Exploring the Relationship between State Financial Aid Policy and Postsecondary Enrollment Choices: A Focus on Income and Race Differences

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Abstract This study explores the relationship between state financial aid policies and postsecondary enrollment for high school graduates (or equivalent diploma holders). Utilizing an event history modeling for a nationally representative sample from the National Education Longitudinal Study (NELS:88/2000) in addition to state-level policy variables, this study examined how state aid policies differentially affect students' postsecondary enrollment choices depending on their family income and race/ethnicity between the years 1992 through 2000. The findings demonstrate that there is a clear and consistent gap in college enrollment for students who are from different income and race/ethnic groups, and that changes in state financial aid policy are significantly related with the type of institutions a student attends across income and racial groups. The study findings have important implications for state aid policy as well as future research on the role of public financial aid policy in college choice of students from different income and racial/ethnic backgrounds.

Keywords State financial aid · College choice · Timing of college enrollment · Race and income differences

Traditionally it has been a goal of financial aid policy to break the link between family socioeconomic background and college opportunities (McPherson and Schapiro 2006). The first Higher Education Act in 1965 formalized the system of student aid programs that established a commitment to expanding college opportunities for economically disadvantaged students. The rise in broad-based state merit-aid programs since the early 1990s, however, represents one of the most pronounced policy shifts away from a long tradition of need-based aid. As the first of its kind, since Georgia's HOPE (Helping Outstanding Pupils Educationally) scholarship began in 1993, fourteen more states have adopted state merit-aid programs modeled after HOPE (Heller and Marin 2002).

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The changes in public financial aid policies pose particular barriers to postsecondary choices of underrepresented student populations (Ellwood and Kane 2000). Disparities in college attendance rates by socioeconomic status (SES) and race/ethnicity are widening over time, and the gaps are particularly pronounced in the four-year college participation rates, with lower-SES and minority students concentrated in lower-priced and non-selective institutions (Hearn 2001; Kane 2004; McPherson and Schapiro 1998, 2006; Perna 2002). The growing gaps in enrollment and the increasing inequality in postsecondary opportunity suggest that financial aid policy to mitigate the influence of family income and related socioeconomic factors has not effectively reduced the gaps in college participation (Hearn 2001). The limited effectiveness of financial aid and the persisting barriers to college faced by underrepresented students raise the question of whether or not the role of financial aid is conditioned by one's socioeconomic and racial/ethnic backgrounds. This study will provide answers to this inquiry by conducting a longitudinal investigation of the roles that state financial aid policies play on enrollment in different types of postsecondary institutions for high school graduates (or equivalent diploma holders). The study especially focuses on how changes in state aid policies are differentially associated with the types of institutions a student enrolls in depending on their family income and race/ethnicity.

Prior research reveals that different types of financial aid have distinct effects on college enrollment and that these results often vary between different subgroups of students (DesJardins 2001; Heller 1999; Paulsen and St. John 2002). Generally, the findings suggest a positive impact of grants on promoting college enrollments (Heller 1999; Moore et al. 1991), but this positive effect seems to differ according to student characteristics such as income and race (Avery and Hoxby 2004; Heller 1997). Research on state grants have found positive influences of need-based grants on college choice and enrollment decisions of low-income students (Perna and Titus 2004; St. John et al. 2004). In addition to state need-based grants, there is growing evidence that state merit-based grants influence student college choice. With a dramatic increase in state merit-based programs, researchers have increasingly investigated the effects of state merit aid programs on college choice, with most research studying Georgia's HOPE Scholarship (e.g., Cornwell et al. 2006; Dynarski 2000; Singell et al. 2006). A series of evaluations of the HOPE and other state merit aid programs suggest that merit-based programs had a disproportionate impact on the choice to attend in-state four-year institutions for students from White and middle- to upper-income families, while having little impact on minority and low-income students' college opportunity (Binder and Ganderton 2004; Cornwell et al. 2006; Dynarski 2004).

Although the existing studies have paid proper attention to socioeconomic and race/ethnic differences in the impact of public financial aid policies on college choice, they are subject to the following limitation. Most studies that address the association between state-level financial aid policy and students' college choice behavior have modeled this relationship without considering the longitudinal (or temporal) process of enrollment decisions. Furthermore, prior studies failed to consider the time-variant nature of financial aid policies suggesting that yearly changes in state-level financial aid policies may affect students' enrollment decisions in the state once they decide to attend college. Studies that fail to consider temporal dimensions often made inferences based on cross-sectional data that contains information only about a single point in time, and employing cross-sectional methods may produce biased results by ignoring the choice of students who enrolled in college at later points in time as well as by ignoring time-varying information about financial aid policies that change over time. Thus, it is critical to consider the temporal nature of college enrollment over time by utilizing an appropriate longitudinal model that

enables us to investigate the choice of students from varied background who enrolled in college at different time points.

Theoretical Framework

Researchers have investigated college choice utilizing economic and sociological frameworks to address both economic and social forces affecting a student's college choice process (Hossler et al. 1989; Jackson 1982). The primary economic theory applied to the study of college choice is the human capital model. This approach views college choice as a form of rational investment in the acquisition of human capital that maximizes expected utility (Catsiapis 1987; Hossler et al. 1989; Manski and Wise 1983; Paulsen 1990, 2001). The theory predicts that prospective students decide whether to attend college and select among a range of institutions only if the expected current and future benefits (e.g., financial aid, future earnings) outweigh the anticipated costs of their choice (e.g., tuition and fees, living expenses, and foregone earnings as opportunity costs) (DesJardins and Toutkoushian 2005; Fuller et al. 1982). The calculation of benefits and costs regarding college-choice decisions may vary substantially across individuals because the college choice process cannot be detached from social, academic, economic, and cultural influences (Kane 2006; Paulsen 2001).

Although the economic approach has made strides toward incorporating the independent role of finances in college attendance, it has been criticized for overlooking the indirect role that financial aid and college costs plays prior to enrollment, such as "concerns about finances on college preparation, aspirations, and applications for college and financial aid" (St. John 2006, p. 1607). In other words, the approach fails to consider the possibility that concerns about college costs and financial aid can negatively influence decisions regarding how to prepare for college, especially for students with limited financial resources. In addition to financial concerns, the expectation of financial aid may also influence a student's decision to apply to and enroll in a college (DesJardins et al. 2006). For instance, Kim et al. (2009) find that students from different race and income groups respond differentially to aid packages in their application and enrollment decisions depending on their levels of aid expectations. The expectations of financial aid as well as concerns about college affordability may indirectly influence students' college choice process, and thus should not be overlooked in examining the comprehensive role of financial aid.

Sociological approaches explore how a variety of interrelated family social class, individual, and contextual factors jointly structure college opportunity, and the constructs of social and cultural capital have particularly been integrated into economic approaches to account for non-financial factors on college enrollment. Cultural capital involves the accumulation of credentials, skills, and knowledge, which are transmitted from middle- and upper-class parents to their children to maintain class status and privilege across generations (Bourdieu 1990; McDonough 1997). Social capital is acquired through a form of a social relationship or a network of relationships that can be converted to socially valued resources and opportunities including emotional support and privileged information (Lin 1999; Portes 1998; Stanton-Salazar 1997). Coleman (1988) argues that parents and family play a primary role in promoting the status attainment of their children, emphasizing strong social ties within the family. With a heavy focus on parents and family social capital, researchers have typically conceptualized parental involvement as a form of social capital that promotes college enrollment (Perna and Titus 2005; Rowan-Kenyon 2007).

In other studies, social capital is also manifested through parents' and/or students' behavior in seeking information and knowledge available through social relationships in the college choice process, and evidence on the significant effects of access to postsecondary information on college enrollment has been found (Engberg and Wolniak 2010; O'Connor et al. 2010).

