The Causal Effect of Campus Residency on College Student Retention

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ABSTRACT

Despite theoretical evidence positing a positive relationship between campus residency and collegiate outcomes, prior research has not established a causal link. Utilizing propensity score matching and national longitudinal data, this study investigates whether living in university-owned housing impacts retention. The results suggest that the impact of living on campus is not negligible: the probability of remaining enrolled into the second year of college is 3.3 percentage points higher for on-campus residents than off-campus residents. Colleges should consider evaluating the impact of their campus housing programs on academic outcomes to inform important housing policy decisions.

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Housing and residence life administrators at colleges and universities across the country, as demonstrated through campus housing promotional materials, claim that living in university-owned facilities improves students' academic outcomes. Extant empirical research provides little causal evidence to back up these claims. If living on campus increases student retention, then students who do not live on campus may be at a disadvantage. Many first-year students cannot live on campus due to housing shortages. Students who make late decisions to attend college, particularly low-income students who delay registration due to financial constraints, may not have the opportunity to reside on campus. To estimate the extent to which this situation constitutes a lost opportunity, this study utilizes quasi-experimental methods to estimate the causal impact of campus residency on college retention.

SOCIAL SUPPORT, NETWORKS, AND INTEGRATION

On-campus residents may receive opportunities for social support, resources, and integration into the campus community that give them an advantage over students living off campus. Because living on campus implies greater interaction with peers, who experience similar stressors, campus residency may facilitate increased social support. Social support is directly beneficial and acts as a buffer protecting students from the impact of external stressors (Cohen & Willis, 1985). Psychological stresses, including loneliness, isolation, and anxiety, are correlated with dropping out (Ting, 2000). Residential life activities may combat the sense of isolation that new students experience by dividing the campus into smaller, more knowable communities (Tinto, 1993).

Campus residents may also have access to additional resources that aid students' ability to navigate through college procedures, such as a network of resident advisors and staff members. Through living on campus, students experience constant interaction with campus staff and other students with whom they exchange information about classes, the registration process, college requirements, and financial aid. Overall, living on campus may keep students “in the know” by providing a network through which they can gain information necessary for retention.

Increased social support and access to resources may encourage further integration into campus life. Vincent Tinto has been one of the most prominent supporters of the notion that integration into the campus community is an important predictor of retention. In Tinto’s (1993) Student Departure Model, the decision to stay at or leave college is a function of the student’s personal and academic background and how well he or she integrates into the academic and social life of the campus. By becoming more involved in the campus community, students learn to effectively live in the college environment. Additional research supports his theory by suggesting that integration and involvement in the college experience are positively associated with degree completion (Allen & Haniff, 1991; Astin, 1993; Pascarella, 1985). More recent studies continue to develop the concept of student engagement by including measures of interactions between student behaviors and perceptions (Milem & Berger, 1997), “psychosocial engagement,” defined as the energy students invest in their social interactions (Braxton, Hirschy, & McClendon, 2004), and the practices and conditions of institutions in addition to the behaviors of students (Kuh, Cruce, Shoup, Kinzie, & Gonyea, 2008). The growing literature also explores the role of campus diversity and climate in student engagement as well as differential degrees of integration and feelings of belonging across subgroups (Hausmann, Schofield, & Woods, 2007; Locks, Hurtado, Bowman, & Oseguera, 2008).

Despite the potential benefits of living on campus, it is important to consider that not all influences of the campus community are positive. Campuses where alcohol consumption is regarded as normative behavior may encourage heavy drinking among campus residents, which is correlated with less favorable academic outcomes (Perkins & Berkowitz, 1986). Furthermore, living among peers who participate in consumptive or self-indulgent behavior, such as purchasing new clothing, electronic equipment, or frequently eating out, may promote overspending. This pattern can cause hardship for students with less financial flexibility, which may also be negatively associated with retention. Overall, living on campus may influence student retention through multiple mechanisms, many of which, but not all, are positive.

Researchers have used a number of techniques to investigate the relationship between student engagement and retention. Many studies employ multivariate persistence models to estimate the role of several factors in student retention. Berger and Milem (1999) employed seven sets of independent variables, including background characteristics and behavioral and perceptual measures of campus integration, to test the effect of student involvement and students' perception of involvement on persistence into the second year of college. Kuh et al. (2008) included a dummy variable for students' housing situations as part of their student persistence models and found a significant relationship between student housing status and both first-year GPA and student persistence into the second year. This study combines the use of multivariate models with causal inference by utilizing propensity score matching (PSM) in addition to a series of logistic regression models.

PREVIOUS RESEARCH: SORTING THROUGH THE EVIDENCE

Housing and residence life departments assert the benefits of living on campus but often fail to assess how well such housing arrangements achieve these objectives. In some cases, institutional offices rely on internal analyses to demonstrate that housing is indeed an important key to college success. One example is Huhn's (2006) analysis of the "housing effect" on first-year outcomes at the University of Wisconsin-Madison. After comparing descriptive statistics from students living on and off campus, she found that freshmen who lived in university housing were more likely to achieve above average GPAs and to remain enrolled into the second year. However, Huhn acknowledged that the freshmen who were academically best prepared, as measured by ACT scores, were the most likely to live in campus housing while the least prepared were the most likely to live off campus. In other words, students living on and off campus differed from the outset of the study, making these comparisons less convincing. The choice to live at home instead of on campus may reflect different financial situations, family structures, and levels of college preparedness associated with poorer college outcomes (Turley, 2006). While some of these differences may be observable, and thus controlled through statistical modeling, others are not.

The fact that students self-select into living on or off campus makes it more challenging to compare campus residents to non-residents. In an observational study, investigators cannot control the treatment assignment, making direct comparisons of outcomes from the treatment groups misleading (D'Agostino, 1998). To date, I am unaware of any studies of campus residency that appropriately deal with this selection issue through the use of quasi-experimental methods.

Instead, the majority of previous studies make an effort to respond to the dearth of knowledge about the effects of campus housing on student success through comparisons of campus residents and non-residents. For instance, Chickering and Kuper (1971) used findings from the Project on Student Development in Small Colleges and studies by the Office of Research of the American Council on Education to provide information about the effect of campus housing and commuting on the nature of students' college experiences. The authors speculate that the initial difference between residents and commuters is the discrepancy between the "haves and the have-nots" (Chickering & Kuper, 1971, p. 257). Over time, residents encounter a range of new conditions, experiences, and people who impact their beliefs, attitudes, and participation in college (Chickering & Kuper, 1971). While the findings show little difference between commuters and residents in frequency of faculty contact, sharp differences in extracurricular activity and peer relationships were observed. Residents' participation drastically exceeded that of commuters. It is difficult to know if these differences reflect preexisting variation.

