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Analyzing the Impact of Home Locales on Access to Tertiary Education; Trends in Students' Access to Bucknell University

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Abstract

Access to postsecondary education has been found in previous studies to be correlated with socioeconomic status as well as with various other indicators, such as parents' education levels and cultural expectations. However, addressing the impact of home locales and geographical proximity to colleges in addition to these individual characteristics is a crucial part of understanding college access. In this honors thesis, the following questions will be examined: how has access to college and the decision to matriculate changed in recent years? How does distance from colleges and differing characteristics of home locales influence acceptance to a university and the decision to matriculate? By utilizing data from Bucknell University's Offices of Admissions, Registrar, and Financial Aid as well as census tract data from the American Community Survey, this paper examines the impact of distance from a student's home to Bucknell University's campus and other characteristics of their home locale on the probability of an applicant being accepted as well as on the probability of an accepted student choosing to matriculate. This study finds that the impact of parental income on students being admitted to Bucknell has decreased over the years, and the impact of parental income decreases with increases in distance. This finding indicates that parental income has become less significant in the likelihood a student is admitted over time, especially when considering applicants from different parts of the country. Further, this study finds that census tract level characteristics have a highly significant impact on both the probability of being accepted and the choice to matriculate. The results indicate that there are strong relationships between home locale, geography, and college access, therefore supporting potential policy interventions that devote more attention to the relationship between geography and other socioeconomic factors in college admission and matriculation decisions.

1. Introduction

Access to higher education has recently been a prominent topic of discussion in the media, especially with the January 2017 *New York Times* Upshot article identifying schools in the United States that have a greater percentage of students from the top 1% than from the bottom 60% of the income distribution. Bucknell University, in particular, ranks sixth on this list of colleges with the highest ratio between the percentage of students in the top 1% to the percentage in the lower 60%. This article was based on a scholarly research report written by Raj Chetty, which analyzes how and if colleges impact the upward mobility of its students and which schools are most "successful" in completing this mission. In his study, upward mobility is defined as the percentage of students from the bottom quintile of the income distribution that end up in the top quintile of the income distribution (Chetty et al 2017). However, in addition to noting how helpful schools can be in promoting upward mobility once students matriculate, attention must also be paid to the access that high school students have to tertiary education. For many students, especially those from lower socioeconomic backgrounds, attending college may not seem like a realistic option due to the high costs of tuition and other ancillary expenses.

Many students from low-income families and neighborhoods are not provided the necessary information to make an educated decision about attending college. This information deficit is often impacted by the socioeconomic status of their neighborhood as well as by their geographic location and distance from educational institutions. Many of these students and their families are unaware of various fee waivers and financial aid programs that would make a college degree much more attainable (Olson 1984).

Other characteristics of home locales have also previously been found to impact college enrollment, such as the education levels of a student's community and the expectations placed on

its high-school students and graduates. Students are very heavily influenced by the environments they live in and their tertiary schooling patterns often reflect those of their home locale. This helps explain why high-achieving students from certain areas of low-socioeconomic status may be more likely to forego attending a four-year institution and instead act in a more "income-typical" manner, by choosing to attend a two-year institution, pursue an associate degree, or obtain a job and give up the idea of a four-year college or university altogether (Hoxby 2013).

It is important to look at the factors that influence access to higher education and college enrollment because, in today's economic climate, a college degree is required for most high-paying jobs and to have any realistic desire to advance to a higher spot in the income distribution. Further, it is imperative that the initiatives of higher education institutions to improve access be assessed because colleges and universities should be held responsible for the role that they play in promoting economic mobility. For students from low-income families, in particular, attending an elite institution can be the factor that changes their projected future economic trajectory. If a low-income student attends an elite institution, they have a much higher chance of moving up the income distribution than if they attend a public university (Chetty et al 2017). Therefore, increasing access to elite institutions for students from low-income households and locales is crucial in reversing the increasing income disparity that is so prevalent in society today; to cite just one statistic, in 2016 the overall United States Gini Coefficient had risen approximately five points from its level in 1986, thirty years prior, indicating increased income inequality (FRED 2018).

Universities such as Bucknell have a choice in the role that they play in this economy. They can either continue to reinforce and reward privilege, or they can increase access to quality education, resources, and connections, for those students who need it most. As many similar

institutions have done for at least the past decade, Bucknell has a published mission statement to increase diversity of all forms and to expand Bucknell's pool of prospective students by attracting high-quality achievers regardless of their socioeconomic background. While this goal is included in the university's strategic plan, it is clear that this institution must continue working to attain this goal. The *New York Times* article reprinted that Bucknell ranks sixth on the list of schools with a higher ratio of students from the top 1% of the income distribution than from the bottom 60% of the income distribution (Chetty et al 2017). In fact, 20.4% of the Bucknell class of 2013 (accepted to the university in 2009) were from families making $630,000 a year or more, while only 12.2% were from families making $65,000 or less (Chetty et al 2017).

Many general studies on access to higher education have previously been completed, but this research paying close attention to the impact of geography and home locales on enrollment for one representative university provides a significant contribution to the literature. In this study, Bucknell specific data from the last twelve years is examined to assess whether Bucknell has achieved its goal of "increasing diversity of all forms" (Bucknell Strategic Plan 2006). Specifically, it looks at how access and the decision to matriculate has changed over time, and provide policy recommendations for the institution. Conclusions and assumptions can then be extrapolated for peer institutions and the role of tertiary institutions in the context of upward mobility, privilege, and success in America today.

The remainder of this paper is organized into six sections. Section Two discusses previous research on access to higher education and the college decision-making process. Sections Three and Four discuss the composition of the dataset and the theoretical models used in the analysis. Section Five examines the results of the empirical models and the evidence of relationships between census tract level characteristics of home locales, distance from a student's

home to Bucknell, and other student attributes and the probabilities of an applicant being accepted to Bucknell and of an accepted student matriculating. Section Six addresses the limitations of this study. Finally, Section Seven summarizes the research in this thesis and discusses the potential for future research.

2. Literature Review

2.1 Access to Postsecondary Education

The lack of widespread access to higher education is an issue prevailing in our society today, given the importance of college education to economic success. Important factors that influence college enrollment have been found to include "family income, parental education, high school peer relationships, and the proximity of a college to a student's home" (Kohn et al. 1976). These factors have been analyzed in previous studies to understand their impact on the probability of a student applying to and choosing to attend various forms of tertiary education. Below, each of these factors is discussed in turn.

Many high-achieving students from low-income families do not apply to selective colleges or universities, acting in an "income-typical" rather than an "achievement-typical" manner (Hoxby 2013). Students who act in an income-typical manner tend to be more dispersed and may be the sole or one of a few high-achieving students in their region or school. Therefore, these prospective college students are not reached by traditional methods of disseminating information and consequently are poorly informed about college opportunities. This information deficit is often impacted by the socioeconomic status of their neighborhood as well as their geographic location and distance from educational institutions. Many of these students and their families are unaware of various fee waivers for college applications and financial aid programs for college attendance that would make a college degree much more attainable (Olson 1984). Furthermore, students' perceptions of what their parents can pay may also sway their decision on where to attend college (Terenzini 2001).

The misunderstanding and lack of awareness of the financial aid opportunities that exist are often correlated with the education levels of prospective students' parents. If parents do not

have college educations, they are more likely to find the required forms too confusing and to have more resistance to their children going off to school (Hoxby 2013). In contrast, more highly educated parents encourage their children to develop higher expectations for themselves, which can include going to college and obtaining a degree (Dubow 2009). Therefore, if a child has more educated parents, they have a higher probability of applying to and enrolling in an institution of higher education.

Moreover, the more affluent and educated the parents are, the more likely it is that their children will attend an elite institution. However, for lower-income students, future economic success is more dependent on the quality of school they attend for tertiary education than for their higher-income peers. For example, lower-income students at elite schools have a "much higher chance of reaching the top 1 percent of the earnings distribution" than if they attended even an excellent public university (Chetty 2017). On the other hand, children from high-income households are likely to end up in a high-income bracket regardless of their choice of college. For students from lower socioeconomic backgrounds, elite colleges provide the connections to jobs and industries that these students did not previously have access to, unlike their higher-income peers (Thompson 2018). Therefore, attending elite colleges is arguably more important for racial minorities and low-income students than for their more affluent white peers. However, it remains difficult for those with financial need to gain access to these elite institutions, especially as affluent parents, counselors, and the admissions offices at elite institutions continue to habitually reinforce existing privilege.

Although racial and ethnic gaps in educational attainment have decreased over the past few decades, substantial gaps remain. Greater proportions of Blacks, Hispanics, and Native Americans drop out of college before obtaining a degree than their white peers, even when other

socioeconomic variables and college plans and intentions are controlled for (Kao 2003). When high school grades and test scores are controlled for, the effect of race has been shown to decrease, indicating that racial differences in college attendance or completion could possibly be due to differences in academic preparation (Camburn 1990). This would shift focus to the academic institutions where students of color receive their primary and secondary education. The quality of these institutions in their home locales could also be impacting their access to college as well as their likelihood to attend and complete postsecondary education.

