THE RELATIONSHIP BETWEEN COLLEGE COSTS, LOCAL LABOR MARKET CONDITIONS AND PERSISTENCE AMONG COMMUNITY COLLEGE STUDENTS

Gregory S. Kienzl
University of Illinois, Urbana-Champaign

Tatiana Melguizo
University of Southern California

Mariana Alfonso
Inter-American Development Bank

The authors wish to thank Tom Bailey, Juan Carlos Calcagno, Tim Leinbach, Lisa Hudson, Steve DesJardins, Clifford Adelman, and the attendees of the Association for Institutional Research conference. This research was supported by a grant from the Association for Institutional Research/ National Postsecondary Education Cooperative (Grant #06-516). Opinions are those of the authors alone and do not necessarily reflect those of the granting agencies or of the authors' home institutions.

June 25, 2007

Abstract

The main objective of this study is to analyze the influence of in-state tuition and labor market conditions on the persistence and degree completion of traditional-aged community college students. This study uses the 1992 high school graduating class of the National Education Longitudinal Study (NELS:88/2000) to develop a new model of community college persistence and attainment that takes into account direct (in-state tuition), indirect (wage data by industry), and relative (change in tuition greater than wage) costs to students. The hypotheses that year-to-year changes in tuition, wages, and the relative change of both affect students' enrollment and attainment behavior are formally tested. The analysis suggests that community college students do not solely nor independently look at in-state tuition or wages in the local labor market when making attainment decisions; they also simultaneously weigh the relative costs of each. This is especially true for students on the path toward an associate's degree. On the other hand, there is little evidence that such costs play a role in community college students' persistence.

Keywords: *community colleges*, *local labor markets*, *persistence*, *attainment*, *commuting zones*

1. Introduction

In a widely-cited review of the economic benefits of sub-baccalaureate education, Grubb (2002, p. 302) concluded that "the pre-baccalaureate labor market appears to be quite local." Employers who need workers with a sub-baccalaureate credential tend to search locally and sub-baccalaureate students take advantage of these established ties (and reduced job search costs) by looking to local industries for employment. With such a clear connection to local businesses, it should not be surprising that previous research has found a countercyclical relationship between enrollments in community colleges and local economic conditions (Betts and McFarland, 1995). Simply stated, the former increases when the latter worsens. The next logical, but so far largely undeveloped, strand of research—linking local labor market conditions and students' enrollment and attainment decision-making—deserves some attention.

The percentage of community college students who work while enrolled is more than 80 percent and growing (Horn and Nevill, 2006). Combining (or in many cases, juggling) a job with coursework may improve post-schooling employment opportunities, but it may also draw students away from their desired academic goal, especially when the demand for employees with a sub-baccalaureate education is strong. Nevertheless, the extent to which substantial wage shifts in the local labor market affects community college students' pathway through postsecondary education is a salient research and policy question that has been scarcely examined in the literature.

Therefore, the primary purpose of this study is to expand the traditional views of persistence and attainment at the sub-baccalaureate level to include the relationships between institution-specific tuition charges, occupation-specific wages in the local labor market, and the relative change of these two factors in a tractable model. Employment and wage data from 12 industries[1] from 1992 to 2000 are available, but only the average wages from the most dominant industry—the one with the largest employment during the given observation period—in the local labor market are included in the estimation.

The theoretical underpinnings of the analysis follow that a sudden boost in the local economy may raise wages (a positive wage shock), providing enough incentive for students to continue their enrollment and eventually complete a degree. However, for some individuals, this tangible gain to a college education must be weighed against an increase in the indirect (or opportunity) costs associated with rising wages. The opportunity costs of postsecondary education are primarily the wages that students would have earned had they chose not to enroll in college.[2] For students who are uncertain about their attainment prospects, this cost can increase the likelihood that they will temporarily stop out or drop out entirely from postsecondary education. Unfortunately, the empirical research trails these theoretical inferences, especially when dealing with students who are enrolled at a community college.[3] A discrete-event behavioral model for the persistence and attainment processes is developed and applied on a sample of first-time community college students in fall 1992. The analysis focuses on community college students because they are most likely to be at the margin between college and work (Kane and Rouse, 1999) and, thus, expected to be the most affected by changing labor market conditions.

The unique influences of these direct and opportunity costs on educational outcomes are estimated after controlling for a comprehensive set of student demographic and socio-economic characteristics, as well as measures of college preparedness and degree aspirations. The inclusion of these economic determinants, as well as an examination by gender, is the main contribution of this analysis to the extensive literature on postsecondary students' persistence and attainment.

Additional contributions to the economics literature are made by using local labor market characteristics rather than aggregate state-level measures, as well as modeling the extent to which students respond to relative changes in in-state tuition costs and local labor market conditions. Ultimately, the proposed models account for the continuous reevaluation of the costs and benefits faced by students prior to enrolling for another year of postsecondary education.

The study develops as follows. In the next section, the relevant literature regarding the economic factors that influence postsecondary enrollment decision-making is reviewed. In section three, the datasets and variables used in the empirical estimations are explained along with the empirical strategy. Findings are discussed in section four, and a summary of main results and areas of future research are provided at the end.

2. Literature Review

Community college students tend to be more sensitive to changing local labor market conditions than four-year college students, which is often neglected in persistence and attainment studies. A major tenet of human capital theory states that direct and opportunity costs of college affect an individual's decision to, first, enroll in college and then remain enrolled until completion or when economic conditions favor work rather than schooling (Becker, 1967; Mincer, 1974; Stratton, O'Toole, and Wetzel, 2005). Yet many of the models developed to explain student persistence and attainment in postsecondary education posit that high school academic preparation (Adelman, 1999); psychosocial readiness and motivation (Allen, 1999; Napoli and Wortman, 1998); academic and social integration opportunities while enrolled in postsecondary education (Pascarella and Terenzini, 2005; Tinto, 1993); sufficient guidance and counseling (Grubb and associates, 1999); alignment of educational and occupational expectations (Schneider and Stevenson, 1999); and financial aid (Cabrera, Nora, and Castaneda, 1992; Cofer and Somers, 2000a; DesJardins, Ahlburg, and McCall, 2002; Dowd and Coury, 2006) all have significant effects on the probability of staying in college and, ultimately, attaining a degree. With few exceptions, these models have been designed with the traditional[4] four-year college student in mind and, as such, perform rather poorly when used to explain the transitional behavior of community college students.[5] More critically, none of them take into account how year-to-year changes in the local labor market affect students' persistence and attainment.

