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Investigating the Impact of Financial Aid on Student Dropout Risks: Racial and Ethnic Differences

Introduction

In the United States it is well established that investment in higher education is beneficial to individuals and society and that it promotes economic development. Increasingly, the higher education system has come to be seen as not only a provider of individual, social, and economic opportunity, but also a critical element in the national quest for equality of opportunity across socioeconomic, gender, and racial/ethnic lines (Anderson & Hearn, 1992). Park (1996) suggests that the larger the dispersion of schooling among the labor force, the greater the income inequality; and Bowen (1997) concludes that a democratic-capitalist society could use education, especially higher education, as a means of gradually reducing inequalities in the human condition. Bowen also notes, "In the long run, education could be an effective and acceptable means for changing the distribution of social position" (p. 58).

Achieving equal educational opportunity has long been a concern of American higher education, and a major challenge is the persistent dispar-

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ity in college outcomes across racial/ethnic groups. Despite the increase in the absolute number of degree recipients among minority students, policy researchers (Cook & Cordova, 2006; Nettles & Perna, 1997; Perna, 2000 & 2005) have pointed out that minority students continue to lag behind their White peers in completing a bachelor's degree. In the recent Annual Status Report by the American Council on Education (Cook & Cordova, 2006), the authors find that racial and ethnic differences in the percentage of students who persist to a bachelor's degree have actually widened over time, creating a larger disparity between Whites and their underrepresented counterparts. For example, among the 1989–90 cohort, 27.4 percent of African American and 29.4 percent of Hispanic students at four-year institutions dropped out of higher education, while only 25 percent of their White peers did so. The dropout rate for Hispanics among the 1995–96 cohort was similar to the rate in 1989–90 cohort at 29 percent, but the rate for African Americans increased to 30 percent; meanwhile, the dropout percentage for Whites declined to 18.8 (Cook & Cordova, 2006). Thus, it is evident that significant inequality of opportunity across racial/ethnic groups continues to plague the American higher education system.

There are many barriers to educational opportunities for minority students, among which a major one is related to the affordability of higher education (Long & Riley, 2007). Long and Riley found that over 56 percent of African American and 58 percent of Hispanic dependent students had unmet need after all aid was considered, whereas only 40 percent of Whites had unmet need (see Table 3 in Long & Riley, 2007). While a myriad of financial aid programs are available to help families pay for college, recent shifts in policy (e.g., more reliance on loans and merit aid) may have materially changed the way aid influences student behavior, especially regarding their college enrollment and continuation decisions. In light of the continuing gap in educational attainment by race/ethnicity, higher education stakeholders are increasingly interested in equalizing postsecondary opportunities for underrepresented groups, and are increasingly examining how financial aid may help remedy this condition.

The Effects of Financial Aid Among Racial and Ethnic Groups

Although educational researchers have provided general evidence of inequality in educational outcomes (e.g., student persistence and dropout behavior) among important subgroups of students, there is a dearth of evidence that focuses on the ways in which financial aid influences these inequalities among socioeconomic and racial/ethnic groups. In many of the studies to date researchers have only included socioeconomic and

racial/ethnic characteristics as statistical controls, without examining in-depth the ways in which financial aid differentially affects these groups. Some researchers (Chen & DesJardins, 2008; Chen, 2008) have suggested that this analytic strategy is sub-optimal given the possibility of heterogeneous treatment effects, that is, different student populations may be differentially affected by financial aid. The few existing studies that have examined differential aid treatment effects have focused on differences by income groups (Chen & DesJardins, 2008; Paulsen & St. John, 2002; St. John & Starkey, 1995), with the strategy being to estimate separate regressions for these sub-groups. For instance, Paulsen & St. John (2002) and St. John & Starkey (1995) examine whether students from different income groups respond differentially to financial aid in their within-year persistence decisions. They find that low-income students are more responsive to grants, whereas lower-middle-income students are more influenced by loan and work-study aid (Paulsen & St. John, 2002). In another study, Chen and DesJardins (2008) investigate the longitudinal effects of different forms of aid on student dropout risks by income group, but no significant differences are evident.

Following the lead of the research examining the socioeconomic differences in financial aid effects, a few studies have investigated whether there are such differences by race and ethnicity. Using data from Indiana's four-year public institutions, Hu and St. John (2001) found that grants have stronger effects on persistence for African-Americans and Hispanics than for Whites. Using NPSAS 87 data from the National Center for Education Statistics, St. John, Paulsen, and Carter (2005) found that grants enhanced within-year persistence more for African-Americans than their counterparts from other racial and ethnic groups.

This line of research has significantly increased our understanding of financial aid effects by race/ethnicity, but it is still limited in several ways. First, the results of these studies may not be applicable to the current national population. Some of the data are over a decade old, and some of this research is limited to institutions in only one state. Second, none of these studies formally investigate the possibility that there are interaction effects between types of aid and one's race/ethnicity. Whether or not there are such differences should be determined through formal tests for interaction effects (Jaccard, 2001). Third, prior studies of how financial aid affects various racial/ethnic groups focus mainly on differences between aid recipients and non-recipients and do not examine how *amounts* of various types of financial aid may affect these racial/ethnic groups' continuation decision. We believe that in order to better understand the ways financial aid influences dropout risks among students from different racial/ethnic background, researchers need to explore how variations in the types and

amounts of aid affect student sub-group behavior. Fourth, and most importantly, existing research is often cross-sectional, failing to take into account the longitudinal nature of the continuation/dropout process and how financial aid may affect these decisions for different racial and ethnic groups. To remedy these limitations in the literature, we utilize a heterogeneous model and event history methods to guide a longitudinal investigation into how financial aid affects college dropout behavior by racial and ethnic groups. In addition, to remedy an important limitation of the financial aid effects literature that uses the Beginning Postsecondary Students survey (BPS:96/01) data, we employ a two-sample strategy to solve the incomplete information problem with regard to the financial aid variables included in BPS. By using a nationally representative dataset, employing research methods specifically designed to study temporal events, investigating the role of interactions among race/ethnicity and financial aid, and by utilizing complete multi-year aid *amount* information, this study will improve our collective understanding of how financial aid affects dropout risks across various racial/ethnic student groups. More importantly, given the dramatic shift of financial aid policy from need-based programs to loans and merit-based programs in recent years, the present research will help to inform policy-makers' development of new financial aid policies in order to improve equal opportunity in higher education.