Levin and Clowes (1982) used the National Longitudinal Study of the High School Class of 1972 (NLS). They narrowed their sample to only students who planned to attend graduate school to ensure that the students had uniform aspirations. This was one of few attempts to control for pre-treatment differences between students living on and off campus. They found that, of students living in college-owned facilities, 66% received their baccalaureate in four years, compared to 55% of their peers who lived at home with their parents (Levin & Clowes, 1982, p. 102). Housing may facilitate integration into the college community, encouraging the higher rate of degree completion that Levin and Clowes observed. Residents may be more likely to form an attachment to undergraduate life, as they spend all their time on the college campus (Astin, Green, Korn, & Maier, 1984). In Astin's (1993) "What Matters in College" four-year study, his findings suggest that student involvement in college, including energy devoted to the "college experience," affects both learning and personal development.

Additional research suggests that living on campus improves academic outcomes for all students but has the greatest impact on students taking remedial coursework ("developmental" students). In Thompson, Samiratedu, and Rafter's (1993) study of first-time freshmen at a southeastern public university, development students living on campus earned higher GPAs than their off-campus developmental peers, supporting the notion that high-risk students might benefit more than others from living on campus (p. 45). However, the authors acknowledge that more highly motivated students tend to apply for admission earlier and are therefore more likely to be placed in the limited on-campus housing facilities, but they fail to address the issue methodologically.

Turley and Wodtke (2010) conducted a recent study of campus residency utilizing fixed-effects regression analyses. Holding institutional factors constant, they find that the effect of residence on achievement varies by race and college-type. GPAs of White students are similar irrespective of housing status. However, Black students who live on campus, particularly at liberal arts schools, maintain higher GPAs than those living off campus with family. This pattern may be because living off campus with family is associated with increased family responsibilities, fewer resources, and inadequate transportation (Turley & Wodtke, 2010).

Although campus residency is frequently associated with improved academic outcomes, research overall shows little consistent impact of residency because the observed effects vary by group and in magnitude. Blimling (1989) conducted a meta-analysis to integrate and summarize the empirical research from 1966 through 1987 regarding the influence of college residence halls on academic performance. Results indicate that residence halls do not generally exert a major influence on students' academic performance. However, causality has yet to be rigorously tested, as no previous study appropriately deals with self-selection into campus housing.

To expand existing research and attend to the need of methodologically addressing the selection issue, I employ propensity score matching (PSM) and regression analyses.

DATA

Most previous studies used data from a sample of students restricted to one college, generally large public research universities, to study the effect of on-campus housing (Blimling, 1989). Focusing on single institutions prevents any analysis of institutional differences on the impact of campus residency (Turley & Wodtke, 2010). This study employs the most recent cohort of the Educational Longitudinal Study (ELS: 2002) to obtain students' pre-college details and the Integrated Postsecondary Education Data System (IPEDS: 2003-2004 & 2004-2005) to gather institutional variables. The merging of these two datasets provides the most up-to-date cohort information relevant to current housing experiences. The ELS is ideal for conducting propensity score matching (PSM) because it is a rich dataset, providing vast pre-college information on the students.

Both the ELS and the IPEDS are conducted by the US Department of Education. The ELS: 2002 is a national longitudinal study that currently includes three waves: the base year in 2002 when students were tenth-graders, the first-follow-up in 2004 when students continuing through their high school career were seniors, and the second follow-up in 2006 when students who went straight into postsecondary schooling were in the spring semester of their second year of college. In the base year, random selection was used to obtain a representative sample of high school sophomores; and in the first follow-up, the sample was "freshened" (National Center for Education Statistics [NCES], 2009a). Therefore, the basis of the second follow-up sampling frame was the sample of students selected in the base year when they were tenth graders in 2002 combined with the sample of freshened students who were 12th graders in 2004 (Ingels et al., 2007).

The ELS consists of information obtained from student questionnaires, transcripts, and federal Free Applications For Student Aid forms (FAFSAs), including college enrollment information through spring 2006 collected in the 2006 second follow-up. The IPEDS gathers institutional information from every college, university, and technical and vocational postsecondary school that participates in federal student financial aid programs (NCES, 2009b).

Due to the availability of ELS data up to spring 2006, it was necessary to include only students who began college in fall 2004 because the second follow-up extends into the second year for students who went straight from high school into college. The sample is representative of students entering college in the fall of 2004 who had been enrolled in high school as tenth graders in 2002 or who had been enrolled as 12th graders in 2004. I eliminated students at colleges that do not offer housing and those at colleges requiring them to live on campus. This winnowing restricted the final sample to mostly four-year colleges, as many two-year colleges do not offer campus housing--which has the unfortunate effect of truncating the SES distribution. However, since the population of interest is students who have the choice of living on or off campus, it was necessary to eliminate students who lack the option. Part-time students, married students, or students with children are unlikely to live on campus and are more likely to systematically differ from full-time college students. For these reasons, I eliminated them from the final sample. I also eliminated students who did not include information on their enrollment and housing status and those who were missing more than 40%

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1. According to Royston (2004), there is no firm rule available to determine the proportion of missing observations at which multiple imputation is no longer reliable. The assumption that data are missing at random (MAR) requires that none of the variables have missing scores related to the values of the variable itself after controlling for other variables. This assumption is difficult to check, yet multiple imputation can give valid results only if the MAR assumption is legitimate (Royston, 2004). My decision to include only cases containing 60% of the variables is based on my observation that cases missing more than 40% of observations missed similar pre-treatment variables, including high school GPA, credits taken in English, math, science, and AP courses, as well as total credits taken (all transcript information). Systematic bias seemed plausible, challenging MAR. For this reason, I eliminated 17 cases from the sample.

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of the variables. The final analytic sample includes 3,408 students, with 2,249 living on campus and 1,159 living off campus. The control group includes both students living at home and students living elsewhere off campus. Due to the small number of students living off campus but not at home, a separate analysis of these students was not possible. To ensure that the control group was not sensitive to the inclusion of students living elsewhere off campus, I conducted a separate analysis of only the students living at home in the control group. This analysis yielded comparable results to the main analysis.

In most large-scale national datasets, missing data are unavoidable due to the sheer volume of cases and variables. For this reason, it was necessary to perform multiple imputation (MI).

