ESSAYS IN HIGHER EDUCATION ECONOMICS

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Amanda Leigh Griffith

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Amanda Leigh Griffith, Ph.D.

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One of the main issues at the forefront of higher education policy discussions in the last decade concerns the under-representation of low-income and minority students at our nation's more selective colleges and universities. This dissertation focuses on this issue by examining the factors that impact on the college application decisions of low-income and minority students, as well as their success in selective colleges and universities after matriculation and finally by investigating how the use of merit-based financial aid programs affects the representation of low-income and minority students and other institutional spending patterns.

The first essay uses the *National Longitudinal Survey of Youth: 1997* to examine how the distance from one's home to the nearest selective college or university affects a student's decision to apply to a selective college or university. Students that live near to a selective colleges or university may be more likely to apply to this type of institution, both because of the lower costs, and also possibly due to increased knowledge of the opportunities available at this type of college. The results show that as distance to a selective college decreases, students are more likely to apply to one, and not necessarily the closest one. Colleges may be able to increase the representation of low-income students in their application pools by increasing the information available to students living far away from any selective institutions.

The second essay examines the success of low-income and minority students after they enroll at elite colleges and universities. I use the restricted access versions of the *National Longitudinal Survey of Freshmen* and the *National Education Longitudinal Study of 1988* to examine how institutional fit, both academic and social,

impact educational outcomes such as GPA, persistence and college major choice. I find that on average, minorities and students from low-income families achieve lower grade point averages and are less likely than other students to graduate within 6 years. Poor academic fit can negatively impact grades, but has little effect on persistence. Income peer group size does not affect grades or persistence, but does play a role in college major choice. Same race peer group size influences grades and persistence in addition to affecting college major choice.

The third essay focuses on the increased use by private colleges and universities of financial aid based on "merit", as opposed to based solely on financial need. Using data from the College Board's *Annual Survey of Colleges* and other secondary data sources I examine how the increased use of merit aid impacts upon the socioeconomic and demographic composition of student bodies, and how faculty salaries, tuition costs, and the use of adjunct faculty members changes after a change to a merit-aid policy. Results show that the percentage of students from low-income and minority families decreases following the introduction of merit-aid, and several institutional expenditure and student cost categories also change.

BIOGRAPHICAL SKETCH

Amanda Leigh Griffith grew up in Vershire, Vermont and graduated from Thetford Academy in 2000. She attended Colgate University in Hamilton, New York, graduating in May of 2004. At Colgate she double-majored in Biology and Economics, receiving Honors in the first and High Honors in the second. Following graduation, she began her graduate studies in Economics at Cornell University with a National Science Foundation Graduate Research Fellowship. She received her Master of Arts in Economics in January of 2008 and will receive her Doctor of Philosophy Degree in August of 2009. Following completion of her degree, she will become an assistant professor of Economics at Wake Forest University.

For Mom and Dad

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CHAPTER 1

INTRODUCTION

One of the issues currently at the forefront of higher education policy discussions centers on how to address the under-representation of low-income and minority students in our nation's colleges and universities, particularly at the more selective of these institutions. Studies have shown that there is an ample supply of high test score low-income and minority students available, but average four-year college enrollments of these students do not reflect this. This is a concern not only as a question of equal access to higher education for deserving students of all backgrounds, but because research has shown that there is a wage benefit associated with graduating from a more selective institution and that this benefit is larger for low-income and minority students.

A number of selective colleges and universities, both public and private, have introduced programs targeting low-income students through the use of increased financial aid. Many of these programs also include increased recruitment efforts. For these policies to be fully successful, policymakers must have a good understanding of the factors that are important in the application and enrollment decision for low-income and minority students.

The second chapter of this dissertation focuses on the decision to apply to a selective college or university, and examines how particular factors may differ in their importance and impact on application decisions of low-income students. This chapter uses a nationally representative data set, the *National Longitudinal Survey of Youth, 1997*, to examine how proximity to a selective college during high school can impact on college application decisions. Low-income students live significantly farther away

from selective colleges and universities, as most of these institutions are concentrated in the Northeast while low-income students are not. Living near to a selective college may increase application rates to this type of institution for two reasons. Close proximity lowers the convenience and cost of attendance as students can commute more easily, and it might also provide more information to students on the opportunities available at selective colleges and universities. This chapter examines how the distance to the closest selective college or university impacts a student's decision to apply to a selective institution. The results from this chapter will help programs aimed at increasing the representation of low-income students in selective college applicant pools by highlighting how admissions offices can target these students.

Although many of the current policies are focusing on the first step of the process, enrolling low-income and minority students in college, it may also be important to examine what happens to these students after matriculation. Low-income and minority students may face some hurdles at selective institutions. Students of both groups have lower test scores on average, placing those attending selective colleges in the lower tail of the test-score distribution. Additionally, due to the low-representation of low-income and minority students at these colleges, these students have fairly small peer groups as defined by income or race, which could impact on educational outcomes through the formation of their social networks. How well a student matches academically and socially with the institution they attend may impact on their educational success. Chapter three examines how institutional fit impacts on college success using two longitudinal data sets, the *National Longitudinal Survey of Freshmen* and the *National Education Longitudinal Study of 1988*. Administrators and policymakers can hopefully use the results of this study to get a sense of how well

students of these two groups are succeeding at selective colleges and universities, and if there are problems that could be addressed by policy.

In addition to the policies specifically focusing on low-income and minority students, there are many recent changes in institutional policies that could have important consequences for the enrollment of these students. Over the last decade many private four-year colleges and universities have started awarding merit-based financial aid, as opposed to awarding financial aid based solely on need. This move has come under fire as many feel that diverting financial aid resources away from need-based aid to merit-based awards that are more likely to go to higher-income students will lead to a crowding-out of low-income students at these colleges. In a time when there is a focus on *increasing* the representation of these students, it is important to understand how policies such as a merit-aid policy can impact on this goal.

Chapter four examines how the enrollments of low-income and minority students change following the introduction of a merit aid program at private four-year institutions using data from the College Board's *Annual Survey of Colleges*. One of the main motivations for switching to merit-based aid is the desire to attract and enroll more high-test score students. This chapter investigates how successful merit aid programs have been at increasing the quality of the student body. In addition to diverting financial aid resources from need-based aid, it is possible that colleges use other avenues to fund their new merit aid programs. Colleges may raise the tuition and fees that students face in order to recoup their losses, or they may change their spending in other areas, such as on faculty salaries and employment. As many private colleges, and recently the more selective of these institutions, move to financial aid based not solely on need, but also on merit, it is important to understand what institutional policies follow this policy change.

The three main chapters of this dissertation examine three aspects of one current policy issue, the under-representation of low-income and minority students at selective colleges and universities. Hopefully the results of these three studies will be helpful to policymakers, administrators and researchers interested in understanding how to increase the representation of these students at our nation's selective colleges, how other policies may impact upon this goal, and also how to ensure that they succeed academically after matriculation.

CHAPTER 2

CAN'T GET THERE FROM HERE: THE DECISION TO APPLY TO A SELECTIVE COLLEGE[1]

I. Introduction

This paper examines the factors that are important during the college application process, with a specific focus on the roles of family income and proximity of selective schools on the decision of whether to apply to a selective college. It employs a very rich national longitudinal data set with sample members applying to college in the early 2000s.

Attending a selective four-year college can impact relative lifetime earnings (see, for example, Brewer, Eide, & Ehrenberg, 1999; Long, 2008), and the earnings premium may be larger for students from low-income backgrounds (Behrman, Constantine, Kletzer, McPherson, & Schapiro, 1996; Dale & Krueger, 2002). Yet low-income students are under-represented at elite colleges and universities (Heller, 2004; Hill, Winston & Boyd, 2005). Bowen, Martin, Kurzweil and Tobin (2005), in their book *Equity and Excellence in American Higher Education*, show that only 11 percent of students from families in the bottom quartile of the income distribution are enrolled at the 19 elite colleges and universities in their sample. They argue that increasing the representation of students from low-income families has significant benefits, both in terms of increased social mobility for the low-income students

[1] This paper was co-written with Donna S. Rothstein of the U.S. Bureau of Labor Statistics. It will be published in the *Economics of Education Review* (link to article: http://dx.doi.org/10.1016/j.econedurev.2009.01.004).

themselves, and in terms of increased socioeconomic diversity within colleges, which has benefits for all students enrolled.

Recently, a number of selective institutions have implemented programs aimed at increasing the representation of students from low-income families. These programs, developed by both public and private elite institutions such as Harvard, Yale, Princeton, the University of Virginia, and the University of North Carolina, among others, are varied in their approaches. However, most have at their core a promise to cover most or all of the school's tuition for students with low family income. Many programs also include attempts to increase awareness of the institution and the opportunities available there for low-income students. The hope is that the various measures will lead to a larger applicant pool of low-income students at selective institutions, resulting in their higher representation in the matriculating classes. Preliminary results from Harvard suggest that although effects of the program are modest thus far, it appears to be succeeding (Avery, Hoxby, Jackson, Burek, Poppe & Raman, 2006).

To ensure that these programs can successfully target low-income student populations, one needs to examine why so few low-income students apply to more selective four-year institutions. For according to a 2005 study by Hill, Winston and Boyd (2005) there is a sizeable pool of high ability, low-income students in the U.S. (as measured by test scores and reported family income). Although the cost of attending a selective college or university can be quite high, tuition costs may not be the only hurdle that low-income students face. Proximity to post-secondary institutions could be important in students' college application decisions, and may be a more significant factor for low-income students. About 46 percent of the more elite institutions in the U.S. are located in Northeastern states, yet many of the low-income

students that could attend these colleges are located in geographically distant states.[2] For example, in the data set we use in this paper, only 12 percent of students with a grade point average of 3.5 or more who are in families in the bottom quartile of income live in the Northeast.

College proximity can have two distinct effects on college application decisions. First, distance can impose costs and make students less likely to apply to colleges far away from their homes. For example, students may want to attend college (and therefore will apply to colleges) close to home for convenience, lower travel costs, and for the option of living at home to avoid paying for room and board. One might expect that financial reasons for attending a college closer to home may be more pressing for students from low-income families.

Second, living close to a selective four-year college can expose students to what these colleges have to offer and encourage students to try to attend a selective four-year college. Do (2004) refers to this as a spillover effect, which may be particularly influential for lower-income students. For example, living close to a college may raise awareness of opportunities available at post-secondary institutions and help create a college-going expectation for nearby youths. Living near a selective institution could have an additional spillover effect, increasing the probability that students would strive to attend a selective college or university. Both effects suggest that as distance to a selective college increases, the less likely a student is to apply to one.

In this paper, we use the National Longitudinal Survey of Youth 1997 (NLSY97) to assess the roles of college proximity and family income in the decision to apply to a selective four-year college. We analyze the college application decision

[2] We define elite or selective four year colleges as those ranked by *Barron's Profile of American Colleges* (2001) as most or highly competitive.

using a bivariate probit model with selection. The application process is shown in two stages: (1) the choice to apply to a four-year college (selection), and (2) the choice to apply to any selective four-year college versus only non-selective four-year colleges. The selection model yields some interesting findings. First youths from families with low income are much less likely to apply to four-year colleges than those from families with high income, even after controlling for test scores, high school grade point average, and many other family, school, and location characteristics. Second, family income does not have an effect on the type of four-year colleges to which students applied. And third, proximity to selective colleges does matter--students are less likely to apply to a selective four-year college the further they live from one.

II. Prior literature

Several studies have focused on the college application decision, but few have focused on the decision to apply to a selective college or university.[3] Recent studies have found mixed results on the importance of family income in the decision to apply to a selective college. Two studies focusing on applications to a specific institution find contrasting results. Desjardins, Dundar and Hendel (1999) examine the decision to apply to a large, high-quality public university in the Midwest. Their findings indicate that students from low- and middle-income families are more likely to apply to the institution than students from high-income families. Weiler (1994) looks at the decision to apply to a specific selective private institution in a suburban location. He finds that as parental income increases, students are significantly more likely to apply to the focus institution. Toutkoushian (2001) looks specifically at the application decisions of high school seniors in New Hampshire, and finds that low levels of

[3] See Hossler, Braxton and Coppersmith (1989) for a review of many of the earlier articles examining the college application decision.

parental income do not discourage students from applying to the more selective schools in the sample.

In a very recent paper, Koffman and Tienda (2008) examine how a 1996 law in Texas (HB588), which guarantees admission to public colleges and universities in Texas to high school seniors graduating in the top 10 percent of their class, affected the distribution of socioeconomic status of the applicant pool to two Texas flagship public universities. They find that the admission policy did little to change the application rate of students from poor high schools. These results suggest that even with guaranteed admission there are still hurdles to overcome in order to increase the application rates of low-income students. To remedy the situation, the authors advocate increased, targeted recruitment of top students from poor high schools. But to do this, one must understand what factors are important to low-income students in their application decisions.

Very little research has looked at how student proximity to a college or university impacts his or her college application decisions.[4] Turley (2009) is an exception. She uses NELS:88 data to examine how college proximity influences the probability of applying to a two- or four-year college. Turley measures college proximity as the number of colleges within commuting distance of a student's home (12 miles for urban youths and 24 miles for rural/suburban youths). She finds a very small increase in the probability of applying to a four-year college associated with a 1 unit increase in the number of four-year colleges in close proximity. These results suggest that college proximity influences the college application decision, but she does not look at college selectivity, which is the focus of the current paper.

[4] However, note that Card (1995) uses proximity to a four-year college as an instrument for years of schooling. He finds that students living closer to four-year institutions, on average, attained higher total years of schooling.

Two recent studies find that college proximity affects the college enrollment decision, and may have a larger effect for students from families with low income. Do (2004), using data from High School and Beyond, examines college matriculation decisions for low- versus high-income students. Results suggest that low-income students are more likely to attend a high quality college if they live near a good public university, with mixed results for the impact of living near other types of elite institutions. Using a sample of Canadian high school seniors, Frenette (2006) finds that students who live further away from top universities are less likely to attend one and that the effect is significantly stronger for students from low-income backgrounds.

III. Empirical approach

In order to investigate factors affecting college application choices, this study estimates a bivariate probit selection model (see, for example, Maddala, 1983). The first (selection) stage is the decision of whether to apply to a four-year college vs. a two-year or no college. The second stage, which is the main focus of our paper, is then whether to apply to any four-year selective college vs. only non-selective four-year colleges. The second stage is censored, in that the outcome is only observed for those who choose to apply to a four-year college.

Students have different portfolios of four-year college applications, and we reduce them to a 1 (at least one selective four-year college), 0 (only non-selective four-year colleges) dependent variable in the second stage. Ideally, we would like to have a dependent variable that reflects the richness of the application choices. However, as we will see in the next section, only 237 students apply to any selective college in our data set, with 61 percent of these applying to only one selective college and another 22 percent applying to only two selective colleges.

We use two variables to identify the first stage of the bivariate probit selection model: distance to a two-year college and the State unemployment rate.[5] The theory behind the use of these variables to identify the selection process is as follows: As the unemployment rate rises, parents and their children may steer away from expensive four-year colleges in favor of two-year colleges. Two-year college proximity is likely to affect the two-year versus four-year college decision, but unlikely to have an effect on a student's decision to apply to a selective versus a non-selective four-year institution. In practice, we find that these two variables are statistically insignificant in the second stage.

Explanatory variables that may influence the college application decision are broken into five descriptive categories:

(i.) personal--gender, race, ethnicity, and test score;

(ii.) family—income, parent education, family structure, and family size;

(iii.) high school—type of institution, racial composition, and percent of low-income

students;

(iv.) location—median income, urbanicity, region;

(v.) distance—distance to college type.

The rich data set used in this paper allows one to control for such an exhaustive list of characteristics. The hope is that the effects of these variables can shed light on the college application decision, particularly the roles that college proximity and family income play in the process.

[5] State unemployment rate is from Table 572 of the 2001 edition of the *Statistical Abstract of the United States.*

IV. Data and variables

This paper employs the National Longitudinal Survey of Youth 1997 (NLSY97) to study the college application decisions of youths in the U.S. The NLSY97 consists of nearly 9,000 youths who were born in the years 1980-84. The youths were 12-17 when first interviewed in 1997, and have had annual in-person interviews ever since. In 2003 (round 7), the NLSY97 added a section on college choice for youths born in the years 1983 and 1984. Youths who attended at least twelfth grade or received a GED report the colleges applied to in each application cycle, among other information.[6] The survey repeated the section for the same two birth years in 2004. The NLSY97 geocode CD and confidential data available to researchers who come to the U.S. Bureau of Labor Statistics provide college UnitIDs, high school id codes, as well as residential zip code, county, and state for each survey year. The paper merges in high school characteristics from the Q.E.D. (Quality Education Data) and uses county of high school residence to link to information from the 2000 edition of the *County and City Data Book*.

The study obtains parent reports of household income from the round 1 NLSY97 parent questionnaire.[7] Family structure, household size, and biological mother's education are also from round 1. The NLSY97 defines race and ethnicity as three mutually exclusive groups: non-black and non-Hispanic, black and non-Hispanic, and Hispanic. The survey oversamples the latter two groups. ASVAB (Armed Services Vocational Aptitude Battery) test scores are available for about 80 percent of the NLSY97 sample. From the summer of 1997 through the spring of 1998, NLSY97 youths took the computer-adaptive version of the ASVAB. Four of the

[6] The sample is limited to those with a high school diploma or GED in the analysis that follows.
[7] Household income is missing for 25 percent of the youths in the NLSY97 sample, with about half due to a missing parent interview. Descriptive statistics are shown for non-missing observations. In the analyses that follow, variables with missing observations are given a value of zero, and a dummy variable for the missing variable is included in the regression.

subtests combine to form a composite measure of math and verbal aptitude. This aptitude measure is similar to the Department of Defense's Armed Forces Qualification Test (AFQT) score available in the NLSY79. NLSY97 survey personnel internally normed these tests and created the composite math and verbal aptitude percentile score (0 (lowest) to 99) provided in the NLSY97 data set.

The paper uses college UnitIDs to merge in information on selectivity and other characteristics of colleges from the 2000 IPEDS and the College Board's Annual Survey of Colleges.[8] The rankings in *Barron's Profile of American Colleges* (2001) are used to define selective colleges (those with a most or highly competitive ranking). In 2000, 146 U.S. colleges are considered to be selective by the Barron's rankings. The average median SAT score is 1272 for the sample of selective institutions.

Finally, the study uses zip codes from a student's senior year of high school and the complete list of selective four-year, non-selective four-year, and two-year colleges to create measures of college proximity.[9] U.S. Gazetteer files from the U.S. Census Bureau provide the latitude and longitude of the centroid of each zip code in decimal degrees. One can then convert decimal degrees to radians, and then calculate the distance in miles between the zip code of student i and the zip code of school j.[10] Once this is completed for all student and school zip code combinations, we use the minimum distance to each school type to define college proximity.

[8] We exclude for-profit colleges in our analysis. At the time of the survey, for-profit schools were a very small part of the college application set. We delete 27 observations in which the respondent only applied to for-profit four-year colleges. Note that only 9 students who apply to public and private four-year colleges in our final sample also apply to a for-profit college.

[9] We exclude for-profit colleges from these measures.

[10] The formula is $4000*\arccos\{\sin(\text{school}_j \text{ latitude})*\sin(\text{student}_i \text{ latitude}) + \cos(\text{school}_j \text{ latitutude})*\cos(\text{student}_i \text{ latitude})*(\cos(\text{school}_j \text{ longitude} - \text{student}_i \text{ longitude})\}$.

V. Descriptive statistics

Table 2.1 displays descriptive statistics for the NLSY97 sample, separated by type of school application and selectivity. The categories are: Did not apply, two-year college, any four-year college, non-selective four-year college, and selective four-year college. The first three categories are mutually exclusive, and the last two are mutually exclusive subsets of the third column. Students who apply to multiple types of school are placed in the highest category (for example, applications to both a non-selective four-year college and a selective four-year college place the student in the selective category). On average, students who apply to at least one selective college, apply to 3.5 four-year colleges; the number is lower, 1.7, for those who apply to non-selective four-year colleges. About 95 percent of students who apply to only non-selective four-year colleges are accepted. The number is much lower for the selective category (73 percent), reflecting the increased difficulty of acceptance at more selective four-year colleges.

Table 2.1 indicates an under-representation of students from low-income families in the selective college applicant pool. We divide household income into approximate quartiles based on Current Population Survey data of households with a 12 to 17-year old youth present.[11] Only about 14 percent of students in families with income under $25,000 apply to a selective four-year college, compared to over 46 percent from families with income of at least $70,000. Note that low-income students make up the largest share of those who apply to no college or apply to a two-year college only.

A number of authors (for example, Bowen, et al., 2005) have noted the under-representation of low-income, high ability students in the pool of students who apply

[11] See U.S. Census Bureau (1997). Note that the NLSY97 round 1 parent interview asked parents to report income from calendar year 1996.

Table 2.1: Descriptive statistics, by type of college application

	Did not apply	Two-year college	Any four-year college	Non-selective four-year college	Selective four-year college
Number of four-year college applications	.000	.000	2.101 (1.541)	1.738 (1.182)	3.511 (1.919)
Selective college					
Apply to any selective	.000	.000	.205	.000	1.000
Accepted if applied	----	----	.733	----	.733
Non-selective college					
Apply to any	.000	.000	.942	1.000	.717
Accepted if applied	----	----	.961	.954	1.000
Distance variables					
Distance to selective four-year college	105.033 (186.407)	86.934 (125.703)	88.833 (148.251)	97.747 (158.855)	54.192 (88.663)
Distance to non-selective four-year college	10.600 (13.178)	10.861 (13.359)	9.658 (16.361)	10.190 (17.425)	7.591 (11.106)
Distance to two-year college	12.463 (19.603)	9.633 (12.732)	11.544 (15.291)	12.381 (16.386)	8.290 (9.286)
Personal characteristics					
Female	.454	.502	.548	.556	.519
Black	.256	.244	.233	.255	.148
Hispanic	.249	.249	.124	.129	.105
Math/verbal percentile score	36.517 (25.234)	41.480 (24.185)	64.960 (25.358)	61.229 (24.995)	78.643 (21.768)
High school grade point avg.	2.648 (.733)	2.792 (.664)	3.295 (.601)	3.218 (.606)	3.594 (.477)
Family characteristics					
Income < $25,000	.405	.327	.178	.189	.140
Income ≥ $25,000 and < $45,000	.252	.293	.233	.251	.167
Income ≥ $45,000 and < $70,000	.208	.233	.261	.269	.231
Income ≥ $70,000	.135	.147	.327	.291	.462
Biological mother's years of education	11.844 (2.539)	12.285 (2.875)	13.922 (2.797)	13.743 (2.739)	14.615 (2.915)

Table 2.1 Continued.

