

What Mattered More? An Analysis of Factors That Affected the Success of University Response
to COVID-19

by

Michael Christopher Davis

Honors Thesis

Appalachian State University

Submitted to The Honors College in partial fulfillment of the requirements for the degree of

Bachelor of Science

May, 2021

Approved by:

Phillip Ardoin

Phillip Ardoin, Ph.D., Thesis Director

Susan D. McCracken

Susan McCracken, Ph.D., Second Reader

Jefford Vahlbusch, Ph.D., Dean, the Honors College

Abstract

This analysis seeks to understand the causes affecting variations in COVID-19 case rates at American college campuses during the Fall 2020 semester. The literature suggests that certain university policies like testing and community factors like partisanship will impact case rates in a significant way. Data is reported by university COVID-19 dashboards, and the dependent variable is measured as the percent of students, faculty, and staff on each campus to test positive for COVID-19. Testing frequency is shown to increase, not decrease, COVID-19 case rates, and Greek life percentage, in-person opening decisions, county partisanship, state COVID-19 case rates, and county COVID-19 case rates are the statistically and substantively significant variables in the model. These findings indicate that while university decisions can play a significant role in shaping university COVID-19 case rates, external factors like community behavior and COVID-19 spread hold the most explanatory power. The results tend to not support the reasoning for widespread angst by frustrated students and faculty toward university administrators regarding university re-opening in Fall 2020.

Introduction

To say the terms “unprecedented” and “uncertain” have been overused is an understatement, but the COVID-19 global pandemic has been just that. Businesses, hospitals, and governments have had to adjust their operating systems in ways thought unimaginable a year ago, and universities have been no exception. The current situation begs the following question: what makes some colleges and universities more successful at combating and managing COVID-19 on their campuses in Fall 2020? Does the empirical evidence support the case studies and anecdotal evidence? Of course, students getting tested and wearing masks are great tools to

stop the spread of COVID-19, but to what extent COVID-19 is under the university's control is unknown.

To better understand what factors impacted the success of universities and colleges' response and ongoing attempts to address COVID-19, this study provides a systematic analysis of the theoretically relevant internal and external factors understood to impact COVID-19 infection rates. This research offers a chance to see if the explanations and statements put forth by university and political leaders match the empirical evidence. Also, this research seeks to find out what is driving the success in containing COVID-19 infection rates at American colleges and universities during the fall 2020 semester. Ultimately, this analysis seeks to provide a better understanding of which factors could impact COVID-19 rates across the country, and the consequences of not knowing are already devastating. The results of the first few weeks of the Fall 2020 semester are troubling. Communities that had large universities in them saw case increases of about 56% and those who didn't saw a 6% decline (Diep). Determining what factors impact the spread of COVID-19 and what doesn't at American universities will help college administrators, public health officials, and elected leaders make decisions based on past experience that should lessen the loss of life and economic hardship for the next global epidemic or pandemic (Smalley).

Literature Review and Theory

Ever since the pandemic began in March 2020, American universities have been trying to figure out the safest and most effective ways to operate and fully reopen their campuses. Some campuses have opened during the Fall 2020 semester fully in person while others are fully online, but most have opted for varying combinations of both. For the Fall 2020 semester, universities have taken vastly different approaches with varying degrees of success with many

common goals and strategies. Most universities have tried to limit on campus spread of the virus as much as possible by requiring masks and enforcing social distancing in classes, but off-campus students continue to account for most campus COVID-19 cases (Diep). This trend may not seem alarming, but ninety-two percent of students at mid-size schools are separated by three degrees of separation or fewer (Renner). This means even if the vast majority of students are following campus COVID-19 guidelines, it only takes ten percent of the student body to account for nearly eighty percent of a university's COVID-19 infections (Renner). Albeit still a serious public health issue, if a campus's COVID-19 spread can be contained to the campus community, this allows for a much better scenario than if vulnerable community members start getting infected by younger college students (Diep).

Location/Population Density

Regarding characteristics among campuses with low rates of COVID-19, Vasquez and Perez (2020) find that location matters: campuses that are more geographically isolated should have lower COVID-19 infection rates. For example, one would expect that a geographically isolated campus like Western Carolina University in rural Cullowhee, North Carolina, would fare better regarding COVID-19 infections in comparison to an urban campus like UNC Charlotte. Universities with smaller surrounding populations should have lower rates of COVID-19 infection.

Greek Life

Smaller universities with a small population of students who are Greek affiliated have avoided some of the superspreader events that other campuses with larger Greek communities have had (Hubler). Harmon et. al (2020) documented the systemic, nationwide effect that some Greek-letter organizations have had on their university's COVID-19 infection rates. Therefore,

one should generally expect to see lower rates of COVID-19 infection on campuses that have a smaller Greek life presence. For example, the University of Washington had over 100 Greek students test positive for COVID-19 after one weekend of parties (Treisman).

COVID-19 Spread Within County and State

Given how COVID-19 can be spread between campuses and their surrounding communities, one should expect that when the rate of COVID-19 cases in each county not attributable to the university (number of COVID-19 cases in the county minus the number of COVID-19 cases at the respective university) is lower, then the university should have less COVID-19 cases because of lesser community to campus spread. For example, Los Angeles and New York City were two of the biggest COVID-19 hotspots in the nation, so one would expect that New York University and University of California, Los Angeles would have higher rates of COVID-19 infection than cities and counties that had less COVID-19 cases. However, the possibility must be considered for some counties the university is having a greater impact on community spread than vice versa. For example, in Clarke County, Georgia, the home of the University of Georgia, COVID-19 spread was manageable until the University of Georgia started the new semester. Out of the 5118 cases in Clarke County, Georgia, during the Fall 2021 semester, only 635 were not affiliated with the university. Also, following this same thought process, in states with lower rates of COVID-19 infection and with smaller populations, their universities should have somewhat lower rates of COVID-19 spread.