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2. I elected to use multiple imputation over a more traditional method like listwise deletion. The use of listwise deletion, which drops subjects that are missing data on any variable used in the analyses, would have decreased the sample from 3,408 to 2,342. Listwise deletion requires data to be "missing completely at random" (MCAR), which means that missing observations are unrelated to the values of the variable itself (Allison, 2001). Listwise deletion would produce a random subsample of students if the missing values were truly MCAR. Otherwise, the subsample would be biased, which would most likely have inflated effects on matching because results depend on the subjects in the sample available for matching and the traits they exhibit. Therefore, to preserve the sample and to avoid making an invalid assumption required by listwise deletion, I used MI to deal with missing values. Unfortunately, it also seems unlikely that listwise deletion would be a reliable check for whether the final results are sensitive to the use of MI. Therefore, to make MI's MAR assumption more tolerable, I took other steps (see note 3) to avoid utilizing variables or subjects that might violate this assumption.

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MI relies on the assumption that the data are missing at random (MAR), meaning that non-response probabilities do not depend on any unobserved information (van Buuren, Boshuizen, & Knook, 1999, p. 682). Imputation using Chained Equations (ICE), a MI approach and program in Stata, mitigates this assumption by creating a small number, m, of completed copies of the data set in which missing observations are replaced by plausible values instead of assuming one "true" response model (Royston, 2005; van Buuren, Boshuizen, & Knook, 1999). The conservative choice of m = 5 ensures greater precision of the estimated regression coefficients (Rubin, 1987). To further ensure precision of estimates, I eliminated the continuous income variable (used for the descriptive statistics), which had a large percentage of missing observations. An increased proportion of missing observations in a given variable is accompanied by diminished reliability of estimates relating to that variable, increasing unknown bias (Royston, 2004, p. 240). Royston selected 50% as the threshold beyond which he chooses not to imput missing values. I selected 40% because the income variable is important in determining both a student's decision to live in housing and his or her chances of retention, and I hope to maintain as reliable an estimate as possible.

In the regression and propensity score matching (PSM) analyses, I replaced the continuous income values reported in the Free Application For Student Aid (FAFSA) with a composite parent income variable from survey data. Although the FAFSA information would be ideal, it was not useful for the analyses.

In obtaining descriptive statistics, I used a sampling weight provided by the ELS with the Stata svy command to correct standard errors. I then selected a cross-sectional weight for students who responded in the second follow-up and had transcript information to eliminate any bias that might result from students' self-reports of their GPA.

The appendix presents a description and coding of all variables (dependent and independent) used in each analysis. I used enrollment information from the second follow-up to create a dummy variable indicating student retention into the second year of college, the dependent variable. The ELS included information stating whether the student was enrolled in college during each month between January 2004 and August 2006. To be considered "retained," students must remain enrolled throughout fall semester of 2004 (September through December of 2004), spring semester of 2005 (January through May of 2005), and then must re-enroll in the fall of 2005 (September of 2005).

METHODS

Propensity Score Matching as Data Preprocessing

Without the option of a randomized controlled trial, college students must be stratified into subgroups in a manner that will control for the systematic differences between on-campus and off-campus dwellers. I accomplished this requirement by matching students in the treatment group (those living on campus) with students in the control group (those living off campus).

I follow Ho, Imai, King, and Stuart's (2007) example by preprocessing the data with matching methods to make the treatment group as similar as possible to the control group. Matching is an attempt to model the selection process by including information that contributes to a student's decision to live on campus (Morgan & Winship, 2007). Propensity score matching (PSM) sums the probability of deciding to live on campus into one number. I utilized nearest neighbor matching with replacement, kernel matching, and radius matching using software created by Leuven and Sianesi (2003). The subsequent discussion focuses on the results from the kernel-matching technique using Gaussian kernel and a bandwidth of 0.06 to estimate the average treatment effect, although all three techniques yielded very similar results. Kernel matching uses weighted averages of all cases in the control group to construct the outcome estimate. This technique creates a lower variance than nearest neighbor and radius matching, which do not use all available cases, due to maximum use of information (Caliendo & Kopeinig, 2008).

The propensity score model consists of all available observables that might contribute to the housing decision. Unlike the regression analysis, this model does not include variables from during college due to the nature of propensity score matching (PSM). PSM models a student's selection of a housing condition, which occurs before college, and matches students who had a similar propensity to live on campus, but who made different actual housing choices. To make the best match possible, the model includes background characteristics like a student's race, sex, family composition, and parents' income and education. I also included identifiers of academic preparedness (e.g., students' high school GPA) that may predict who lives on campus. Research suggests that the most-prepared students tend to respond faster to their acceptance letters, granting them a place in housing facilities with limited availability (Huhn, 2006; Thompson, Samiratedu, & Rafter, 1993).

The ELS also includes students' and parents' rating of the importance of living at home during college or going away for college, as well as whether the student contributes to the family's support. Social participation, which is very likely to affect students' desire to live on campus, is controlled by including students' average hours of extracurricular activities per week in high school and their rating of the importance of making friends at college. I expect that students who spend more hours on extracurricular activities and consider making friends to be "very important" are more likely to live on campus, where the environment maximizes opportunities to make friends and participate in group activities. The characteristics of the college attended are also likely to affect the housing decision and are included in the model.

By including institutional characteristics of the college attended in the propensity score model, I assume that students choose their institution before they determine whether to live in campus housing. If, in fact, students decide whether they will live in housing before they decide which college to attend, an endogeneity problem arises. Because institutional characteristics are found within the model, which mimics the selection process into housing, there would be bias if these institutional characteristics are determined after the housing choice instead of before. It is reasonable to think that some students' financial situation or familial obligations will cause them to decide to live at home before they decide where to go to college, thus limiting them to institutions in close proximity. I included variables to control for instances where housing precedes institutional characteristics. By including a student rating of the importance of living at home during college and the importance of going away to college, as well as financial information that might impact the decision to live on or off campus, I control for these factors and analytically mitigate the problem of endogeneity.

The validity of the propensity score matching (PSM) model rests on the key assumption that it captures all of the components of the actual selection mechanism. This means that each component of the selection mechanism must be observable and included in the model. This necessary assumption is bold because unobservables are an anticipated element of research. However, the comprehensive dataset in this study makes the assumption more tolerable.

When estimating propensity scores, it is essential to test for covariate balance to ensure the possibility of replicating a natural experiment. Table 1 shows the difference in means between treatment and control before and after matching, as well as their significance levels. While the practice of using hypothesis testing for balance evaluation is common, this approach has been criticized for encouraging the dropping of cases based on significance, which, in turn, decreases the power of further statistical testing to detect imbalance (Imai, King, & Stuart, 2007). Therefore, while not all variables are perfectly balanced, I have not dropped any of the variables from my analysis.

