Education deserts in North Carolina: An analysis of geographic disparities and university access

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ABSTRACT

Much research on access to the higher education system overlooks the importance of a base factor: place. An 'education desert' is defined as an area in which residents are separated from the higher education system by geography and structural factors. This study employs a granular approach to locate education deserts within the state of North Carolina, and analyze the condition of higher education access across the state. By delineating the state into Census tracts (n=2184), the analysis draws more specific boundaries around deserts than did previous researchers. The analysis then goes beyond the binary classification of desert or non-desert, and ranks each census tract's access to the higher education system on a five-point scale. The data shows that approximately one-quarter of the state's population lives in an education desert. Various socioeconomic indicators, such as median household income and the rate of disconnected youth, are found to be significantly correlated with a census tract's access to the higher education system. Distance learning seems to be an apt solution; however, residents of higher education deserts have low rates of internet access, making online education impractical. Policy makers should recognize that gaps in access to higher education, and the subsequent benefits from a degree, have roots in geography and in infrastructure.

Keywords**:** Higher education, Economic desert, Rural education policy, Geography

INTRODUCTION

A college education is widely considered to be a driver of upward social mobility, acting as a socioeconomic equalizer that brings lower unemployment rates, higher lifetime earnings, and better health outcomes for graduates. College degrees benefit both the individual and the community, acting as both a private investment for the student and a public investment for the taxpayer. Access to higher education, however, is unequal -- not all segments of the population attend college at the same rate. The state of North Carolina, the birthplace of public higher education in the United States, is no exception. For North Carolinians, geography can be a strong determinant of whether or not an individual attends college. This paper investigates the effect of place in relation to higher education access, a factor that is often overlooked. As individuals do not live in a 'bubble,' unaffected by place-related barriers such as travel costs, social capital, family obligations, and community expectations, we cannot continue to view them as though they do. As then president of the University of North Carolina System, Margaret Spellings, remarked "We can't allow a child's future to be dependent on ZIP code" (Spellings, 2016). Spellings is right, location has shown to be a significant factor in the likelihood of pursuing higher education, which in turn has the power to either broaden or limit future opportunity. If North Carolina wishes to maintain its place as a leader in higher education, and also decrease economic inequality, it must recognize the disparity and inequality in access to higher education across the state, and work to correct these anomalies.

This analysis reviews postsecondary institutions within the state of North Carolina with respect to their geographic location. Using GIS mapping software, the is delineated state by census tract into areas with and without reasonable access to higher education institutions. Areas with limited access to higher education institutions are referred to as 'education deserts,' a term coined by Hillman (2016), reflecting the lack of opportunity within such areas. Data from the American Community Survey, the Current Population Survey, and the National Center for Education Statistics IPEDS database are used to measure the socioeconomic effect living in an education desert has on North Carolina's population. Additionally, each census tract and postsecondary institution in the state is ranked, based on the level and quality of access to the higher education system that is offered. Access to higher education has a significant effect across many variables, including household income, education attainment level, and the rate of disconnected youth (i.e. residents age 16 to 19 who are neither employed nor pursuing education).

Why does place matter?

"Access to degrees starts with actual access, being able to get to a place where you're able to earn a degree," says Kristin Blagg, K-12 and postsecondary education research associate at the Urban Institute (Douglas-Gabriel, 2018). In spite of decreasing travel costs and the ease of communication in the age of the internet, there is a great deal of regional disparity across the country. Educational attainment is no exception. Literature on 'geography of opportunity' strongly suggests distance and neighborhood effects play a significant role in the college decision process (Hillman, 2016; Shaw et al., 2009; Turley, 2009). Prins and Kassab (2017) note that for prospective students, specifically those living in rural areas, the location of postsecondary institutions can leave such individuals with a feeling that a college education is physically out of reach. The decision of whether or not it is feasible to attend college is a

complex process that challenges individuals in a variety of ways. For some prospective students, mobility is a non-issue; distance to their preferred college or university is not a factor in the decision making process. Others, however, may be confined to attending a college located in their immediate vicinity for any number of reasons. For those, options can be few and far between.