Conceptual Framework

The traditional perspective of research on financial aid often ignores the fact that financial aid effects on college student outcomes could be heterogeneous in the population, that is, students from important sub-groups (e.g., racial/ethnic; income) may respond to financial aid in different ways. Accordingly, a large number of studies treat the impact of financial aid as an aggregate effect for the student population as a whole (Chen, 2008). Based on the limited research that has examined the socioeconomic differences in the effects of financial aid on student behavior, a heterogeneous approach (represented by Leslie & Brinkman, 1987; Heller,1997; St. John, 2003; Chen, 2008) has emerged as an alternative conceptual framework for this line of research. An early form of the heterogeneous approach employed the price-demand notion in research on college *access* (Leslie & Brinkman, 1987; Heller, 1997). Leslie and Brinkman's main argument was that some students respond differently to college prices (i.e., tuition) regarding their college-going decisions. The research they summarized indicated that students from low income families are generally more sensitive to changes in tuition than are their higher-income peers. This important article demonstrated to researchers and pol-

icy makers alike that there are variations in students' responsiveness to college prices and that researchers should be cognizant of this fact when investigating student access decisions. Later, St. John (2003) used a differentiated approach to study how financial aid affects college student persistence. He argued that the impact of student aid on persistence in college is not uniform but varies across racial and income groups. These two studies demonstrated that examining sub-group differences in student behavior regarding their enrollment and continuation decisions is important and should be incorporated in future research in these areas.

Chen (2008) has followed this lead by developing a "heterogeneous approach" to the study of financial aid effects. First, as suggested by Perna and Thomas (2006) that student success is best understood when multiple theoretical perspectives are considered. Chen's (2008) heterogeneous approach stresses the importance of integrating theories from psychological, sociological, organizational, interactionalist, and economic perspectives in student dropout research. The psychological approach emphasizes the impact of individual psychological attributes in the process of dropout. Personal characteristics can be important in affecting students' motivation in academic study, which in turn influences their departure behavior (Heibrun, 1965; Rossmann & Kirk, 1970; Summerskills, 1962). This perspective reveals an individual's internal factors that influence a student's decision to persist or depart. Some important psychological/internal attributes affecting student departure include educational aspiration, internal ability, and skills.

Sociological approach, represented by the conflict theory (Clark, 1960), social reproduction theory (Bourdieu, 1973, 1977), and social attainment theory (Duncan, Featherman, & Duncan, 1972; Featherman & Hauser, 1978), focuses more on the broader external social forces. This perspective claims that, although individual's psychological characteristics are important, the greater process of social stratification is more central. The sociological approach provides a useful foundation for explaining how broad social forces may influence student dropout. Some of the important sociological attributes include socio-economic status, race/ethnicity, and opportunity structure that describe the individual's and the institution's place in the broader hierarchy of society (Tinto, 1992). Assuming that student dropout is analogous to turnover in the workplace, organizational theory (Bean, 1980, 1983; Berger, 2000; Price, 1977) regards student departure as affected by immediate organizational features. These organizational attributes in higher education include institutional structure, size, faculty-student ratios, and institutional resources. Interactionalist theories (Rootman, 1972; Tinto, 1975, 1987) stress the role of both individual and environmental forces, and treats the student dropout process as reflecting

a dynamic interaction between the two. In particular, it argues that experiences promoting students' social and intellectual integration into college communities are likely to strengthen their commitment, which therefore reduces dropout risks. Two important elements proposed and tested in this interactionlist approach include students' social and academic integration into the higher education campus. The economic approach is based on human capital theory (Becker, 1964; Psacharopoulos, 1987) and price theory (Radner & Miller, 1975), suggesting that rational individuals weigh the costs and benefits when deciding to go to college, and that college tuition and financial aid can influence student demand for higher education. This theoretical framework guides student dropout researchers to incorporate financial factors, such as tuition and financial aid, into their analytic models. In conclusion, theories from the psychological, sociological, organizational, interactionalist, and economic perspectives are complementary, each contributing a different insight not offered by the other. Thus, it is suggested that student dropout research need to consider an integration of all these approaches for comprehensive analyses of this important student outcome in higher education (Chen, 2008).

In addition to theory integration, the heterogeneous approach adds some additional economic concepts that may be useful in better understanding the differential effects of aid on student outcomes. For instance, the economic concepts of liquidity constraints, the sensitivity of students to changes in aid types and amounts (aid elasticities), and the notion of debt aversion may help us understand how student subgroups differ in terms of these economic factors and their likely responses to the timing and packaging of financial aid. For example, Chen (2008) also remedies the problem of "main effects bias," which is often missing from earlier work. Chen stresses that researchers not only need to conduct sub-group analyses, but also need to include important interaction effects, such as those between sub-groups (e.g., race/income) and the various forms of financial aid.

Chen (2008) develops two specific hypotheses with respect to how students' responses to financial aid (in their dropout decisions) may change across sub-groups. Given the fact that disadvantaged groups of students (low-income and minority students) tend to have higher liquidity constraints and sensitivity to prices and aid provision, and that they appear to be more debt averse, the heterogeneous approach hypothesizes that these students are more sensitive to *net* tuition and *changes* in the type and amount of financial aid provided. In other words, Chen argues that there may be significant interactions between family income/race and the types and amounts of aid received. More specifically, this perspective hypothesizes that Pell Grants or merit aid decreases the dropout probability among

disadvantaged groups more than that of their peers. Chen also hypothesizes that the strength of the impact of loans and work-study aid on student dropout decisions may not be the same as that of aid that has no repayment (scholarships/grants) or work obligations (work-study).

In summary, compared to the traditional perspective, the heterogeneous approaches represented by Leslie & Brinkman (1987), Heller (1997), St. John (2003), and Chen (2008) suggests that researchers need to rethink the common assumptions underlying the evaluation of financial aid effects in higher education research. This approach provides a comprehensive framework for investigating differential effects of aid on student dropout from college. Although this heterogeneous approach provides a constructive framework for investigating financial aid effects on student outcomes in higher education, it has remained largely untested. What follows is an application of this research framework to examine differences in student dropout behavior among racial and ethnic groups, as a function of their financial aid types and amounts. This research is important because only by focusing on students' heterogeneous responses to educational subsidies can we deepen our understanding of how students make decisions about human-capital investments and thereby provide a firmer foundation for education policy (Dynarski, 2002).

Research Design

Research Questions

In an effort to expand this line of research, this study examines racial/ethnic gaps in student dropout risks, and whether these gaps can be mediated through the provision and timing of financial aid. As documented in the literature review above, there are mixed findings about the differential aid effects on student persistence/dropout across income groups. In this study, we also incorporate interaction effects between income and financial aid into analysis, but our main focus is on aid effects for racial/ethnic groups.