Recent researchers have enriched the theory of college choice by suggesting a multi-level framework of a college enrollment model. Perna (2006) presumes that an individual's college choice is influenced by academic preparation, the availability of financial aid, and family resources to pay for college, which are nested within multiple contextual layers including school and community context, the higher education context, and the broader social, economic, and policy context. Perna's model indicates that the college choice process is influenced not only by individual factors but also by broader social, economic, and policy contexts such as state higher education policy as well as social and economic conditions. For example, individuals are nested within states, and their enrollment decisions may be subject to the state's finance policies and the broader socioeconomic context as well as the educational opportunities provided to its residents. The level of tuition and fee at public institutions is hypothesized to negatively affect a student's college enrollment decisions because tuition increases give additional financial burdens to students and families who have to pay substantial costs of college education. State financial aid policy and state effort to reduce public tuition through direct appropriations to public institutions may be positively related with college enrollment (Heller 1999; Perna et al. 2008; Perna and Titus 2004). Based on this multi-level framework and the related theories, this study hypothesizes the differential impact of state-level financial aid policies on enrollment decisions across students from different income and race/ethnic backgrounds. Specifically, low-income and/or under-represented minority students who may have more unmet needs might be more sensitive to changes in tuition and state financial aid policy than their upper-income and White counterparts. In terms of college destinations, the study hypothesizes that increases in state financial aid will help low-income and underrepresented minority students enroll in any types of institutions including two-year and four-year institutions.

Methodology

The research questions explored in this study are:

1. Do time-to-enrollment trajectories differ for high school graduates who are from different income and race/ethnic groups?
2. Do state financial aid policies influence a student's decision about where to enroll after completing high school?
3. Does the effect of state financial aid on college enrollment vary for students from different income and race/ethnic groups?

Data Sources and Sample

This study uses data from the National Education Longitudinal Study (NELS: 88/2000). NELS followed almost 25,000 eighth-grade cohorts through their high school graduation and later postsecondary education or employment path from 1988 through 2000. As the study sample experienced attrition, NCES refreshed the sample during the follow-up surveys, with the final panel of the survey including 12,140 total respondents. Because high

school completion is a prior condition necessary for transition to postsecondary enrollment, the study sample is restricted to students who graduated from high school or attained an equivalent diploma in or after 1992, and who provided follow-up information on whether or not they attended postsecondary institutions by the year 2000. Students who did not indicate their high school graduation year/month in addition to those who completed high school (or equivalent diploma) before 1992 are therefore eliminated from the sample. Additionally, students who responded that they had enrolled in a postsecondary institution prior to completing high school (i.e., duel or concurrent enrollees) are excluded from the analysis because of the difficulties in tracking these students' time-to-enrollment trajectories given the reverse temporal order between high school completion and postsecondary enrollment. The study also excludes students who did not provide their state of residence information in 12th grade because the missing data for state residence makes it impossible to merge with the state-level data. After removing all these cases the final sample size is reduced to 10,810 individuals.

Because the analyses employ the NELS data collected 1992 through 2000, the study sample to be included in the analyses should remain in the waves of the NELS study conducted from 1992 through 2000. To fulfill this condition, I utilize the sample weight (f4f2pnwt), which applies to the sample who completed the surveys in 1992, 1994, and 2000. Utilizing the sample weight allows the analysis results to be generalized to the nationally representative population of high school seniors in 1992.

I utilize an additional dataset, National Postsecondary Student Aid Study (NPSAS), for constructing the variable (i.e., the amount of financial aid awarded to an individual student) not available in the NELS data. The NPSAS is a comprehensive study that investigates how students and their families pay college costs and how much financial aid is available for them based on a nationally representative sample of students who attend postsecondary institutions. This study uses the NPSAS:92 data for imputing the amount of financial aid for the NELS cohort (who were high school seniors in 1992) in that the time frame surveyed is closer to the NELS study than any other NPSAS waves.

In order to link state-level policies for higher education into student-level analysis, I obtain data for state-level indicators from publicly available databases, including the National Association of State Student Grant and Aid Programs (NASSGAP), *Digest of Education Statistics* (NCES, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000), U.S. Bureau of Labor Statistics, and the U.S. Census Bureau. State-level financial aid data were gathered from NASSGAP annual surveys conducted in 1992 through 2000 (NASSGAP, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000), while data on public tuition, state appropriation, and public high school graduation rate were drawn from the *Digest of Education Statistics* compiled by the NCES. Other state-level indicators related to education, demographics, and economic conditions (e.g., unemployment rate, poverty rate, bachelor's attainment rate) were obtained from public sources such as the U.S. Bureau of Labor Statistics and the U.S. Census.

Variables

The outcome variable for the study is a categorical multinomial measure that differentiates college enrollment in terms of selectivity and the type of institution (0 = not enrolled, 1 = enrolled in two-year or less institutions, 2 = enrolled in four-year non-selective institutions, 3 = enrolled in four-year selective public institutions, 4 = enrolled in four-year selective private institutions). Distinction by institutional selectivity is tested because studies report differential socioeconomic benefits and labor-market returns associated with

attending selective and non-selective postsecondary institutions (Ehrenberg 2004; Kane and Rouse 1995).

The degree to which four-year institutions are selective is determined using the selectivity categories published in *Barron's Guide to American College* (Barron's College Division, 1991) that profiles American colleges and universities with respect to admissions requirements, academic programs, and student life. The Barron's guide provides information on the selectivity of a four-year institution by categorizing the colleges and universities into six groups according to their admissions selectivity: (1) Most Competitive, (2) Highly Competitive, (3) Very Competitive, (4) Competitive, (5) Less Competitive, and (6) Non-competitive. I collapsed these six selectivity categories into two distinct categories that indicate whether an institution is selective (at least competitive and above) or non-selective (less and non-competitive). However, the Barron's measure does not cover all four-year institutions attended by the students, and the four-year institutions with missing selectivity categories are classified as non-selective institutions.

The independent variables used in the model consist of student-level and state-level variables, which were chosen based on the review of literature and theories explained in the previous section (see Appendix Table 5 for a full list of independent variables). Student-level variables include:

(1) Socio-demographic factors that measure demographics and socioeconomic backgrounds (e.g., gender, race/ethnicity, parental education level, family size, income, and high school location)

(2) Postsecondary aspirations, the formation of which is a first step that develops predisposition toward enrollment in the sequence of the college choice process (Hossler and Gallagher 1987)

(3) Two measures of social capital that shape college opportunity are included: the first variable measures the level of parents' educational expectations that represent important sources of social and cultural capital within a family. The second variable measures students' seeking information about financial aid through various social network and resources.

(4) Academic preparation and achievement (e.g., high school GPA, reading and math scores, curricular program, GED status, high school type, postsecondary exam-taking) that have been traditionally regarded as strong determinants of college enrollment as well as the choice of institutions (Adelman 2006; Arbona and Nora 2007; Baker and Velez 1996).

(5) Types of financial aid awards that reflect the role of finances in college attendance within the human capital framework.

Informed by Perna's multilevel model of college choice (2006), state-level financial and socioeconomic contextual variables that may influence individuals' enrollment decisions are also considered in the model (See Appendix Table 6 for a descriptive information of the state-level variables). State-level variables include variables related to state financial aid policy (including need-based and non need-based aid per FTE), public tuition, and state appropriations per FTE as well as demographic and educational indicators for each state (e.g., state per capita income, poverty rate, unemployment rate, public high school graduation rates, and baccalaureate attainment rate).

The state-level variables are included in the form of lagged variables because the decision to enroll in college may be influenced by state policies that took place prior to the year when a student enrolls in college. Experimenting with different sets of lagged variables (up to three years) using a series of Wald tests revealed that all state-level predictors

lagged three years significantly improved the model fit ($p < 0.01$). Conceptually, the relatively longer time lags (three years) may also fit with the phenomenon of policy diffusion which could have been slower in the past than in the present times. For example, it is possible that there were fewer sources of available information for students who entered college in the 1990s (e.g., the study sample) than for the current generation of students who enjoy greater access to information about financial aid and college preparation through advancement of technology and widely available internet access. If this is true, it may take longer time for older generation of students to react to state financial aid policy due to a lack of available information than for current student generations. Based upon the results of the Wald tests and conceptual reasoning, the final model includes the sets of lagged state-level variables by three years.

Statistical Method

This study employs event history methods to capture the temporal nature of postsecondary enrollment. Event history modeling is an empirical technique that allows us to "study the occurrence and timing of events" in a longitudinal process (DesJardins 2003), and has been recently used in higher education research to investigate the temporal aspects of student dropout and degree completion (Chen 2008). Defined as a transition from one state to another, the event modeled in this study is the transition from high school to college. It is also possible that a student can choose between different types of institutions, and in this case enrollment in institutions with different levels of selectivity are considered different or "competing" events because these events cannot happen at the same time when an individual student initially enrolls in college.