3. Description of the Data and Methodology

Datasets and sample

This study combines a number of different national datasets over a 9 year period. The main dataset is the postsecondary transcript file of the National Education Longitudinal Survey (NELS:88/2000). NELS:88/2000 allows student transitions in and out of postsecondary education and the labor market to be observed for 8 years after high school graduation in 1992, which is deemed to be sufficient length of time for the students in the sample to attain a postsecondary credential. Conversely, it is also enough time for these students to leave postsecondary education, with some returning and others not.

Transcript data reduce the likelihood of measurement or recall errors inherent in self-reported enrollment information, but the most tangible advantage of using them for this analysis is the precise documentation of when and where students attended college (Adelman, 2004; Adelman, Daniel, and Berkovits, 2003). All postsecondary institutions attended by students are identified in the transcript datafile, which allows secondary information, such as in-state tuition, to be merged into the datafile from the U.S. Department of Education's Integrated Postsecondary Education Data System (IPEDS) surveys. Of particular interest for this study is the location of each postsecondary institution. Using zip codes from the IPEDS Institutional Characteristics survey, institutions (and by extension students) were placed within a local labor market, which is defined in the next sub-section.

Individual-level information from NELS:88/2000 is further complemented with economic data for each year from 1991 to 2000 provided by the U.S. Department of Labor's Current Employment Survey (CES). Whereas in-state tuition is calculated to measure the direct costs of college, CES data allow county-level employment and wage data to be aggregated in order to measure the opportunity costs of college; namely, the average wage in the dominant industry in the area. Within local labor markets, there is a tremendous amount of employment and wage variation across industries. To simplify the estimation, wages from the dominant industry—based on employment—is used rather than the full set of industries. The rationale for doing so rests on the assumption that most local labor markets are driven in large part by one or two industries, i.e., manufacturing in the North Central states, agriculture in the Plains, and service in most urban areas. Any measurable shift in local labor market wages will be driven primarily by the industry that employs the most workers. All in-state tuition and wage amounts are expressed in constant 2000 dollars.

The sample consists of students who started postsecondary education at a community college.[6] Of the more than 12,100 students in NELS:88/2000 who were interviewed in the 12th grade, 3,278 observations remained after a number of restrictions. They included limiting the sample to high school graduates or those with a high school equivalency diploma, such as a general educational development (GED) credential, who enrolled directly into postsecondary education the fall following high school graduation, and were located 8 years later.[7] Only students for which there is complete information in each of the variables described in the next three sections are included in the sample. Thus, the final sample contains 1,972 community college students. However, the persistence and attainment models require the data to be structured in a person-period format. Exhibit 1 depicts the person-period structure using variables that are described in more detail below. Under this data structure, each enrollment period, defined as an academic year starting on July 1st of a year and ending on June 30th of the following year, represents an observation. As a result, the sample size increases to 7,430 observations. However, due to largely random missingness[8], the working sample size is 4,280; of which, 2,196 are female and 2,084 are male.

<< INSERT EXHIBIT 1 HERE >>

Definition of "local"

Given that local economic conditions are central to the analysis, units of geography that are large enough to encompass employment opportunities within a reasonable distance are needed. Such units are shown in Figure 1. They were developed by Tolbert and Sizer (1996), who analyzed 1990 Census data on county-to-county flows of commuters to and from work using a hierarchical clustering framework. Their analysis resulted in 741 unique geographic areas in the United States, which the authors termed *commuting zones*.

<< INSERT FIGURE 1 HERE >>

There are several aspects of commuting zones that make them highly desirable for this type of analysis. Like labor markets, commuting zones are not necessarily bound by single county or state borders. Relying on commuting patterns, not imposed boundaries, allows for more realistic representation of a local labor market. In addition, they lie between counties and metropolitan statistical areas (MSAs) in size, but unlike MSAs, commuting zones cover every area of the country. As a result, non-metro labor markets can be examined.

Commuting zones are also large enough to capture variations in economic activity in these non-metro markets (Tolbert and Sizer, 1996). Lastly, since they are based on a contiguous cluster of counties, county-level employment and wage information can be aggregated and, in this analysis, weighted based on county-level population figures from the 2000 Census. The specific measures of local economic conditions used in this study are the average annual wage in the commuting zone from 1992 to 2000 and, for each year that a student is enrolled, the change in average annual wages from the previous year to the current.

Dependent variables

Three educational outcomes of community college students are examined in this study. First, the persistence process is modeled by observing if (and when) students drop out and do not return to postsecondary education. If students have not attained a postsecondary credential and are no longer enrolled (earning at least one credit in the academic year) within the 8 years, they are assigned a value of 1; otherwise a value of 0 is given for each period enrolled. The second and third outcomes involve the attainment process.[9] Conceptually speaking, degree attainment is counter-related to dropping out of postsecondary education. Earning any credential is first used to model the overall attainment process, and then associate’s degree attainment is examined separately as a special case. An associate's degree continues to be the main outcome for community college students and college administrators and, therefore, is worth additional inspection. More formally, a value of 0 is assigned if students complete at least one credit during the enrollment period but does not attain a degree during that year and 1 if attainment of any degree (or an associate's degree) during the period under consideration is observed.

Students are "at risk" of dropping out or earning a credential during each enrollment period. If students do not enroll or earn a single credit during the enrollment period, a missing value is assigned to all three dependent variables. This is because students who are not enrolled or earn any credit are not at risk of dropping out or attaining a degree during that period. In effect, the "clock" stops during these breaks in the enrollment spell. Also, if students attain a degree during period *t*, missing values are assigned to the outcome variable for all subsequent periods because they are no longer at risk for attaining that degree or dropping out.

Independent variables – Time-invariant

A common set of student background characteristics are assumed to be constant across enrollment periods. They include students' race/ethnicity, sex, math and reading test scores from the 12th grade, and bachelor's degree expectation (a dummy variable indicating whether students in grade 12 expected to earn a bachelor's degree). To account for compositional differences beyond a simple intercept shift, the analysis is run separately by sex. The socioeconomic status of students, as measured in 1992, was divided into quartiles and also used as an explanatory variable. The variable was developed by the National Center for Education Statistics (NCES) from a composite of parental education, parental occupation and household income and has been adjusted to reflect the backgrounds of the community college sub-sample.