As noted above, this study employs the heterogeneous approach (Chen, 2008) to address the following research questions:

1. How are different types and amounts of financial aid distributed by race and ethnicity?
2. Are there differences in college dropout risks for students from different racial/ethnic backgrounds at four-year institutions?
3. Does financial aid differentially affect student dropout risks for students from different racial/ethnic backgrounds? If so, how do the aid effects differ by race and ethnicity?

4. Do different types and amounts of financial aid significantly moderate the relationship between students' race/ethnicity and their dropout risks?

Model Specification

The conceptual framework derived from the heterogeneous approach (Chen, 2008) identifies eight clusters of variables from psychological, sociological, organizational, interactional, and economic perspectives. These constructs include student psychological/internal characteristics, social background information, institutional attributes, interactionalist attributes, and financial factors. Given possible variations in the effects of aid by important student characteristics and the longitudinal nature of the student dropout process, this framework also suggests two new elements: formal tests for interaction effects and a temporal dimension.

As reviewed in Chen's (2008) earlier work, there are three major types of dropout identified in higher education research: stopout, institutional dropout, and system dropout. Students who stop out are those who leave and come back to college after some duration of non-enrollment; institutional dropouts are those who leave one institution but transfer to another; system dropouts are individuals who leave higher education entirely. Considering that student dropout from higher education has been a national issue for decades (Tinto, 1987, 1993), and the fact that dropout is a longitudinal behavior, we define the dependent variable as *system* dropout which is measured by a dichotomous variable indicating whether or not a student dropped out of higher education without return by the end of the sixth year of the observational period. This outcome is derived from a series of variables indicating a student's enrollment status in each year.

The independent variables included are:

- Student psychological attribute and internal ability/skills (educational aspirations, high school GPA, college entrance examination scores, college GPA, major)
- Student social background (age, gender, race/ethnicity, family income, and parental education)
- Financial factors (financial aid and employment)
- Institutional characteristics (institutional control)[1]
- Interactionalist factors (academic and social integration)
- Interaction effects (interaction between race/income and financial aid)
- Time in college

Data Source and Sample

This study uses data from two sources: the Beginning Postsecondary Students survey (BPS:96/01) and the National Postsecondary Student Aid Study (NPSAS: 96), both of which are surveys sponsored by the National Center for Education Statistics (NCES). The BPS:96/01 is a nationally representative survey that follows (for six years) a cohort of students who started their postsecondary education during the 1995-96 academic year. Compared with many other national surveys, BPS:96/01 is a desirable dataset because it contains the most recent data about postsecondary education and contains detailed and temporal (yearly) information about student enrollment as well as types and amounts of financial aid received.

Despite these advantages, BPS has its limitations, one of which is the lack of information about the amounts of work-study aid that students receive after their freshman year in college. We remedy this deficiency by employing an innovative approach: We employ a "two-sample" method hotdeck procedure to impute the amount of work-study aid post-freshman year by matching BPS students with missing work-study aid data to students with like characteristics from the National Postsecondary Student Aid Study (NPSAS: 96) data and use the work-study information from the latter to "fill in" the missing work-study amounts in the BPS. NPSAS: 96 is a comprehensive nationwide study designed to examine how students and their families pay for postsecondary education and the BPS:96/01 study is a sub-sample of NPSAS:96, making the latter an ideal candidate to invoke this two sample estimation strategy. The hotdeck imputation method (Little & Rubin, 1987; Roth, 1994) employed will be discussed in more detail later in the article.

To sum up, BPS: 96/01 provides the bulk of the data used in this study, and NPSAS:96 provides information for imputing the amount of the work-study award. The sample is limited to undergraduate students at four-year institutions. The effective sample includes 6,730 students who first matriculated to four-year institutions in 1995–96. Given the complex sampling design of the BPS (96/01) survey, in our analyses we utilize the proper weights, strata, and cluster variables that are provided in the data. By taking into account these complex survey design characteristics we are able to generalize the results to the U.S. population of beginning postsecondary students in the 1995–96 academic year.

Research Methods

Originally developed in biostatistics to model human lifetimes, event history analysis is a longitudinal method often applied in medical, economic, and social science research for examining the occurrence and tim-

ing of events (Allison, 1995). With the availability of longitudinal datasets such as Beginning Postsecondary Students Longitudinal Study (BPS), High School and Beyond (HS&B), and National Education Longitudinal Study (NELS), event history methods have been introduced into the research of higher education for investigating student persistence/dropout behavior (Chen & DesJardins, 2008; DesJardins, Ahlburg, & McCall, 2002; Ishitani, 2003; Johnson, 2006) and have also been used to study policy diffusions in states (McLendon, Deaton, & Hearn, 2007).

To understand why it is important to use event history methods for analyzing longitudinal data, we first need to understand two central problems when using this type of data: (a) How to deal with censoring, namely, how to combine information for those who did and did not experience events; and (b) how to incorporate explanatory variables whose effects and values may vary over time. Difficulties arise when conventional methods like multiple regression are applied to analyze this type of data (Allison, 1984). Given the fact that some students may not experience the event (in our case, system dropout) before the end of the observation period, and that student enrollment status, their academic performance, and other factors (e.g., the types and amount of financial aid received) often change over time, event history modeling is an ideal technique to examine how multifaceted factors affect the occurrence and timing of dropout over the life of students' academic careers (DesJardins, 2003).

Event history models can be divided into two types, "continuous-time methods" such as Cox's method, and "discrete-time methods" (Yamaguchi, 1991). In the present study we employ a discrete-time logit model to account for the differences in the timing of dropout and to control for time-varying regressors such as the types and amounts of financial aid students receive. Discrete-time methods are used because continuous-time models do not adapt readily to the study of school enrollment and departure contexts, where time is often measured discretely, in quarters, semesters, or years (Singer & Willet, 1993). For example, dropout times in BPS data are measured in yearly intervals, as opposed to precise records, such as days, hours, or minutes that may be the unit of analysis in other contexts. The second consideration is that discrete-time models offer an unbiased way to handle "tied" events, such as dropouts that occur during the same time period (year) (Yamaguchi, 1991; Singer & Willett, 2003). Finally, the discrete-time hazard model is preferred because we are concerned with the magnitude of the baseline hazard rate, which cannot be obtained through a continuous-time model. Estimating a discrete-time model allows us to understand how baseline dropout risks vary over time.

