Optimal Spatial Distribution of Colleges

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Abstract: Are 4-year and 2-year colleges located such that aggregate educational attainment is maximized and/or attainment inequality minimized? We attempt to answer these questions. We estimate multinomial logit and conditional logit models of students’ enrollment choices as a function of the distance of each student from each 4-year and 2-year college in the U.S. Not surprisingly, we find that students are less likely to attend distant colleges, and resistance to distance is much stronger for enrollment for 2-year colleges. We predict the aggregate level of educational attainment and inequality in attainment that results from the current spatial distribution of colleges. We simulate what would happen if public colleges were hypothetically moved to a randomly selected location within the state and evaluate the extent to which there could be gains made by such hypothetical re-locations (or, more realistically, college expansions in particular needed areas). We find that states could modestly increase educational attainment by shifting 4-year public college locations toward populated areas and moving 2-year colleges away. Doing this, however, modestly raises inequality in educational attainment.

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1. Introduction

Merced California, with a population of 237,287 in its Metropolitan Statistical Area (American Community Survey, 2005), was selected as the tenth location for a campus of the University of California (UC) system. UC-Merced, hailed as the “first American student-centered research university of the 21st century” was opened in 2005, ten years after the site was selected by UC Regents (UC-Merced, 2015). The location choice was hotly contested and the outcome of political pressure, demographic change, and land availability (Reinhold, 1988). A similar choice was faced in the state of Washington, which in 1990 opened the third campus of the University of Washington in Bothell, a mere 16 miles northeast of the main campus in Seattle. Are these locational choices optimal? Would these states have higher educational attainment if they had instead increased enrollment at the existing campuses closer to students’ residences in the large population areas of Los Angeles, San Francisco, and Seattle? What if other states are looking to expand their 4-year enrollment, where would a new college be placed in order to increase educational attainment the most? Finally, is there a tension between raising average levels of attainment and reducing inequality in attainment? This paper answers these questions.

The goal of our simulation is to find the placements of a state’s public 4-year and 2-year colleges such that the educational attainment of the state’s youth is maximized (and separately such that inequality in the educational attainment of the state’s youth is minimized). We focus on the locational choices of public colleges as these institutions have a mission to serve the population of the state, whereas the missions of private institutions are not necessarily as clearly aligned with state priorities. States constantly struggle with the question of whether to increase their enrollment, which campuses ought to be supported for expansion, and where and whether to open new branches.

1 Nearly one-hundred years earlier, the main campus in Seattle was relocated in 1895 from downtown Seattle to its present location 4 miles northeast of downtown to take advantage of available land allowing for campus expansion (University of Washington, 2015).
We find that states could modestly increase educational attainment by shifting public college locations, or more precisely the location of enrollment opportunities, by moving 4-year college enrollment toward populated areas and moving 2-year colleges in the opposite direction. Doing this, however, modestly raises inequality in educational attainment. We arrive at these conclusions as the result of a simulation model that is grounded in the observed enrollment choices of students.

2. Model, Method, and Data

Our model assumes that students make a decision about whether to attend college, the level of college (2-year vs. 4-year), and which particular college to attend in the following steps. First, the student asks herself which 4-year college she would be likely to attend if she attended a 4-year college. She places probabilities on the likelihood of attending each possible 4-year college and these probabilities are higher for nearby colleges, in-state colleges, and colleges that have larger enrollments. Then, she computes her expected utility from choosing to attend a 4-year college. This expected utility is a weighted average of the utilities of attending each particular 4-year college, where the weights are equal to the probability of attending that college. If 4-year colleges are located far from the student, or if the nearby 4-year colleges are tiny and thus have low likelihoods of her attending one of them, then she will have low utility from attending a 4-year college. She then repeats this prospective analysis for the prospect of attending a 2-year college. Finally, she makes a decision about whether to attend a 4-year, attend a 2-year, or not attend a 4-year or 2-year college. We estimate this model using the following steps.

2.1 How geography affects the utility of 4-year and 2-year colleges

The first step leading to our simulation is to compute the predicted weighted average utility of the set of colleges that each student faces as a function of the distance to those colleges.² We start by modeling the choice of enrolling in a particular 4-year college conditional