Family size	4.694	4.584	4.437	4.457	4.359
	(1.589)	(1.485)	(1.337)	(1.370)	(1.198)
Both biological parents	.469	.518	.651	.623	.759
Biological parent + step.	.166	.141	.100	.109	.068
Biological mother only	.288	.275	.202	.218	.139
Biological father only	.032	.029	.022	.024	.017
High school characteristics					
Private	.017	.012	.028	.018	.065
Catholic	.009	.030	.074	.062	.120
Log(school size)	6.945	7.012	7.004	7.000	7.022
	(.836)	(.774)	(.674)	(.670)	(.688)
Student/teacher ratio	17.026	17.520	16.583	16.518	16.846
	(5.861)	(5.963)	(5.152)	(4.892)	(6.088)
% Black	20.856	19.627	21.342	22.079	18.011
	(27.090)	(26.532)	(29.164)	(30.167)	(23.910)
% Hispanic	17.335	16.472	10.573	10.284	11.875
	(25.016)	(23.763)	(19.453)	(19.231)	(20.432)
% Chapter I	25.632	25.308	21.827	22.824	17.324
	(19.050)	(19.608)	(19.611)	(19.959)	(17.301)
Location characteristics					
Urban	.758	.773	.767	.746	.850
Log median income in county	10.486	10.493	10.531	10.512	10.605
	(.227)	(.222)	(.258)	(.259)	(.236)
Midwest	.218	.216	.254	.266	.207
West	.261	.304	.177	.172	.198
South	.359	.348	.370	.371	.367
State unemployment rate	4.065	4.111	3.890	3.896	3.866
	(.843)	(.772)	(.832)	(.842)	(.790)
N	965	546	1158	921	237

Note: Means, standard deviations in parentheses. Monetary values are in constant 1996 dollars. Distance is in miles. Means exclude any missing observations. Selective four-year college is defined as having a *Barron's Profile of American Colleges* (2001) rating of most or highly competitive.

to selective schools. We find this in the NLSY97 as well. Suppose we limit our sample to those who scored in the 75th percentile or better on the math/verbal portion of the ASVAB. Of these high-scoring youths who are from families in the bottom two quartiles of income, 65 percent apply to a four-year college, and of those, 25 percent apply to a selective four-year college. In contrast, of high-scoring youths who are in the top quartile of family income, 85 percent apply to a four-year college, and of those, 40 percent apply to a selective four-year college. Thus we see income differentials in the first stage decision—whether to apply to a four-year college at all—as well as in the second stage decision--whether to apply to a selective four-year college.

Table 2.1 shows that, on average, youths who apply to a selective college have a significantly shorter distance to a four-year selective college than youths who apply to non-selective four-year colleges: 54 miles vs. 98 miles. On average, students live significantly further from selective colleges than non-selective four- and two-year colleges. This differential reflects the small number of selective colleges and universities in the U.S. and their geographic distribution. For example, of the 146 colleges rated as selective, 46 percent are in the Northeast and about 57 percent are in the Northeast and California. To put this in perspective with respect to the NLSY97 sample, youths in the Northeast live less than 19 miles from a selective college, on average, but those who live in the South or Midwest average about 95 miles, and those in the West average about 149 miles.

The difference in average distance to a selective college also varies by income level. For example, in the NLSY97 sample, students from families in the lowest quartile of income live an average of 95 miles from a selective college, but students from families in the highest quartile of income live an average of 87 miles from a selective college. If instead, we look at a measure of whether a student has a selective

college within 50 miles of his or her high school residence, we find that 51 percent of students from low-income households have a selective college in close proximity compared to 63 percent of students from high-income households.

VI. Results

Marginal effects from independent probits and a bivariate probit with selection for the probability of applying to any four year college and the probability of applying to a selective vs. non-selective four-year college are shown in Table 2.2. The results from the two sets of equations are similar. A Wald test cannot reject the null hypothesis that the equations are independent ($p = .17$). Both variables used as exclusion restrictions are significant in the first stage. Given the richness of the NLSY97 data, we are able to account for much of the heterogeneity between youths through covariates.

Family income has a large effect in the first stage, but no effect in the second stage. This suggests that, all else equal (including test scores and high school grade point average), students with lower family incomes are less likely to be in the pool of applicants who apply to any type of four-year college. However, given they get past this hurdle, low-income students are not any less likely to apply to a selective college. Relative to the highest income group, youths in families in the lowest income quartile are about 16 percentage points less likely to apply to any four-year college, those in the next lowest income quartile are about 9 percentage points less likely to apply, and those in the second to highest income quartile are about 7 percentage points less like to apply. Policies that aim to increase the applicant pool of low-income students at elite four-year colleges may have to take into account that a number of these students are not applying to any four-year college.

A number of background characteristics are significantly associated with the likelihood of applying to a selective college. For example, students with higher aptitude, as measured by test scores, are significantly more likely to apply to a selective four-year college, relative to a non-selective four-year college. High school grade point average has the same type of effect. High school environment can play a major role in influencing students' college choice, by preparing students academically and also possibly by providing information about the availability of opportunities at more selective institutions. Students who attend private high schools are significantly more likely to apply to a selective college by about 16 percentage points. Students from low-income families are much more likely to attend public high schools than their higher-income peers.

Longer distances to a selective college decrease the probability of applying to one. The marginal effects from the bivariate probit suggest that a 75 mile increase in distance to a selective college (about half a standard deviation for the four-year application group) decreases the likelihood of applying to one by about 2 percentage points. When we interacted distance with family income quartiles, we found that the distance effect does not vary with family income. To get a feel for the magnitude of the distance effect, note that a .3 point increase in high school grade point average (about half a standard deviation for the four-year application group) increases the likelihood of applying to a four-year selective college by about 2.3 percentage points. Distance to the nearest non-selective college does not have a significant effect in either stage. In addition, the distance to a two-year college has a positive effect in the first-stage. As the distance to the nearest two-year college increases, the likelihood of applying to a four-year college increases.

Table 2.2: Four-year college vs. two-year or no college application and selective four-year college vs. non-selective four-year college application decisions, marginal effects from probits and bivariate probit with selection

	Probability of applying to a:			
	Four-year college (probit)	Selective college (probit)	Four-year college (bivariate probit)	Selective college (bivariate probit)
Distance variables				
Distance to selective four-year college	-.010 [a]	-.047*** [a]	-.001 [b]	-.026*** [a]
	(.010)	(.012)	(.001)	(.008)
Distance to non-selective four-year college	-.001	.001	-.001	.001
	(.001)	(.001)	(.001)	(.001)
Distance to two-year college	.002**	----	.002**	----
	(.001)		(.001)	
Personal characteristics				
Female	.046**	-.033	.044**	-.020
	(.022)	(.023)	(.022)	(.014)
Black	.163***	-.026	.164***	-.021
	(.039)	(.038)	(.039)	(.022)
Hispanic	.030	-.047	.027	-.030*
	(.039)	(.033)	(.039)	(.018)
Math/verbal percentile score	.067*** [b]	.031*** [b]	.068*** [b]	.016*** [b]
	(.001)	(.006)	(.005)	(.004)
High school grade point average	.246***	.150***	.248***	.078***
	(.017)	(.023)	(.017)	(.012)
Family characteristics				
Income < $25,000	-.156***	.049	-.156***	.038
	(.038)	(.050)	(.038)	(.034)
Income ≥ $25,000 and < $45,000	-.093***	-.006	-.092***	.002
	(.036)	(.034)	(.036)	(.021)
Income ≥ $45,000 and < $70,000	-.069**	-.041	-.067*	-.021
	(.035)	(.028)	(.035)	(.016)
Biological mother's years of education	.033***	.003	.034***	.001
	(.005)	(.005)	(.005)	(.003)
Both biological parents	.140***	.042	.141***	.021
	(.032)	(.037)	(.032)	(.023)
Biological mother only	.077*	.014	.081**	.005
	(.042)	(.053)	(.041)	(.031)
Biological father only	.048	-.062	.055	-.035
	(.072)	(.063)	(.072)	(.031)

Table 2.2 Continued.

High School characteristics				
Private	.150*	.256**	.159*	.163*
	(.088)	(.109)	(.087)	(.089)
Catholic	.311***	.093*	.311***	.043
	(.062)	(.056)	(.062)	(.034)
Log(school size)	.046**	-.022	.049**	-.018
	(.019)	(.023)	(.019)	(.014)
Student/teacher ratio	.001	.002	.001	.001
	(.002)	(.002)	(.003)	(.002)
% Black	.001	.002**	.001	.010** [b]
	(.001)	(.001)	(.001)	(.005)
% Hispanic	-.001	.003***	-.001	.016*** [b]
	(.001)	(.001)	(.001)	(.006)
% Chapter I	.003***	-.002**	.003***	-.0015** [b]
	(.001)	(.001)	(.001)	(.007)
Location characteristics				
Urban	.003	.064***	.006	.036**
	(.030)	(.024)	(.030)	(.014)
Log median income in county	.062	.096*	.051	.063*
	(.058)	(.055)	(.058)	(.033)
Midwest	-.061*	-.055*	-.066*	-.028
	(.036)	(.029)	(.036)	(.017)
West	-.146***	.008	-.144***	.005
	(.040)	(.041)	(.040)	(.025)
South	-.064*	.014	-.064*	.013
	(.034)	(.033)	(.034)	(.021)
State unemployment rate	-.040**	----	-.036**	----
	(.016)		(.015)	
Rho (ρ)		---	.998	
			(.009)	
Log likelihood	-1305.921	-474.027	-1777.749	
N	2669	1158	2669	

Robust standard errors in parentheses. Conditional marginal effects are shown in the right-most column. *, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.
[a] Marginal effect and standard error multiplied by 100. [b] Marginal effect and standard error multiplied by 10.

To check the robustness of our key result regarding proximity to a selective college we create a number of alternative measures. The first set is for a 50-mile radius of the student's high school zip code: (1) the presence of a selective college within a 50-mile radius of the student's high school zip code, (2) a series of mutually exclusive dummy variables that describe whether the respondent has 1, 2, or 3 or more selective four-year colleges within a 50-mile radius, and (3) the number of freshman slots at selective schools within the 50-mile radius divided by 1000. The second set includes two mutually exclusive dummy variables for the presence of a selective college within a 50-mile radius and presence of a selective college between a 51- and 100-mile radius, as well as (1) and (3) above defined for a 100-mile radius rather than 50. In addition to verifying that our results are robust, these alternative measures allow us to examine whether the effect of college proximity is non-linear. On the one hand, students may only require one selective college within a certain radius to increase the likelihood that they will apply to one. On the other hand, an increase in the number of selective colleges in close proximity, and freshmen slots at these colleges, may further raise the probability of applying to one.

Table 2.3 shows college proximity marginal effects for selective colleges from six different probits of the probability of applying to any selective four-year college vs. only non-selective four-year colleges.[12] The probits control for all of the background variables included in the second stage estimates in Table 2.2. The results in Table 2.3 are very similar to those in Table 2.2: close proximity to a selective college raises the likelihood of applying to one. For example, having a selective college within a 50-mile radius increases the likelihood of applying to one by about 6 percentage points. Although it looks as though moving from having one to two

[12] Given our prior finding that we could not reject the null hypothesis that the first and second stage equations are independent, we estimate probits only. However, the results are very similar when we estimate bivariate probits.

Table 2.3: Alternative selective four-year college proximity measures: Selective four-year college vs. non-selective four-year college application decision, marginal effects from probits

	Descriptive statistics			Probit
	Four-year college	Non-selective four-year college	Selective four-year college	Pr(Apply to selective four-year college)
Specification 1: Have selective four-year college within a 50-mile radius	.592	.559	.717	.059** (.026)
Specification 2: Have one selective four-year college within a 50-mile radius	.205	.193	.249	.056 (.036)
Have two selective four-year colleges within a 50-mile radius	.098	.091	.122	.096* (.050)
Have three or more selective four-year colleges within a 50-mile radius	.289	.275	.346	.057 (.039)
Specification 3: Number of selective four-year college slots within a 50-mile radius/1000	3.147 (4.480)	2.920 (4.360)	4.027 (4.825)	.008* (.004)
Specification 4: Have selective four-year college within a 50-mile radius	.592	.559	.717	.090*** (.030)
Have selective four-year college within a 100 mile radius, but not a 50-mile radius	.139	.142	.127	.085* (.047)
Specification 5: Have selective four-year college within a 100-mile radius	.731	.701	.844	.080*** (.025)
Specification 6: Number of selective four-year college slots within a 100-mile radius/1000	6.852 (7.943)	6.435 (7.846)	8.474 (8.126)	.009*** (.003)
N	1158	921	237	1158

Note: Means, standard deviations in parentheses in first three columns. Marginal effects with robust standard errors in parentheses in last column. Specifications include controls for personal, family, high school, and location characteristics. *, **, *** indicate significance at 10%, 5%, and 1% levels, respectively.

selective colleges within a 50-mile radius increases the likelihood of applying to one, these two effects are not statistically different. The effect of the slots measure is modest--an increase in selective freshman slots within a 50-mile radius by 1500 (about one third of a standard deviation), increases the likelihood of applying to a selective college by 1.2 percentage points. Interestingly, the effects of having a selective college within a 50-mile radius (potentially commuting distance) vs. only one within a 100-mile radius are not statistically different. In addition, the results from the last two specifications are similar to those that used the 50-mile radius. The earlier finding of a negative and significant effect of distance to a selective college on the probability of applying to one appears robust to alternative proximity measures.

This paper has suggested two hypotheses about the effects of distance: (1) distance imposes costs and makes students less likely to apply to colleges far away and (2) living close to a selective four-year college exposes students to what this type of college has to offer and encourages students to try to attend a selective four-year college. It is difficult to differentiate between the two stories because both suggest the same sign in the college application equations: as distance to a selective college increases, the less likely a student is to apply to one.

A pure distance cost story would suggest that students who live in close proximity to a selective college would apply to that one, rather than a selective college farther away. This does not appear to be the case. About 72 percent of students who applied to a selective college in the NLSY97 lived within 50 miles of a selective institution. However, of these students, only 38 percent applied to the closest (give or take 25 miles), and in fact on average applied to institutions much further away. We would expect the cost story to be more binding for lower-income students, but the number is very similar (39 percent) for students from families in the bottom two

quartiles of income. The probit results using alternative measures of college proximity, shown in Table 2.3, also suggest that a true cost story may not fully explain the importance of distance. For example, a pure distance cost story would suggest that having a selective college within 50 miles would increase the probability of applying to one more so than having one between 51 and 100 miles. However, in specification (4) we cannot reject the null hypothesis that the effects are the same. These findings suggest that distance costs alone do not appear to be driving the results for the most selective colleges.

Our results fit well with those of past studies. We estimate a bivariate probit with selection to attempt to tease apart the impacts of factors affecting the decision to apply to a four-year college, and the decision to apply to any selective four-year college versus only non-selective four-year institutions. After controlling for a wealth of covariates and selection, we find that family income on its own is not a deterrent to applying to a selective college. These results are very similar to the findings of Toutkoushian (2001). Our results build on Turley's 2009 finding that college proximity impacts the likelihood of applying to a four-year college. We find that selective college proximity also impacts the likelihood of applying to a four-year selective college. We do not, however, find that proximity effects differ by family income, as found by Do (2004) and Frenette (2006) for the selective college enrollment decision.

Of course, we would be remiss not to mention that the application stage is only the first part of the puzzle of how to increase the representation of lower-income students at selective colleges. Students must be accepted at a selective college and then ultimately enroll. Do low-income students have similar acceptance rates to their high-income peers? Bowen, Kurzweil, and Tobin (2005) suggest that they do within their sample of 19 selective colleges and universities. We estimate some simple

probits to see whether income levels are related to the likelihood of being accepted at a four-year selective college, given the student applied to at least one. We control for all of the same variables in the selective college choice equations shown in Table 2.2, including test score and high school grade point average.

Our results indicate that students in the lowest income quartile are about 26 percentage points less likely to be accepted at a selective four-year college relative to their peers in the highest income quartile. The addition of a control for the number of selective college applications the student submitted causes the marginal effect to increase. Clearly, we have a selection problem, in that we are conditioning our sample on students who apply to selective colleges. In addition, the number of low-income students who apply to selective schools in the NLSY97 sample is low. However, these results provide some suggestive evidence that even once low-income students get past the hurdle of applying to at least one selective college, something that very few low-income students do, they are less likely to be accepted. Perhaps this is due to non need-blind admissions practices at some colleges. If a student is on the margin for acceptance, perhaps some colleges take into account the amount of funding each student would require to enroll. If this is occurring, lower-income students may be at a disadvantage at the acceptance stage. Research using a larger data set could shed more light on this issue. But the results here point to another potential reason for the under-representation of low-income students at selective colleges—lower acceptance rates.

VII. Conclusion

Low-income students are under-represented at selective four-year colleges and universities. Remedying this problem could potentially increase social mobility for low-income students as well as boost socioeconomic diversity within colleges. A

number of selective institutions have implemented programs aimed at increasing the representation of students from low-income families. Most of these programs involve the lowering or elimination of tuition costs for qualified low-income students. However, tuition costs of college may not be the only hurdle facing these students. About 46 percent of the more selective institutions in the United States are located in Northeastern states, and many of the low-income students that could attend these colleges are located in geographically distant states. Physical distance from a selective college may be an important issue to low-income students for both financial and non-monetary reasons, such as convenience, travel costs, and the option of living at home. A nearby college or university may also provide spillover effects by raising awareness of opportunities available at colleges and creating a college-going expectation for nearby youths.

This paper uses data from the NLSY97 to analyze the relationship between various personal, family, school, and geographic background characteristics and the likelihood of applying to a selective four-year college or university. Particular attention is paid to the influence of distance to selective colleges, and whether the effect differs for low-income students. Basic means show that students who apply to selective four-year colleges live almost half as far from an elite institution as students who apply to non-selective four-year colleges. In addition, a lower proportion of students from families in the lower two quartiles of income apply to a selective four-year college compared to a non-selective four-year college.

We estimate a bivariate probit with selection. The first stage (selection) is the probability of applying to any four-year college, and the second stage is the probability of applying to any four-year selective college vs. only non-selective four-year colleges. The results suggest that lower-income students are much less likely to apply to any four-year college. However, income does not appear to impact the

likelihood of applying to a selective college. Distance to a selective four-year college has a significant impact on the probability that a student will apply to a selective school. As the distance to the closest selective college increases, students are less likely to apply to this type of college, all else equal. Low-income students do not seem to be any more sensitive to distance than their high-income peers.

The findings from this paper can provide some suggestions for selective colleges that are trying to increase their representation of students from low-income families. First, a number of high-test score students from low-income families are not applying to any four-year colleges. As advocated by Koffman and Tienda (2008), increased recruitment of top students from poor high schools may be productive. Second, the geographic mismatch of low-income students and selective institutions appears to be a factor in the college application process. Helping low-income students with travel costs and logistics may increase a school's attractiveness. In addition, educating students in lower-income and education areas that are far from any selective colleges about the opportunities available at selective colleges may be fruitful. Finally, it appears that, all else equal, low-income applicants to selective colleges are less likely to be accepted. Future research that examines the acceptance decisions in more detail, as well as factors that affect enrollment behavior, can provide further insight into how to increase the representation of students from low-income families at selective four-year colleges and universities.

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CHAPTER 3

DETERMINANTS OF GRADES, PERSISTENCE AND MAJOR CHOICE FOR LOW-INCOME AND MINORITY STUDENTS

I. Introduction

There has been a recent push by post-secondary institutions, policy-makers, and educational researchers, to address the issue of under-representation of high-ability low-income students at our nation's colleges and universities[13]. This is in addition to the on-going push to increase enrollment of under-represented minorities at four-year colleges and universities. Studies have found that there is a wage premium associated with graduating from an elite college or university, where the under-representation of minority and low-income students is the most dramatic (see for example Brewer, Eide &Ehrenberg, 1999). In particular, research has shown that low-income students that graduate from a selective college or university enjoy a wage premium (Behrman, Constantine, Kletzer, McPherson & Schapiro, 1996; Dale and Krueger, 2002). Increasing the number of low-income and minority students that receive degrees from elite colleges and universities therefore will increase lifetime earnings for these students, as well as possibly have benefits in terms of intergenerational income mobility.

Many individual post-secondary institutions have announced programs in the past few years, mostly financial aid based, aimed at attracting and enrolling more students from low-income backgrounds. Currently, the majority of these institutional

[13]There is a fairly sizeable population of low-income students in the U.S. with test scores high enough to attend selective institutions (Hill, et al., 2005). However, students from the bottom of the income distribution make up a much smaller percentage of the student bodies at the most selective institutions than one would expect given the size of the potential pool of high-ability low-income students (see for example Ehrenberg, 2006; Hill et al., 2005; Heller, 2004).

programs are focused on increasing matriculation of low-income students at their institutions and preliminary research from Harvard suggests that the program there has been somewhat successful in its goals. (Avery, Hoxby, Jackson, Burek, Poppe & Raman, 2006) However, as of yet, there has been less of a focus on the determinants of educational outcomes of minority and low-income students enrolled at elite colleges and universities and how these outcomes can be improved. Once they have matriculated, do students from these sub-groups do equally well in terms of their educational outcomes, such as grade point average (GPA), or persistence? How do their own characteristics and those of the institution they attend affect their choices of college major? Although there is a body of research examining measures of college success such as GPA and persistence, very little of this work has focused on how the importance of the determinants of these outcomes may differ for students from low-income backgrounds or those from underrepresented minority groups. This paper focuses on how the fit, both academic and social, between the student and the institution they attend impacts his/her educational outcomes, and how the importance of these measures of fit may differ for students from different income and racial backgrounds.

Low-income and minority students face a number of hurdles at selective four-year institutions both academically and socially. Income and race have been found to be correlated with test scores - minority and low-income students on average tend to have lower test scores and be less well-prepared educationally when they enter college. This may affect their success at elite colleges and universities, where median test scores are very high and the average student has been very well prepared for this level of study. The importance of fit between a student and their institution in terms of test scores may differ for students from low-income and minority backgrounds. These students may find themselves more or less capable than the average student of

overcoming this kind of hurdle, perhaps due to their background. Socially, the environment at these institutions may be very unfamiliar for students from these groups. The student bodies at these colleges and universities have very low percentages of low-income and minority students which may have social consequences for students from these groups that may in turn have educational spillovers. If students feel out of place because there are not many other students from similar backgrounds with which to form friendships and study-groups, their coursework and other outcomes may suffer. Or, it may be the case that these students could do better in an unfamiliar environment as this may cause them to reach outside of their comfort zone and form bonds with students of different backgrounds, which could in turn enhance their learning and educational outcomes.

For these reasons, it is important to study how the interaction between students' own characteristics and those of the institution they attend can affect their outcomes. This paper will attempt to shed light on the post-secondary educational experiences of low-income and minority students, with a focus on students attending elite colleges and universities. To do this I use two datasets, the *National Longitudinal Survey of Freshmen (NLSF)* and the *National Education Longitudinal Study of 1988 (NELS:88)* to examine the determinants of college GPA, persistence and college major choice. This paper proceeds as follows. Section II discusses the literature in this area and discusses in more detail the hypotheses this paper tests. Descriptive statistics are found in Section III, followed by Results in Sections IV, V, VI and VII and then concluding remarks.