Before illustrating the analytic model in more detail, it is necessary to address another concept central to event history methods, the issue of "censoring." Censoring occurs when an individual's event time (here time to dropout) is unknown either because the student does not experience the target event, dropout because they graduate without dropping out or they remain continuously enrolled during the observation period (they may experience the event after the end of the observation period, but this remains unobserved; Singer & Willett, 2003). Censoring can be categorized into two major types: right- vs. left-censoring. Right censoring arises when an event time is unknown because event occurrence is not observed; whereas left censoring occurs when an event is unknown because the beginning of time is not observed. Because the Beginning Postsecondary Student study (BPS 96/01) follows a cohort of students who started their postsecondary education during the 1995-96 academic year, and observes these individuals for six years, the beginning of time is observed for each individual and left censoring is not an issue. Right-censored cases due to graduation are removed from the risk set at the time of graduation, and those who remained enrolled continuously throughout the six-year observation period are right censored at the end of year six.

Formally, the baseline model for this event history analysis is a discrete-time hazard model without interaction effects, and is represented in equation (1) below:

$$\text{Logit } h(t_{if}) = [\alpha_1 D_{1if} + \alpha_2 D_{2if} + \ldots + \alpha_J D_{Jij}] + [\beta_1 X_{1if} + \beta_2 X_{2if} + \ldots + \beta_P X_{Pif}] \quad (1)$$

The risk of student dropout is estimated by including a set of dummy variables indicating the academic year (*D*s) and other explanatory variables (*X*s). The time dummies are intercepts indicating the baseline logit hazard function for each year. The βs are estimable parameters that represent the changes in the baseline logit hazard function associated with changes in the values of the corresponding predictors. In this study there are two types of predictors included: time-invariant and time-varying regressors. The time-invariant regressors represent student background (e.g., age, gender, race/ethnicity, income, parents' highest educational level), pre-college preparation (e.g., high school GPA, SAT score), educational aspirations, institutional characteristics (e.g., institutional control), and first-year college experience (e.g., first-year college GPA, first-year major, academic and social integration in the first year of college, total amount of merit-only grants and scholarships in year one, and first-year employment). The time-varying predictors mainly pertain to student aid, including the amount of Pell Grants in 1996–2001, amount of Stafford

subsidized and Perkins loans 1996–2001, amount of Stafford unsubsidized loan 1996–2001, amount of work-study award in 1996, and whether or not the student received a work-study award 1997–2001.

To address the research questions detailed above, three additional sets of variables that are not specified in Equation (1) are incorporated into the final model. First, because the main purpose of this research is to investigate whether and, if so, how any racial/ethnic gaps in student dropout risks vary by different types and amounts of aid students receive, a series of interaction terms (between race/ethnicity and income, and financial aid) are included and tested separately. For example, the major research interest in this study is comparing how racial/ethnic differences in dropout risks vary as a function of the Pell Grant amount received, therefore, the focal independent variable is race/ethnicity and the moderator variable is Pell Grant. Because race/ethnicity is a categorical variable, it is represented by four dummy variables,[2] D_{Black}, $D_{Hispanic}$, and D_{Asian} with White being treated as the reference group. Product terms are generated between each of these dummy variables and Pell Grant, and a discrete-time hazard model is run adding D_{Black}, $D_{Hispanic}$, and D_{Asian}, *Pell*, D_{Black} * *Pell*, $D_{Hispanic}$ * *Pell*, and D_{Asian} * *Pell* to Equation (1). This same strategy is used to study the interactions between race/ethnicity and other types of aid, including Stafford subsidized and Perkins loan, Stafford unsubsidized loan, merit aid, and work-study. Second, we also construct and test a set of interaction terms between income and financial aid, to check for differences in aid effects by family income. A third set of interaction terms are between student year in college and financial aid are included to test whether financial aid effects vary over time.

Data Analysis

Before conducting the longitudinal analysis, several preparatory analyses were conducted. As in most empirical research, the data used in this study has missing cases for some of the variables used as regressors. To deal with the missing data issue we use multiple imputation,[3] a method recommended by Allison (2001) to perform missing data imputation. To do so we employ software developed at the University of Michigan (known as IVEware; see http://www.isr.umich.edu/src/smp/ive/ for details) which uses a sequential regression imputation method described in Raghunathan, Lepkowski, Van Hoewyk, and Solenberger (2001). Multiple imputation methods can avoid some of the problems associated with the other imputation approaches (e.g., restriction of variance), it can be used with virtually any kind of data and any kind of regression technique, and when conducted properly produces unbiased estimates of the statistics

(Allison, 2001). As a result of this procedure, multiple imputation generates five datasets, which requires the function of incorporating multiple datasets in the analytic software for the event history analysis.

A second preparatory step, which is important and unique in this study, is to remedy the missing work-study amount information. In the BPS data, dollar amount information is available for all financial aid variables in each year, except for work-study awards. BPS provides data for the amount of work-study award students received in 1996 (most sample members' first year in college), but only dummy variables are available indicating whether or not students received work-study award in each of the subsequent five years. In order to follow suggestions in the literature to use detailed information about financial aid, including using aid amounts instead of aid indicators only (DesJardins, Ahlburg, & McCall, 2002; Paulsen & St. John, 2002), we applied a hotdeck procedure to impute the amount of work-study award students received each year after their freshmen year using data from the NPSAS:96 survey. Although this method is not covered in Allison's (2001) discussion about missing cases imputation, others claim it is superior to listwise, pairwise, and regression imputation methods (Little & Rubin, 1987; Roth, 1994). Generally, the two sample hotdeck procedure replaces missing values in the BPS sample with values drawn from similar cases in the NPSAS sample. The matching procedure is operationalized as follows. First, we identified variables common to both the NPSAS and BPS datasets that are hypothesized to predict the amount of work-study a student receives. Next, we created a subset of the NPSAS file that included a student's work-study amount and the variables thought to predict these amounts. A subset of the BPS data was constructed that included the same matching variables contained in the NPSAS subset. The BPS subset included only students in their 2nd, 3rd, 4th, 5th, or 6th year in college and who also had positive work-study amounts. These two files were combined into one data set used in the hotdeck imputation procedure. The hotdeck procedure matched a BPS subset file student to a NPSAS subset sample student based on similar values on the matching variables, which included (but was not limited to) year of enrollment in college, gender, race/ethnicity, Pell Grant, and loan amounts.

This matching procedure is done multiple times, resulting in a distribution of imputed values for each student with missing work-study data and remedying estimate invariance problems encountered when one employs single imputation methods such as mean imputation. Once the distribution of imputed values is constructed, the average imputed value is then substituted for the missing data value in the BPS sample. The culmination of this procedure was to use values of the estimated amount of work-study from the NPSAS sub-sample to fill in the missing values for students in

the full BPS file. The percentage of students in the BPS file with missing work-study amount information varied by year of enrollment, with as few as 5 percent and as high as 18 percent of cases being imputed.