There are several reasons why location maintains relevance in the college decision process. Attending a college or university close to home offers significant financial advantages. As of 2016, the average cost of room & board in the U.S. ranged from $6,805 per year at public two-year colleges, to $11,183 at private four-year institutions (National Center for Education Statistics, 2016, Table 330.40). As financial aid for higher education in the U.S. has become increasingly focused on loans rather than grants, the additional non-tuition related expenses, such as room and board, may be too much for some students, especially those from poorer families, to afford (Turley, 2009). By living close to a college or university, students can benefit from a 'push' factor, making the decision pursue a college degree more lucrative due to the financial incentive of being able to save room and board costs. Students working to pay for college costs can also be at a disadvantage if there is no college or university nearby, as a move to college would likely mean a change in employment. Additionally, ties to family and community can be significant. It may be the cultural norm for some students to live at home throughout their college years, while others may stay in their home to care for family members (Desmond and Turley, 2009; Turley, 2009). Students restricted by location may choose to forgo a college education altogether. Hillman (2016) notes that the restriction of place imposed upon students living in areas with few higher education opportunities likely exacerbates current inequality in education attainment; in turn, Rothwell and Massey (2014) find that areas with low education attainment levels also have the lowest levels of upward social mobility.

Disparity and Divergence

In recent years, obtaining a college degree has become more important than ever in the United States. Since coming out of the Great Recession, many economists, politicians, and policy makers have noted the 'great divergence' of the U.S. economy during the recovery years (Carnevale et al., 2016). As jobs lost during the last recession have returned, they have mostly returned along a single line: college degrees. While the makeup of America's labor force and jobs has been changing for decades, the effects of the 2008 financial crisis seem to have amplified some of the change. Georgetown University's Center on Education and the Workforce (2016) found that of the 11.6 million jobs added to the U.S. economy during the recovery period following the Great Recession, 73% of those jobs went to workers who had bachelor's degrees. Research conducted by the USDA reports that as of 2015, 33% of the urban population in the U.S. had obtained a bachelor's degree from an accredited college or university, while only 19% of the rural population had obtained the same type of degree. Education attainment levels also vary based on individuals' socioeconomic status, or 'SES.' The National Center for Education Statistics found that 14%of students from a low SES and 29 percent of students from a middle SES obtained a bachelor's degree or higher within eight years of graduating high school, while over 60% of students from a high SES obtained a degree (Kena et al., 2015). College degrees, referred to as an "equalizer," have been shown to level the outcomes of graduates regardless of socioeconomic status (Torche, 2011; Chetty et al., 2017). However, with the current disparity in access to higher education it is likely that inequality related to education attainment levels will

continue. The divide in educational attainment highlights the main focus of this paper, which is the effect geography has on access to higher education, as well as the socioeconomic conditions related to such access.

Higher Education in North Carolina

The state of North Carolina has an extensive higher education system, composed of public, independent, and for-profit institutions. The public university system operates 16 campuses located throughout the state, ranging from highly-selective, top-tier universities such as UNC-Chapel Hill, to broadly accessible institutions such as UNC-Pembroke. The state also has a public community college system composed of 60 institutions across North Carolina's 100 counties, mostly serving local communities. Top-tier independent institutions such as Duke University and Wake Forest University, which admit less than 30 percent of applicants, are also part of North Carolina's higher education landscape, plus accessible independent institutions such as Campbell University and Wingate University, which admit over 70 percent of applicants. Several degree granting, for-profit colleges also have locations throughout the state; these range from narrowly focused institutions, such as nursing or art schools, to programs that include a large variety of degrees. Figures 1, 2 and 3 (Appendix) show the locations of these schools, with a ring drawn around each campus.

Recognizing that access to higher education throughout the state is not equal, several programs and organizations in North Carolina have begun efforts to address this issue. The University of North Carolina System leads the effort. Spellings and the UNC System Board of Governors published a strategic plan for 2017-2022, *Higher Expectations*, which states the following:

> North Carolina invented public higher education, and we have one of the strongest public universities in the country. But we also have too many citizens whose hopes for the future are limited by geography, by income, by struggling K-12 schools, or by college costs that seem out of reach. Too many talented, ambitious students never go to college because the path seems too confusing, the risks too high, the rewards too uncertain. (The University of North Carolina System, 2017, p 4)

