



School of Business

**Finance and Economics Department
Working Paper 05-07**

**Determinants of Student Loan:
Evidence from a Simultaneous Tobit Model**

Shoumi Mustafa

and

Faridul Islam

Determinants of Student Loan: Evidence from a Simultaneous Tobit Model*

Shoumi Mustafa

Post Doctoral Researcher
Office of Student Financial Aid
The Ohio State University
Columbus OH 43210
Phone: 614-292-2314
E-mail: smustafa@fa.adm.ohio-state.edu

Faridul Islam

Associate Professor
Department of Finance and Economics
Utah Valley State College
Orem, UT 84058-5999
Phone: 801-863-8858
E-mail: islamfa@uvsc.edu

Abstract

We estimate the determinants of student loans within a simultaneous tobit framework. We ask whether family resources or tuition has a larger impact on the amount of loan. Depending on the answer, existing loan-based federal financial aid policies can have radically different implications. When family resources are relevant, poor students borrow more, and earn smaller returns to education. If tuition dominates, the ease of borrowing may facilitate student choices. We find that loans are more sensitive to marginal changes in tuition, but total impacts of the two factors are remarkably similar. We also find a positive ability-tuition relationship, suggesting that high-ability students from low-income families borrow larger amounts.

Key words: Student loan, simultaneous tobit model, tuition, college choice, family income.

JEL Classification: C35, I21, I22

*An earlier version of this paper was presented at the 80th Annual Conference of the Western Economic Association, held in San Francisco, July 4-8, 2005.

Determinants of Student Loan: Evidence from a Simultaneous Tobit Model

I. Introduction:

During the decade of 1990's, college tuition and fees rose faster than the growth of grants and scholarships offered to students.¹ Because tuition growth outpaced also inflation and the growth in median family income, many students were forced to increase their reliance on loans. During this time, the proportion of undergraduates taking student loans crossed the 50% mark, and average loan size reached new highs. In 1999-2000, the average borrower among four-year college students had accumulated a debt burden of between \$25,000 and \$32,000 at graduation.² Debt repayments claimed between 5 and 15% of post-college pre-tax earnings of the fresh graduates, echoing the concern expressed in Baum and O'Malley (2003).

The size of the debt and attendant repayment difficulties have attracted research interests to understanding the impact of loans on college enrollment and persistence (Schwartz, 1985, Moore *et al*, 1991; Reyes, 1995), progress to post-graduate studies (Monks, 2001), and career choice (Colquitt *et al*, 1996; Minicozzi, 2005). Researchers have also investigated the determinants of loan repayment (Knapp and Seaks, 1992). Surprisingly, there have been few attempts to analyze what motivate some students to borrow very large amounts, in the first place.³ Admittedly, tuition hikes are likely to be behind the recent spurt in borrowing. However, we need to recognize that all students do not borrow identical amounts. In fact, loan amounts vary widely by borrowers' family income and college costs. Against this backdrop, this paper identifies and analyzes the determinants of student loans. In particular, we focus on family

¹ Grants are usually need-based while scholarships are allocated mostly on merit. In the remainder of the paper, we refer to both as grants, defining it as financial aid not requiring repayments or service in return.

² The 1999-2000 graduates borrowed \$6,238 per year on average (Wei and Berker, 2004). For college spells of four and five years, debt burdens are \$24,952 and \$31,190, respectively.

resources and costs of attendance, and ask which of the two has a larger effect on borrowing. We also ask whether borrowing is related to students' efforts of smoothing consumption over time.

It is important to draw the distinction between family resources and college costs, two oft-cited determinants of student loans. While students have little control over family resources, costs of attendance, to a large extent, are outcomes of the choices they make. For example, tuition, the major cost component has a dispersed distribution in each of the states, and students can choose from a variety of colleges that vary widely by cost and quality. Similarly, the choice over attending an in or out-of-state college also adds considerable variations to the costs.

Judged on the basis of the respective effects of family resources and attendance costs (on loan amounts), one can arrive at radically different conclusions about the role of the current system of financial aid that has evolved to rely heavily on loans.⁴ For example, if family income is the foremost determinant of borrowing then poor students have to borrow larger amounts, and are destined to receive strictly smaller net returns to higher education, relative to their affluent but otherwise identical counterparts. The existing loan-based financial aid system may thus be interpreted as sustaining intergenerational income inequality, and even intensifying it if borrowing costs dissuade low-income individuals from pursuing higher education altogether.⁵ On the other hand, if large borrowing is essentially a result of students choosing to attend expensive, high-quality colleges when cheaper alternatives are available, the ease of borrowing under the current system may be viewed as facilitating such choices.

This paper explores the determinants of borrowing using a two-period utility maximization model in which loans bridge the gap between current (college) costs and resources,

³ Finnie and Ross (1996) and Schwartz and Finnie (2002) analyze borrowing of Canadian students.

⁴ At its inception in 1965, federal financial aid comprised mostly of grants. Over the next three decades, loans gradually became the mainstay of federal aid. See Gladieux and Hauptman (1995).

and also allow inter-temporal substitution of consumption. In the ensuing empirical specification, loan amounts depend on family resources, tuition net of grants (net tuition), and expected future earnings. Because of the presence of a large number of students with a zero loan amount in our sample, the econometric specification follows a tobit model. **To** Because students choose rather than take tuition as given, net tuition is likely to be endogenous to loan amounts. We take explicit account of the possible endogeneity, and implementing Amemiya's (1979) Generalized Least Squares estimates. Our data are taken from the Second Follow-up Survey of the Beginning Post-secondary Students Longitudinal Study, 1994.⁶

Comment [F11]:

The paper examines the determinants of student loans of first-time freshman four-year college students who graduated within the five years of initial college enrollment. Although the population of student borrowers represents a smorgasbord of individuals including graduates and dropouts from both two and four-year colleges, the eventual four-year college graduate is by far the heaviest borrower. Despite the overwhelming importance of the topic to educators and policy makers, it has received inadequate research interest. Our effort thus fills an important gap.

Our result shows that borrowing is very sensitive to marginal changes in net tuition: for a \$1,000 increase in net tuition, average loan amounts increase by \$161. A thousand dollar loss in family income by contrast, increases average loans by only \$16 on the margin. While these results attribute the recent surge in student loans to phenomenal increases in tuition, we find that the total contributions of net tuition and family income are both large and very similar.⁷ We conclude that students sharing both features, i.e., off less affluent families and attending expensive colleges borrow the largest amounts.

⁵ Subsidized federally loans cost less than the market rate. However, the limited availability of these loans forces students to approach substantially costlier commercial lenders.

⁶ The BPS:90/94 is from the National Center on Education Statistics of the Department of Education.

⁷ We calculate total contributions by combing sample ranges of the two factors with the respective marginal effects.