Budget

University resources may be another important factor to consider. Schools that can afford and/or have a laboratory nearby that can run thousands of tests per week are at an advantage regarding the testing aspect of fighting COVID-19. For example, Duke University, a school with

an endowment of almost nine billion dollars, has spent “several million dollars” on COVID-19 preparedness (Tan). Numerous other costs besides testing including airflow improvement, supplies, and other campus modification efforts to be COVID-19 compliant exceeded millions of dollars, and some campuses simply could not afford to have such dramatic drops in enrollment and athletic attendance. Given this dynamic, one should expect campuses with large budgets to generally have lower rates of COVID-19 infection controlling for other factors.

Testing

Testing frequency for students is an area where vast disparities exist between universities. For example, the majority of students at universities considered COVID-19 hotspots (areas where escalating and unchecked campus to community spread are occurring) are not being frequently tested (Nadworny and McMinn). This decision was potentially justified by the guidance of the Trump administration CDC to not recommend wide-ranging surveillance testing on college campuses (Nadworny and McMinn). Several New England universities have entered into a frequent COVID-19 testing pact with the Broad Institute of MIT and Harvard to centralize college COVID-19 testing for the region, and their efforts seemed to have paid off and have potentially indicated that extensive testing is one of the best tools universities have to fight the virus, especially entry testing and testing of asymptomatic students (Hubler). If universities can identify these individuals, they can isolate and quarantine these students to prevent further spread. One study states that universities should be testing students twice a week to control the virus on their campuses (Bradley). Critics have said that those who have been investing large amounts of resources in unproven technologies like temperature screening should instead focus their resources more on testing (Singer and Browning). One opposing theory about how testing impacts COVID-19 case numbers is that testing more would reveal more positive cases that

would not have otherwise been discovered and therefore inflates COVID-19 case numbers relative to similar schools that test less. However, given the public health support for testing as a means to lower COVID-19 infection rates, one should expect to see campuses that test rigorously (controlling for other variables) to see lower rates of COVID-19 infection on their campuses.

Partisanship

The COVID-19 pandemic has become an extremely polarizing political issue regarding lockdowns, compliance with COVID-19 protocols, and the perception of the seriousness of COVID-19 itself. Democratic governors have been much more likely to impose mask mandates, stay-at-home orders, and limits on gatherings, while rank and file Democrats view the pandemic as a much more serious public health threat than their Republican counterparts (Deane et. al). For example, in February 2021, 82% of Democrats believed that COVID-19 was a serious public threat while only 41% of Republicans agreed (Deane et. al). Although these stark contrasts in beliefs do not automatically imply better COVID-19 compliance and lesser infection rates, one should expect to see lower COVID rates of infection (as a percentage) at universities located in more Democratic-leaning communities. This result should hold for regions as a whole that are more Republican or Democrat. For example, Southern universities may have a much higher COVID-19 infection rate than Northeastern universities.

Percentage of Students in Residential Housing

The percentage of students living on campus for the Fall 2020 semester is important given the earlier stated fact that most COVID-19 spread occurs off-campus, not on campus. This could be occurring for many reasons including that the university can regulate the behavior of on-campus residential students much more than students who live off-campus, the potential for a “we’re in this together” pitch to be more effective when everyone is living in a smaller, compact

community. Another consideration is that campuses with a high percentage of residential students also tend to be small campuses (US News and World Report). This would lead one to believe that universities with lower on-campus living percentages would have higher rates of COVID-19 infection than universities with most of their students living on campus. This belief does go against the conventional wisdom that the more students universities brought back to campus the greater risk they would have for COVID-19 spread. However, this variable is attempting to measure the effect of on-campus student populations *before* the decision was made to re-open as a general measure of the living patterns of the student population. This variable will not be able to measure mid-semester de-densification efforts that took place at universities that experienced considerable amounts of COVID-19 cases such as UNC-Chapel Hill.

Administrative Leadership

Another important point of emphasis is the failure of a “one size fits all approach” (Bradley). Each university has a different location, student body, budget, and leadership, so while there methods that have had some degrees of success, there is no one “right answer.” Some universities have succeeded with the same strategies that universities have not had any success with, and some variation between campuses is simply not reasonably quantifiable to measure. Regarding his experience leading Appalachian State University’s COVID-19 response, Emergency Management Director Jason Marshburn emphasized the need for buy-in from students, faculty, staff, and families of COVID-19 protocols for a university to be able to effectively fight the virus (Davis and Marshburn). Marshburn also believes that although accountability mechanisms are absolutely necessary, community buy-in is much better than having to resort to negative reinforcement options (Davis and Marshburn). Punitive measures may incentivize students to not cooperate with local public health or not get tested at all

(Courage). Marshburn further elaborated on the pros and cons of a governing board like the UNC System Board of Governors leading the system COVID-19 response versus complete university autonomy (Davis and Marshburn.). A governing board can leverage resources in ways that individual campuses cannot and ensure everyone is “on the same page,” but each campus may need the flexibility that goes beyond the governing board’s desires (Davis and Marshburn). The UNC System Board of Governors’ decision to not allow any campus to not reopen and the eventual decision to allow campuses like NC State and UNC-Chapel Hill to go fully virtual show the need and eventual desire for flexibility. Given these competing advantages between university autonomy and strong governing board leadership, one may not observe many variations within COVID-19 infection rates between universities that have different governing board structures; thus, the type of governing board will not be statistically or substantively significant. This variable will not be a part of the regression analysis since the relevant decision that the governing board would be making (i.e. how to re-open campus) has already been coded for in the categorization of reopening plans.

Unmeasurable Variables

There are other more qualitative techniques and strategies that universities have used including de-densifying residence halls, aggressive enforcement of mask and social distancing protocols, creating meal support plans for quarantined students, and providing alternative safe, in-person experiences for students (Yamey and Bhadelia, Hubler, Courage). However, these strategies are not quantifiable given the scope of this thesis and the difficulty that would occur attempting to collect this data. Perhaps the most important non-measurable variable for this research was the “culture of compliance” on each campus. “Culture of compliance” refers to the frequency of illegal mass gatherings, visitation and mask violations, and general willingness to

