

Institutional Characteristics and College Student Dropout Risks: A Multilevel Event History Analysis

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Received: 1 March 2011 / Published online: 15 October 2011
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Abstract In the past two decades, although access to higher education for American students has improved, student persistence in 4-year institutions is far from assured. There have been a number of research studies on student persistence/dropout in higher education, but most have focused on the characteristics and behavior of students as illustrated by the “student-centered research tradition”. This study focuses on what institutional characteristics contribute to conditions that reduce student dropout risks. By analyzing longitudinal and hierarchical data, this research proposes and tests a multilevel event history model that identifies the major institutional attributes related to student dropout risk in a longitudinal process. Evidence indicates that institutional expenditure on student services is negatively associated with student dropout behavior. Implications of the results for institutional practices and future research are discussed.

Keywords Institutional effect · Institutional policies and practices · Persistence · Retention · Attrition · Dropout · Event history analysis · Multilevel analysis

In the past two decades, although access to higher education for American students has improved, student persistence in 4-year institutions is far from assured (Tinto and Pusser 2006). National data consistently indicate that approximately one fifth to one quarter of college students drop out at the end of their freshmen year (Ryan 2004). Among the cohort who began in a 4-year institution in 1995–1996, only 53.4% earned a Bachelor’s degree within 5 years (National Center on Education Statistics 2005).

There have been a number of research studies on student persistence/dropout in higher education, but most have focused on the characteristics and behavior of students as illustrated by the “student-centered research tradition” (Smart et al. 2006). Few studies have focused on what colleges can do to create conditions that foster student persistence (Berger and Milem 2000).

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Existing studies on institutional effect have expanded our understanding of student dropout risk; however, there are several aspects in this field of research that warrant further exploration. First, as Titus (2004) suggested, few studies have attempted at a national level to identify institutional factors associated with college student persistence/dropout. Second, rarely has prior research applied the appropriate analytic methods to account for the longitudinal characteristics of institutional variables and the student dropout process, the multilevel nature of national data, and the changes in institutional characteristics over time. Further, institutional effect studies in the student persistence/dropout literature are mostly limited to institutions' structural or financial attributes, lacking broader insights into other important factors such as faculty characteristics at the institutional level.

Building on earlier studies, the present research analyzes longitudinal and hierarchical data, and addresses how institutional characteristics are related to college student dropout risk over time. The major goals of this project are: (1) to propose and test a multilevel event history model that identifies the major student and institutional attributes related to student dropout risk in a longitudinal process; and (2) to promote policy changes that address the persistent high dropout rates in higher education from an institutional perspective.

What *colleges* can do to reduce student dropout risk is a pressing issue in higher education (Perna and Thomas 2006). This study is timely given that “the interactive relationship between organizational behavior and student outcomes remains unexamined when one considers that organizational behavior is a theoretical domain with great potential to improve our understanding about how the college environment affects students” (Baird 1988; p. 268). The findings will be valuable for policy review, specifically for procedural changes at the institutional level. The ultimate goal of this project is to help effectively translate knowledge into practices and policies institutions can adopt to enhance success.

Literature Review

Organizational Theories

Established in the 1950s, organizational behavior is an applied social science discipline focusing on the behavior and nature of people within organizations, and the behavior and nature of organizations within their environments (Miner 2002). Although organizational models are appealing because they provide information that can be easily turned into policy via organizational action (Tinto 1993), organizational theories and studies of college student outcomes have been surprisingly disjointed (Berger and Milem 2000).

Given that organizational behavior is a theoretical domain with great potential for improving our understanding of how college attributes affect students (Baird 1988), several prominent conceptual models have been created. Bean's (1983) causal model of student attrition, developed from Price's (1977) model of turnover in work organizations, argues that higher education institutions differ in their structural linkages to occupational and economic groups, and therefore institutional capacity to allocate graduates to high status occupations varies. Tinto's (1987) interactionist approach provides an inclusive view of the student dropout process by integrating psychological, social, and organizational perspectives. It emphasizes the impact of dynamic, reciprocal interaction between the environment and individuals and offers an explicit model for testing hypotheses about student

dropout. The main point is that experiences promoting students' social and intellectual integration into college communities are likely to strengthen their commitment and reduce dropout risk. The third model, Berger and Milem's (2000) framework, focuses on the structural-demographic features of an institution. In line with the structural-contingency theory (Pfeffer 1982), this model maintains that institutions' structural and demographic characteristics such as size and selectivity may influence student involvement in the academic and social sub-systems on campus and their persistence/dropout outcomes.

More recently, Titus (2006a) incorporated the resource dependence theory and proposed that financial aspects of organizations might also influence students' decisions in continuous enrollment. Resource dependency theory, presented by Pfeffer and Salancik (1978), argues that organizations are externally constrained and require resources from the environment. Compared with other theoretical approaches, this theory emphasizes the importance of resources such as revenue and expenditure.

Research of Institutional Effects on College Student Dropout

To date, organizational theory has provided an important foundation for scholars to examine the relationship between institutional characteristics and student dropout decisions. One line of research investigated the student demographics of an institution concluding that the percentage of minority students in an institution is positively associated with dropout (Rhee 2008).