We also use SAT scores, the ability indicator as a proxy for expected future earnings. Our results show that SAT scores do not affect loan amounts directly, prompting a negation of consumption smoothing as a motive for borrowing. However, SAT scores have a strong, positive relationship with net tuition. The indirect influence of ability (SAT scores) on loans (via tuition) suggests that high ability students do borrow more. And they do so to attend expensive colleges, possibly to take advantage of any earnings effect of college quality.

The paper is organized as follows. Section II develops the behavioral and the econometric models, data descriptions are in section III. Our results and concluding remarks are in sections IV and V, respectively.

II. Methodology:

a. The Behavioral Model:

We use a two-period utility maximization model in exploring the borrowing behavior of four-year college graduates. Periods 1 and 2 denote the in-college and the post-graduation time, respectively, and in both periods, students can work for pay. We assume that conditional on enrolling in a four-year college, students choose optimum levels of leisure (s_t , $t = 1, 2$) to maximize discounted lifetime utility.⁸ Students lacking resources in period 1 resort to borrowing. Borrowing may also be motivated by individuals' efforts to substitute consumption between current and future periods, regardless of the nature of the short-term resource constraint. Loans are paid back with interest in period 2.

We assume utility to be separable over time. Period 1 wages are normalized to 1, and we denote period 2 expected wages with w_2^e . The market rate of interest is r , and borrowing costs are denoted by θ . The question involves solving the problem.

$$\text{Max } U(s_1) + \beta U(s_2) \quad [0 < \beta < 1]$$

Subject to, $[-(L - s_1) + NT - \delta FI] - D + [1/(1+r)]*[-w_2^e(L - s_2) + D(1+\theta)] = 0$,

and, $s_t \geq 0$, $t = 1, 2$

Students receive wage income $(L-s_1)$ and $w_2^e(L-s_2)$ in periods 1 and 2, respectively, where L measures the maximum available time in each period. They pay tuition net of grants (NT).⁹ Students also receive a fraction of family income (δFI), where FI is annual family income and $0 \leq \delta < 1$. They borrow D in period 1, and pay back $D*[(1+\theta)/(1+r)]$ in period 2. Optimum values of s_1 and s_2 are obtained by solving the problem, and the amount of loan consistent with maximum lifetime utility is found from the budget constraint. From the sum of amounts borrowed and paid back, i.e., $[D*[1/(1+r)](r-\theta)]$, loan amounts depend crucially on $(r-\theta)$. We consider three different scenarios.

Case 1: $r > \theta$. Borrowing expands the budget set and thus increases lifetime utility. In the absence of exogenous restrictions, individuals are likely to borrow an unlimited amount.

In reality, loan amounts are finite primarily because of exogenous restrictions. Although interest rates associated with subsidized federal loans are typically lower than the market rate, federal loans are subject to caps. Those in need of additional funds can seek higher-interest bearing unsubsidized loans or even more expensive commercial educational loans, giving rise to a positive relationship between loan amounts and borrowing costs. Borrowing costs may also include non-pecuniary costs. As a result, $r > \theta$ may not hold even if the market rate of interest exceeds observed borrowing rates.

Case 2: $r = \theta$. The amount of loan is indeterminate, as borrowing does not affect the budget set. The amount of loan, therefore, depends on chosen values of s_1 and s_2 .

⁸ The model can accommodate other choices, but without adding insights into the borrowing process.

⁹ We relax the assumption of a given NT in our econometric specification.

Case 3: $r < \theta$. Individuals would like to increase lifetime utility by borrowing negative amounts (lending). We exclude the possibility of lending in view of transaction costs.

We explore the comparative static properties of loans using case 1 and case 2. Assume that the individual in question borrows a given amount in equilibrium. For an exogenous increase in net tuition (NT), the amount borrowed must increase to satisfy the budget constraint. By the same token, a reduction in family contribution (δFI) should increase the amount of loan.

In illustrating how loans respond to attempts of inter-temporal substitution of consumption, we use the first-order conditions of the optimization problem. For interior solutions of s_1 and s_2 , $[\delta U/\delta s_1]/[\delta U/\delta s_2] = [\beta(1+r)](1/w_2^e)$, i.e., in equilibrium, the marginal rate of substitution between period 1 and period 2 leisure equals the discounted (inverse) expected wage. An increase in expected wages causes the right-hand side to fall, and equilibrium is restored only through adjustments in the left-hand side. We may have a reduction in $[\delta U/\delta s_1]$ implying an increase in s_1 , or an increase in $[\delta U/\delta s_2]$, consistent with a reduction in s_2 . In either case, *ceteris paribus*, the amount borrowed has to increase to satisfy the budget constraint.

b. Empirical Specification:

Based on the behavioral model, the utility maximizing level of loan (D^*) can be positive, zero, or negative. Under the assumption of high transaction costs, individuals do not lend (borrow negative) when $D^* < 0$. For such cases the observed loan amount is zero. We assume utility to be linear in its arguments for suitable transformations, and express loan amounts as a linear function of its determinants.

$$D^* = ZB + u$$

$$D = D^* \text{ if } D^* > 0, \text{ and } D = 0 \text{ if } D^* \leq 0 \quad (2.1)$$

where, u is a random error term. Under assumption of $u \sim N(0, \sigma^2)$, the system of equations (2.1) defines a type I tobit model.

Our goal is to specify an estimable equation for loans in which family resources, net tuition, and expected post-college wages appear as relevant determinants. We use two different measures of family resources. The first, annual family income is from 1989-90, the first year students in our sample attend college (NOT CLEAR). Because income is subject to year-to-year fluctuations, we complement it with measures of parental education, an indicator of the permanent family income. Both variables measures family resources, and exert negative influences on the amount of loan. The next relevant determinant is net tuition (NT). We define net tuition as the difference between the published sticker price of a college that the student attends, and grants and scholarships s/he receives. *Ceteris paribus*, NT is expected to have a positive impact on borrowing.

Expectations of post-college wages in part, determine the amounts students borrow. Since expected wages are not observable, we must rely on proxy variables. Our first proxy is based on the notion that wages are functions of (individual) productivity. In line with the human capital theory, we argue that college attendance and graduation add to individual productivity, and assume such addition to be increasing in students' innate ability. We consider the pre-college SAT scores as a measure of (innate) ability and use the variable as a proxy for expected future wages. Because of the positive relationship between ability and expected wages, SAT scores are likely to exert a positive influence on loan amounts.

Future earnings depend also on the length of time students expect to stay active in the post-college labor market. Older students have a shorter period to work after graduation, and thus

may borrow smaller amounts. As a proxy for expected future earnings, age at college entry is likely to have a negative impact on the amount of loan.

Expectations of future wages may depend on wage discriminations based on gender or race. Because men typically earn more than comparable female workers, , male students may borrow more. By the same token, black students may borrow less relative to the whites. However, gender and race are indicators of individuals' preferences as well, and the race variable (black=1) is also negatively correlated with family income, which is itself a determinant of borrowing. As a result, the impacts of gender or race (on loans) may not be known a priori.