The time-to-event can be measured continuously or discretely, and this difference in the metric of time used distinguishes discrete-time models from continuous-time models in event history analysis. The NELS data provide both the month and year of students' high school completion and/or college enrollment, but this study aggregates the time metric used for the analysis to the year-level in order to match the data with state-level data that contain information on yearly changes in the level of state variables (from 1992 through 2000). In this study, occurrences of an individual's event are observed in years and it is therefore appropriate to apply a discrete-time event history model that reflects the measurement characteristics of the data.

Estimating the Discrete-Time Hazard Model of Enrollment

Due to its importance as a "fundamental dependent variable in an event history model" (Allison 1984, p. 16), understanding of the hazard rate should precede the discussion of the model specification for the study. Hazard rate for discrete-time models is defined as the conditional probability that a student experiences an event in each discrete time period t, given that the event has not already occurred prior to that time (Ishitani and DesJardins 2002; Singer and Willett 1991). To investigate the independent effects of state financial aid and other variables on enrollment hazards, the study includes a set of covariates to estimate the hazard of enrollment using the multinomial logit link function ($0 =$ not enrolled, $1 =$ enrolled in two-year or less, $2 =$ non-selective four-year enrollment, $3 =$ selective public enrollment, $4 =$ selective private enrollment) for a competing-event model. The discrete-time hazard model is formally specified as:

$$\text{Log } h\left(p_{tij}\right) = \beta_0 + \beta_1 x_i + \beta_{12} z_j(t) + \beta_3 \sum_{t=2}^{9} Time_{tij} + \beta_4 \sum_{j=2}^{50} State_{ji}$$

where $h\left(p_{tij}\right)$ is a probability indicating whether an individual i who resides in a state j enrolls in a specific type of institution in time period t, relative to those who did not enroll in any postsecondary institution, given that she or he has not experienced any of the events prior to that time. The vector x_i contains individual-level time-constant covariates (e.g., race/ethnicity, gender, and academic preparation) including the variables that measure each individual's expected amount of a Pell grant, state need-based and non need-based grants, and squared-terms of the expectations of each aid type that capture any non-linear effects; The vector $z_j(t)$ contains state-level covariates that change over time (e.g., state-level need-based and non need-based aid, public tuition, state per capita income, and annual unemployment rate). Additionally, in order to capture the variation in state aid by race and income groups, interactions between race/income and the types of state aid are included in the model.

The variable $Time_{tij}$ denotes a vector of time-dummy indicators (assigned one for each year an individual i enrolls in college) that control for the effect of time. The year 1992 ($t = 1$) is set as the reference category and the rest of time dummy variables from 1993 ($t = 2$) through 2000 ($t = 9$) are controlled for in the model. The vector $State_{ji}$ denotes state fixed-effect dummy variables that represent each state, which are included to control for unobserved time-constant state-specific effects on residents' enrollment behavior.

It is important to note that due to the nested structure of the data used in this study (i.e., students are nested within states), a clustered event history model by state is utilized to deal with the potential statistical dependence between students who reside in the same state. Consideration of this nested structure by adjusting standard errors to allow for clustering by state enables estimating correct standard errors, confidence intervals, and significance tests (Beise and Voland 2002). In addition, since some of the predictor variables (e.g., expected financial aid) are based on the results of other estimated equations, the standard errors need to be adjusted. This was accomplished by bootstrapping techniques (Efron and Tibshirani 1993) where I re-estimated the entire system of equations 200 times when estimating the multinomial regression model.

Imputation of Missing Data

Imputing Expected Financial Aid Amount for Individuals

In the absence of the financial aid amount awarded to the NELS participants, it is possible to impute the *expected* amount of aid that may have been awarded to the NELS participants. This imputation can be done if the relationship between financial aid amount and predictors associated with aid award can be estimated using a secondary dataset where financial aid information is available. In this study, the absent aid information for the NELS participants is imputed using the NPSAS:92 dataset that provides information on how much a student received of different types of financial aid for a representative sample of college students for the academic year 1992–1993.

The imputation procedure starts by estimating the expected amount of a federal Pell grant. I examined the 1992 Expected Family Contribution (EFC) formula that determines a student's financial need and identified the variables (common in both NELS and NPSAS data) that are important in predicting the Pell grant eligibility. These variables include

parents' income and marital status, family size, gender, and race/ethnicity. Once the predictor variables are identified, the expected amount of financial aid are structurally estimated following the procedures proposed by DesJardins et al. (2006) who examined the effect of financial aid *expectations* on college application and enrollment behavior. According to their study, the probability of receiving financial aid, multiplied by the predicted amount of aid conditional on receiving aid equals the expected amount of aid (or expectations about aid) for each student.

The process of estimating expected amount of aid for each type of aid, using DesJardins et al.'s methods, is as follows. Using NPSAS sample, I first estimate the probability of receiving a Pell grant (utilizing logistic regression) for each student conditional on gender, race/ethnicity, parents' income and marital status, family size, and a squared-term of family size that captures any non-linear effects. In addition to these predictor variables, the interaction variables between family size and income and between family size and race are included to capture any differences in the effects of race and family income depending on the number in the family (the increase of which represents fewer social and financial resources for college enrollment). The formal goodness of fit tests (i.e., likelihood ratio tests) supports the inclusion of the interaction terms (the model fit improves significantly with their inclusion compared to the model with no interaction terms).

After estimating the probability of being awarded a Pell grant, I employ ordinary least squares (OLS) regression to estimate the predicted amount of a Pell grant for those who received a Pell grant, using the same set of predictor variables. The estimated coefficients of each predictor for the NPSAS sample in both regressions (i.e., logistic and OLS regressions) are used to estimate the probability of receiving a Pell grant and the predicted Pell amount conditional on receiving a Pell grant for the NELS sample. Finally, the expected amount of a Pell grant for the NELS sample is calculated by multiplying the probability of receiving a Pell grant by the predicted Pell amount, conditional on having received a grant award. This two-stage calculation process is done in order to replace unobserved expected Pell amount with its imputed value for each NELS participant based on the relationship between Pell award and the predictors of the grant estimated with the NPSAS data (Card and McCall 1996). Once the expected amount of a Pell grant is estimated, a similar calculation is done for estimating the expected amount of state need-based grant and non need-based grant, respectively.

Multiple Imputation of Missing Data

The problem of missing data should be accounted for because estimation biases may be caused by failing to handle missing data properly. Among various methods of imputing missing data, multiple imputation is considered a methodologically rigorous approach to deal with missing data. Multiple imputation is "the technique that replaces each missing or deficient value with two or more acceptable values representing a distribution of possibilities" (Rubin 2004, p. 2). In this study, although all the state-level variables have no missing cases, data are missing on most of the student-level variables to varying degrees. The proportion of missing cases for each variable ranges from 0.1 percent (race) to 26 percent (high school cumulative GPA). This study uses a multiple imputation software called *Amelia II* to impute missing data. *Amelia II* creates multiple "complete" datasets in which the missing values are filled in with different imputations that reflect the uncertainty about the missing data. Because the rate of missingness for the data is not high, adopting the program default of creating five imputed datasets ($m = 5$) is deemed adequate for this study (Royston 2004). Schafer (1999) also claims little or no practical benefits to using

more than five to ten imputations when rates of missing information are not unusually high. After imputation, *Amelia II* saves the five imputed datasets and the analysis results drawn from these multiply imputed datasets are then combined using the STATA software.

Limitations

This study is subject to several limitations. First, due to the unavailability of information about the actual financial aid amount offered to each student, I impute the expected financial aid amount each student may have been eligible for using the NPSAS data. Using the NPSAS data for imputing financial aid amount awarded to the NELS participants may be subject to criticism because both datasets collect information from different student populations. The difference in the sample population suggests that financial aid awards may not have the same relationship with predictor variables in the NPSAS sample as in the NELS sample. Although the sample of students are not exactly equivalent (because the two national studies used different sampling frames), both datasets collect information from nationally representative students who attended high school in the early 1990s and thus are likely to be comparable to each other.

However, causal statements about the relationship between the expected financial aid amount and students' enrollment outcome variables should be made with caution because of the weak identification problem. As discussed earlier, only a small number of variables were available for use (e.g., family income, family size, gender, race) to predict the expected amount of financial aid because the common variables included in both datasets were insufficient. Due to the data limitation, it may be possible that the proportion of variance explained by this group of variables in predicting expected financial aid may not be high, leaving a substantial portion of unexplained variance in financial aid equations. This study, therefore, suffers from the weak identification problem since a lack of sufficient predictors made it difficult to truly identify the financial aid prediction model, and causal inferences are not made with regard to the effect of expected aid variables based on the imputed aid variables.