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Using regression analysis on the matched sample should reduce the residual imbalance. This effect can be predicted because running a regression analysis after matching, instead of utilizing a simple difference in means, helps to control for any confounding variables due to imperfect matching (Ho et al., 2007). Moreover, by preprocessing the data through matching, the regression estimates become less dependent on modeling choice because it reduces the link between the treatment variable (living on campus) and the control variables (Ho et al., 2007).

To avoid the comparison of groups that cannot be compared, it is necessary to restrict estimates of the average effect of treatment to the region of common support. The software calculates the measure of common support by dropping treatment observations whose p-score is higher than the maximum or lower than the minimum p-score of the controls. Within the five datasets formed through multiple imputation, 38 cases, on average, were off the common support. It is probable that these cases are not a part of the population of interest because their counterfactual is most likely undefined, based on their high propensity to live in housing. Figure 1 illustrates the distribution of propensity scores among the treated and untreated cases.

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Regression

The analyses include two distinct sets of logistic regressions: a set of regressions run prior to matching and a modified version of the complete model run after matching. In line with previous research utilizing multivariate persistence models (Berger & Milem, 1999; Kuh et al., 2008), I performed a series of logistic regressions predicting retention into the second year on the unmatched data. The independent variables that were central to the regression analyses were blocked into five models, each representing a group of characteristics that might impact a student’s chances of remaining enrolled in college. These sets of covariates were entered one at a time to assess the role of living on campus (model 1), background variables (model 2), educational information (model 3), social support variables (model 4), and additional stressors (model 5) on student retention. The measures included in each model are listed in the appendix.

To improve upon existing research, I then ran a modified version of model 5 on the preprocessed data to eliminate any bias remaining after matching. The social support variables include indicators of integration and participation that should not be included in an analysis conducted on the matched sample. This is because previous literature suggests that social support and college participation are part of the mechanism driving the effect of campus residency on student retention. Therefore, the regression model run on the matched sample includes all variables from model 5 except for "talk with faculty," "meet with advisor," "work in library," "intramural sports," "varsity sports," and "extracurriculars." I removed these variables from the model to ensure that part of the treatment was not controlled away, now that the sample is matched based on this treatment. The results provide a causal estimation of the effect of campus residency on retention into the second year of college.

Analyses and Results

Descriptive Statistics

For a summary of characteristics of the population of interest, I compare treatment and control cases in the non-imputed dataset. Table 2 shows the distribution of racial/ethnic backgrounds within the treatment group and within the control group. Table 3 provides a summary of some of the initial differences between treatment and control groups.

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Most notably, the two groups differ substantially in 2004 parental income, with those living on campus having an average income of $71,516, while those living off campus have an average income of $56,206. Students living off campus also work, on average, almost twice as many hours a week as campus residents. Additional differences, as anticipated, arise in the hours per week spent on high school extracurricular activities, with campus dwellers participating 7 hours and their off-campus peers 5.2 hours. Subsequently, there is a discrepancy in frequency of participation in collegiate extracurriculars, with campus residents averaging 2.216 on a scale of 1 to 3 (1 = never, 2 = sometimes, 3 = often) compared to 1.698 for their off-campus counterparts.

Propensity Score Matching

As previous studies have indicated, the unmatched students in treatment and control groups differ in academic outcomes, with a significant positive treatment effect on the treated. (See Table 4.) For the unmatched sample, the retention into the second year for campus residents is 5.16 percentage points higher than that of non-residents.

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When students who live on campus are matched with students who live off campus but share similar propensity scores, the difference between treatment and control remains positive, .0415, but the t-statistic drops to 2.396, which still indicates a significant difference in retention for campus residents and non-residents. This difference suggests that living on campus raises the retention rate of students by 4.15 percentage points. However, it is important to control for imperfect matching, observed in the remaining significant differences between treatment and control means in Table 1, by utilizing parametric methods on the matched sample.

Regression Analysis

First, I ran a logistic regression on the unmatched sample, in line with previous literature. These results are presented in Table 5 in the metric of odds-ratios. Consistent with prior research, the results suggest that the impact of campus residency on retention into the second year of college is positive and significant ($p < .001$) net of student background characteristics.

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However when differences in students' pre-college academic information and college characteristics are accounted for, the positive impact is rendered insignificant. This implies that researchers utilizing models that do not control for educational information may find a significant positive relationship between living on campus and retention that is in fact attributable to other (typically unmeasured) differences between students. The relationship between living on campus and retention remains positive, though not significant, after controlling for social support, which includes the mother's aspirations for the student, how frequently the student discusses college with parents, and how frequently he or she participates in extracurricular activities.

A change in the direction, but not the significance, of the relationship between campus residency and retention results from controlling for additional stressors. Table 6 displays the results of a logistic regression run on the matched data utilizing a modified version of the full model.

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The first column of Table 6 presents the findings in odds-ratios, enabling a comparison between the results produced by the unmatched sample presented in Table 5 and those produced by the matched data. Including the change in probability, delta-p, in Table 6 highlights the discrepancy between the results of the logistic regression on preprocessed data and the difference in means (Table 4) typically utilized after matching. Delta-p expresses the meaning of the logistic regression coefficients in terms of probabilities rather than changes in odds (Peng, So, Stage, & St. John, 2002). For continuous variables, delta-p is an estimate of the change in the probability of retention into the second year of college associated with a one-unit change in a predictor variable (Cabrera, 1994; Peng et al., 2002). For dichotomous predictor variables, delta-p provides an estimate of the change in the probability of retention into the second year for students having the specified characteristic compared to those who do not. While the difference in means suggests that students living on campus have an estimated probability of remaining enrolled into the second year of college that is approximately 4.2 percentage points higher than those living off campus, the regression analysis suggests a 3.3 percentage point increase for on-campus dwellers. While utilizing logistic regression to reduce bias remaining after matching decreased the estimated probability of retention, the findings still indicate that living on campus has a significant effect on retention into the second year ($p < .01$).

DISCUSSION AND LIMITATIONS

Although larger effects of living on campus are observed among the unmatched sample, when propensity score matching (PSM) is applied and proper groups are analyzed, the effect of campus residency on student retention into the second year remains significant. The reduction in the size of the effect when utilizing difference in means and logistic regression on the matched sample illustrates the importance of using parametric methods to eliminate any bias remaining due to imperfect matching (Ho et al., 2007). The finding that campus residents experience a 3.3 percentage point increase in their probability of persisting into their second year provides causal support for the notion that campus residency improves retention. This finding suggests that initiatives enabling more first-year undergraduates to live on campus could increase the retention of first-year students.