So far, we have not entertained borrowing costs as a determinant of loan amounts. We do not have data on total loans disaggregated by rates of interest, and we cannot use the latter to control for borrowing costs. Instead we rely on the implications of eligibility conditions for subsidized federal loan - the cheapest education loan.

Federal regulations dictate that a student is eligible to receive subsidized federal loans only if she satisfies the following condition: Total Cost of Attendance [(TC) – Grants & Scholarships (G&S) – Expected Family Contributions (EFC)] > 0, where EFC is determined solely by the Department of Education (DOE).¹⁰

Looking at the eligibility condition of $(TC - G\&S - EFC) > 0$, it is clear that students qualify for subsidized federal loans only if they have strictly positive unmet needs after exhausting family resources and grants (and scholarships). Given that the growth of grants etc have failed to keep pace with the growth of tuition in the 1980s and, beyond, the costs of attendance (tuition plus cost of living) have stayed ahead of the former regardless of which college a student attends. In other words, for an individual student, the $(TC - G\&S)$ component is always strictly greater

than zero. As a result, whether a student is eligible for subsidized loan, [i.e., $(TC-G\&S-EFC) > 0$], depends pivotally on EFC.¹¹ We exploit this piece of information in our measure of borrowing costs. By hypothesis, EFC should have a negative influence on the amount of loan.¹²

Based on the foregoing discussion, we specify the equation for the annual average loan amount for individual i as follows.

$$\text{Loan}_i^* = \beta_1' W_i + \beta_2' A_i + \beta_3 EFC_i + \gamma NT_i + u_i \quad (2.2)$$

$$\text{Loan}_i = \text{Loan}_i^* \text{ if } \text{Loan}_i^* > 0, \text{ and } \text{Loan}_i = 0, \text{ if } \text{Loan}_i^* \leq 0$$

In equation (2.2), W is a vector of family income and parental education indicator, A is a vector of individual characteristics including SAT scores, age, and indicators of gender, race, marital status, and status of financial dependence. NT is tuition net of grants, and EFC is expected family contribution.

c. Econometric Considerations

The behavioral model treats net tuition (NT) as exogenous to loans. However, NT is likely to be endogenous because factors that determine loan amounts also guide students' choice of college, and net tuition. Should there be factors that simultaneously determine loan amounts and net tuition but remain unobserved by researchers, then NT has a non-zero correlation with the error term in equation (2.2). Unless the endogeneity is explicitly taken into account, parameter estimates from the model in equation (2.2) are inconsistent.

In view of the above, we propose the following equation for net tuition.

$$NT_i = \alpha_1' W_i + \alpha_2' A_i + \alpha_3 EFC_i + \alpha_4 S_i + v_i \quad (2.3)$$

¹⁰ Using a need analysis formula set by Congress, DOE obtains EFC using information on factors including income, assets, number of dependents currently in college etc., reported in students' financial aid application. See <http://finaid.org/calculators/finaidestimate.phtml> for a detailed description.

¹¹ Students ineligible for federal subsidized loans can receive student loans of the more expensive varieties, namely the federal unsubsidized loan or education loans from commercial bank.

¹² EFC is non-linear in family income, and thus identified in the loan equation.

Where, W , A , and EFC also appear in the loan equation, but S , the instrumental variable does not. Taken together, equations (2.2) and (2.3) define a simultaneous tobit model of loan amounts. The joint distribution of u_i and v_i is given by, $(u_i, v_i) \sim N(0, \Sigma)$, where Σ is a symmetric 2×2 matrix with typical element σ_{ij} , $i = 1, 2$ and $j = 1, 2$.

In reduced form, the system of equations is presented as follows.

$$\text{Loan}_i^* = \Pi_1 X_{1i} + \eta_{1i} \quad (2.4)$$

$$\text{Loan}_i = \text{Loan}_i^* \text{ if } \text{Loan}_i^* > 0, \text{ and } \text{Loan}_i = 0, \text{ if } \text{Loan}_i^* \leq 0$$

$$\text{NT}_i = \Pi_2 X_{2i} + \eta_{2i} \quad (2.5)$$

where, X_1 is a vector consisting of W , A and EFC , and X is a vector that includes X_1 and S as its components.

The estimation of a tobit model within a simultaneous equation framework is allowed under a number of estimators, including the two-step estimator of Nelson and Olson (1977), Amemiya's (1979) Generalized Least Square estimator (AGLS), and the two-step estimator of Smith and Blundell (1986). Because Amemiya's method is more efficient, we chose the AGLS estimates. However, we implement Newey's (1987) formulation of the AGLS estimates, recognizing that it is different from what Amemiya had prescribed.

In Amemiya's original formulation, tobit and OLS were to be applied to equations (2.4) and (2.5), respectively to obtain estimates of the reduced form parameters, namely Π_1 and Π_2 . Structural parameters of the model in equation (2.2) are then estimated by applying Generalized Least Squares (GLS) on the reduced form parameters (Π_1 on Π_2). Newey (1987) proposed a simpler procedure. His formula can be used to obtain the AGLS estimates of structural parameters from a two-step process. Under this, the predicted values of endogenous explanatory

variable (NT) are used in the second step of the tobit model. The choice of Newey's formulation is dictated by ease of computation.¹³

We provide a formal test for endogeneity of net tuition, following Smith and Blundell (1986). The test is built around the intuition that unobserved determinants of loan amounts are correlated with some, but not all of the unobserved determinants of net tuition. Hence, if we control for the influence of the unobservables that determine both NT and loans in equation (2.2), then NT is not correlated with the error term. Following this argument, we decompose the error term in equation (2.2) as follows.

$$u_i = \rho v_i + \zeta_i \quad (2.6)$$

where, v_i is the error term from equation (2.3), and $\rho = (\sigma_{12}/\sigma_{22})$ with σ_{ij} denoting the typical element of the variance matrix given for equations (2.2) and (2.3). Substituting equation (2.6) in equation (2.2), we obtain the following.

$$\text{Loan}_i^* = \beta_1' W_i + \beta_2' A_i + \beta_3 \text{EFC}_i + \gamma \text{NT}_i + \rho v_i + \zeta_i \quad (2.7)$$

$$\text{Loan}_i = \text{Loan}_i^* \text{ if } \text{Loan}_i^* > 0, \text{ and } \text{Loan}_i = 0 \text{ otherwise, and } \zeta_i \sim N(0, \sigma_\zeta^2).$$

Since v_i is not observed, we use its estimated value – the residual from an OLS regression of NT from equation (2.5). It follows, if net tuition (NT) is exogenous to loan, then the coefficient of (the estimated) v_i in equation (2.7) should be statistically insignificant.

The identification of the tobit model is determined by the usual rank condition. Because we use one exclusion restriction for one endogenous variable, our model is just-identified. The instrumental variable in question reflects financial aid characteristics of students' states of residence, and is described in section III. We argue that the characteristics of their states of residence do not have a direct relation with unobserved determinants of students' loan amounts.