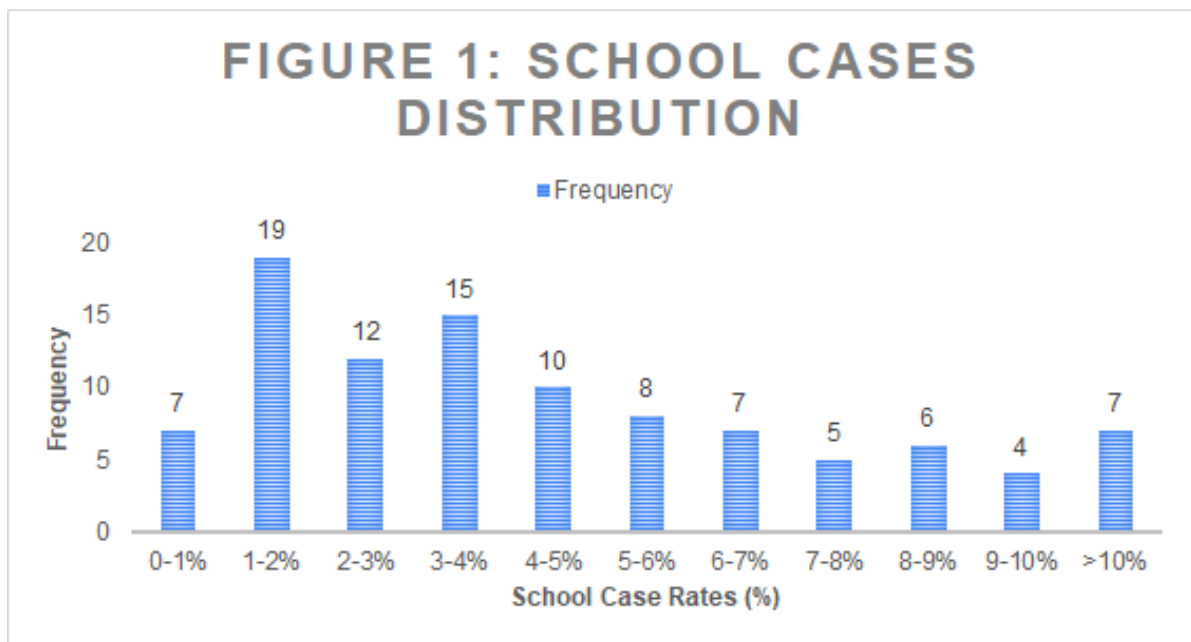
change one's social behaviors within the student population. The "culture of compliance" at the county level is indirectly measured by partisanship. It is extremely difficult to codify social norms into usable data points.

Data/Methodology

The primary research question involves the extent of COVID-19 spread on college campuses, and the dependent variable for the model is COVID-19 infection rates. COVID-19 infection rates are measured as percentages of the entire university population. The data for COVID-19 infections at each university included students, staff, and faculty COVID-19 cases for the Fall 2020 semester dates noted on the university website, and these statistics included both university testing positive cases and self-reported cases. When conflicts between available data and university semester start and end dates occurred, the most precise measures are included in the dataset. The data was obtained by a combination of university COVID-19 dashboards and contacting relevant university officials and requesting data. As a check, the *New York Times* database of cumulative COVID cases for universities from March 2020 until December 2020 was cross-referenced to ensure the data collection was consistent and the case statistics reported closely matched the collected data.

University COVID-19 cases are measured as a percentage of the university population to indicate the extent of COVID-19 spread on each campus instead of raw case numbers. The literature suggests even in a relatively modest sample of 100 universities variation between universities of COVID-19 cases and testing would be quite large, and the empirical evidence supports this claim. UC Berkeley only had 0.4% of their student population get COVID-19, while almost 1 in 5 Clemson University students tested positive for COVID-19. The average campus had 4.7% of their campus test positive for COVID-19, and the median campus had 3.7%

of their campus population test positive for COVID-19. Figure 1 provides a frequency distribution of the eleven categories of COVID-19 case rates expressed as a percentage. The majority of universities' COVID-19 case rates are between 0-4%. Appalachian State University's school case rate is 4.2%, so they would be in the fifth of eleven categories. After considering the overall mean and median, ASU had a relatively mediocre percentage of students who tested positive for COVID-19 in comparison to other universities in the sample.



The reporting of testing numbers at each university followed a similar procedure. This information was usually reported on each university's COVID-19 dashboard or upon request from university personnel. The only data manipulation with this variable occurred when universities published COVID-19 testing data for the entire year but did not specify for each semester. Instead, this number was usually divided in half if the distribution of testing in the Fall and Spring was relatively even, and if not, appropriate weights were applied. Given that the testing numbers were so large and that testing frequency between universities varied greatly, any potential errors from not having a precise measurement should not affect the validity of the

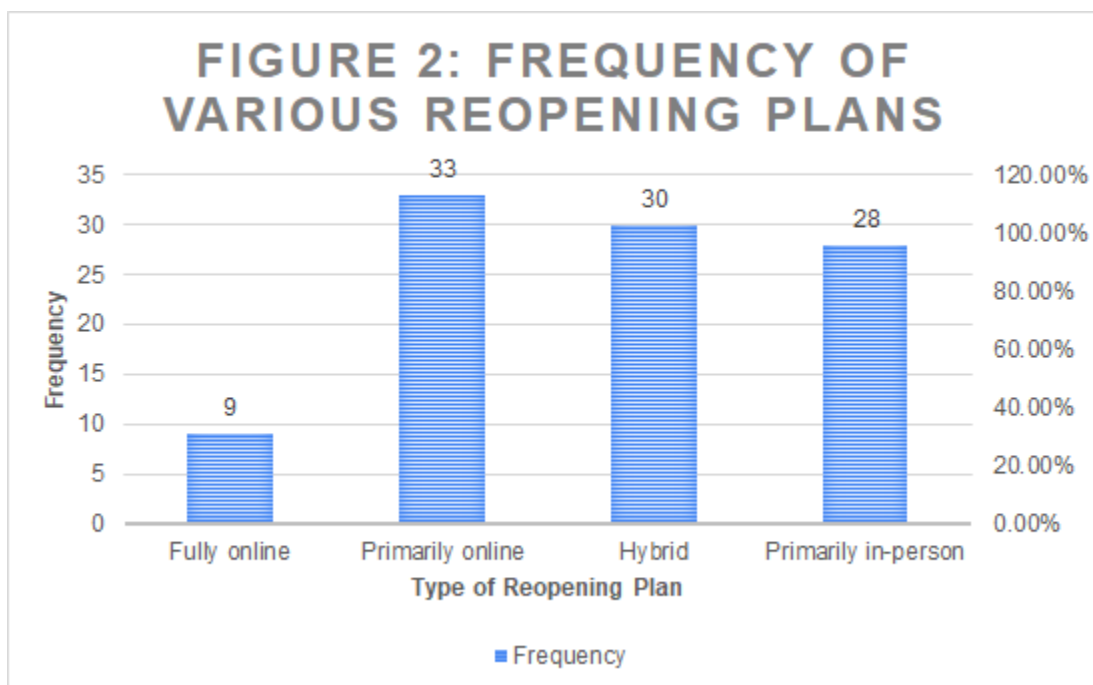
findings. This occurred with the University of Washington, Howard University, and Johns Hopkins University. The University of North Carolina at Chapel Hill, University of New Mexico, and Wake Forest University did not report a reliable metric for any approximation of Fall 2020 COVID-19 testing.

