities have retention rates around 80 percent and that the average first-year attrition rate from 294 U.S. colleges and universities is 20 percent.

descriptive evidence suggests that financial resources and academic ability are important determinants of whether a student continues his or her college education. The means also suggest that students who receive more financial aid are more likely to be retained. However, prior work suggests that need and non-need-based aid depend on both need and merit (e.g., Singell, 2001). Thus, the empirical work tests whether the provision of financial aid affects retention after controlling for need and merit.

V. Empirical Results

The bivariate probit estimates are robust across alternative specifications, but differ from those obtained by estimating simple probit models for enrollment and re-enrollment. Specifically, the basic bivariate probit specification presented below is compared to separate but equivalent probit specifications using a likelihood ratio test, which yields a chi square statistic of 147.4 that rejects their independence at the one percent significance level. The subsequent results show that joint estimation is important for the model of re-enrollment because the self-selection of enrollees significantly affects the marginal impact of the explanatory variables on retention. On the other hand, most of the marginal effects for the enrollment model do not differ significantly between a bivariate and univariate probit estimates beyond generally higher significance levels in the joint specification resulting from improved efficiency. Thus, the bivariate enrollment and re-enrollment results are presented separately to focus on the unique attributes of the two decisions and are compared to univariate probit estimates for enrollment and re-enrollment.

A. The Enrollment Model

The bivariate probit coefficient estimatess, marginal effects, and the correlation between the errors in the enrollment and re-enrollment models (Rho) are presented in Table 2, along with the marginal effects for an identical specification of a univariate probit model of enrollment for comparison. The correlation coefficient is positive, significant, and large in magnitude, which indicates that those unobserved attributes that make a student more likely to enroll also cause him or her to be more likely to re-enroll. This result could suggest that there are unmeasured factors, such as a parent who is alumni, that make a student relatively committed to the UO, but may also indicate that unobserved need and merit have similar impacts on the enrollment and re-enrollment decision. Alternatively, the high degree of correlation may reflect the exclusion of non-financial factors, which are unavailable in these data but have been found to be important in prior work (e.g., Langbein and Snider, 1999).

The marginal effects are numerically evaluated around the mean value of the explanatory variables using either the bivariate or univariate normal distribution, which includes the average value of Rho in the bivariate model. Nonetheless, despite the high degree of correlation between enrollment and re-enrollment, the magnitude of marginal effects are not statistically different between the bivariate and univariate models (except for the FAFSA variable). The similarity between the two models likely reflects the fact that self-selection is largely a problem for retention and not enrollment.

For brevity, the discussion primarily focuses on the bivariate probit results that account for the observed correlation between the enrollment and re-enrollment decision.[6]

The coefficient on the individual attributes are all significant at traditional levels, suggesting that the relative appeal of the UO varies across individual characteristics. In particular, female and non-white students whose peers have a higher median income are less likely to enroll, whereas instate students are more likely to enroll. The negative and significant coefficient on contact age suggests that motivated students who may research their higher educational opportunities more thoroughly and apply to more universities are less likely to enroll at the UO. At the same time, the positive and significant coefficient on the number of days between the application date and the first day of class in the Fall, suggest that persons who are interested in a particular school tend to apply earlier.

Attributes of the students high school also appear to significantly affect the enrollment decision. The positive coefficient on the number of SAT scores sent to the UO from a student's high school suggests that there are reputation effects. On the other hand, the negative coefficients on number of AP courses, and the binary variables for attendance at a private secular and religious high school indicate that students who come from more exclusive high schools are less likely to enroll at the UO.

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[6]Singell and Stone (2001) model the joint decision to apply and enroll, where the potential self-selection occurs at the enrollment stage. Although the results indicate that the application and enrollment processes are negative and significantly correlated, the affect of the self-selection on the marginal effects of the explanatory variables in the enrollment model are relatively small. Thus, self-selection appears to be relatively important for the decision to re-enroll.