Socioeconomic and demographic factors have large influences on high school students' access to college, or to any postsecondary educational institution, for that matter. However, characteristics of a students' home locale and their geographic location also largely impact their likelihood of attending college and students' access to tertiary education.

2.2 Impact of Home Locale on Students' Access to Schools

While socioeconomic factors clearly play a large role in a student's ability and decision to attend college, there is also an important role played by geography and the characteristics of a student's home locale. In fact, many of these socioeconomic factors are actually correlated to and impacted by the geographic environment a student lives in. Therefore, it is important to acknowledge geography and the role that it plays in access to higher education.

Various factors impact students' access to colleges and universities. These include geographic characteristics of a student's home locale as well as the distance from a student's home to the nearest college or university and the distance from their home to the nearest metropolitan area. "Geography may also operate as a mediating mechanism by influencing the structure, decisions, and socialization opportunities in different communities and schools, which

will then shape individual opportunities and educational choices" (Hu 2003). In addition to the socioeconomic factors discussed above, such as income, wealth, and family structure, geography plays a large role in determining the opportunities available, as it is a large contributing factor to the institutions and social structure that individuals are surrounded by.

Previous studies have found that distance and geography shape students' decisions about where to apply and where to enroll in college; the farther a student lives from a college or university, the less likely he or she is to apply and ultimately enroll (Desjardins 2006). For mobile students, distance takes a nonlinear relationship, causing enrollment demand to be "u-shaped," where it declines and eventually rises with distance (Hillman 2016). This nonlinear relationship is consistent with the argument that the market structure for four-year colleges is converging in a way that makes distance a less relevant factor in college choices (Hoxby 2009). However, it is converging for only the most mobile students, and even though students may increasingly be applying to colleges far away from home, they ultimately enroll in colleges or universities closer to home (Hillman 2016).

Put another way, "geography can be destiny when opportunities are richly available for some and rare or even nonexistent for others" (Hillman 2016). If a student lives closer to a university or a college, they are more likely to consider tertiary education, particularly of the kind that they are most familiar with. Emphasizing the importance of geographical location and the proximity of a student's home to other institutions, "decreasing the distance to the nearest college increases the likelihood the students will choose to attend college" (Alm et al 2009). This finding emphasizes the impact of a student's home locale on their decisions about whether or not to apply to college as well as what kind of higher education to apply to. In particular, "students who live nearer to colleges are more likely to attend colleges, and students who live nearer to

universities are more likely to attend universities" (Alm et al 2009). As proximity to a college or university has been found to impact enrollment, there are areas in the United States that have been labeled "education deserts", in which the nearest college is over an hour drive away (Myers 2018).

Further expanding on the influence of geography, economist Raj Chetty's research into upward mobility with respect to geography found that upward relative mobility and absolute mobility vary substantially at both the regional level and within regions. Chetty finds, for example, that urban areas "tend to exhibit lower levels of intergenerational mobility than rural areas on average" (Chetty 2014). Moreover, Chetty found that spatial variation was also substantial for intermediate outcomes such as consistent college attendance and college quality rank. This finding shows that geographical location and the other aforementioned indicators have an impact not only on overall mobility but also on intermediate outcomes such as college attendance. It also sheds light on the differences between urban, suburban, town, and rural areas.

More broadly, a number of socioeconomic characteristics are determined or influenced by a person's surrounding environment. In rural locales, more people live in poverty, report poorer health status, and have a greater prevalence of obesity than people who live in urban or suburban areas (Parks 2003). People living in rural areas are also more likely to live in the aforementioned "education deserts"; they are also more likely to have lower incomes, fewer years of education, and less likely to have obtained a college degree (Myers 2018).

Further, smaller percentages of students in rural schools enroll in postsecondary institutions, no matter which baseline population is used when compared to the percentages of students in urban or suburban areas (Hu 2003). According to one study, students from rural counties are only 84.7% as likely to attend postsecondary education as students from urban areas

(Koricich 2013). Despite a fairly high rate of secondary school completion, those rural students who drop out of high school are less likely to return to complete their education, while few rural high school graduates aspire to go on to higher education (Khattri 1997). Rural high school graduates who do go on to postsecondary education are also less likely than their non-rural peers to attend a selective university and are instead more likely to attend a two-year college (Koricich 2013). If they do decide to attend college, they are more likely to postpone entry and less likely to be continuously enrolled (Byun 2015). This could be due to a variety of reasons, including a lower prioritization of education in rural areas and a higher prioritization of earning additional income attained by farming or working in industry. For these students, the opportunity cost of going to college seems too high when considering the potential income they would be giving up. Many of these rural-non-rural differences can be explained by differences in socioeconomic status and in the quality of high school education and students' college preparation in these different environments.

Various geographic factors, including characteristics of a student's home locale, the distance from a student's home to the nearest college or university, as well as the distance from a student's home to the nearest metropolitan area, all impact college aspirations, the access that students have to postsecondary education, and their educational decision-making processes. Therefore, in order to level the playing field, policy needs to focus on this geographical aspect of access in addition to other socioeconomic factors that can impact college access and enrollment.

2.3 Impact of Policy and University Outreach on Students' Access

While socioeconomic and geographical factors clearly influence students' access to higher education and their decision-making process, federal policies and university efforts to improve access also play substantial roles.

Financial aid programs are one example. As indicated above, there is a need to reach parents from lower socioeconomic levels and to supply them with better financial information on application costs and costs of attendance because this lack of information has been shown to cause incorrect assumptions about the cost of college. This information asymmetry can potentially be solved by supplementing current state and federal financial aid policies to reduce some of the barriers to applying to college (Terenzini 2001). Over the years, the cost of higher education has risen steadily as a percentage of family income; this finding is especially the case for low-income families, in large part due to the long-term stagnation of wages and incomes at the lower ends of the income distribution (Mishel et al 2015). In addition, Federal Pell Grant awards given to students in the bottom of the income distribution, have fallen dramatically as a percentage of the cost of attendance due to rising tuition costs, resulting in reduced purchasing power in recent years (*Access Denied* 2001; Ficklen 2002). This is in part due to the fact that middle-income affordability and merit have been the focus of federal, state, and institutional level policy makers (*Access Denied* 2001; Ficklen 2002). Therefore, many low-income students abandon their plans for full-time on-campus attendance, choosing instead to attend part-time or abandon college altogether in order to take a job.

Although current financial aid programs have been found not to do much to increase enrollment in general, they have been found to influence a student's choice of college or university, especially when considering schools outside of their home state (Vergolini et al

2015). Vergolini et al also concluded that "policies foreseeing financial incentives conditional on merit and financial need have a crucial role in reducing inequalities in the access to specific fields of study in specific institutions" (Vergolini et al 2015). These findings emphasize the importance of financial aid, especially when interacted with distance to a university from a student's home, thus, highlighting the important role that both financial aid and geography have in a student's college decision. It is also important from a policy perspective to track student progress through their educational career in order to promote equal educational opportunity. More interventions earlier on in a student's educational career can have a greater impact on postsecondary outcomes (Hu 2003).

In a document published by the Advisory Committee on Student Financial Assistance, recommendations were made for federal and state governments to increase access to college for prospective students. Some cost-related recommendations include the following: preserving the current maximum Pell Grant and maintaining commitment to nontraditional students' eligibility; helping to provide nontraditional students with more and better information on college costs, student aid, and other financial supports; leading an initiative to help these students access additional financial supports; and changing the funding regulations and allocations in the Federal Work-Study Program to provide more benefits for students (*Access Denied* 2001; Ficklen 2002). As far as encouraging states and institutions to implement better educational practices, the Advisory Committee also recommends supporting education reform and career pathway initiatives and encouraging institutions to offer more aid to students in need (*Access Denied* 2001; Ficklen 2002). In order to expand college access for students in rural areas, in particular, federal and state governments could also provide targeted grant funding to rural communities in order to support dual enrollment programs and higher educational curricula (Koricich 2013).

In addition to looking at more widespread policies on a national level, it is also important to pay close attention to college-specific initiatives that are part of these institutions' strategic plans. For example, to increase diversity and access, colleges and universities could offer distance education opportunities and put greater effort into recruiting and supporting low-income rural students, in particular, during the admissions process (Koricich 2013). These kinds of initiatives can show the priorities of an institution and can help to explain patterns in enrollment. As one example, Bucknell University's strategic plan included goals to "Expand Bucknell's pool of prospective students and attract high-quality achievers who exemplify our goal of diversity in all its forms" (Bucknell Strategic Plan 2006). This plan shows Bucknell's mission to expand "diversity of all forms", which can include race, socioeconomic status, and geographical diversity. Bucknell currently has students from approximately thirty states and fifty countries, yet, as noted earlier, has more students from the top one percent of the income distribution than from the bottom sixty percent (Chetty 2017).