Despite its important implications, the study is not without its limitations. Although the population of interest is first-year, full-time college students, utilizing the ELS 2002 cohort limits the sample to students who participated in the study and provided information about residence and enrollment status during their first year of college. Generalizing these results inherently assumes that the students in the analytic sample are representative of all first-time, full-time college students who were high school sophomores in spring 2002 and/or were seniors in spring 2004 and who are not married and do not have children.

Using national data, rather than data from only one school, is likely to capture more of the population of interest, making generalizations more acceptable. However, the use of national data makes it more difficult to include campus-level factors, such as climate or housing policies that impact student housing decisions. Unfortunately, this study is limited in its ability to capture institutional factors beyond institution type. Ideally, campus-level influences could be captured by matching students within a given institution, however, the small sample of students at each institution made it impossible to do so. The use of PSM on ELS data enabled this study to capture a number of important student-level variables to control for differences between students living on and off campus. While this is an advance beyond previous research, it would have been ideal to also include campus-level variables impacting student housing decisions.

Another limitation of the study concerns the availability of additional outcome measures. The second follow-up of the ELS only captures students through their sophomore year in college. It is possible that the effect of living on campus may escalate over time, impacting college completion. Furthermore, the second follow-up fails to include students' college GPA information, which makes it impossible to investigate the effect of campus residency on achievement. The next follow-up on the 2002 cohort should have this information, allowing further exploration of the impact of living on campus on academic outcomes.

IMPLICATIONS

Future Research

The results of this study suggest that, when the effect of campus residency is investigated without controlling for initial differences between treatment and control groups, these initial differences have the potential of skewing the results. When students living on and off campus are matched based on observable characteristics, the difference in second-year retention decreases but remains significant. Further attempts to investigate the role of campus residency on academic outcomes should control for these differences by utilizing quasi-experimental methods.

Future research should employ the methodological tools in this study, while also attempting to capture campus-level variables that cannot be derived from the ELS or IPEDS. Evaluation studies within single schools could shed light on the impact of specific campus housing policies on retention and other academic outcomes. Studies conducted on a single campus should use quasi-experimental methods to control for differences between campus residents and non-residents. Schools that randomly assign students to residence halls, often due to housing shortages, should consider exploiting this randomization. A natural experiment might further investigate the relationship of living on campus and academic outcomes. Randomization would eliminate any unobservables distinguishing between treatment and control groups, but no data on lottery-based housing assignment are currently available.

Higher Education Policy

While the findings of this national-level study suggest that campus housing positively impacts retention, including additional institutional factors may result in an increased or decreased effect of housing based on the individual college campus. When faced with financial constraints that make it difficult to provide students with the best education possible, it is vital to evaluate whether escalating investment in campus residency is sound. Many housing departments have no means of assessing the effect of their programs.

Given the potential impact of housing on students, individual college campuses should initiate an evaluation process to determine whether they are meeting their goals. Evaluation systems have the ability to produce excellent answers to tough questions. If evaluations follow the principles of causal inference, utilizing quasi-experimental or experimental methods, college administrators could obtain trustworthy information to guide policy decisions.

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TABLE 1
DIFFERENCE IN MEANS BETWEEN TREATMENT AND CONTROL FOR COVARIATES

	Before PSM		*After PSM*	
Variable	*Difference in Means*	*% Bias*	*Difference in Means*	*% Bias*
Race				
White	.012	2.6	.001	0.2
Black	.057***	17.9	-.015	-4.7
Asian	-.041**	-11.2	.007	2.0
Other minority	-.035*	-8.9	.004	1.9
Hispanic	-.068***	-22.9	.004	1.3
Female	.022	4.5	.013	2.7
Parent's income	.684***	32.3	.040	1.9
Parent:				
graduated high school	-.057***	-17.1	-.009	-2.8
attended two-year college	-.034**	-11.9	-.010	-3.6
graduated two-year	-.025*	-8.7	.001	0.2
attended four-year	-.021	-6.6	.010	3.1
graduated four-year	.051**	11.2	-.011	-2.4
earned master's degree	.061***	16.5	.004	1.1
earned advanced degree	.056***	19.6	.012	4.1
First language English	.092***	25.4	-.005	-1.4
High school GPA	.110***	20.4	.042*	7.7
Total academic units	.907***	28.2	. 233*	7.3
SAT exam comp	79.7***	45.7	19.8***	11.3
Contribute support	-.063***	-22.6	-.002	-0.8
First college attended is:				
Four-year	.148***	46.5	.008	2.4
Two-year	-.045***	44.9	-.007	-2.3
Less than two-year	-.007**	-9.5	-.000	-0.4
Public	-.191***	-45.4	-.061**	-14.5
Private not-for-profit	.209***	51.2	.062**	15.2
Private for-profit	-.016***	-12.5	-.001	-0.6
Highly selective	.214***	50.1	.033*	7.7
Not selective	-.040***	-12.5	.009	3.0
High school extracurriculars	1.685***	29.3	.180	3.1
Staying home very important	-.250***	-71.8	.003	0.9
Staying home very important to parent	-.250***	-71.8	.003	0.9
Social life very important	.130***	28.4	-.009	-1.9
Going away very important	.234***	52.2	.030	4.3
Cohort growth	-10.988	-4.8	-7.374	-3.2
Room and board	672.2***	36.4	136.2*	6.0

Note. Differences between the differences in means between treatment and control on unmatched data in this table and in the descriptive statistics (Table 3) reflect the use of multiple imputation and unweighted data for the analyses and the use of sampling weights in the descriptive statistics.

*p < .05. **p < .01. ***p < .001

TABLE 2
RACE AND ETHNIC DISTRIBUTION FOR ON-CAMPUS AND OFF-CAMPUS STUDENTS

Condition	*White*	*Black*	*Asian*	*Hispanic*	*Other**
Treatment	.766 (.013)	.166 (.013)	.068 (.007)	.056 (.007)	.036 (.005)
Control	.755 (.019)	.113 (.014)	.087 (.010)	.147 (.022)	.049 (.009)
Observations (n)	3600	3598	3601	3792	3595

Note: Table 2 presents unadjusted means and standard errors (in parentheses). N =3,783 when using the survey command (to implement sampling weight) in Stata. While the number of observations using the survey command is 3,783, this represents 814,963 in the population.

*"Other" includes Native Americans and Pacific Islanders.