The results also suggest that academic ability affects the enrollment decision. Specifically, students who have a higher high-school GPA are less likely to enroll. Although the coefficient on cumulative SAT is positive, the quadratic term is negative and indicates that students who have higher than a 960 cumulative SAT score (which is necessary for admission) are less likely to enroll. Thus, the results for the non-financial aid variables generally suggest that, all else equal, financially and academically able students are less likely to enroll at a large public university like the UO.

The financial-aid variables indicate that need may have non-linear effects on the decision to attend a large public university. Specifically, the positive marginal effect on FAFSA completion indicates that students who apply for financial aid are 3.7 percent more likely to enroll. This may suggest that applying for aid is a sign on interest in a particular university, controlling for the actual level of aid received, but may also indicate that large public universities like the UO tend to attract students who require some form of financial assistance. In fact, the marginal effect on FAFSA from the univariate probit model is negative and significant suggesting the needy students are less likely to enroll if the analysis does not account for the self-selection process. In addition, the negative coefficient for a positive financial eligibility level (i.e., aid-eligible students) and the positive coefficient for a negative financial eligibility level (i.e., non-aid-eligible students) implies that relatively wealthy and relatively poor aid applicants are both less likely to enroll. Thus, a large public university like the UO appears to attract middle income students who may have some financial need which limit their

ability to go out of state or to private universities, but not so much need that it limits their access to college.

All of the coefficients on the financial-aid variables are significantly different from zero, but do not indicate that all forms of aid increase the probability of enrolling. For example, a $1000 increase in need-based grants and subsidized loans is predicted to increase the probability of enrolling at the UO by 2.5 and 9.4 percent, respectively, whereas a $1000 increase in unsubsidized loans and college work study are predicted to reduce the probability of enrolling at the UO by 0.9 and 7.9 percent. These findings suggest that "inexpensive funding" for college encourages a student to enroll, but that "more expensive" funding that requires the student to work or that is unsubsidized discourages a student from enrolling. Again, the fact that subsidized loans have the largest marginal impact of any type of need-based aid on enrollment suggests that "middle-income" students tend to favor large public universities, because the most needy aid recipients receive grants and the least needy aid recipients receive unsubsidized loans, all else equal.[7]

The coefficients on the scholarship variable and its interaction with high-school GPA and FAFSA indicate that scholarships can significantly influence the decision to

[7]The bivariate probit model is also estimated including each grant and subsidized loan type separately. This alternative specification has no qualitative effect on the non-financial aid coefficients, which are highly robust to the specification. In addition, each type of subsidized loans has a positive significant effect on both enrollment and re-enrollment, whereas the individual grants are generally insignificant. This finding may suggest that state and institutional grants are used by the financial aid office to insure that students of equal need receive similar grant levels such that it is not the individual grant level but the combined grant levels that are important regarding enrollment.

enroll at the UO, but that this effect varies with both merit and need. Specifically, the marginal effect indicates that, all else equal, a $1000 scholarship increases the probability of enrolling at the UO by 28.2 percent. However, a student who completes a FAFSA has a 4.7 percent lower probability of enrolling for each $1000 of scholarship, such that a $1000 scholarship increases the probability of enrolling by 23.5 percent for students who have applied for aid. In addition, each point of high-school GPA lowers the response to a $1000 scholarship by 5.4 percent, such that a 4.0 GPA high-school student has a 3.5 percent lower probability of enrolling than the average UO applicant for each $1000 of scholarship. It follows that scholarships raise the probability of enrolling for all students, but yield a smaller enrollment response for more academically-able or financially-constrained students.