¹³ We are grateful to Joe Harkness at the Institute of Policy Research of the John's Hopkins University for the

However, because our model is just-identified, we are not in a position to formally test the exclusion restriction.¹⁴ In stead, we focus on the validity of the instrument in explaining net tuition (NT), the endogenous explanatory variable of loan amounts. We test the validity using a conventional 'F' test as well as a test of weak instruments, as prescribed in Bound, Jaeger and Baker (1993).

III. Data and definition of variables:

a. Data and Sources:

The data for the study are taken from the second follow-up survey of the Beginning Postsecondary Student Longitudinal Study (BPS:90/94), sponsored by the National Center for Education Statistics (NCES) of the Department of Education. The BPS:90/94 sample uses a subset of the National Postsecondary Student Aid Study 1989-90 (NPSAS:90), also from the Department of Education. The NPSAS:90 was designed to obtain information on how post-secondary students finance education by collecting data on 61,120 sample students, enrolled in post-secondary education in 1989-90 (U.S. Department of Education, 1990). The BPS:90/94 sample consists of 7,253 of the NPSAS:90 respondents who were the first-time freshman college enrollees in 1989-90. The information was obtained from administrative data from respondents' colleges. The BPS:90/94 conducted follow-up surveys in 1992 and 1994 using computer assisted telephone interviews (U.S. Department of Education, 1994).

The follow-up surveys were unable to reach 1,235 of the original 7,253 BPS:90/94 respondents, leaving a sample of 6,018 respondents. Of this, only 3,810 were enrolled in four-year colleges. For purpose of this paper we require respondents to be four-year college graduates with consistent financial aid and tuition information. As such, we excluded 2,641 of the 3,810 for

program initially used in the current study.

¹⁴ Lee (1993) provides the test statistic for overidentifying restrictions in a simultaneous Tobit model.

not satisfying the requirement. Of those excluded, 931 did not graduate. Financial aid and tuition information were missing for 1,495 and 215, respectively. We were thus left with only 1,169. Finally we excluded another 29 students who were 35 or older at college entry. Our final sample thus has 1,140 respondents.

The removal of a large proportion of respondents from the original BPS:90/94 sample was necessitated by the requirement of consistent financial aid information on four-year college graduates. Since these students include the heaviest borrowers, the data are suitable for an analysis of the determinants of large loans. In section V, we show how the deletion of the respondents affects demographic, family and individual characteristics of our sample.

b. Definition of the Variables

We use three variables that are closely related to aspects of financial aid: annual average loan, net tuition defined as gross tuition less annual average grant, and expected family contributions (EFC). The variables are expressed in thousands of nominal dollars. The EFC variable is available directly from BPS:90/94, but not the other two. However, the data set provides records for each of the years between 1989-90 and 1993-94 if its respondents received any aid, if so the type of aid (grant, loan or a combination), and the total amount of aid. The data set also provides the total amount of student loan that respondents received in those five years.

We compute annual average loan amounts by dividing total loans by the number of years each respondent received loans. For net tuition, we subtract annual average amount of grant from gross tuition. While gross tuition is available from the 'Institutional Characteristics' file of the Integrated Postsecondary Education Data System (IPEDS), we still need to compute the annual average grant amounts. We do so in two steps. First, we obtain total amounts of grant as the

difference between total aid and total loan, and in the second step, we divide total grants by the number of years for which respondents received grants.

We use annual family income at college entry and measure it in nominal thousand dollars. We use a dummy variable to indicate parental education. The variable takes a value of one if at least one parent of the student has a four-year college degree. Dummy variables are used also to represent students' gender, race, marital status, and the status of financial dependence. The gender dummy takes a value of one for male, and is zero otherwise. Three separate dummy variables indicate black, Asian, and students belonging to other races, while white students are in the omitted race category. The marital status dummy takes a value of one if the student is single, and is zero otherwise. Another dummy variable takes a value of one if the student is financially dependent on her parents. We use two continuous measures of individual characteristics, namely students' age at college entry (in years), and the sum of quantitative and verbal sections from their pre-college SAT scores.

We use all of the above variables in the loan equation. In our reduced form equation for net tuition, we include an additional (instrumental) variable. The (dummy) instrumental variable takes a value of 1 if respondents' states provide larger grants to their residents who attend private colleges (relative to students at public colleges), and is zero otherwise. Ten states including Florida, Iowa, Kansas, Kentucky, Michigan, North Carolina, South Carolina, South Dakota, Texas and Wisconsin pursue such a policy, possibly to equalize net tuition across public and private colleges (U.S. Department of Education, 1999).

IV. Results:

a. Descriptive Statistics

In table 1, we report sample summary statistics. Column (1) reports the statistics for the entire sample, and between column (2) and column (3), we show the differences between the non-borrowers and the borrowers. As stated in section IV, we had to delete a large number of the original BPS:90/94 sample respondents in the process of obtaining our working sample. While such concerns are legitimate, we present below a basis for comparing the results of our sample with those of BPS:90/94 sub-sample of four-year college attendees, to highlight the differences.

From column 1 of table 1, 42.7% of our respondents are male. We also find that 87.0% of the respondents are White, while Black, Asian, and other races constitute 5.1%, 6.4%, and 1.4% of the sample, respectively. The average annual family income is \$59,644, and almost 60% of our sample respondents are children of college graduate parents. Column (1) also shows that our sample respondents are mostly single (99.2%), predominantly financially dependent on their parents (93.7%), and of 18 years of age on average at college entry. They have a combined SAT score of 1053 on average, and average expected family contributions, the important financial aid variable is 12,545.

In contrast to the above, of the BPS:90/94 sub-sample of four-year college students, 46.6% are male, and 82.4% are White, while Black students account for 7.4%. Looking at the gender and the race compositions of the two samples, it is evident that our working sample has larger proportions of female and white respondents. Moreover, relative to the BPS:90/94 sub-sample of four-year colleges students, our sample has larger proportions of single (99.2% vs. 95.9%) and financially dependent (93.7% vs. 80.0%) students. Our sample students are slightly younger at college entry as well (18 years vs. 18.8 years). Parental education and expected

family contributions also distinguish the two samples sharply: only 45.7% of the original BPS:90/94 sub-sample respondents are children of college graduate parents (relative 60% in our sample), and they have expected family contributions of 9,228 on average (relative to 12,545 in our sample).

The comparison makes it clear that relative to the BPS:90/94 original sub-sample of four-year college students, our sample respondents are off more educated family background, and are also academically more able. With respect to demographics, our sample comprises larger proportions of white and female students. The differences in individual and family characteristics and especially the loss in demographic heterogeneity in our sample are not surprising given our focus on first-time freshman four-year college students all of whom graduated within five years of initial enrollment. Admittedly, we confine our focus to a particular section of the undergraduates. However, the sample of four-year college graduates is particularly suited to an analysis of large borrowing, given that the four-year college graduates are by far the heaviest of student borrowers.