Independent variables – Time-variant

Whereas time-invariant variables remain constant for each person in each period, time-varying variables can take on different values for each time period. The time-varying explanatory variables used in the model include the in-state tuition charge at each postsecondary institution attended,[10] as well as wages in the local labor market. In all, wages from 12 industries are merged into the NELS:88/2000 datafile. Only the wage from the dominant industry—that is, the one with the largest employment—is used as an indicator of economic conditions. The direct effects of both in-state tuition and average annual wage within each commuting zone are estimated, but given that the sample is based on students who have presumably already decided that the benefits of acquiring additional education outweigh the costs, it is necessary to capture the *relative* change in costs and benefits.

To accomplish this, the ratio between the in-state tuition and the average wage in the commuting zone is calculated. Instances where increases in in-state tuition are greater than increases in the average wage are indicated with a binary variable. For example, if in-state tuition rises, say, 5 percent in a given year, but the average wage in the commuting zone increases only 3 percent, then this event is indicated in the model with a binary variable. As mentioned earlier, Figure 1 presents examples from actual data to assist in the conceptualization of the time-varying measures used in the analysis.[11]

The rationale behind the inclusion of the relative change variable in the models is that, at the margin, if increases in in-state tuition outpace increases in the average wage in the commuting zone, then students are likely to leave postsecondary education—either permanently or return when conditions improve. Therefore, it is expected that after controlling for in-state tuition and average wage, this comparison of the rates of change will have an additional negative effect on dropping out but a positive effect on degree attainment.

Estimation strategy

A reduced-form model of both processes can be expressed in a multilevel cost-benefit (or utility maximization) equation below.

$$y^*_{ijt} = \alpha + X'_{ij}B_1 + Z'_{ijt}B_2 \qquad (i \text{ and } j = 1,\ldots,N;\ t = 1,\ \ldots,T) \qquad (1)$$

$$y_{ijt} = 1 \text{ if } y^*_{ijt} > 0\text{; otherwise } y_{itj} = 0$$

where y is the observed binary outcome, y^* is the unobservable propensity to drop out or complete a college degree, i denote the student population of interest and t is the time period, which is an academic year. All time-varying covariates are also indexed by j, which identifies specific commuting zones. Individual characteristics, X_{it}, are fixed (or assumed fixed) over time, whereas X_{ijt}, a vector of direct and indirect college costs, can vary over time.

Typically, researchers interested in persistence and attainment chose two points in time to examine the evolution of the process. In the first period, when students start their postsecondary education, a set of relevant variables are observed. Most are assumed to be related to the outcomes of interest, such as graduation, drop out, still enrolled, or transfer, and constant over time. After a certain period of time, the direct effect of these factors is estimated on the educational outcomes or some combination of policy-relevant education outcomes. However, this type of estimation approach fails to account for the longitudinal process involved. Time-varying covariates cannot be modeled and censored cases cannot be handled.

Discrete-event analysis provides a natural approach to model the occurrence of an event and its timing while controlling for time-varying covariates. The statistical method used in this study to model the educational outcomes of community college students is an extension of the single-event, discrete-time hazard model (Allison, 1984; Singer and Willett, 2003). The discrete-time hazard function is the conditional probability that students *i* will drop out or earn a degree in time period *t* given that either event had not occurred in an earlier time period. The basic discrete-time hazard function can be written as:

$$h_{ijt} = \Pr\left[y_{ij} = t \mid y_{ij} \geq t, X_i j, Z_{ijt} \right] \quad (2)$$

where h_{ijt} is the hazard function given that students have not dropped out or attained a degree before *t*, and observable heterogeneity is measured by the set of time-invariant and -variant individual, institutional, and local labor market factors. Algebraically, assuming a logit link, the relationship in (2) can be written as:

$$\log_{ijt}\left(h_{ijt}\right) = \alpha + X'_{ij}\beta_{ij} + Z'_{ijt}\beta_{ijt} \quad (3)$$

In equation (3), by taking the log of the hazard, a linear relationship between the conditioning data and logit hazard has now been defined. The *X*s have been defined above and βs are parameters to be estimated. Taking an inverse transformation of both sides, the following equation is derived:

$$\log_{ijt}^{-1}\left(h_{ijt}\right) = \frac{1}{1+e^{-\left(\alpha + X'_{ij}\beta_{ij} + Z'_{ijt}\beta_{ijt}\right)}} \quad (4)$$

The relationship between the predictors and the hazard are now nonlinear and analogous to the usual logistic regression model (Singer and Willett, 2003).

Using a person-period data structure, the log-likelihood function can be computed using a standard logistic regression routine. Maximizing this function with respect to βs will provide consistent parameter estimates for whether and when an event occurs, as well as the effect of time-invariant and varying predictors. The analysis was conducted without population weights as recommended by Winship and Radbill (1994) and Muthén and Satorra (1995). Although the data are not weighted, the standard errors of the estimates are calculated using the Huber/White sandwich method; otherwise known as "robust" standard errors.[12]

The treatment of time is another feature worth explaining in greater detail. A fully flexible construction of time within the hazard function framework would include dummy variables for each period a student is enrolled and, hence, "at risk." This may be the ideal, but alternative constructs are acceptable if they closely mirror the shape of the fitted hazard probabilities. For both the persistence and attainment models, expressing time with a constant and a quadratic term largely captures the shape of the fully flexible construct.[13]

4. Discussion of findings

Descriptive characteristics of sample

The descriptive characteristics of the sample of first-time community college students in 1992 are shown in Table 1. A majority of the sample, 51 percent, is female, and 72 percent are White, non-Hispanic. There is an under-representation of Black, non-Hispanic students among those who dropped out without attaining a credential. These findings are consistent with previous research (Bailey et al., 2004), and provide some insights into the type of students who are most affected by changing in-state tuition costs and labor market conditions. Additionally, 71 percent of the students who initially enrolled in a community college expect to earn a bachelor's degree at some point and, not surprisingly, a greater proportion of degree-attainers in the sample reported having this educational expectation compared to drop outs, 73 versus 68 percent, respectively.

<< INSERT TABLE 1 HERE >>

The overall attainment rate of these students is 49 percent, which means that slightly more than half dropped out and did not return to postsecondary education at some point during the eight years. This finding lies near the upper end of the estimates previously reported by Horn and Berger (2004), who reported that 37 percent of first-time, community college students in the early 1990s completed any degree, and Adelman et al. (2003), who found that 54 percent of students who took more than 10 credits at a community college did not attain a degree.[14] Of those who attained any postsecondary credential, over half earned an associate's degree. Of the remaining degree attainers, 42 percent earned a bachelor's degree as their highest award and 7 percent earned a certificate, but unfortunately there are insufficient sample sizes to apply the attainment model to these two potential outcomes.