Second, the failure to completely control for individual-level aid award may be related to the problem of omitted variable bias (or self-selection bias) caused by the inability to control for all potential sources of variations in the outcome variable. Omitted variable bias happens when one or more explanatory variables that ought to be included in a model are left out, resulting in errors in the estimate of the effect of the variables included in the model (Jargowsky 2005). Unobserved (and thus omitted) factors in this study, such as differences in individual aid packages offered by states and postsecondary institutions, may impact a student's enrollment decision significantly, and thus may confound the effect of other covariates on the outcome variable. Therefore, it is important to consider the possibility of omitted variable bias when interpreting the estimation results that follow this section.

Results

Descriptive Results

Table 1 offers the summary statistics for the student-level independent variables used in the regression analyses. The proportion of female (49.7%) and male (50.3%) students is

Table 1 Descriptive statistics of the sample ($N = 10810$, weighted)

Category	Variable	% or mean
Gender	Female	49.7
	Male	50.3
Race/Ethnicity	White	72.1
	Black	12.4
	Hispanic	10.1
	Asian	4.0
	Other ethnicity	1.4
Family income measured in 1991	Income less than $7,500	5.3
	Income $7.5k to $15k	9.5
	Income $15k to $25k	15.0
	Income $25k to $50k	35.2
	Income $50k to $75k	21.6
	Income $75k to $100k	7.0
	Income more than $100k	6.4
Parents' highest education level	Less than bachelor's degree	69.5
	Bachelor's degree or beyond	30.5
Parental educational expectation	Less than bachelor's degree	21.5
	Bachelor's degree or beyond	78.5
Family size	Number of family members	4.24
High school	Urban	26.1
Location	Suburban	41.3
	Rural	32.6
Postsecondary aspiration	Less than bachelor's degree	26.6
	Bachelor's degree or beyond	73.4
Information on financial aid	Information from a teacher/counselor	Yes: 55.5
		No: 44.5
	Information from a school representative	Yes: 39.4
		No: 60.6
	Information from U.S. Department of Education	Yes: 25.6
		No: 74.4
	Information from colleges and universities	Yes: 45.8
		No: 54.2
Academic preparation	High school cumulative GPA (standardized)	13.99 (0–104.6)
	Reading score in high school (standardized)	51.0 (29–68.4)
	Math score in high school (standardized)	51.2 (29.6–71.4)
Curricular program	Academic	70.3
	Non-academic	29.7
High school type	Public	92
	Private or catholic	8
Postsecondary exams	Took any type of postsecondary exams	Yes: 73.4
		No: 26.6
GED	GED recipients	6.6
	High school graduates	93.4

similar. White students comprise the largest race/ethnic group of the sample (72.1%), whereas African Americans, Hispanics, and Asians comprising 12.4 percent, 10.1 percent, and 4 percent, respectively. Among the seven different income groups, more than a half of students come from families with incomes between $25,000 (35.2%) and $75,000 (21.6%). Approximately 5 percent and 10 percent of students come from the lowest (less than $7,500) and the second lowest income groups ($7,500 to $15,000), respectively, while the highest and the second highest income groups accommodate 6.4 percent and 7 percent of the total student population, respectively. A comparable proportion of students (14.2%) come from families with incomes less than $15,000. Approximately a quarter of students attended high schools located in urban areas (26.6%), whereas a higher proportion of students attended schools located in rural (32.6%) or suburban areas (41.3%).

Figure 1 illustrates the chronological patterns of event occurrences over time using event history techniques that allow graphical plotting of the time-to-enrollment trajectories
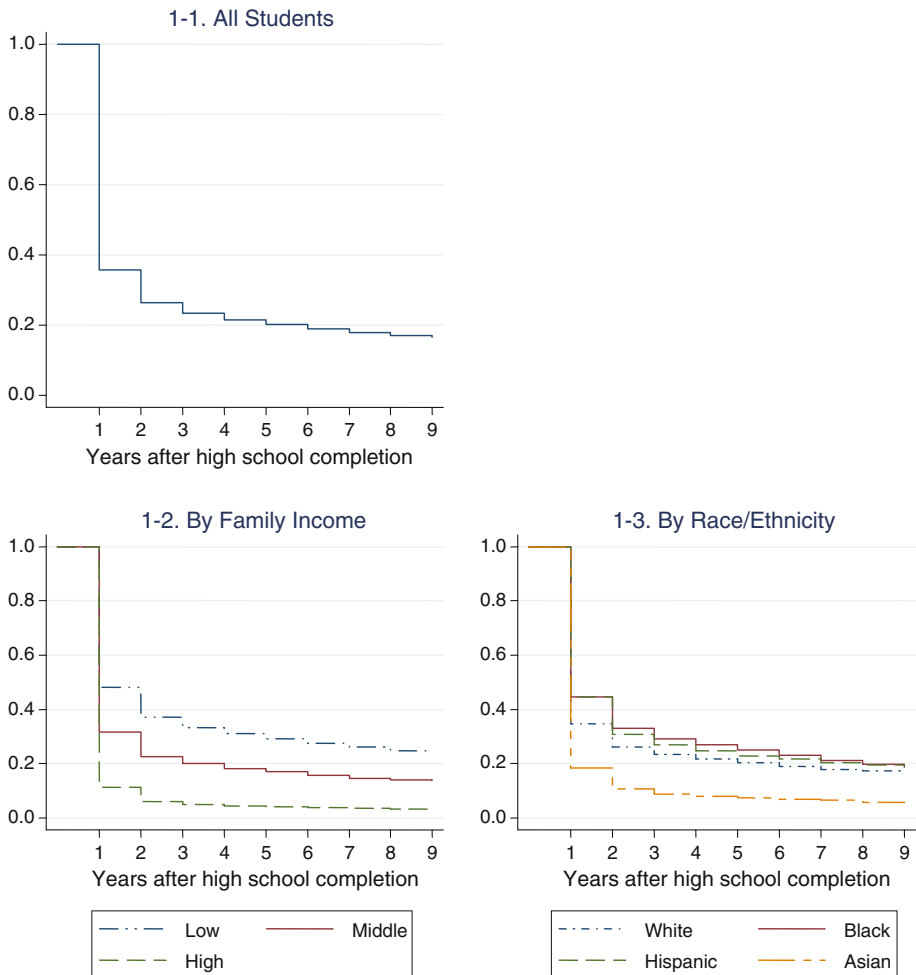

Fig. 1 Time-to-enrollment trajectories

for different income and race/ethnic groups. Figure 1-1 indicates that for all students, the probability of enrollment in general peaks in just after high school, but decreases rapidly as time elapses after high school. Higher income groups (greater than $75,000) are more likely to enroll than any other income groups whereas the low-income groups (less than $25,000) exhibit the least likelihood of transition to higher education throughout the observation period (see Fig. 1-2). With regard to race/ethnic differences, Asian students are the most likely to make the transition to postsecondary education whereas African Americans exhibited consistently the least likelihood of enrollment throughout the study period (see Fig. 1-3). The results pertaining to enrollment trajectories by income and race/ethnicity indicate that there is a clear and consistent gap in college enrollment for students who are from different income and race/ethnic groups.

Estimating the Multinomial Discrete Hazard of Enrollment

Table 2 presents the estimates differentiated by the selectivity and the type of post-secondary institutions relative to non-enrollment, including the interaction effects between income/race and state aid variables. With regard to race/ethnic variations, the odds of enrollment in two-year colleges are significantly higher for Hispanics relative to Whites (odds ratio = 1.89). Higher parents' education level and educational expectations for their child are significant and positive factors for enrollment in four-year institutions. Students' postsecondary aspiration and academic achievement in high school (including test scores, taking postsecondary exams, being in an academic program) are also positively related to enrollment in four-year institutions. Financial aid information obtained from a school representative is positively associated with enrollment in non-competitive institutions (odds ratio = 1.68) and private competitive institutions (odds ratio = 2.28).

Students' expectation about a Pell grant is negatively related to enrollment in two-year college (odds ratio = 0.83) while the expectation of state need-based grant is (marginally) negatively associated with enrollment in private competitive institutions (odds ratio = 0.32). With regard to state-level aid variables, conditional on the individual expectations of financial aid, an increase in state need-based grants is positively associated with the odds of enrollment in two-year institutions (odds ratio = 1.2), and state non need-based grants are negatively associated with the odds of enrollment in non-competitive institutions (odds ratio = 0.16). The effects of public tuition and state appropriations are also significantly negative for the odds of enrollment in two-year and competitive four-year institutions.