² Beginning with Card (1995), numerous papers have used distance to the nearest college as an instrumental variable that predicts years of education in efforts to understand the effect of educational attainment on labor market outcomes. Our approach models enrollment choices uses
on attending some 4-year college. Let $U_{4ij}$ represent the utility of the 4-year college $j$ to student $i$. We model $U_{4ij}$ as a function of the log of the straight line distance between student $i$ and college $j$ ($D_{ij}$), the total undergraduate enrollment of college $j$ ($E_j$), an indicator for whether college $j$ is in the same state as student $i$ ($B_{ij}$), and a random component ($\varepsilon_{4ij}$) as follows:\(^{3,4}\):

$$U_{4ij} = \ln(E_j) + \beta_4 \ln(D_{ij}) + \xi_4 B_{ij} + \varepsilon_{4ij}$$

Assuming that the student maximizes her utility, then the probability that the student will choose 4-year college $j$ ($\pi_{4ij}$) is given by the following:

$$\pi_{4ij} = \Pr[\max(U_{4i1}, \ldots, U_{4iJ}) = U_{4ij}]$$

We use a conditional logit specification to estimate this probability as follows:

$$p_{4ij} = \frac{\exp(\ln(E_j) + \beta_4 \ln(D_{ij}) + \xi_4 B_{ij})}{\sum_{k=1}^{K} \exp(\ln(E_k) + \beta_4 D_{ik} + \xi_4 B_{ij})} = \frac{E_j \exp(\beta_4 \ln(D_{ij}) + \xi_4 B_{ij})}{\sum_{k=1}^{K} E_k \exp(\beta_4 \ln(D_{ik}) + \xi_4 B_{ij})}$$

Note that if two colleges are the same distance from student $i$ and both are located in the same state as student $i$, but college $a$ has twice the enrollment of college $b$, then this model predicts that the probability of student $i$ enrolling in college $a$ is double the probability of student $i$ enrolling in college $b$. We believe this to be a realistic assumption, as a student would be more likely to choose a college with more open "seats."

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3 With the specification in (1) we are assuming that student-specific traits are orthogonal with the distance to a college conditional on their choice of a 2- or 4-year postsecondary institution. We acknowledge that this may be an unrealistic assumption, but it is necessary to maintain the computational simplicity of the specification. Running an alternative-specific logistic regression with individual controls would yield parameter estimates for each "alternative" (or college), which is unwieldy given the large number of colleges.

4 We assume that distance has a non-linear relationship with the utility of attending a particular college. Specifically, we assume that there is a logarithmic relationship between the two variables. We think that this makes the most intuitive sense. Suppose that going to a college within 50 miles entails living at home. Each additional mile traveled increases the driving commute and thus has a high daily cost. If going to a college over 100 miles away involves living on campus and only driving or flying home for breaks, then the cost would most likely be substantially less than the cost of a daily commute. So we would expect that distance would have a strong initial negative impact on the utility of attending a college, but beyond a certain point would have a relatively flat disutility.
We estimate this model using data from the Education Longitudinal Study of 2002 (ELS:2002), conducted by the U.S. Department of Education, which followed a nationally representative sample of 10th graders in 2002 through 2012. We focus on the first 4-year college attended by the 6,490 students included in the 2006 second follow-up survey who attended a 4-year college as their first “real” postsecondary institution attended after high school.\(^5\)\(^6\) Given that we are using the first postsecondary institution attended as of the second follow-up, we are estimating the influence of distance on college decisions for the subset of high school students who choose to attend a postsecondary institution in the initial two years following their expected completion of high school. We construct an indicator variable for whether the student’s first 4-year college was one of the 2,309 4-year colleges included in the Integrated Postsecondary Education Data System (IPEDS) with complete enrollment information for the 2004-06 surveys, the years between the first and second follow-ups of the ELS:2002. In addition, we eliminate all postsecondary institutions that offer only distance learning options from the analysis as, arguably, distance should not play a role in a student’s decision to enroll in this type of campus. This question was not included in the 2004-06 surveys, so we define distance-learning only institutions as those that responded that they offered only distance learning options during the 2011 survey year, the first year the question is included. We calculate the Vincenty (1975) distance between each student and each college using the coordinates of the college and student.\(^7\)

To find the coordinate location of the student we use the zip code of the student’s family residence during the first follow-up study (when the student is in 12th grade). If missing, we use the residential zip code from the base year survey. If still missing, we replace with the zip code of the high school during the base year survey. This provides 100% coverage of the 16,200

\(^5\) All frequencies from ELS:2002 have been rounded to the nearest ten.

\(^6\) The first “real” institution is the institution listed with the earliest start date. It is noted, however, that an exception is made when the earliest postsecondary institution is attended during the summer of the same year of high school completion/exit and the postsecondary institution with the second earliest start date and longer enrollment time was started in August, September, or October of the same year. If these conditions are met, then the first “real” postsecondary institution is the institution with the second earliest start date (see ELS Codebook for more information).