The testing ratio (the number of tests divided by school population) serves as a better benchmark for the extent of COVID-19 testing than raw testing numbers since it controls for the university population's size. The average number of tests completed at each campus is 56,212 (average test ratio of 2.953), and the fewest number of tests done at a university is 540 tests (minimum test ratio of 0.044), and the greatest number of tests administered is 935,163 (maximum test ratio of 20.112).

Budget data were obtained through a variety of internet resources including news articles, university websites, and financial statements with the most recent data available. The university's budget represented the university's operating revenues for that given year. Budgets are relatively stable over time and fluctuations from 2018 to 2019 are going to be minimal. The average budget reported is \$1.627 billion, and the minimum reported budget is \$32 million while the largest reported budget is \$8.947 billion.

The classification of reopening plans for each university was provided by the College Crisis Initiative at Davidson University. Each university's plans were either classified as fully online, primarily online, primarily in-person, or fully in-person. Fully online means that no classes were offered in-person, primarily online means the vast majority of classes were offered online, hybrid is a mix of the two often with professors having the final choice, and primarily in-person means that the vast majority of classes were offered in person. Figure 2 indicates more universities chose some sort of fully online or primary online option in comparison to primarily

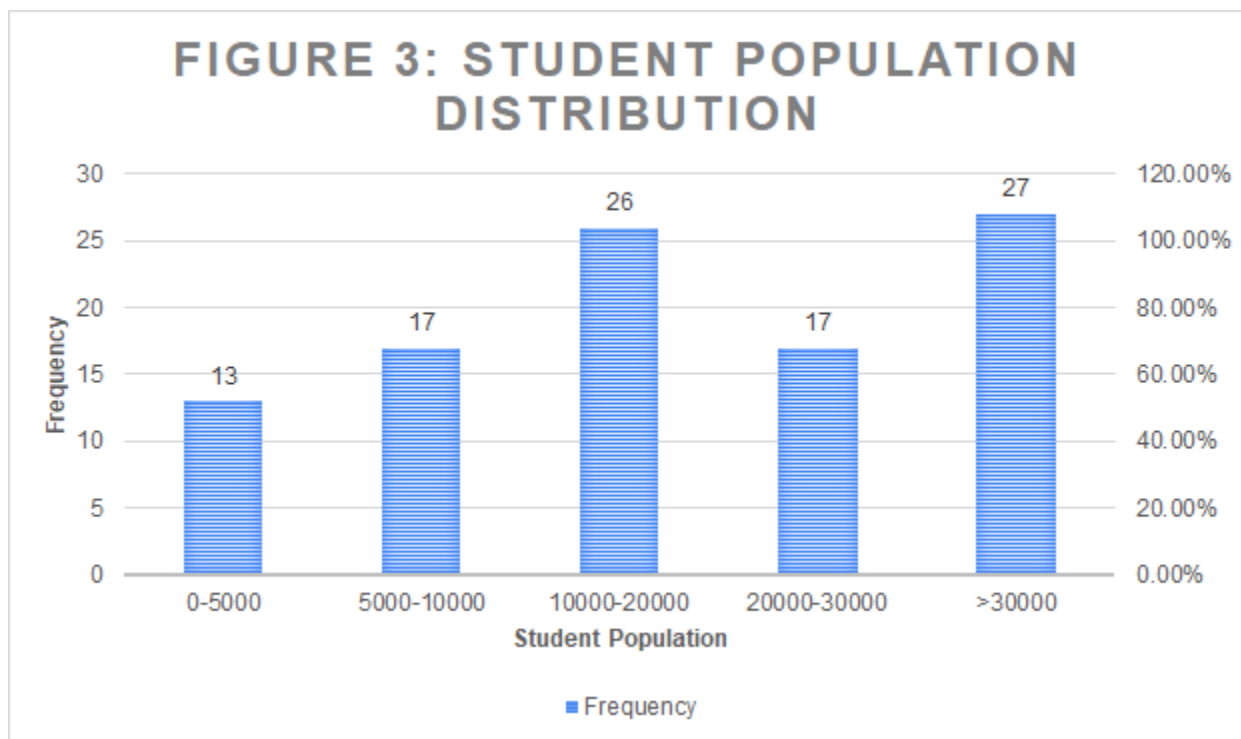
in-person and fully in-person options (no universities in the sample opened fully in-person, and few within the College Crisis Initiative database did). In the model, the online variable includes primarily online, fully online, and hybrid observations because of the suspicion that most universities who selected a hybrid plan would not have been under much pressure to offer many in-person classes, the belief that professors would have opted for online instead of in-person more often than not, and that hybrid courses would have had more online aspects than in-person aspects.



The partisanship of the surrounding university communities (Democrat Vote Share in the model) is measured by the percentage of the vote that Joe Biden received in the 2020 presidential election. These data are significant in determining whether partisanship has any effect on university COVID-19 fluctuations. The data were reported by CNN and *Politico*'s election results pages in the county in which the university resides (CNN and *Politico*). Reliable city-level voting data are not widely available, so county partisanship is best measured by the most recent voting data. This statistic should capture the overall partisanship or lack thereof of

the university and its surroundings. The average vote share for Joe Biden in the 2020 presidential election was sixty-one percent. The minimum vote share is twenty-four percent, and the maximum reported vote share is ninety-two percent.