II. Background and Empirical Approach

Two ways to measure college success are grades earned during college and persistence to a Bachelor's degree. Research has shown that both measures are

closely linked with future success and earnings. All else equal, students with higher GPAs upon graduation have been found to have higher future incomes. Results of studies suggest that a full one point increase in college GPA is associated with roughly a 9% increase in earnings (Jones & Jackson, 1990). In a separate paper, Wise finds a much smaller average effect of GPA on earnings, but his results suggest that the effect is almost twice as large for students graduating from more selective institutions (1975). Graduate and professional programs also take college GPA into account when admitting students, and therefore GPA can have important consequences for further education. Many studies have found that the wage premium associated with a four-year degree is larger for those students receiving a degree from a more selective institution, as measured by median SAT scores (see for example Brewer, Eide & Ehrenberg, 1999). A typical finding is that a one hundred point increase in median SAT scores of an institution is associated with a 3-7% increase in future earnings (Kane, 1998). Although Dale and Krueger (2002) don't find this connection for all students[14], their results suggest that students from low-income families enjoy an 8% earnings increase for a 200 point increase in the median SAT scores of the institution they attend. Additionally, a 2005 study by Thomas and Zhang shows that graduating from a more selective institution not only leads to higher salaries, but also to higher levels of wage growth after graduation. These findings suggest that understanding what factors can impact both college GPA and persistence is important. Past research has examined how student and institutional characteristics can impact GPA and persistence, but there has not been a focus on how interactions between these two groups of characteristics can impact educational outcomes.

[14] Dale and Krueger do find that students graduating from institutions with higher expenditures per student enjoy a wage premium (2002).

Studies have found that both test scores and high school GPA are significant predictors of college GPA and persistence. Students with higher test scores and grades have demonstrated higher ability prior to entering college, and therefore tend to perform better in college and are more likely to persist to a four-year degree (Cohn, Cohn, Balch & Bradley, 2004; Titus, 2004). In addition to showing scholastic ability, these measures also indicate that students that are better prepared during their time in high school to do college level work and earn higher grades in their college courses. In terms of institutional characteristics, research has shown that students attending more selective institutions are more likely to persist to a degree (Titus, 2004).

There has been relatively little work examining how interactions between college characteristics and personal characteristics can impact the educational outcomes of students. It is possible to measure how good of a fit a student has with their chosen institution along two main dimensions, academic and social. The research in this area has mostly focused on the first measure, with many studies examining how affirmative action affects the outcomes of students in minority groups. This body of research generally finds that minority students on average have test scores below that of the average at the institution they attend, but that this does not impact their probability of graduating[15]. Minorities attending selective colleges and universities in fact seem to be more likely to graduate, suggesting that the hurdles they may face at these elite institutions do not ultimately harm persistence (see for example Bowen & Bok, 1998; Alon & Tienda, 2005; Cortes & McFarlin, Jr., 2008). Fischer and Massey show that for Black and Hispanic students, having an SAT score below the institutional average actually leads to a slight increase in first-year GPA (2007). Light and Strayer use student test score quartiles and institutional quality measures to

[15] Loury and Garman, in their 1993 AER and 1995 JOLE papers, report an exception to this general pattern of findings. Using the NLS72, the authors find that Black students earn lower GPAs and have lower future incomes if they are "mismatched" with their institution.

show that students are more likely to graduate if they are well-matched quality wise with the institution they attend (2000). Bowen and Bok, using the *College and Beyond* database, show that graduation rates increase for both Black and White students of all SAT levels as the quality of the institution attended increases (1998). These studies provide evidence that academic institutional fit can play a role in determining educational outcomes, but it is still unclear how important this measure of fit is and how its effect may differ for students from different racial and income groups.

The evidence on the importance of social integration is less developed. Research has shown that peers can affect academic performance. Studies examining peer effects using the ability of randomly assigned roommates in college have found evidence that students have higher educational outcomes if they associate with higher ability students (Sacerdote, 2001; Zimmerman, 2003). Results of these types of studies suggest that the formation of social networks by students in college can have importance consequences for their educational outcomes. A body of research focusing on the formation of social networks by undergraduate students has found that both race and income can play an important role. Mayer and Puller (2008) use friendship formation on the website Facebook.com for students at ten Texas Universities to examine the importance of race in social interactions. They find that race is a significant determinant of a friendship formation, particularly for non-white students. Similarly, using the volume of emails between Dartmouth students as a measure of social interaction, Marmaros and Sacerdote (2006) find that within-race interactions are more likely to occur. Additionally, the authors find that aided students are more likely to interact with other aided students than with a non-aided student, suggesting that family income, in addition to race, is important in social group formation by undergraduate students.

Therefore, it seems logical that the composition of the student body at the institution a student attends could affect the formation of his/her social network in college, and therefore their educational outcomes. Fletcher and Tienda (2008), with a sample of students at one large University in Texas, show that students with more peers at college that attended the same high school do slightly better in their first-year GPA and are slightly more likely to persist past the first two years. They also find evidence that for minority and disadvantaged students, increasing the number of students at the university from their high school from their own peer group (either defined by race or income) has a positive impact on both grades and persistence. The results of a study examining grades and satisfaction with college for students at a liberal arts college found that students felt a stronger sense of belonging and performed better academically if a larger percentage of the student body came from their own social class (Ostrove & Long, 2007).

The results of these studies provide suggestive evidence that the socio-demographic composition of an institution could affect educational outcomes such as grades and persistence for low-income and minority students. Students who feel more comfortable in their college surroundings - possibly because there are more students with similar backgrounds with which to form friendships - may perform better academically as a result. This may be because the effort they put into their work is more productive if they are socially comfortable or that students that are better able to form social networks are then better able to form study-groups and gain knowledge through their peers, therefore increasing their educational output. It is also conceivable that minority or low-income students at institutions with very few other students from their respective peer groups may benefit from this by forming friendships outside of their normal social group, which could have an impact on their educational outcomes. In particular, if this causes students to form social networks

and study groups composed of students with higher test scores than they would otherwise, this could positively impact educational outcomes.

In this paper I examine how measures of institutional fit, both academic and social, can affect educational outcomes of low-income and minority students. To do this, I estimate first-year and cumulative college GPA, and the probability of graduating from one's original institution within six years, transferring to a different institution, or dropping out of college altogether, as functions of a set of measures of institutional fit. Academic fit is measured by the difference between a student's own SAT score and the median SAT score of the four-year college or university that he or she attends. This measure is interacted with an indicator for low-income status and it is not immediately obvious what sign one would expect this interaction to take; are low-income students more or less sensitive to an increase in the test score gap? These students come from a very different background, both family and education wise, and therefore they may deal with a mismatch in quality very differently than higher income students. Low-income students may not be as well equipped to deal with the mismatch, as a result of fewer educational resources earlier in their lives. It is also possible that the low-income students that have found their way into these selective institutions are experienced with educational adversity and are better equipped to deal with a mismatch than your average student. Size of peer group, with peers defined by race or income status, is used to measure one element of social institutional fit. These measures are used to test whether students' academic outcomes are impacted on by the percentage of the student body at their institution that comes from their own peer group[16]. All models are also estimated separately by racial group to examine how the effects of institutional fit may differ for students of different races.

[16] There is evidence that minority students take into account the size of a peer group defined along race lines when choosing what college to attend, and therefore, this measure is likely endogenous (Griffith & Rask, 2005). It is unclear in which direction this bias may go. Minority students taking into account

Students that attend a college or university at which their SAT scores do not match well, either due to large gaps above or below, have gone through two particular steps to get there. First, the institution has chosen to accept the student knowing their test scores, and secondly, the student has chosen to enroll at the institution knowing how they will fit into the test score distribution of the student body. The impact of an academic "mismatch" for these students is likely quite different from that of the exogenous impact for the average student due to this selection. This suggests two policy questions. What is the exogenous effect of a large gap in SAT scores and the median score of the institution? What is the effect of a large gap in SAT scores for students that have been selected into this situation? Both are interesting questions, but this paper will focus on the second to investigate whether an academic "mismatch" affects educational outcomes for the distribution of students that we see enrolled at selective colleges and universities. I also will present results of an instrumental variables estimation of the exogenous impact of a "mismatch" in order to compare the effects. The results of this comparison are used to draw conclusions about the preferences of students and colleges, as well as to comment on the success of both at sorting low test score students into the "correct" institutions to maximize their educational outcomes.

In addition to understanding how the two measures of institutional fit affect grades and persistence, I examine their impact on a third type of outcome: student's choice of major. Earnings and occupational choice are linked to a student's choice of major during college and there is a wide body of research examining college major

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the size of the minority student population at an institution when making matriculation decisions may do so for a couple of reasons. They may be conscientious, hard-working students that pick the school with the best setting for them to succeed educationally, suggesting a positive bias. Students may instead care about social opportunities and be less concerned with how the size of the minority population will affect their grades, suggesting a possible negative bias. Ideally, one would instrument for peer group size, but unfortunately a valid instrument is not available in this data set.

choice. Studies have found that socioeconomic status can affect choice of major, and that this effect can differ by gender (Leppel, Williams & Waldauer, 2001). In particular, they find that low-income students tend to be less likely to major in fields associated with risky income returns, such as Business (Saks & Shore, 2005). However, a 2005 study by Bowen and co-authors examining college major choice of students at 19 selective colleges and universities in the U.S. finds that the pattern of college major choice for low-income students is very similar to that of higher-income students. Other studies have also found that major choice can differ by race and in particular that black students are less likely to choose majors in Business or STEM fields like engineering and the physical sciences (Loury & Garman, 1995). Here, I examine how the measures of institutional fit described above can impact on major choice, with a focus on the measures of social fit. The socioeconomic and racial composition of the institution a student attends may influence the make-up of the social networks formed during college. This may in turn affect course-taking behavior, and ultimately choice of college major.

III. Data and Descriptive Statistics

In order to investigate these questions, I use two restricted-access longitudinal datasets, the *National Longitudinal Survey of Freshman* (NLSF) and the *National Education Longitudinal Study of 1988* (NELS:88). The NLSF consists of a sample of about 4000 students that first enrolled at 28 selective colleges and universities in the fall of 1999. The sample and survey were modeled after the Andrew W. Mellon Foundation *College and Beyond* survey, with a few differences in the sample of institutions included. Minority students are over-sampled in this dataset, resulting in relatively equal numbers of students from each of four groups: White, Black, Hispanic and Asian. This sampling design allows for an in-depth analysis of how the effects of

the explanatory variables differ between racial groups. Follow-up surveys were administered in the spring of each year for the first four years after matriculation. In each wave, students are asked to report what college courses they took in each semester of that year, and what grades they received in each class. This can then be used to calculate their GPAs for each semester, as well as their cumulative GPAs for all four years[17]. The data also includes an indicator for whether students receive a degree within six years, and if students transferred from their original institution.

The NELS:88 is a nationally representative dataset that surveyed approximately 24,000 students in eighth grade in 1988. These students were administered follow-up surveys in the tenth and twelfth grades, as well as during their post-secondary experiences. Roughly 4,500 students in this sample attended a four-year college or university immediately following graduation from high school, and the study includes full college transcripts for these students. This paper uses data on high school characteristics, test scores and family background information from the second follow-up, administered while the students were in their senior year of high school. Outcomes of college GPA and whether the student received a Bachelor's degree and/or transferred from his/her original institution are reported in the transcript studies.

For both samples, data on institutional characteristics were compiled from three main sources. Information on educational expenditures per student, control of the institution (Public or Private), and percentage of the student body from each racial group was obtained from the IPEDS database. Median SAT scores for each institution in the samples were obtained from the College Board's *Annual Survey of Colleges*

[17] A transcript study by Massey, et al. (2003) verified that self-reported grades were very similar to actual grades received and produce similar results when used in estimations.

data[18]. The percentage of the student body that receives Pell Grants is used as a proxy for the percentage of students at each institution from low-income families. All institutional characteristics were collected for the year in which students started their post-secondary study (for NELS:88 this is the 1992-1993 academic year, for the NLSF, this is the 1999-2000 academic year[19]).

Descriptive statistics for the student level variables from the NLSF and NELS:88 can be found in Tables 3.1 and 3.2 respectively, for the whole sample and broken down by income and race. Here, low-income is defined as all students reporting family incomes of less than $35,000 in their senior year of high school[20]. It is immediately noticeable that the NLSF successfully sampled all four main racial groups fairly equally. This is helpful in this study, allowing larger sample sizes for minority groups, as well as a larger sample of low-income students. Although average high school GPA is similar across the two income groups in both samples, SAT scores are markedly different. Students from low-income backgrounds on average have SAT scores about 90 points lower than their higher income counterparts. As a result, 70% of low-income students in the NLSF sample attended an institution at which their personal SAT score is below the median SAT score of the school, while only 50% of higher income students did so. Of the students that have SAT scores below the median of their institution, low-income students have average scores that are much lower than the median, on average about 50 points lower than higher income students.

[18] What is referred to as a median SAT score in this paper is actually the midpoint of the inter-quartile percentile range. Assuming SAT scores within this range at an institution are not clumped at one end or another, this measure is a good approximation of the median.
[19] Institution-level data is not available from IPEDS for the 1999-2000 year so these variables are taken as the average of the values reported in 1998 and 2000.
[20] Family income is only reported in ranges in both data sets and therefore a continuous measure of family income is not available. Although $35,000 is not an equivalent family income in both time periods due to inflation, this paper uses the same income cut-off as the next lowest cut-off in NELS:88 is much lower than $35,000 in 1999 dollars. Estimations using this lower cut-off ($25,000 in 1991 dollars) yield qualitatively similar results, but lose some precision due to small sample sizes. Results are also not sensitive to using a higher income cut-off in either data set.

Table 3.1: Descriptive Statistics for Student Variables (NLSF)

	Whole Sample	Income ≥35K	Income <35K	Black	Hisp.	Asian	White
Female	0.581	0.574	0.617	0.650	0.581	0.565	0.524
Black	0.268	0.240	0.403				
Asian	0.244	0.255	0.190				
Hispanic	0.233	0.217	0.314				
HS GPA	3.701	3.714	3.639	3.554	3.700	3.786	3.775
	(0.331)	(0.322)	(0.368)	(0.375)	(0.325)	(0.281)	(0.274)
HS private	0.289	0.301	0.229	0.296	0.335	0.245	0.282
SAT	1304	1318	1228	1194	1278	1374	1359
	(161)	(156)	(167)	(167)	(140)	(135)	(133)
SAT<MedianSAT	0.532	0.498	0.708	0.812	0.678	0.310	0.360
Difference in SATs if below Median	127 (110)	117 (107)	164 (113)	167 (127)	124 (95)	80 (77)	87 (86)
Parent: BA	0.240	0.235	0.264	0.264	0.248	0.243	0.204
Parent: Grad degree	0.537	0.607	0.193	0.413	0.442	0.595	0.700
Income < $35,000	0.176			0.266	0.238	0.137	0.065
Income < $50,000	0.297			0.383	0.439	0.577	0.068
GPA First-Year	3.177	3.208	3.025	2.980	3.094	3.308	3.336
	(0.509)	(0.490)	(0.567)	(0.517)	(0.528)	(0.454)	(0.440)
Cumulative GPA	3.248	3.276	3.113	3.047	3.193	3.372	3.393
	(0.438)	(0.422)	(0.485)	(0.439)	(0.443)	(0.383)	(0.385)
Grad Orig. Inst. 6 yrs	0.828	0.843	0.768	0.757	0.822	0.871	0.869
Transfer	0.111	0.106	0.124	0.141	0.127	0.078	0.096
Dropout	0.061	0.050	0.109	0.102	0.051	0.051	0.035
Major Humanities	0.067	0.069	0.059	0.053	0.075	0.057	0.083
Major Soc. Sci.	0.145	0.140	0.166	0.173	0.165	0.109	0.130
Major Bus./Econ.	0.091	0.094	0.080	0.070	0.072	0.120	0.103
Major STEM	0.180	0.181	0.176	0.137	0.159	0.224	0.203
N	3924	3261	663	1051	916	959	998

There are also significant differences in test scores across racial groups. Black and Hispanic students have significantly lower SAT scores on average and are more than twice as likely than Asian or White students to attend an institution at which their personal scores are below the median. For students with SAT scores below the median, the gaps are much larger for Black and Hispanic students, than for White and

Table 3.2 : Descriptive Statistics for NELS:88

	Whole Sample	Income≥35K	Income<35K
Female	0.553	0.525	0.606
Black	0.079	0.056	0.146
Asian	0.103	0.101	0.108
Hispanic	0.077	0.061	0.127
HS GPA	3.155	3.172	3.109
	(0.565)	(0.562)	(0.571)
HS Private	0.229	0.265	0.125
Pct. Free Lunch G12	15.535	13.128	22.556
	(18.785)	(16.983)	(21.796)
SAT	1078	1100	1013
	(179)	(175)	(174)
SAT < Median	0.49	0.40	0.41
Difference in SATs	130	124	149
if below Median	(89)	(86)	(94)
Par: Some College	0.338	0.287	0.476
Par: BA	0.237	0.264	0.162
Par: MA	0.170	0.212	0.056
Par: PhD/Prof. Deg.	0.114	0.150	0.016
Income < $35,000	0.262		
GPA First-Year	2.693	2.734	2.574
	(0.744)	(0.720)	(0.799)
Cumulative GPA	2.822	2.871	2.679
	(0.683)	(0.647)	(0.760)
Grad Orig. Inst. 6 yrs	0.565	0.601	0.500
Transfer	0.212	0.222	0.172
Dropout	0.224	0.178	0.329
N	4140	3090	1060

Asian students. These numbers suggest that if there is a link between entering college with SAT scores well below the median at an institution and educational outcomes, then low-income and minority students are more likely to be impacted than other students.

Tables 3.1 and 3.2 also suggest that low-income and minority students are at a disadvantage in terms of outcomes during college. Low-income students have first

year GPAs that are 0.2 points lower on average than higher income students. This gap narrows slightly by senior year in the NLSF sample, but remains significant, and does not narrow at all for the NELS:88 sample. Black and Hispanic students also have lower GPAs then White and Asian students in both the first year and cumulatively, and these gaps do not narrow. We see a similar pattern with persistence in the NLSF sample. Low-income and minority students are less likely to have graduated from their original institution within 6 years, and are more likely to have transferred from their original institution or dropped out of college altogether[21]. In the NELS:88 sample, it is the case that low-income students are less likely to have graduated from their original four-year institution within six years, and more likely to have dropped out of college altogether. However, in this sample, low-income students are actually less likely to have transferred to another college than their higher income peers.

Descriptive statistics for choice of college major by senior year for the students in the NLSF sample are also shown in Table 3.1. Students are about twice as likely to major in a STEM field or a Social Science, than Humanities or Economics/Business. Some of these differences in means may be due to the programs available to major in at each of the institutions included in this sample. There are not any immediately obvious differences in major choice for the two income groups, although low-income students are slightly less likely to have majors in the Humanities or Business/Economics, there is not a significant difference in means. This may be due to the typically low returns to Humanities majors, and high variability in returns to Business/Economics majors, a behavior that has been documented in the literature. There are some significant differences in major choice across races. Black and

[21] Here dropping out is defined as having not transferred away from or received a Bachelor's degree from one's original institution within 6 years of matriculation. Transfer students have transferred from their original institution to another four-year college or university, but these students may or may not have received a degree within 6 years of matriculation.

Hispanic students seem to be concentrated in Social Science and STEM majors, as well as in majors not included in any of these main categories, whereas White and Asian students seem to be concentrated in Social science, Business/Economics, and STEM majors. This grouping of Black and Hispanic students in STEM majors seems contradictory to the findings of some past research, but is very similar to the findings of Bowen et al. (2005). As that study focused on fairly selective colleges and universities and also found very little difference across races in college major choice, it seems likely that the difference is a result of the highly selective nature of both the students and institutions in the NLSF.

Table 3.3 contains descriptive statistics for the samples of four year institutions attended by students in each of the two data sets. Panel A shows the sample of 28 four year schools in the NLSF, 82% of which are private. This is a sample of highly selective institutions with educational expenditures per student at $44,000 on average[22], and an average median SAT score of 1326. Showing the under-representation of low-income students at elite colleges and universities, the percent of students receiving Pell Grants is 15%. However, there is much variation between institutions in the NLSF sample as this percentage ranges from 8% to 44%. These colleges and universities also have low percentages of students from minority groups with these percentages ranging from less than 1% to over 87%[23].

A set of similar statistics for the sample of schools attended by students in the NELS:88 data are displayed in Panel B. These institutions are far less selective, and

[22] A number of institutions attended by students in the NLSF sample have exceptionally high educational expenditures per student, leading to a fairly high average. However, the median of educational expenditures per student is still quite high, at almost $32,000 per student.
[23] One institution surveyed in the NLSF is a Historically Black College or University (HBCU), which is generating the very high maximum for percent minority. If one looks at the sample of institutions not considered to be HBCUs, the maximum on percent minority is 40%

Table 3.3: Descriptive Statistics for Institutions attended by students in the NLSF & NELS:88 Samples

Panel A: NLSF Institutions

	Mean	Std. Dev.
Private	0.82	0.39
Educ. Exp/student	43.58	32.94
Median SAT	1326	92
Inst.GPA1	3.19	0.13
Inst. GPA	3.27	0.12
Pct. Pell	15.20	8.26
Pct. Black	9.23	15.36
Pct. Hispanic	4.84	2.60
Pct. Asian	11.55	8.01
N	28	

Panel B: NELS:88 Institutions

	Mean	Std. Dev.
Private	0.54	0.50
Educ. Exp/Student	8.95	8.92
Median SAT	1098	110
Pct. Pell	28.81	14.70
Pct. Black	10.12	19.32
Pct. Hispanic	3.98	8.07
Pct. Asian	3.52	5.76
N	1040	

less likely to be private. The average educational expenditures per student is only $9,000[24] and the average re-centered median SAT score is 1098, about 200 points lower than for the institutions in the NLSF sample. These institutions also have a much larger average percentage of Pell Grant recipients, 29%. Due to these differences between samples, results of estimations using this sample of schools may be very different, but perhaps more representative of four-year colleges and universities in general and specifically of the population of less selective four-year institutions, than those resulting from the NLSF estimations. Therefore, the use of

[24] All dollar amounts were adjusted for inflation to $1999, using the inflation calculator at www.bls.gov/data/inflation_calculator.htm

both datasets allows us to directly compare how results differ for students at very selective colleges and universities, as in the NLSF, and for those at four-year institutions across a broader range of selectivity as seen in NELS:88.

IV. Results: Determinants of GPA

Cumulative and first-year GPA were estimated using the Tobit function shown below in equation (1) in order to take into account a small amount of clustering (roughly 10% of the sample) at a GPA of 4.0. Results are quantitatively very similar to those using OLS, but there is a slight gain in efficiency. Assuming that there is a continuous underlying variable GPA° that correctly measures grade point average but that we only observe the variable GPA such that:

$$GPA = GPA^{\circ} \;\; if \;\; GPA^{\circ} < 4$$

$$GPA = 4 \;\; o.w.$$

One can then maximize the following likelihood function in (1) to obtain consistent and unbiased estimates of β.

$$(1) \qquad \mathcal{L}(\beta, \sigma) = \left[1 - \Phi\left(\frac{x'\beta}{\sigma}\right)\right]^{1-d} \cdot \left[\frac{1}{\sigma}\phi\left(\frac{1}{\sigma}\left(GPA - \frac{x'\beta}{\sigma}\right)\right)\right]^{d}$$

Where d is an indicator equal to 1 if $GPA^{\circ} < 4$, and equal to 0 otherwise.