Next we focus on the difference between the borrowers and the non-borrowers, as highlighted between column (2) and column (3) of table 1. It appears that the lack of family resources is the dominant contributor to borrowing, as one would expect. The annual family income of non-borrowers (\$75,661) is more than twice that of the borrowers (\$36,089). Moreover, parental education, the other indicator of family resources also differs widely between borrowers and non-borrowers. At least one parent of 70% of the non-borrowers has a four-year college degree, compared to only 44.6% for the borrowers.

We find that the borrowers received substantially larger amounts of grants: \$4,346 relative to \$1,891 for non-borrowers (per year). This is hardly surprising because grant eligibility

is mostly a function of family resources. Borrowers, however, attended more expensive colleges, as observed in average gross tuition of \$8,498 and \$7,293 for borrowers and non-borrowers, respectively. Because borrowers received larger grants, they paid strictly smaller net tuition on average.

In table 2, we present a cross-tabulation of grant and loan recipients. The table shows a very large overlap between the two groups. Of the 1,140 respondents in our sample, 464 (40.7%) received loans, and 738 (64.7%) received grants. More importantly, of the 464 loan recipients, 442 (95.6%) received grants as well.

On the basis of the foregoing observations, we understand that borrowers are off less affluent families, and they receive larger grants on average. These students initially receive need-based grants and scholarships, and then borrow to bridge the difference between expenditures and available resources. It is crucial for our purpose to note that although an individual student cannot influence the availability of her resources, to a large extent, she herself determines the expenditure flow. As a result, although small family resources are a common denominator among the borrowers, the extent of the resource gap, and consequently the amount of loan can differ dramatically among them, depending on choices they make.

In table 3, we focus on why loan amounts vary among the borrowers. We divide the borrowers into four quartiles using the sample distribution of loan amounts, and compare summary statistics on them. Column (1) through column (4) reports the statistics on borrowers from the first (lowest) through the fourth (highest) quartiles, respectively.

The most prominent feature of table 3 is a striking lack of variation in family resources among the borrowers. For example, borrowers from quartiles 1, 3, and 4 received \$1,498, \$3,796 and \$6,616 per year respectively, but had almost identical average family income, at just short of

\$38,000. Parental education, the other indicator of family resources also shows little variation with loan amounts. It appears that the variation in the amount of loan is related to factors other than family resources.

We suspect that tuition is one such factor as both gross and net tuition increase steeply with loan amounts. Between borrowers from the first and the fourth quartiles, gross tuition increases from \$6,959 to \$10,048, while net tuition increases from \$3,637 to \$5,291. It appears that borrowing is related to a lack of family resources as well as to larger expenses that are due mostly to decisions on college choice. Because we also find a positive association between average SAT scores and loan amounts, it is possible that students with high academic ability attend more expensive colleges, and are forced to borrow larger amounts.

b. Estimates

In table 4, we present tobit model estimates for the determinants of loan amounts. Estimates in column (1) are from a single equation model under the assumption of net tuition being exogenous to loans. The entries in column (2) are AGLS estimates, obtained by taking explicit account of the endogeneity of net tuition. In obtaining AGLS estimates, we apply OLS to the reduced form model of net tuition. The OLS estimates are reported in column (3). In the bottom row of table 4, we report statistics on the exogeneity test (of net tuition) and the relevance of the instrumental variable used in the reduced form net tuition equation.

From the estimated coefficients of the single equation tobit model, in column (1) of table 4, we find that variables indicating family resources and net costs of attendance are statistically significant determinants of student loans, and have their expected signs. The two measures of family resources – family income and parental education – both have negative signs. Net tuition representing expenditures is positively related to the amount of loan. We also find a statistically

significant, positive coefficient for SAT scores. Because SAT scores represent ability, high ability students borrow larger amounts. This apparently is a validation of the hypothesis that high ability students finance current consumption using borrowed funds in expectation of large future earnings. In addition, we find negative coefficients of EFC, our measure of borrowing costs, and a positive coefficient of the dummy variable for male students. Factors such as race, age, marital status or status of financial dependence, however, do not have statistically significant coefficients.

The single equation model estimates presented in column (1) of table 4 are obtained on the assumption that net tuition is exogenous to loans. Our test however, rejects the assumed exogeneity of net tuition. . As a result, we do not ascribe to the implications of the single equation estimates reported in column 1 of table 4. The exogeneity test in question follows the procedure in Smith and Blundell (1986) and shows a t -statistic of -1.631 significant at 10% error level (would it not be better to report the p -value?). Because the endogeneity of net tuition follows from the presence of unobserved determinants of loans that also influence net tuition, a negative t -statistic suggests that such unobserved factors simultaneously influence loan amounts and net tuition in strictly opposite directions. Unobserved components of family income are likely to fit the bill because similar to the influence of observed family income, they are likely to influence loans negatively and net tuition positively.¹⁵

Correcting for endogeneity brings in dramatic changes in the coefficients of especially net tuition and SAT scores. Between the single equation and the AGLS estimates in columns (1) and (2) of table 4, respectively, the coefficient of net tuition increases almost four-fold, from 0.118 to 0.444. At the same time, the coefficient of SAT scores drops from 0.003 to 0.0003, and

becomes statistically insignificant. The sharp elevation in the value of the coefficient of net tuition confirms that ignoring the endogeneity of net tuition causes a serious underestimation of its coefficient. The irrelevance of SAT scores in the AGLS estimates, on the other hand, suggests that once the endogeneity of net tuition is taken into account, ability ceases to have a direct influence on loans, prompting a negation of (ability induced) inter-temporal substitution of consumption as a motive behind borrowing.

Ability, nonetheless, has an indirect influence on loans, as evidenced in the large, positive relationship between SAT scores and net tuition from estimates of the reduced form net tuition equation. From column (3) of table 4, a 100-point increase in SAT scores results in a \$735 increase in net tuition. The observed positive relationship between ability and net tuition is actually the sum of two opposing underlying relationships. First, with all else constant, among students attending the same college, those with higher ability receives larger grants (scholarships). As a result, within the same college, we have a negative relationship between ability and tuition less grants (net tuition). However, a much stronger and positive “between-college” relationship dominates the negative (within-college) relationship giving rise to a net positive association between ability and net tuition. The second relationship is essentially a reflection of the fact that students possessing superior academic ability attend expensive high quality colleges. In recent years this is reflected in an increase in the concentration of high ability students in such colleges (Clotfelter and Rothschild, 1993).