The first step of the data analysis portion of the study is to produce descriptive statistics of the sample. Given the focus on race/ethnicity and income differences in aid effects, data are summarized for each of these groups to examine their distribution of financial aid resources. Second, the life-table and Nelson-Aalen estimation methods are also applied to compare hazard curves for different income and racial/ethnic groups. These two analytical techniques are the two important methods for estimating hazard functions in event history methods (Singer & Willett, 2003). Third, we estimate a baseline hazard model, a discrete-time hazard model without interaction terms. By taking student time in college and the time-dependent factors into consideration, the baseline model allows us to determine whether the hazard of dropout varies depending on students' levels of financial aid. In addition, the results help identify what other factors are related to the likelihood of student dropout. Next, separate analysis are conducted for each racial/ethnic and income group in order to determine whether there are differences in aid effects for these groups. For example, we ran separate analyses for the racial/ethnic student groups. Worth noting is that the sample size for Native Americans (n = 670) is too small for a separate analysis, therefore the racial/ethnic subgroup analyses focused on the other four racial/ethnic groups only (White, African Americans, Hispanics, and Asians). Because this stage of analysis focuses on a sub-sample, and the function of sub-group analysis of multiple datasets is not available in the current version of IveWare, we conducted event history analysis in Stata on each of the five imputed datasets for each race/ethnic group. After the sub-group analyses, we then combined the estimations from all five imputed datasets for each group. The process of the sub-group analysis by income is similar to that of the analysis by race/ethnicity.

As explained (Chen, 2008), dividing the data into subgroups often reduces a studies' power to detect differential aid effects because the sample sizes are reduced. In addition, whether or not aid effects are significantly different for sub-groups should be determined through formal interaction effects tests. Thus, the next stage of the analysis involves a series of tests to determine whether there are variations in dropout risks by race/ethnicity and income, and whether these differences are a function of the types and amounts of financial aid received.

The first two sets of interaction terms considered were between race/ethnicity and financial aid and income and financial aid. A third set of interactions between each type of financial aid and a student's year in col-

lege were also included after the first two sets of interaction effects are tested. Each set of interactions are added to the baseline model independently and each model with a group of interaction terms was then compared with the baseline model using a formal goodness-of-fit test (Wald test). A significant test suggests that the interaction terms are significantly different from zero, which means the model should include the interaction terms.

The final part of the analysis included fitting a model that simultaneously includes all significant interaction terms identified through the prior formal tests. The results discussed below presents the findings for this model, with special attention to the variations in financial aid effects for students from different racial/ethnic backgrounds.

Limitations

This study has several limitations that deserve discussion. First, the longitudinal data of BPS tracks students from their freshman year to six years later, thus the dropout outcome this study uses is defined using this six-year observation period. However, some students, although small in number, could return to higher education after the six-year observation window, thereby making them long-time stopouts rather than dropouts. This "right censoring" due to limits on the observation period is always evident, but given our experience in estimating dropout behavior we do not believe a longer time horizon would materially change the results obtained.

Second, we are not able to more fully explore the institutional effects due to data limitations. The BPS (96/01) tracks students from new entrance to higher education until the end of the sixth year, but the institutional information is only available for the first-institutions students attended. So the examination of institutional effects on student dropout of higher education as a whole is limited in this paper due to the characteristics of the dataset.

The second limitation has to do with self-selection. As several researchers (Alon, 2005; Cellini, 2008; DesJardins, 2005) have pointed out, one reason for the inconsistent findings in the prior student aid studies is the difficulty in controlling for the relationship between aid eligibility and college outcomes. The effect of aid received may be due to non-random selection into aid eligibility, and the unobserved factors that produce aid eligibility may also be related to student outcomes. In this study, we were unable to control for aid eligibility due to data limitations. However, by using event history methods, we hope to mitigate the selection bias problem from another important perspective. That is, compared to cross-

sectional data analysis methods, using longitudinal methods on data with multiple time points can help to establish causal ordering. When using cross-sectional data analysis it is sometimes difficult to know whether there are reciprocal relationships between variables, but when one can establish that an event happened later in time then at least one of the requirements of causal inference has been met (ordering). Mechanisms unfold over time, and in order for there to be an effect a certain sequence of events has to take place. Also, we mitigate some of potential selection bias problems by estimating a model that includes parametric controls for unobserved differences in students, which is known as frailty model (Yashin, Vaupel & Iachine, 1995).

Third, as McPherson (1993) suggests, whenever the data allow, it is desirable to disaggregate aid by type (grant, loan, work-study) and sources (federal, state, local, and institutional). Therefore, to assess the effects of financial aid we tried to control for the influences of aid of all types from all major sources, namely Pell Grants, subsidized Stafford loans and Perkins loans, unsubsidized Stafford loans, work-study aid, and merit aid. However, because many financial aid variables available in the BPS overlap with each other in terms of their sources, it is difficult to delve further to obtain separate and clean variables indicating financial aid from every source. For example, institutional need-based aid is not included in this study due to this limitation. In the present study, Pell Grants, subsidized/Perkins loans, unsubsidized loans, and work-study aid represent the major types of financial aid from the federal government; while the merit aid variable measures merit-based scholarships granted from both state governments and individual institutions.

Fourth, because the focus of this paper is on the differential aid effects across race/ethnicity, we did not explore how any variations in aid effects for racial/ethnic groups may be moderated by income. Future studies that include three-way interaction terms between aid, income, and race/ethnicity may help us understand whether and if so how these three factors interact and the impact this has on student dropout behavior.

Fifth, we investigated an important issue in higher education: the differential aid effects on student dropout risks. However, another issue that is equally important to policy-makers is the possible variation in aid effects on student stopout behavior, and whether financial aid differentially affects the timing and duration of the (potential) "repeated event." Repeated event models have been estimated elsewhere (DesJardins, Ahlburg, & McCall, 2006) but not using national data. Other research is needed in this area, especially studies using nationally representative data sets.

Results

The descriptive analyses provide information about the underlying patterns in aid distribution and dropout risk by race/ethnicity and income (not shown). In general, minority students tend to receive larger Pell Grants and subsidized Stafford and Perkins loans amounts than their majority counterparts. The trend in aid distribution by income is clearer. Low-income students were more likely to receive Pell Grants, subsidized Stafford and Perkins loans, and work-study aid. Among aid recipients, low-income students also received the largest amounts of financial aid, including Pell Grants and subsidized Stafford and Perkins loans.

Nelson-Aalen estimation results (not shown) confirm that dropout risks vary by race/ethnicity and income. Compared to Whites and Asians, African Americans and Hispanics are found to be more likely to drop out of higher education in the first year. Low-income students also tend to have higher risks of dropping out than the other income groups. Both patterns are consistent across the six years of the observation period.