B. The Re-Enrollment Model

The coefficients and the marginal effects from the bivariate probit model of re-enrollment are presented in Table 3, along with the marginal effects from a univariate probit model of the re-enrollment decision of enrollees for comparison. Again, the marginal effects are evaluated at the mean of the explanatory variables; The bivariate results are also conditioned on the student enrolling as a freshman (i.e., the likelihood function is evaluated assuming that the student has enrolled) to make them directly comparable to the univariate results that focus on the retention behavior of enrollees. Table 3 shows that the magnitude, significance, and even the sign of the conditional marginal effects from the bivariate probit model can differ from those obtained using the univariate probit model, which highlights the importance of accounting for the selection

process: For brevity, the discussion focuses on the marginal effect differences for the financial aid variables, which are particularly pronounced.

In general, the coefficients on the explanatory variables in the re-enrollment model are significant and have the same sign as in the enrollment model, whereas the magnitude of the marginal effects are frequently smaller in absolute value. For example, the marginal effects of gender, nonwhite, median household income, contact age, days from apply to enroll, SAT sent to UO, and private secular and religious high schools all have the same sign as in the enrollment model, but with a smaller marginal effect. Thus, re-enrollment decision appears to respond to the same observed factors that determine the initial enrollment decision. This is important because it suggests that the attributes that attract a student to a university also tend to encourage him or her to stay at university such that policies directed at increasing enrollment are also likely to increase retention. On the other hand, the smaller marginal effects likely reflect the fact that most students re-enroll in their second year (i.e., 80 percent) and supports prior work that “non-economic” factors are important in the decision to re-enroll (Tinto, 1993; Wetzel et al, 1999).

On the other hand, a number of observed personal attributes and economic factors do have a large influence the decision to re-enroll. For example, academic performance is important to the re-enrollment decision. Specifically, the marginal effect of college GPA indicates a one point increase in grade point average in college increases the probability of enrolling by 6.5 percent, whereas the marginal effect for high-school GPA indicates a similar increase in high-school performance reduces the

probability of re-enrolling by 10.6 percent. Jointly, these results suggest that students who perform well in college are more likely to remain at the UO, but that students who expect to perform well in college (based on their performance in high school) have a lower retention probability. The marginal effect for cumulative SAT score also indicates that, for the relevant range of SAT scores (i.e., above 950), more-able students are less likely to be retained. Thus, even though students who perform well in college are more likely to stay, less academically-prepared students tend to be more likely to enroll in the subsequent year controlling for academic performance in college.[8]

Most of the financial-aid variables also have significant marginal effects. The marginal effect on FAFSA, indicates that students who complete a FAFSA during their second year are 17.6 percent more likely to re-enroll, which is nearly 6 times its effect on the initial enrollment decision. This result likely reflects that students who complete a FAFSA are revealing their intentions to stay and not necessarily that needy students are more likely to be retained: On the other hand, the transaction costs from changing schools and the smaller number of affordable alternatives may make it harder for needy students to change universities. At the same time, the conditional marginal effect for FAFSA is less than half that of the univariate estimate suggesting FAFSA completion is less important in the re-enrollment process once the model controls for fact that students who initially enroll are more likely to re-enroll. Nonetheless, similar to the

[8]A specification that includes the difference between the college and high-school GPA (not presented) indicates that students who perform relatively well in college in comparison to high-school are significantly more likely to re-enroll at the UO. In other words, the retention effect of academic performance appears to be conditioned on student expectations regarding performance.

enrollment findings, the marginal effects on the two financial eligibility variables suggest that financial aid applicants at the extreme ends of the income distribution are less likely to re-enroll. Thus, overall, the results indicate that "middle-income" financial aid applicants are the most likely to enroll and re-enroll at a large public university like the UO.[9]

The coefficients and marginal effects for all the components of the financial-aid package are significant at traditional levels with the exception of unsubsidized loans. A $1000 increase in grants or scholarships is predicted to increase the probability of re-enrollment by 1.3 and 4.3 percent, respectively, which is approximately half of their predicted effect on enrollment. At the same time, a $1000 of college work study is predicted to reduce the probability of re-enrollment by 5.7 percent, which is also smaller than its enrollment effect. Thus, students re-enrollment response to need-based aid appears to be smaller in magnitude than the initial enrollment response, but is also sensitive to the level of the subsidy similar to the enrollment decision.