Being aware of current inequality in education attainment throughout the state, the UNC System is currently administering its third GEAR UP, or "Gaining Early Awareness and Readiness for Undergraduate Programs," grant in an effort to address this issue. The GEAR UP program, which is funded by the U.S. Department of Education, operates with a goal to "significantly increase the number of students who are prepared to enter and succeed in postsecondary education" by working with middle and high schools in low-income communities. The program locates underperforming areas across the state and works to create "college-going culture" in an effort to increase both high school graduation rates and enrollment in postsecondary education (The University of North Carolina System, 2018). The UNC System also has both system-level and school-level initiatives to improve higher education across the state, falling under five broad categories: access, affordability and efficiency, student success, economic impact and community engagement, and excellent and diverse institutions. Highlights of the UNC System's strategic plan include increasing the enrollment of both low-income and rural students, lowering achievement gaps among students, increasing graduates in high-need

fields, and requiring each campus to create a plan to aid a distressed North Carolina county, all of which are rural (The University of North Carolina System, 2017). The North Carolina Community College System has a strategic plan similar to that of the UNC System, with goals such as increasing access to postsecondary education and decreasing achievement gaps, especially among marginalized students (North Carolina Community Colleges, 2018).

The North Carolina legislature has also made efforts to increase access and affordability. In 2016, the North Carolina General Assembly approved funding for 'NC Promise.' The NC Promise program reduced tuition to $500 per semester for NC residents at three select schools across the state, starting in the fall of 2018. Elizabeth City State University, UNC Pembroke and Western Carolina University were strategically chosen with geography in mind, placing all NC residents within 150 miles of an affordable location. The state legislature instituted a cap on all student fees, which are not allowed to increase more than three percent per year; incoming freshman will be provided a fixed-tuition rate for eight consecutive semesters (The University of North Carolina System, 2018).

MATERIALS AND METHODS

Research design

This study set out to answer several questions in regards to higher education access, or 'education deserts,' in the state of North Carolina.

Research Question 1: How many North Carolinians live in a higher education desert?
Research Question 2: Which institutions in North Carolina are most accessible?
Research Question 3: Which areas in North Carolina have the most access to the higher education system?
Research Question 4: Which economic outcomes are correlated with higher education deserts?

The working definition of a higher education desert is an area with either (1) zero colleges or universities located nearby or (2) one community college as the only broad-access institution nearby. This is modified from Hillman and Weichman (2016) to recognize the presence of accessible public and/or private four-year institutions. Note that an area may be home to an elite college yet be a higher education desert. Highly selective schools restrict prospective students via a competitive admissions process, thus, these schools may not be a viable option for members of the local community who live near the school but cannot gain admittance. Since community colleges are restricted in their curricular offerings, these schools are not an option for any student seeking a bachelor's or graduate degree. Community colleges, along with the majority of for-profit schools and online degree programs, have lower completion rates and other student outcome measures, such as loan default rates and lifetime earnings (Fain, 2018; NCES, 2011).

Institutional data

Data on schools were obtained from IPEDS, the National Center for Education Statistics Integrated Postsecondary Education Data System. Six of the IPEDS groups were reviewed: public four-year, private four-year, private for-profit four-year, public two-year, private two-year, and private for-profit two-year schools. Institutions that do not grant degrees, such as

technical schools which only offer professional certification, were excluded from this study. Additionally, satellite locations were excluded, as they tend to house either specialized or graduate programs. The final tally included 134 institutions, with 16 members of the UNC system and 58 community colleges. Mean enrollment is 3,015 with mean price for in-state students of $17,507 (See Table 1, Appendix). A comparison of means using the Mann-Whitney U test found significant differences between two-year and four-year schools in all measures.

IPEDS provided data on acceptance rates, full-time equivalent (FTE) enrollment, tuition, graduation rates, and highest degree awarded. One key question is whether a college or university improves the economic trajectory of its students. Chetty, Friedman, Saez, Turner and Yagan (2017) published mobility report cards, analyzing the success of institutions in moving graduates into higher income brackets than their parents. Their mobility score for each institution is utilized. Nationwide, the highest scoring institutions were not the Ivy League ones, due to restricted access, but mid-tier state institutions such as Cal-State Los Angeles and University of Texas – Pan American (Rio Grande Valley).

Geographic data

This study uses 2010 U.S. Census tracts as the area of measure. These statistical subdivisions of counties are comparatively small units of analysis. North Carolina's 100 counties are divided into 2,184 tracts, which can be as large as 600 square miles or smaller than one-quarter square mile. Tracts are drawn based on population size, typically having a population of around 1,800 to 8,000 people (U.S. Census Bureau, 2012). That said, population varies. Some urban tracts in North Carolina have a population over 15,000 people, whereas several rural tracts have a population of less than 1,000 people. Overall, North Carolina is the ninth most populous state in the country.