School population size data was reported by the US News and World Report profile for each university, and this metric included the total student population of both undergraduate and graduate students (US News and World Report). The average student population is 20,940, and the smallest university has 805 students while the largest university has 68,390 students. Figure 3 displays the distribution of university size according to population, and the distribution is slightly skewed toward larger universities since they tended to provide more useful data for this thesis.



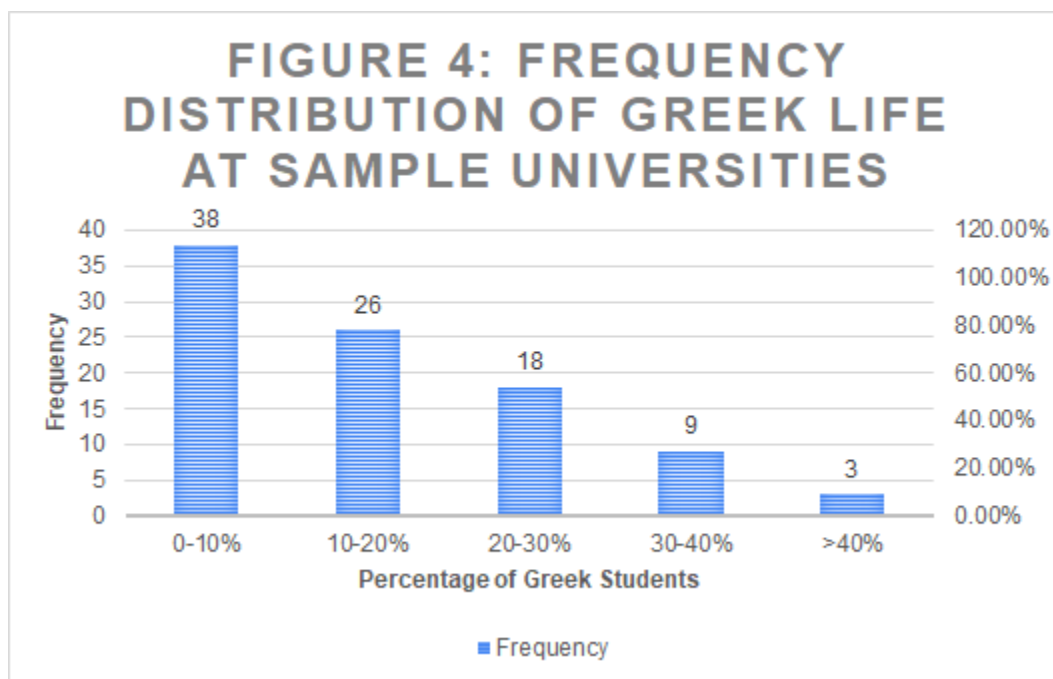
State and county COVID-19 data was reported and collected from StatNews.com's state cumulative COVID-19 database, and this data was measured during the same university academic calendar semester dates as the COVID-19 case and testing variables (StatNews).

Independent cities like Roanoke, Virginia, are counted as counties for this thesis, and Washington, D.C. was excluded as a county because of its ability to be an extreme outlier. The county COVID-19 rate is measured as a percentage of the county population to give a more representative metric of the extent of COVID-19 infection within a county while controlling for population. To ensure that the university COVID-19 case rate is not an endogenous variable for county COVID-19 cases, the variable `Non_University_CaseRate` is added to obtain a measure of COVID-19 spread within a county while controlling for the effect of the university's COVID-19 infections. The average county COVID-19 case rate is 3.43% (26,866 average raw case numbers) with a minimum of .28% (445 cases) and a maximum of 24.4% (219,473 cases). Regarding state COVID-19 spread, the average rate of state COVID-19 infection is 3.1% (average number of cases is 286,693) with a minimum of 0.389% (minimum number of cases is 3,892) and a maximum of 10.234% (maximum number of cases is 1,148,046).

State, county, and town population data are 2019 Census Bureau statistics (US Census Bureau). The median county population is 471,519 with the smallest county having 17,691 residents and the largest having 10,040,000 residents. The median town population is 121,110 with the smallest college town having only 6,377 residents and the largest having 3,967,000 residents. California is the largest state based on population in the sample with a population of 39,510,000 residents, and Vermont is the state with the smallest population with 623,989 people.

The percentage of the undergraduate population in Greek life data from each university came from a combination of sources since the information was not easily accessible for each campus. The university's Greek life website was the first source of information, then US News and World Report, then `Collegedata.com` (US News and World Report, `CollegeData`). Santa Clara University's official Greek life statistic is zero percent; however, this occurred because all

of their Greek life is unaffiliated from the university, and Colorado College, Western Carolina University, Florida Memorial University, the University of Colorado at Colorado Springs, North Michigan University, and the University of Wisconsin at La Crosse did not report any Greek life data. These missing observations should not substantially affect the findings given that not reporting Greek life participation data is not related to COVID-19 infections, so the errors will be randomly distributed throughout the dataset. The average percentage of Greek students was 16.36% with some campuses not allowing any Greek life and a maximum of 45% of students involved in Greek life. Figure 4 provides the frequency for each quintile range of Greek life percentage at sample universities, and the majority of universities have less than twenty percent of their students in Greek life with a plurality having less than ten percent.



The percentage of students at each university living on campus data was provided by a combination of US News and World Report, Collegedata.com, and university residential life websites (US News and World Report, CollegeData). The average percentage of students living

on campus is forty-four percent with a minimum of zero percent and a maximum of ninety-three percent.

Empirical Results

The model provided a rather robust theoretical and substantive level of significance for several of the variables hypothesized to influence COVID-19 rates on campuses.

Considering the external variables, two variables considered external factors (outside the university's control) are both statistically and substantively significant whereas three of the internal factors (characteristic of the university or within university control) are found to be statistically and substantively significant. Table 1 provides a more detailed description of the results. The adjusted R-squared term from the model explains 36.2% of the variation between university COVID-19 rates. This finding suggests the model provides substantive explanatory power considering the number of cases and the general lack of understanding associated with COVID-19 case rates.