Elite colleges have a heightened ability to change the lives of minority and low-income students over public and lower tiered institutions (Chetty 2017). This power, theoretically, should invoke the altruistic desire to design and implement policy that could increase access for those students who would most benefit from an education at an elite institution. However, America's most selective colleges continue to act as upholders of privilege, continuing to admit more students from the top one percent than the bottom sixty percent of the income distribution (Chetty 2017). These same institutions have the ability and potential to create opportunity and promote upward mobility (Thompson 2018). Therefore, it is so important for these schools to focus their policies on finding the right students who would benefit the college or university as

the institution mutually benefits them, allowing these students the opportunity for upward mobility.

However, even though strategic plans and goals of elite institutions increasingly assert that they aim to increase diversity and access to minority and low-income students, it is unclear if there have really been any major improvements over the years.

2.4 Existing Gaps in the Literature

Although previous studies have been conducted on overall access to higher education, returns to the investment of a college education, and the impact of college on upward mobility, there have been few that look specifically at the impact of students' home locales on their access to one institution of higher education. This honors thesis contributes to the existing literature by conducting a study on Bucknell University applicants from Fall 2006 to Fall 2018. In recent years, more and more colleges, specifically those that identify as liberal arts institutions, have made it one of their primary missions to increase the diversity of students as well as access to their institution for prospective students of lower socioeconomic status. This research examines access to Bucknell over the past twelve years to analyze what factors influence a student's desire to apply to, and matriculate at, the university and how these factors have changed over time, paying close attention to the impact of distance and characteristics of home locales.

3. Data

The data used in this study to analyze admittance, matriculation, and access to Bucknell utilizes records from Bucknell University's Offices of Admissions, Registrar, and Financial Aid. The sequential cross-sectional dataset is comprised of all domestic Bucknell applicants from Fall 2006 to Fall 2018. Socioeconomic and geographic information about students' home locales were obtained from the United States Census American Community Survey (ACS) for three different five-year spans (2006-2010, 2008-2012, and 2012-2016).

The data were made available after many meetings with representatives from the Bucknell University Offices of Admissions, Registrar, Financial Aid, Career Development Center, Institutional Research, and various data experts from Library and I.T. All persons who were to interact with the data fulfilled Institutional Review Board (IRB) requirements. Once the data was obtained, it was de-identified so that no single observation could be traced back to an individual's identity. The de-identification was done by matching data using the student's Bucknell identification number and then removing that information once all the data was matched. The de-identified data includes demographic information, financial aid information, race, gender, parent income, year of student acceptance, as well as other various indicators.

In addition, home addresses were used to geocode each student's home locale and match them to a census tract. Once the match was made, however, the tract identification number was deleted along with the original student address to make sure no individual could be identified from the cleaned dataset. If there was only one student in the dataset from Montana, for instance, they could be easily identified if student addresses were left in. The data used in this matching process comes from the American Community Survey (ACS) by the US Census for three different five year spans (2006-2010, 2008-2012, and 2012-2016). Variables captured from the

ACS surveys are defined in Table A and include the total population of home locale, racial distributions, educational attainment statistics, and the Gini Index of Income Inequality. For Bucknell applicants from 2006 through 2009, the first five-year span of ACS data is used; for applicants from 2010-2012, the second ACS five-year span is used; and for applicants from 2013-2018, the third five-year span of data is used. However, due to a lack of observations in educational attainment in the last five-year span, the 2008-2012 ACS data set is used for the educational attainment variables for Bucknell applicants from 2013 through 2018 as well as for 2010-2012 applicants.

The dataset originally contained 102,435 total observations once entries with missing observations were deleted. Of this dataset of all applicants, 37,683 observations reported parental income and therefore can be used in the econometric acceptance model. The subset of this data that includes only admitted students contains 32,166 observations, but only 18,609 reported parental income and can be used in the matriculation model.

For all Bucknell applicants from Fall 2006 to Fall 2018, the average parental income is $163,671.50 with a standard deviation of $193,451.80. The minimum income reported is negative, but input as 0 to be more easily utilized in the regression. The maximum income reported is $9,295,888.00. The average distance that an applicant lives from Bucknell is approximately 519.96 miles with a standard deviation of 812.41 miles. Applicants that live anywhere from 0 to 25 miles away from Bucknell are all given distances of 25 miles away to ensure that all data points remain unidentifiable. The applicant with the maximum distance from Bucknell University's campus applied from a home 5,936.07 miles away. Of applicants in this dataset, approximately 16.80% are need-based aid recipients and 3.99% are Pell Grant recipients. Approximately 65.51% of applicants live in suburban home locales, 2.83% live in towns,

13.08% live in rural locales, and the rest are from cities. The census tract Bucknell applicants come from is on average 82.42% percent white, has a Gini coefficient of 0.44, has 11.11% of houses worth over $1 million, and 6.53% of people living below the poverty level. On average, applicants' census tracts have 28.19% of the population over the age of twenty-five with a bachelor's degree and 6.33% with an associate degree.

For the admitted students' data, the average parental income is $181,651.60 with a standard deviation of $200,529.70. The minimum income reported is negative, but input as 0 to be more easily utilized in the regression. The maximum income reported is $6,137,867.00. The average distance that an accepted student lives from Bucknell is approximately 573.16 miles with a standard deviation of 874.66 miles. Accepted students that live anywhere from 0 to 25 miles away from Bucknell are all given distances of 25 miles away to ensure that all data points remain unidentifiable. The accepted student with the maximum distance from Bucknell University's campus lives 5,913.25 miles away. Of accepted students in this dataset, approximately 30.76% are need-based aid recipients and 6.95% are Pell Grant recipients. Approximately 63.95% of accepted students live in suburban home locales, 2.70% live in towns, 12.46% live in rural locales, and the rest are from cities. The census tract Bucknell accepted students come from is on average 82.98% percent white, has a Gini coefficient of 0.44, has 12.65% of houses worth over $1 million, and 6.29% of people living below the poverty level. On average, accepted students' census tracts have 29.57% of the population over the age of twenty-five with a bachelor's degree and 6.06% of that population with an associate degree.

Table A in the Appendix provides further explanation of the variables and their sources, whilst tables B and C provide descriptive statistics of the variables.

4. Models

This study applies an empirical probit model to the dataset due to the nature of the binary dependent variable of whether a student matriculated to Bucknell. A nearly identical model with whether a student was admitted as the binary dependent variable is also run, using the full dataset of all applicants. Since the dataset is large enough, the probit model is preferred over the logit model because it assumes a normal distribution of errors. The probit model is also preferred over an ordinary least squares linear probability model because it allows for nonlinearity and restricts the probability of the dependent variable to be between zero and one. Further, it allows for the interpretation of individual demographic and socioeconomic variables on the probabilities a student will be accepted to or matriculate at Bucknell. The models take the following form, where X is a vector of the regressors. The full models can be found in the Appendix (Models A and B).

$$Pr(Accepted=1|X) = \Phi(\beta \bullet X_{it}) + \mu_{it}$$

$$Pr(Matriculated=1|X) = \Phi(\beta \bullet X_{it}) + \mu_{it}$$

In order to look at student access to Bucknell, matriculation and acceptance are used as binary dependent variables. Since data is only available on Bucknell applicants, matriculation can be used to study access if it is assumed that the factors that influence a student to apply to a school and the factors that influence them to matriculate once they are accepted are expected to be correlated. This correlation is assumed in this study by using yield as a surrogate for a school's attractiveness and applications. Students who choose to matriculate are theoretically representative of the subset of the college-going population who are attracted to a specific college or university and also have the academic and extracurricular qualifications necessary to

get in. Therefore, matriculation patterns of accepted students can be used to comment on the kinds of people who apply to Bucknell University out of all college-going students.

In order to investigate the effects of a student's geographic location and home locale on their access to Bucknell, the models contain variables measuring socioeconomic status and other characteristics of home locales. The American Community Survey reports many statistics by census tract; these, in addition to data provided to Bucknell on students' applications, are included in the model. Previous studies have found that socioeconomic status and other characteristics of home locales have a strong influence on students' ability and decision to attend postsecondary education (Alm et al 2009; Cabrera 2000; Dubow 2009; Hillman 2016; Hoxby 2013; Hu 2003; Koricich 2013; Parks 2003; Thompson 2018).

Indicator variables for students' homes located in suburban, town, and rural areas are also included in the model, with city left out. Suburban is defined as the area outside a principal city and inside an urbanized area; town is defined as the area inside an urban cluster outside of an urbanized area; rural is defined as the rural territory outside of an urbanized area. Differences between these environments have been found in previous studies, including the fact that in rural locales, more people live in poverty, report poorer health status, and have a greater prevalence of obesity than people who live in urban or suburban areas (Parks 2003). Because of the differences between people and lifestyles in these different kinds of environments, these dummy variables are included in the model. For example, previous studies have found that smaller percentages of students in rural schools enroll in postsecondary institutions compared to other baseline populations (Hu 2003; Koricich 2013).