Results for Tobit estimations of college GPA in the first year and cumulative for the first four years, using the NLSF dataset are shown in Tables 3.4 and 3.5 respectively. All four columns include controls for personal characteristics, such as gender, race, parent's education level, high school GPA, composite SAT score, whether they attended a public or private high school, and main course of study in

college, as well as institution characteristics, such as expenditure per student, control (public or private) and the mean and variance of GPA at the institution level[25].

Table 3.4:Determinants of First-year GPA (NLSF)

	Whole Sample	Black	Hispanic	Asian	White
Black	-0.153				
	(0.020)***				
Hispanic	-0.13				
	(0.016)***				
Asian	-0.004				
	(0.017)				
High School GPA	0.439	0.419	0.381	0.513	0.495
	(0.026)***	(0.050)***	(0.077)***	(0.054)***	(0.054)***
Private High School	0.037	0.099	0.018	-0.016	0.059
	(0.021)*	(0.030)***	(0.037)	(0.038)	(0.034)*
Income< $35,000	0.022	0.062	-0.106	0.182	-0.059
	(0.054)	(0.089)	(0.077)	(0.087)**	(0.201)
Income ≥ $75,000	0.041	0.07	0.073	-0.024	0.047
	(0.021)*	(0.027)***	(0.036)**	(0.037)	(0.031)
Dist. Sat Below Median	-0.083	-0.058	-0.088	-0.061	-0.068
	(0.025)***	(0.030)*	(0.050)*	(0.046)	(0.037)*
Low Inc. x Dist. Below Median	-0.027	-0.046	0.031	-0.098	0.083
	(0.021)	(0.028)*	(0.026)	(0.058)*	(0.035)**
Dist. SAT above Median	0.154	0.204	0.156	0.149	0.107
	(0.024)***	(0.050)***	(0.049)***	(0.021)***	(0.034)***
Low Inc. X Dist. Above Median	-0.091	-0.108	0.09	-0.254	0.049
	(0.065)	(0.060)*	(0.069)	(0.114)**	(0.105)
Pct Pell Grant	0.002	0.006	0.001	0.002	-0.001
	(0.001)*	(0.002)**	(0.002)	(0.001)*	(0.002)
Low Inc. x PctPell	0.001	0.002	0.001	-0.003	0.006
	(0.001)	(0.004)	(0.003)	(0.003)	(0.008)
Pct Own Race		0.002	0	-0.003	0
		(0.001)*	(0.006)	(0.001)***	(0.001)
Observations	3748	1009	875	915	949

Notes: Robust standard errors in parentheses. * significant at 10%; **significant at 5%; *** significant at 1%. Includes controls for gender, SAT scores, parent's education, exp/student, mean and variance of institutional GPA, institution type and student's major course of study.

[25] Average institutional GPA and its variance were calculated using students in the NLSF sample. Assuming this was a relatively random sample, this measure should capture the institutional averages fairly well.

Table 3.5:Determinants of Cumulative GPA (NLSF)

	Whole Sample	Black	Hispanic	Asian	White
Black	-0.168				
	(0.022)***				
Hispanic	-0.114				
	(0.013)***				
Asian	-0.021				
	(0.017)				
High School GPA	0.392	0.368	0.344	0.455	0.467
	(0.020)***	(0.028)***	(0.065)***	(0.050)***	(0.038)***
Private High School	0.051	0.089	0.027	0.022	0.078
	(0.017)***	(0.021)***	(0.029)	(0.024)	(0.027)***
Income< $35,000	0.018	0.045	-0.057	0.109	0.057
	(0.033)	(0.056)	(0.081)	(0.067)	(0.185)
Income ≥ $75,000	0.03	0.055	0.046	-0.019	0.036
	(0.018)*	(0.029)*	(0.03)	(0.036)	(0.025)
Dist. Sat Below Median	-0.057	-0.025	-0.055	-0.061	-0.058
	(0.020)***	(0.026)	(0.047)	(0.032)*	(0.033)*
Low Inc. x Dist. Below Median	-0.026	-0.041	0.045	-0.109	0.001
	(0.013)*	(0.018)**	(0.028)	(0.046)**	(0.056)
Dist. SAT above Median	0.1	0.184	0.086	0.107	0.064
	(0.015)***	(0.043)***	(0.050)*	(0.021)***	(0.023)***
Low Inc. X Dist. Above Median	-0.017	-0.136	0.121	-0.107	-0.022
	(0.029)	(0.079)*	(0.068)*	(0.048)**	(0.101)
Pct Pell Grant	0.002	0.008	0.001	0.002	-0.002
	(0.001)***	(0.001)***	(0.001)	(0.001)**	(0.001)***
Low Inc. x PctPell	0	0	-0.002	0	0.001
	(0.001)	(0.002)	(0.003)	(0.002)	(0.008)
Pct Own Race		0.001	-0.004	-0.002	0
		(0)	(0.007)	(0.001)***	(0.001)
Observations	3748	1009	875	915	949

Notes: Robust standard errors in parentheses. * significant at 10%; **significant at 5%; *** significant at 1%. Includes controls for gender, SAT scores, parent's education, exp/student, mean and variance of institutional GPA, institution type and student's major course of study.

Looking at Tables 3.4 and 3.5, Column (1) in both tables shows the results for the estimation of GPA for the entire sample[26]. High-income students have slightly higher GPAs than middle-income students in both the first-year and cumulatively. Although low-income students have lower average GPAs, low-income status does not have a direct effect on GPA after controlling for personal and institutional characteristics and measures of institutional fit. However, even after controlling for personal and institutional characteristics and measures of institutional fit, Black and Hispanic students still earn lower GPAs in both the first year and cumulatively. As seen in past research, educational background is particularly important in determining college GPA. Students that performed better in high school, as measured by high school GPA, also earned higher grades in college and students that attended private high schools have higher GPAs in college. These findings provide support for the common practice of using these measures heavily in admissions decisions.

The degree of fit between a student and the institution they attend in terms of academic measures can also impact college GPA. Academic fit is measured by the gap between personal SAT scores and institution median SAT scores and this effect is allowed to differ for students with scores below and above the median to test for asymmetries. For students with SAT scores below the institutional median, the larger the gap in the scores, the lower the average GPA. This effect occurs both in the first year and overall, although the size of the effect decreases slightly by the fourth year. A higher-income student with a personal SAT score 100 points below the institutional median would on average have a cumulative GPA that was 0.06 points lower. This effect is stronger for low-income students, by about 0.03 GPA points, although the

[26] All estimation results reported for the whole sample are not weighted to take into account the specific sampling design to obtain relatively equal numbers of students from each racial group. However, when the data is weighted to be representative of the racial distribution we see at the institutions in the NLSF sample the results are very similar, and therefore results are not sensitive to this type of weighting.

coefficient is not significant for first-year GPA. Low-income students that enter college with SAT scores 100 points below the institutional median will on average have GPAs that are lower by 0.09 points than if they had attended an institution with median scores equal to their own[27]. Remember, 70% of all low-income students have SAT scores below the median, and the average gap is well over 100 points. Therefore, this is a significant group of students that is affected. Given results of past studies relating changes in GPA to earnings, this effect is small in terms of future earnings, but still significant. A 0.09 point decrease in GPA would be associated with less than a 1% decrease in lifetime earnings.

Students entering universities with SAT scores above the median receive higher GPAs, and the effect of the gap in scores is almost twice as large as for those with scores below the median. It is not altogether surprising that the impact of a gap in test scores is not symmetric for those below the median and those above. It may be that this positive gap in scores is measuring additional academic ability which is leading to higher grades received in college. It is also possible that students entering with scores below the median are positively influenced by their higher-scoring peers, and therefore the "cost" of entering with scores below the median is slightly mediated.

The grades of low-income students do not seem to be impacted by the size of their peer group as defined by income, a measure of social fit. It may be that this measure of peer group size is not precise enough, in that it doesn't directly measure the size of the peer group an incoming student may come in contact with most often, the number of low-income students in their own class. In some of the larger

[27] One might think that the effect of a large test score gap, either below or above, may differ by the range of SAT scores at the institution. Students at institutions with a fairly wide distribution of test scores may find a large test score gap to be less of a hindrance. Estimations including an indicator variable for schools with a large test score range (an inter-quartile range of greater than 200 points) show no evidence of this and if anything, suggest that students with large test score gaps below the median that attend schools with large test score ranges earn lower GPAs than those attending institutions with a "tighter" test score distribution.

universities, students may only come in contact with peers within their own school, field, or dorm, and the peer group size there may not be proportionate to that in the entire student body. Therefore, although there is not a significant result found here, it is possible that the available measure is just not fine enough to capture it.

Results of similar estimations of GPA for the NELS:88 data are reported in Table 3.6. Results from this sample, all four-year colleges or universities attended by students in the NELS:88 data, can be used to examine whether the results found using the NLSF are specific to students attending selective colleges or universities, or if these effects are universal to students attending four-year institutions. As with the NLSF results, there is no direct effect of income on college GPA in the NELS:88 sample. The farther below the median of the institution a student's personal SAT score falls, the lower their GPA in both their first year and cumulatively. A student with a SAT score 100 points below the median has a first year GPA that is 0.08 points lower. This gap shrinks slightly, to 0.06 GPA points, by their final year, but remains significant. Opposite to what was found with the NLSF data, low-income students with SAT scores below the median have *higher* GPAs in both their first and final years as this gap increases. On average, low-income students with SAT scores 100 points below the median will have first-year GPAs that are only 0.03 points lower, and the effect on cumulative GPA is almost negligible. The difference in results between the two samples is likely due to both differences in selectivity of the students and the institutions they attend. Low-income students at more selective institutions, as seen in the NLSF, receive lower grades than high-income students due to a large gap in SAT scores, whereas at the far less selective sample of institutions contained in the NELS:88 sample, low-income students with large test score gaps are able to perform better. Low-income students at selective institutions may have been less well prepared to adapt to the high level of work required to succeed in their courses. This same type

Table 3.6: Results for estimation of GPA and Persistence using NELS:88

			Multinomial Logit Coefficients	
	GPA1	**GPA**	**Dropout**	**Transfer**
Black	-0.039	-0.196	-0.041	-0.479
	(0.041)	(0.035)***	(0.162)	(0.194)**
			[1.36]	[-6.56]
Hispanic	-0.154	-0.116	0.437	0.142
	(0.047)***	(0.034)***	(0.168)***	(0.192)
			[5.83]	[0.08]
Asian	0.017	-0.088	-0.301	-0.075
	(0.038)	(0.027)***	(0.182)*	(0.156)
			[-3.71]	[0.11]
High School GPA	0.527	0.337	-1.25	-0.61
	(0.040)***	(0.023)***	(0.146)***	(0.110)***
			[-14.73]	[-3.95]
Private High School	-0.028	-0.036	-0.279	-0.081
	(0.03)	(0.021)*	(0.137)**	(0.124)
			[-3.44]	[-0.06]
Income<$35,000	-0.072	0.034	0.553	-0.752
	(0.064)	(0.048)	(0.260)**	(0.278)***
			[11.48]	[-12.83]
Dist. Sat Below Median	-0.083	-0.062	0.057	-0.185
	(0.020)***	(0.015)***	(0.086)	(0.089)**
			[1.64]	[-3.18]
Low Inc. x Dist. Below Median	0.047	0.062	-0.077	0.261
	(0.028)*	(0.021)***	(0.107)	(0.117)**
			[-2.25]	[4.46]
Dist. SAT above Median	0.084	0.069	0.389	0.099
	(0.026)***	(0.017)***	(0.119)***	(0.104)
			[5.00]	[-0.20]
Low Inc. x Dist. Above Median	0.05	-0.013	-0.375	0.039
	(0.044)	(0.034)	(0.189)**	(0.181)
			[-5.43]	[2.32]
Pct. Pell Grant	0.002	0.002	0.018	0
	(0.001)	(0.001)*	(0.005)***	(0.005)
			[0.26]	[-0.08]
Low Inc. X Pct. Pell	0.001	-0.001	-0.008	0.014
	(0.002)	(0.001)	(0.007)	(0.009)
			[-0.17]	[0.25]
Observations	3970	2410	910	860

Notes: Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. Average marginal effects for multinomial logit estimations included in brackets. All columns include controls for gender, race, high school type and GPA, SAT, % free lunch, parent's education, institution type, exp/student and Pct. residential.

of students attending less selective institutions may be able to substitute less difficult courses in order to keep their grades up, something that is likely not an option at more elite institutions as the level of work is very high in all courses. When an interaction between the gap in scores and an indicator for institutions with re-centered SAT scores greater than or equal to 1250 is included, results suggest that the impact of a gap in scores is greater at more selective schools. The results for the effect of a gap in SAT scores may be heightened at more selective schools, but these results may also have some implications for students at four-year institutions in general. Again, although the effect on GPA is significant, in terms of policy significance, the effects are small. Similar to the findings with the NLSF sample, the percentage of students at an institution receiving Pell Grants does not have a significant impact on the GPAs of low-income students.

In order to examine if and how these findings may differ by race, Tables 3.4 and 2.5 also show estimates of first-year and cumulative GPA for each of the four main racial groups separately, using the NLSF sample. There are some differences between the races that are immediately apparent. Low-income Asian students have higher first-year GPAs than their higher-income counterparts. This effect is no longer significant for cumulative GPA, but remains positive. Low-income Asian students are far more likely to be immigrants to the U.S. than their higher income counterparts; 46% of low-income Asian students are foreign-born whereas only 28% of higher income Asian students are. As immigrants or children of immigrants, these students may benefit from an additional drive to succeed in college in the United States. It is also possible that foreign-born low-income students have higher levels of academic preparation in their home countries, which allows them to perform better in their first

year of college[28]. As with the pooled sample, there is no direct effect of low-income status on GPA for students of the other three race categories. High school GPA is an important predictor of college GPA for all four groups, but having attended a private high school does not impact GPA for Asian and Hispanic students.

Academic fit plays a role in determining GPA for students of all races, but the effects differ by group. Students from all four groups have lower first-year GPAs the farther their SAT score is below the institutional median and the size of the effects decrease slightly by the fourth year and in some cases are no longer significant. Although negative for all groups, the coefficients are significant for all but Asian students in the first-year, and then only significant for White and Asian students in the cumulative GPA equations. The impact on first-year GPA of academic fit is largest for Hispanic students: a 100 point gap between their score and the median of their institution is associated with a 0.09 points lower GPA (0.06 for cumulative GPA). The results are similar for White and Black students but slightly smaller. Low-income Black and Asian students with large test score gaps below the median have even lower GPAs than a higher-income student in this position and for both groups this effect persists through the fourth year. A low-income Asian student with a SAT score 100 points below the institutional median would have a GPA 0.17 points lower on average in the fourth year.

Students from all four groups with personal scores above that of the median of the institution they attend earn higher GPAs both in the first-year and cumulatively as the gap between scores increases. The effect of a gap is much larger for students

[28] Estimations of GPA for the Asian sub-sample controlling for whether the student was born in the U.S. continue to show that low-income Asian students earn higher first-year GPAs than higher-income Asian students. It may be that low-income Asian students that are foreign-born and receive a substantial amount of their pre-college education outside of the U.S. are better prepared for college-level work. Unfortunately, I am unable to control for how long the student has been in the U.S. to test this theory.

scoring above the median than for those scoring below. For Black and Asian low-income students, this effect is slightly dampened, and the total effect is actually negative in the first-year and zero by the fourth year for low-income Asian students scoring above the median. Low-income Hispanic students scoring above the median experience a bump in cumulative GPA. Academic fit is therefore an important determinant of GPA, but this measure has varying effects depending on the race of the student and whether their scores fall above or below the median. Grades of low-income Black and Asian students are more sensitive to a large gap in test scores, particularly for students scoring below the median. Hispanic students with scores below the median do not earn significantly lower cumulative GPAs as this gap increases, but Hispanic students above the median do extremely well in terms of first-year and cumulative GPA, particularly so those from low-income backgrounds.

In order to examine the effects of social fit, both the percentage of low-income students in the student body and the percent own race in the student body are included in these estimations, to examine how the size of peer groups as defined along both income and race lines can affect grades earned in college. Percent own race significantly impacts GPA for Black and Asian students. If the percent of the student body that is Asian is 10% higher, Asian students would have on average 0.03 points lower first-year GPA and 0.02 points lower cumulative GPAs, which are small effects. For Black students, a higher proportion of the student body that is Black is associated wither higher first-year GPA by 0.02 points (for a 10% increase). For the other two groups, there is no effect of the percentage of one's own race in the student body. As we saw in the pooled sample, there is no effect of the size of the low-income peer group at their institution for low-income students of any race.

V. Results: Persistence

The multinomial logit function shown below in (2) was used to estimate the probability of graduating within 6 years from one's original institution, transferring from the original institution attended in freshman year, or dropping out of college.

$$(2) \qquad P(y = j) = \frac{e^{x\prime\theta_j}}{1 + e^{x\prime\theta_j}} \;\; for\; j = 0,1,2$$

Results of multinomial logit estimations of persistence for the NLSF sample are reported in Table 3.7, as well as separately for each of the main race groups in Table 3.8. Coefficients reported are relative to the base category of remaining at one's original institution and receiving a degree within six years. Average marginal effects are reported in brackets. As with GPA, there is no direct effect of income for the whole sample. Low-income students in the Hispanic sub-sample are more likely to dropout than higher-income students, relative to staying and graduating. High school GPA plays an important role in predicting persistence. Students with higher high school grades are less likely to transfer from their original institution or to dropout. Having attended a private high school does not have a significant impact on any of these outcomes.

As the gap between a student's SAT score and that of the median score of the institution he or she attends widens, students with scores below the median are slightly less likely to transfer, but academic fit does not impact on the probability of dropping out versus staying and receiving a degree within six years. Students that first matriculate at a selective college with a large gap between their scores and the median may have fewer "better" outside options to which they could transfer, which may be generating this result. After breaking down the estimations by race, one can see that the effect of academic fit on these measures of persistence varies by race. White students with scores below the median are more likely to stay and graduate within six

Table 3.7: Multinomial Logit Estimates of Probability of Transferring or Dropping Out (NLSF)

	Dropout	Transfer
Black	0.98	0.292
	(0.173)***	(0.126)**
	[5.91]	[1.96]
Hispanic	0.275	0.244
	(0.26)	(0.116)**
	[1.35]	[2.17]
Asian	0.295	-0.209
	(0.282)	(0.158)
	[1.90]	[-2.15]
High School GPA	-0.697	-0.687
	(0.166)***	(0.156)***
	[-0.50]	[-1.09]
Private High School	-0.093	0
	(0.188)	(0.11)
	[-3.20]	[-2.15]
Income < $35,000	0.058	-0.113
	(0.501)	(0.275)
	[0.41]	[-1.09]
Dist. Sat Below Median	-0.055	-0.412
	(0.157)	(0.101)***
	[0.04]	[-3.88]
Low Inc. x Dist. Below Median	0.243	0.016
	(0.157)	(0.123)
	[1.30]	[-0.05]
Dist. SAT above Median	0.126	0.279
	(0.182)	(0.172)
	[0.45]	[2.56]
Low Inc. X Dist. Above Median	0.195	0.145
	(0.364)	(0.241)
	[0.93]	[1.23]
Pct. Pell Grant	0.009	-0.009
	(0.015)	(0.01)
	[0.05]	[-0.09]
Low Inc. X Pct. Pell	0.009	0.004
	(0.025)	(0.015)
	[0.05]	[0.03]
Constant	0.018	5.99
	(1.721)	(1.427)***
Observations	240	440

Notes: All coefficients are relative to base category of graduating from original institution within 6 years. Robust standard errors in parentheses.* significant at 10%; **significant at 5%; ***significant at 1%. Average marginal effects in brackets. Includes controls for gender, SAT scores, parent's education, educ. exp/student, and institution type.

Table 3.8: Multinomial Logit Estimates of Probability of Transferring or Dropping Out by Race(NLSF)

	Black		Hispanic		Asian		White	
	Dropout	**Transfer**	**Dropout**	**Transfer**	**Dropout**	**Transfer**	**Dropout**	**Transfer**
High School GPA	-0.762	-0.891	-0.868	-0.125	-1.164	-0.432	-1.455	-1.263
	(0.274)***	(0.222)***	(0.463)*	(0.391)	(0.440)***	(0.578)	(0.698)**	(0.439)***
	[5.07]	[-8.89]	[-3.58]	[-0.76]	[-5.23]	[-2.42]	[-4.07]	[-9.99]
Private High School	-0.033	0.168	-0.05	-0.153	0.108	0.22	-0.546	-0.273
	(0.248)	(0.254)	(0.352)	(0.22)	(0.355)	(0.344)	(0.493)	(0.264)
	[0.58]	[2.03]	[-0.11]	[-1.57]	[0.41]	[1.51]	[-1.45]	[-2.01]
Income < $35,000	-0.4	-0.305	1.512	0.653	-0.012	-0.974	-1.796	0.66
	(0.633)	(0.321)	(0.603)**	(0.66)	(0.744)	(0.747)	(2.443)	(0.918)
	[2.81]	[-2.71]	[7.17]	[6.30]	[0.32]	[-5.20]	[-3.61]	[7.33]
Dist. Sat Below Median	-0.319	-0.44	0.403	-0.446	0.532	-0.456	-1.532	-0.685
	(0.184)*	(0.258)*	(0.555)	(0.237)*	(0.572)	(0.309)	(0.706)**	(0.310)**
	[2.01]	[-4.49]	[2.00]	[-5.02]	[2.69]	[-3.36]	[-4.52]	[-5.14]
Low Inc. x Dist. Below Median	0.32	0.2	0.123	-0.065				
	(0.202)	(0.166)	(0.283)	(0.3)				
	[-2.43]	[1.74]	[0.56]	[-5.02]				
Dist. SAT above Median	-0.228	-0.762	-0.853	-0.155	0.322	0.602	1.555	0.725
	(0.285)	(0.525)	(0.502)*	(0.317)	(0.461)	(0.352)*	(0.393)***	(0.318)**
	[0.65]	[-8.34]	[-3.50]	[-1.09]	[1.23]	[3.97]	[4.58]	[5.47]
Low Inc. X Dist. Above Median	-0.478	-3.819	-0.695	0.172	0.176	0.235	1.677	-0.15
	(0.632)	(2.057)*	(1.452)	(0.632)	(0.553)	(0.519)	(0.948)*	(1.078)
	[-2.51]	[-42.95]	[-3.05]	[2.29]	[0.71]	[1.53]	[5.28]	[-1.87]
Pct. Pell Grant	0.006	0.006	0.02	-0.009	-0.006	-0.021	0.004	-0.008
	(0.021)	(0.013)	(0.022)	(0.014)	(0.026)	(0.014)	(0.01)	(0.012)
	[-0.04]	[0.06]	[0.09]	[-0.11]	[-0.02]	[-0.14]	[0.02]	[-0.07]

Table 3.8 Continued.