In order to further investigate institutional choices exclusively for students who enrolled in college, those who did not enter college are dropped from the analyses and then the multinomial model is re-estimated (with a baseline category of enrollment in two-year or less institutions) as Appendix Table 7 shows. Thus, the estimated odds ratios are interpreted as values relative to enrollment in two-year or less institutions. In addition to the existing variables, the model controls for a variable indicating whether a student is enrolled in an in-state or out-of-state institution in order to better illuminate the enrollment choices of students who move out of state to attend a college.

Appendix Table 7 indicates that the odds of enrolling in private competitive institutions (relative to enrollment in two-year or less colleges) are significantly higher for out-of-state students than for in-state students. It is also interesting to note that the interaction terms between state non-need based grants and family income groups are significantly positive across different types of institutions. The positive interaction effects suggest that state non need-based aid increases the odds of enrollment in either non-competitive or competitive

Table 2 Estimating the hazard of postsecondary enrollment by selectivity

Variables	Two-year			Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.
Female	1.35	0.11	***	1.33	0.18	*	1.34	0.17	*	1.51	0.21	**
Asian	2.81	1.40	~	2.45	1.50		2.34	1.31		2.77	1.56	~
Hispanic	1.89	0.59	*	2.08	1.07	~	1.05	0.52		0.57	0.30	
Black	1.91	0.88		3.14	1.85		1.55	0.84		1.49	0.87	
Other race	0.29	0.22		0.98	1.05		0.18	0.18	~	0.03	0.05	~
Parental education: bachelor's or above	1.37	0.21	*	1.83	0.33	**	1.96	0.33	***	2.49	0.49	***
Income $7.5k to $15k	1.38	0.47		0.55	0.27		0.75	0.47		1.34	1.04	
Income $15k to $25k	1.02	0.75		0.53	0.41		1.39	1.26		4.30	5.14	
Income $25k to 50k	0.79	0.91		0.37	0.51		2.17	2.85		3.43	5.43	
Income $50k to $75k	1.31	1.90		0.66	1.04		3.65	5.56		1.69	3.10	
Income $75k to $100k	0.91	1.42		0.51	0.88		3.16	3.99		1.42	2.55	
Income more than $100k	0.79	1.20		0.41	0.73		7.61	15.39		5.38	13.09	
Family size	0.90	0.06		0.90	0.07		0.81	0.22		0.94	0.08	
Urban	1.26	0.14	*	1.36	0.23	~	1.61	0.66		1.78	0.31	**
Rural	0.78	0.07	**	1.05	0.16		0.81	0.42		1.01	0.18	
Postsecondary plan: bachelor's or above	2.22	0.18	***	6.20	1.05	***	12.82	2.19	***	5.83	1.06	***
Parental educational expectation: bachelor's or above	1.41	0.23	~	1.88	0.44	*	4.23	0.84	***	2.41	0.52	***
FA info from a teacher/counselor	1.17	0.15		1.33	0.27		1.40	0.20	*	1.24	0.21	
FA info from a school representative	1.06	0.21		1.68	0.27	**	1.15	0.23		2.28	0.60	*
FA info from Dept. of education	1.27	0.18		1.31	0.25		1.22	0.22		1.27	0.40	
FA info from colleges and universities	0.89	0.11		0.82	0.12		0.94	0.11		0.77	0.17	
HS reading score	1.22	0.08	**	1.30	0.15	*	1.18	0.11	~	1.48	0.17	**
HS math score	0.90	0.12		1.23	0.21		1.66	0.27	*	1.73	0.29	**

Table 2 continued

Variables	Two-year			Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.
HS cumulative GPA	1.06	0.06		1.13	0.11		1.04	0.07		1.12	0.11	
Took postsecondary exams	1.68	0.14	***	3.19	0.53	***	5.11	0.87	***	4.25	0.87	***
Attend public HS	0.79	0.18		0.66	0.19		0.53	0.14	*	0.28	0.08	***
Academic program	1.35	0.10	***	1.63	0.24	**	1.64	0.23	***	1.54	0.29	*
GED	1.12	0.12		0.63	0.27		0.84	0.33		0.60	0.28	
Expected amount of a Pell grant	0.83	0.02	*	0.83	0.12		0.93	0.08		1.00	0.11	
Squared expected Pell	1.01	0.00		1.01	0.01		1.00	0.00		1.00	0.00	
Expected amount of state need grant	1.30	0.50		0.96	0.24		1.20	0.34		0.32	0.05	≀
Squared expected state need grant	0.97	0.04		1.03	0.04		1.00	0.04		1.13	0.03	
Expected amount of state non-need grant	1.30	0.99		1.37	2.73		9.96	14.48		22.47	29.43	
Squared expected state non-need grant	0.67	0.86		1.16	1.47		0.59	0.22		0.69	0.31	
State need-based grant prior to 3 years	1.20	0.08	**	1.13	0.15		0.76	0.11	≀	1.09	0.19	
State non-need grant prior to 3 years	0.85	0.19		0.16	0.11	*	0.65	0.36		1.19	0.61	
Public tuition prior to 3 years	0.92	0.02	**	0.93	0.05		0.90	0.04	*	0.88	0.06	*
State appropriation prior to 3 years	0.99	0.01	*	0.99	0.01		0.96	0.01	***	0.98	0.02	
Year 2 (1993)	0.56	0.15	*	0.33	0.25		0.22	0.04	***	0.18	0.05	***
Year 3 (1994)	0.32	0.16	*	0.15	0.19		0.12	0.03	***	0.15	0.07	***
Year 4 (1995)	0.26	0.16	*	0.11	0.03	***	0.09	0.03	***	0.14	0.08	**
Year 5 (1996)	0.20	0.15	*	0.09	0.03	***	0.08	0.03	***	0.14	0.08	***
Year 6 (1997)	0.17	0.14	*	0.07	0.03	***	0.07	0.03	***	0.10	0.05	***
Year 7 (1998)	0.11	0.11	*	0.05	0.03	***	0.04	0.03	***	0.14	0.20	
Year 8 (1999)	0.07	0.08	*	0.04	0.03	***	0.03	0.05	*	0.08	0.06	**
Year 9 (2000)	0.03	0.05	*	0.03	0.12		0.00	0.04		0.03	0.19	
Public HS graduation rate prior to 3 years	1.00	0.02		1.02	0.04		1.02	0.04		1.09	0.05	≀

Table 2 continued

Variables	Two-year			Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.
% bachelors or higher prior to 3 years	0.96	0.04		0.90	0.07		1.11	0.09		0.88	0.09	
State per capita Income prior to 3 years	1.16	0.07	**	1.01	0.16		1.09	0.08		1.05	0.11	
% Poverty prior to 3 years	0.98	0.01	?	0.99	0.03		0.97	0.03		1.05	0.03	?
% Unemployment prior to 3 years	1.04	0.06		0.97	0.10		1.00	0.14		0.94	0.18	
Hispanic × state need grant	0.86	0.03	***	0.96	0.07		0.98	0.05		1.10	0.07	
Black × state need-based grant	0.97	0.04		0.91	0.08		1.01	0.07		0.99	0.06	
Asian × state need grant	0.81	0.07	*	0.96	0.09		0.87	0.07		0.93	0.09	
Other × state need grant	1.10	0.12		0.93	0.70	?	1.13	0.23		2.11	0.46	***
Hispanic × state non-need grant	0.89	0.13		0.96	0.35		1.13	0.26		1.83	0.67	
Black × state non-need grant	0.95	0.11		1.41	0.39		0.87	0.22		0.79	0.25	
Asian × state non-need grant	1.91	0.70		0.46	0.32		1.98	0.88		1.48	0.64	
Other × state non-need grant	2.48	0.89	*	2.82	1.55	?	2.60	1.63		0.02	0.06	
Income $7.5k–$15k × state need grant	0.95	0.05		1.11	0.10		1.19	0.12	?	1.13	0.14	
Income $15k–$25k × state need grant	0.97	0.05		0.98	0.10		0.97	0.09		0.87	0.13	
Income $25k-50k × state need grant	0.94	0.04		1.05	0.08		0.97	0.08		0.90	0.11	
Income $50k–$75k × state need grant	0.83	0.04	***	0.87	0.07	?	0.91	0.08		0.83	0.10	
Income $75k–$100k × state need grant	0.95	0.06		1.08	0.15		1.00	0.11		0.89	0.16	
Income more $100k × state need grant	1.01	0.13		1.14	0.15		1.02	0.12		0.92	0.13	
Income $7.5k–$15k × non-need grant	1.43	0.30		2.56	1.21	?	1.26	0.73		1.35	0.79	
Income $15k–$25k × non-need grant	0.85	0.21		1.21	0.66		0.99	0.46		0.53	0.34	
Income $25k-50k × non-need grant	1.02	0.26		1.30	0.62		0.79	0.37		0.84	0.50	
Income $50k–$75k × non-need grant	1.00	0.24		0.89	0.40		0.69	0.34		0.79	0.44	
Income $75k–$100k × non-need grant	0.85	0.34		1.10	0.62		1.41	0.83		0.65	0.42	