TABLE 3
DESCRIPTIVE STATISTICS: UNADJUSTED MEANS, AND STANDARD ERRORS FOR VARIABLES OF INTEREST

Variable	*Observations*	*Treatment*	*Control*
Sex (female)	3,783	.554 (.013)	.543 (.017)
Parents' 2004 income[a]	2,230	71516.22 (1742.55)	56205.96 (1989.98)
Parent's highest level of education	3,783	5.327 (.059)	4.560 (.079)
SAT scores	3,408	1069.309 (6.168)	996.946 (7.425)
High school GPA	3,563	3.192 (.017)	3.085 (.024)
Number of Advanced Placement (AP) units	3,563	1.560 (.074)	1.092 (.086)
High school extracurriculars, hours per week	3,543	7.000 (.174)	5.197 (.204)
Discuss college with parents in high school	3,633	2.862 (.009)	2.761 (.016)
Talks to faculty	3,778	2.163 (.017)	2.042 (.023)
Meets with advisor	3,774	2.193 (.015)	2.078 (.020)
Participates in collegiate extracurriculars	3,775	2.216 (.019)	1.698 (.029)
Work during college, hours per week	3,729	10.150 (.319)	19.120 (.492)
Can student afford college without working?	3,712	.848 (.010)	.706 (.018)

Note: N = 3,783, using the survey command to implement sampling weight in Stata. While the number of observations using the survey command is 3,783, this represents 814,963 in the population. The following variables were asked in terms of the frequency (scale: 1 = never, 2 = sometimes, 3 = often) with which a student: discussed college with parents, talks to faculty, meets with advisor, and participates in extracurricular activities in college.

*Due to the high degree of missing values, I used a composite income variable in which incomes are categorized into groups for propensity score matching (PSM) and regression. For ease of comparing treatment and control, I used the continuous parent income variable, in U.S. dollars, from 2004 here despite the lower number of observations.

TABLE 4
DIFFERENCE IN MEANS OF RETENTION INTO SECOND YEAR BETWEEN TREATMENT AND CONTROL

Sample	*Difference in means*	*S.E.*	*T-Statistic*
Unmatched	.0516	.0113	4.57
Matched	.0415	.0173	2.39

Note: The estimates for all matched results are an average of the results across the five data sets formed in multiple imputation. I used Rubin's (1987) procedure for combining estimates and standard errors (Schafer & Graham, 2002) to find the regression estimate and standard error for the matched sample.

TABLE 5
RESULTS FROM LOGISTIC REGRESSION MODELS PREDICTING RETENTION: UNMATCHED DATA

Variable Names	*Model 1*	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Live on Campus	*1.652*** (.183)*	*1.567** (.182)*	*1.213 (.151)*	*1.057 (.137)*	*.915 (.124)*
Race					
White		.865 (.211)	.808 (.204)	.803 (.203)	.808 (.201)
Black		.525* (.137)	.860 (.236)	.733 (.202)	.752 (.205)
Asian		1.303 (.372)	.949 (.283)	1.010 (.301)	.980 (.288)
Other Minority		1.040 (.285)	1.093 (.307)	.986 (.279)	1.011 (.286)
Hispanic		.895 (.200)	1.004 (.233)	.939 (.220)	.930 (.220)
English is first language		.623* (.146)	.716 (.171)	.700 (.169)	.668 (.164)
Female		1.468** (.165)	1.158 (.139)	1.065 (.135)	1.060 (.135)
Parents' income		1.132*** (.032)	1.108** (.033)	1.106** (.033)	1.086** (.033)
Parent's education		1.114** (.035)	1.065 (.035)	1.043 (.035)	1.039 (.035)
Units math in high school			1.010 (.080)	1.007 (.081)	.999 (.081)
Units English in high school			.897 (.062)	.884 (.062)	.897 (.064)
Units science in high school			1.035 (.076)	1.025 (.077)	1.021 (.077)
Total units in high school			1.078** (.029)	1.079** (.029)	1.077** (.029)
Total AP units			1.074 (.052)	1.047 (.050)	1.040 (.050)
High school GPA			2.329*** (.279)	2.343*** (.286)	2.359*** (.291)
SAT score			1.000 (.000)	1.000 (.000)	1.000 (.000)
Public college			.929 (.127)	1.000 (.139)	.993 (.140)
Highly selective college			1.493* (.277)	1.465* (.275)	1.388 (.263)
Mother's aspirations for student				1.092* (.043)	1.100* (.044)
Student very frequently:					
Discusses college with parents				1.365* (.194)	1.352* (.193)
Talks with faculty				1.294 (.206)	1.340 (.216)
Meets with advisor				1.259 (.190)	1.243 (.189)
Works in library				1.177 (.149)	1.198 (.153)
Plays intramural sports				.945 (.168)	.946 (.169)
Plays varsity sports				1.177 (.226)	1.114 (.216)
Participates in extracurriculars				1.716** (.269)	1.715** (.271)
Contributes to another's support					.543** (.097)
Hours worked per week					.986** (.005)
Afford school without work					1.135 (.171)

Note: N = 3,408. The results are presented in odds-ratios followed by standard errors in parentheses.
*p < .05. **p < .01. ***p < .001