Event history analysis of the baseline model (Table 1) reveals that student dropout decisions are influenced by many factors, including student age, family income, parental education, student educational plans, first-year college GPA, major field, financial aid, and the academic year in which students were enrolled. In particular, changes in three types of aid (Pell Grants, Subsidized Stafford and Perkins Loans, and merit aid) each had a significant impact in reducing dropout risks, with the effect size being largest for Pell Grants. Consistent with Chen and DesJardins' (2008) study, the risks of dropout vary over time, and the magnitude of dropout risks is relatively larger in later years than in the freshmen year.

The cross-race (Table 2) and cross-income (Table 3) comparisons of aid effects facilitate our understanding of the differential effects of aid amounts on dropout risks for students from different racial/ethnic and family income backgrounds. Results demonstrate that students from different racial/ethnic backgrounds have different levels of dropout responsiveness to changes in the types and amount of aid provided. In particular, compared to White students, minority students tend to be less likely to drop out when awarded more in Pell Grants. Moreover, low-income students tend to respond more in their decisions to persist or drop out to Pell Grants and merit aid, which reduces the net tuition students have to pay.

The results of the model including the interaction effects (see Table 4) indicate that only two sets of interaction terms are statistically significant. One set of interactions is between Pell Grants and race/ethnicity, and the other is between unsubsidized loans and academic year. Compared with

TABLE 1

Estimator for the Baseline Model of Student Dropout

	Odds ratio	Standard Error	Significance
Age 20–24	1.45	0.23	
Age 25–29	2.30	0.41	*
Age 30–34	2.17	0.36	*
Age > 34	4.84	0.30	***
Black	1.05	0.18	
Hispanic	1.28	0.18	
Asian	1.13	0.27	
Native	1.58	1.17	
Female	0.94	0.11	
Middle Income	0.88	0.13	
High Income	0.68	0.18	*
Parental Education: Bachelor's or Above	0.66	0.12	***
Educational Plan: Above Bachelor's Degree	0.55	0.14	***
Middle Level High School GPA	0.94	0.14	
High Level High School GPA	0.74	0.20	
SAT/ACT	1.00	0.00	
Pell Grants in $1000	0.86	0.07	*
Subsidized Stafford and Perkins Loans divided by $1,000	0.87	0.03	***
Unsubsidized Stafford Loans divided by $1,000	0.94	0.06	
Merit Aid in divided by $1,000	0.88	0.05	*
Work-Study Aid divided by $1,000	0.90	0.11	
First Year College GPA	0.99	0.00	***
Academic Integration	1.00	0.00	
Social Integration	1.00	0.00	
First Year Employment	1.01	0.24	
Social Sciences	0.88	0.19	
Hard Sciences	0.73	0.30	
Life Sciences	0.65	0.23	
Engineering	0.75	0.28	
Education	0.85	0.24	
Business	0.70	0.19	*
Health	0.58	0.23	*
Technology	0.98	0.22	
Uncodable	0.84	0.17	
Year 2	0.99	0.13	
Year 3	1.27	0.14	
Year 4	1.28	0.15	
Year 5	1.75	0.17	*
Year 6	1.52	0.23	
Public Institution	0.84	0.11	

Notes: a. Variables italicized indicate time-varying.

b. To identify who these merit-aid recipients really are, we conducted *t*-tests to compare the mean SAT scores and mean family income for recipients and non-recipients. Results demonstrate that merit aid recipients have significantly higher SAT scores than non-recipients, while there is no evidence that the mean family income is different across both groups.

Significance: ***p <0.001; **p <0.01; *p <0.05

TABLE 2
Comparison of Aid Effects Across Race/Ethnicity

	White	Black	Hispanic	Asian
Pell Grants	1.05	0.81	0.58*	0.47*
Subsidized Stafford & Perkins Loans	0.87*	0.73*	0.85	1.14
Unsubsidized Stafford Loans	0.89*	0.84*	0.98	0.95
Merit Aid	0.87*	0.80	0.82	1.19
Work-Study Aid	0.97	0.92	0.67	0.47

Note: Significance: *p <0.05

TABLE 3
Comparison of Aid Effects Across Income Groups

	Low Income	Middle Income	High Income
Pell Grant	0.78*	0.93	0.93
Subsidized Stafford and Perkins Loans	0.94	0.82*	0.99
Unsubsidized Stafford Loans	0.86	0.88*	1.07
Merit Aid	0.67*	0.90	0.98
Work-Study Aid	0.89	0.93	0.96

Note: Significance: *p <0.05

their White peers, minority students, especially Asians, tend to have lower dropout risks when awarded higher Pell Grants. To be more specific, receiving larger Pell Grant amounts tends to reduce dropout probabilities significantly more for Asian students than for their White counterparts. With regard to the time-varying effects of unsubsidized loans, the significantly stronger effect on dropout risks in the sixth year than in the first year may be an artifact of the small number of students still at risk of dropout at the end of the six year observation period. Although low-income students tend to respond more to Pell Grants than their higher income peers, this differential aid effect is not significant at conventional levels.

To better illustrate the significant interaction effect between Asian and Pell Grants (*White * Pell Grants* is the reference group), we use the methods recommended by Jaccard (2001). We calculate the predicted probabilities of dropout for each race/ethnic group conditional on the amount of Pell Grants received while holding constant the other regressors at specified values (for dummy variables) or at their respective means (for contin-

TABLE 4

Full Event History Model with Interaction Effects

	Odds ratio	Standard Error	Significance
Age 20–24	1.43	0.23	
Age 25–29	2.29	0.40	*
Age 30–34	2.16	0.36	*
Age > 34	4.62	0.31	***
Black	1.15	0.20	
Hispanic	1.45	0.19	
Asian	1.37	0.30	
Native	1.66	1.35	
Female	0.94	0.11	
Middle income	0.88	0.13	
High income	0.69	0.18	*
Parental education: Bachelor's or above	0.66	0.12	***
Educational plan: Above Bachelor's degree	0.55	0.15	***
Middle Level High School GPA	0.95	0.14	
High Level High School GPA	0.75	0.21	
SAT/ACT	1.00	0.00	
Pell Grant divided by $1,000	1.05	0.10	
Subsidized Stafford and Perkins Loans (in $1,000s)	0.87	0.03	***
Unsubsidized Stafford Loans divided by $1,000	0.96	0.10	
Merit Aid divided by $1,000	0.88	0.05	***
Work-Study Aid divided by $1,000	0.90	0.11	
First Year College GPA	0.99	0.00	***
Academic integration	1.00	0.00	
Social integration	1.00	0.00	
First Year Employment	1.01	0.24	
Social Sciences	0.89	0.19	
Hard Sciences	0.73	0.30	
Life Sciences	0.66	0.23	
Engineering	0.76	0.28	
Education	0.86	0.24	
Business	0.70	0.19	
Health	0.58	0.23	***
Technology	0.99	0.23	
Uncodable	0.85	0.17	
Public Institution	0.84	0.12	
Year 2	0.98	0.13	
Year 3	1.34	0.15	*
Year 4	1.18	0.16	
Year 5	1.79	0.18	***
Year 6	1.70	0.24	*
Pell * Black	0.73	0.18	
Pell * Hispanic	0.71	0.21	
Pell * Asian	0.52	0.32	*
Pell * Native	0.67	1.26	
Year 2 * Unsubsidized loans	1.02	0.13	
Year 3 * Unsubsidized loans	0.86	0.16	
Year 4 * Unsubsidized loans	1.12	0.17	
Year 5 * Unsubsidized loans	0.95	0.13	
Year 6 * Unsubsidized loans	0.71	0.16	*