A second line of research found that institutions' structural characteristics (size, selectivity, control) have significant associations with student persistence/dropout. To be more specific, size (Ryan 2004; Titus 2004) and selectivity (Kim 2007; Titus 2004, 2006a; Gansemer-Topf and Schuh 2006) are both negatively related to student dropout. Institutional control is also a significant factor, with higher retention rates in private institutions (Kim 2007; Titus 2006a; Ryan 2004).

The relationship between institutions' faculty characteristics and student persistence/dropout outcomes has largely been neglected in prior research (Tinto and Pusser 2006; Schuster 2003). Among the only two existing studies, both (Schibik and Harrington 2004; Ehrenberg and Zhang 2005) found that the percentage of courses taught by part-time faculty is negatively related to retention rates. Research in K-12 education (Rumberger and Thomas 2000) found that schools with a higher student–teacher ratio tend to have higher dropout rates; it is worth considering the possible effects of student–faculty ratio in higher education as well.

Although there has been some recent research on the roles of institutional finance, it is not clear how expenditure on instruction is related to student persistence/dropout. Some studies found this type of expenditure to positively contribute to first-year retention rates in private institutions (Gansemer-Topf and Schuh 2006) and to graduation rates in all institutions (Ryan 2004); however, another study (Titus 2006a) found no significant relationship. Expenditure for academic support has been found to significantly improve persistence and graduation rates in some studies (Gansemer-Topf and Schuh 2006; Ryan 2004), but not significantly predict college degree completion in other research (e.g., Titus 2006a). Expenditure on student services was found to have a positive effect on students' persistence in some studies (Astin 1993; Webber and Ehrenberg 2009), but negatively related to first-year retention or 6-year graduation rates in private institutions (Gansemer-Topf and Schuh 2006), and not to be significantly related to degree completion (Ryan 2004; Titus 2006a).

The present study integrates important aspects of Bean's (1983), Tinto's (1987), Berger and Milem's (2000), and Titus' (2004, 2006a) work into a comprehensive conceptual

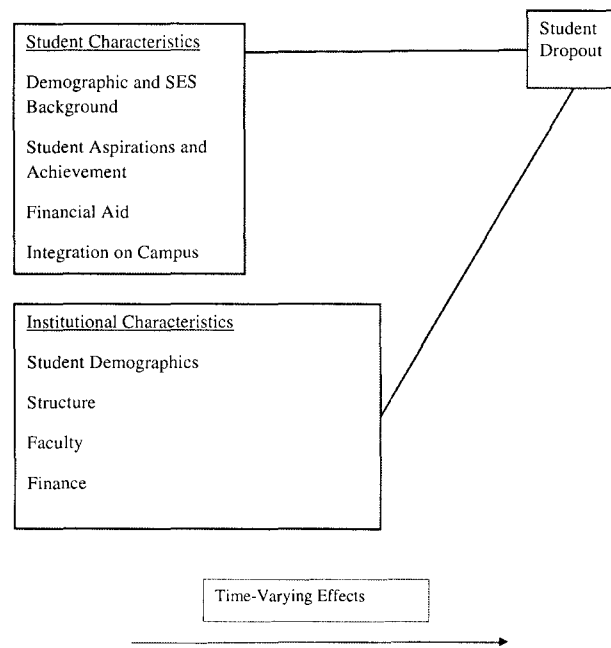


Fig. 1 Conceptual model of the discrete time multilevel analysis of college student dropout risks

model. It is hypothesized that institutional demographics, structural characteristics, faculty, and financial resources may affect student dropout risk. Given the longitudinal nature of student departure and the hierarchical structure of the data, multilevel event history modeling is used for advancing this field of research. The goal of this study is to identify which types of institutions have lower dropout risks. Through this research, the proposed conceptual framework (Fig. 1) will be made available for extensive investigations in the future.

Research Design

Research Questions

This multilevel event history study addresses two major research questions:

- (1) How do student level variables predict student dropout over time from their first institution?
- (2) How are the various institutional level factors related to student dropout over time after controlling for student level predictors?

Data Sample

This study uses combined data from the Beginning Postsecondary Students (BPS96/01) and Integrated Postsecondary Education Data System (IPEDS) 1995–2000. The BPS tracks a nationally-representative cohort of students who entered higher education for the first

time in the academic year 1995–1996 for 6 years, until 2001. It is a highly desirable dataset because it contains yearly information about student enrollment as well as other time-varying variables such as financial aid received. IPEDS¹ is a system of interrelated surveys of institutions in seven areas: characteristics, prices, enrollment, student financial aid, degrees and certificates conferred, student persistence and success, and institutional human and fiscal resources. The combined use of these two datasets enables longitudinal tracking of students along with detailed time-varying information about institutional contexts. The sample is limited to Fall 1995–1996 first time, full-time, degree-seeking undergraduate students attending 4-year institutions. The final sample is comprised of 5,762 students attending 400 four-year institutions.