The results show that scholarships are as important for retention as they are for the initial enrollment decision. Specifically, a $1000 scholarship is predicted to

[9]Specifications that include the FAFSA decision from the previous year in the re-enrollment model indicate that students who complete a FAFSA have both a greater commitment and less access to the UO. Specifically, the marginal effect of the current-year FAFSA increases to 23.1, which is 24 percent larger than when the FAFSA in the prior year is excluded. However, the marginal effect of the prior-year FAFSA indicates a 25.1 percent lower probability of re-enrolling. Thus, need and commitment appear to have offsetting effects on the probability of re-enrolling. In addition, the coefficient on the correlation coefficient (Rho) declines when the prior-year FAFSA is included in the model, suggesting that some of the positive correlation between the enrollment and re-enrollment decision is due to unmeasured need. Nonetheless, the predicted effect of the remaining explanatory variables do not change qualitatively.

increase the probability a student re-enrolls by 26.4 percent, which is not statistically different from its effect on enrollment. However, this effect is almost half that predicted by the univariate probit model. This result may suggest that the financial aid office uses some discretion to direct scholarships to those students who it perceives are on the margin for re-enrolling and for whom the scholarship may make the most difference, which could lead the univariate probit model to overstate the effect of scholarships on re-enrollment because it does not account for the selection process by the financial aid office. Thus, retention may depend on the self-selection process of both students and universities.

Finally, similar to the enrollment model, the response to a scholarship depends on both need and merit. Specifically, a student who has a one point higher high-school GPA or who has completed a FAFSA is 3.7 and 13.3 percent less likely to re-enroll, respectively, than an otherwise comparable student. Again, these effects are approximately half that predicted by the univariate probit model that suggests that GPA and FAFSA completion reduce the re-enrollment probability to a scholarship by 5.8 and 28.0 percent, respectively. However, in either case, the re-enrollment response to a scholarship is tempered by ability and need, which is consistent with the enrollment results. Thus, merit-based scholarships appear to have a cumulative effect over time that is likely to raise the graduation rate of financially-able students more those who are financially constrained, even after controlling for ability.

VI. Concluding Remarks

Prior retention studies largely ignore the effect of financial aid on college attrition, even though descriptive evidence suggests that it is the financially constrained who are most likely to exit college without a degree. This paper examines the effect of financial aid on the enrollment and re-enrollment decision. A sequential random-utility model of the decision to enroll and then re-enroll in college is developed and yields a bivariate probit model with self-selection, which explicitly accounts for the possibility that the unmeasured attributes of enrollees make them relatively committed to college. Detailed individual data for students at the University of Oregon are used to estimate the effects of financial aid on both the enrollment and re-enrollment decision, controlling for a student's attributes, ability, and background. This paper extends prior work by using the unique detail of institution-specific data to examine that the effect of financial aid on the re-enrollment decision, but also exploits the sequential college completion process to condition the re-enrollment probabilities for college selection such that the implications for retention may be broader than is typical of a single-institution study. Overall, the results indicate that a university tends to retain the type of students whose attributes make them most likely to enroll in the first place.

The financial aid results indicate that need-based aid improves retention, but that its level effectiveness varies with need. Specifically, grants (i.e., Pell grants, state supplemental grants, and need-based institutional grants) increase the retention probability by 1.3 percent per $1000, whereas subsidized loans increase the retention probability by 4.3 percent per $1000. Thus, financial aid does appear to increase retention on the margin for needy students. However, because grants are provided to

relatively needy students in comparison to those who exclusively receive subsidized loans, the smaller marginal effect for grants relative to subsidized loans suggests that the disadvantage of being a low-income student is not offset by their access to grants. Moreover, the level of college work study and unsubsidized loans are found to actually lower the probability of retention.