Note: Variables underlined indicate time-varying
Significance: ***p <.001; **p <0.01; *p <0.05

uous regressors). Table 5 presents the predicted probabilities of dropping out at the end of the first year. The results indicate that among students who did not receive a Pell Grant, minority students have higher probabilities of dropping out than their White peers. Specifically, other factors being equal, for students with no Pell Grant in the first year, the dropout probability is 0.59 for African Americans, 0.65 percent for Hispanics, 0.63 for Asians, 0.67 for Native Americans, and 0.56 for Whites.

In order to examine the effectiveness of the Pell Grant in reducing the dropout gap by race and ethnicity, we estimated differences in the probability of dropping out given different Pell Grant awards. Our simulation results indicate that when Pell Grant amounts increase by $1,000 increments, the dropout risk gaps are narrowed between minority students and Whites. The largest and statistically significant reduction in these gaps is between Asians and Whites. For example, for students who did not receive a Pell Grant the probability of dropping out for Asians is 7 probability points higher than that of Whites (0.63 vs. 0.56). However, for those who received $1,000 Pell Grants, the predicted probability of dropping out for Asian students is 9 points *lower* than that of their White counterparts (0.48 vs. 0.57). We also observed similar reductions in dropout risks between other minority groups and Whites for different Pell Grant amounts, but these probability estimates are measured less precisely and not significant at conventional levels.

Robustness Checks

To test the sensitivity of our results to potential bias due to not properly controlling for unobserved differences in students, we conducted a number of additional analyses.[4] We first estimated a discrete-time proportional

TABLE 5

Predicted Probability of Dropout by Race/Ethnicity Conditional on Pell Grants

Pell Grant Amount	Whites	African Americans	Hispanics	Asian Americans	Native Americans
$0	0.56	0.59	0.65	0.63	0.67
$1,000	0.57	0.53	0.58	0.48	0.59
$2,000	0.58	0.46	0.51	0.34	0.50
$3,000	0.59	0.40	0.43	0.21	0.42

Note: This table reflects individuals with the following characteristics: Male freshman less than 20 years old who enrolled in a public institution with family income less than $25,000, whose parents' education level is BS/BA or above, whose educational plan is to attain a bachelor's degree or higher, whose high school GPA is at the low-level, and who received no other types of aid. Other regressors held constant at their respective means.

hazards model and incorporated parametric specifications (e.g., gamma mixture distribution) to control for unobserved individual heterogeneity (or UH; also often known as "frailty"). We include the same time-varying and time-constant regressors that were used in the original discrete-time logit regression model discussed above. Our results indicate that, at least in the BPS sample we use, controlling for UH may be important. We found that three variables that were originally non-significant at the five-percent level in the original discrete-time hazard model were significant in the frailty model. These variables are the African American student indicator, the dummy variable indicating a major in engineering, and the term representing the interaction of Pell Grant receipt and Hispanic students.

Even though it appears that controlling for UH matters in this case, a technical problem encountered makes us less sure of this finding. The commercial software packages (SAS, SPSS, Stata) available to estimate discrete-time proportional hazard models with UH controls do not permit one to account for complex survey designs (stratification, clustering, weighting) that can be employed when using logistic regression to estimate discrete-time spell data. Not adjusting for stratification and clustering will tend to produce underestimates of the standard errors leading to inflated coefficient p-values. In order to adjust the standard errors of the discrete-time proportional hazards model with UH for the complex survey design we employed an ad hoc sensitivity analysis strategy. We estimated the discrete-time logit model with and without complex survey design adjustments. This permits us to calculate the design effect (DEFF) for each regressor included in the original model. We then adjusted the standard errors of the discrete-time proportional hazards model with UH using the design effects calculated from the original logit regressions estimated. Our sensitivity analysis indicates that the only variable that changes significance is the estimate on the Social Integration variable. The *p*-value when no adjustment is made for the complex survey design is –2.09 (significant at < 0.05), but when we adjust the standard error for this variable for the design effect the *p*-value is –1.93, no longer significant at the five-percent level.

Due to the limitations of the available software we could not include sampling weights when estimating the discrete-time proportional hazards model that controls for frailty. We know of no commercially available software that will permit one to simultaneously estimate frailty and control for complex survey design. We attempted to use bootstrap methods to adjust the standard errors but given the large data set, many parameters to estimate, and the computationally intensive and iterative maximum likelihood process, employing this approach was not feasible. We hope that the commercial software packages will be further developed to allow one to

account for complex survey design effects when accounting for frailty. Doing so will help us better understand how controlling for unobserved individual differences heterogeneity affect results in hazard models.

In addition to the above, we also estimated a competing risks event history model using multinomial logistic regression that allows us to account for the (possible) negative correlation between dropout and graduation behavior. Because multinomial logit is a standard technique in most commercially available statistical packages, we were able to adjust our results for the complex survey design (but could not control for frailty). Our results (not shown, but available on request) indicate that dropout and graduation are negatively correlated, but that even after controlling for graduation the dropout results do not change in any substantively meaningful way compared to those produced by the original discrete-time logistic regression model discussed above. For example, no coefficients change sign nor statistical significance, and the average change in the point estimates (odds ratios) across all variables is small (about 2 percent). The largest changes in individual regressor effects are for the age dummies, with differences in the odds ratios about +7 percent for the AGE2025 dummy, –7 percent for the AGE2530 dummy, –8.7 percent for the AGE3035 indicator, and –10.7 percent for the AGEGT35 category. One other noteworthy change is in the variable indicating one's educational plans with the odds ratio increasing by 8 percent relative to the original estimates.