Next we focus on the relevance of the instrumental variable used to identify the loan equation. The variable indicates whether students’ states of residence allocate larger grants to state residents who attend private colleges (relative to those at public colleges). Such policies

¹⁵ It is possible that affluent students receive large amounts of cheaper student loans, and invest own resources in profitable ventures. However, while federal regulations disqualify them for the cheapest loans, we also find that non-

apparently follow from states' desire to equalize net tuition between private and public college attendees. We expect students from states adhering to the policy to have smaller net tuition. Our results show that the instrumental variable indeed has a statistically significant, negative effect on net tuition. The conventional F statistic ($F=35.04$) strongly rejects the null hypothesis of no effect of the variable. Additionally, our test following Bound, Jaeger and Baker (1993) confirms that the variable is not a weak instrument.

Endogeneity corrections affect estimated coefficients of other determinants of loans as well, but by smaller margins. For example, the coefficient of parental education indicator increases in magnitude from -1.150 to -1.475 , whereas the coefficient of family income increases from -0.041 to -0.044 . The coefficient of expected family contributions also increases in magnitude from -0.122 to -0.145 . In addition, we find that male students borrow more relative to female students, but the coefficient of the AGLS estimate is smaller. The lack of statistical significance of race, age, marital status, and status of financial dependence persists in the AGLS estimates.

The AGLS estimates answer parts of our question – what determines borrowing? Next, in accordance with our goal of quantifying their relative contributions, we compare marginal contributions of the statistically relevant determinants of loans. We present the marginal effects in column (1) and column (2) of table 5.¹⁶

From column (1) of table 5, we find net tuition with a marginal effect of 0.161, i.e., for a thousand-dollar increase in net tuition, the unconditional expected value of loan increases by \$161. Relative to the sample average amount of loan (\$1,485), it is a 10.8% increase. In contrast, a thousand-dollar increase in family income reduces loans by only \$16, a 1.1% relative decrease

borrowers are almost twice as rich as borrowers, on average.

¹⁶ Unconditional expected values are sample average loan amounts without disregarding zero values.

(to the sample average loan amount). We also find that relative to the children of parents without a college degree, the children of four-year college graduate parents borrowed \$556 less. From column (2) table 5, we find similar patterns of marginal effects on the conditional expected value of loans.

It is evident that between tuition and family resources, the former has the larger marginal impact on loans. The result attributes the recent surge in loans to sharply rising tuition against a modest growth in family income.¹⁷ The finding is especially helpful in predicting the course of student loans in response to changing tuition and family income.

Table 5 also shows that a thousand-dollar increase in EFC reduces loans by \$53. The result suggests that students would borrow larger amounts if cheaper loans were available. The cap on cheaper subsidized federal loans, therefore, poses binding constraints.

Male students, relative to their female counterparts, are found to borrow \$229 more on average, *ceteris paribus*. However, it is unclear whether male students borrow more because they expect larger post-college earnings, or if it is a reflection of differences in preferences across gender.. A similar situation prevails with the dummy variable for black students. The variable is not statistically significant, implying that *ceteris paribus*, the borrowing behavior of black students is identical to the same of white students. It should be noted that the variable (black=1) accounts for differences in expected future wages between blacks and whites, and is also negatively correlated with family resources. As a result, while expectations of smaller future wages may have a dampening effect on loans, an upward pressure from (smaller) family resources can neutralize it.

¹⁷ Between 1992-93 and 2002-03, public 4-year college tuition increased at 2.78% per year (calculated from the Mini Digest of Education Statistics, 2003). Family income also increased over the period, but at a much smaller rate. Because of its modest growth and a small marginal effect on loans, family income failed to dampen the increase in loans forced by rising tuition.

Our next step is to compare total contributions of net tuition and family resources on loans. The exercise is necessary because our denominator for marginal changes (a thousand-dollar), is equivalent to less than 2.0% of the sample average family income, but represents almost 20.0% of the sample average net tuition. We, therefore, make the contributions of the two variables comparable by combining sample ranges of net tuition and family income with their respective marginal effects.

In the top and bottom panels of table 6, we present the total contributions of the relevant variables to the unconditional and conditional expected value of loans, respectively. In order to calculate total impacts of net tuition (on unconditional expected value of loans), we divide our sample into four quartiles, using the sample distribution of net tuition. We compare the average net tuition between the first (lowest) and the fourth (highest) quartiles, and find a difference of \$11,482. Seen in combination with its marginal effect of 0.161, *ceteris paribus*, a movement from the lowest to the highest net tuition quartile forces a student to increase the unconditional annual average amount of loan by \$1,849.

We repeat the same exercise for family income by dividing the sample into four quartiles, using the sample distribution of family income. Combining the difference of \$110,119 in family income between the first and the fourth quartiles, and the marginal effect of 0.016, we find a total contribution of \$1,762. In other words, *ceteris paribus*, if the average family income of a student from the fourth (highest) quartile were replaced with the average family income from the first (lowest) quartile, average loans would increase by \$1,762.

Family income and parental education go hand in hand, and a movement from the fourth to the first income quartile is accompanied with a 45.6% reduction in the proportion of college-graduate parents (from 83.7% to 38.1%). When we combine the 45.6% drop between the fourth

and the first income quartile with the marginal effect of \$556 (of having college graduate parents), the lowering of parental education causes annual average loans to increase by \$255. Taken together, family income and parental education cause loans to increase by \$2,017 (\$1,762 + \$255). Net tuition and family resources, therefore, have very large and similar total impacts on the unconditional annual average amount of loan.

The calculation of total contributions on the conditional expected value of loan involves the same set of exercises, but using only the borrowers in our sample. We find that a jump from the first to the fourth net tuition quartile causes the conditional expected value of loans to increase by \$1,334. For a movement from the fourth to the first family income quartile, we find loans to increase by \$1,112 on account of the loss of family income alone. The accompanying loss of parental education causes loans to increase by another \$148. As a result, we have a total impact of \$1,260.

Given the large and similar total impacts of family resources and net tuition, it is evident that students tend to borrow larger amounts if they are off poor families, or if they choose to attend expensive colleges. Obviously, those who share both features do borrow the largest amounts. Because ability and net tuition are highly correlated, we argue that high-ability students off low-income families borrow the largest amounts.

The positive, but indirect relationship between ability and loan amounts (via net tuition) deserves further scrutiny. It is generally true that high-ability students attend expensive, high-quality colleges. The motivation for such concentrations could be rooted in differing sources. While reputed colleges pursue aggressive recruitment policies to attract high-ability students, students themselves could be drawn to such colleges by the quality of the student body or of the faculty. Importantly, a positive relationship between college quality and post-college earnings

would suggest that larger borrowing today is an attempt by high-ability students to bolster earnings tomorrow. While estimates of the earnings-effects of college quality in the relevant literature are dispersed, a majority of the studies finds a positive relationship between college quality and student earnings (Mustafa, 2003).

An area of concern about our results relates to the large marginal effect of net tuition. The recent surge in student loans, according to the result, is a consequence of sharply rising tuition. Although federal subsidized loans with interest below the market rate constituted parts of those loans, yielding subsidies along the way, borrowing from more expensive commercial sources have also grown noticeably in recent years.¹⁸ If current trends in tuition, grants, and subsidized loans continue, higher borrowing costs would reduce net returns from higher education, rendering it a less attractive investment opportunity.