Merit-based scholarships have the largest retention effects of any type of aid, increasing the retention probability by as much as 26 percent per $1000. On the other hand, the response to scholarship aid of students who apply for need-based aid is nearly half that of students who do not, suggesting that the merit-based aid has the greatest retention benefits for well-to-do students. The fact that a similar result is found for the enrollment decision suggests that the cumulative effect of merit-based aid over a college career could significantly lower the graduation rate of needy students below that of *equally able* students who do not require aid.

Overall, the findings in this paper suggest that academically able, but financially needy, students do not have equal access to a college degree even though the lion's share of financial aid is directed at needy students. Moreover, Ehrenberg and Mavros (1995) find that financial aid at the graduate level, which is almost exclusively merit based, increases both the speed and likelihood of completing a degree. Thus, given the well-document (and possibly increasing) return to a higher degree, the recent greater emphasis on non-need-based aid at both the governmental and institutional level could increase income inequality in the United States. Furthermore, Hoxby and Terry (1999) find increasing income inequality among college-educated workers, which

they partly attribute to the increasing likelihood that high-aptitude students attend demanding, costly universities. Thus, a greater emphasis on non-need-based aid could exacerbate income inequality simply by insuring greater segregation by income among the quality spectrum of universities.

Table 1 Descriptive Statistics for 1997 and 1998 Freshmen Cohorts[a]

	Applicants		Enrollees		Re-Enrollees	
	Mean	Std. Error	Mean	Std. Error	Mean	Std. Error
Enrollment	0.3653	0.4815	1.0000	0.0000	1.0000	0.0000
Re-Enrollment	0.2926	0.4550	0.8010	0.3993	1.0000	0.0000
Gender	0.5808	0.4934	0.5675	0.4955	0.5698	0.4952
Nonwhite	0.2158	0.4114	0.1921	0.3940	0.1923	0.3942
Median Household Income	39.1390	16.4462	34.1030	13.0531	34.3494	13.3161
Contact Age	16.7521	0.7220	16.7066	0.7906	16.6928	0.7960
Days from Apply to Enroll	240.6506	42.9481	235.7933	48.5730	237.3612	47.9774
In-State Student	0.4015	0.4902	0.6367	0.4810	0.6395	0.4802
AP Courses Offered	8.4824	6.0456	7.1959	5.6496	7.3342	5.6885
SAT Exams Sent to UO	32.0801	33.2249	43.5860	36.1775	44.4594	36.3534
Private Secular	0.1150	0.3190	0.0890	0.2847	0.0896	0.2856
Private Religious	0.0778	0.2678	0.0332	0.1791	0.0308	0.1729
High School GPA	3.3854	0.4074	3.3607	0.4061	3.3825	0.4086
Cumulative SAT Score	1.1316	0.1466	1.1051	0.1467	1.1119	0.1455
College GPA	-	-	2.8204	0.6975	2.9437	0.5738
Completed FAFSA	0.5818	0.4933	0.6665	0.4715	0.6555	0.4753
Positive Financial Eligibility	3.7601	5.6874	3.8979	5.1458	3.5099	5.1490
Negative Financial Eligibility	-2.7166	9.2735	-2.6509	8.7738	-1.7343	7.0195
Grants	0.4679	1.2556	0.7081	1.5270	0.7567	1.5698
Subsidized Loans	1.7640	1.8025	2.1242	1.8262	2.8412	2.4244
Unsubsidized Loans	4.7120	5.8869	4.3150	4.9280	4.8439	5.0827
College Work Study	0.5768	0.9866	0.6278	0.9820	0.6892	1.0134
Scholarships	0.2529	0.6780	0.2351	0.6959	0.3098	0.8214
1998 Cohort	0.5105	0.4999	0.5019	0.5001	0.5037	0.5001
Number of Observations	10647		3889		3115	

a - SAT score measured in units of a 1000. All dollar denominated variables are in units of a $1000.