Linear distance from a student's home to Bucknell is included in the model because the distance from a students' home to an educational institution is one of the main relationships

being investigated in this study and has been previously found to influence the decision to attend tertiary education (Alm et al 2009). A Log(distance)^2 variable is also included in the model to allow for the relationship between distance and acceptance/matriculation to be nonlinear. The non-linearity is expected because Bucknell University tends to have more students apply and matriculate from the east and west coasts of the United States but not as many from the middle of the country.

Education levels of students' home locales are accounted for by including variables for the percent of adults over the age of twenty-five in the census tract with a bachelor's degree and the percent of this population with an associate degree. These variables are included in the model because it has been found that more highly educated parents encourage their children to develop higher expectations for themselves, which can include going to college and obtaining a degree (Dubow 2009). The education level of a student's home locale has a similar influence on their decisions and actions regarding postsecondary education. Therefore, including the percentage of the population of a home locale over the age of twenty-five with bachelor's degrees can also be included in the model as a proxy for the omitted variable of student ability/ambition. As students from more educated areas likely have more educational resources and can therefore perform better academically than students without access to such resources, there is a correlation between education levels of home locales and student ability. Because of this relationship, the percentage of a census tract population with bachelor's degrees can serve as an imperfect proxy for student ability. Doing so will allow other variables to be interpreted without bias.

Other characteristics of home locales are controlled for using the variables percent white, the Gini coefficient of equality, the percent of housing values over $1,000,000, and the percent of the census tract population below the poverty level. These variables are included because they

explain different attributes about the areas that students come from that can influence their decisions and attitudes towards postsecondary education. For example, students from higher income areas generally have better access to higher education and more elite institutions than their peers from lower-income areas (Thompson 2018). While the percent white variable helps explain the racial makeup of the communities from which Bucknell applicants apply, this variable can also be used as a proxy variable for the proximity a student lives to the nearest college. Areas with larger white populations have been found in the literature to have more public two-year and more private four-year colleges of all selectivity levels nearby; for every one percent increase in the white population, the number of private four-year colleges nearby more than doubles in rate (Hillman 2016). Because the proximity a student lives to the nearest educational institution has been found to greatly influence overall access to postsecondary education, it is an important factor to consider in the model. Since data on the actual distance from an applicant's home to the nearest college or university is not included in the current dataset, the percent white variable obtained from American Community Survey data will serve as a suitable proxy.

Parental income is also included in the model because studies have shown that students from higher socioeconomic statuses often are more likely to have access to and ultimately matriculate at elite colleges. Further, high-achieving students from low-income families are much less likely to apply to and attend selective colleges or universities than their peers from high-income families (Hoxby 2013). However, because parental income is obtained from applicants filling out the Free Application for Federal Student Aid (FAFSA), the model is somewhat restricted and cannot accurately predict the likelihood of matriculation for students from the highest income brackets, due to lack of data.

A year variable is included in the models to allow the variables that impact a student being admitted and the decision for an admitted student to matriculate to vary over time. Since the data for this study includes applicants from Fall 2006 to Fall 2018, the year variable goes from 1 to 13, with year one corresponding to 2006 and year twelve corresponding to 2018. A year squared variable is also included to help account for the potential nonlinearity of the relationship between year of admittance and the decision to matriculate/likelihood of the student being accepted. Additionally, student race and gender variables are included in the model as controls.

Interacted variables are also included in the model to allow the relationship between different variables and the effect that relationship has on the dependent variable to be tested and observed. Variables need to be interacted to allow the effect of one independent variable to be dependent on the value of another dependent variable. For example, log(parental income) and log(distance) are interacted in this model to estimate whether the distance to Bucknell changes the estimated relationship between income and matriculation. If, for example, a middle-class child from a remote state is more likely to matriculate to Bucknell than a middle-class child in Pennsylvania or New Jersey, then the coefficient on the interacted variable will be positive. Other interaction terms include year interacted with suburban, rural, and town indicators, Log(parental income), and log(distance); suburban, rural, and town indicators interacted with log(distance); suburban, rural, and town indicators interacted with log(parental income).

The probit models will clarify how census tract attributes in addition to socioeconomic and demographic characteristics influence students' likelihood to be accepted and matriculate to an elite institution, such as Bucknell University, and their overall access to postsecondary education.

Ordinary least squares linear probability model and logit model regression results can be provided by the author upon request.

5. Results

Evaluating the two probit models on acceptance and matriculation to Bucknell University led to the following key findings. Distance from Bucknell University has a significant non-linear relationship with both the probability of being accepted and the probability of matriculation. In addition, education levels and other characteristics of a student's home locale are highly significant both on the probability of an applicant being accepted and on the probability of an accepted student matriculating.

5.1 Acceptance Probit Model Results

Using data from all students who applied to Bucknell from Fall 2006 to Fall 2018 that filled out the FAFSA, a probit model using acceptance to Bucknell as the binary dependent variable was estimated. Acknowledging some limitations due to omitted variables, this model shows which variables have significant effects on the likelihood of an applicant being accepted to Bucknell University.

As seen in Table D, the probit regression provides evidence that students' characteristics, as well as characteristics of their home locales, have significant relationships with the probability that the student is admitted. With the time and time squared variables being significant at the 95% confidence level, it can be concluded that there have been significant non-linear changes in acceptance patterns over time; the likelihood of an applicant being accepted is positive with time at a decreasing rate. For every one year increase, the likelihood that a student is accepted increases by approximately 2.41%, on average. However, the impact of application year on acceptance is decreasing by approximately 0.6% per year.

Distance to Bucknell University from an applicant's home was found to have a highly significant non-linear relationship with acceptance to the University. The relationship between distance and likelihood of being accepted to Bucknell University has not changed over time, according to this model, indicating that Bucknell is not expanding the geographical source of its acceptance pool over time. However, the impact of distance to Bucknell does vary by parental income. For every one percent increase in the linear distance from a student's home to Bucknell University's campus, the impact of parental income on the likelihood of a student being accepted decreases by approximately 3.17% on average. This relationship suggests that distance from the institution's campus has a significant impact on a student's access to the institution and whether or not they will be admitted. The finding that the distance from Bucknell varies by parental income indicates that Bucknell treats applicants from different locations differently when determining acceptance, likely in an attempt to increase their geographic diversity; students from lower-income families are more likely to gain admittance from Bucknell when they live farther away. As low-income families are also more likely to receive financial aid, this finding is consistent with previous findings that financial aid programs can drastically influence a student's choice of a college or university when considering schools outside of their home state (Vergolini et al 2015). As students whose parents have lower incomes are likely to need financial aid, they might be more influenced by financial aid packages to attend a college far from home than students who are from higher-income families or who live closer to the college under consideration.

Various characteristics of home locale were also found to be significant predictors of whether or not an applicant was admitted to Bucknell University. The Gini Index of Inequality variable was found to be extremely significant, indicating that if an applicant comes from a less

equal home locale, they are more likely to be admitted to Bucknell University. For every 0.1 increase in the value of the Gini coefficient, there is a 3.3% increase in the likelihood that an applicant is accepted to Bucknell. This indicates that students from areas with more income inequality are more likely to be accepted to Bucknell University.

The percent of the community that is white was found to be insignificant in this model. This suggests that other socioeconomic factors of a locale are more influential on an individual and their future academic path than the racial makeup of their home community. As percent white was also serving as a proxy for the number of colleges nearby a student's home, it also appears as though the number of colleges near an applicant's home does not impact their likelihood of being accepted to Bucknell University.

The education levels of home locale, however, do play a role in whether an applicant is admitted to Bucknell University. For every ten percent increase in the percentage of the population over twenty-five who received a bachelor's degree, an applicant has a 4.62% increased chance of getting into Bucknell University. For every ten percent increase in the percentage of the population over twenty-five of their home locale that has received an associate degree, an applicant's probability of being accepted decreases by 3.85%. These findings support the claim that students tend to behave in ways that are familiar to them. If they grew up in a more educated community, they are more likely to pursue higher education and to have more educational resources available to them. This result is consistent with previous studies that find that more highly educated parents encourage their children to develop higher expectations for themselves, which can include going to college and obtaining a degree (Card 1993; Dubow 2009). Children are very likely to follow the examples set for them by their parents and other community members; the more educated their community is, the more likely it is that they will

pursue higher education as well. Further, a more highly educated community could also provide better resources for that student and therefore allow the applicant to present stronger qualifications than applicants from less educated areas; this result follows the intuition of using education levels of home locales as an imperfect proxy for student ability. Because students from more educated areas are more likely to be accepted, it can be assumed that student ability and ambition have a positive significant relationship with the probability of being accepted as well.