Model Specification

Because BPS only provides information for the first institution students attended, within-institution persistence or dropout are considered as appropriate outcomes for investigation (Titus 2004, 2006a). In the current study, the dependent variable is defined as *institutional dropout* measured by a dichotomous variable, indicating whether or not a student left his/her first 4-year institution without return by the end of the sixth year of the observational period. Thus, the origin state is the enrollment in the first institution in the fall of 1995–1996, the destination state is the occurrence of leaving the first institution without return by 2000–2001, and the duration is the number of years of enrollment at the first institution.

The independent variables are both student and institutional level and were identified as potentially important in the literature (See Appendix for the original variables from BPS and IPEDS). The student-level variables include student demographic and socioeconomic background, educational aspiration and achievement, financial aid, and integration on campus. Demographic variables capture age (a dummy variable indicating whether the student's age, with over 20 as the reference group), gender (a dummy variable indicating whether the student is female), and race/ethnicity (dummy variables indicating African American, Hispanic, Asian, and other, with the omitted group being White). The socioeconomic status variable is a composite sum of standardized parental income and standardized parental education, following the conventional approach used in previous research (Titus 2006c). The mid-SES (two middle quartiles of the standardized score) and high-SES (highest quartile) groups are compared with the low-SES group (lowest quartile, reference group).

Educational aspiration is measured by highest educational plan with the omitted group being “Bachelor's degree or below”. Academic achievement variables include high school GPA (dummy variables indicating mid-level and high-level, with low-level as the reference group),² college GPA (standardized score of college GPA), and undergraduate majors (dummy variables indicating social, investigative, enterprising, and other, with artistic as the reference group).³

¹ The IPEDS data for this study are from the Delta Cost Project (<http://www.deltacostproject.org>), which provides a user-friendly interface (Schneider 2010).

² The low high school GPA ranges from D– to B–, middle GPA ranges from B to B+, and high GPA ranges from A– to A.

³ Following the work of John Smart (Smart and Umbach 2007) and Paul Umbach (Umbach and Milem 2004), this study utilizes John Holland's concept of six disciplinary clusters for recoding college student majors in the first year. Detailed discussion about the categorization can be found in Smart and Umbach (2007).

Financial aid includes time-varying variables measured by Pell grant, Perkins and subsidized loans, work-study aid, and first-year merit-aid between academic years of 1995–1996 and 2000–2001. Among them, work-study aid is a dummy variable indicating whether the student received this aid with “No, did not receive aid” as the reference group. All other types of aid variables are continuous variables (in \$1,000) indicating the amount of aid the student received.

College integration variables include academic integration and social integration indexing the overall level of academic and social integration a student experienced in college in the first year. These two variables are used in their standardized-score forms. A series of “year” variables are created, with “1” indicating enrolled, and “0” indicating not enrolled for a specific academic year; “Year 1” is the reference group.

Institutional characteristics covered in this model are institutional demographics, structure, faculty resources, and financial resources. Institutional demographics and structure are measured by institutional size (logarithm), percentage of disadvantaged minority students, institutional control (public vs. private), and selectivity (low-, mid-, and high-level). Faculty resources variables are indicated by percentage of part-time faculty and full-time faculty–student ratio (full-time faculty per 100 FTE). Financial resources variables include instructional expenditures (logarithm), academic support expenditures (logarithm), and student service expenditures (logarithm). All institutional level variables are time-varying, except institutional control and selectivity.

Finally, two sets of interaction effects variables are included to consider the possible variation in the relationships between institutional characteristics and dropout risk across student subgroups. The first is the interaction between SES/race and financial aid, as the literature suggests students from different backgrounds may respond to financial aid differently in their persistence/dropout behavior (e.g., Chen 2008; Chen and DesJardins 2008, 2010; Hu and St. John 2001; Paulsen and St. John 2002). The second set includes interaction effects between student SES/racial background and institutional faculty and financial resource factors, because: (a) it is important to examine whether the relationships between institutional characteristics and dropout risks vary by student subgroups (Tinto 1993); and (b) institutional faculty and financial resources are the major policy/practice variables within institutional control, which has important policy implications for institutions to improve student persistence rate.

Analytic Methods and Statistical Model

With an increasing interest in educational research that focuses on the longitudinal process of student outcomes such as student dropout, event history methods (or hazard/survival analysis) have emerged as a distinctive and effective group of analytic methods for this type of research (Yamaguchi 1991). As Barber et al. (2000) suggest, classical statistical procedures such as event history methods assume individuals behave independently. However, it is possible that individuals in the same context behave more similarly than individuals from different contexts; as a result, statistical procedures that incorporate the multilevel data structure are necessary and important. Another rising focus still understudied is the relationship between institutional characteristics and student persistence/dropout. Existing multilevel studies (e.g., Kim 2007; Rhee 2008; Titus 2004) have greatly improved our understanding of this relationship, but the standard multilevel methods utilized in this type of research often do not incorporate time or time-varying covariates into analysis. One recent methodological development in higher education research is represented by a limited number of studies (Bahr 2009; Titus 2006b), which include

longitudinal information at the student level. However, no previous research has considered time-varying institution-level factors in analysis.