	Black		Hispanic		Asian		White	
	Dropout	Transfer	Dropout	Transfer	Dropout	Transfer	Dropout	Transfer
Low Inc. X Pct. Pell	0.004	-0.001	-0.011	-0.041	0.02	0.047	0.062	-0.004
	(0.038)	(0.01)	(0.025)	(0.038)	(0.02)	(0.019)**	(0.06)	(0.025)
	[-0.04]	[-0.02]	[-0.02]	[-0.43]	[0.07]	[0.31]	[0.20]	[-0.06]
Pct. Own Race	0.003	-0.001	0.109	0.022	0.026	-0.045	-0.033	-0.005
	(0.004)	(0.004)	(0.063)*	(0.04)	(0.012)**	(0.018)**	(0.010)***	(0.007)
	[-0.02]	[-0.01]	[0.45]	[0.16]	[0.14]	[-0.32]	[-0.10]	[-0.03]
Constant	3.612	5.041	-6.408	5.792	-0.915	6.232	18.77	10.026
	(1.850)*	(3.052)*	(5.995)	(2.168)***	(5.048)	(3.469)*	(7.105)***	(4.444)**
Observations	110	150	50	120	50	80	40	100

Notes: All coefficients are relative to base category of graduating from original institution within 6 years. Robust standard errors; in parentheses. * significant at 10%; **significant at 5%; *** significant at 1%. Average marginal effects included in brackets. Includes controls for gender, SAT scores, parent's education, educ. exp/student, and institution type.

years than to transfer or dropout, whereas White students with scores above the median are less likely to stay and graduate as the gap increases. Black students with scores below the median are more likely to stay and graduate as this gap increases, a finding that is consistent with past research looking at the success of low- income students at more selective colleges and universities. Low-income Black students with scores above the median are less likely to transfer as this gap increases. An academic "mismatch" for Asian students has no effect on the probability of dropping out. However, Asian students with gaps above the median are less likely to transfer from their original institution. Hispanic students with score gaps below the median are less likely to transfer from their original institution.

Percent own race in the student body affects persistence for all sub-samples except Black students, but in varying ways. As the percentage of own-race students increases, White students are less likely to dropout and more likely to stay and graduate within six years, but this effect is very small: a 10% increase in percent white is associated with about a one percentage point increase in the probability of graduating. In contrast, an increase in the percentage of own-race students at an institution is linked with a higher probability that Hispanic students will dropout by about 4 percentage points (for a 10% increase in percent Hispanic). Similarly, Asian students are more likely to dropout as percent own-race in the student body increases, but are also less likely to transfer from their original institution. However, these effects are fairly small, a 10% increase in own-race increases the probability of dropping out by 1 percentage point, and decreases the probability of transferring by 3 percentage points for Asian students. These results suggest that social fit, as measured by the percentage of students of one's own race can impact persistence but that this effect is very different for students of different races. Asian and Hispanic students are slightly more likely to dropout with more students of their peer group around.

However, although percent own-race does not affect the probability of transferring for Hispanic students, it is linked with a decrease in the probability of transferring for Asian students. Persistence of Black students does not seem to be affected at all by changes in their peer group size. These results are in contrast to the findings of Fletcher and Tienda that an increase in same race peer group size leads to increased persistence (2008). However, their measure of peer group is quite different from the one used in this paper, and is far more specific. Peer group size in their paper focuses on students of the same race that also attended the same high school, and therefore is more a measure of the size of a social network that is already developed to some extent. This paper focuses on the potential to form a social network amongst peers of one's own race, regardless of having known each other prior to college. Therefore, as these two measures are quite different, they are likely getting at different aspects of social fit, and it is not surprising that the results would be different.

Peer group size defined along income lines significantly impacts persistence for Asian students only. If the percentage of low-income students at an institution increases by 10%, low-income Asian students are more likely to transfer from their original institution by about 3 percentage points, but their probability of dropping out is not affected. Again, although some effects of peer group size for low-income students were identified here, it is likely that the proxy used is not fine enough of a measure to accurately capture all of the effects.

Results in Table 3.6 of multinomial logit estimations of persistence using NELS:88 show some similarities with a few notable differences. In this data set, low-income students are 11.5 percentage points more likely to drop out of college and are less likely to transfer by about 13 percentage points. Less selective colleges or universities, as those attended by students in NELS:88, may not be able to offer as much financial aid to low-income students which could lead to increased stop-outs and

drop-outs. There is no effect on dropping out of a gap in scores below the median, but this measure has a negative impact on the probability of transferring. Low-income students scoring below the median are slightly more likely to transfer schools, by about one percentage point. Higher-income students scoring above the median are more likely to drop out, but the effect on dropping out of a gap above the median for low-income students is virtually zero. Similar to the results using the NLSF, there is no impact of low-income peer group size for low-income students. With a few exceptions, the results of estimations of persistence for students attending the less selective sample of institutions contained in NELS:88 are qualitatively very similar to the results from the NLSF sample.

VI. Results: Instrumental Variables Approach

This paper has measured the effect of an academic "mismatch" on students that have been admitted by and chosen to attend schools at which there exists a gap between their own SAT scores and the median scores of the institution. For a student to enroll at a school at which they do not match academically, assuming both schools and students have at least partial information on the true impact this "mismatch" will have on the student's outcomes, one or both of two things is likely to be true. First, the college likely has identified some traits that make the student attractive to the university despite the test score gap or that suggest to the admissions counselor that the student has the ability to overcome the test score gap and succeed educationally. Second, the student must have selected him or herself into that mismatched position knowing what impact the test score gap will have on his/her outcomes. An alternative measure would be to examine the effect of a "mismatch" for the average student in the data, removing the selection on unobservable characteristics. An instrumental variables approach is used to obtain the exogenous impact of a gap in test scores on

grades and persistence. The difference between a student's SAT scores and the median SAT scores at the closest selective college or university to the high school the student attended, either above or below, are used to instrument for the actual test score gaps that are observed[29]. Students that live closer to selective colleges and universities are more likely to apply to a selective institution, and distance can also play a role in enrollment decisions, suggesting that this choice of instrument is a reasonable one (Griffith & Rothstein, 2007; Griffith & Rask, 2005)[30]. Estimates for first-year GPA, cumulative GPA, the probability of dropping out, and the probability of transferring for the NLSF sample using these instruments for the SAT gaps are shown in Table 3.9[31]. The Two-Stage Least Squares estimate of the exogenous impact of a gap in SAT scores below the median on GPA measures is about three to five times larger than that for students that have been selected into this position. The effect of a gap for low-income students also increases about three-fold such that having SAT scores 100 points below the median results in a 0.21 point decrease in cumulative GPA for low-income students, and an even larger decrease of 0.42 points in first-year GPA. The effects of an SAT gap on dropping out remains insignificant in the instrumented model and now a gap in scores below the median has no effect on the probability of transferring. A comparison of these results with those of the original estimations suggests that there is positive selection at work in the acceptance of students to institutions and their choice of where to enroll. Students that enroll at institutions at which they are not matched well academically in terms of SAT scores are those that

[29] Four-year institutions are considered selective if they have median SATs greater than 1100, to correspond to the minimum selectivity level of the institutions included in the NLSF sample. The IV results are not sensitive to this cut-off.

[30] The F-statistics for the inclusion of the instruments in the first-stage estimations are all greater than 150, significantly above a reasonable critical value suggesting that the instruments have significant explanatory power for the endogenous regressors. All first-stage results are available from the author on request.

[31] Results of IV probits are reported for both measures of persistence. Although these results are not directly comparable to those of the multinomial logit estimations, they do provide suggestive evidence of the effect of using instruments for the measures of gaps in SAT scores.

Table 3.9: Instrumental Variables Estimation of GPA and Persistence Measures (NLSF)

	GPA1	GPA	Dropout	Transfer
Black	-0.135	-0.164	0.449	0.07
	(0.027)***	(0.021)***	(0.145)***	(0.112)
Hispanic	-0.089	-0.096	0.062	0.079
	(0.030)***	(0.024)***	(0.163)	(0.122)
Asian	-0.02	-0.028	0.172	-0.108
	(0.022)	(0.018)	(0.112)	(0.087)
High School GPA	0.499	0.415	-0.352	-0.391
	(0.042)***	(0.032)***	(0.199)*	(0.157)**
Private High School	0.051	0.056	-0.053	-0.001
	(0.019)***	(0.015)***	(0.089)	(0.069)
Income< $35,000	0.03	0.032	-0.086	-0.025
	(0.057)	(0.046)	(0.215)	(0.191)
Income ≥ $75,000	0.011	0.019		
	(0.024)	(0.019)		
Dist. Sat Below Median	-0.355	-0.15	0.269	0.07
	(0.155)**	(0.122)	(0.713)	(0.553)
Low Inc. x Dist. Below Median	-0.067	-0.061	0.186	-0.009
	(0.026)**	(0.021)***	(0.097)*	(0.088)
Dist. SAT above Median	0.564	0.292	-0.224	-0.139
	(0.189)***	(0.149)*	(0.917)	(0.709)
Low Inc. X Dist. Above Median	-0.148	-0.028	0.505	0.084
	(0.071)**	(0.056)	(0.269)*	(0.254)
Pct Pell Grant	-0.001	0.001	0.006	-0.004
	(0.002)	(0.002)	(0.006)	(0.005)
Low Inc. x PctPell	0.004	0.001	0.004	-0.002
	(0.002)	(0.002)	(0.01)	(0.009)
Observations	3748	3748	3910	3910

Notes: Robust standard errors in parentheses. * significant at 10%; **significant at 5%; *** significant at 1%. Includes controls for gender, SAT scores, parent's education, exp/student, mean and variance of institutional GPA, institution type and student's major course of study. Difference in SATs and median scores of nearest selective institution in high school used as instruments for Academic Fit measures

seem to be better equipped to deal with this gap, as the effect of a test score gap on the grades of this group of students is much smaller than in the absence of selection.

VII: Results: College Major Choice

A Multinomial Logit Model, shown in equation (3), is used to estimate the probability of majoring in one of four fields - STEM, Humanities, Social Sciences or Economics/Business versus an alternate major in any other field.

$$(3) \qquad P(y = j) = \frac{e^{x\prime\theta_j}}{1 + e^{x\prime\theta_j}} \quad for\ j = 0, \ldots, 5$$

Average marginal effects from multinomial logit estimations for the whole sample and by race are displayed in Tables 3.10 and 3.11 respectively, and the estimated coefficients can be found in Appendix Tables A3.1 and A3.2. All coefficients are in comparison to choosing a major in any field not included in the four main fields, henceforth the residual major category. Looking at the results for the whole sample, in Table 3.10, one can see that Black and Hispanic students are more likely to choose a major in the Social Sciences, by about 3-4 percentage points. Although the

Table 3.10: Average Marginal Effects (x100) from Multinomial Logit Estimation of College Major Choice

	STEM	Humanities	Soc. Sci.	Bus./Econ.
Black	-1.71	-0.85	**4.45**	-1.73
Hispanic	-2.21	0.48	**3.27**	-2.19
Asian	1.25	**-2.24**	**-2.40**	1.89
HS GPA	**9.61**	0.58	**2.75**	-0.35
Private HS	-0.92	-0.40	1.47	-0.18
Income <$35,000	2.54	2.24	-3.32	**4.96**
Dist. Below Median	**-2.61**	-0.27	2.34	**-2.54**
Dist Above Median	1.93	-1.09	-1.45	-0.28
Pct. Pell Grant	0.03	0.02	**-0.14**	0.09
Low. Inc. X Pct. Pell	-0.05	**-0.12**	0.27	-0.17
Observations	690	260	570	360

Note: Bolded average marginal effects correspond to significant coefficients in original multinomial logit estimation

coefficients are not significant, results suggest that Black and Hispanic students are less likely to major in a STEM or Business/Economics field, a finding similar to that in the literature. Asian students are about 2 percentage points less likely to choose a major in the Humanities or Social Sciences. Results show that coming from a low-income background can affect a student's choice of major, but in a way contrary to the findings of some past studies. Low-income students are about 5 percentage points more likely to choose a Business/Economics major than their higher income peers. This difference may likely be driven by the very high level of selectivity of the colleges and universities in the NLSF sample. The types of students attending these schools are not necessarily representative of students attending four-year institutions in general, and therefore one may expect differences in their major choices. The farther a student's SAT score is below the median of the institution they attend, the less likely they are to choose a major in STEM or Business/Economics field. These are likely the higher grading majors at these institutions, and it is not surprising that lower test score students, as compared to their peers, would be less likely to be majoring in these fields. In terms of peer group size effects, low-income students at schools with a higher percentage of Pell Grant students are less likely to major in the Humanities.

Average marginal effects from estimations of college major choice by race are shown in Table 3.11. Students of all races with higher high school GPAs are more likely to choose a STEM field major, although this finding is not significant for Hispanic students. Income plays a role for Hispanic students only. Low-income Hispanic students are more likely to major in Economics/Business or a STEM field. This is opposite to the finding for the whole sample, and the findings of the literature, but past studies have not looked as specifically at students of different races.

Table 3.11: Average Marginal Effects (x100) from Multinomial Logit Estimation of College Major Choice by Race

	Black				Hispanic			
	STEM	**Humanities**	**Soc. Sci.**	**Bus./Econ.**	**STEM**	**Humanities**	**Soc. Sci.**	**Bus/Econ**
HS GPA	**14.13**	-0.26	**4.78**	0.77	5.36	-2.68	0.04	0.42
Private HS	-0.25	**-3.09**	2.41	-0.10	0.50	0.05	0.92	0.94
Income <$35,000	-1.97	5.74	-0.08	4.65	**7.51**	-3.32	-0.58	**5.37**
Dist. Below Median	-0.71	-0.75	0.56	-1.79	-0.70	-1.85	0.52	0.00
Dist Above Median	2.23	-1.32	-4.53	-0.61	4.04	2.67	-1.62	-4.32
Pct. Pell Grant	**-0.30**	-0.07	-0.12	**0.60**	0.20	-0.05	-0.19	0.10
Low. Inc. X Pct. Pell	0.12	-0.22	-0.07	-0.16	-0.11	-0.03	0.00	0.02
Pct Own Race	**-0.09**	0.04	-0.05	**0.05**	-0.41	0.69	**1.74**	-0.62
Observations	140	60	180	70	140	70	150	70
	Asian				**White**			
	STEM	**Humanities**	**Soc. Sci.**	**Bus/Econ**	**STEM**	**Humanities**	**Soc. Sci.**	**Bus/Econ**
HS GPA	**8.44**	-0.14	3.64	-4.28	**6.97**	**6.44**	-0.57	**1.93**
Private HS	-2.02	1.73	2.55	-1.05	-2.24	-0.12	1.00	-0.16
Income <$35,000	7.53	-0.28	-4.58	2.82	-8.32	0.81	-10.02	27.05
Dist. Below Median	0.48	3.66	-0.87	-1.55	1.47	-3.79	-0.47	**-6.22**
Dist Above Median	-2.26	**-3.33**	0.38	-0.33	0.73	0.40	2.91	-3.73
Pct. Pell Grant	0.20	0.07	**-0.47**	0.00	**0.38**	0.11	**-0.25**	-0.06
Low. Inc. X Pct. Pell	-0.19	-0.13	**0.52**	-0.28	0.37	0.12	**0.98**	-1.28
Pct Own Race	**-0.49**	**-0.29**	**0.42**	0.08	**0.12**	**-0.21**	-0.04	**0.33**
Observations	210	60	110	120	200	80	130	100

Note: Bolded average marginal effects correspond to significant coefficients in original multinomial logit estimation

Results by race suggest that peer group size can play an important role in major choice. Low-income Asian and White students are more likely to choose a Social Science major as the percentage of low-income students at their institution increases. Peer group size in terms of race also affects college major choice, but somewhat differently for students of each race group. As the percent of Black students in the student body increases by 10%, Black students are about 1 percentage point less likely to choose a STEM major, and about 0.5 percentage points more likely to choose a Business/Economics major. Although the coefficients were not significant in the whole sample estimation, Black students were slightly less likely to major in a STEM field or Business/Economics. Therefore these results suggest that an increase in their racial peer group size further decreases the probability that a Black student will choose a STEM field major, but slightly increases the probability of majoring in Business/Economics. Similarly, an increase in racial peer group size for Asian students decreases their probability of major in a STEM field and increases their probability of majoring in a Social Science, but also decreases the probability of choosing a Humanities major. Although changes in peer group size have similar distributional effects on Asian and Black students, the size of the effects are much larger for Asian students, suggesting that they are possibly more sensitive to changes in the racial distribution in terms of their major choice. Hispanic students react slightly differently to changes in the racial distribution. As the percentage of Hispanic students increases, Hispanic students are much more likely to choose a major in the Social Sciences. An increase of 10% for peer group size leads to a 17 percentage point increase in the probability a Hispanic student will choose a Social Science major, a fairly large effect.

These findings on college major choice suggest that although measures of institutional fit can have an impact on college major choice, it is mostly personal

characteristics like test scores that drive the decision-making process. However, social fit can have an impact on major choice, although it is unclear exactly what mechanism is at work. An increase in the percentage of the student body that comes from one's own racial group has an important impact on course-taking behavior and college major choice, but this effect differs in both distributional impact and size between the main racial groups.

VIII. Conclusion

In the past years there has been a push to increase access for minority students to the more selective colleges and universities in the U.S, with a recent push focused on low-income students. However, very little is actually known about the factors which affect the educational outcomes of these students while in college, and in particular how the fit between students and the institutions they attend can impact outcomes. A large fraction of minority and low-income students attending selective institutions begin their post-secondary experiences at institutions with median SAT scores well above their own personal scores. In addition, the socioeconomic and demographic composition of most selective institutions is such that low-income and minority students are faced with very small peer groups, as defined by income or race, at their college of choice. This paper uses restricted-access data from both the NLSF and NELS:88 to examine how educational outcomes of low-income and minority students are impacted by two different measures of institutional fit, academic and social. This first measure of fit examines how well students fare educationally if there are large gaps between their own SAT scores and the median scores of the institution they attend. The second measure examines whether social fit along race and income lines can impact educational outcomes and choices. The formation of social networks

may be affected by the size of peer groups defined in this way, which may in turn impact educational outcomes and choices.

Results are summarized in Table 3.12. They suggest that academic fit can have a significant negative impact on a student's first-year and cumulative GPA, but this total effect is very small in a policy sense. The impact on GPA of having a gap in SAT scores below the median is greater for low-income students, a significant finding given that low-income students are much more likely to be in this position and those that are have much larger gaps between their own scores and the institutional median

Table 3.12: Summary of Results for GPA and Persistence using NLSF and NELS:88

	All	Black	Hispanic	Asian	White
Low-Income	+ Dropout (NELS) (-) Transfer (NELS)		+ Dropout	+ GPA1	
Score Gap Below	(-) GPA1 & GPA (-) Transfer	(-) GPA1 (-) Dropout	(-) GPA1 (-) Transfer	(-)GPA	(-) GPA1 & GPA (-) Dropout (-) Transfer
Low-Income X Score Gap Below	(-) GPA + GPA1 & GPA (NELS) + Transfer (NELS)	(-) GPA1 & GPA		(-) GPA1 & GPA	+ GPA1
Score Gap Above	+ GPA1 & GPA + Dropout (NELS)	+ GPA1 & GPA + Grad	+ GPA1 & GPA (-) Dropout	+ GPA1 & GPA + Transfer	+ GPA1 & GPA + Dropout + Transfer
Low-Income X Score Gap Above		(-) GPA1 & GPA (-) Transfer	+ GPA	(-) GPA1 & GPA	+ Dropout
Low-Income X Pct. Pell				+ Transfer	
Pct. Own Race		+ GPA1	+ Dropout	(-) GPA1 & GPA + Dropout (-) Transfer	(-) Dropout

on average. This additional impact of low test scores on GPA for low-income students suggests that these students are less prepared than the average student to deal with an academic mismatch, most likely due to fewer resources dedicated to their education prior to college. However, a "mismatch" in terms of test scores does not have a negative effect on persistence; students with large test score gaps below the median are less likely to transfer institutions and are not any more likely to dropout. Citing results of other studies, low-income students attending a selective institution with median SAT scores 100 points higher will on average have earnings that are 4% higher. This increase in median SAT scores, relative to their own personal scores is associated with a decrease in college GPA, leading to earnings that are less than 1% lower. Therefore, the direct positive effect on earnings of attending a more selective institution outweighs the indirect negative effect operating through lower college GPAs for these students.

As the increase in earnings associated with persistence outweighs the change in earnings associated with grades, one might be more concerned with whether students ultimately graduate, despite how they perform in terms of grades while enrolled in college. Therefore, the results for low-income students are somewhat reassuring; after controlling for background characteristics, low-income students are not any less likely to graduate within six years, and their location in the test score distribution at their institution does not negatively impact their probability of graduating. However, despite controlling for other personal characteristics and gaps in test scores, Black students are still more likely to dropout, and Black and Hispanic students are more likely to transfer from their original institution and earn lower GPAs.

A comparison of estimations of GPA and persistence using the very selective NLSF sample and the more representative NELS:88 data set suggest that the results regarding the importance of academic fit between a student and the institution they

attend are not specific to highly selective schools. Results show that students entering college with SAT scores well below the median of the institution they attend suffer in terms of GPA at colleges across a wide range of selectivity and there is evidence that a gap in SAT scores has a stronger impact at more selective schools. Therefore, the GPAs of students with fairly high SAT scores attending institutions with median scores 100 points above their own will be impacted more than those of students with lower SAT scores that are 100 points below the median of the institution they attend.

Results of instrumental variables estimations show that the students that have been accepted by and chosen to attend colleges or universities at which their SAT scores are far below the median experience a much smaller decrease in GPA than would the average student with a given SAT score placed in a position of "mismatch" with their institution. Admissions counselors have access to information that could predict a student's probability of academic success that is not observable to the researcher, such as evidence of a high level of motivation and dedication to their studies which may come through in letters of recommendation. Schools therefore may admit students with low test scores but high levels of these "unobservable" traits. Students are also aware, at least to some extent, of their ability to succeed in different academic situations, and those that choose to enroll at a school at which their scores are far below the median are likely those that are fairly sure they can handle the challenging academic atmosphere. The existence of a much smaller effect of a test score gap for the population of students that select into this situation suggests that the admissions and enrollment process is doing a fairly good job of identifying which students can handle a test score gap and students are doing a good job of sorting into schools to maximize their academic success. However, there is still a slight negative impact of an academic "mismatch," for which there are two probable explanations. It may just be that this process of identifying which students can handle a test score gap

is not perfect, as neither students nor schools likely have perfect information, resulting in a slight loss for "mismatched" students. An alternative explanation is that schools may value other traits that a researcher cannot observe that low test score students may exhibit, and are willing to trade a little bit of scholastic merit to achieve this diversity in their student body. Either explanation would produce the results shown here, and it is likely that both are at work.