Table 2 Bivariate Probit Estimates for the Probability of Enrolling at the UO

Variables	Coefficient	Std. Error	Bivariate Marginal Effect	Std. Error	Univariate Marginal Effect	Std. Error
Constant	0.8201	0.6759	-	-	-	-
Gender	-0.0574*	0.0286	-0.0211**	0.0105	-0.0177*	0.0105
Nonwhite	-0.1566**	0.0342	-0.0561**	0.0119	-0.0484**	0.0122
Median H/H Income	-0.0083**	0.0011	-0.0030**	0.0004	-0.0036**	0.0004
Contact Age	-0.0468**	0.0189	-0.0171**	0.0069	-0.0202**	0.0070
Days from Apply to Enroll	0.0009**	0.0003	0.0003**	0.0001	0.0003**	0.0001
Instate	0.4696**	0.0386	0.1847**	0.0143	0.1887**	0.0141
AP Courses Offered	-0.0062*	0.0029	-0.0022**	0.0011	-0.0032**	0.0010
SAT Sent to UO	0.0046**	0.0005	0.0017**	0.0002	0.0017**	0.0002
Private Secular	-0.1661**	0.0438	-0.0590**	0.0151	-0.0677**	0.0150
Private Religious	-0.2820**	0.0603	-0.0972**	0.0194	-0.1071**	0.1921
High-School GPA	-0.5642**	0.0419	-0.2063**	0.0153	-0.1907**	0.0155
Cumulative SAT[a]	3.1001**	0.1010	1.3444**	0.0379	1.0910**	0.0307
Cumulative SAT Squared[a]	-0.0018**	0.0004	-0.0007**	0.0002	0.0006**	0.0002
1998 Cohort	-0.0198	0.0274	-0.0083	0.0099	-0.0089	0.0099
FAFSA	0.1016*	0.0609	0.0370*	0.0221	-0.0794**	0.0249
Positive Financial Eligibility	-0.0106**	0.0041	-0.0038**	0.0015	-0.0041**	0.0017
Negative Financial Eligibility	0.0031**	0.0015	0.0011**	0.0005	0.0011*	0.0006
Grants	0.0690**	0.0137	0.0252**	0.0050	0.0278**	0.0054
Subsidized Loans	0.2565**	0.0196	0.0938**	0.0072	0.1069**	0.0077
Unsubsidized Loans	-0.0249**	0.0041	-0.0091**	0.0015	-0.0097**	0.0016
College Work Study	-0.2185**	0.0250	-0.0799**	0.0091	-0.0969**	0.0099
Scholarships	0.7718**	0.3225	0.2823**	0.1180	0.2438*	0.1255
Scholarships*GPA	-0.1483*	0.0841	-0.0542*	0.0307	0.0552*	0.0327
Scholarships*FAFSA	-0.1294**	0.0507	-0.0473**	0.0185	-0.0025	0.0194
Rho	0.9036**	0.0200	-	-	-	-
Log-Likelihood	-6817.1960		-	-	-	-

** - indicates significant at the 5 percent level; * - indicates significant at the 10 percent level.
a - Coefficient and marginal effect multiplied by 1000.