To address the above problems, the present study combines event history analysis with multilevel models, and remedies the deficiency in the literature by accounting for longitudinal information at both student and institutional levels. Event history or hazard/survival analysis can be classified as discrete or continuous, the distinction being the metric used to measure the time-of-event occurrence (Yamaguchi 1991). Given that student dropout is recorded in academic years which are discretely observed, this study applies the multilevel discrete-time event history method.

Multilevel event history models, particularly models involving both individual and macro-level time-varying covariates, are not common (Barber et al. 2000). The availability of longitudinal data from both BPS and IPEDS and the recent development of software programs that can handle multilevel event history modeling create a unique opportunity to apply advanced methods to study institutional effects on student dropout over time. With both individual and institutional-level time-varying covariates incorporated in the multilevel event history model, this study aims to examine how institutional factors are related to student dropout risks. This is a two-level discrete-time event history model, with students as level 1 and institutions at level 2. Consistent with what Barber et al. (2000) recommended, all time-varying variables, including institutional level factors that change values over time, are put at level 1 in the model.

Two concepts are important for understanding event history analysis. The first is censoring, which occurs when an individual's event time (here dropout time) is unknown, either because some individuals never experience the target event (e.g. because they graduated) or experience the event after the study's observation period (Singer and Willett 2003). In the current event history analysis, there are two types of cases who are censored: cases due to graduation are removed from risk set at their graduation time, and those who remained enrolled until the sixth year are censored at the end of the observation period. The other key concept is the hazard, which in this study is the risk of event occurrence in each discrete time period. This is the fundamental quantity that assesses the conditional probability that a student will drop out in a particular year in college, given that he or she has not experienced this event in any earlier time period. Hence, dropout risk in this study refers to the conditional dropout rate, with censored cases removed from the base sample in each time interval.

Data Analysis

The analysis was carried out in three consecutive steps:

Step 1: Data Reconstruction First, to deal with the missing data issue, multiple imputation, as recommended by Allison (2001), is conducted by employing Stata. "For each imputed data set, the missing data are filled in with values drawn randomly [with replacement] from the distribution. Analyses are performed on each data set as though the data had been completely observed. The results of these analyses are then pooled to provide point and variance estimates for the effects of interest" (p. 186). Multiple imputation can be used with virtually any kind of data and any kind of regression model and produces unbiased estimates of the statistics (Allison 2001). As a result of this procedure five datasets were generated for the multilevel event history analysis in the present study. Second, the student-level and institutional data that contain time-varying factors were converted into long form data, which has multiple records for each person for each time period. Such a data format supports analyses of change over time (Singer and Willett

2003), then a series of “year” variables were created. Third, the potential multicollinearity problem was checked by the use of the correlation and Variance Inflation tests.⁴

Step 2: Descriptive Analysis The first step of the data analysis is to produce descriptive statistics of the sample. The life-table and Nelson-Aalen estimation methods were applied to understand hazard curves for the sample. These two analytical techniques are important methods of estimating hazard functions in event history methods (Singer and Willett 2003).

Step 3: Multilevel event history Analysis This stage of analyses includes a set of multilevel event history models. The first is a fully unconditional model (FUM) model, with no predicting variables at the within- or between-institution level (Raudenbush and Bryk 2002) to examine whether the odds of dropout vary significantly across institutions. Empirical Bayes (EB)-estimated log odds from the FUM model were used to calculate the unadjusted predicted probabilities for dropout rates across institutions. These initial estimates provided the basis for later assessment of the model with all variables included. In the second model, student level variables as well as time-varying institutional variables were entered. The institutional level variables added into this model include percentage of disadvantaged minority students, percentage of part-time faculty, faculty–student ratio (full-time faculty per 100 FTE students), institutional size, expenditure on instruction, expenditure on academic support, and expenditure on student services.

The third model incorporates institutional level variables that do not change over time during the observation period, institutional control and selectivity. In this model, the coefficients of financial aid variables and institutional factors (institutional faculty and financial resource variables) are allowed to vary by SES and race/ethnicity to test interaction effects. These coefficients are also allowed to vary by time to test whether the relationships change year-by-year. After fitting the model with interaction effects, multivariate hypothesis testing was conducted to examine whether this model represents a significant improvement over the model without interaction effects. Weights were applied to ensure the generalizability of the findings (Thomas and Heck 2001; Toutkoushian and Conley 2005).

Limitations

This study has several limitations that deserve discussion. First, the study’s estimates are for first-institution dropout. This was necessary because BPS (96/01) provides information only about a student’s first institution. Although it is possible in BPS (96/01) to differentiate students who transferred to destination institutions and found success there and those who transferred but did not persist, it is impossible to track their destination institutions because BPS (96/01) does not provide that data. Thus, the outcome variable measures only one aspect of dropout and the results cannot be interpreted to be applicable for overall dropout in the higher education system as examined in previous studies (e.g., Chen and DesJardins 2008, 2010).