Peer group size defined along income lines does not seem to have a significant impact on GPA or persistence. The one exception is for low-income Asian students, who are more likely to transfer as the percentage of the student body that is low-income increases. However, it should be noted that this measure is very broad, and only measures percentages in the entire student body. At large schools, this may not very accurately measure the percentage of low-income students within the student population that these students come into contact with on a daily basis. It is possible that although no effects were found here, there are actually significant effects of income peer group size on grades and persistence. Peer group size defined by race does significantly impact both grades and persistence. Asian students receive lower grades, but are more likely to dropout and less likely to transfer as the percentage of Asian students at their institution increases. Black students receive slightly higher grades as the percentage of Black students increases, but own-race peer group size does not affect persistence for Black students. The grades of Hispanic students are not affected by peer group size, but they are more likely to dropout as peer group size increases.

There is a significant impact of peer group size on choice of college major. Results from the NLSF show that as the percentage of Pell Grant recipients increases, Hispanic students are more likely to major in Business/Economics, mitigating the negative direct effect of coming from a low-income background on the choice of this

major field. Percentage of the student body that comes from one's own racial group can also affect major choice for all three non-white racial groups, although the distributional effects across major fields are different across racial groups. As peer group size changes, students may form social networks with very different compositions, and therefore be influenced to take different types of courses, leading to different major choices.

A large percentage of low-income and minority students may earn slightly lower GPAs during their post-secondary experience due to low test scores upon matriculation, however, the wage premium associated with graduating from a selective institution outweighs this small negative effect on grades. Although gaps in test scores and peer group size can partly explain the much lower grades and rates of persistence of Black and Hispanic students, these measures along with the other personal and institutional characteristics fail to explain all of these differences. Black and Hispanic students are still more likely to dropout or transfer, and receive lower grades. These findings suggest that there is still room for improvement and perhaps additional educational programs are needed to help compensate for the lower average level of preparation of low-income and minority students and to help these students adjust to their social and educational surroundings at college. Further research is needed to examine what else may impact the educational outcomes of minority students, and if these factors are something that policy can address. Finally, as the socioeconomic and racial composition of colleges and universities change, it is important to consider how this will impact major choice, as this helps determine the supply of new workers in the major fields. Results from this paper suggest that these changes in composition can have important implications for major choice, and that these effects differ for students of different races.

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CHAPTER 4

KEEPING UP WITH THE JONESES: INSTITUTIONAL CHANGES FOLLOWING THE ADOPTION OF A MERIT AID POLICY

I. Introduction

The adoption of a policy of awarding financial aid based on merit, as opposed to strictly need-based aid, has increased markedly at private colleges and universities over the last two decades. This increased use of merit aid by private colleges and universities has been a popular topic of discussion by educators, researchers and the press. Merit aid is often used by many private colleges and universities seeking to increase their enrollments of high test score students in order to boost the quality of their student bodies. It is well documented that test scores, such as SAT and ACT scores, are highly correlated with income and race. Many fear that merit based awards will go mainly to higher income and non-minority students, leading to a decrease in the enrollment of low-income students, as well as possibly students from under-represented minority groups. In a 2006 study, Heller estimates that greater than 60% of institutionally offered merit aid went to students with family incomes above the median, and 13% went to students from families earning greater than $125,000. If financial aid funds must be split between merit-based awards and need-based aid and many if not most of the merit-based awards are going to higher-income students, there will be fewer funds available to subsidize the costs of attendance for low-income students. This seems to be a reality for many financial aid offices - a 2003 study by the Lumina Foundation reports anecdotes from college administrators indicating that

there is often a trade-off occurring between need and merit in financial aid decisions at some institutions.

However, it may be the case that the use of merit aid by private institutions does not have a negative impact on the enrollment of low-income students. Some argue that merit aid can actually help to improve the financial situation of an institution by bringing in more "almost full-pay" students (Bowen et. al, 2005). In this case, on average the merit awards do go to higher income students, but they do not fully subsidize the cost of attendance and as enrollment goes up, net tuition revenues could go up as a result. This increased revenue could then be used to increase the quality of the institution and/or to increase need-based financial aid. The 2003 Lumina Foundation report shows that some colleges and universities report using merit aid as a tool to increase enrollment and fill their classes to capacity. A 2006 case study examining one such institution showed that following the introduction of merit aid there was an increase in tuition revenues as well as an increase in the representation of low-income students (Scannell, 2006).

There is also the concern that in order to provide merit aid, institutions might need to divert funds originally intended for other areas than just need-based aid, such as for increases in faculty salaries, or hiring of full-time faculty versus adjunct faculty. Colleges also might use increases in tuition or other fees such as room & board to cover the increase in spending on merit-based financial aid. Diverting funds in these ways may impact educational outcomes and direct costs to students, and therefore it is important to understand how the introduction of merit-aid programs can affect spending patterns at institutions.

This paper will help to shed light on these questions by first examining what factors influence an institution's decision to begin offering merit-based aid. The paper then continues by examining how the socio-economic and demographic composition

of the student bodies at private four-year colleges and universities change following the introduction of a merit aid policy, and by investigating whether the use of merit aid is successful in that its adoption is followed by increases in the quality of the student body and/or by enrolling larger classes, and lastly, by exploring what trade-offs institutions may be making in order to fund their merit awards.

Private colleges and universities respond to low growth in the median SAT scores of their freshmen classes as compared to their peer institutions by introducing a merit aid program. The results suggest that there is a decrease in the representation of low-income students after schools begin offering merit aid, and a redistribution of Black students from top schools to bottom ranked schools. However, the sizes of these effects are different for colleges of different initial quality. The use of merit aid is associated with modest gains in median SAT scores of the incoming class, particularly for middle tier colleges. In terms of changes in spending in other areas, the use of merit aid is associated with an increase in tuition for middle and bottom tier schools, and a slight decrease in associate and full professor salaries at top-tier schools. These results suggest that the use of merit-aid may lead to an increase in the under-representation of low-income and minority students at private four-year colleges and universities and that for some institutions funds may also be diverted to fund these scholarships which could result in negative impacts on student outcomes.

This paper proceeds as follows. Section II reviews the literature in the area and discusses in more detail the questions I will test. Section III contains descriptive statistics, followed by results in Section IV, and in Section V, I conclude.

II. Background

With the expansion in the use of merit-based financial aid, there has been an accompanying increase in research focused in this area. However, at this point most

research has focused on state merit aid programs and specifically, the Georgia HOPE scholarship. This program was designed to increase enrollment of college-able students at colleges and universities in Georgia, and also to entice students to remain in state to pursue their post-secondary degrees. As a result, much of the research focusing on this program and other state programs like it, have examined the enrollment impacts, and how these effects are distributed across different sub-populations of students[32]. Singell and coauthors (2006) use Pell grant data to show that the introduction of the Georgia HOPE scholarship did lead to an increase in access to higher education for low-income students. However, in a 2000 paper, Dynarski shows that while the HOPE scholarship program was successful in its goal to increase enrollment, there was very little of an effect for low-income and Black students who often were not eligible for the award due to low test scores. A later paper examining similar merit aid programs in other states showed more favorable enrollment effects for Black and Hispanic students (Dynarski, 2003). Results of another study examining the response of four-year colleges and universities to the introduction of the Georgia HOPE scholarship show that institutions reacted by increasing tuition and other fees (Long, 2004). Although the Georgia HOPE scholarship, and other state programs like it, has very different goals, the results of these studies show that the impacts of merit-based aid may not be distributed evenly across income and race groups. These studies also provide evidence of one way in which institutions may respond to an increase in spending on aid – increases in tuition.

Research examining the effects of institutionally funded merit aid awards by four-year colleges and universities is much more limited, mostly due to the scarcity of data on institutional spending on merit aid. A 2006 paper by Ehrenberg, Zhang and

[32] For other examples of work examining effects of the Georgia HOPE scholarship see Cornwell et al., 2006 and Cornwell & Mustard, 2005.

Levin investigates how the use of institutionally funded National Merit Scholarships affects the enrollment of students that receive a Pell Grant. Their results show that institutions that fund National Merit Scholarships for their enrolled students that have earned them enroll fewer Pell Grant recipients, a proxy for the number of low-income students. Although this is a specific type of institutionally funded merit-based financial aid these results show that institutionally funded aid programs based on academic merit can lead to a crowd-out of lower-income students.

If the introduction of institutionally funded merit aid awards at private colleges and universities also leads to a reallocation of funds from other sources to financial aid, this may impact educational outcomes of students. One possible way this could happen is if colleges or universities increase the use of part-time or adjunct faculty for teaching in order to cut costs on faculty salaries which may negatively impact students' grades and persistence. Ehrenberg and Zhang (2005) find that colleges or universities that employ more adjunct professors have lower persistence rates of students into their second year. Students that are taught mostly by this type of professor that by definition does not have as strong of a tie to the college or university, and in some cases may be less qualified than a tenure-track professor, may not be as satisfied with their academic experience and therefore are less likely to persist into their second year. Using administrative data from the public higher education system in Ohio, Bettinger and Long in a 2006 paper find similar evidence that taking more classes taught by adjunct professors is associated with lower persistence rates for students. However, they find that there also might be some positive impacts of adjunct professors in that they can increase the probability of taking future courses in the subject taught, particularly in fields such as engineering and education (Bettinger & Long, 2007).

Institutions may also cut back on spending on faculty salaries in order to help fund merit aid awards. Lower real faculty salaries, or smaller raises, could lead to an increase in turnover of high quality faculty who are already employed by the university (Ehrenberg et al., 1991). Additionally, these colleges and universities will likely find hiring of high quality new faculty to be difficult as outside options will now be more attractive. This could possibly lead to a decrease in faculty quality, which could in turn impact student outcomes. This paper will examine how student body characteristics, faculty salaries, tuition and fees levels, and percent of the faculty that are adjuncts are impacted by the use of institutionally offered merit aid. Additionally, I will investigate how the effect of merit aid on these outcomes may differ for colleges and universities of different quality levels. The results shed light on the perhaps unintended consequences of merit-based financial aid.

III. Data and Descriptive Statistics

To examine the choice to offer merit aid and to evaluate the effects of the use of merit-based financial aid by private colleges and universities, this paper uses data from the College Board's *Annual Survey of Colleges* for the years of 1987-2005. Each year the College Board sends a survey to institutions that includes a set of questions regarding their financial aid practices. The survey specifically asks the institution to report if they award non-need based financial aid that is based on academic merit. This paper focuses on private four-year colleges and universities as public colleges and universities are more limited in their control over their funding sources and spending. I restrict the sample to private four-year colleges that report in the beginning of the sample period (1987) that they do not offer financial aid based on

merit[33]. By doing this, I have defined the set of 133 private four-year schools that are "at-risk" of offering merit aid in order to compare characteristics before and after the addition of merit aid. A majority of private four-year colleges and universities were already offering merit aid when the data window opens in 1987 and as a result the remaining set of "at-risk" institutions is fairly small. However, as much of the concern regarding the effects of merit aid policies are focused on the institutions that have switched to merit aid in the last two decades, this sample should capture the population of interest. There are 40 schools that never begin offering aid and 93 schools that begin offering merit aid during the nineteen year time period. This paper follows these schools through the sample period, observing the year in which they begin offering aid. This information is used to define at each point in time how many years an institution has offered merit aid.

Data on student body characteristics, and institutional characteristics and spending are merged in from a number of sources. The percentage of students receiving a Pell Grant is obtained from the Pell Grant Recipients data and is used to proxy for the percentage of low-income students at each institution in each year. The racial composition of each college or university is derived from the *Integrated Postsecondary Education Data System* (IPEDS), a product of the National Center for Education Statistics (NCES). Measures of student body quality and application pool quality such as 75th percentile SAT scores and median SAT scores of incoming freshmen[34], number of applicants, admit rate and yield rate come from the College Board data set, as does the percent of enrolled freshmen from outside the U.S. Institutional costs and spending data, including tuition, room & board, and average

[33] The sample of private four-year colleges and universities excludes post-secondary institutions specializing in the study of music or the arts, and religious seminaries.
[34] What is referred to as the median SAT score is actually calculated as the midpoint of the interquartile range.

salary by faculty rank, come from IPEDS. Finally, the percent of faculty employed part-time is derived from IPEDS data.

Figure 3.1 shows the percentage of private four-year colleges and universities in the sample offering merit-based financial aid for each year in the sample period, 1987-2005. The trends are also shown for each tier. Tiers are defined using median SAT scores of the student body at the start of the sample period to partition the complete sample of private four-year institutions into terciles.[35] By definition, no

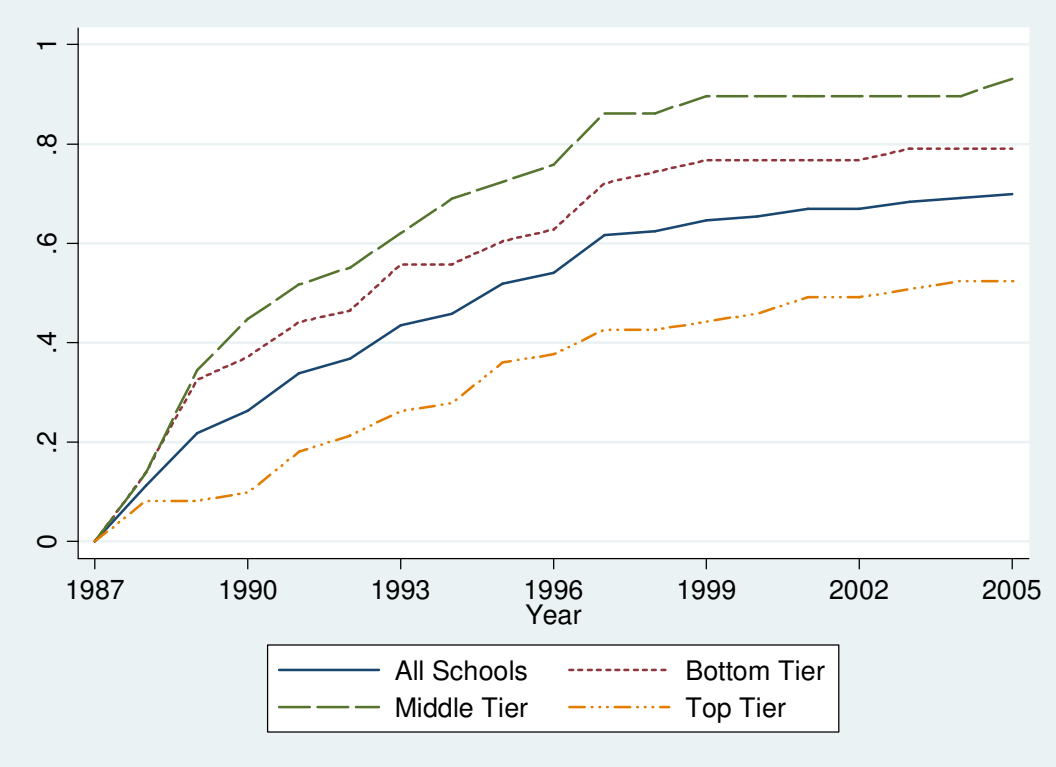

Figure 3.1: Percent of private four-year colleges and universities offering merit-based financial aid: 1987-2005.

[35] More specifically, the median SAT scores in 1987 of all private four-year colleges and universities reporting complete merit-aid data for the sample period, including those that offer merit for the entire period, were used to break the sample into terciles. Bottom tier schools have SAT scores below 1020, Middle Tier schools have SAT scores between 1020 and 1110, and Top Tier schools have SAT scores greater than or equal to 1110. All SAT scores prior to 1996 were re-centered using the crosswalk provided by the College Board. If SAT scores were missing in 1987, 1988 values were used if available, or if not, SATs were imputed using expenditures per student, urbanicity, % residential, and student body size.

institutions in the sample were offering merit aid in 1987. There is a fairly steep and steady increase for the whole sample, and as a result, in 2005 about 70% of the top tier colleges and universities in the sample have started offering merit aid. The bulk of this increase comes from schools in the bottom and middle tiers, as about 50% of the schools report offering merit aid in 2005, whereas over 90% of mid-tier schools offer merit aid in 2005. One of the main hypothesized motivations behind the use of merit-based financial aid is to attract more high ability students to enroll at one's institution. Bottom and mid-tier schools have the most incentive to do this in order to move up in the hierarchy of private four-year colleges and universities by enrolling a higher quality student body. However, top-tier colleges may decide to begin offering merit aid as a way to stay competitive and to retain high-ability students as more and more colleges around them are trying to steal these students away. Figure 3.1 illustrates that there has been a strong movement by private four-year colleges and universities towards merit-based financial aid. When weighted by the size of the undergraduate student body, the trends look very similar, showing that there is not a specific pattern over time to the size of schools that have decided to begin offering merit aid.

Descriptive statistics for the outcome variables of interest are shown in Tables 4.1a and 4.1b. Mean values are reported for the beginning and end of the sample period, as is the percent change in each variable over the time period for the whole sample of schools and by tier. The percentage of students receiving Pell Grants has increased by 15% over the sample period. The majority of this increase has occurred in the mid-tier and bottom tier schools. Although there has been a fairly large increase in percent Pell over the time period, low-income students still make up a much smaller proportion of the upper-tier schools; only 14% of the student body at top tier schools as compared to almost 48% at bottom tier schools. The percentage of Hispanic

Table 4.1a: Descriptive Statistics for Outcome Variables in 1987 and 2005 for main sample and by tier

Variable	All Schools			Bottom Tier		
	1987	*2005*	*% Change*	*1987*	*2005*	*% Change*
Pct. Pell	23.48	27.07	15%	39.97	47.03	18%
	(21.63)	(21.65)		(25.07)	(25.70)	
Pct. Black	13.31	13.74	3%	30.93	31.06	0%
	(27.76)	(26.18)		(41.94)	(39.68)	
Pct. Hispanic	2.63	5.02	91%	2.65	4.48	69%
	(5.36)	(5.03)		(8.92)	(7.55)	
Pct. Asian	3.78	6.02	59%	2.05	2.50	22%
	(6.69)	(7.77)		(9.34)	(8.42)	
# Applicants	3467	4490	29%	554	1207	118%
	(4219)	(5292)		(528)	(1268)	
# Freshmen	474	546	15%	186	220	18%
	(467)	(519)		(165)	(204)	
Median SAT	1153	1174	2%	953	954	0%
	(153)	(195)		(48)	(132)	
75th Percentile SAT	1257	1275	1%	1067	1069	0%
	(148)	(187)		(54)	(140)	
Admit Rate	58.81	54.68	-7%	83.33	68.71	-18%
	(23.39)	(24.91)		(10.63)	(23.93)	
Yield	46.20	40.15	-13%	54.15	47.86	-12%
	(15.49)	(18.32)		(18.95)	(25.71)	
% Foreign Freshmen	3.35	4.24	26%	2.35	2.85	21%
	(3.38)	(3.17)		(3.70)	(1.86)	
% FT Students	83.24	88.28	6%	70.48	77.09	9%
	(20.21)	(17.32)		(26.44)	(24.19)	

Table 4.1a Continued.

Variable	All Schools			Bottom Tier		
	1987	*2005*	*% Change*	*1987*	*2005*	*% Change*
Room & Board	6044	7821	29%	4639	5553	20%
	(1573)	(2129)		(1328)	(1771)	
Tuition	13750	22348	63%	7113	12855	81%
	(6184)	(8627)		(2679)	(4301)	
% PT Faculty	30.38	35.87	18%	34.79	44.71	28%
	(16.24)	(21.95)		(16.78)	(22.32)	
Avg. Asst. Prof Salary	43949	52905	20%	32418	40621	25%
	(11127)	(13417)		(7752)	(7656)	
Avg. Assoc. Prof Salary	54645	63813	17%	39068	47101	21%
	(14299)	(16985)		(8675)	(8862)	
Avg. Prof. Salary	71750	83821	17%	45132	55464	23%
	(24132)	(31053)		(13764)	(15341)	
Observations	133	133		43	43	

Note: Reported statistics for 1987 race variables are from 1988. All dollar amounts are in 2005 dollars. Median SATs before 1996 were adjusted for re-centering. Tiers are defined by reported Median SAT scores in 1987: Bottom Tier schools have SAT scores less than 1020, Middle Tier schools have SAT scores between 1020 and 1110, and Top Tier schools have SAT scores greater than or equal to 1110.

Table 4.1b: Descriptive Statistics for Outcome Variables in 1987 and 2005 for main sample and by tier

Variable	Middle Tier			Top Tier		
	1987	*2005*	*% Change*	*1987*	*2005*	*% Change*
Pct. Pell	22.84	26.46	16%	12.71	13.94	10%
	(16.50)	(14.64)		(12.78)	(5.25)	
Pct. Black	6.82	8.40	23%	3.97	4.64	17%
	(16.51)	(16.50)		(2.31)	(2.30)	
Pct. Hispanic	1.80	3.86	114%	3.00	5.94	98%
	(2.12)	(2.91)		(2.21)	(3.33)	
Pct. Asian	2.64	4.68	77%	5.55	9.03	63%
	(5.26)	(8.14)		(4.30)	(5.83)	
# Applicants	1461	2604	78%	5055	6956	38%
	(900)	(1857)		(4777)	(6289)	
# Freshmen	413	515	25%	697	775	11%
	(269)	(302)		(558)	(620)	
Median SAT	1061	1111	5%	1273	1327	4%
	(23)	(108)		(87)	(100)	
75th Percentile SAT	1176	1209	3%	1365	1420	4%
	(31)	(92)		(97)	(95)	
Admit Rate	71.92	68.59	-5%	46.86	41.40	-12%
	(15.72)	(15.76)		(20.18)	(21.61)	
Yield	48.10	35.99	-25%	43.20	38.49	-11%
	(17.40)	(16.93)		(12.80)	(13.47)	
% Foreign Freshmen	3.45	3.00	-13%	4.02	5.05	26%
	(3.96)	(3.24)		(2.65)	(3.15)	
% FT Students	80.82	88.64	10%	93.38	95.63	2%
	(13.46)	(9.38)		(10.04)	(8.83)	

Table 4.1b Continued.

Variable	Middle Tier			Top Tier		
	1987	*2005*	*% Change*	*1987*	*2005*	*% Change*
Room & Board	5888	7758	32%	6824	8902	30%
	(1634)	(2184)		(1091)	(1266)	
Tuition	11742	21172	80%	18624	29886	60%
	(4894)	(5615)		(3285)	(3625)	
% PT Faculty	38.72	48.32	25%	23.34	24.17	4%
	(14.01)	(22.60)		(14.07)	(14.42)	
Avg. Asst. Prof Salary	40909	49788	22%	52156	62305	19%
	(7212)	(10197)		(6731)	(10308)	
Avg. Assoc. Prof Salary	48216	60022	24%	65331	76163	17%
	(11555)	(13721)		(7037)	(11613)	
Avg. Prof. Salary	60233	72555	20%	89250	107463	20%
	(16859)	(21923)		(14323)	(23336)	
Observations	29	29		61	61	

Note: Reported statistics for 1987 race variables are from 1988. All dollar amounts are in 2005$. Median SATs before 1996 were adjusted for re-centering. Tiers are defined by reported Median SAT scores in 1987: Bottom Tier schools have SAT scores less than 1020, Middle Tier schools have SAT scores between 1020 and 1110, and Top Tier schools have SAT scores greater than or equal to 1110.

students enrolled has grown significantly over time, and the bulk of this increase has occurred at mid-tier and top tier schools. Despite the increases, in 2005 Hispanic students make up only 5% of the student bodies at the schools in the sample. There is a very similar pattern for the increase in representation of Asian students. Although there has been very little increase in the percentage of Black students enrolled at schools in the sample, there have been large percentage increases in the top two tiers. Black students are much more highly represented in the student bodies at bottom tier schools than at top tier schools, 31% in the bottom tier versus only 5 % in the top tier.