Using census tracts as opposed to counties provides several advantages. Census tracts are smaller, allowing for a more detailed analysis of conditions. There can be differentials in socioeconomic conditions across counties that census tract-level data can reveal. To define deserts and non-deserts, commercial mapping software was used to select census tracts within a fifteen-mile ring around the qualifying institutions (accessible public or private four-year schools). Census tracts that fell on or within this boundary were defined as areas with access, or non-deserts, and those falling outside of the boundary were defined as deserts.

Economic data

The majority of data used to measure socioeconomic conditions were obtained from the 2010 Census and the 2016 American Community Survey (ACS). Some data are only reported at the county level, such as the rate of disconnected youth, which was obtained from the U.S. Census Bureau through the Federal Reserve Bank of St. Louis' FRED database. Historic population data was retrieved directly from the U.S. Census Bureau, and is only available at the county level.

Additional data provided by the USDA Economic Research Service (ERS) illustrates economic dependency and county structure across North Carolina. Of North Carolina's 100 counties, 46 are designated as being metro, meaning there is at least one high-density urban center present with a population greater than 50,000. The metro counties are highlighted in Figure 4 (Appendix). The majority of North Carolina's counties are considered non-metro,

lacking large urban hubs. The USDA also provides information on industry specific economic dependency, labeling counties as being either non-specialized, mining, farm, manufacturing, government, or recreation dependent. Non-specialized counties account for roughly half of the state, while federal and state government, manufacturing, and recreation dependent counties account for the remaining areas.

Population data

North Carolina's oldest institution is Salem College, founded in 1772. The campuses of the UNC system were established over time, beginning in 1789 with the flagship in Chapel Hill. UNC Charlotte and UNC Wilmington were the last two universities to open, in 1946 and 1947 respectively. A wave of community college openings began in 1958 and continued into the 1970s. Rural schools that were brought into the UNC system were selected either by successful personal lobbying (e.g. Appalachian Training School / Appalachian State University) or to serve a particular demographic group (e.g. Indian Normal School of Robeson County / UNC Pembroke) (Currie, 1998; UNC-P (n.d.); historical population is likely a relevant predictor of current campus locations.

The majority of colleges and universities were established around population centers of their time. In 1800, the most populous counties were primarily located in the northern coastal plains and along the border of the piedmont region. The first three colleges to open in the state, Salem College, Louisburg College, and UNC Chapel Hill were in these areas. By 1850, several colleges and universities were placed around the Greensboro and Raleigh areas, both of which had seen significant population growth. By 1950, all of the current major colleges and universities in North Carolina had opened their doors, most of which were placed around large population centers including Charlotte, Greensboro, and Raleigh. Administrators of a newly formed institution would likely choose a location near prospective students.

RESULTS

Around one in four North Carolinians live in a higher education desert. Many of the deserts are located in rural areas, with deserts averaging 398 residents per square mile and non-deserts averaging 1,608 residents per square mile. These 622 desert tracts cover 56 percent of the state's land area. Figure 5 (Appendix) shows the deserts with the darker background color. The 27 percent of North Carolinians who live in higher education deserts likely have access to a community college, given the mean of 0.9 community colleges per tract. However, access beyond the two-year degree is sparser.

This analysis next goes beyond the binary classification of desert or non-desert to create a five-point scale, ranking each of the 2,184 tracts in terms of higher education access. As a first step, each university was scored based on degree offerings (associate's or bachelor's+), accessibility (with higher acceptance rates as better), full time equivalent (FTE) enrollment (with more students as better), tuition revenue per FTE (with lower tuition as better), scope (with a general focus as better than specialized), graduation rate (with higher as better) and social mobility score (with higher as better). The top scoring public institutions were North Carolina State University at Raleigh and the University of North Carolina at Charlotte. Top scoring private institutions include Campbell University and Queens University.

Next, the total score for each census tract was tallied as the sum of school scores within its boundaries. The tracts were divided into five equal groups. Figure 6 (Appendix) shows the top tier and the bottom tier. The top tier tracts are clustered in the three largest metropolitan areas. None of lowest ranking tracts are in metropolitan areas.