Parental income was found to be highly significant in whether an applicant was accepted to Bucknell University. For every one percent increase in parental income, an applicant increased the probability of getting accepted by 23.07%, holding all else constant. This finding is consistent with Chetty's findings of Bucknell, which found that the University had more students from high-income families than low-income families (Chetty et al 2017). Over time, however, this effect of income on the probability of acceptance has decreased. On average, the impact of parental income on whether an applicant is accepted has decreased by 0.3% per year since 2006. These results suggest that Bucknell has been improving over the past twelve years as far as increasing socioeconomic diversity among the students who are accepted to the institution, consistent with the goal in its 2006 strategic plan to "increase diversity of all forms". Because parental income is having a smaller influence on the probability that a student will be accepted each year, the playing field is becoming more leveled for applicants of all socioeconomic statuses, thereby helping "Expand Bucknell's pool of prospective students and attract high quality achievers who exemplify our goal of diversity" (Bucknell Strategic Plan 2006).

Although the type of home locale a student comes from is not found to be significant on its own, the type of home environment that a student is from is found to be significant when interacted with time, the linear distance from a student's home to Bucknell University's campus,

and an applicant's parental income. For instance, if an applicant is from a suburban locale, for every one percent increase in parental income, their probability of being accepted to Bucknell University decreases by approximately 3.07%, on average, compared to an applicant from a city. For every one percent increase in linear distance from Bucknell in miles, a suburban applicant's probability of being accepted increases by 0.53%, on average. If a student is from a town, they are 24.5% more likely to be accepted to Bucknell University than their peers from urban locales. Further, if a student is from a town, for every one percent increase in their parental income, they are 7.93% less likely to be accepted. However, over the past twelve years, students from towns have become more likely to be accepted. For every one year increase, students from towns are 1.68% more likely to be accepted. If an applicant is from a rural locale, their probability of being accepted has also increased over the past twelve years. For every one additional year, the probability a rural student is accepted increases by 1.27%. Further, if a student is from a rural locale, for every one percent increase in their parental income, their probability of being accepted decreases by approximately 2.99% on average. Home locales, when interacted with distance from Bucknell, parental income, and time, help explain some of the story of students getting into Bucknell University. It is also possible that some of the story that is currently being told by these coefficients is being biased by omitted variables.

In this model, variables concerning individual financial need were also considered. Both indicator variables for being a need-based aid recipient and a Pell grant recipient were found to be highly significant. If an applicant is a need-based aid recipient, they are approximately 8.77% more likely to be accepted to Bucknell University, holding all else constant. If a student is a Pell Grant recipient, they are approximately 5.68% more likely to be accepted. These positive significant relationships between need-based aid variables and acceptance indicate that Bucknell

is following through on its goal to increase access to students of lower socioeconomic status in order to increase the overall diversity of the institution.

This model also found a significant relationship between gender and the probability a student is accepted. If the applicant is female, she is 5.23% more likely to be accepted than her male counterpart. The regression results also show that an Asian applicant is approximately 9.39% more likely to be accepted than their white counterparts. Further, Hispanic or Latino students are 4.87% more likely to be accepted than those applicants who do not identify as Hispanic or Latino.

5.2 Matriculation Probit Model Results

Since data was restricted to the information that Bucknell collected from their applicants, a model using matriculation as the binary dependent variable out of a sample of all accepted students was estimated to evaluate students' access to Bucknell. This proxy relationship can be made if it is assumed that the students who matriculate to Bucknell are representative of the group of students that applies to Bucknell out of the entire college-going population.

Initially, when the normal probit model was run, there was a concern for heteroscedasticity present in the model. When tests were run to test for heteroscedasticity, the null hypothesis of homoscedasticity was able to be rejected with a p-value less than 0.001. To control for this issue, a heteroscedastic probit model was employed, which relaxes the assumption that the error distribution has unit variance. The heteroscedastic probit model allows the error variance to depend on some of the predictors in the regression model. The results provided in Table E are the marginal effects of the heteroscedastic probit model.

As seen in Table E, the Probit regression provides evidence for the relationship between characteristics of a student's home locale and the likelihood that they matriculate to Bucknell. Further, we can see that these influences have not been constant over time since variables that include the year of student acceptance are found to be significant.

In this model, the base case due to omitted terms is a white male from a city who receives no need-based aid from Bucknell University. All marginal effects interpretations are in relation to this base case.

Although the year variable is not found to be significant, year squared is, which suggests a non-linear relationship between year and the likelihood of matriculation. This indicates that there have been changes in matriculation trends over time, but not necessarily at a constant linear rate. For every one year increase, accepted students are approximately 0.54% less likely to matriculate to Bucknell. Because this value is so small, while time is found to have a non-linear statistically significant relationship with the probability of matriculation, application year is not practically significant on the decision to matriculate and is not telling a large part of the story. Further, the interaction terms between year and type of home locale are found to be significant which suggests that there have been some changes in characteristics of students matriculating over the years.

The distance from a student's home to Bucknell University is found to be significant at the 95% confidence level. Since both log(distance) and $\log(\text{distance})^2$ were significant, distance to Bucknell University has a significant nonlinear relationship on whether or not a student will matriculate. This finding is consistent with previous studies that state the proximity of a college to a student's home is a significant factor in college enrollment (Desjardins 2006; Hillman 2016; Kohn et al. 1976). The non-linearity of distance is likely accounting for the high number of

students from the east and west coasts of the United States who matriculate to Bucknell, and the relative lack of students from the middle of the country. This result is consistent with previous research that found a significant "u-shaped" relationship with enrollment demand and distance from home; enrollment demand declines and eventually rises with distance (Hillman 2016). The impact of distance also varies by type of home locale. For students from rural locales, in particular, for every one percent increase in the number of miles from Bucknell, their probability of matriculation decreases by an additional 9.12% on average.

Other characteristics of a students' home environment were also found to be significant. For every ten percent increase in the number of houses in the area with values worth one million or more, the likelihood that a student matriculates increases by 1.05%. While this finding shows that students from wealthier areas are more likely to matriculate, this model also found that students from areas with higher percentages of people below the poverty level are also more likely to matriculate. For every ten percent increase in the percent of the census tract population below the poverty level, the likelihood a student matriculates increases by 4.60%. This finding likely shows two ends of the spectrum; students from wealthy areas who can afford the steep prices of Bucknell University's tuition and students from impoverished areas who likely received financial aid packages that enabled them to attend Bucknell and hope to use Bucknell's alumni network to allow them to move into a higher-income bracket in the future. This interpretation is consistent with Thompson (2018) which states that for students from lower socioeconomic backgrounds, elite colleges provide the connections to jobs and industries that these students did not previously have access to, unlike their higher-income peers. Therefore, attending elite colleges is arguably more beneficial for lower-income students than their peers from higher-income brackets.

The percentage of white people in a student's census tract was shown to be insignificant on the likelihood of matriculation in this model. As the percent white variable was also being used as a proxy for the number of colleges nearby a student's home locale, the regression results from this model also show no significant relationship between the number of colleges close to a student's home and the likelihood of matriculation. These results can therefore neither confirm nor deny the findings of Alm et al, who claim that decreasing the distance from a student's home to the nearest college increases the likelihood that the student will choose to attend college (2009).

The levels of education from a student's home locale were found to be highly significant indicators of whether a student matriculated to Bucknell. For every ten percent increase in the number of people over the age of twenty-five with bachelor's degrees, the likelihood of matriculation increases by 2.58%. This finding is consistent with previous research because if a student comes from a more educated area, they are more likely to pursue and attend higher education, particularly from an elite institution (Card 1993; Chetty 2017; Hillman 2016). On the other hand, for every ten percent increase in the number of people who have received an associate degree, the likelihood of matriculation decreases by 7.10%. This finding is also consistent with previous claims that students are most likely to follow the examples set for them and the paths to which they are exposed in their home locales (Card 1993; Hoxby 2013). For example, if most people from a student's home environment pursue an associate degree, the student is likely to follow suit and pursue an occupational degree as opposed to other forms of tertiary education.

Log of parental income is found to be significant at the 95% confidence level. For every one percent increase in parental income, the probability a student matriculates increases by

approximately 8.47%, holding all else constant. This finding, again, is consistent with Chetty's findings of Bucknell, which stated that the University has more students from high-income families than from low-income families (2017). The interaction terms between parental income and year as well as between parental income and the distance from a student's home to Bucknell were both found to be insignificant. This finding suggests that there is not a significant relationship between parental income and distance on whether a student matriculates to Bucknell once they are accepted and that the impact of parental income on matriculation has not changed over time. However, the impact of parental income on a students' likelihood of matriculation does differ by home locale. If a student lives in a suburban area, for every one percent increase in parental income, their likelihood of matriculation decreases by 8.63%. If a student is from a town, they are 10.14% less likely to matriculate for every one percent increase in their parental income. If a student is from a rural home locale, for every one percent increase in their parental income, their likelihood of matriculation decreases by 8.07%, holding all else constant. This finding shows that different geographic home locales have different relationships with parental income on the likelihood a student will matriculate. This could be due to the fact that other factors are at play and that different kinds of environments may place different expectations on their high-school graduates.