The second limitation has to do with self-selection. Like similar previous research (Titus 2006a, b), this study was unable to adjust for the possibility of self-selection at the student level in such areas as on-campus residency, postsecondary plans, willingness to borrow, willingness to work, eligibility for need-based and merit aid; and at the institutional level in such areas as choice of institution (e.g., public vs. private). One difficulty controlling for selection bias in this study is that the data do not provide the information

⁴ Following previous work (Zhang and Ness 2010), this study used the interpolation method for imputing missing values in panel data.

needed for controlling for those unobserved variables at both levels. The other challenge is that the combined use of multilevel modeling, longitudinal analysis, and statistical methods accounting for the self-selection is still in the stages of development (Titus 2006a). Thus, this study does not employ causal inference methods to address the research questions. However, compared with research using cross-sectional data, this event history method study can mitigate the selection bias problem by establishing causal ordering.

Results

Life-table method results (not shown) indicate that within the six-year observation period the cumulative dropout risk is about 56%. The dropout risk fluctuates by year, but is the highest in the first year (17.7%). Nelson-Aalen estimation results confirm that dropout risks vary by SES and race/ethnicity. Low-SES students tend to have higher risks of dropping out than other SES groups. Compared to Whites, African Americans, Hispanics and the other race/ethnicity group (except Asians) are found to be more likely to drop out in the first year. Both patterns are consistent across the 6 years of the observation period.

The descriptive analyses provide information about the distribution of the variables in the model (Table 1). At the institutional level, 44.93% of the first-institutions are private while 55.07% are public. In terms of selectivity, 55.07% of the institutions are least selective, 19.12% are moderately selective, and 25.81% are the most selective. The average percentage of disadvantaged minority students across all these institutions is 15%, the average percentage of part-time faculty 32%, average faculty–student ratio 6.01, average size of full-time enrolled students is 12,175, and the average expenditure on instruction, academic support, and student services is \$88,100,000, \$21,200,000, and \$10,100,000, respectively. Cross-tabulations (not shown) demonstrate the underlying patterns in first-institution characteristics and dropout from the first-institution in 1996. In general, those who dropped out in each of these 2 years tend to come from public institutions and low-selectivity institutions; they are also more likely to have enrolled in institutions with a higher percentage of minority students, a lower full-time faculty–student ratio, a smaller number of full-time enrolled students, and a lower level of expenditures on instruction, academic support and student service support. These patterns are consistent across the 6 years of the observation period.

As discussed earlier, the analysis of student dropout started with a fully unconditional model (FUM) to determine whether the amount of variation across institutions in students' chances of dropout was statistically nonzero. Table 2 indicates that the chance of dropout varied significantly across the 400 institutions (reliability is .66, and $p < .001$). The empirical Bayes (EB) random intercept for the institutional level in the residual file from the FUM was also used for calculating the estimated institutional-level college student dropout rate. The estimations indicate there is a considerable variation in the estimated probability of dropout across all institutions, with a range of 38% for the estimated dropout rates.⁵ These two findings, namely the significant random effects (as shown in Table 2) and the considerable difference in the dropout rate across institutions, supported the next step, a comprehensive HGLM analysis of student dropout that incorporated random effects at the institutional level.

⁵ This range does not include the estimated probability for an outlier institution, which will be discussed later in the paper.

Table 1 Descriptive statistics for variables in the study

Variables	Weighted percentage	Standard error
Cumulative dropout from first institutions by 2001	40.73	0.008
Dropout from first institutions in 1996	17.97	0.006
Age less than 20	89.35	0.006
Race/ethnicity		
White	75.35	0.007
African American	10.63	0.005
Hispanic	6.58	0.004
Asian	6.29	0.004
Other	1.14	0.001
Gender		
Male	45.42	0.008
Female	54.58	0.008
Socioeconomic status		
Low SES	25.00	0.007
Middle SES	49.41	0.008
High SES	25.58	0.007
Highest education planned		
Bachelor or lower	23.05	0.007
Above bachelor	76.95	0.007
High school GPA		
Low GPA	24.61	0.005
Mid GPA	33.82	0.008
High GPA	42.32	0.008
First-year major		
Artistic	9.91	0.05
Social	14.99	0.06
Investigative	24.95	0.07
Enterprising	11.34	0.01
Other	38.81	0.01
Standardized academic integration (first-year)	0	0.016
Standardized social integration (first-year)	0	0.016
Standardized college GPA (first Year)	0	0.020
Financial aid		
Pell grant (for aid recipients)	1140.86	19.23
Subsidized loan (for aid recipients)	2622.72	22.98
Unsubsidized loan (for aid recipients)	2466.36	45.93
Receiving work-study (%)	16.88	0.005
Merit aid (for aid recipients)	3309.15	103.84
First-year institutional characteristics (1996)		
First institutional control		
Private (%)	44.93	0.008
Public (%)	55.07	0.008

Table 1 continued

Variables	Weighted percentage	Standard error
First institutional selectivity		
Least (%)	55.07	0.008
Moderate (%)	19.12	0.007
High (%)	25.81	0.007
Percentage of disadvantaged minority students	0.15	0.003
Percentage of part-time faculty	0.32	0.030
Faculty–student ratio (Full-time faculty per 100 FTE students)	6.01	0.036
Size (full-time enrollment)	12,175	209.33
Expenditure on instruction	88,100,000	1,939,969
Expenditure on academic support	21,200,000	482,092
Expenditure on student services	10,100,000	167,621