Economic Implications

As policymakers consider higher education deserts, a key question is whether there are meaningful consequences for residents of higher education deserts. One relevant population segment to consider is young adults. Disconnected youth are between the ages of 16 and 19, not enrolled in school, unemployed, or not in the labor force. Rates of disconnected youth are much higher in counties that contain higher education deserts than those that do not. For areas with accessible four-year higher education institutions, the average rate of disconnected youth is around 7%. The rate tops 30% in some of the higher education deserts. Economic outcomes including household income, home value, and employment rate also differ between higher education deserts and other areas. A comparison of means using the Mann-Whitney U test found significant differences between higher education deserts and non-deserts for all measures; results are reported in Table 2 (Appendix).

There is a significant negative correlation between status as a higher education desert and variables that indicate measure economic stability: household income, home value, and the employment rate (See Table 3). There is also a significant negative correlation with variables that measure educational attainment: the percentage of residents over age 25 who are high school graduates and the percentage of residents over age 25 who are college graduates. Readers recognize the well-known correlation between measures of economic stability and measures of educational attainment. There is a significant positive correlation between status as a higher education desert and the percentage of youth whom are disconnected. High rates of disconnected youth bode poorly for an area's future economic growth.

DISCUSSION

While these results emphasize the role geography plays in access to higher education, some remain skeptical of the legitimacy of an 'education desert.' Robinson and Smith (2018) claim that education deserts should only be defined as areas where residents have no access to higher education whatsoever. This claim implicitly assumes that all institutions are able to serve their respective communities equally, offering a wide variety of programs and degrees. However, all higher education institutions are not equal. Due to the various degree offerings, admissions standards, price, and other factors, students may find themselves within geographical proximity of a school, but the school may very well lie outside of their scope.

Another criticism associated with research into education deserts involves distance learning. Some suggest that in the absence of a traditional brick-and-mortar school, students will simply enroll in online courses. Distance learning has the potential to significantly increase access to the higher education system. However, to enroll and complete online work, a reliable connection to broadband internet is necessary. This can be troublesome. Between 2% and 10% of Americans do not have access to the type of broadband internet needed for online coursework (Blagg and Rosenboom, 2018). In North Carolina, as of 2017, there were 15 counties where over half of county residents did not have access to broadband internet services. In five of these counties, the rate of residents without broadband access was greater than 90% (North Carolina

Association of County Commissioners, 2017). Using census tract data from the American Community Survey, the number of computers in homes, broadband access and internet access (of any speed) are compared.

Households in higher education deserts have less access than households in other areas, with internet disparities compounding other geographic disparities. The percentages of households with and without computer access, broadband access and internet access vary; see Table 4 in the Appendix. The Kolmogorov-Smirnov Test and the Shapiro-Wilk tests both reject the hypothesis of normally distributed data. A comparison of means using the Mann-Whitney U test found significant differences between higher education deserts and non-deserts for all measures.

Completion rates, important across all forms of higher education, are an area of concern for online programs. While data collected by the U.S. Department of Education for online college completion rates is incomplete, estimates show that, on average, students enrolled in completely online programs drop out of college with no degree or award at much higher rates than their peers at traditional brick-and-mortar institutions (Burnsed, 2010; Lederman, 2018). Lederman (2018) found that blended programs, which combine online learning with face-to-face instruction, had much better outcomes, but these are a less practical solution to geographic barriers.

Among the alternatives to traditional four-year degree granting schools is the community college system. As of 2016, 39.6% of all undergraduate students (both full-time and part-time) were enrolled in public two-year schools (National Center for Education Statistics, 2016, Table 303.70). Among these students enrolled in two-year schools, over 62% are part-time; for perspective, only 24% of undergraduates enrolled in four-year schools are part-time. Public two-year schools serve a large portion of undergraduate students, but come with several drawbacks. Two-year schools, by nature, do not offer degrees beyond an associate's level. For students seeking a bachelor's degree or higher, a community college would not be a suitable option. Additionally, two-year colleges report lower completion rates than traditional four-year schools. Data from the National Center on Education Statistics (2016) reveals that only 23.6% of students enrolling in public two-year institutions graduate within 150% of the expected, or "normal," time from that institution. One reason for low completion rates is that many students begin their postsecondary education at community colleges, and then transfer to four-year schools. Students who begin at community colleges and transfer to four year schools, however, are still much more likely to leave the higher education system without a degree. For students who begin at public two-year schools, 26.5% complete their degree at the initial institution, and an additional 11.2% completing their degree at a second institution. The remaining two-thirds lack a degree at the six-year mark. The same data show that for students who begin their postsecondary education at four-year schools, 53.5% (public four-year) and 63.7% (private, non-profit four-year) complete their degree within six years (Shapiro et. al, 2017, p 14). Leaving with no degree is costly, as students not only have to pay back any student loans, but also miss the benefit from the earnings' premium associated with college degrees.