Table 3 Bivariate Probit Estimates of the Probability of Re-Enrolling at the UO

Variables	Coefficient	Std. Error	Bivariate Marginal Effect (Given Enroll=1)	Std. Error	Univariate Marginal Effect	Std. Error
Constant	-2.7823**	1.0334	-	-	-	-
Gender	-0.1091**	0.0433	-0.0179**	0.0071	-0.0327**	0.0100
Nonwhite	-0.1886**	0.0523	-0.0285**	0.0076	-0.0214*	-0.0105
Median H/H Income	-0.0009	0.0017	-0.0001	0.0002	0.0015**	0.0003
Instate	0.3998**	0.0547	0.0690**	0.0109	0.0144	0.0122
Contact Age	-0.0398	0.0285	-0.0064	0.0046	-0.0050	0.0062
Days from Apply to Enroll	0.0011**	0.0004	0.0002**	0.0001	0.0001	0.0001
AP Courses Offered	0.0057	0.0043	0.0008	0.0007	0.0026**	0.0009
SAT Sent to UO	0.0041**	0.0007	0.0007**	0.0001	0.0001	0.0001
Private Secular	-0.0369	0.0666	-0.0061	0.0104	0.0284*	0.0169
Private Religious	-0.2640**	0.0932	-0.0370	0.0113	-0.0177	0.0176
High-School GPA	-0.6542**	0.0648	-0.1063**	0.0105	-0.1274**	0.0139
Cumulative SAT[a]	7.0630**	1.5611	1.1440**	0.0270	1.4624**	0.3671
Cumulative SAT Squared[a]	-0.0037**	0.0007	-0.0006**	0.0001	-0.0008**	0.0017
College GPA	0.4014**	0.0369	0.0647**	0.0035	0.1723**	0.0111
1998 Cohort (in 1999)	-0.0023	0.0407	0.0004	0.0066	-0.0041	0.0789
FAFSA	0.8734**	0.1181	0.1758**	0.0354	0.3804**	0.0789
Positive Financial Eligibility	-0.0151	0.0117	-0.0024	0.0019	-0.0025	0.0038
Negative Financial Eligibility	0.0081**	0.0037	0.0013**	0.0006	0.0016	0.0011
Grants	0.0776**	0.0312	0.0125**	0.0051	0.0109	0.0098
Subsidized Loans	0.2657**	0.0401	0.0428**	0.0076	0.0621**	0.0140
Unsubsidized Loans	-0.0120	0.0102	-0.0019	0.0016	0.0016	0.0033
College Work Study	-0.2446**	0.0619	-0.0394**	0.0106	-0.0566**	0.0202
Scholarships	1.6342**	0.4245	0.2636**	0.0707	0.4746**	0.1445
Scholarships*GPA	-0.2310**	0.1082	-0.0372**	0.0176	0.0577*	0.0347
Scholarships*FAFSA	-0.8263**	0.2242	-0.1333**	0.0379	0.2798**	0.0853
Log-Likelihood	-6817.1960		-	-	-	-

** - indicates significant at the 5 percent level; * - indicates significant at the 10 percent level.
a - Coefficient and marginal effect multiplied by 1000.

References

Angrist, J.D., (1993). "The Effect of Veterans Benefits on Education and Earnings." *Industrial and Labor Relations Review*, 46:4, 637-52.

Becker, W. E., (1990). "The Demand for Higher Education." in *The Economics of American Universities*, pp 155-188, Eds S. Hoenack & E. Collins. NY: State University of New York Press.

Duffy, E.A. & Goldberg, I. (1998). *Crafting a Class: College Admissions and Financial Aid, 1955-1994*. Princeton: Princeton University Press.

Dynarski, S.M. (1999). "Does Aid Matter? Measuring the Effect of Student Aid on College Attendance and Completion." Harvard University Working Paper.

-------- (2000). "Hope for Whom? Financial Aid for the Middle Class and Its Impact on College Attendance." National Tax Journal, 53:3 629-61.

Card, D. & Lemieux, T. (2000). "Dropout and Enrollment Trends in the Post-War Period: What Went Wrong in the 1970s?" NBER Working Paper.

Curs, B. & Singell, L.D., Jr. (2001). An Analysis of the Application and Enrollment Process for In-state and Out-of State Students at a Large Public University, forthcoming *Economics of Education Review*.

Ehrenberg, R.G. & Sherman, J.R. (1984). "Optimal Financial Aid Policies for a Selective University." *Journal of Human Resources*, 19:2, 203-30.