If a student is a need-based aid recipient, their likelihood of matriculation increases by approximately 6.92% on average, compared to students who do not receive financial aid. If a student is a Pell Grant recipient, meaning that they come from a low-income family, they are 20.87% more likely to matriculate to Bucknell if they are accepted, holding all else constant. This finding is consistent with previous research that calculated the benefit of a student from a low-income family attending a high-ranked, or elite institution. For students from lower

socioeconomic backgrounds, elite colleges provide the connections to jobs and industries to which these students did not previously have access, unlike their higher-income peers (Thompson 2018). Therefore, attending a college such as Bucknell University could help students from low-income families reach higher status on the income distribution than if they attended a public university (Chetty 2017). Bucknell is known for its strong alumni network and job placement after graduation, so the positive significant relationship between a student being a need-based aid or Pell Grant recipient and the likelihood of matriculating is consistent with the findings of Chetty and Thompson.

The type of locale a student comes from is also significant in whether or not they matriculate to Bucknell. If they are from a suburban area, they are 14.13% more likely to matriculate than students from cities, holding all else constant. For every one year increase, the likelihood for a suburban student to matriculate increases by an additional 3.67%. Further, for every one percent increase in parental income, the likelihood a suburban student matriculates decreases by approximately 8.63%.

If a student is from a town, there is not a significant effect on matriculation, holding all else constant. However, there is a significant relationship between a student being from a town and time as well as a student being from a town and their parental income. If a student is from a town, for every one year increase, their likelihood of matriculation increases by 3.22%. For every one percent increase in their parental income, the probability of matriculation decreases by 10.14%.

If a student is from a rural locale, they are 33.34% more likely to matriculate to Bucknell than their peers from urban locales. This contradicts the findings from a 2013 study that found that students from rural counties were only 84.7% as likely to attend postsecondary education as

students from rural areas (Koricich 2013). For every one year increase, admitted students from rural locales are an additional 3.82% more likely to matriculate as well. This indicates that, over the past twelve years, Bucknell has attracted more students from rural locales. Further, for every one percent increase in parental income, a student from a rural area is 8.07% less likely to choose to attend Bucknell. For every one percent increase in the distance from Bucknell, a student from a rural area is 9.12% less likely to matriculate to Bucknell University. This finding of the significant negative relationship between rural locale and distance to Bucknell and the likelihood of matriculation is also consistent with previous studies that found that students who live farther from educational institutions are less likely to attend college (Alm et al. 2009). While a Bucknell applicant can be assumed to be in a subset of students who plans to attend some type of four-year institution, the negative relationship between distance and rural locale indicates that the proximity of a student's home to the college campus is a significant factor in deciding whether to matriculate. This finding goes along with the fact that high-school graduates from rural locales tend to stay closer to home for both financial reasons and community ties if they do decide to pursue post-secondary education (Hillman 2016).

This model found no significant relationship between gender and the likelihood of matriculation. This result is intuitive because most Bucknell classes are approximately 50% male and 50% female. However, significant relationships were found between race and a student's decision to attend Bucknell. Compared to a white accepted student, black or African American accepted students are 3.60% less likely to matriculate and Asian accepted students are 13.79% less likely to matriculate. Further, students who indicated they were Hispanic or Latino were 9.79% less likely to matriculate than students who were not. While there could be many explanations for this racial disparity, one could be Bucknell's reputation of having a lack of

racial diversity. This reputation could be a reason why Bucknell has fewer applicants of color and further, why, of those admitted, students who are not white are less likely to choose to attend the institution.

6. Limitations

As with any Economic study, this research has some limitations due to the availability of data. A major limitation, especially in the model with acceptance as the binary dependent variable, is the lack of access to student achievement and ability variables such as high-school GPA, SAT or ACT scores, or class rank. While education of home locale was used as an imperfect proxy for student ability and ambition, a more accurate model would include more specific ability variables or use a more suitable variable as a proxy. Further, variables indicating whether a student was a Bucknell legacy or student-athlete were also not included in the data set. This could cause bias if it is believed that students with family members who attended the institution or student-athletes receive priority from the admissions office. Further, another omitted variable could be a variable indicating whether a student applied early decision or regular decision, as there are suspicions that the admissions criteria can vary depending on whether an applicant applies early or regular decision. In addition, an indicator variable for whether or not a student is the child of a Bucknell faculty or staff member could also be an omitted variable as these students receive tuition discounts, which could influence their decision to matriculate. Other potential omitted variables that could be biasing the model include the college for which a student applied into, as admissions criteria vary between the College of Arts and Sciences, the College of Management, and the College of Engineering.

As this dataset only contained parental income for students who filled out the FAFSA, another major limitation of this study is the fact that its results can only be applied to students who applied for financial aid. A less restricted model would utilize financial data on all student families, not only on the ones that filled out the FAFSA. Unfortunately, this data is not currently available or easily accessible.

Further, in looking at the impact of the location of a student's home on their access to tertiary education, another variable that is omitted from the models in this study is the distance from a student's home to the nearest college or university. In this study, the omitted variable was controlled for using the percent of the census tract that is white as a proxy variable. Previous literature has shown that decreasing the distance to the nearest college increases the likelihood that a student will choose to attend college, so this variable is likely causing bias in the error term. Another variable that could be causing omitted variable bias is the distance in miles from a student's home to the nearest metropolitan area, as that distance has also been found to impact college aspirations in previous studies.

Since the data used in this study is only for Bucknell applicants, it is not necessarily representative of all college applicants in the United States. If the necessary data could be collected and obtained, future research should look at trends for Bucknell applicants and accepted students compared to data for all domestic college applicants in the United States. Further, as this study was only conducted with data from twelve years for one institution, the findings may not be directly representative of all other liberal arts schools. Future research should be conducted using similar data from multiple schools and see if these schools have similar trends over time in order to make more general conclusions.

In addition, future research could potentially look at the subsets of schools that individual students apply to and where they end up matriculating. This topic presents many potential paths to explore that could unearth substantial findings that would be useful to all institutions of higher education when they revise their strategic plans and decide how to use their resources. Further, results from studies looking at access to and patterns in college enrollment can also be highly informative to policymakers at institutional, local, and national levels. However, as student data

of this kind is often confidential, obtaining the data and the necessary clearance will likely be the biggest obstacle.

7. Conclusion

This thesis examined Bucknell University applicants over the past twelve years (Fall 2006 to Fall 2018) in order to analyze factors that influence the likelihood of an applicant being accepted and of an accepted student matriculating at Bucknell University. As the focus of this study is the impact of a student's home locales on their access to higher education, the primary variables of interest were those that indicated the distance from a student's home to Bucknell University and other variables that described a student's home locale.

In the probit model of the likelihood of a student being accepted to Bucknell, one of the most significant findings is that there is a significant negative relationship between distance to Bucknell and parental income. This indicates that as a student lives farther away from Bucknell University, the impact of their parental income on the probability of being accepted is lower, on average. This seems to tell the story that Bucknell is trying to increase the geographic diversity of its students by potentially offering more aid and access to students who apply to the university from farther distances. Other factors that significantly affected whether a student was admitted to the university in this model included the education levels of a student's home locale, as well as the levels of income inequality, and the type of area a student came from. Students from more educated areas were more likely to be accepted, most likely because they had strong academic preparation thanks to their home environment; college was likely a part of the discussion of their future beginning at a very young age. In addition, applicants from more unequal areas were more likely to be admitted. Further, several variables indicating differences in home locales were found to be significant, indicating that where a student comes from really does influence their access to Bucknell.

In the probit model of the likelihood of a student matriculating to Bucknell University, distance from the campus, the type of area a student came from, as well as other characteristics of a student's home locale were all found to be significant. Distance was found to have a significant nonlinear effect on the probability of matriculating, supporting previous research that distance from home plays a large role in the decision on where to attend college. The wealth, poverty, and income inequality levels of a home locale all were significant on the likelihood of a student accepted to Bucknell University choosing to matriculate, as were the education levels. These characteristics of home locales likely shaped students' perceptions of college and postsecondary education and therefore impacted their college choice process. Students from more highly educated areas were more likely to matriculate to Bucknell than accepted students from areas with a lower percentage of the population over the age of twenty-five with a bachelor's degree. Students from areas of higher income inequality and higher-income families were more likely to matriculate than those from lower-income locales or families, further supporting Chetty's claim about the income distribution of Bucknell University students.

This study used two probit regressions to show that the probability an applicant is accepted to Bucknell, as well as the probability an accepted student chooses to matriculate, are both significantly impacted by the distance from a student's home to Bucknell University's campus, their parental income, and other characteristics of their home locale. These findings contribute to the existing literature on access to higher education and can be used to influence the aims of institutions' strategic plans as well as general policy recommendations.