Some may still consider this definition of education deserts to be overly narrow, given that elite schools, as well as community colleges, are excluded when determining whether or not an area is classified as being an education desert. This decision was made to reflect the reality of the higher education landscape, in which elite schools tend to draw the majority of students from outside of their local area, and where community colleges are not equipped to offer the same

levels of upward social mobility as four-year institutions. This study focused upon schools that are both accessible and potential drivers of upward social mobility.

Areas of Future Research

This study uses census tracts to divide the state into geographic units. While census tracts are relatively small, further research could employ the use of census blocks, potentially revealing even finer levels of inequality within communities. Areas currently defined in this study as having access to higher education may indeed contain within them smaller areas with limited access to the higher education system.

Future studies could also look into the question of how living in an education desert affects college choices at an individual level. This study finds significant correlations between an area's access to the higher education system and various socioeconomic indicators for the local population, but does not explore how desert status affects the individual. To better assist areas with less access to higher education, it would be useful for policymakers to know how living in an education desert affects the college decision process.

Additionally, the effects of an area's desert status could be measured over time. Questions such as whether or not access to higher education changes over time with changes in socioeconomic conditions could be answered. Researchers may also investigate the effect that closing colleges have on socioeconomic conditions: when an area's access to higher education decreases because an institution has closed, are there changes over time in these same socioeconomic indicators? Likewise, when an area's access to higher education has increased because of new or moved college locations, what is the effect on the local community?

CONCLUSION

Separating the state of North Carolina into areas with and without access to higher education reveals a form of structural inequality in the higher education system, solidified by geography. Many struggling areas, particularly rural areas, offer fewer choices when it comes to postsecondary education. Predictors include local economic reliance on agriculture and on public sector employment. Limited access to higher education is likely to hinder economic growth, given the U.S. economy's shift toward white-collar jobs, most of which require a four-year degree. Online classes are not feasible without reliable high-speed internet access. Policymakers, then, could benefit from reviewing how the distribution of colleges reinforces inequality in educational attainment, which therefore reinforces` regional economic inequality.

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APPENDIX

Figure 1. Public Four-Year Institutions (Left) & Public Two-Year Institutions (Right)

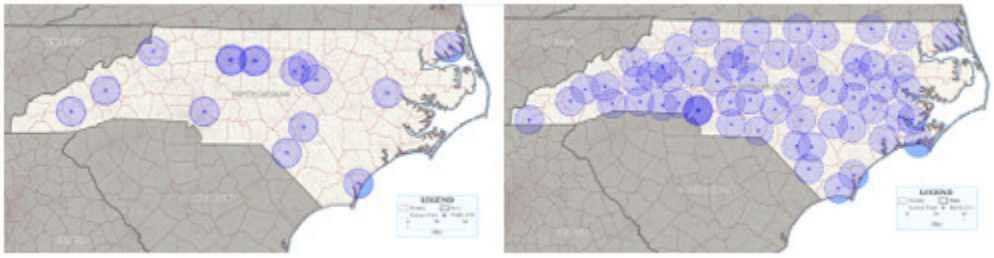

Figure 2. Public Four-Year Institutions (Left) & Public Two-Year Institutions (Right)

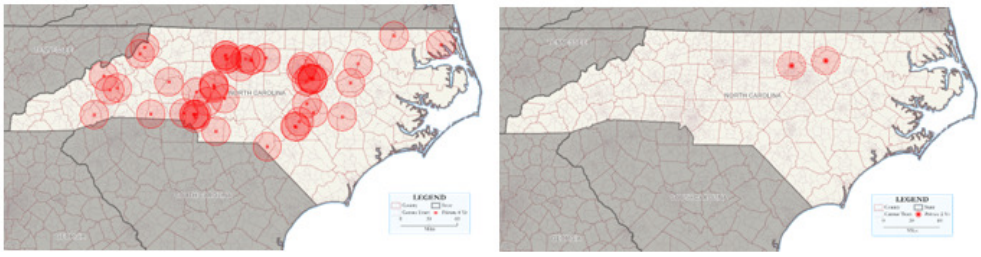

Figure 3. Private Four-Year For-profit Institutions (Left) & Private Two-Year for profit Institutions (Right)