TABLE 6
RESULTS FROM LOGISTIC REGRESSION MODELS
PREDICTING RETENTION: MATCHED DATA

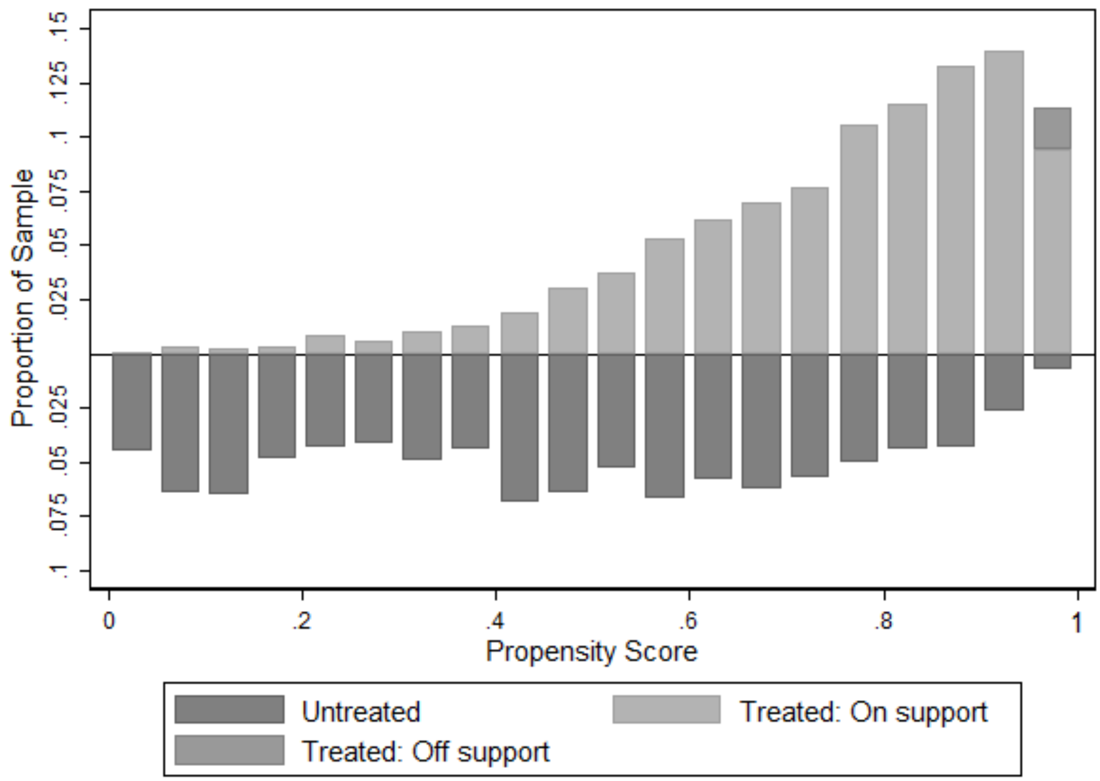
Variable Names	*Odds-Ratio (SE)*	*Beta (SE)*	*Delta-p**
Live on Campus	*1.353** (.145)*	*.302 (.107)*	*.033*
Race			
White	.545* (.131)	-.554 (.228)	-.046
Black	.567* (.133)	-.567 (.235)	-.048
Asian	.511* (.134)	-.671 (.262)	-.053
Other Minority	1.169 (.317)	-.156 (.271)	
Hispanic	1.218 (.306)	.197 (.251)	
English is first language	.931 (210)	-.072 (.226)	
Female	1.023 (.111)	.023 (.108)	
Parents' income	1.061* (.029)	.059 (.027)	.006
Parent's highest level of education	1.075** (.032)	.072 (.030)	.007
Units of math in high school	1.166* (.082)	.154 (.070)	.014
Units of English in high school	.929 (.058)	-.074 (.062)	
Units of science in high school	1.041 (.064)	.040 (.061)	
Total units in high school	1.030 (.022)	.029 (.021)	
Total AP units	1.067 (.040)	.064 (.037)	
High school GPA	3.112*** (.343)	1.135 (.110)	.072
SAT comprehensive score	.999 (.000)	-.001 (.000)	
Public college	1.069 (.119)	.067 (.112)	
Highly selective college	1.415* (.987)	.347 (.141)	.039
Mother's aspirations for student	1.154*** (.038)	.143 (.033)	.013
Very frequently:			
Discusses college with parents	1.232 (.162)	.209 (.132)	
Contribute to another's support	.456*** (.078)	-.786 (.171)	-.067
Hours worked per week	.992 (.004)	-.008 (.004)	
Afford school without work	1.012 (.136)	.012 (.134)	

Note: For the matched sample, the average N across the five imputed data sets is 3,370 based on an average of 38 cases being off the common support. The results are presented in odds-ratios and coefficients (with standard errors in parentheses) and delta-p, which is the change in probability of retention into the second year. Delta-p is presented only for variables with significant findings.

*I computed delta-p statistics for the continuous variables using Petersen's (1985) calculation for Delta-P and express them as a change in percentage points from the baseline percentage. However, I used Cruce's (2009) revised calculation for Delta-P for categorical variables. Utilizing a revised calculation for Delta-P explicitly recognizes the reference group by including the products of the parameter estimate and the mean-centered values for the categorical independent variable of interest (Cruce, 2009). The following information is necessary to calculate Cruce's (2009) Delta-P for dichotomous variables, which are listed with their respective $\bar{x}$, the sample mean for the reference group: Live on campus ($\bar{x}$ =.907), White ($\bar{x}$ =.894), Black ($\bar{x}$ =.816), Asian ($\bar{x}$ =.928), highly selective college ($\bar{x}$ =.955), contribute to another's support ($\bar{x}$ =.758). The predictive probability, $\bar{y}$, is**Error! Bookmark not defined.** .889.

*p < .05. **p < .01. ***p < .001

Figure 1. Distribution of propensity scores in treatment and control groups



APPENDIX:

DESCRIPTION OF VARIABLES

APPENDIX TABLE 1

VARIABLES UTILIZED IN REGRESSION ANALYSIS

	Variable Name	*Description*
Dependent variable	Retained into second year	Dichotomous variable indicating whether the student remained enrolled into fall 2005
Independent variables	Live on campus	Dichotomous variable indicating whether the student lives on campus.
Background Information	White	Dichotomous indicator of whether student self-identifies as White
	Black	Dichotomous indicator of whether student self-identifies as Black
	Other minority	Dichotomous indicator of whether student is a minority other than Asian, Black, or Hispanic (combines students who self-identify as Pacific Islanders and Native Americans into "other minority" category, due to low n for each)
	Asian	Dichotomous indicator of whether student self-identifies as Asian
	Hispanic	Dichotomous indicator of whether student is Hispanic
	Female	Dichotomous indicator of whether student self-identifies as female
	Parents' income	A categorical measure of parents' income during student's senior year in high school (2003-2004): 1 = $1,000 or less; 2 = $1,001 to $5,000; 3 = $5,001 to $10,000; 4 = $10,001 to $15,000; 5 = $15,001 to $20,000; 6 = $20,001 to $25,000; 7 = $25,001 to $35,000; 8 = $35,001 to $50,000; 9 = $50,001 to $75,000; 10 = $75,001 to $100,000; 11 = $100,001 to $200,000; 12 = $200,001 or more. (The continuous measure available from the 2004-2005 school year FAFSAs had large amounts of missing data, making it less favorable for multiple imputation)*
	Parents' highest level of education	An ordinal categorical variable indicating parents' highest level of education with the following values: 1 = did not finish high school; 2 = high school diploma or GED; 3 = attended 2-year college, no degree; 4 = graduated from 2-year; 5 = attended 4-year college, no degree; 6 = graduated from 4-year college; 7 = completed master's or equivalent; 8 =completed M.D., Ph.D., or other advanced degree
	First language	A dichotomous indicator of whether English is the student's first language
Educational Information	High school grade point average	Continuous measure of student's high school grade point average
	Total advanced placement	Continuous measure of total AP credits taken in high school