The conditional likelihood of community college students dropping out of postsecondary education is greatest in the first two years; nearly one-fifth of the sample did not return to postsecondary education after the first period (see Table 2). However, for all but the last two periods, the probability that community college students attained a postsecondary credential—conditional on making it to that particular period—is greater than the probability of dropping out. The expectation is of a degree "spike" in the second period, but with many students attending part-time or transferring to other institutions (mainly four-year colleges), the conditional probability is largely the same from the second to the sixth period while peaking in the third period. This trend reverses in the last two periods as the conditional likelihood of attaining a degree after the sixth period of enrollment decreases to a negligible amount compared to the conditional likelihood of dropping out.

<< INSERT TABLE 2 HERE >>

Results from estimation

The findings discussed in the remainder of this section focus specifically on the time-variant measures of in-state tuition (*direct* costs), average wage of the dominant industry in the local labor market (*opportunity* costs), and instances when the former outpaces the latter (*relative* costs). According to the results of the persistence model (Table 3), the average wage in the local labor market is not a significant predictor of dropping out of postsecondary education and, only for females, is in-state tuition a key determinant. The sign on this variable indicates that tuition increases have a negative effect on dropping out—a finding that, while statistically significant, is worth additional examination. The relative change measure is also insignificant, which suggests that the dropout process is more a function of individual characteristics (academic preparation and educational expectation) and presumably institutional influences than economic conditions. So what are the consequences of these findings on the results from the attainment models?

<< INSERT TABLE 3 HERE >>

Remaining enrolled in a community college has positive, although modest, benefits on the economic well-being of students, but the greatest economic gains are experienced by students who attain degrees, particularly bachelor's degrees (Kane and Rouse, 1999; Marcotte, Bailey, Borkoski, and Kienzl, 2005). Once again, the relationship is (theoretically) reciprocating—the labor market needs employees with the skills learned at the sub-baccalaureate level and students who complete such credentials are rewarded economically. But do wage shocks provide a strong enough incentive for community college students to complete? In short, tuition and local labor market conditions play a greater role in influencing whether community college students earn a postsecondary credential whether they drop out. In addition, the impact of tuition and labor market conditions affects females differently than males and associate's degree attainment quite differently than other educational outcomes.

Unlike in the persistence model, in-state tuition and average wage in the commuting zone affects community college students' attainment over time. However, the effect of each of the time-variant costs impacts males and females differently. The results from the overall attainment model (Table 4) suggest that increases in tuition slightly improve the degree attainment for females, whereas males in higher wage labor markets actually experience lower degree attainment than similar males in lower wage ones. In terms of the former, the direction of the effect—female students who enroll in a high tuition college are more likely than those who attend a lower cost institution to complete a postsecondary credential—runs counter to the prevailing wisdom (Cofer and Somers, 2000b; Hippensteel, St. John, and Starkey, 1996; St. John and Starkey, 1994).[15] This seemingly contrary finding can be explained, in part, as in-state tuition serving as a proxy for the expected economic payoff of earning a postsecondary credential.

<< INSERT TABLE 4 HERE >>

Additional insights into the decision-making process of community college students are generated from the associate's degree attainment model (Table 5). Although increases in tuition lower students' likelihood of attaining an associate's degree, if the change in tuition is greater than the change in wages, the combined effect is positive. Specifically, the estimated increase in odds for males is 48 percent and 65 percent for females.

<< INSERT TABLE 5 HERE >>

The larger effect of the relative cost variable in the associate's degree model compared to the overall attainment model suggests that students who pay more than the average cost to attend a community college have an incentive to complete. Another explanation is related to institutional quality. Community colleges that charge relatively higher in-state tuition presumably have greater resources to provide a wider range of programs and support services, such as academic and career counseling. This finding, however, should not be misconstrued as justification for raising tuition at community colleges because doing so will price out certain students, particularly those from lower socio-economic backgrounds.

5. Concluding remarks

Accounting for variations in the local economy is a crucial factor that can explain student persistence and attainment in higher education, but as the previous section showed, it is rarely examined. With constantly changing economic incentives, it is entirely conceivable that students are reevaluating their costs relative to the benefits after each year and some may even do so after each semester (Light, 1996; Stratton et al., 2005). The economic climate is especially important for community college students because such institutions are uniquely tied to local business and industry. Thus, time-dependent models of postsecondary enrollment and attainment with information on local labor market conditions that vary over time are necessary.

This study enhances the understanding of college persistence and attainment by examining how time-varying measures of direct and indirect costs affect the pursuit and completion of additional postsecondary education. To accomplish this, discrete-event behavioral models are developed and applied separately to explain the persistence and attainment processes of a cohort of first-time community college students. The economic conditions faced by community college students are measured using an innovative unit of geography, called *commuting zones*, in order to better understand how local labor characteristics influence the persistence and attainment processes of these students. The results confirm previous findings and call others into question.

The analysis suggests that community college students are not solely (and independently) looking at in-state tuition or wages in the local labor market when making re-enrollment decision. This is especially true for students on the path to an associate’s degree. The hypothesis that tuition and wage increases contributing positively to dropping out is not supported, as well as the expectation that relative costs (tuition increases outpacing wage gains) is a key factor in the drop out process. In fact, of those who remained enrolled, the evidence suggests that an increase in tuition appears to provide an incentive or extra motivation to finish a degree, especially an associate’s degree. Nevertheless, while increases in in-state tuition itself has a positive effect on degree completion, in general, and associate’s degree attainment, more specifically, such increases may adversely affect students from low socio-economic backgrounds who are less likely to persist and, thus, not attain a postsecondary credential.