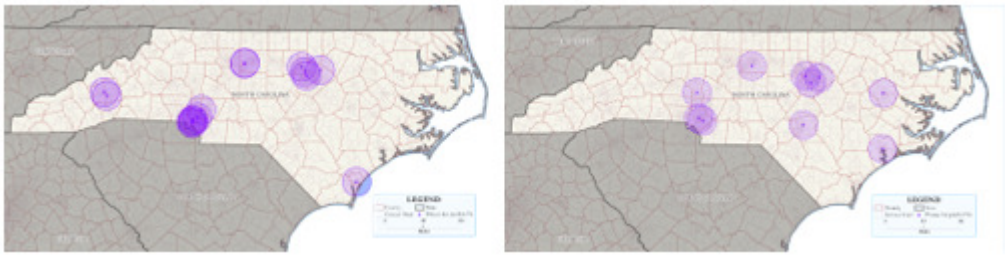

Figure 4. Metro Status

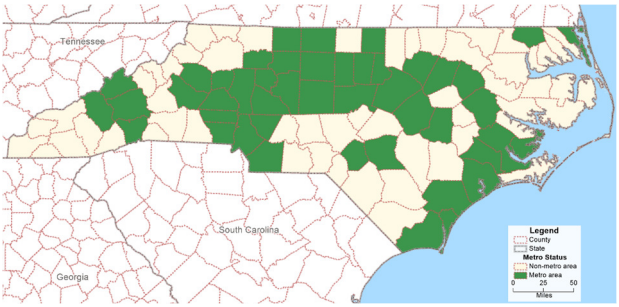

Figure 5. Map of Higher Education Deserts in North Carolina

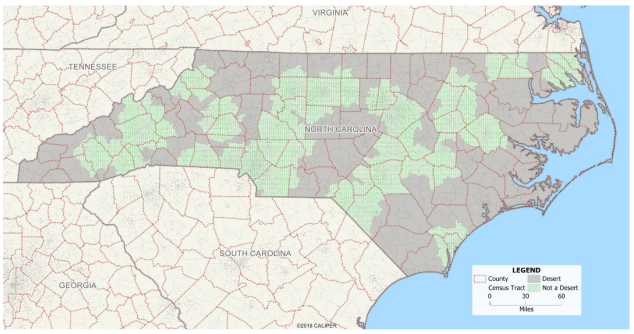

Figure 6. Top 20% of the tracts (Left) and Bottom 20% of the tracts (Right)

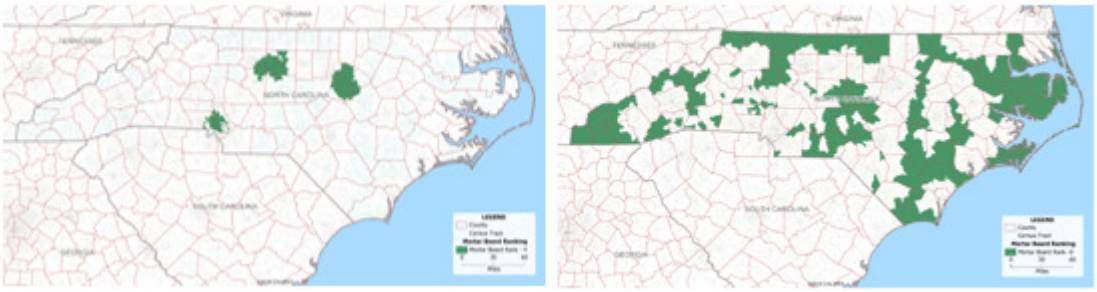

Table 1. Summary Statistics, Higher Education Institutions

Variable	Mean		Std. Dev.	Min	Max
Acceptance rate	82.3%		23.7	11.0%	100.0%
Four-year institutions	64.6%	***	21.6	11.0%	100.0%
Two-year institutions	96.2%		13.3	31.0%	100.0%
Full time equivalent (FTE) enrollment	3,015		5,119	42	29,421
Four-year institutions	4,503	***	6,973	44	29,421
Two-year institutions	1,135		2,192	42	12,513
Total price for in-state student	$17,507		$11,468	$4,426	$69,169
Four-year institutions	$25,685	***	$12,482	$6,625	$69,169
Two-year institutions	$11,112		$4,647	$4,426	$28,600
Graduation rate	35.7%		22.1	6.9%	94.2%
Four-year institutions	50.8%	***	18.1	16.0%	94.2%
Two-year institutions	20.8%		19.1	6.9%	50.8%