As the distance to Bucknell was found to be significant, it is important that geography and the substantial differences in home locales across the country be included in discussions about access to college. While various aid programs are currently implemented throughout the

country, policy needs to acknowledge the impact of geography and differences among communities if the United States ever hopes to chip away at the "education deserts" that are scattered throughout the country (Myers 2018).

Finally, while locality and geography focused policies must be implemented on a regional and national level, individual institutions can also take strides to improve access on their own. Many schools, such as Bucknell University, currently aim to increase the socioeconomic diversity, among other forms of diversity, of their student body. From the regressions completed in this study, it was found that Bucknell has been increasing its geographic reach over the past twelve years, as well as allowing the impact of parental income to become less impactful on the likelihood of a student being accepted to the institution. Although these effects are somewhat small, they do indicate that Bucknell is moving in the right direction. Even more progress can be made if colleges work even harder to simultaneously increase their geographic diversity and socioeconomic diversity. As noted at several points in this paper, there are students living in "education deserts", areas with low income, low education, and low access to college, who could be high-achieving if provided with the proper resources. The primary focus for policymakers and university administrators should be how to increase access for students such as these. Elite institutions have an important but unrealized potential to help lower-income students obtain upward mobility. If colleges and universities, such as Bucknell University, focus on increasing their access for students from all kinds of home locales, they will be creating more opportunity and upward mobility rather than simply reinforcing existing privilege. Doing so could do much to reverse the general trends toward greater inequality.

I. References

Advisory Committee on Student Financial Assistance, Washington, DC. *Access Denied: Restoring the Nation's Commitment to Equal Educational Opportunity. A Report of the Advisory Committee on Student Financial Assistance*. ERIC Clearinghouse, 2001.

Alm, James, and John V. Winters. "Distance and intrastate college student migration." *Economics of Education Review*28.6 (2009): 728-738.

"Bucknell University Strategic Plan." *Bucknell University*, 2006.

Byun, Soo-Yong, et al. "Rural–Nonrural Differences in College Attendance Patterns." *Peabody Journal of Education* 90:2 (2015): 263-279.

Camburn, Eric M. "College completion among students from high schools located in large metropolitan areas." *American Journal of Education* 98.4 (1990): 551-569.

Cabrera, Alberto F., and Steven M. La Nasa. "Understanding the college-choice process." *New directions for institutional research* 2000.107 (2000): 5-22.

Card, David. "Using geographic variation in college proximity to estimate the return to schooling." *NBER working paper*w4483 (1993).

Chetty, Raj, et al. *Mobility Report Cards: The Role of Colleges in Intergenerational Mobility*. No. w23618. national bureau of economic research, 2017.

Chetty, Raj, et al. "Where is the Land of Opportunity? The Geography of Intergenerational Mobility in the United States." *The Quarterly Journal of Economics* 129.4 (2014): 1553-1623.

Chingos, Matthew. "America's Education 'Deserts' Show Limits of Relaxing Regulations on Colleges." *The New York Times*, The New York Times, 14 Aug. 2018.

Deming, David, and Susan Dynarski. "Into college, out of poverty? Policies to increase the Postsecondary Attainment of the Poor." *National Bureau of Economic Research* (2009).

DesJardins, Stephen L., Dennis A. Ahlburg, and Brian P. McCall. "An integrated model of application, admission, enrollment, and financial aid." *The Journal of Higher Education* 77.3 (2006): 381-429.

Dubow, Eric F., Paul Boxer, and L. Rowell Huesmann. "Long-term effects of parents' education on children's educational and occupational success: Mediation by family interactions, child aggression, and teenage aspirations." *Merrill-Palmer quarterly (Wayne State University. Press)* 55.3 (2009): 224.

"Economic Diversity and Student Outcomes at America's Colleges and Universities: Find Your College." *The New York Times; The Upshot*, The New York Times, 18 Jan. 2017.

Ficklen, Ellen, and Jeneva E. Stone. "Empty Promises: The Myth of College Access in America. A Report of the Advisory Committee on Student Financial Assistance." (2002).

"GINI Index for the United States." *FRED*, Federal Reserve Bank of St Louis, 25 Apr. 2018, fred.stlouisfed.org/series/SIPOVGINIUSA.

Hillman, Nicholas W. "Geography of college opportunity: The case of education deserts." *American Educational Research Journal* 53.4 (2016): 987-1021.

Hillman, Nicholas, and Taylor Weichman. "Education deserts: The continued significance of "place" in the twenty-first century. Washington, DC: American Council on Education." (2016).

Hoxby, Caroline M. "The changing selectivity of American colleges." *Journal of Economic perspectives* 23.4 (2009): 95-118.

Hoxby, Caroline, and Sarah Turner. "Expanding College Opportunities for High-Achieving, Low Income Students." *Stanford Institute for Economic Policy Research Discussion Paper* 12-014 (2013).

Hu, Shouping. "Educational aspirations and postsecondary access and choice." *education policy analysis archives* 11 (2003): 14.

Khattri, Nidhi, Kevin W. Riley, and Michael B. Kane. "Students at risk in poor, rural areas: A review of the research." (1997).

Kao, Grace, and Jennifer S. Thompson. "Racial and ethnic stratification in educational achievement and attainment." *Annual review of sociology* 29.1 (2003): 417-442.

Kohn, Meir G., Charles F. Mansk, and David S. Mundel. "An empirical investigation of factors which influence college-going behavior." *Annals of Economic and Social Measurement, Volume 5, number 4*. NBER, 1976. 391-419.

Koricich, Andrew. "The Effects of Rurality on College Access and Choice." *Research Brief*, National Partnership for Educational Access, 2013.

Mishel, Lawrence, Elise Gould, and Josh Bivens. "Wage Stagnation in Nine Charts." *Economic Policy Institute*. Economic Policy Institute, 6 Jan. 2015.

Myers, Ben. "Who Lives in Education Deserts? More People Than You Might Think." *The Chronicle of Higher Education*, The Chronicle of Higher Education, 17 July 2018.

Olson, Lorayn, and Rachel A. Rosenfeld. "Parents and the Process of Gaining Access to Student Financial Aid." *The Journal of Higher Education* 55.4 (1984): 455-480.

Parks, S. E., Robyn A. Housemann, and Ross C. Brownson. "Differential correlates of physical activity in urban and rural adults of various socioeconomic backgrounds in the United States." Journal of Epidemiology & Community Health 57.1 (2003): 29-35.

Terenzini, Patrick T., Alberto F. Cabrera, and Elena M. Bernal. "Swimming against the Tide: The Poor in American Higher Education. Research Report No. 2001-1." *College Entrance Examination Board* (2001).

Thompson, Derek. "Does It Matter Where You Go to College?" *The Atlantic*, Atlantic Media Company, 11 Dec. 2018.

Vergolini, Loris, and Nadir Zanini. "Away, but not too far from home. The effects of financial aid on university enrolment decisions." *Economics of Education Review* 49 (2015): 91-109.

II. Appendix

(Model A: Acceptance Probit Estimation)

$$Accepted_i = \beta_0 + \beta_1 Year_t + \beta_2 Year^2_t + \beta_3 Log(ParentalIncome)_i + \beta_4 Log(ParentalIncome)_i * Year_t + \beta_5 Log(Distance)_i + \beta_6 Log(Distance)^2_i + \beta_7 Log(Distance)_i * Year_t + \beta_8 Log(ParentalIncome)_i * Log(Distance)_i + \beta_9 FinancialAid_i + \beta_{10} Pell_i + \beta_{11} Female_i + \beta_{12} Black_i + \beta_{13} Asian_i + \beta_{14} RaceOther_i + \beta_{15} Hispanic_i + \beta_{16} Suburban_i + \beta_{17} Town_i + \beta_{18} Rural_i + \beta_{19} Suburban_i * Year_t + \beta_{20} Town_i * Year_t + \beta_{21} Rural_i * Year_t + \beta_{22} Suburban_i * Log(ParentalIncome)_i + \beta_{23} Town_i * Log(ParentalIncome)_i + \beta_{24} Rural_i * Log(ParentalIncome)_i + \beta_{25} Suburban_i * Log(Distance)_i + \beta_{26} Town_i * Log(Distance)_i + \beta_{27} Rural_i * Log(Distance)_i + \beta_{28} PercentWhite_i + \beta_{29} Gini_i + \beta_{30} PercHval1Mil_i + \beta_{31} PercBelowPovLevel_i + \beta_{32} PercBachDG_i + \beta_{33} PercAssocDG_i + \mu_{it}$$