Endnotes

[1] The 12 industries are: agriculture; mining; construction; manufacturing; transportation; wholesale trade; retail trade; finance, insurance, and real estate; service; federal government; state government; and local government.
[2] An opportunity cost can also be considered a "benefit." For this study, it may be helpful to view these costs as such.
[3] Community colleges are defined exclusively as public two-year postsecondary institutions. The two terms are used interchangeably.
[4] The term "traditional" defines students who do not delay enrollment from high school, attend full time while living on campus, and do not interrupt enrollment.
[5] For a review of how well these models apply to community college research, see Bailey and Alfonso (2005).
[6] Initial attendance was determined from the variable, REFINST, which identifies the true first institution based on students' postsecondary transcripts.
[7] The college delayers are expected—if they ever enroll in postsecondary education—to be even more adversely affected by changes in direct and indirect costs. Thus, the estimates reported in this study, which are based on a more traditional-aged college student, are likely to be lower than if the entire NELS:88/2000 sample was used. In other words, the true impact of direct and indirect costs on the sample of first-time community college students is underestimated.
[8] A comparison of the missing to nonmissing variables is available from the authors upon request.
[9] Another possible outcome—still enrolled in 2000 without attaining a degree—was considered. However, only a few students fell into this category and, thus, for the sake of simplicity, they were treated as drop outs. A censored term was added to the two models, but its inclusion does not change the overall findings and thus was omitted.
[10] Average in-state tuition was chosen as a measure of direct costs rather than the actual tuition charged by institutions due to the likelihood of multi-institutional enrollment patterns of community college students (Adelman, 2005). If community college students change institutions, however, they are likely to remain in-state. Therefore using the average public two-year tuition addresses this point (Rouse, 1995). Nevertheless, switching institutions can be considered a distinct process, but it is not the focus of this analysis.
[11] For additional examples of a person-period data structure, see Singer and Willett (2003) and Scott and Kennedy (2005).
[12] See Zeger and Liang (1986) for a thorough discussion of how to derive robust standard errors and Winship and Radbill (1994), Thomas and Heck (2001), and Thomas, Heck, and Bauer (2005) for discussions of their importance.
[13] Higher order terms were examined, such as cubic and quartic, but the models with only a constant and quartic term fit the data best as determined by a Wald chi-squared test. The results from this test are available from the authors upon request.
[14] Adelman et al. (2003) and the current analysis both used NELS:88/2000. However, this study did not place a similar restriction of earning more than 10 credits on the data, which explains why the estimates of the former are higher than those of the latter.
[15] Unlike the studies cited above, Dowd and Coury (2006) finds that tuition has a positive impact on persistence to the second year and associate's degree attainment over five years. However, it should be noted that none of the studies cited used in-state tuition in the same manner as the current analysis nor examined the same educational outcomes, which may partially explain the divergence from most of the findings in the literature.

References

Adelman, C. (1999). *Answers in the tool box: academic intensity, attendance patterns, and bachelor's degree attainment*. Washington, DC: Office of Educational Research and Improvement, U.S. Department of Education.

Adelman, C. (2004). *Principal indicators of student academic histories in postsecondary education, 1972-2000*. Washington, DC: Institute of Education Sciences, U.S. Department of Education.

Adelman, C. (2005). *Moving into town-and moving on: The community college in the lives of traditional-age students*. Washington, DC: Office of Vocational and Adult Education, U.S. Department of Education

Adelman, C., Daniel, B., and Berkovits, I. (2003). *Postsecondary attainment, attendance, curriculum, and performance: Selected results from the NELS:88/2000 Postsecondary Education Transcript Study (PETS)*. Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Allen, D. (1999). Desire to finish college: An empirical link between motivation and persistence. *Research in Higher Education,* 40(4), 461-485.

Allison, P.D. (1984). *Event history analysis: Regression for longitudinal event data*. (Quantitative Applications in the Social Sciences Series paper 46). Thousand Oaks, CA: Sage University Publications.

Bailey, T.R., and Alfonso, M. (2005). Paths to persistence: An analysis of research on program effectiveness at community colleges. *Lumina Foundation for Education New Agenda Series,* 6(1).

Bailey, T.R., Leinbach, D.T., Scott, M., Alfonso, M., Kienzl, G.S., and Kennedy, B. (2004). *The characteristics of occupational sub-baccalaureate students entering the new millennium*. New York, NY: Community College Research Center, Teachers College, Columbia University.

Becker, G. (1967). *Human capital and the personal distribution of income: An analytical approach*. Ann Arbor, MI: University of Michigan Press.

Betts, J.R., and McFarland, L.L. (1995). Safe port in a storm: The impact of labor market conditions on community college enrollments. *Journal of Human Resources*, 30(4), 741-765.

Cabrera, A.F., Nora, A., and Castaneda, M.B. (1992). The role of finances in the persistence process: A structural model. *Research in Higher Education*, 33(5), 571-593.

Cofer, J., and Somers, P. (2000a). A comparison of the influence of debtload on the persistence of students at public and private colleges. *Journal of Student Financial Aid*, 30(2), 39-58.

Cofer, J., and Somers, P. (2000b). Within-year persistence of students at two-year colleges, *Community College Journal of Research and Practice*, 24(10), 785-807.

DesJardins, S.L., Ahlburg, D.A., and McCall, B.P. (2002). Simulating the longitudinal effects of changes in financial aid on student departure from college. *The Journal of Human Resources*, 37(3), 653-679.

Dowd, A.C., and Coury, T. (2006). The effect of loans on the persistence and attainment of community college students. *Research in Higher Education*, 47(1), 33-62.

Grubb, W.N. (2002). Learning and earning in the middle, part I: National studies of pre-baccalaureate education. *Economics of Education Review*, 21(4), 299-321.

Grubb, W.N., and associates. (1999). *Honored but invisible: An inside look at teaching in community colleges.* New York, NY: Routledge.

Hippensteel, D.G., St. John, E.P., and Starkey, J.B. (1996). Influence of tuition and student aid on within-year persistence by adults in two-year colleges. *Community College Journal of Research and Practice*, 20(3), 233-242.

Horn, L., and Berger, R. (2004). *College persistence on the rise? Changes in 5-year degree completion and postsecondary persistence rates between 1994 and 2000*. (NCES 2005-156). Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Horn, L., and Nevill, S. (2006). *Profile of undergraduates in U.S. postsecondary education institutions: 2003–04, with a special analysis of community college students* (NCES 2006-184). Washington, DC: National Center for Education Statistics, U.S. Department of Education.

Kane, T.J., and Rouse, C.E. (1999). The community college: Educating students at the margin between college and work. *Journal of Economic Perspectives*, 13(1), 63-84.

Light, A. (1996). Hazard model estimates of the decision to reenroll in school. *Labour Economics, 2*(4), 381-406.

Marcotte, D., Bailey, T.R., Borkoski, C., and Kienzl, G.S. (2005). The returns to education at community colleges: Evidence from the National Education Longitudinal Survey. *Education Evaluation and Policy Analysis*, 27(2), 157-175.

Mincer, J. (1974). *Schooling, experience and earnings*. New York, N.Y.: Columbia University Press.

Muthén, B.O., and Satorra, A. (1995). Complex sample data in structural equation modeling. *Sociological Methodology*, 25, 267-316.

Napoli, A.R., and Wortman, P.M. (1998). Psychosocial factors related to retention and early departure of two-year community college students. *Research in Higher Education*, 39(4), 419-455.