With the exception of the cumulative dropout variable, all descriptive statistics in the table are based on data for 1996. Due to limited space, statistics for other years are not presented here but can be provided upon request

Total sample size: 5,762. Total number of institutions: 400

Table 2 HGLM unconditional model: reliability estimates and variation among institutions

Random institutional level coefficient	Reliability estimate
Intercept for dropout	0.66
Estimation of level two variance components	Variance component
Intercept for dropout	0.53***

* $p < .05$, ** $p < .01$, *** $p < .001$

Intercepts reported here are the log-odds of first-institution dropout (relative to persistence) according to the results of the HGLM fully unconditional model

Multilevel event history analysis of the model after both student- and institutional-level variables are included (Table 3) reveals that student dropout risks at their first institution by the end of the sixth year are influenced by many factors, including student SES, educational plans, first-year college GPA, first-year academic and social integration on campus, financial aid, and the academic year in which students were enrolled. In particular, results indicate a substantial gap in the risks of dropout across socioeconomic status. Specifically, controlling for all other factors, the odds of dropout for mid-SES students were 81% of that for low-SES students ($p < .01$) and the odds of dropout for high-SES students were 62% of that for low-SES students ($p < .01$).

Higher educational plans above a Bachelor's degree were strongly associated with a lower probability of dropout (Odds-ratio = 0.68, $p < .001$). Students' first-year integration on campus was significant: students with a higher level of academic or social integration tended to have a lower dropout risk. College GPA is the predictor with the largest magnitude in estimation: A one standard deviation increase in college GPA was associated with a 41% decrease in the odds of dropout (Odds-ratio = 0.59, $p < .001$). Four types of aid (Subsidized Stafford and Perkins loans, unsubsidized loans, work-study, and merit aid) each had a significant and negative relationship with dropout risk. The risk of first-institution dropout varies over time, and the magnitude of dropout risk is relatively smaller in later years (except 2nd year) than in the freshmen year.

Table 3 Multilevel event history model of student dropout from first institution

	Odds ratio	Standard error	Sig.
Age less than 20	0.82	0.12	
Black	1.12	0.11	
Hispanic	1.20	0.13	
Asian	0.83	0.13	
Other	1.25	0.26	
Female	1.11	0.06	
Mid SES	0.81	0.07	***
High SES	0.62	0.10	***
Educational plan	0.68	0.07	***
Mid HSGPA	0.76	0.12	
High HSGPA	0.72	0.17	
Z score of academic integration	0.91	0.04	***
Z score of social integration	0.87	0.04	***
Z score of college GPA	0.59	0.04	***
Social discipline	0.90	0.13	
Investigative discipline	0.97	0.12	
Enterprising discipline	0.87	0.14	
Other major	1.01	0.12	
Pell grant (in \$1000)	0.93	0.06	
Subsidized loan (in \$1000)	0.92	0.02	***
Unsubsidized loan (in \$1000)	0.95	0.02	*
Receiving work-study	0.81	0.08	**
Merit aid (in \$1000)	0.94	0.02	**
Year2	0.98	0.07	
Year3	0.58	0.09	***
Year4	0.38	0.11	***
Year5	0.43	0.14	***
Year6	0.30	0.22	***
Public	1.01	0.11	
Mid-selective	1.04	0.12	
Highly-selective	0.84	0.12	
Pct of minority	0.82	0.20	
Log of size	0.94	0.15	
Pct of part-time faculty	0.96	0.16	
Full-time faculty–student ratio	1.00	0.02	
Log of instructional	0.99	0.14	
Log of academic support	1.01	0.07	
Log of student service	0.85	0.08	*

* $p < .05$, ** $p < .01$, *** $p < .001$

In addition to the results on student-level variables, the analysis also reveals some new and important findings about institutional factors related to dropout risk. Institutional expenditure on student services was found to be significantly related to dropout after controlling for differences in the student-level variables and other institutional-level

variables. Colleges placing a higher priority on student services had lower odds of student dropout after controlling for differences in the student-level variables and other institution-level variables. Students in institutions with a higher level of expenditure on student services are significantly less likely to drop out from their first institution.

To determine whether the relationships between institutional variables and dropout risk vary by SES and race/ethnicity, this study conducted regressions that included interaction terms. There is no evidence for significant interaction effects between institutional characteristics and these student sub-group variables. In other words, the relationships between institutional variables and dropout risks are the same across different student SES or racial/ethnic groups. However, three sets of interaction terms related to financial aid are significant. In general, compared to their advantaged peer groups (high SES groups, Whites), disadvantaged groups (low-SES groups, minorities except Asians) tend to have lower dropout risks when awarded higher financial aid (Pell grants/subsidized loans/merit aid). The tests of whether and how institutional factors are related to student dropout year-by-year reveal that, in general, there is little evidence for institutional characteristics-year or aid type-year interactions.⁶

The model reveals no significant relationships between institutions' structural characteristics (selectivity, control) and student dropout, which is contrary to some previous studies (Kim 2007; Titus 2004, 2006a; Gansemer-Topf and Schuh 2006). To further understand the inconsistency, an additional set of tests were done to compare results with and without controlling all other institutional characteristics (percentage of minority students, institutional size, percentage of part-time faculty, full-time faculty–student ratio, and the three institutional expenditure variables). Analysis shows that both structural characteristics, which were significant without any control of other institutional variables, became non-significant after other institutional variables were accounted for.