V. Conclusion:

We identify and analyze the determinants of student loans U.S. four-year college graduates. The focus is on the relative effects of the two most likely determinants of loans: family resources and college tuition. The distinction between the two is useful, since students have little control over family resources, but they choose tuition. We estimate a tobit model of loan amounts, taking explicit account of the chosen nature of net tuition.

Our results show that loans are more sensitive to marginal changes in net tuition. However, total impacts of both net tuition and family resources are large and remarkably similar. Thus choices students make as well as factors beyond their control play important roles in borrowing. Students who share both features naturally borrow the largest amounts. Because

¹⁸ Between 1995 and 2004, annual disbursements of private sector education loans increased from \$1 billion to \$10 billion (College Board, 2004).

ability is positively related to net tuition, we argue that high-ability students from low-income families are the largest borrowers.

It is important to emphasize that our effort concerns the group of first-time freshman four-year college attendees who graduated within five years of initial enrollment. As such, we are not able to address some of the other important issues including how prospects of large borrowings (and repayments) affect college enrollment, persistence, and eventual graduation. These could form part of future research. Nevertheless, our estimates suggest that large borrowing is mandatory for low-income students while it is mostly a choice for those from the top of the ability distribution, facilitating the attendance at expensive, high quality colleges.

If tuition growth stays its course, and allocations of grants and scholarship do not increase significantly then 'choice' as a determinant of student loan is likely to diminish substantially. Given the large marginal effect of net tuition, rising tuition would force students with low income, regardless of their ability, to borrow very large amounts in order to attend moderate or even low-quality colleges.

Although subsidized federal loans have been the mainstay of student loans, the rise of substantially costlier commercial loans is unmistakably visible. Because the size involved in loan repayments does reduce the net returns from higher education, we believe that future research should also focus on how the prospects of large borrowing at rates that may be considered very high may affect the decision to invest in higher education.

References:

- Amemiya, Takeshi. "The Estimation of a Simultaneous-Equation Tobit Model." *International Economic Review* 20 (1979, No. 1):169-181.
- Baum, Sandy and Marie O'Malley. College on Credit: How Borrowers Perceive their Education Debt. Results of the 2002 National Student Loan Survey-Final Report. 2003
- Bound, John, David Jaeger and Regina Baker. "The Cure can be Worse than the Disease: A Cautionary Tale Regarding Instrumental Variables." Cambridge, MA: National Bureau of Economic Research Technical Paper No. 137. 1993
- Clotfelter, Charles and Michael Rothschild. "The Growing Concentration of Top Students at Elite Schools." In Philip J. Cook and Robert H. Frank (ed) *Studies of Supply and Demand in Higher Education*. Chicago, IL. The University of Chicago Press. 1993
- Colquitt, W. M. Zeh, C. Killian and J. Cultice. "Effect of Debt on US Medical School Graduates' Preferences for Family Medicine, General Internal Medicine, and General Practitioners." *Academic Medicine* 71 (1996, No. 4):399-411
- Finnie, Ross and Saul Schwartz. *Student Loans in Canada: Past, Present and Future*. Toronto: C.D. Howe Institute. 1996.
- Gladieux, Lawrence, and Arthur M. Hauptman. *The College Aid Quandary: Access, Quality, and the Federal Role*. Washington, DC: The Brookings Institution/College Board. 1995.
- Knapp, Laura G. and Teery G. Seaks. "An Analysis of the Probability of Default on Federally Guaranteed Student Loans." *Review of Economics and Statistics* 74 (1992, No.3):404-11.
- Lee, Lung-Fei. "Amemiya's Generalized Least Squares and Tests of Overidentification in Simultaneous Equation Models with Qualitative or Limited Dependent Variables." *Econometric Reviews* 11 (1993: No.3):319-328.
- Minicozzi, Alexandra. "The Short Term Effect of Educational Debt on Job Decisions." *Economics of Education Review*. 24 (2005):417-430.
- Monks, James. "Loan Burdens and Educational Outcomes." *Economics of Education Review* 20 (2001, No. 6):545-50.
- Moore, Robert, A. Studenmund and Thomas Slobko. "The Effect of the Financial Aid Package on the Choice of a Selective Private College." *Economics of Education Review* 10 (1991: No.4):311-321.

- Mustafa, Shoumi. *Three Essays on College Enrollment, Completion and Labor Market Returns*. Unpublished Ph.D. thesis. The Ohio State University, 2003.
- Nelson, F and L. Olson (1977). "Specification and Estimation of a Simultaneous Equation of Model with Limited Dependent Variables." *International Economic Review* 19 (1978):695-705.
- Newey, Whitney K. 1987. "Efficient Estimation of Limited Dependent Variable Models with Endogenous Explanatory Variables." *Journal of Econometrics* 36 (1987): 231-250.
- Reyes, Suzanne Louise. *Educational Opportunities and Outcomes: The Role of the Guaranteed Student Loan*. Unpublished Ph.D. thesis. Harvard University, 1995.
- Schwartz, J. B. 1985. "Student Financial Aid and the College Enrollment Decision: The Effects of Public and Private Grants and Interest Subsidies." *Economics of Education Review* 4 (1985, No. 7):129-144.
- Schwartz, S and R. Finnie. "Student Loan in Canada: An Analysis of Borrowing and Repayment." *Economics of Education Review* 21 (2002):497-512.
- Smith, Richard J. and Richard W. Blundell. "An Exogeneity Test for A Simultaneous Tobit Model with an Application to Labor Supply." 1986. *Econometrica* 54 (1986, No. 3):679-685.
- U.S. Department of Education. *National Postsecondary Student Aid Survey (NPSAS), 1990*.
 _____ *Beginning Postsecondary Students Longitudinal Study Second Followup (BPS:90/94), 1994*.
 _____ *State Aid*, NCES 99-186, by John B. Lee and Suzanne B. Clery. Project Officer: C. Dennis Carroll. Washington, DC: 1999.
 _____ *The Digest of Education Statistics*, 2004.
- Wei, C.C., Li, X., and L. Berkner. *A Decade of Undergraduate Student Aid: 1989-90 to 1999-2000* (NCES 2004-158). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Table 1: Financial Aid, Individual Characteristics and College Choice: By Borrowing Status