Pascarella, E.T., and Terenzini, P.T. (2005). *How college affects students: Volume 2: A third decade of research*. San Francisco, CA: Jossey-Bass.

Rouse, C.E. (1995). Democratization or diversion? The effect of community colleges on educational attainment. *Journal of Business and Economic Statistics*, 13(2), 217-224.

Schneider, B., and Stevenson, D. (1999). *The ambitious generation: America's teenagers, motivated but directionless*. New Haven, CT: Yale University Press.

Scott, M., and Kennedy, B. (2005). Pitfalls in pathways: Some perspectives on competing risks event history analysis in education research. *Journal of Educational and Behavioral Statistics*, 30(4).

Singer, J.D., and Willett, J.B. (2003). *Applied longitudinal data analysis: Modeling change and event occurrence.* New York, NY: Oxford University Press.

St. John, E.P., and Starkey, J.B. (1994). The influence of costs on persistence by traditional college-age students in community colleges. *Community College Journal of Research and Practice*, 18(2), 201-213.

Stratton, L., O'Toole, D., and Wetzel, J. (2005). *A multinomial logit model of college stopout and dropout behavior* (Discussion paper 1634). Bonn, Germany: IZA.

Thomas, S.L., and Heck, R.H. (2001). Analysis of large-scale secondary data in higher education research: Potential perils associated with complex sampling designs. *Research in Higher Education*, 42(5), 517-540.

Thomas, S.L., Heck, R.H., and Bauer, K.W. (2005). Weighting and adjusting for design effects in secondary data analyses. *New Directions for Institutional Research*, 127, 51-72.

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition*. Chicago, IL: University of Chicago Press.

Tolbert, C.M., and Sizer, M. (1996). *U.S. commuting zones and labor market areas: A 1990 update.* Washington, DC: Economic Research Service, U.S. Department of Agriculture.

Winship, C., and Radbill, L. (1994). Sampling weights and regression analysis. *Sociological Methods and Research*, 23(2), 230-257.

Zeger, S.L., and Liang, K-Y. (1986). Longitudinal data analysis for discrete and continuous outcomes. *Biometrics*, 42(1), 121-130.

Exhibit 1. Example of person-period data structure, time-variant characteristics, and education outcomes

		Time-variant characteristics			Outcomes		
ID	Period enrolled	In-state tuition (x1,000 in 2000 dollars)	Average wage in commuting zone (x1,000 in 2000 dollars)	Rate of tuition increase greater than commuting zone wage	Dropped out of postsecondary education	Attained a degree at any point	Attained an associate's degree
1	1	1.253	34.453	0	0	0	0
1	2	1.322	34.304	1	0	0	0
1	3	1.331	34.372	1	0	0	0
1	6	2.514	24.966	0	0	0	0
1	7	2.224	30.814	0	0	1	0
2	1	1.709	28.563	0	0	0	0
2	2	1.814	28.665	1	0	0	0
2	3	1.876	28.987	1	0	0	0
2	4	2.004	29.397	1	0	1	1
3	1	2.333	23.914	1	0	0	0
3	2	2.419	23.597	1	0	0	0
3	3	2.416	24.056	0	0	1	0
4	1	1.477	19.571	1	0	0	0
4	2	1.582	19.586	1	0	0	0
4	3	1.602	19.597	1	0	0	0
4	4	1.667	29.026	1	0	0	0
4	7	1.750	30.805	1	0	0	0
4	8	1.784	31.927	0	0	0	0
4	9	1.739	32.293	0	1	0	0
5	1	2.027	30.757	0	0	0	0
5	2	2.165	30.580	1	0	0	0
5	3	2.192	30.821	1	0	0	0
5	4	2.238	31.227	1	1	0	0
6	1	0.975	22.572	0	0	0	0
6	2	1.121	22.245	1	0	0	0
6	3	1.214	20.198	1	0	0	0
6	4	1.228	20.334	1	0	0	0
6	5	1.295	20.632	1	0	0	0
6	7	1.277	23.762	0	0	1	1

Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.