Table 2 continued

Variables	Two-year			Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.	Odds ratio	SE	Sig.
Income more $100k × non-need grant	0.80	0.41		1.46	1.15		0.46	0.42		0.47	0.38	

*** $p < .001$ ** $p < .01$ * $p < .05$ ~ $p < .10$

As a measure of goodness of fit, the average McFadden's (pseudo) R-square (unweighted) estimated for the five imputed datasets is 0.28, suggesting that 28% of the variability is explained by this set of variables used in the model

Standard errors are bootstrapped using 200 replications to account for the fact that some independent variables are based on predicted values. The 200 replications were done for each of the five multiply imputed datasets (a total of 1,000 replications)

49 State fixed-effect dummy variables (reference group: Alabama) are controlled for in the model, with District of Columbia dropped from the analyses

four-year institutions (relative to enrollment in two-year or less institutions) among students from middle to upper income groups.

Subgroup Analyses by Income and Race

As sub-analyses of the model presented in Table 2, Tables 3 and 4 provide estimation results about the effects that state financial aid has on the probability of enrollment in different types of institutions across the income and racial/ethnic groups. Table 3 illustrates the estimates of the relationships between state financial aid (both the individual expectations and state-level grants) and enrollment in each type of institution for low income groups (family incomes less than $25,000) and high income groups (family incomes greater than $75,000). Changes in individual expectations of state grants are not significantly related to the odds of enrollment in any type of institution, but state-level need-based grants are significantly associated with low-income students' enrollment decisions. An increase in state need-based grants raises the odds of enrollment in two-year colleges and private competitive colleges (odds ratio = 1.2 and 1.92, respectively).

   Table 4 provides separate estimation results by racial groups. The effects of individual aid expectations are significant only for Asians. Having higher expectations about state need-based grants increases the probability that Asian students enroll in two-year colleges and non-competitive colleges (odds ratio = 1.07 and 1.13, respectively). The relationship between state-level grants and enrollment in the types of colleges differs across racial groups. For Whites, an increase in state-level need-based aid is positively related to enrollment in two-year colleges and non-competitive colleges, but is negatively associated with Hispanics' and African Americans' enrollment in either type of college. State need-based grants are, however, negatively related to enrollment in either public or private competitive institutions for both Whites (odds ratio = 0.75) and African Americans (odds ratio = 0.61). An increase in state non need-based grants is positively related to Asians' enrolling in public competitive colleges (odds ratio = 6.18), but lowers the odds of enrollment in the same type of institutions for Whites (odds ratio = 0.7).

Discussions and Implications

This study adds new contributions to the college choice literature by exploring longitudinally the roles that state financial aid policies play on the type of college attended by a student. The study findings suggest that low-income and underrepresented minority students (including African Americans and Hispanics) experience far more transitioning difficulties than their upper-income and White peers after high school. The results confirm the prior research demonstrating that delayed college entrants tend to be at a greater socioeconomic disadvantage than those who enroll in college immediately either due to a lack of financial resources and access to social network and information, or cultural capital that perpetuates a culture of college-going behavior within a family (Goldrick-Rab 2006; Rowan-Kenyon 2007). Delaying postsecondary enrollment, however, poses a clear educational disadvantage since the delayed time between high school graduation and college enrollment substantially increases the chances of college dropout rates while decreasing the chances of a bachelor's degree attainment (Ahlburg et al. 2002; Bozick and DeLuca 2005). In terms of a policy perspective, it is thus recommended that high schools and communities should collaboratively provide better social, academic, and financial assistance to students from disadvantaged backgrounds so that they do not delay their postsecondary entry.

Table 3 Estimating the hazard of postsecondary enrollment by income

Variables	Two-year		Non competitive		Public Comp		Private Comp	
	Low	High	Low	High	Low	High	Low	High
Expected amount of state need grant	1.56 (1.27)	0.72 (3.3)	1.39 (1.41)	12.61 (92.6)	1.65 (1.41)	19.78 (170.4)	0.62 (0.67)	37.50 (367.3)
Squared expected state need grant	0.92 (0.11)	1.34 (7.47)	0.95 (0.12)	0.07 (0.64)	0.97 (0.1)	0.06 (0.6)	1.03 (0.14)	0.08 (0.71)
Expected amount of state non-need grant	1.40 (4.9)	0.37 (1.69)	17.40 (133.2)	1.00 (4.64)	0.48 (2.17)	2.18 (10.68)	17.78 (88.7)	4.49 (27.13)
Squared expected state non-need grant	0.37 (1.59)	1.98 (17.23)	0.01 (0.07)	0.31 (2.96)	4.37 (22.45)	0.17 (1.73)	0.80 (4.34)	0.10 (1.16)
State need-based grant prior to 3 years	1.20*** (0.07)	0.96 (0.17)	1.10 (0.21)	0.92 (0.15)	0.88 (0.13)	0.81 (0.13)	1.92** (0.4)	0.82 (0.15)
State non-need grant prior to 3 years	0.98 (0.03)	1.03 (0.3)	0.47 (0.23)	0.87 (0.32)	0.79 (0.28)	0.88 (0.29)	2.06 (1.7)	0.60 (0.27)

All other covariates except for the state dummies (shown in Table 2) are controlled for in the model. As a measure of goodness of fit, the average McFadden's (pseudo) R-squares (unweighted) estimated for each model are 0.31 (low-income model) and 0.44 (high-income model), respectively. State fixed-effect controls are dropped due to a non-convergence problem in estimation resulting from sample reduction. Instead, eight regional division dummies used by the Census Bureau (reference group: New England) are controlled for in the model

Table 4 Estimating the hazard of postsecondary enrollment by race

Variables	Two-year		Non competitive		Public Comp		Private Comp	
	White	Asian	White	Asian	White	Asian	White	Asian
Expected amount of State need grant	1.44 (1.93)	1.07* (0.03)	0.63 (1.16)	1.13* (0.05)	0.74 (1.19)	1.10~(0.05)	0.23 (0.54)	1.09~(0.05)
Squared expected state need grant	0.98 (0.17)	1.00* (0.0)	1.14 (0.27)	1.00** (0.0)	1.09 (0.21)	1.00* (0.0)	1.29 (0.4)	1.00* (0.0)
Expected amount of state non-need grant	0.45 (1.13)	0.89 (0.17)	0.83 (2.92)	0.87 (0.2)	7.88 (21.9)	0.87 (0.18)	9.96 (29.2)	0.88 (0.18)
Squared expected state non-need grant	2.25 (7.62)	1.00 (0.0)	3.52 (10.73)	1.00 (0.0)	1.15 (3.31)	1.00 (0.0)	2.04 (6.0)	1.00 (0.0)
State need-based grant prior to 3 years	1.13** (0.05)	1.25 (0.24)	1.28* (0.15)	1.25 (0.3)	0.75* (0.1)	1.31 (0.28)	0.97 (0.17)	1.35 (0.35)
State non-need grant prior to 3 years	1.04 (0.04)	6.06* (5.31)	0.47 (0.3)	1.07 (1.05)	0.70* (0.1)	6.18* (5.31)	1.13 (0.18)	1.96 (1.77)