Finally, a sensitivity test was conducted to compare the results with and without including an outlier institution. The EB estimation reported earlier demonstrates that the estimated dropout probability varies substantially across institutions and is also skewed. Specifically, one institution has an estimated dropout probability more than eight standard deviations above the national average; the rest of the institutions have dropout probability less than four standard deviations away the national average. Thus, the same analysis was conducted with this outlier institution excluded. Results for the student and institutional level factors in the reanalysis when the outlier institution was excluded are quantitatively similar to those reported in this paper.

Conclusions

Policy Implications

Student Level

This study using national longitudinal data examined the relationships between institutional characteristics and educational opportunity as measured by student dropout risk.

⁶ There are two exceptions. Results demonstrate that the relationship between Pell grants and dropout risks and between unsubsidized loans and dropout risks are significantly stronger in the fourth year or sixth year than in the first year (results are available upon request). It is questionable how much significance should be attached to these interactions because there is a small level of risk remaining by this late stage of a college career, which may lead to imprecise estimates.

Before moving on to the policy implications based on findings on institutional characteristics, however, it is necessary to briefly discuss what implications we can derive from results at the student level.

First, consistent with Tinto's (1987, 1992) interactionist theory, and Pascarella and Terenzini's (2005) review, this study reveals that academic preparation and college experience are important in predicting dropout: educational aspirations, first-year GPA, and academic and social integration are all negatively associated with dropout at first institution. Institutional planners might want to establish or adjust student retention programs by paying more attention to the roles of these factors.

Second, the results also shed light on the possible leverage role of financial aid policies in reducing college student dropout risk. Consistent with previous literature (DesJardins et al. 2002; Singell 2004), this study finds a negative relationship between the amount of financial aid (subsidized loans, merit aid) received and drop out. In addition, a consistent finding across the interaction effect tests is that financial aid that reduces net tuition (e.g., Pell grants or merit aid) is related to a narrower dropout gap between low-SES students and their higher SES peers. These findings confirm the need for a consistent emphasis on financial aid at the federal and state levels to promote equality in higher education.

Third, consistent with previous studies, results also indicate that the risk of dropping out of the first institution change over time (DesJardins et al. 1999); the risk of dropping out is the highest in the first year. Programs and practices that aim at reducing dropout can probably maximize their effects by placing more emphasis on student persistence in the first year.

Institutional Level

The results at the institutional level have implications for educational practices. This study found that institutional policies and practices, namely financial resources, may have important implications for student dropout behavior. Specifically, students who attend institutions with a higher level of expenditure on student services tended to have lower risks of dropping out.⁷ This finding is consistent with Webber and Ehrenberg's (2009) discovery that student services expenditures influence graduation and persistence rates. On the other hand, institutional expenditures on instruction and academic support are not significantly related to dropout risk. This finding is consistent with Astin's (1993) argument that investment in student services is a more critical environmental factor than the investment in instruction. In sum, findings at the institutional level seem to suggest that institutional financial resources emphasizing students' social development outside the formal instructional program may promote college student persistence at their first institution.

The finding of a significant relationship between expenditures on student services and dropout implies that institutional administrators may need to look beyond the structural aspects of institutions to reduce dropout rates. Other dimensions such as institutional expenditures may matter in student retention at their first institution. Unlike many traditional views that regard student service expenditures as "frills" that make no direct

⁷ Student service, according to the definition in IPEDS, is a functional expense category that includes expenses for activities whose primary purpose is to contribute to students' emotional and physical well-being and to their intellectual, cultural, and social development outside the context of the formal instructional program (NCES 2002).

contribution to students' persistence in college (Webber and Ehrenberg 2009), this study demonstrates that this type of institutional spending may significantly reduce student dropout rates at their first institution. At the same time, however, it is also recognized that this study alone cannot serve as a strong justification for putting additional funds into student services without further research. Institutional administrators in different spending categories (academic support, instruction, and student services) may need to collaborate to strengthen institutional capacity in supporting and instructing students. Should more solid evidence of the relationship between student service expenditure and dropout risk be forthcoming in the future research, institutions may need to evaluate existing expenditure patterns and put a priority on budgeting for student services to provide the best resources for promoting student success.

Research Implications

Methodologically, this study suggests a new approach for evaluating the relationship between institutional characteristics and college student dropout. In general, the existing research has paid limited attention to possible institutional effects on college student dropout in a longitudinal process. The present study adapts discrete time event history methods, and adds a new perspective by incorporating multiple years of both student and institutional level variables as predictors of student dropout in first institutions. While these methods are applied in this research to the analysis of dropout in an institutional context, they are applicable to a wide variety of other longitudinal analyses involving clustered data. It is hoped this multilevel and longitudinal organizational research approach will deepen our conceptual understanding of the field, help us focus on the importance and complexity of higher education research, and move us toward more thorough investigations in the future.