Figure 1. Depiction of commuting zones in the United States, 1990

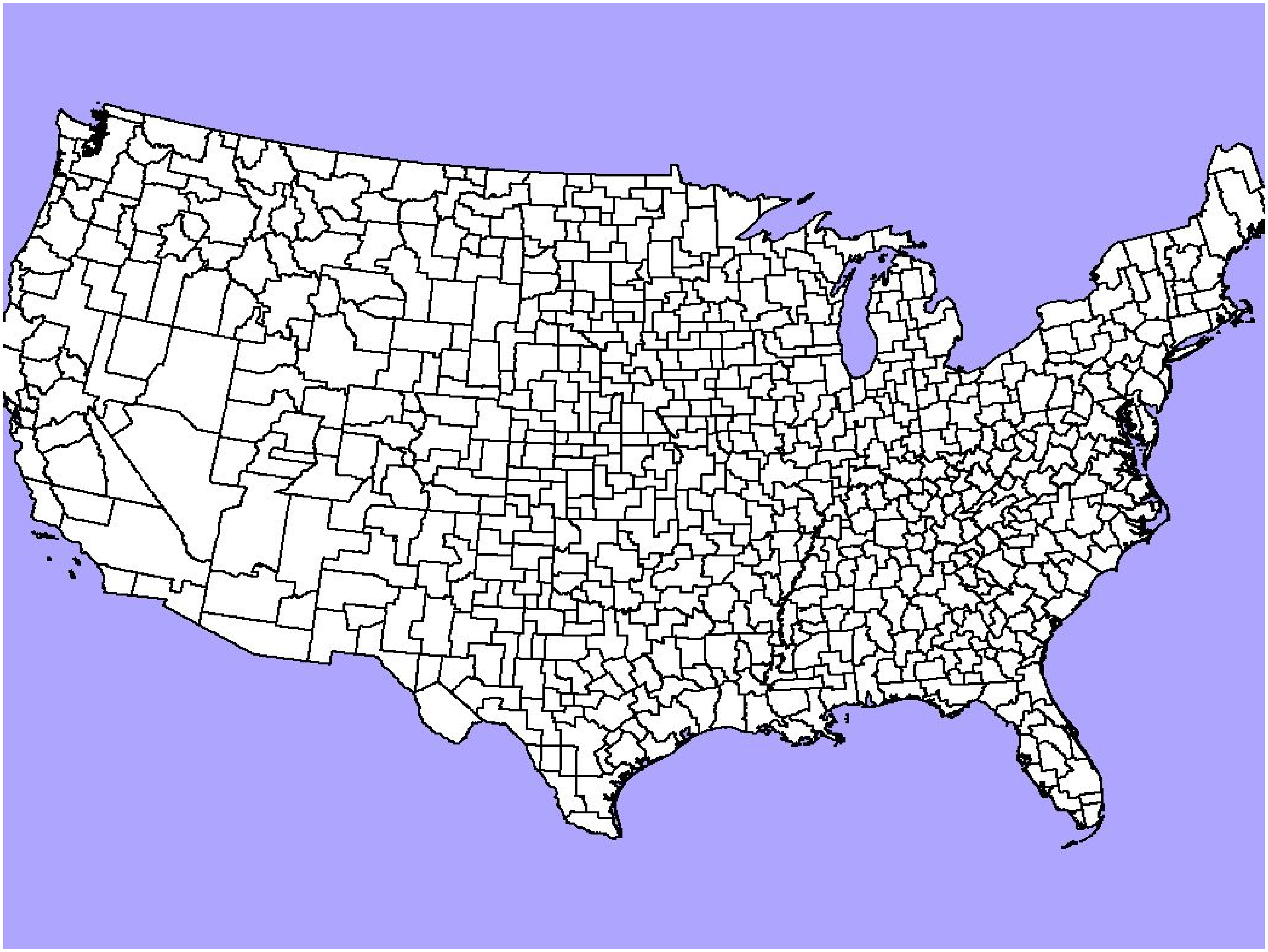

Table 1. Descriptive statistics of community college students and local labor market characteristics by persistence and attainment processes

	Overall		Dropped out		Attained degree	
Outcome	Mean	Std dev	Mean	Std dev	Mean	Std dev
Dropped out of postsecondary education	49.5%					
Attained a degree at any point	50.5%					
Certificate as highest attainment	3.6%				7.1%	
Associate's degree as highest attainment	25.6%				50.5%	
Bachelor's degree as highest attainment	21.5%				42.4%	
Background characteristics						
Female	51.3%		47.8%		54.6%	
White, non-Hispanic [*ref*]	71.8%		65.7%		77.8%	
Black, non-Hispanic	5.4%		7.1%		3.8%	
Hispanic	14.2%		17.6%		10.8%	
Other[1]	8.6%		9.6%		7.6%	
12th grade reading test score	0.506	0.08	0.499	0.09	0.512	0.08
12th grade math test score	0.510	0.08	0.497	0.08	0.522	0.08
Lowest SES quartile	33.0%		35.0%		31.0%	
Middle SES quartile [*ref*]	56.4%		55.0%		57.8%	
Highest SES quartile	10.6%		10.0%		11.2%	
Expects to earn a BA	70.6%		67.7%		73.4%	
Time-varying labor market characteristics						
In-state tuition (x1,000 in 2000 dollars)	2.272	2.38	1.987	2.01	2.551	2.67
Average wage in commuting zone (x1,000 in 2000 dollars)	26.035	7.41	26.373	7.50	25.704	0.73
Rate of tuition increase greater than commuting zone wage	45.3%		41.6%		48.9%	
Number of observations	4,280		2,092		2,188	
Number of individuals	1,356		640		716	

[1] Other includes individuals from Asian/Pacific Islander and Native American backgrounds.

Note: Data are unweighted.

Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.

Table 2. Distribution of events by period

Period when event occurred	Enrolled	Dropped out	Attained degree
Period 1	100.0%	18.6%	1.6%
Period 2	77.6%	15.9%	15.5%
Period 3	59.1%	10.1%	24.0%
Period 4	43.4%	8.1%	14.9%
Period 5	33.6%	10.4%	15.4%
Period 6	24.8%	7.8%	13.7%
Period 7	18.3%	6.8%	8.9%
Period 8	14.9%	13.9%	5.4%
Period 9	5.1%	8.3%	0.7%

Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.

Table 3. Regression results of persistence process with time-invariant and -variant characteristics by gender

	Dropped out					
	Overall		Male		Female	
Time-invariant variables	Coef. (se)	Odds ratio (se)	Coef. (se)	Odds ratio (se)	Coef. (se)	Odds ratio (se)
Period enrolled	-0.497***	0.608***	-0.431***	0.650***	-0.552***	0.576***
	(0.09)	(0.05)	(0.13)	(0.08)	(0.12)	(0.07)
Period enrolled^2	0.089***	1.094***	0.085***	1.088***	0.094***	1.099***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Female	-0.034	0.966				
	(0.1)	(0.1)				
Black, non-Hispanic	0.03	1.031	0.073	1.076	0.036	1.037
	(0.2)	(0.21)	(0.32)	(0.34)	(0.26)	(0.27)
Hispanic	-0.015	0.985	-0.219	0.803	0.159	1.172
	(0.14)	(0.14)	(0.22)	(0.17)	(0.2)	(0.24)
Other[1]	-0.21	0.811	-0.182	0.833	-0.241	0.786
	(0.2)	(0.16)	(0.27)	(0.22)	(0.29)	(0.23)
12th grade reading test score	0.638	1.892	0.746	2.109	0.662	1.938
	(0.73)	(1.39)	(1.04)	(2.19)	(1.04)	(2.01)
12th grade math test score	-3.787***	0.023***	-3.276***	0.038***	-4.473***	0.011***
	(0.78)	(0.02)	(1.13)	(0.04)	(1.07)	(0.01)
Lowest SES quartile	-0.01	0.99	0.181	1.198	-0.183	0.832
	(0.11)	(0.11)	(0.17)	(0.2)	(0.15)	(0.12)
Highest SES quartile	-0.223	0.8	-0.125	0.883	-0.397	0.672
	(0.18)	(0.14)	(0.21)	(0.18)	(0.33)	(0.22)
Expects to earn a BA	-0.513***	0.599***	-0.446***	0.640***	-0.596***	0.551***
	(0.11)	(0.07)	(0.16)	(0.1)	(0.16)	(0.09)
Time-variant variables						
In-state tuition (x1,000 in 2000 dollars)	-0.021	0.979	0.024	1.024	-0.080**	0.923**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Average wage in commuting zone (x10,000 in 2000 dollars)	-0.094	0.91	-0.085	0.919	-0.133	0.875
	(0.07)	(0.06)	(0.09)	(0.09)	(0.09)	(0.08)
Rate of tuition increase greater than commuting zone wage	0.115	1.122	0.157	1.17	0.098	1.103
	(0.11)	(0.12)	(0.15)	(0.18)	(0.15)	(0.16)
Number of observations	4,280	4,280	2,092	2,092	2,188	2,188
Number of individuals	1,356	1,356	640	640	716	716

[1] Other includes individuals from Asian/Pacific Islander and Native American backgrounds.
Note: Data are unweighted.
Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.