**** Means are different at a statistically significant level of 1%.*

Table 2. Summary statistics, Economic variables

Variable	Mean		Std. Dev.	Min	Max
Disconnected youth, County	8.3%		3.3	0.0%	30.2%
Desert area	7.6%	***	2.9	1.2%	22.2%
Non desert area	10.1%		3.7	0.0%	30.2%
Household income, Census tract	$51,268		2,3830	$9,488	$201,528
Desert tract	$44,189	***	15,539	$11,250	$173,526
Non desert tract	$54,141		25,924	$9,488	$201,528
Value of house, Census tract	$170,646		99,148	$15,700	$918,500
Desert tract	$150,936	***	85,012	$27,100	$708,200
Non desert tract	$178,636		103,294	$15,700	$918,500
Employment rate of population, Census tract	44.8%		8.2%	0.0%	90.0%
Desert tract	40.8%	***	6.2%	0.0%	60.0%
Non desert tract	46.3%		8.4%	10.0%	90.0%
Population Age 25+ with a high school diploma	85.8%		8.9%	49.5%	100%
Desert tract	83.4%	***	8.2%	57.6%	100%
Non desert tract	86.8%		9.1%	49.5%	100%
Population Age 25+ with a bachelor's degree	28.6%		19.0%	1.6%	100%
Desert tract	19.9%	***	12.3%	2.6%	87.9%
Non desert tract	32.1%		20.1%	1.6%	100%
Population, Census tract	4,581		1,984	7	16,589
Desert tract	4,352	***	1,888	284	15,949
Non desert tract	4,674		2,014	7	16,589
Population density, Census tract	1,268		1,504	0.8	13,991
Desert tract	399	***	578	3.6	4,425
Non desert tract	1,620		1616	0.8	13,991

*** *Significant at the 1% level.*

Table 3. Correlations between higher education desert status and economic outcomes

	Status as a Higher Ed desert	Tract ranking	Household median income	Pop. Age 25+ with a high school diploma	Pop. Age 25+ with a bachelor's degree	House value	Dis-connected youth	Employ-ment rate of pop.
Status as a Higher Ed desert	1							
Tract ranking	-0.741***	1						
Household median income	-0.201***	0.325***	1					
Population Age 25+ with a high school diploma	-0.179***	0.272***	0.675***	1				
Population Age 25+ with a bachelor's degree	-0.301***	0.455***	0.767***	0.749***	1			
Median house value	-0.137***	0.243***	0.779***	0.646***	0.824***	1		
Disconnected youth	0.338***	-0.440***	-0.322***	-0.306***	-0.437***	-0.344***	1	
Employment rate of population	-0.285***	0.408***	0.434***	0.412***	0.507***	0.350***	-0.367***	1

*** *Significant at the 1% level.*

Table 4. Higher education deserts and household internet access

Variable	**Mean**		**Std. Dev.**	**Min.**	**Max**
Households with at least one computer	84.5%		9.9	46.2	99.6
Higher education desert tract	80.6%	***	9.2	52.8	99.6
Non desert tract	86.1%		9.7	46.2	99.6
Households with no computer	15.5%		9.9	0.4	53.8
Higher education desert tract	19.4%	***	9.2	0.4	47.2
Non desert tract	13.9%		9.7	0.4	53.8
Households with internet access	75.0%		13.2	25.5	99.0
Higher education desert tract	69.9%	***	11.9	36.0	97.9
Non desert tract	77.1%		13.2	25.5	99.0
Households with broadband internet	74.4%		13.3	23.6	98.8
Higher education desert tract	69.1%	***	11.9	33.7	97.9
Non desert tract	76.6%		13.3	23.6	98.8
Households with no internet	25.0%		13.2	1.0	74.5
Higher education desert tract	30.1%	***	11.9	2.1	64.0
Non desert tract	22.9%		13.2	1.0	74.5

*** *Significant at the 1% level. N=1528 desert tracts and 614 desert tracts.*