	Units in English	Continuous measure of total credits of English taken in high school
	Units in science	Continuous measure of total credits of science taken in high school
	Units in math	Continuous measure of total credits of math taken in high school
	Total academic units	Continuous measure of total credits taken in high school
	SAT exam comp	Continuous measure of exam score in terms of composite Scholastic Aptitude Test (SAT)
	Four-year	Dichotomous indicator of whether the college attended in fall of 2004 is a four-year institution
	Two-year	Dichotomous indicator of whether the college attended in fall of 2004 is a two-year institution
	Less-than-two-year	Dichotomous indicator of whether the college attended in fall of 2004 is a less-than-two-year institution
	Public	Dichotomous indicator of whether the college attended in fall of 2004 is a public institution
	Private not-for-profit	Dichotomous indicator of whether the college attended in fall of 2004 is a private, not-for-profit institution
	Private for-profit	Dichotomous indicator of whether the college attended in fall of 2004 is a private for-profit institution
Social Support	Highly selective	Dichotomous indicator of whether the college attended in fall of 2004 was ranked as highly selective in IPEDS
	Discuss college	Dichotomous indicator of whether student often discussed college with parents during high school
	Mother's aspirations	A categorical measure of mother's highest aspiration for student's education with the following values: 1 = did not finish high school; 2 = high school diploma or GED; 3 = graduated from 2-year; 4 = graduated from 4-year college; 5 = completed master's or equivalent; 6 = completed M.D., Ph.D., or other advanced degree.
	Talk to faculty	Dichotomous indicator of whether student often talks to faculty about academic matters outside of class
	Meet with advisor	Dichotomous indicator of whether student often meets with advisor with the following
	Work in library	Dichotomous indicator of whether student often does school work in a campus library
	Extracurricular activities	Dichotomous indicator of whether student often participates in extracurricular activities in college
	Intramural sports	Dichotomous indicator of whether student often participates in intramural or nonvarsity sports
	Varsity sports	Dichotomous indicator of whether student often participates in varsity sports
Additional Stressors	Contribute support	Dichotomous indicator of whether student contributes to children's or anyone else's support
	Hours worked per week	Continuous measure of the hours worked weekly during the 2004-2005 academic year
	Afford college without work	Dichotomous indicator of whether student can afford to attend college without working, based on self-report

* I used the continuous income variable from the 2004-2005 FAFSA in the descriptive statistics, which used unimputed data.

APPENDIX TABLE 2

VARIABLES UTILIZED IN PROPENSITY SCORE MATCHING (PSM)

Variable Name	*Description*
White	Dichotomous indicator of whether student self-identifies as White
Black	Dichotomous indicator of whether student self-identifies as Black
Asian	Dichotomous indicator of whether student self-identifies as Asian
Other minority	Dichotomous indicator of whether student is a minority other than Asian, Black, or Hispanic (combines students who self-identify as Pacific Islanders and Native Americans into "other minority" category, due to low n for each)
Hispanic	Dichotomous indicator of whether student is Hispanic
Female	Dichotomous indicator of whether student self-identifies as female
Parents' income	A categorical measure of parents' income during student's senior year in high school (2003-2004): 1 = $1,000 or less; 2 = $1,001 to $5,000; 3 = $5,001 to $10,000; 4 = $10,001 to $15,000; 5 = $15,001 to $20,000; 6 = $20,001 to $25,000; 7 = $25,001 to $35,000; 8 = $35,001 to $50,000; 9 = $50,001 to $75,000; 10 = $75,001 to $100,000; 11 = $100,001 to $200,000; 12 = $200,001 or more
Parents graduated high school	Dichotomous variable indicating whether high school was the parents' highest level of education
Parent attended two-year	Dichotomous variable indicating whether parent attended a two-year college (but did not complete) as their highest level of education
Parent graduated two-year	Dichotomous variable indicating whether parent graduated from two-year college as the parents' highest level of education
Parent attended four-year	Dichotomous variable indicating whether parent attended four-year postsecondary institution (but did not complete) as the parents' highest level of education
Parent graduated four-year	Dichotomous variable indicating whether parent graduated from a four-year postsecondary institution as the parent's highest level of education
Parent earned master's degree	Dichotomous variable indicating whether the parent's highest level of education was a master's degree
Parent earned advanced degree	Dichotomous variable indicating whether the parent's highest level of education was earning an advanced degree (Ph.D., M.D., or other advanced degree)
First language	A dichotomous indicator of whether English is the student's first language
Total academic units	Continuous measure of total credits taken in high school
SAT exam comp	Continuous measure of exam score in terms of composite Scholastic Aptitude Test (SAT)
Contribute support	Dichotomous indicator of whether student contributes to children's or anyone else's support
Four-year	Dichotomous indicator of whether the college attended in fall of 2004 is a four-year institution
Two-year	Dichotomous indicator of whether the college attended in fall of 2004 is a two-year institution
Less than two-year	Dichotomous indicator of whether the college attended in fall of 2004 is a less-than two-year institution
Public	Dichotomous indicator of whether the college attended in fall of 2004 is a public institution
Private not-for-profit	Dichotomous indicator of whether the college attended in fall of 2004

	is a private, not-for-profit institution
Private for-profit	Dichotomous indicator of whether the college attended in fall of 2004 is a private for-profit institution
Highly selective	Dichotomous indicator of whether the college attended in fall of 2004 was ranked as highly selective in IPEDS
Not selective	Dichotomous indicator of whether the college attended in fall of 2004 was ranked as not selective in IPEDS
High school extracurricular activities	Continuous variable indicating number of hours per week in high school spent on extracurricular activities
Staying home very important to student	Dichotomous indicator of whether student ranked living at home during college as "very important" (3 on a scale of 1 to 3) in student questionnaire
Staying home very important to parents	Dichotomous indicator of whether parent ranked student living at home during college as "very important" (3 on a scale of 1 to 3) in parent questionnaire
Social life very important	Dichotomous indicator of whether student ranked an active social life during college as "very important" (3 on a scale of 1 to 3) in student questionnaire
Going away very important	Dichotomous indicator of whether student ranked going away to college as "very important" (3 on a scale of 1 to 3) in student questionnaire
Cohort growth	Continuous measure of the difference between the number of full-time, first-time undergrads in 2004 and the number of full-time, first-time undergrads in 2003 at the student's college (proxy of residence hall capacity; if the cohort size has greatly increased, it might mean less housing is available)
Room and board	Continuous measure of the cost of room and board at the student's college in the 2004-2005 academic year