The results challenge the common perceptions about effective institutions. Although some evidence in the literature has shown that private and selective institutions tend to have lower dropout rates (e.g., Kim 2007; Titus 2004), in this study these types of institutions were not significantly different after controlling for student background characteristics, institutional demographic variables, and faculty and financial resources. This study provides support for Pascarella and Terenzini's (2005) proposition that what institutions *do* affects student outcomes more than what those institutions *are*, as the findings reveal that institutional variables more proximal to students' experiences (e.g., expenditure on student services) may be more powerful influences than conventional institutional features (e.g., selectivity). Future research is encouraged to further examine the effects of other institutional characteristics closely connected to students' experiences, such as peer environments, faculty cultures, and internal structural or policy considerations.

Further empirical research is warranted before policy changes can be advocated for several reasons. First, as mentioned earlier, research on what institutional characteristics matter in student dropout/persistence decisions is still very limited. As students' college degree completion has become increasingly important to policy makers, whatever expenditures contribute to student success should arguably have high priority in institutional budget decisions. Thus, more related research is needed in this field. Second, although this research found that expenditure on student services is negatively related to dropout risk, it is unclear as to what specific student services are effective for reducing dropout. As indicated in IPEDS data, student services expenditure is a functional expense category for the offices of admissions, registrar, student counseling, and student activities. Some areas covered under this category may not have direct impact on student dropout.

For example, admissions offices and registrar's offices are primarily concerned with recruiting students to the college and university or scheduling classes and record keeping of courses and grades (Gansemer-Topf and Schuh 2006), so their influence on student success may be less direct than other areas. In addition, student services expenditures cover a variety of expenses on items ranging from student cultural events, student newspapers, intramural athletics, student organizations, and supplemental instruction outside the normal administration. Intercollegiate athletics and student health services may also be included except when operated as self-supporting auxiliary enterprises. Future research needs to differentiate among these expenditures to provide more concrete and constructive suggestions for student affairs administrators regarding organizational and programmatic policies that promote student persistence.

This study also has implications for NCES about future data collection efforts. Separate categories of institutional expenditures are needed to more closely analyze their relationships with college student outcomes. For example, the variable of instructional expenditure includes expenses on general academic instruction, occupational and vocational instruction, community education, preparatory and adult basic education, and regular, special, and extension sessions. It also includes expenses for both credit and non-credit activities. In the present research, more specific expenditure categories separating institutional variables more directly connected to college student dropout (e.g., general academic instruction) from those that are not (e.g., preparatory and adult basic education) would have allowed for a more focused analysis of expenditure variables and dropout risk. Thus, it is suggested that NCES data collection staff revisit the IPEDS survey questions and break the current expenditures into sub-categories to provide a more specific description of institutional expenditures and facilitate a more accurate control for the effect of institutional characteristics directly related to student outcomes.

Acknowledgments This research is based upon work supported by the Association for Institutional Research, the National Center for Education Statistics, the National Science Foundation, and the National Postsecondary Education Cooperative under Association for Institutional Research Grant # RG10-119. Financial support is gratefully acknowledged. The comments from the anonymous reviewers are very constructive and are greatly appreciated.

Appendix

See Table 4.

Table 4 Variables in the study and corresponding names in BPS/IPEDS

Variable name	BPS/IPEDS name
Dependent variable	
Cumulative dropout outcome at first-institution 1995–1996 to 2000–2001	PROUFY1 –PROUFY6
Student predictors	
Student demographic and socioeconomic background	
Age	AGE
Gender	GENDER
Race/ethnicity	RACE
Total income of parents or independent students	CINCOME
Parents highest education level	PBEDBOT2

Table 4 continued

Variable name	BPS/IPEDS name
Student aspirations and achievement	
Educational aspiration	SBHIGHED
High school GPA	HCGPAREP
College GPA (1995–1996)	SEGPAY1
Major field of study (1995–1996)	MAJORS3
Integration on campus	
First-year academic integration	ACADINT
First-year social integration	SOCINT
Student financial aid (1995–1996 to 2000–2001)	
Pell grant	PELL96 – PELL01
Perkins loan	PERK95 – PERK00
Stafford subsidized loans	STSUB95 – STSUB00
Stafford unsubsidized loan	T4UNS95 – T4UNS00
Received work-study	AHWKSTY1 – AHWKSTY3 QCWKAY4 – QCWKAY6
First-year total merit-aid	MERITAID
Institutional predictors (1995–1996 to 2000–2001)	
Student demographics within the institution	
Total enrollment	TOTAL_ENROLLMENT
Enrollment of Hispanics	TOTAL_ENROLLMENT_HISP_TOT
Enrollment of African Americans	TOTAL_ENROLLMENT_BLACK_TOT
Enrollment of Native Americans	TOTAL_ENROLLMENT_AMIN_TOT
Size	FTE_COUNT
Structure	
Control	CONTROL
Selectivity	INSTSEL
Faculty	
Percentage of full-time faculty	FULL_TIME_FACULTY_SHARE
Full-time faculty–student ratio	FT_FACULTY_PER_100FTE
Finance	
Instructional expenditure	INSTRUCTION01
Academic support expenditure	ACADSUPP01
Student service expenditure	STUDSERV01

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