	(1)	(2)	(3)
	Entire Sample	Non-borrowers	Borrowers
	N=1,140	N=676	N=464
Annual average loan amount (\$,000)	1.485 (2.301)	-	3.647 (2.262)
Annual average grant amount (\$,000)	2.911 (4.335)	1.891 (4.100)	4.346 (4.213)
Individual & Family Characteristics			
Male	0.427	0.411	0.450
White	0.870	0.902	0.823
Black	0.051	0.034	0.075
Asian	0.064	0.059	0.071
Other races	0.014	0.004	0.028
Single	0.992	0.997	0.985
Dependent	0.937	0.939	0.933
SAT scores	1053 (190)	1061 (189)	1042 (189)
Age at enrollment (years)	18.004 (1.102)	17.994 (1.030)	18.017 (1.198)
At least one parent is college graduate	0.595	0.697	0.446
Annual family income (\$,000)	59.644 (62.129)	75.661 (72.289)	36.089 (28.446)
Expected family contributions	12.545 (16.291)	17.353 (18.985)	5.728 (7.194)
College Characteristics & Related Choices			
Gross tuition (\$,000)	7.784 (4.828)	7.293 (4.962)	8.498 (4.537)
Net tuition (\$,000)	5.268 (4.728)	5.799 (5.284)	4.494 (3.643)

Table 2. Overlap of Loan and Grant Receipt

	Non-Borrowers N=676 Number (Column Percentage)	Borrowers N=464 Number (Column Percentage)
Students without grant N=402	380 (56.21%)	22 (4.74%)
Students receiving grant N=738	296 (43.79%)	442 (95.26%)

Table 3. Characteristics of the Individual and Their Colleges: By Quartiles of Loan Amounts

	(1)	(2)	(3)	(4)
	Borrower Quartile 1	Borrower Quartile 2	Borrower Quartile 3	Borrower Quartile 4
Annual average loan amount (\$,000)	1.498 (0.616)	2.810 (0.287)	3.796 (0.331)	6.616 (2.337)
Annual average grant amount (\$,000)	3.558 (3.043)	4.199 (3.762)	4.128 (3.537)	5.535 (5.797)
Individual & Family Characteristics				
Male	0.398	0.478	0.436	0.491
White	0.837	0.835	0.818	0.802
Black	0.098	0.043	0.082	0.078
Asian	0.032	0.095	0.082	0.078
Other races	0.024	0.026	0.018	0.043
Single	0.975	0.991	0.990	0.983
Dependent	0.935	0.922	0.972	0.905
SAT scores	1015 (185)	1041 (182)	1001 (184)	1110 (193)
Age at enrollment (years)	18.033 (1.347)	17.965 (0.566)	18.118 (1.717)	17.957 (0.848)
At least one parent is college graduate	0.431	0.409	0.463	0.483
Annual family income (\$,000)	37.748 (24.029)	31.297 (18.593)	37.558 (37.283)	37.590 (30.816)
Expected family contributions	5.920 (5.674)	5.145 (5.826)	5.926 (10.367)	5.908 (6.215)
College Characteristics & Related Choices				
Gross tuition (\$,000)	6.959 (4.379)	8.218 (4.541)	8.880 (4.247)	10.048 (4.450)
Net tuition (\$,000)	3.637 (3.507)	4.240 (3.446)	4.878 (3.322)	5.291 (4.066)

Table 4. Estimates from Single Equation and Simultaneous Equation Tobit Model of Loan Amounts and Ordinary Least Square Regression of Net Tuition

	Dependent variable		
	Loan amount	Loan amount	Net Tuition
	(1)	(2)	(3)
	Single Equation Tobit Estimates	Simultaneous Tobit (AGLS) Estimates	OLS Estimates
	Coefficient (Std. Error)	Coefficient (Std. Error)	Coefficient (Std. Error)
Intercept	3.565 (3.761)	4.928 (3.998)	-4.066 (3.418)
SAT score (100 points)	0.003*** (0.001)	0.0003 (0.002)	0.735*** (0.085)
1 if male	0.719** (0.295)	0.623** (0.310)	0.225 (0.245)
1 if black	0.795 (0.614)	0.895 (0.618)	-0.401 (0.552)
1 if Asian	-.0715 (0.589)	-0.250 (0.618)	0.386 (0.491)
1 if other race	1.534 (1.066)	1.673 (1.113)	-0.691 (1.018)
1 if single at enrollment	-1.421 (1.534)	-1.766 (1.615)	1.081 (1.491)
1 if dependent on parents	0.0443 (0.645)	0.335 (0.689)	0.835 (0.523)
Age at enrollment	-0.147 (.141)	-0.133 (0.147)	-0.014 (0.125)
1 if at least one parent is graduate	-1.150*** (0.311)	-1.475*** (0.382)	1.046*** (0.259)
Annual average family income (\$,000)	-0.041*** (0.006)	-0.044*** (0.007)	0.010*** (0.003)
Expected family contributions	-0.122*** (0.020)	-0.145*** (0.025)	0.064*** (0.009)
Net tuition (\$,000)	0.118*** (0.038)	0.444** (0.210)	-
E: 1 if state gives larger aid to private college students	-		-1.616*** (0.273)
Adjusted R ²	-	-	0.282
F statistic of Ho: E = 0		-	35.04
F statistic of Ho: E is a weak instrument			35.50
Log Likelihood	-1633.167	-	
t statistic of Ho: Cov (u ₁ , NT) = 0 where u ₁ is unobserved determinant of loan	-1.631 exceeds critical value at 10% error level.		

Notes: ***, **, and * indicate statistical significance at 0%, 5% and 10% error levels respectively.

Equations also include dummy variables indicating missing values of SAT score, age, income, and EFC.

Table 5. Marginal Effects of Statistically Significant Determinants of Loans (from Endogeneity Corrected AGLS Estimates).

	Dependent Variable = Annual Average Loan Amount (\$,000)	
	(1)	(2)
	On Unconditional Expected Value of Loan	On Conditional (on Loan>0) Expected Value of Loan
I if male	0.229	0.185
I if one parent is graduate	-0.556	-0.444
Annual average family income (\$1,000)	-0.016	-0.013
Expected family contributions	-0.053	-0.043
Tuition net of grants (\$1,000)	0.161	0.130

Table 6: Total Effects of Statistically Significant Determinants of Loan Amounts (Based on AGLS Estimates)

	Difference in average value between the first and the fourth quartiles	Marginal Effects	Total Impacts (\$,000)
Effect on unconditional expected value of loan			
Quartiles defined by sample distribution of Net Tuition			
Net Tuition (\$,000)	\$11.482	0.161	\$1.849
Quartiles defined by sample distribution of Family Income			
Family Income (\$,000)	\$110.119	-0.016	-\$1.762
Parental education (effect in \$,000)	0.456	-0.556	-\$0.255
Combined effect of family income and parental education (\$,000)	-	-	-\$2.017
Effect on expected value of loan (conditional on borrowing)			
	Difference in average value between the first and the fourth quartiles	Marginal Effects	Total Impacts (\$,000)
Quartiles defined by sample distribution of Net Tuition for borrowers			
Net Tuition (\$,000)	\$10.264	0.130	\$1.334
Quartiles defined by sample distribution of Family Income for borrowers			
Family Income (\$,000)	\$85.537	-0.013	-\$1.112
Parental education (effect in \$,000)	0.371	-0.444	-\$0.148
Combined effect of family income and parental education (\$,000)	-	-	-\$1.260