Ehrenberg, R.G. & Mavros, P.G. (1995). "Do Doctoral Students' Financial Support Patterns Affect Their Times-to-Degree and Completion Probabilities?" *Journal of Human Resources*, 30:3, 581-609.

Ellwood, D. & Kane, T. (1999) "Who is Getting a College Education? Family Background and the Growing Gap in Enrollment," Harvard University Working Paper.

Hoenack, Stephen A. and William C. Weiler (1975) Cost-related tuition policies and university enrollments. *Journal of Human Resources*, 10, 332-60.

Hoenack, S. A. & Weiler, W.C. (1979) "The Demand for Higher Education and Institutional Enrollment Forecasting." *Economic Inquiry*, 17, 89-113.

Hoxby, C. & Terry, B. (1999) “Explaining Rising Income and Wage Inequality Among the College-Educated.” National Bureau of Economic Research Working Paper, No. 6873.

Kane, T. (1994). “College Entry by Blacks since 1970: The Role of College Costs, Family Background, and the Returns to Education.” *Journal of Political Economy*, 102:5 878-911.

Langbein, L.I. & Snider, K. (1999). “The Impact of Teaching on Retention: Some Quantitative Evidence.” *Social Science Quarterly*, 80:3, 457-72.

Leslie, L.L & Brinkman, P. T. (1987) Student Price Response in Higher Education: the Student Demand Studies. *Journal of Higher Education*, 58, 181-204.

Light, A. (1995). “The Effect of Interrupted Schooling on Wages.” *Journal of Human Resources*, 30:3, 472-502.

Light, S. & Strayer, W. (2000). “Determinants of College Completion.” *Journal of Human Resources*, 35:2, 299-332.

Manski, C.F. & Wise, D.A. (1983) *College Choice in America*, Cambridge: Harvard University Press.

Marcus, R.D. (1989). “Freshmen Retention Rates at U.S. Private Colleges: Results from Aggregate Data.” *Journal of Economic and Social Measurement*, 15:1, 37-55.

McPherson, M.S. (1998). *The Student Aid Game*. Princeton: Princeton University Press.

McPherson, M. S. & Schapiro, M.O. (1991) “Does Student Aid Affect College Enrollment? New Evidence on a Persistent Controversy.” *American Economic Review*, 81, 309-318.

-------- (1994). “Merit Aid: Students, Institutions, and Society.” Consortium for Policy Research in Education Research Report No. 30. August.

Meng, C. L. & Schmidt, P. (1985). “On the Cost of Partial Observability in the Bivariate Probit Model.” *International Economic Review*, 26, 71-85.

Robst, J., Keil, J., & Russo, D. (1998). The Effect of Fender Composition of Faculty on Student Retention,” *Economics of Education Review*, 17:4, 429-39.

Singell, L & Stone, J.A. (2001). “The Good, the Poor, and the Wealthy: Who Responds Most to College Financial Aid? “ forthcoming *Bulletin of Economic Research*.

Singell, Larry D., Jr., (2001) “Merit, Need, and Student Self Selection: Is there Discretion in the Packaging of Aid at a Large Public University?,”forthcoming *Economics of Education Review*.

Selingo, J. (1999). “Copying Georgia’s HOPE: States That are Weighing Tuition-Scholarship Proposals.” *The Chronicle of Higher Education*, April 16, A37.

Tinto, V. (1993). *Leaving College*, University of Chicago Press, Chicago, IL.

Venti, S.F. & Wise, D.A. (1983). “Individual Attributes and Self-Selection of Higher Education: College Attendance versus College Completion.” *Journal of Public Economics*, 21:1, 1-32.

Wetzel, J.N., O’Toole, D. & Peterson, S. (1999) “Factors Affecting Student Retention Probabilities: A Case Study, Journal of Economics and Finance, 23:1, 45-55