Table 1: Multivariate Regression Results

	Variable	Unstandardized Coefficients	Standard Errors	T statistic
Internal Factors	Testing Frequency Ratio	0.002	0.001	1.905*
	Online/In Person	-0.019	0.007	-2.573**
	Greek Life	0.075	0.030	2.526**

	Percentage			
	On-Campus Student Percentage	-0.008	0.022	0.708
	Budget	0.005	0.005	0.953
	School Population	-0.005	0.009	-0.600
External Factors	State Case Rate	0.573	0.213	2.696***
	Democratic Vote Share	-0.097	0.025	-3.940***
	County Case Rate	0.187	0.121	1.547

Dependent Variable: School_Case_Rate

N = 100

Adjusted R-Square=0.362

*** <= 0.1 level of significance,**

****<= 0.05 level of significance**

*****<= 0.01 level of significance**

Partisanship

The partisanship of university surrounding communities is statistically significant at the 0.01 level of significance. The negative direction of the effect is consistent with the theory that Democratic vote share and school case rates would have a negative relationship. The applications

of the coefficient provide that for every ten percent increase in a county's Democratic partisan lean, this corresponds to approximately a one percent reduction in a university's COVID-19 case rate. This dynamic is extremely significant given the wide range for this variable (Range =0.62) and its ability to explain a large amount of variation in the sample. Considering partisanship within a county doesn't tend to fluctuate and its explaining power, partisanship complicates any attempts from the university or local/state/federal government to alter COVID-19 behaviors. For example, even after frequent endorsement from GOP leadership figures, significant numbers of Republicans, particularly Republican men, will not get vaccinated, and these behaviors have a direct impact on policymaker's ability to impact COVID-19 case rates.

County COVID-19 Case Rate

The COVID-19 county case rate is almost statistically significant at the 0.1 level of significance. However, the theoretical positive relationship between county COVID-19 case rates and university COVID-19 case rates was confirmed by the model. The correlation coefficient suggests that a ten percent increase in county COVID-19 case rates corresponds with about a two percent increase in the university COVID-19 rates which suggests a strong relationship between the spread of COVID-19 in the surrounding community and the university; thus, shedding doubt on the extent that universities can remain isolated from their local communities regarding the spread of communicable diseases.

State COVID-19 Case Rate

The state COVID-19 case rate is statistically significant at the 0.01 level of significance. The evidence from the model supports the theoretical positive relationship between state COVID-19 case rates and university COVID-19 case rates. The correlation coefficient suggests a one percent increase in the State COVID-19 infection rate corresponds to a half percentage point

increase in university COVID-19 infections, further emphasizing the role that state COVID-19 case rates play in shaping university COVID-19 case rates. In retrospect, the fact that the discussion and criticism surrounding the decision to re-open college campuses did not include the strong explanatory power of state COVID-19 case rates was a serious error that has not been corrected.

Greek Life

The Greek life at each university is statistically significant at the 0.05 level of significance. The positive direction of the effect is consistent with the theoretical positive relationship between the presence of Greek life and the percentage of students with COVID-19 infections. The correlation coefficient suggests that a ten percent increase in Greek life participation corresponds to almost a one percent increase in COVID-19 cases, and at a plurality of sample universities this one percent represents hundreds of additional infected students. This finding seems to indicate that universities should be taking special efforts to regulate the COVID-19 behaviors of their Greek communities. Additionally, the stereotypical association between Greek life and Republican partisanship suggests that partisanship could be impacting COVID-19 case rates in the community and within the student population.

On-Campus Percentage

The percentage of students living on campus at each university has extremely high levels of statistical insignificance. The negative theoretical relationship between the on-campus percentage and COVID-19 case rates is not supported by the model. This finding might suggest that the backlash about chancellors bringing students back to campus (controlling for re-opening classification) may have been premature.

Budget

The budget at each university has extremely high levels of statistical insignificance. The negative theoretical relationship between the budget and COVID-19 case rates is not supported by the model. Yes, there are some universities with extremely large budgets and endowments that had low levels of COVID-19 spread, but in general, money did not protect schools from COVID-19. The most painful takeaway from this finding might be that the large sums of money spent on COVID-19 preparation were either spent in the wrong areas or irrelevant in general.

School Population

The student population at each university has extremely high levels of statistical insignificance. The positive theoretical relationship between the student population and COVID-19 case rates is not supported by the model.

Testing Frequency

The COVID-19 test ratio is significant at a 0.1 level of significance. The positive direction of the effect is surprisingly different from the hypothesized negative relationship between testing and school case rates. The substantive significance of these findings is not particularly strong. Given that the average test ratio is 2.952 and the standard deviation for the test ratio variable is 4.043, the correlation coefficient for the test ratio would create between one-fifth and one-half of percentage point variation in the school COVID-19 case rate for most universities in the sample. Although this difference may seem minuscule, a percentage point can amount to hundreds of COVID-19 cases at some universities. However, one must consider that the direction of the effect could potentially change or become insignificant within the ninety-five percent confidence interval when discussing the applicability of this variable.

Online/Inperson Reopening

The online reopening status of the university is statistically significant at the 0.05 level of significance. The negative theoretical relationship between opening online and COVID-19 case rates was consistent with the results. In general, universities that opened fully online, primarily online, or hybrid had COVID-19 case rates that were 0.02 lower than universities that opened fully in-person. This finding suggests that the decision by university system leadership or chancellors on how to re-open their campuses played a fairly significant role in affecting university COVID-19 case rates.

Model Adjustments

Some issues arose with the model and the following changes were made. `Non_University_CaseRate` was removed from the model after discovering that this variable and `County_CaseRate` have a high degree of multicollinearity ($r=0.96$). Since the budget and student population variables are highly skewed, the variables were transformed into natural log variables to normalize them.

Discussion

These results confirm and rebuff some of the conventional wisdom regarding how American universities handled the COVID-19 pandemic. The role of community behavior at the state and local level has been cemented as one, if not the most, important factors driving variation in COVID-19 case rates at colleges and universities. Democratic willingness to abide by COVID-19 guidelines at a higher rate than Republicans provides a stronger relationship and significance level than any other variable in the model, suggesting that the behaviors of those in the surrounding community play a larger role than one would expect. The relationships between state COVID-19 cases and county COVID-19 cases would lead one to believe that the ability of universities to defy state and local COVID-19 spread trends is unlikely. Considering that these

results held after controlling for all of the internal factors in the model and any endogenous effect that university cases might have on county COVID-19 case rates, the importance of these findings should not be minimized. The fact that not a single external factor is statistically or substantially insignificant further emphasizes the importance of the previously mentioned external factors.