Conclusion

With an attempt to address the fundamental policy issue about financial aid and educational opportunity, as measured by student dropout risks, this study analyzes a national longitudinal data set and identified several important findings. The results from this research indicate that American society still faces a serious challenge in equalizing educational opportunity for minority and lower income students. Consistent with prior studies, the descriptive statistics demonstrate that substantial inequities in dropout risks across race/ethnicity remain. Results of these disparities in college opportunities strongly reinforce the notion that equalizing educational opportunities should still be a focal point of higher education policy makers and institutional practitioners.

As to the effects of financial aid to the student population in general, this study confirms Singell's (2002) finding of a positive effect on student retention of subsidized loans, and the results of a non-significant effect of unsubsidized loans, and significant and positive effects of merit and need-based aid are consistent with the findings in some prior studies (DesJardins, Ahlburg, & McCall, 2002; Singell, 2002).

This study also identified distinct impacts of financial aid on college student dropout risks across different student sub-groups. An important finding from this study is that financial aid has differential effects on student dropout risks across racial groups. Among non-grant recipients, minority students tend to have higher risks of dropping out than Whites. However, when they receive larger Pell Grants, minority students (especially Asian students) have lower dropout risks while the rates for their White peers do not change much. Combined with results from college access studies, this research indicates that the opportunity gaps between minorities and Whites in terms of college trajectories could be narrowed in part by improved access to the financial resources required to initiate and maintain college enrollment. For example, given the racial/ethnic gap in degree attainment, and evidence of differential aid effects on dropout by race/ethnicity, institutions may want to make sure that accurate information about student aid programs is available to minority students about these sources of funding not only before enrolling in college but also once enrolled.

The results of differential aid effects across race/ethnicity also suggest important implications for national financial aid policy-making. In recent years, American financial aid policy has shifted its emphasis from increasing the educational opportunity for low-income students toward focusing on the affordability concerns of students from middle-income families. As a result, loans, merit aid, and education tax credits are increasingly replacing need-based aid. Students' unmet financial need has risen over the past decade, demonstrating that low-income and minority students are especially likely to face substantial unmet need even after taking into account family contributions and all available grants and loans (e.g., Long & Riley, 2007). For example, based on the National Postsecondary Student Aid Survey (NPSAS:2004), 56 percent of African Americans, 58 percent of Hispanics, and 60 percent of Asians had unmet need after all aid was considered, compared with only 40 percent of Whites with unmet need (Long & Riley, 2007). Combined with these trends, we hope there will be a greater emphasis on need-based aid at the federal level to promote equality in higher education opportunity regardless of income and racial differences. Given the substantial unmet needs of low-income and minority students, states and institutions must also be careful to maintain the mission to increase educational opportunity for these disadvantaged groups.

Apart from implications for policymaking and institutional practices, this study suggests areas for further research, in terms of theory and research designs and analytical methods. First, this study is an attempt to deepen and expand the notion that students are differentially responsive to changes in prices and aid amounts (Leslie & Brinkman, 1987; Heller,

1997). Based on economic theories and findings from prior literature, we tested the hypotheses with respect to how student response to financial aid in their dropout decisions may change by income and race/ethnicity. The findings indicate that the proposed approach is correct in assuming that financial aid effects may vary by race/ethnicity. Results also reveal that the role that financial aid plays in the student dropout process is more complex than the one portrayed by the traditional approach which often ignored the timing of student dropout and sub-population variability. In particular, Asian students tend to have significantly decreased dropout risks when awarded with larger amounts of Pell Grants, compared to their White peers. To understand this finding it is worth noting Asian Americans are often found to place greater value on higher education than do the other racial/ethnicity (Paulsen & St. John, 2002). Thus, this cultural and value difference may play an important role in leading to the significant interaction effect between Pell Grants and Asian (vs. Whites). We suggest that future studies need to incorporate cultural factors to explain this phenomenon. Some of these cultural factors that may be considered include the value that is placed on obtaining an advanced degree and the knowledge and information students have about the relative costs and benefits of various alternatives (DiMaggio & Mohr, 1985; McDonough, 1997; Perna & Titus, 2005). We hope that this heterogeneous approach will deepen our conceptual understanding of the field, help us to focus on the importance and complexity of student financial aid issues, and move us toward a more thorough investigation in the future.

We would also like to provide suggestions to NCES about future data collection efforts. A multiple-wave survey is needed to analyze the changes that happen over the course of student careers. In the available national longitudinal datasets, such as BPS (96/01), the longitudinal information is not as complete as is needed. To be more specific, although some financial aid variables (e.g. Pell Grants and Subsidized Stafford Loans) have complete amount information, many others do not (e.g. work-study aid and merit aid). Furthermore, ideally, full information is needed for variables that may change over time and whose changes may be observable and measurable (e.g. family income, college GPA, and major field). This is partly because some studies (DesJardins, Ahlburg, & McCall, 1999) indicate that variables like college GPA may have stronger impacts on reducing dropout risks in the first year than they do in subsequent years. The other reason is that students may change dependency status in their academic career. After students are married, have legal dependents other than a spouse, or are aged 24 or older, they can declare themselves as independent. In accordance, they no longer rely on their parents to finance education, and their income levels decrease, which

often significantly increases their eligibility for financial aid. Thus, longer-term income data are needed to provide a more accurate description of students' financial capacity, and facilitate a better control for the effect of family income on student dropout risks in a longitudinal process. Revising survey questions and conducting follow-up surveys on these time-varying variables would provide the data necessary for a thorough analysis.

Promoting equal educational opportunities through policies and interventions is by no means an easy task. In addition, demographic changes in the United States will make this task more challenging. It is projected that the race distribution of the nation's population is becoming more diverse, with a majority of the college-age youth being minorities by 2050 (Swail, 2002). This increased diversity in the nation's population will exert increasing pressure on the already strapped financial aid system (Long & Riley, 2007) and call for strengthened efforts from higher education researchers and policy-makers to identify and implement effective financial aid policies to promote equal opportunity in higher education.

Endnotes

[1]Because of the high negative correlation with tuition and the variable indicating public institutions, we need to remove one of them to avoid multicollinearity problems. We decided to include institutional control variable, and the sensitivity test demonstrates that models with either tuition or institutional control yield similar results.

[2]As will be discussed in the limitation section, the sample size for Native Americans is too small for a separate analysis, therefore the racial/ethnic sub-group analyses focused on the other four racial/ethnic groups only.

[3]In this study, the proportion of the missing cases for each variable ranges from 0.3% (for "Major") to 17% (for "High School GPA").

[4]We thank an anonymous reviewer for suggesting this.

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