Table 4. Regression results of attainment process with time-invariant and -variant characteristics by gender

	Attained any degree					
	Overall		Male		Female	
Time-invariant variables	Coef. (se)	Odds ratio (se)	Coef. (se)	Odds ratio (se)	Coef. (se)	Odds ratio (se)
Period enrolled	1.336***	3.804***	1.389***	4.011***	1.307***	3.694***
	(0.1)	(0.37)	(0.14)	(0.58)	(0.13)	(0.49)
Period enrolled^2	-0.116***	0.890***	-0.126***	0.882***	-0.110***	0.895***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)
Female	0.351***	1.421***				
	(0.1)	(0.14)				
Black, non-Hispanic	-0.433*	0.649*	-0.739*	0.478*	-0.229	0.795
	(0.24)	(0.16)	(0.4)	(0.19)	(0.31)	(0.25)
Hispanic	-0.565***	0.569***	-0.742***	0.476***	-0.466**	0.627**
	(0.15)	(0.08)	(0.23)	(0.11)	(0.2)	(0.13)
Other[1]	-0.602***	0.548***	-0.579**	0.560**	-0.720***	0.487***
	(0.18)	(0.1)	(0.26)	(0.14)	(0.26)	(0.13)
12th grade reading test score	-0.849	0.428	-1.353	0.259	-0.355	0.701
	(0.69)	(0.3)	(0.98)	(0.25)	(0.97)	(0.68)
12th grade math test score	2.635***	13.944***	1.63	5.103	3.571***	35.552***
	(0.77)	(10.76)	(1.12)	(5.71)	(1.05)	(37.19)
Lowest SES quartile	0.044	1.045	0.046	1.047	0.08	1.083
	(0.1)	(0.11)	(0.16)	(0.17)	(0.14)	(0.15)
Highest SES quartile	-0.009	0.991	-0.131	0.877	0.204	1.226
	(0.15)	(0.15)	(0.2)	(0.18)	(0.24)	(0.3)
Expects to earn a BA	-0.250**	0.779**	-0.218	0.804	-0.309**	0.734**
	(0.11)	(0.08)	(0.16)	(0.13)	(0.16)	(0.11)
Time-variant variables						
In-state tuition (x1,000 in 2000 dollars)	0.028*	1.029*	0.001	1.001	0.046**	1.047**
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Average wage in commuting zone (x10,000 in 2000 dollars)	-0.148**	0.862**	-0.216**	0.806**	-0.079	0.924
	(0.07)	(0.06)	(0.1)	(0.08)	(0.1)	(0.09)
Rate of tuition increase greater than commuting zone wage	0.220**	1.246**	0.207	1.23	0.232	1.262
	(0.11)	(0.13)	(0.16)	(0.2)	(0.14)	(0.18)
Number of observations	4,280	4,280	2,092	2,092	2,188	2,188
Number of individuals	1,356	1,356	640	640	716	716

[1] Other includes individuals from Asian/Pacific Islander and Native American backgrounds.
Note: Data are unweighted.
Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.

Table 5. Regression results of associate's degree attainment process with time-invariant and -variant characteristics by gender

	Attained associate's degree					
	Overall		Male		Female	
	Coef.	Odds ratio	Coef.	Odds ratio	Coef.	Odds ratio
Time-invariant variables	(se)	(se)	(se)	(se)	(se)	(se)
Period enrolled	1.339***	3.817***	1.702***	5.484***	1.259***	3.523***
	(0.15)	(0.56)	(0.31)	(1.72)	(0.17)	(0.61)
Period enrolled^2	-0.139***	0.870***	-0.206***	0.814***	-0.119***	0.888***
	(0.02)	(0.02)	(0.05)	(0.04)	(0.02)	(0.02)
Female	0.487***	1.627***				
	(0.13)	(0.21)				
Black, non-Hispanic	-0.108	0.898	-0.314	0.731	0.043	1.044
	(0.28)	(0.26)	(0.54)	(0.39)	(0.34)	(0.36)
Hispanic	-0.787***	0.455***	-0.776**	0.460**	-0.855***	0.425***
	(0.21)	(0.1)	(0.34)	(0.16)	(0.29)	(0.13)
Other[1]	-0.634***	0.530***	-0.581	0.559	-0.726**	0.484**
	(0.24)	(0.13)	(0.37)	(0.21)	(0.32)	(0.15)
12th grade reading test score	-0.219	0.804	-0.035	0.966	-0.547	0.579
	(0.92)	(0.74)	(1.37)	(1.32)	(1.23)	(0.71)
12th grade math test score	3.278***	26.518***	2.347	10.454	4.151***	63.525***
	(1.02)	(27.16)	(1.62)	(16.97)	(1.3)	(82.48)
Lowest SES quartile	-0.02	0.98	-0.229	0.795	0.106	1.112
	(0.13)	(0.13)	(0.23)	(0.18)	(0.17)	(0.19)
Highest SES quartile	-0.158	0.854	-0.464	0.628	0.254	1.29
	(0.22)	(0.19)	(0.3)	(0.19)	(0.33)	(0.42)
Expects to earn a BA	-0.383***	0.682***	-0.371*	0.690*	-0.414**	0.661**
	(0.13)	(0.09)	(0.2)	(0.14)	(0.18)	(0.12)
Time-variant variables						
In-state tuition (x1,000 in 2000 dollars)	-0.156***	0.856***	-0.109***	0.897***	-0.195***	0.823***
	(0.04)	(0.03)	(0.04)	(0.03)	(0.06)	(0.05)
Average wage in commuting zone (x10,000 in 2000 dollars)	-0.024	0.976	-0.107	0.898	0.057	1.058
	(0.09)	(0.09)	(0.14)	(0.12)	(0.12)	(0.13)
Rate of tuition increase greater than commuting zone wage	0.461***	1.585***	0.383*	1.467*	0.502***	1.652***
	(0.13)	(0.21)	(0.21)	(0.3)	(0.17)	(0.28)
Number of observations	4,280	4,280	2,092	2,092	2,188	2,188
Number of individuals	1,356	1,356	640	640	716	716

[1] Other includes individuals from Asian/Pacific Islander and Native American backgrounds.
Note: Data are unweighted.
Source: National Education Longitudinal Survey:88/2000, Integrated Postsecondary Education Data System, and Current Employment Survey, various years.