Applicant pools have increased quite a bit over the sample period, especially at bottom tier schools (over 100%). However they are still significantly larger at top tier schools. This is hardly surprising, as the top tier colleges are the most in demand by students, especially high ability students, and they are also on average larger schools with more slots for freshmen students. It may also be that this jump in applications for middle tier schools is partly driven by the increased use of the common application by these schools (Liu, et. al, 2007). Although the applicant pool has grown steadily, the size of the freshmen class has not grown at the same rate. As a result, admit rates have fallen over time. Interestingly, yield rates have also fallen over time. This may also be a result of the "apply everywhere" philosophy that seems to have taken hold in recent years. Admitted students may have more options of where to enroll, and therefore the probability of enrolling a particular admitted student may be falling. Schools in the sample enroll a small percentage of foreign freshmen, 4% in 2005, but there has been an increase over time for the bottom and top tier schools. The majority of the student bodies at the schools in the sample are composed of full-time students and this percentage has increased slightly over time for all schools.

In terms of charges, both room & board and tuition have increased significantly during the sample period. Changes in room & board charges have been comparable across tiers, at around a 20-30% change in charges, although the average charges do go up as you move up a tier[36]. Tuition charges follow the same pattern in terms of means, but the large increases in tuition have occurred mostly at the bottom and middle tier colleges and universities. Despite these big increases in the bottom two tiers, the tuition levels at top tier schools are still significantly higher, with an average of almost $30,000 for top tier schools in 2005 versus only $13,000 at bottom tier schools and $21,000 at middle tier schools.

Colleges in all three tiers have seen similar percent increases in average faculty salaries. As with tuition, top tier colleges and universities have much higher average salaries at every rank than do colleges and universities from the bottom two tiers. Top tier schools employ more of their faculty full-time than do schools from the bottom two tiers. On average, 24% of the faculty at top-tier schools is employed part-time, versus 44-48% at bottom and middle tier schools.

The descriptive statistics in Tables 4.1a & 4.1b show that for both types of colleges in the main sample, those that begin offering aid at some point during the time period, and those that never do (for ease of discussion I will refer to them as Change and Never schools) there are definite time trends for all of the variables of interest. This does not, however, tell us if the practice of offering merit aid affects these variables, and by how much. Figure 4.2 shows the percentage of the student body that receives Pell Grants by the number of years since or until merit aid is first offered, for all of the Change schools and also separated by tier. There are fewer schools with many years of observations before they began offering merit aid causing the trends to be very jumpy before year zero, and then smooth out considerably.

[36] All dollar amounts have been adjusted for inflation and are reported in constant 2005 dollars.

Despite the jumpy nature of the percentages before merit aid is offered, there is a distinct pattern that emerges at year 0. For all three tiers there is a somewhat steady increase in percent Pell in the years leading up to the introduction of the merit aid policy, and then starting at year zero, this incline flattens out and may even start to reverse about 10 years following the policy change. This pattern, although not showing a strict decline in percent Pell following the policy change, does provide descriptive evidence that there was an effect on the income distribution of students following the switch to merit aid.

Figure 4.2: Average % Pell Grant Recipients for all schools that began offering merit aid after 1987 by # years and by tier.

As mentioned previously, a likely main motivation for offering merit-based aid is to increase the quality of the student body by attracting more high-scoring students to enroll. Figure 4.3 shows the median SAT scores of the incoming freshman class by

the number of years until or since merit aid is first offered. There is no clear pattern relating the number of years offering merit aid and the average median SAT scores, so perhaps these policies are if anything, only moderately successful in actually increasing the quality of the student body. It is also possible that instead of increasing student body quality, the policies work to maintain student body quality such that in the absence of such a financial aid program the institutions would have experienced decreases in their median SAT scores. A more formal regression analysis is required to examine this relationship. The next section examines empirically whether the descriptive relationships that do appear remain after controlling for other characteristics.

Figure 4.3: Average Median SAT scores for all schools that began offering merit aid after 1987 by # years and by tier.

IV. Empirical Methods and Results

A. Factors Affecting the Decision to Offer Merit Aid

This paper has put forth a number of hypotheses in the introduction as to why private four-year colleges might begin to offer merit-based financial aid. To examine the factors that affect this choice I estimate a proportional hazards model for the decision to begin offering merit aid in each academic year. Between each observed time period, institutions have the choice to continue not to offer merit aid or to begin offering merit aid. This decision is modeled as a function of an institution's own characteristics in the beginning of the time period and how these characteristics interact with those of peer institutions.

Following the hypotheses outlined above there are two measures of particular interest. If colleges notice that they are enrolling high ability students at a lower rate than their peer institutions, or in other words are experiencing slower growth in their median SAT scores than peer colleges, they may offer merit aid awards to increase their yield of high ability students. Lower tier colleges may want to increase the quality of their student body, but could also have trouble filling their freshman classes and therefore may respond to low enrollment growth by introducing a merit aid program. To investigate these two relationships I include indicators of whether the institution had lower growth in either median SAT scores or total undergraduate enrollment than their peer institutions and then include interactions of both measures with indicators for the tier of the college[37].

[37] As none of the institutions in the sample have started offering merit aid at the beginning of the sample period, their "spells" of not offering aid are already in progress. The proportional hazards model takes this into account, assigning all schools the same start date of 1960. The results are not sensitive to changes in this start date. The estimations also take account of the fact that the "spell" is right-censored for Never schools as we never observe their switch to merit aid.

Table 4.2: Probability of offering Merit Aid - Hazard Ratios from proportional hazards model estimation

	(1)	(2)	(3)	(4)
	50 SAT Pts	**100 SAT Pts**	**200 Miles**	**200 Miles & 100 SAT Pts**
Expenditures/Student	0.803***	0.801***	0.806***	0.803***
	[0.068]	[0.068]	[0.067]	[0.068]
Bottom Tier	0.728	0.689	1.163	0.744
	[0.281]	[0.274]	[0.696]	[0.292]
Top Tier	0.528	0.519	0.884	0.521
	[0.250]	[0.252]	[0.542]	[0.253]
Lower SAT Growth than Peers	2.015*	2.271**	2.697	2.216*
	[0.829]	[0.938]	[1.641]	[0.911]
Lower SAT Growth than Peers X Top Tier	0.436	0.482	0.183**	0.466
	[0.235]	[0.261]	[0.124]	[0.252]
Lower SAT Growth than Peers X Bottom Tier	0.477	0.579	0.418	0.522
	[0.291]	[0.333]	[0.294]	[0.299]
Lower UG Growth than Peers	0.656	0.682	0.899	0.657
	[0.276]	[0.288]	[0.369]	[0.276]
Lower UG Growth than Peers X Top Tier	1.342	1.376	1.752	1.396
	[0.739]	[0.759]	[0.998]	[0.771]
Lower UG Growth than Peers X Bottom Tier	1.498	1.69	1.187	1.489
	[0.811]	[0.916]	[0.671]	[0.804]
Observations	1262	1262	1262	1262

Note: Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%. Also includes controls for Common Application status, and University.

Hazard ratios from estimations of the probability of beginning to offer merit aid with several different peer group definitions are reported in Table 4.2. Column 1 (2) of Table 4.2 defines peer institutions as those with median SAT scores within a 50 (100) point band of the focus institution's own median SAT scores. Column 3 defines the peer institutions using a distance metric – including all private four-year institutions located within 200 miles of the focus institution. Column 4 combines these two types of peer group measures and defines peers as all institutions with median SAT scores within a 100 point band of the focus institution and also within a 200 mile radius. The results seem not to be very sensitive to the peer group definition. Colleges that are experiencing slower growth in median SAT scores as compared to their peer institutions are significantly more likely to begin offering merit aid in that time period. When peer group is defined only by distance top tier colleges are less likely to begin offering merit aid if they are experiencing low growth in their SAT scores. However, for top tier institutions it is unlikely that this is the correct peer group to consider – top tier institutions compete on a national scale for students. Although anecdotally it appears that some colleges, in particular lower tier colleges, may be using merit aid as a way to fill their classes, low enrollment growth as compared to peer institutions does not have a significant effect on the probability of beginning a merit aid program. Therefore it seems that colleges are strategically using merit aid as a way to stay competitive in the market for high ability students, and these results largely confirm the common hypothesis for the use of merit aid.

B. The Effects of Merit Aid on Institutional Characteristics

The descriptive statistics in the previous section suggest that for this sample of four-year colleges and universities, there have been significant changes in the variables describing the student bodies, costs and spending on faculty over the sample

period, and that some of these changes may have followed the introduction of merit-based financial aid by the institutions. In order to examine this more closely I estimate the relationship between the number of years a college or university has offered merit aid, and the outcome variables of interest. One might expect that if there are impacts on the distribution of students or institutional spending, these effects may not be constant over time once the school has decided to offer aid. There are a number of reasonable scenarios for the time pattern of the possible effects. Institutions might have an immediate response in terms of spending that over time may fade away as they find alternate funding sources for their merit awards. In contrast, there may not be an immediate effect if schools anticipate offering merit aid and have an alternate funding source in mind that is depleted over time leading to a need to cut spending in other areas in order to continue funding merit awards. Therefore, it seems most reasonable to allow a fairly flexible form for the effect of merit aid over time, rather than to take a difference-in-differences approach.

To allow for these possible nonlinearities, the model is estimated as a function of a series of indicators for the time elapsed since merit aid was first introduced. Quadratic time trends are also included to account for the common changes in the variables of interest over the sample period. These trends are allowed to differ for Change and Never institutions, as the types of schools that choose to begin offering merit aid during the sample period are often on quite different trajectories for the time period. Institutional fixed effects are included, as well as time-varying variables such as expenditures per student, percent residential, urbanicity, and whether the institution uses the common application in their admissions process. In order to investigate how the effect of offering merit aid may differ for colleges of different initial quality,

variables indicating how long a college has had merit aid were interacted with indicators for tier[38].

In the previous section I have just shown that the decision to begin offering merit aid is endogenous, and therefore the effects estimated in this section should not be interpreted as causal estimates. However, the estimations do control for institution fixed effects and allow for differential time trends, hopefully capturing much of the differences in the types of institutions that begin offering merit aid and those that do not yet. Perhaps most importantly, what we are most interested in examining is how these outcome variables have changed following the introduction of a merit aid policy, not how these variables might change if a private four-year college were "forced" to exogenously adopt a merit aid policy as this is very unlikely to occur.

Table 4.3 shows the results of Ordinary Least Squares (OLS) estimations of how the composition of the student body changes in the years following the introduction of a merit aid policy. Column 1 shows how the changes in the percent of the student body that is low-income, as proxied by the percent receiving Pell grants, has changed as merit-based financial aid was introduced for the institutions in the sample. There does not seem to be a significant immediate effect following the introduction of merit aid for middle and top tier institutions. However, there is an increase in the share of students that receive Pell Grants at bottom tier institutions in the first five years following the policy change. A negative relationship begins to take shape at middle and top tier colleges three to five years after adoption, and the percent of Pell grant students at schools that have offered merit aid for six to ten years is roughly 5 percentage points lower than for these schools before they started offering aid. As the time elapsed since introduction of merit aid increases to ten years or

[38] Alternative median SAT cutoffs were used to test for sensitivity of results to tier assignment, but all results are robust to changing the tier cutoffs by 20 points in any direction.

Table 4.3: Effects of a Merit aid policy on student body demographics

	(1)	(2)	(3)	(4)	(5)
	% Pell	% Black	% Hispanic	% Asian	% Int'l Fresh.
Merit ≤ 2yrs	-0.77	-0.52	-0.047	-0.177	-0.524
	[1.027]	[0.616]	[0.242]	[0.360]	[0.836]
X Bottom Tier	3.216**	1.730**	-0.103	-0.074	1.899*
	[1.311]	[0.791]	[0.311]	[0.462]	[1.073]
X Top Tier	-0.247	0.061	0.021	-0.185	1.044
	[1.302]	[0.764]	[0.300]	[0.446]	[0.980]
Merit 3-5 yrs	-2.166**	-1.066*	-0.045	-0.181	-0.827
	[1.002]	[0.587]	[0.230]	[0.342]	[0.747]
X Bottom Tier	3.312***	0.764	-0.14	-0.612	1.888**
	[1.176]	[0.694]	[0.272]	[0.405]	[0.955]
X Top Tier	0.37	0.582	0.378	0.087	1.765**
	[1.170]	[0.677]	[0.266]	[0.395]	[0.834]
Merit 6-10yrs	-5.073***	-1.554**	-0.438*	-0.327	1.073
	[1.074]	[0.645]	[0.253]	[0.376]	[0.799]
X Bottom Tier	4.125***	2.539***	0.025	-0.661*	1.293
	[1.067]	[0.647]	[0.254]	[0.378]	[0.870]
X Top Tier	0.516	0.515	1.005***	0.125	-0.527
	[1.074]	[0.639]	[0.251]	[0.373]	[0.779]
Merit >10yrs	-6.141***	-2.192***	-0.590*	-0.047	0.186
	[1.385]	[0.836]	[0.328]	[0.488]	[1.024]
X Bottom Tier	4.358***	4.017***	0.019	-1.138***	1.681*
	[1.183]	[0.722]	[0.284]	[0.421]	[0.974]
X Top Tier	-1.504	0.603	0.991***	-0.272	0.128
	[1.223]	[0.728]	[0.286]	[0.425]	[0.881]
Observations	2493	2251	2251	2251	1802
R-squared	0.93	0.99	0.95	0.96	0.58

Note: All estimations include institution fixed effects and controls for expenditures per student, % residential, urbanicity, and whether the institution uses the common application, and differential quadratic time trends (Change vs. Never).

greater, the relationship becomes negative for all institutions, but the change is much smaller for bottom tier colleges. Middle and top tier institutions experience a net decrease of about 6 percentage points 10 years out, whereas bottom tier institutions see a decrease only about 2 percentage points. Although in the last section I did not find evidence that colleges experiencing low enrollment growth were more likely to

switch to merit aid, there is anecdotal evidence that this is true, and it is argued that in this case there is the possibility of actually increasing the share of Pell Grant recipients in conjunction with merit aid. These results lend some credence to this argument as bottom tier institutions have an initial increase in percent Pell, but long-run there is still a crowding-out of low-income students.

The introduction of merit-based financial aid is associated with a decrease in the percentage of Black students enrolled at colleges in the top two tiers. As with percent Pell, there seems to be little immediate effect, but three to five years after adoption of merit aid there is a decrease in percent Black by about 1.5 percentage points at both top and middle tier colleges. Schools in the top two tiers continue to experience a decrease in the percentage of students that are Black with a total decline of about 2 percentage points after 10 years of offering merit aid. Bottom tier colleges experience an increase in percentage of Black students of about 2 percentage points after having offered merit aid for more than 10 years, suggesting that Black students are being redistributed from top tier colleges to bottom tier colleges as a result of merit aid programs.

The results show that although following the introduction of merit aid percent Black falls in the top two tiers and rises in the bottom tier, there are only very small changes in percent Hispanic across the tiers. Ten years following the switch to merit aid there seems to be a decrease of about 0.5 percentage points at institutions in the bottom two tiers, and a corresponding increase of about 1 percentage point at top tier institutions. The introduction of merit aid is associated with a decrease in percent Asian at the institutions in the bottom tier, but no change for the top two tiers. The fall in percent Asian at the bottom two tiers is quite small with a decrease of 0.7 percentage points three to five years after adoption and a decrease of about 1.3 percentage points ten years out.

One possible way for institutions to increase tuition revenues in order to help fund the adoption of a merit-based financial aid policy is for these schools to enroll more freshmen from outside of the United States. International students generally receive little to no financial aid and therefore are much more likely to pay the full posted tuition. Column 5 of Table 4.3 provides evidence that this might be a strategy some institutions are employing. Middle and top tier schools experience an increase in enrollment of international freshmen of about 2 percentage points 3-5 years following the introduction of merit aid, with a slightly larger increase at bottom tier colleges (3.5 ppts). Percent foreign then goes back to pre-merit levels ten years after adoption of merit aid for middle and top tier institutions, and the increase at bottom tier institutions falls slightly to 1.7 ppts.

Table 4.4 displays the results of estimating how successful the practice of offering merit aid has been at increasing median SAT scores and enrollment of high ability students, increasing the size of applicant pools and the number of enrolled freshmen, as well as the effect of merit aid on admit and yield rates. The results in column 1 indicate that for all schools the introduction of merit-based financial aid is followed by an increase in median SAT scores for the entering class. Top tier colleges actually experience drops in SAT scores in the first two years following the switch to merit aid, likely due to the fact that the institutions in this category that are most likely to begin offering merit aid are those that were having trouble attracting high ability students at the same rate as their peers, as shown in the previous section. However, these institutions rebound somewhat, and return to pre-merit levels and possibly experience slight gains in median SAT scores 10 years out. For middle tier colleges, there is a lag with the effect arising about three to five following introduction of merit aid, and leading to an increase in median SAT scores of about 22 points, a fairly modest increase. Ten years out this effect rises to 35 points. It may be that it takes a

Table 4.4: Effects of a Merit Aid policy on admissions and student body characteristics

	(1) Median SAT	(2) SATQ75	(3) # Freshmen	(4) Applicants	(5) Admit Rate	(6) Yield
Merit ≤ 2yrs	12.322	12.413	0.309	9.086	-3.011*	-0.498
	[8.715]	[8.949]	[13.494]	[142.611]	[1.799]	[1.862]
X Bottom Tier	-4.974	-10.992	-13.688	50.878	3.007	-3.602
	[12.325]	[12.742]	[17.345]	[207.498]	[2.617]	[2.706]
X Top Tier	-24.536**	-16.319	-6.456	-1.043	1.966	2.917
	[10.369]	[10.631]	[17.115]	[172.390]	[2.174]	[2.252]
Merit 3-5 yrs	22.246**	18.433**	-12.652	-49.929	-5.020***	3.361*
	[8.725]	[9.036]	[13.420]	[143.468]	[1.809]	[1.880]
X Bottom Tier	0.993	6.13	-2.04	238.379	-0.91	-8.568***
	[11.043]	[11.459]	[16.109]	[187.054]	[2.359]	[2.438]
X Top Tier	-19.330**	-5.525	-12.683	119.498	2.808	-3.673*
	[9.595]	[9.911]	[16.001]	[159.486]	[2.011]	[2.087]
Merit 6-10yrs	29.196***	27.918***	19.737	-145.356	-5.316***	3.704*
	[9.088]	[9.397]	[14.483]	[151.944]	[1.916]	[1.983]
X Bottom Tier	11.379	15.152	-39.886***	222.124	-0.903	-15.120***
	[10.081]	[10.452]	[14.588]	[171.619]	[2.164]	[2.221]
X Top Tier	-33.228***	-17.523*	-31.137**	391.068***	3.312*	-1.423
	[8.782]	[9.051]	[14.661]	[146.029]	[1.842]	[1.907]
Merit >10yrs	34.498***	47.604***	10.96	-58.731	-4.466*	-1.985
	[11.232]	[11.647]	[19.255]	[191.857]	[2.420]	[2.503]
X Bottom Tier	-28.495***	-27.672**	-32.476**	-273.813	0.869	-10.173***
	[10.893]	[11.353]	[16.245]	[181.118]	[2.284]	[2.364]
X Top Tier	-31.041***	-26.262***	-2.503	353.307**	2.27	5.207**
	[9.577]	[9.907]	[16.755]	[163.617]	[2.064]	[2.136]
Observations	1879	1898	2267	2049	2049	2054
R-squared	0.95	0.94	0.98	0.98	0.87	0.76

Note: All estimations include institution fixed effects and controls for expenditures per student, % residential, urbanicity, and whether the institution uses the common application, and differential quadratic time trends (Change vs. Never). Estimations in column (3) have a linear trend only.

few cycles of offering merit aid before word gets out and the program begins to attract many higher test score students, or that there is some critical mass that must be attracted before the median scores will actually rise significantly. Bottom tier institutions experience gains in median SAT scores similar to middle tier colleges following the introduction of merit aid. However, ten years after the introduction of the policy, bottom tier colleges have median SAT scores that are only slightly higher than before the policy.

Merit aid policies are meant to increase the size of the top tail of the ability distribution at colleges, so perhaps a better measure of whether colleges have been successful in this goal is the 75th percentile SAT score. Column 2 shows how the 75th percentile changes following the introduction of merit aid. Colleges at all tiers experience an increase in these scores following the policy change. This effect is largest for middle tier colleges, with an increase of about 48 points, as compared to increases of about 20 points at top and bottom tier colleges ten years following the policy change.

As discussed previously, bottom tier colleges also likely have a second incentive for offering merit aid, to increase enrollment. In column 3, results show that bottom tier institutions that have offered merit aid for 10 years or more actually have slightly smaller freshmen classes than before they began offering merit aid, by about 32 students. Top tier institutions also seem to experience slight decreases in their freshmen class sizes 6-10 years following a switch to merit aid. For both tiers that experience changes in freshmen class size it is possible that the use of merit aid has allowed the institutions to reach a standing where they can begin to decrease class sizes, leading to lower student to faculty ratios and higher quality education. It is also possible for bottom tier colleges that although we did not find evidence for slow enrollment growth as an incentive to begin offering merit aid, this is indeed the case and perhaps merit aid is not a successful tool to reach this goal.

Top tier colleges experience increases in applicant pool size six to ten years following the introduction of merit aid. For the bottom two tiers, applicant pool sizes remain unchanged ten years following the policy change. Columns 5 and 6 of Table 4.4 show the results for the admit rate (calculated as the number of students admitted divided by the number of students that applied) and yield (calculated as the number of students that enroll divided by the number of students that were granted admission).

There is a decrease in the admit rate, about 5 percentage points, in the three to ten years following the introduction of merit aid. This negative relationship remains over time with only a slightly decrease in the size of the fall in admit rate, and a slightly smaller fall in admit rate for top tier institutions. Results in column 6 show that the introduction of merit aid is followed by an increase in yield rates at middle and top tier colleges and a decrease in yield at bottom tier colleges. For middle tier colleges the strategy of using merit-based financial aid to increase enrollment of high-test score students seems to be somewhat fruitful given the slight increase in median and 75th percentile SAT scores associated with this policy, and increase in overall yield rates. Evidence is mixed for the success of merit aid at bottom and top tier colleges. Bottom tier colleges experience an increase in SAT scores but see a fall in freshman enrollment. Top tier colleges see only very slight increases in median SAT scores, but larger increases in yield and 75th percentile SAT scores.