(Model B: Matriculation Probit Estimation)

$$Matriculation_i = \beta_0 + \beta_1 Year_t + \beta_2 Year^2_t + \beta_3 Log(ParentalIncome)_i + \beta_4 Log(ParentalIncome)_i * Year_t + \beta_5 Log(Distance)_i + \beta_6 Log(Distance)^2_i + \beta_7 Log(Distance)_i * Year_t + \beta_8 Log(ParentalIncome)_i * Log(Distance)_i + \beta_9 FinancialAid_i + \beta_{10} Pell_i + \beta_{11} Female_i + \beta_{12} Black_i + \beta_{13} Asian_i + \beta_{14} RaceOther_i + \beta_{15} Hispanic_i + \beta_{16} Suburban_i + \beta_{17} Town_i + \beta_{18} Rural_i + \beta_{19} Suburban_i * Year_t + \beta_{20} Town_i * Year_t + \beta_{21} Rural_i * Year_t + \beta_{22} Suburban_i * Log(ParentalIncome)_i + \beta_{23} Town_i * Log(ParentalIncome)_i + \beta_{24} Rural_i * Log(ParentalIncome)_i + \beta_{25} Suburban_i * Log(Distance)_i + \beta_{26} Town_i * Log(Distance)_i + \beta_{27} Rural_i * Log(Distance)_i + \beta_{28} PercentWhite_i + \beta_{29} Gini_i + \beta_{30} PercHval1Mil_i + \beta_{31} PercBelowPovLevel_i + \beta_{32} PercBachDG_i + \beta_{33} PercAssocDG_i + \mu_{it}$$

Table A: Variable Names, Definitions, and Sources

Variable Name	Definition	Source
Year	Year that student applied to Bucknell (1 corresponds to 2006 and 13 corresponds to 2018)	Bucknell Office of Admissions
Parental Income	Parental Income in dollars as reported on the FAFSA	Bucknell Office of Financial Aid
Distance	Calculated linear distance in miles from student's home to Bucknell University's campus	Generated from data from Office of Admissions
Need-Based Aid Recipient	Indicator variable equal to 1 if a student received need-based aid from Bucknell	Bucknell Office of Financial Aid
Pell	Indicator variable equal to 1 if a student is a Pell Grant Recipient (federal award given to students from low-income families)	Bucknell Office of Financial Aid
Suburban	Indicator variable equal to 1 if student is from a Territory outside a Principal City and inside an Urbanized Area	Locale code generated from student addresses from Bucknell Office of Admissions
Town	Indicator variable equal to 1 if student is from a Territory inside an Urban Cluster	Locale code generated from student addresses from Bucknell Office of Admissions
Rural	Indicator variable equal to 1 if student is from a Census-defined rural territory	Locale code generated from student addresses from Bucknell Office of Admissions
Percent White	Percent of people in census tract that are white	American Community Survey
Gini	Gini Index of Income Inequality (scale of 0 to 1)	American Community Survey
PercHval1Mil	Percent of households in census tract worth $1 million or more	American Community Survey
PercBelowPovLevel	Percent of people in census tract below the poverty level	American Community Survey
PercBachDegree	Percent of the census tract population over the age of 25 that has a bachelor's degree	American Community Survey
PercAssocDegree	Percent of the census tract population over the age of 25 that has an associate's degree	American Community Survey
Female	Indicator variable equal to 1 if student is female	Bucknell Office of Admissions
Black	Indicator variable equal to 1 if a student is Black or African American	Bucknell Office of Admissions
Asian	Indicator variable equal to 1 if a student is Asian	Bucknell Office of Admissions

RaceOther	Indicator variable equal to 1 if a student is race "other" (includes Hawaiian/ Pacific Islander and American Indian/ Alaska Native)	Bucknell Office of Admissions
Hispanic or Latino	Indicator variable equal to 1 if a student identifies as Hispanic or Latino	Bucknell Office of Admissions

Table B: Variable Statistics (All Applicants)

Variable Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Year	7.172934	3.867266	1	13
Parental Income	163,671.5	193,451.80	0	9,295,888
Distance	519.9623	812.4068	25	5936.067
Need Based Aid Recipient	0.168033	0.373896	0	1
Pell	0.039905	0.195735	0	1
Suburban	0.65506	0.475349	0	1
Town	0.028279	0.165768	0	1
Rural	0.130823	0.337206	0	1
Percent White	0.824276	0.184864	0	1
Gini	0.435598	0.065567	0.0264	0.7585
PercHval1Mil	0.111179	0.188847	0	0.918121
PercBelowPovLevel	0.065378	0.072092	0	0.924032
PercBachDegree	0.28188	0.098099	0	0.866667
PercAssocDegree	0.063261	0.030437	0	0.8
Female	0.491117	0.499921	0	1
Black	0.063114	0.243168	0	1
Asian	0.075668	0.264466	0	1
RaceOther	0.012491	0.111064	0	1
Hispanic or Latino	0.069121	0.253659	0	1

Table C: Variable Statistics (Admitted Students)

Variable Name	Mean	Standard Deviation	Minimum Value	Maximum Value
Year	7.232364	3.946326	1	13
Parental Income	181,651.6	200,529.70	0	6,137,867
Distance	573.1649	874.6625	25	5913.252
Need Based Aid Recipient	0.307601	0.461501	0	1
Pell	0.069454	0.254225	0	1
Suburban	0.639577	0.480123	0	1
Town	0.026986	0.162042	0	1
Rural	0.124576	0.330238	0	1
Percent White	0.829855	0.166391	0	1
Gini	0.441806	0.066608	0.0264	0.7408
PercHval1Mil	0.126492	0.199674	0	0.918121
PercBelowPovLevel	0.062926	0.068788	0	0.924032
PercBachDegree	0.29565	0.094591	0	0.618582
PercAssocDegree	0.060578	0.030274	0	0.8
Female	0.522493	0.499494	0	1
Black	0.044998	0.207299	0	1
Asian	0.099427	0.299234	0	1
RaceOther	0.013263	0.114401	0	1
Hispanic or Latino	0.069672	0.254593	0	1

Table D: Variable Significance in Admittance Model

Variable	Marginal Effects	Significance Level
Year	0.02408876	**
$Year^2$	- 0.00322896	***
Log(ParentalIncome)	0.23071252	***
Log(ParentalIncome)*Year	- 0.00371731	**
Log(Distance)	- 0.47701355	***
$Log(Distance)^2$	0.1204918	***
Log(Distance)*Year	- 0.00174818	
Log(ParentalIncome)*Log(Distance)	- 0.03173726	**
Need-Based Aid Recipient	0.08766204	***
Pell	0.05685301	***
Suburban	0.00531540	
Town	0.24509315	.
Rural	0.01757963	
Suburban*Year	0.00127588	
Town*Year	0.01684336	***
Rural*Year	0.01270640	***
Suburban*log(ParentalIncome)	- 0.03079399	*
Town*log(ParentalIncome)	- 0.07925463	**
Rural*log(ParentalIncome)	- 0.02991152	.
Suburban*log(Distance)	0.00529962	**
Town*log(Distance)	- 0.00075674	
Rural*log(Distance)	0.01311000	
PercentWhite	0.01812073	
Gini	0.33194477	***
PercHval1Mil	-0.04335420	.
PercBelowPovLevel	- 0.02544035	
PercBachDegree	0.46212202	***
PercAssocDegree	- 0.38530764	***
Female	0.05233344	***
Black	0.00474032	
Asian	0.09390633	***
RaceOther	0.03355120	
Hispanic or Latino	0.04874388	***

Significance codes:
*** $0.00 < p < 0.001$
** $0.001 < p < 0.01$
* $0.01 < p < 0.05$
. $0.05 < p < 0.1$

Table E: Variable Significance in Matriculation Model

Variable	Marginal Effects	Significance Level
Year	- 0.0058959	
$Year^2$	- 0.0027188	***
Log(ParentalIncome)	0.084695	*
Log(ParentalIncome)*Year	0.000049293	
Log(Distance)	- 0.34279	**
$Log(Distance)^2$	0.041433	*
Log(Distance)*Year	0.0046759	.
Log(ParentalIncome)*Log(Distance)	- 0.00034032	
Need-Based Aid Recipient	0.069185	***
Pell	0.20873	***
Suburban	0.14131	.
Town	0.14575	
Rural	0.33341	*
Suburban*Year	0.036723	***
Town*Year	0.032239	***
Rural*Year	0.038203	***
Suburban*log(ParentalIncome)	- 0.086327	***
Town*log(ParentalIncome)	- 0.10141	**
Rural*log(ParentalIncome)	- 0.080763	***
Suburban*log(Distance)	- 0.00064921	
Town*log(Distance)	0.049107	
Rural*log(Distance)	- 0.091194	**
PercentWhite	- 0.012107	
Gini	0.19159	**
PercHval1Mil	0.10539	**
PercBelowPovLevel	0.46042	***
PercBachDG	0.25804	***
PercAssocDegree	- 0.70964	***
Female	- 0.0038997	
Black	- 0.035999	*
Asian	- 0.13790	***
RaceOther	- 0.041714	
Hispanic or Latino	- 0.097888	***

Significance codes:
*** 0.00 < p < 0.001
** 0.001 < p < 0.01
* 0.01 < p < 0.05
. 0.05 < p < 0.1