Variables	Two-year		Non competitive		Public Comp		Private Comp	
	Black	Hisp	Black	Hisp	Black	Hisp	Black	Hisp
Expected amount of state need grant	0.98 (0.03)	1.00 (0.01)	0.96 (0.04)	1.00 (0.02)	0.97 (0.05)	1.00 (0.02)	1.00 (0.04)	1.02 (0.03)
Squared expected state need grant	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)
Expected amount of state non- need grant	1.15 (0.11)	1.07 (0.14)	1.26 (0.17)	0.99 (0.09)	1.15 (0.12)	1.09 (0.11)	1.12 (0.17)	1.01 (0.09)
Squared expected state non-need grant	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)	1.00 (0.0)
State need-based grant prior to 3 years	0.90 (0.07)	0.85* (0.06)	0.68* (0.12)	1.03 (0.18)	0.91 (0.14)	1.15 (0.09)	0.61* (0.13)	1.10 (0.26)
State non-need grant prior to 3 years	1.01 (0.05)	1.32 (0.29)	0.86 (0.23)	1.46 (0.65)	0.85 (0.3)	1.68~(0.31)	0.48 (0.3)	0.70 (0.38)

All other covariates except for the state dummies (shown in Table 2) are controlled for in the model

As a measure of goodness of fit, the average McFadden's (pseudo) R-squares (unweighted) estimated for each race model are 0.34 (White), 0.39 (Black), 0.38 (Hispanic), and 0.51 (Asian). State fixed-effect controls are dropped due to a non-convergence problem in estimation resulting from sample reduction. Instead, 8 regional division dummies used by the Census Bureau (reference group: New England) are controlled for in the model

In terms of college destinations, conditional on the individual aid expectations, state-level need-based aid positively affected the odds of enrollment in two-year institutions when considering the whole sample of students. The positive relationship between state-level need-based grants and college enrollment was especially pronounced among low-income students as higher need-based aid increased their probability of enrollment in both two-year colleges and private competitive colleges. For students from disadvantaged socioeconomic backgrounds, increased availability of need-based aid may remove financial barriers to access to *any* college as well as to *selective* colleges, suggesting that higher statewide investment in need-based aid grants can counter unequal access to selective four-year colleges by socioeconomic origins. The findings on the impact of state need-based aid confirm the prior research on state aid policy variables documenting the substantial influence of state need-based grants on promoting needy students' college access and choice (Perna and Titus 2004; St. John and Chung 2006).

The benefits of state need-based grants on postsecondary opportunity, however, were not equally distributed across racial groups. An increase in state-level need-based grants lowered the probability of enrollment in either two-year or four-year colleges especially among Hispanics and African Americans, and the limited aid effects for them may be due to lower availability of information about state financial aid systems compared to other racial groups. Prior research revealed that underrepresented minorities are typically embedded in social relationships and networks deficient in social capital, and their heavier reliance on family and community results in limited information and support for college preparation and enrollment (Ceja 2006; Perez and McDonough 2008). It may be that underrepresented minority students tend to obtain information about applying to state grants from family or friends rather than seeking information from outside networks. However, their family or friends may provide limited information if they have no prior experience of college attendance or if their social networks are isolated or under-resourced. In combination, the lack of adequate information about the availability of state financial aid and unsettled financial concerns may prevent African American and Hispanic students from attending any type of college.

The aforementioned state aid effects, however, should be interpreted with caution in that state financial aid policies are probably endogenous to postsecondary enrollment patterns across states. For example, it is possible that the college-age population and the college participation rate of under-represented minorities may be relatively lower in states that implement generous need-based aid policies than in states with a stringent budget for need-based grants. Accordingly, the negative influence of state need-based aid in enrollment propensities for Hispanics and African Americans may simply reflect this endogenous variation in the patterns of state aid policy and college enrollment. Future research is guaranteed to address this potential endogeneity problem in order to allow causal inferences in the impact of state financial aid policy.

With regard to state non-need based aid, increased availability of state-level non need-based grants lowered the probability of enrollment in non-competitive colleges for the whole sample of students, and especially lowered the odds of enrollment in public competitive colleges among Whites. This finding does not support the prior research evidence suggesting that the merit-based scholarships encouraged Whites and upper-income students to attend four-year colleges relative to minority and low-income students (Cornwell et al. 2006; Dynarski 2002). Two possible explanations are proposed for the discrepancy between the prior research and the present study findings. First, it is possible that the potential endogeneity of state aid policies may drive the results if states that implement a generous merit-based aid policy have lower minority populations (predominantly Whites) and rank lower in college enrollment rates than other states that have not introduced merit

aid programs. Second, the inconsistency may also stem from the fact that unlike the present study, most previous research on state merit (or non-need) aid programs are based on a single state aid program (e.g., Georgia's HOPE Scholarship). In order to better identify the role of state non need-based grants in the college choice process, further investigation of the effects that state-funded non need-based aid programs implemented in various states have on postsecondary destinations is suggested as an area for future research.

In summary, the study's longitudinal modeling of college enrollment expands our understanding of how individual students' transition to college differs across income and racial/ethnic groups and how state aid policies affect enrollment choices for students from different income and race/ethnic groups. In the presence of persistent socio-economic and racial/ethnic disparities in postsecondary education opportunity, the reality that not all students enjoy equal access to postsecondary education justifies further investigations of college choice issues varied by student income and race/ethnicity. I hope the findings from this study could help policymakers implement targeted financial aid policies toward the socially and economically disadvantaged student population who may not make the most of public financial aid support in order to boost their immediate enrollment in four-year colleges and especially in more selective colleges.

Appendix

See Appendix Tables 5, 6 and 7.

Table 5 Coding of independent variables

Category	Variable	Variable descriptions
Gender	Female	1 if female
Race/ethnicity	White	1 if White (Reference group)
	Black	1 if Black
	Hispanic	1 if Hispanic
	Asian	1 if Asian
	Other ethnicity	1 if Other Ethnic Group
Family Income measured in 1991	Less than $7,500	1 if Income is in associated range
	$7,500 to $15,000	1 if Income is in associated range
	$15,000 to $25,000	1 if Income is in associated range
	$25,000 to $50,000	1 if Income is in associated range
	$50,000 to $75,000	1 if Income is in associated range
	$75,000 to $100,000	1 if Income is in associated range
	More than $100,000	1 if Income is in associated range
Family size	Family size	The number of family members
Parental education	Parental education	1 if parents' highest educational level is four-year college graduation or beyond

Table 5 continued

Category	Variable	Variable descriptions
Region of	Urban	1 if Urban
High school	Suburban	1 if Suburban (Reference group)
Location	Rural	1 if Rural
Postsecondary aspiration	Aspiration	1 if a student' highest level of education planned is bachelor's degree or beyond
Parental influence	Parental educational expectation	1 if parents expect their child to graduate four-year college or beyond
Financial aid	Imputed financial aid	Expected amount of Pell grant, state need-based, and non need-based grants (/$100)
Information on financial aid	Information from a teacher/counselor	1 if students talked to a teacher/counselor about financial aid
	Information from a school representative	1 if students talked to a school representative about financial aid
	Information from U.S. Dept. of education	1 if student read information about financial aid provided by U.S. Dept. of Education
	Information from colleges and universities	1 if student read information about financial aid provided by colleges and universities student applied for admission
HS academic preparation	High school GPA	A continuous measure of cumulative high school GPA for the last year attended
	Reading standardized score in high school	A continuous measure of standardized test scores in reading
	Math standardized score in high school	A continuous measure of standardized test scores in math
Curricular program	Academic	1 if a student took academic program
High school type	Public	1 if a student attended public high school
	Postsecondary exams	1 if a student took any type of postsecondary exams
GED	GED/HS diploma	1 if GED recipients
State level	State need-based aid	Average amount of the state need-based grants for undergraduate students per FTE adjusted to 2006 dollars (/$100)
	State non need-based aid	Average amount of the state non-need-based grants for undergraduate students per FTE adjusted to 2006 dollars (/$100)
	Public institutional tuition	Amount of undergraduate in-state tuition and fees adjusted to 2006 dollars for the public higher education system (/$100)
	State funding for public institutions	Amount of state and local appropriations per FTE adjusted to 2006 dollars for the public higher education system (/$100)
	Public high school graduation rate	Public high school graduation rate with in a state
	College attainment rate	Percent of the state population with a bachelors or higher degree
	State per capita income	State per capita real income adjusted to 2006 dollars (/$1,000)
	Poverty rate	Percent of the state population that is in poverty
	Unemployment rate	State annual average unemployment rate