In the literature and public discourse, testing has been regarded as a method that should have a robust effect on COVID-19 rates. However, the model provides little evidence to support that conclusion. Perhaps the theory that schools who test more will have more COVID-19 cases *ceteris paribus* than those who don't since these universities did not test enough to capture the full extent of COVID-19 on their campuses has more merit than originally thought. Of all the internal factors in the model, this is only one that is statistically significant directly within the decision-making purview of the university. Yes, Greek life percentage is a statistically significant and substantively significant internal variable, but limiting this percentage is not something that university administrators could do. The point is that the variable expected to be the most robust and directly within the control of university administrators had minimal importance in explaining variation in COVID-19 infection rates. However, the extent that the university opened online or in-person did seem to have real implications on the levels of COVID-19 spread. Now one knows that this is one of the few decisions that university administrators had to significantly alter COVID-19 case rates. The intense scrutiny that the decision garnered may have been justified; however, many discussions and critiques of the discussion lacked meaningful inclusion of the other important external factors that also heavily impacted COVID-19 case rates. The other internal factors with decision-making relevance in the model are budget and campus reopening and both of these factors did not explain any variation in COVID-19 case rates.

Conclusion

The goal of this analysis has been to determine whether internal university decisions or factors beyond the control of the university had a greater impact on COVID-19 case rates on college campuses during the Fall 2020 semester. In general, the results indicate that community behavior and beliefs about COVID-19 and COVID-19 trends at the state and county level have a more significant impact on the variations in university COVID-19 case rates than the campus profile or decisions influenced by university administrators. However, one should not conclude that university administrators are powerless in their fight against COVID-19. Even though their actions may not affect COVID-19 rates on their campuses most desirably, the even slight variation that the model seems to suggest for some of the internal factors could still end up reducing the rates of infection and potentially save lives. However, the results of this study would suggest that strengthening the “town-gown” relationship should be a priority during the pandemic given the documented effect that county COVID-19 case rates have on their respective universities’ COVID-19 spread.

Although the results provide interesting and valuable takeaways, one must recognize the limitations of the model before becoming more confident in its findings. For example, the sample for this study included 100 traditionally residential universities when there are a few thousand colleges and universities in the United States. Would the same results hold in a larger sample? Also, universities vary greatly in their COVID-19 data collection and transparency, so getting the most accurate data possible is a challenge given the lack of uniform reporting procedures.

Future research with more time and resources could attain an even more precise understanding of COVID-19 and higher education. Now that one knows what the most important factors are, one has a better idea of where enhanced data collection efforts might be more

effective. Another potential area for research would be to examine if these findings held for an analysis of the Spring 2021 semester. With increasing globalization, animal-to-human contact, and climate change, future global pandemics will be more likely, and learning the right lessons from the last one will ensure more lives are saved in the next one.

References

Bills, Michael, and Wallace Pond. “Colleges in Peril Can Be Rescued, but Only If Governing

Boards Transform.” *CHE*, CHE, 13 Jan. 2021.

Bradley EH, An M, Fox E. Reopening Colleges During the Coronavirus Disease 2019

(COVID-19) Pandemic—One Size Does Not Fit All. *JAMA Network Open*. 2020.

CNN. “2020 Presidential Election Results.” *CNN*, Cable News Network, 2020.

College Crisis Initiative. “Home.” *C2I The College Crisis Initiative*, 2020.

CollegeData. “College Search & Match with Our College Finder.” *CollegeData*, 2020.

Courage, Katherine Harmon. “Why Some Colleges Are Winning against Covid-19, and Others

Are Losing.” *Vox*, Vox, 6 Oct. 2020.

Coyne, Carolyn, et al. “Recommendations for Future University Pandemic Responses: What the

First COVID-19 Shutdown Taught Us.” *PLoS Biology*, vol. 18, no. 8, Aug. 2020, pp. 1–6.

Davis, Michael, and Jason Marshburn. “COVID Lessons at ASU.” 8AD.

Deane, Claudia, et al. “A Year of U.S. Public Opinion on the Coronavirus Pandemic.” *Pew*

Research Center, Pew Research Center, 5 Mar. 2021.

Diep, Francie. “As the Pandemic Worsens, Colleges Prepare to Test Their Spring Plans.” *CHE*,

CHE, 6 Jan. 2021.

Diep, Francie. “The 5 Biggest Lessons We've Learned About How Coronavirus Spreads on

Campus.” *CHE*, CHE, 4 Dec. 2020.

Diep, Francie. “Where Campuses Reopened, Covid-19 Cases Spiked. Where Colleges Went

Remote, They Declined.” *CHE*, CHE, 9 Jan. 2021.

Harmon, Amy, et al. “Frats Are Being Frats': Greek Life Is Stoking the Virus on Some

Campuses.” *The New York Times*, The New York Times, 18 Aug. 2020.