Table 4.5 examines the relationship between the introduction of merit aid and tuition, room & board, and the percentage of the student body that is enrolled full-time. All three are measures of direct ways by which an institution could make changes in order to fund increases in merit-aid funding. Middle and bottom tier colleges experience an increase in tuition rates of 2.7% six to ten years following the adoption of a merit aid policy, and this effect increases over time to a 6.5% increase in tuition rates ten years out, as compared to before the adoption of merit aid. In contrast, top tier colleges experience decreases in tuition over this time period of about 5 percentage points 6-10 years following the switch to merit aid and about 3 percentage points 10 years out.

The relationship between a merit aid policy and changes in room & board charges is somewhat different from that of tuition charges. Middle and bottom tier colleges see decreases in room & board charges 3-5 following the introduction of

Table 4.5: Effects of a Merit Aid Policy on student costs and enrollments

	(1) Log (Tuition)	(2) Log (Room/Board)	(3) Log (Total Cost)	(4) % Full-time Stud.
Merit ≤ 2yrs	0.014	-0.028	0.004	1.482
	[0.016]	[0.023]	[0.014]	[0.961]
X Bottom Tier	-0.02	-0.004	-0.014	-0.23
	[0.022]	[0.031]	[0.019]	[1.227]
X Top Tier	-0.016	0.034	0.007	-0.497
	[0.021]	[0.028]	[0.017]	[1.219]
Merit 3-5 yrs	0	-0.108***	-0.028**	2.687***
	[0.015]	[0.021]	[0.013]	[0.938]
X Bottom Tier	0	0.029	0.001	-1.840*
	[0.020]	[0.029]	[0.018]	[1.101]
X Top Tier	-0.026	0.109***	0.030*	-1.851*
	[0.020]	[0.027]	[0.016]	[1.096]
Merit 6-10yrs	0.027*	-0.082***	-0.001	3.807***
	[0.015]	[0.020]	[0.012]	[1.006]
X Bottom Tier	-0.015	0.02	0.006	-0.709
	[0.018]	[0.026]	[0.016]	[0.999]
X Top Tier	-0.071***	0.101***	-0.001	-2.513**
	[0.018]	[0.024]	[0.014]	[1.006]
Merit >10yrs	0.065***	-0.018	0.027*	8.459***
	[0.017]	[0.024]	[0.015]	[1.297]
X Bottom Tier	-0.027	0.014	0.031*	-2.195**
	[0.020]	[0.029]	[0.018]	[1.107]
X Top Tier	-0.097***	0.04	-0.02	-7.471***
	[0.020]	[0.027]	[0.016]	[1.145]
Observations	2262	1820	1795	2517
R-squared	0.98	0.88	0.98	0.92

Note: All estimations include institution fixed effects and controls for expenditures per student, % residential, urbanicity, and whether the institution uses the common application, and quadratic time trends. Estimations in columns (2) & (3) have a linear trend only. Estimation in column (4) allows for differential time trends by Change/Never

merit aid, but this change reverses such that ten years following the policy introduction room & board levels are similar to before the policy. Top tier institutions do not experience changes in room & board charges following a switch to merit aid.

Column 3 shows how these changes in tuition and room & board costs affect total student costs. The result is that for all colleges there is an overall increase in total student costs by ten years out. Bottom tier colleges experience slightly higher increases in total costs of about 5 percent versus 2.7 percent for schools in the top two tiers.

Another way in which institutions could increase tuition revenues in order to balance increases in merit aid expenditures would be to enroll more full-time students. This seems to be a successful strategy for schools at all levels, although the relationship is strongest for the middle tier. Three to five years following the introduction of a merit aid program the percentage of students that are enrolled full-time increases by about 3 percentage points at middle tier colleges and 1 percentage point at bottom and top tier colleges. Middle tier colleges continue to see increases in the percentage of students enrolled full-time with an overall net increase of about 8.5 percentage points ten years following the policy change. After the immediate bump, top tier colleges return to original levels. Bottom tier colleges also experience increases in enrollment of full-time students and ten years following the policy change have student populations that are about 6 percentage points more likely to be enrolled full-time.

Table 4.6 shows results of the effect of merit aid on faculty salaries and the proportion of faculty that are employed part-time. Bottom tier colleges and universities experience an increase in faculty salaries at the assistant professor level of about 5% immediately following the introduction of merit aid. This increases to about 6% ten years following the policy change. However, there doesn't seem to be a relationship between the policy change and assistant faculty salaries at top or middle tier colleges. Middle and bottom tier colleges experience increases in associate faculty salaries of about 5 percent ten years following the switch, but top tier colleges

Table 4.6: Effects of a Merit Aid policy on Faculty employment and salaries

	(1) Log (avg asst. salary)	(2) Log (avg assc. salary)	(3) Log (avg prof salary)	(4) Pct. PT Faculty
Merit ≤ 2yrs	-0.012	0.025*	-0.009	-1.271
	[0.019]	[0.015]	[0.023]	[3.047]
X Bottom Tier	0.049**	0.005	0.067**	1.23
	[0.025]	[0.020]	[0.030]	[4.021]
X Top Tier	-0.005	-0.037**	-0.006	-1.38
	[0.024]	[0.019]	[0.029]	[3.937]
Merit 3-5 yrs	-0.008	0.041***	0.018	-1.274
	[0.019]	[0.015]	[0.023]	[3.068]
X Bottom Tier	0.056**	-0.008	0.012	-1.139
	[0.023]	[0.018]	[0.028]	[3.763]
X Top Tier	-0.026	-0.062***	-0.047*	-5.582
	[0.022]	[0.018]	[0.027]	[3.632]
Merit 6-10yrs	-0.007	0.040**	0.027	-3.018
	[0.021]	[0.016]	[0.025]	[3.355]
X Bottom Tier	0.047**	-0.013	0.005	2.349
	[0.021]	[0.016]	[0.025]	[3.377]
X Top Tier	-0.026	-0.058***	-0.063**	-5.633*
	[0.020]	[0.016]	[0.024]	[3.319]
Merit >10yrs	-0.015	0.051**	0.023	-8.223*
	[0.027]	[0.021]	[0.032]	[4.374]
X Bottom Tier	0.057**	-0.02	0.025	0.113
	[0.022]	[0.018]	[0.027]	[3.445]
X Top Tier	-0.022	-0.058***	-0.045*	-2.108
	[0.023]	[0.018]	[0.027]	[3.411]
Observations	1876	1873	1881	1115
R-squared	0.88	0.93	0.92	0.72

Note: All estimations include institution fixed effects and controls for expenditures per student, % residential, urbanicity, and whether the institution uses the common application, and quadratic time trends. Estimation in column (4) has a linear trend only. Estimations allow for differential time trends by Change/Never.

experience decreases of almost 6 percent. Similarly, there is a positive relationship between merit aid and full professor salary levels at bottom tier colleges in the first five years following the adoption of merit aid. However, average full professor salaries decrease by about 5 percent at top tier colleges ten years following the

introduction of merit aid. Middle and bottom tier colleges are likely trying to increase their overall quality by simultaneously attracting more high-ability students through the use of merit aid, and by retaining and attracting high-quality faculty through higher salaries resulting in the positive relationship identified here. Top tier colleges may be spending less on salary increases for tenured faculty in order to help fund merit aid awards and therefore attract more high ability students to their institution.

Ten years following the introduction of merit aid, the colleges and universities in the whole sample experience a decrease in part-time faculty of 8 percentage points. It is encouraging that these findings point to an increase in the quality of the faculty (through the use of more full-time faculty members) associated with the use of merit-based aid, rather than a decrease in quality. Therefore, although colleges may need to divert funds to cover increased expenditures on merit aid, they are likely not doing so by employing more part-time faculty members which may lead to decreases in instructional quality.

A potential concern regarding the results is that the measure of having had merit aid for ten years or more not only captures effects ten years out but specifically for colleges that adopted a merit aid policy early enough to have ten years of data following. This should not be a huge concern for this particular sample as over 90% of the schools that switch to merit during the time period do so before 1997 at a fairly steady rate and therefore have more than ten years of observations following the switch. However, in an effort to test whether the results shown here are specific to "early-adopters" I split the sample into those who adopted early (pre-1995) and late-adopters (1996 and on). Although you cannot identify effects 10 years out for the late-adopters (of which there are very few), the patterns regarding changes in the variables of interest in the years following a switch to merit aid are qualitatively and quantitatively very similar to the results shown for the whole sample. Therefore it

does not seem that early-adopters experienced very different changes in outcomes than more recent adopters.

V. Conclusion

An increase in the use of merit-based financial aid by private colleges and universities has prompted many questions regarding the effects of this type of policy on the socioeconomic and racial composition of the student body, as well as other areas of educational expenditures and charges. Some argue that merit aid will lead to a crowding-out of low-income and minority students, who on average earn lower test scores and are less likely to receive a merit award. Others feel that merit aid will allow colleges to enroll more high-ability students that are able to pay an amount close to full tuition thereby increasing overall tuition revenues which can then be used to increase the funding of need-based financial aid awards. This paper uses data from the College Board, IPEDS and on Pell Grant recipients to examine this question, as well as to examine what factors cause institutions to begin offering merit aid and to assess how successful merit aid is at increasing the median test scores of entering students and/or increasing freshman enrollment. In addition, this study examines how a switch to a merit aid policy could affect the costs students bear in the form of tuition and room & board, as well as the spending on salaries and full-time faculty which can have impacts on the quality of the education provided at a college.

Colleges adopt a policy of awarding merit-based aid in response to low growth in median SAT scores of their incoming classes as compared to their peer institutions, and therefore to remain competitive with peer institutions at recruiting high-ability students. The results of this study show that most private colleges and universities have been successful at increasing the 75th percentile SAT scores of their incoming freshman class through the use of merit aid. However, these gains are fairly modest –

an average gain of about 47 points for the middle tier colleges and 20 point gains for bottom and top tier colleges ten years following the adoption of the policy.

The use of merit aid is associated with changes in the socioeconomic and racial composition of the student body. The percentage of students receiving Pell grants decreases by about 6 percentage points at colleges in the top two tiers and 2 percentage points in the bottom tier ten years following the introduction of the merit aid policy,. The use of merit aid is also associated with a decrease in the percentage of students that are Black at the top two tiers of about 2 percentage points. Bottom tier colleges experience a slight increase in international student enrollments following the introduction of merit aid. As international students more often than not pay full tuition and costs, this may be one mechanism by which these colleges can increase tuition revenues to balance the increased outlay on financial aid created by merit aid awards.

The introduction of merit aid policies are accompanied by increases in tuition at middle and bottom tier colleges of about 7%, a fairly substantial increase, resulting in a 3 percent increase in net cost. The posted tuition levels at top tier colleges either do not change following the introduction of a merit aid policy or decrease slightly, but total costs rise by about 3%. Bottom tier colleges experience slightly higher increases in total costs of about 5 percent.

There is some evidence that the use of merit aid leads to a decrease in spending in other areas, in particular on faculty salaries at top tier colleges. Top tier colleges see decreases in spending on associate and full professor salaries following the introduction of merit aid, which could result in higher turnover, and increased difficulty of recruiting high quality new faculty members. Middle tier colleges accompany the use of merit aid with increases in spending on associate faculty salaries, which may help these colleges to retain and attract more high-quality professors. Bottom tier colleges experiences increases in faculty salaries at the

assistant and associate level. These increases following the switch to merit aid may signal a move by the institutions to increase quality at both the student level and the faculty level. At all colleges, the introduction of a merit aid policy is associated with an increase in the percentage of faculty that is employed full-time. As Ehrenberg and Zhang (2005) and Bettinger & Long (2004) find that a decrease in the use of part-time faculty has a positive impact on student persistence, this move by colleges should have a positive impact on educational quality.

Overall, this study finds that merit aid programs are modestly successful at increasing test scores. Of course as mentioned earlier, these results must be accompanied by a disclaimer. As shown in the first section of results, the decision to begin offering merit aid is endogenous. Therefore, all results are suggestive of what is happening at private four-year colleges and universities following the introduction of a merit aid policy, but should not be interpreted as causal estimates. In addition, the sample used in the estimations is fairly small and selected, so there may be significant effects that this study is not able to identify. Keeping these caveats in mind, it is still somewhat worrisome, given the already low levels of representation of low-income and minority students at four-year colleges, to find that the introduction of a merit aid policy is associated with a decrease in the percentage of low-income and Black students, particularly at the more selective institutions in the sample. This crowding-out may be due to an increase in merit aid spending at the expense of need-based financial aid. In conjunction with the rising costs to students following the switch to merit, this relationship is something that needs more research. Institutions with merit aid policies may want to consider the unintended consequences of these programs, as they seem to be at odds with the current move to increase representation of low-income and minority students at four-year colleges and universities.

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CHAPTER 5

SUMMARY AND FUTURE WORK

This dissertation has examined three questions in higher education economics linked by a focus on low-income and minority students. The under-representation of low-income and minority students at selective colleges and universities is a salient policy issue, and understanding how to increase enrollment of these students and ensure their success during college will be very helpful as we move forward. It is also important to examine how other institutional policies can affect the enrollment of these students and the quality of the institutions they attend. Hopefully the results of this dissertation can help with all of these goals.

The second chapter examined the decision to apply to a selective college or university and identified proximity to a selective college as a significant factor. The results suggest that this is not just a simple cost or convenience story, but rather that there may be some informational benefit to living near to a selective institution that increases the likelihood of applying to one anywhere, not necessarily the closest. In order to attract more low-income students to apply, recruiters should focus their efforts on areas geographically distant from selective colleges and universities. Students in these areas might benefit from increased availability of information regarding the opportunities available at selective colleges and universities.

The results of chapter two help to point out one important factor in the application decision, but there is still room to examine other potentially significant factors. How does the racial and income composition of a student's high school impact on his/her application decisions? The composition of the high school a student attends can affect the social networks that they form, which in turn could affect their educational outcomes. Additionally, students' decisions may be affected by the

composition and quality of the body of teachers they interact with in high school. There is a growing literature on the importance of role models in education, and this is another area in which role models could potentially be very influential.

The third chapter investigates how measures of academic and social fit impact on the educational success of students enrolled at selective colleges and universities. The findings suggest that the grades and persistence of students with large gaps between their own test scores and those of their peers are not greatly affected, although the impacts are slightly larger for low-income students. This non-effect of a "mismatch" in academic fit seems mostly due to a successful selection process on the parts of the students and the institutions themselves. Instrumental variables estimations suggest that there is a much larger effect on grades for test score gaps once this selection is accounted for, indicating that admissions offices should continue to use other sources of information when evaluating the probability of success for students with low test scores in their admissions process.

Peer group size seems to have little effect on grades or persistence, but does impact on college major choice. As the choice of one's major, and subsequent occupation, can greatly affect earnings, these results further our understanding of this decision-making process. More research in this area would be beneficial and help policymakers to address the ongoing under-representation of women and minorities in science, technology, engineering and mathematics fields during and after college.

Notably, after controlling for background, institutional, and academic and social fit characteristics, Black and Hispanic students continue to earn lower grades and have lower six-year graduation rates from the selective schools in the data set. This is a worrying finding, and more research is needed to discover why this is so and if there are policies that institutions could adopt to address this issue.

Finally, the results of chapter four show that one institutional policy that has recently been spreading, merit aid, can have unintended consequences. This type of policy, while modestly successful at raising the quality of the student body, has been followed by decreases in the enrollment of low-income and minority students as well as changes in spending on faculty salaries and increases in student costs. These changes in spending and costs could be detrimental to institutional quality and student outcomes. In a time when the higher education community is concerned with issues of access for low-income and minority students, it is important to understand how current and new policies can impact on this goal. Other recent policies gaining popularity, such as SAT-optional admissions policies, and the end of Early Decision at many schools, should also be analyzed to see what impact, if any, they have on the enrollment and success of low-income and minority students.

This dissertation has examined three important questions regarding the post-secondary education experiences of low-income and minority students. Hopefully the results will add to the literature and our understanding of the factors affecting the educational success of these students. Additionally, these questions have paved the way to many other interesting and important questions in this area that future research can examine.

APPENDIX

Table A3.1: Multinomial Logit coefficient estimates for major choice in senior year (NLSF)

	STEM	Humanities	Soc. Sci.	Bus./Econ.
Black	-0.106	-0.127	0.297	-0.21
	(0.174)	(0.223)	(0.134)**	(0.163)
Hispanic	0.043	-0.41	-0.212	0.182
	(0.114)	(0.197)**	(0.127)*	(0.147)
Asian	-0.155	0.061	0.208	-0.289
	(0.123)	(0.251)	(0.114)*	(0.19)
HS GPA	0.841	0.37	0.454	0.235
	(0.143)***	(0.326)	(0.157)***	(0.214)
Private HS	-0.058	-0.063	0.1	-0.025
	(0.068)	(0.145)	(0.086)	(0.114)
Income <$35,000	0.302	0.452	-0.118	0.633
	(0.193)	(0.278)	(0.262)	(0.370)*
Dist. Below Median	-0.227	-0.104	0.104	-0.362
	(0.110)**	(0.178)	(0.132)	(0.180)**
Dist Above Median	0.096	-0.186	-0.123	-0.046
	(0.121)	(0.136)	(0.161)	(0.194)
Pct. Pell Grant	0.002	0.003	-0.01	0.01
	(0.008)	(0.009)	(0.004)**	(0.009)
Low. Inc. X Pct. Pell	-0.005	-0.019	0.018	-0.021
	(0.009)	(0.011)*	(0.014)	(0.018)
Constant	-4.026	-6.343	-4.717	-2.690
	(1.036)***	(0.546)***	(1.505	(1.635)*
Observations	690	260	570	360

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All columns include controls for gender, parent's education, exp/student, institution type and Pct. of Majors within each field from Institution. Robust standard errors in parentheses

Table A3.2: Multinomial Logit coefficient estimates for major choice in senior year (NLSF)

	Black				Hispanic			
	STEM	**Humanities**	**Soc. Sci.**	**Bus./Econ.**	**STEM**	**Humanities**	**Soc. Sci.**	**Bus/Econ**
HS GPA	1.511	0.347	0.651	0.449	0.423	-0.312	0.061	0.14
	(0.293)***	(0.545)	(0.308)**	(0.41)	(0.481)	(0.451)	(0.303)	(0.477)
Private HS	-0.044	-0.713	0.115	-0.031	0.085	0.056	0.106	0.184
	(0.229)	(0.373)*	(0.213)	(0.238)	(0.216)	(0.326)	(0.256)	(0.358)
Income <$35,000	-0.001	1.047	0.168	0.754	0.645	-0.36	0.14	0.876
	(0.431)	(0.645)	(0.391)	(0.79)	(0.374)*	(0.768)	(0.461)	(0.462)*
Dist. Below Median	-0.106	-0.196	-0.017	-0.313	-0.089	-0.303	-0.012	-0.036
	(0.169)	(0.32)	(0.168)	(0.209)	(0.256)	(0.478)	(0.318)	(0.335)
Dist Above Median	0.099	-0.343	-0.351	-0.168	0.285	0.408	-0.077	-0.621
	(0.323)	(0.405)	(0.328)	(0.527)	(0.205)	(0.457)	(0.299)	(0.39)
Pct. Pell Grant	-0.023	-0.014	-0.006	0.092	0.014	-0.007	-0.011	0.016
	(0.014)*	(0.016)	(0.011)	(0.016)***	(0.012)	(0.02)	(0.013)	(0.015)
Low. Inc. X Pct. Pell	0.003	-0.049	-0.011	-0.03	-0.01	-0.006	-0.003	0
	(0.025)	(0.04)	(0.02)	(0.036)	(0.012)	(0.028)	(0.021)	(0.023)
Pct Own Race	-0.008	0.007	-0.004	0.007	0.001	0.131	0.14	-0.067
	(0.003)**	(0.006)	(0.003)	(0.003)**	(0.036)	(0.083)	(0.054)***	(0.089)
Constant	-4.472	-6.510	-1.788	-5.683	-6.189	-1.841	-1.367	-3.660
	(2.941)*	(3.155)**	(2.032)	(1.911)***	(2.817)**	(4.829)	-2.173	(3.787)
Observations	140	60	180	70	140	70	150	70

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All columns include controls for gender, parent's education, exp/student, institution type and Pct. of Majors within each field from Institution. Robust standard errors in parentheses

Table A3.2 Continued

	Asian				White			
	STEM	**Humanities**	**Soc. Sci.**	**Bus/Econ**	**STEM**	**Humanities**	**Soc. Sci.**	**Bus/Econ**
HS GPA	0.597	0.162	0.523	-0.189	0.724	1.177	0.303	0.56
	(0.323)*	(0.642)	(0.705)	(0.436)	(0.269)***	(0.391)***	(0.389)	(0.287)*
Private HS	-0.08	0.319	0.257	-0.08	-0.158	-0.052	0.042	-0.056
	(0.27)	(0.33)	(0.27)	(0.249)	(0.203)	(0.269)	(0.283)	(0.288)
Income <$35,000	0.493	0.073	-0.382	0.396	-0.291	0.327	-1.056	1.784
	(0.456)	(1.32)	(0.325)	(0.552)	(0.83)	(0.814)	(0.905)	(1.119)
Dist. Below Median	0.059	0.694	-0.04	-0.108	-0.145	-0.695	-0.251	-0.868
	(0.291)	(0.487)	(0.347)	(0.355)	(0.216)	(0.489)	(0.214)	(0.370)**
Dist Above Median	-0.243	-0.717	-0.092	-0.154	0.039	0.061	0.233	-0.387
	(0.337)	(0.374)*	(0.349)	(0.31)	(0.238)	(0.326)	(0.254)	(0.34)
Pct. Pell Grant	0.006	0.008	-0.048	-0.004	0.025	0.018	-0.016	-0.001
	(0.01)	(0.014)	(0.013)***	(0.008)	(0.010)**	(0.017)	(0.008)*	(0.013)
Low. Inc. X Pct. Pell	-0.012	-0.023	0.048	-0.028	0.022	0.021	0.081	-0.13
	(0.014)	(0.07)	(0.013)***	(0.018)	(0.034)	(0.038)	(0.030)***	(0.098)
Pct Own Race	-0.032	-0.059	0.033	-0.001	0.012	-0.022	0.002	0.04
	(0.007)***	(0.014)***	(0.008)***	(0.008)	(0.006)**	(0.013)*	(0.006)	(0.016)**
Constant	-8.065	-14.34	-3.253	-2.405	-6.148	-3.641	-1.770	-9.211
	(2.790)***	(4.590)***	(2.716)	(2.972)	(2.604)**	(5.099)	(2.689)	(4.575)**
Observations	210	60	110	120	200	80	130	100

Notes: * significant at 10%; ** significant at 5%; *** significant at 1%. All columns include controls for gender, parent's education, exp/student, institution type and Pct. of Majors within each field from Institution. Robust standard errors in parentheses