Table 6 Descriptive statistics of the state-level variables: 1992 to 2000

Variable/Year	1992	1993	1994	1995	1996	1997	1998	1999	2000
Need-based aid per FTE	$260.7	$283.2	$306.3	$293.0	$300.8	$305.8	$324.9	$271.3	$283.9
Non need-based aid per FTE	$31.6	$36.3	$55.0	$57.7	$63.1	$78.0	$88.6	$95.5	$114.2
Avg. Public in-state tuition	$2514.4	$2618.5	$2705.0	$2781.1	$2855.4	$2888.9	$2956.0	$3002.6	$3051.2
State and local appropriations per FTE	$8370.1	$8414.8	$8660.0	$8278.2	$8423.2	$8269.2	$8551.8	$7017.6	$7091.0
Public HS graduation rate	74.8%	74.7%	73.6%	72.0%	71.1%	69.6%	70.2%	69.4%	69.6%
% bachelors or higher	21.5%	21.5%	21.9%	22.8%	23.2%	23.3%	24.0%	25.0%	25.2%
Avg. state per capita income (in dollar)[a]	29946.3	29857.5	30344.8	30775.8	31480.6	32125.0	33535.7	34265.1	35636.9
% poverty	14.8%	15.1%	14.5%	13.8%	13.7%	13.3%	12.7%	11.9%	11.3%
Unemployment rate	7.5%	6.9%	6.1%	5.6%	5.4%	4.9%	4.5%	4.2%	4.0%

All dollar amounts presented here are adjusted to 2006 dollars

[a] The measure of state per capita income is calculated as the real personal income of the residents of a given state divided by the resident population of the state using the Census Bureau's annual midyear population estimates

Table 7 Estimating the hazard of postsecondary enrollment choices by selectivity

Variables	Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds Ratio	SE	Sig.	Odds Ratio	SE	Sig.
Out of state	1.48	0.44		1.05	0.25		5.30	1.26	***
Female	1.02	0.16		1.03	0.10		1.34	0.19	
Asian	0.88	0.53		0.93	0.38		0.85	0.42	
Hispanic	1.18	0.97	***	0.60	0.21		0.22	0.20	
Black	1.35	0.71		0.68	0.36		0.60	0.38	
Other race	3.33	3.49		0.62	0.46		0.09	0.10	
Parental education: bachelor's or above	1.47	0.25		1.49	0.22		1.66	0.31	
Income $7.5k to $15k	0.39	0.20		0.56	0.40		1.22	0.97	***
Income $15k to $25k	0.41	0.32		1.61	1.49		6.65	7.89	
Income $25k to 50k	0.58	0.73	~	3.76	5.78		11.58	24.49	
Income $50k to $75k	0.89	1.57		3.82	6.93		8.58	22.91	
Income $75k to $100k	1.02	1.99		4.06	7.36		12.32	30.79	
Income more than $100k	0.77	1.22		13.71	26.88		45.75	132.38	
Family size	0.99	0.07		0.90	0.06		1.04	0.08	
Urban	1.13	0.25		1.30	0.26		1.50	0.40	
Rural	1.38	0.32		1.04	0.18		1.28	0.30	
Postsecondary plan: bachelor's or above	2.81	0.73	**	5.29	1.22	***	2.30	0.66	*
Parental educational expectation: bachelor's or above	1.34	0.29		2.81	0.72	**	1.78	0.55	
FA Info from a teacher/counselor	1.14	0.20		1.22	0.15		1.15	0.21	
FA info from a school representative	1.56	0.31		1.07	0.13		2.12	0.40	
FA info from dept. of education	0.99	0.17		0.94	0.12		1.00	0.27	
FA Info from colleges and universities	1.00	0.16		1.09	0.16		0.96	0.25	
HS reading score	1.05	0.10		0.96	0.09		1.18	0.13	
HS math score	1.37	0.17		1.89	0.25		1.86	0.29	
HS cumulative GPA	1.07	0.11		0.99	0.08		1.07	0.13	
Took postsecondary exams	1.84	0.42		3.04	0.70	**	2.19	0.65	~
Attend public HS	0.84	0.25		0.67	0.13		0.40	0.12	
Academic program	1.19	0.22		1.15	0.17		1.14	0.27	
GED	0.55	0.19		0.76	0.35		0.61	0.45	
State need-based grant prior to 3 years	1.00	0.18		0.66	0.13		1.09	0.22	
State non-need grant prior to 3 years	0.12	0.09		0.52	0.30		1.43	1.44	
Public tuition prior to 3 years	1.01	0.05		0.98	0.05		0.95	0.08	
State appropriation prior to 3 years	1.01	0.01		0.98	0.01		0.98	0.02	
Year 2 (1993)	0.58	0.07		0.41	0.04		0.33	0.08	
Year 3 (1994)	0.49	0.09		0.42	0.08		0.50	0.20	
Year 4 (1995)	0.46	0.13		0.41	0.12		0.62	0.26	
Year 5 (1996)	0.51	0.19		0.49	0.15		0.78	0.35	

Table 7 continued

Variables	Non competitive			Public competitive			Private competitive		
	Odds ratio	SE	Sig.	Odds Ratio	SE	Sig.	Odds Ratio	SE	Sig.
Year 6 (1997)	0.48	0.23		0.53	0.21		0.65	0.32	
Year 7 (1998)	0.58	0.36		0.49	0.25		1.44	0.85	*
Year 8 (1999)	0.90	0.64		0.80	0.51		1.55	1.29	~
Year 9 (2000)	1.11	1.06	~	0.34	0.40		2.62	3.06	
Public HS graduation rate prior to 3 years	1.04	0.04		1.02	0.03		1.11	0.07	
% bachelors or higher prior to 3 years	0.92	0.06		1.14	0.10		0.91	0.13	
State per capita Income prior to 3 years	0.85	0.09		0.94	0.04		0.86	0.06	
% Poverty prior to 3 years	1.02	0.03		0.99	0.02		1.07	0.04	
% Unemployment prior to 3 years	0.91	0.11		0.95	0.08		0.84	0.16	
Hispanic × state need grant	1.11	0.11		1.11	0.06		1.26	0.10	
Black × state need-based grant	0.94	0.05		1.04	0.06		1.02	0.05	
Asian × state need grant	1.18	0.15		1.05	0.07		1.14	0.08	
Other × state need grant	0.86	0.25		0.99	0.12		1.69	0.33	
Hispanic × state non-need grant	1.16	0.72		1.32	0.25		2.20	0.82	***
Black × state non-need grant	1.50	0.42		0.93	0.20		0.82	0.29	
Asian × state non-need grant	0.25	0.25		1.07	0.22		0.79	0.24	
Other × state non-need grant	1.17	0.87		0.90	0.40		0.07	0.22	~
Income $7.5k–$15k × state need grant	1.14	0.15		1.24	0.14		1.10	0.12	
Income $15k–$25k × state need grant	1.01	0.15		1.03	0.10		0.86	0.11	
Income $25k-50k × state need grant	1.08	0.14		1.02	0.09		0.89	0.11	
Income $50k–$75k × state need grant	1.03	0.14		1.08	0.09		0.93	0.11	
Income $75k–$100k × state need grant	1.13	0.19		1.06	0.11		0.87	0.14	
Income more $100k × state need grant	1.13	0.19		1.03	0.13		0.87	0.14	
Income $7.5k–$15k × non-need grant	2.01	1.17	***	1.01	0.55		1.13	0.94	~
Income $15k–$25k × non-need grant	1.79	1.16	***	1.34	0.56		0.76	0.66	
Income $25k-50k × non-need grant	1.67	0.91	***	0.96	0.38		1.17	0.97	***
Income $50k–$75k × non-need grant	1.07	0.68		0.86	0.34		1.23	1.02	***
Income $75k–$100k × non-need grant	1.59	1.09	***	1.92	1.24	**	1.20	1.11	~
Income more $100k × non-need grant	2.23	1.53	~	0.71	0.43		0.90	0.78	

[a] ***$p < .001$, **$p < .01$, *$p < .05$, ~ $p < .10$

[b] As a measure of goodness of fit, the average McFadden's (pseudo) R-square (unweighted) estimated for the five imputed datasets is 0.35, suggesting that 35% of the variability is explained by this set of variables used in the model

[c] Standard errors are bootstrapped using 200 replications to account for the fact that some independent variables are based on predicted values. The 200 replications were done for each of the five multiply imputed datasets (a total of 1,000 replications)

[d] 49 State fixed-effect dummy variables (reference group: Alabama) are controlled for in the model, with District of Columbia dropped from the analyses

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