- Hubler, Shawn. "Colleges Learn How to Suppress Coronavirus: Extensive Testing." *The New York Times*, The New York Times, 2 Oct. 2020.
- Jr., Juan Perez. "Campus Life sans Covid: A Few Colleges Write the Playbook for Pandemic Success." *POLITICO*, POLITICO, 28 Sept. 2020.
- Martha E. Pollack, Michael I. Kotlikoff. "Opinion | We Run Cornell. Here's How We've Kept Low Covid-19 Rates on Campus." *The Washington Post*, WP Company, 1 Oct. 2020.
- Moerschell, L, Novak, SS. Managing crisis in a university setting: The challenge of alignment. *J Contingencies and Crisis Management*. 2020; 28: 30– 40.
- Nadworny, Elissa, and Sean McMinn. *Even in COVID-19 Hot Spots, Many Colleges Aren't Aggressively Testing Students*. 6 Oct. 2020.
- Renner, Rebecca. "The Colleges with Virtually No Coronavirus Cases." *Science*, National Geographic, 23 Nov. 2020.
- Singer, N., & Browning, K. (2021, March 02). Colleges that require virus-screening tech struggle to say whether it works. Retrieved March 13, 2021.
- Smalley, Andrew. *Higher Education Responses to Coronavirus (COVID-19)*, NCSL.
- StatNews. "The Covid-19 Tracker." *STAT*, 22 Sept. 2020.
- Steven Shepard et al. "Live Election Results: The 2020 Presidential Race." *POLITICO*.
- Tan, Katie. "Duke Estimates COVID-19 Testing and Tracing Will Cost 'Several Million Dollars' over Academic Year." *The Chronicle*, 23 Oct. 2020.
- The New York Times. "Tracking the Coronavirus at U.S. Colleges and Universities." *The New York Times*, The New York Times, 26 Aug. 2020. f
- Treisman, Rachel. "121 University Of Washington Students Infected In Greek Row Outbreak." *NPR*, NPR, 5 July 2020.

U.S. News & World Report. "News, Rankings and Analysis on Politics, Education, Healthcare and More." *U.S. News & World Report*, U.S. News & World Report, 2020.

US Census Bureau. "Data." *Census.gov*.

Vasquez, Michael. "These Colleges Are Winning the Fight Against Covid-19 - at Least for Now." *CHE*, CHE, 25 Sept. 2020.

Yamey, Gavin, and Nahid Bhadelia. "How to Reopen Colleges Safely During COVID-19." *Time*, Time, 29 Sept. 2020.

Data Appendix

Variable	Variable Name	Coding	Variable Description	
College Reopening Status	Reopening	1	fully online	This variable represents what the College Crisis Initiative at Davidson University classified the reopening plans of each university in the sample. Fully online means that no classes were offered in-person, primarily online means the vast majority of classes were offered online, hybrid is a mix of the two often with professors having the final choice, primarily in person means that the vast majority of classes were offered in person. For more info, go to https://collegecrisis.shinyapps.io/dashboard/ .
		2	Primarily Online	
		3	Hybrid	
		4	Primarily in person	
Governor	DemGovernor	1	Democratic Governor	This variable represents that whether at the time of the Fall 2020 semester, whether the state in the sample had a Democratic governor or a Republican governor.
		0	Republican Governor	
Public	PublicUniversity	1	Public	This variable represents whether the institution in the sample is a public or private university. Public universities receive state funding and sometimes have a governing board for their university system. Private institutions, for the most part, are self-funded and self-governed.
		0	Private	
Type of Governi	GovBoard	0	private	This variable reflects classification from the State Higher Education Executive Officers Association (SHEEO) about

ng Board				<p>the state's university governing structure and authority for certain universities. Private schools do not have a state governing authority. State policy agencies that function as a quasi coordinating board are specific to the Michigan Association of State Universities. Coordinating/policy boards provide broads with oversight and policy research with little potential for micromanaging campus autonomy and decision making. Governing boards have broad authority with chancellor selection, resource allocation, and campus planning.</p> <p>https://drive.google.com/file/d/1oqPY6xKt_2a7-_d9qB42ARnDIEVY1s0u/view?usp=sharing</p>
		1	State Policy Agency	
		2	coordinating/policy	
		3	governing	
Region	Region	1	Mid-Atlantic	DC, MD, PA, WV, DE, NJ
		2	Midwest	IL,MI,OK,OH,ND, WI,IN, KS, MO, NE, AK, KY, MN
		3	Mountain West	CO, ID
		4	Northeast	RI,MA, NY, V, CT, ME
		5	South	NC, VA, AL, MS, SC,FL, GA, LA
		6	Southwest	NW, TX, AZ
		7	West	NV,CA, WA

University # of COVID Cases	School_Cases	no coding	This variable measures the # of COVID cases at each university during the Fall 2020 calendar as determined by the university's academic calendar. This includes students, faculty, and employee positives.
% of School With COVID	School_Case_Rate	no coding	This variable is School_Cases divided by School_Pop.
Tests	Tests	no coding	This variable represents the number of tests done at the university done on students, faculty, and staff.
Testing Ratio	Test_Ratio	no coding	This variable is Tests divided by school population to get a more representative measure of the extent that universities tested.
Budget	Budget	no coding	This variable measures the most recent available university operating revenues available via university financial statements.
Democratic Vote Share	DemVoteShare	no coding	This variable represents the percentage of the vote that Joe Biden earned in the county of the university during the 2020 election.
State	State	no coding	This variable gives the abbreviation of the state that the university is in.
School Population	School_Pop	no coding	This variable represents the total graduate and undergraduate student population at the university.

County COVID Cases	County_Cases	no coding	This variable shows the COVID-19 cases that the county of the university had during the Fall 2020 semester listed on its academic calendar. (https://www.statnews.com/feature/coronavirus/covid-19-tracker/)
% of County with COVID	County_Case_Rate	no coding	This variable represents the percentage of the county of the university that had COVID-19 during the Fall 2020 semester listed on its academic calendar. Measured by County_Cases/County_Pop
County COVID Cases W/O University	Non_University_CaseRate	no coding	This variable gauges the extent of potential county impact on COVID university rates controlling for the number of university cases.
County Population	County_Pop	no coding	This variable gives the 2019 Census Bureau population for the county of the university.
Town Population	Town_Pop	no coding	This variable gives the 2019 Census Bureau population for the town in which the university resides.
% of Student Body in Greek Life	Greek_Percentage	no coding	This variable measures the percentage of the undergraduate population that is affiliated with Greek life. These statistics were garnered from university websites, Collegedata.com, and US News and World Report.

% of Student Body in On-Campus Housing	OnCampus_Percentage	no coding	This variable measures the percentage of the student body that lives on campus from US News and World Report and Collegedata.com
State COVID Cases During Fall Semester	State_Cases	no coding	This variable measures the amount of COVID cases in the state that the university resides during the Fall 2020 semester dates on the University's academic calendar
State Population	State_Pop	no coding	This variable represents the 2019 population of the state in which the university resides.
HBCU	HBCU	0 Not HBCU	This variable measures whether the university is an HBCU or not.
		1 HBCU	