\(^7\) Vincenty’s formulae calculate the geodesic distance between two points on the surface of the Earth. The calculation uses an ellipsoidal model of the Earth which is said to be more accurate representation than the spherical model used in the great-circle distance calculation. We use the Stata program vincenty to calculate distance using Vincenty’s formulae (Nichols, 2003).
survey respondents. We then match the zip code with a latitude and longitude provided by the U.S. Census for Zip Code Tabulation Areas from the 2000 Census.\textsuperscript{8} To get the coordinate locations of the colleges, we use the mailing addresses of each of the institutions provided by IPEDS. We then geocode each of the addresses to get a latitude and longitude of the institution.\textsuperscript{9}

After estimating Equation 3, we use the resulting estimate of $\hat{\beta}_4$ and $\hat{\xi}_4$ to estimate $\hat{p}_{4ij}$ and $\bar{U}_{4ij}$ for the full sample of 16,200 survey respondents. Finally, for each student $i$, we then estimate the weighted average utility of the 2,309 ($J$) U.S. 4-year colleges in our analysis given their proximity to student $i$ ($V_{4i}$) as follows:

\begin{equation}
\hat{V}_{4i} = \sum_{j=1}^{J} \hat{p}_{4ij} \times \bar{U}_{4ij}.
\end{equation}

We repeat this analysis for the 2,265 2-year colleges included in the same IPEDS dataset, and estimate $\hat{V}_{2i}$.

\subsection*{2.2 Choice of attending a 4-year college, 2-year college, or neither}

We next estimate the probability that the student attends a 4-year college, a 2-year college, or no college. Note that in this analysis “no college” includes the option of attending a sub-2-year postsecondary institution. Furthermore, if the student reports that they attended a college, but there was no institutional level reported in the ELS:2002 data file (e.g., if the college they report has no IPEDS code and they did not provide an institutional level for the survey) or if the student was a non-respondent in the second follow-up of the study, we assume that they did not attend any college. We define the utilities of these three options as follows,

\textsuperscript{8} Since zip codes do not necessarily denote an area, just a collection of mail routes, the Census has created the Zip Code Tabulation Area which attempts to provide an area representation of a zip code. While this does not provide us with an exact student location, we believe it is a close enough approximation for the purposes of this study.

\textsuperscript{9} To geocode the mailing addresses of the institution, we use the geocode3 command in Stata. This program retrieves latitude and longitude coordinates from Google’s Geocoding API using address information. To check the validity of the geocoded coordinates we make sure that the coordinates place the college within 25 miles of the center of the ZCTA of the student. If not, we look up the exact coordinates of the college through the Google Maps service. Note that recent versions of the IPEDS provide latitude and longitude coordinates for the colleges. This is a resource that we take advantage in the later simulation.
(5a) \[ U_{4i} = \alpha_4 + \gamma_4 \hat{V}_{4i} + \theta_4 X_i + \varepsilon_{4i} \]
(5b) \[ U_{2i} = \alpha_2 + \gamma_2 \hat{V}_{2i} + \theta_2 X_i + \varepsilon_{2i} \]
(5c) \[ U_{0i} = 0 + \varepsilon_{3i} \]

where \( X_i \) is a vector of zip-code and school-level control variables for individual student \( i \). The zip-code level control variables included in the model are median family income, population density (population per square mile), proportion of adults over 25 holding a bachelor’s degree, and the proportion of families below the poverty line. The school-level variables controlled for by the model are the proportion of minority (Black, Hispanic, and American Indian/Alaska Native) students, proportion of female students, and pupil-teacher ratio. In addition, we include indicators for seven different school types: regular public, public charter, public magnet, other public (vocational, special, or alternative education programs), private Catholic school, private school with other religious affiliation, and secular private school. In the model we treat a regular public school (non-magnet/non-charter) as the base-category. It should also be noted that the categories are not fully mutually exclusive. For example, a school could be classified as both a charter and a magnet school.

We include the control variables to avoid omitted variable bias that may occur if there is correlation between a student’s proximity to colleges and the demographics of their locale or the characteristics of their school, both of which may also have a direct effect on the choice of level of college to attend. We gather zip code level information from a combination of the 2000 Census Summary File 3 and the 2007-11 American Community Survey 5-year estimates, prioritizing the former when available. Information about high schools is taken from the U.S. Department of Education’s Common Core of Data (CCD) and Private School Survey (PSS). Multiple imputation using predictive mean matching (PMM) was used to account for any missing covariates in all estimated models.\(^{10}\) All our control variables are at the school or zip code level rather than at the individual student level because in the simulation our unit of

\(^{10}\) We create five datasets with missing values imputed using the predictive mean matching technique using all variables in the model as predictors. PMM uses linear regression to create continuous fitted values for all observations. It then matches the predicted values of the missing observations with the closest values for the observed data (in our situation, we match with five other observations). It then randomly selects one of the matched observations and takes its value to be the value for the missing variable. See Allison (2015) for an extended discussion.
analysis is the high school. In the simulation, we will be predicting the likelihood of a typical student at a given high school choosing to attend a 4-year, 2-year, or no college, as well as the likelihood of attending particular 4-year and 2-year colleges. We use a multinomial logit specification, limiting the sample to high school graduates, to estimate the probability of selecting each of these three choices as follows:

\[
\hat{p}_{4i} = \frac{\exp(\bar{\alpha}_4 + \bar{\gamma}_4 \bar{v}_{4i} + \bar{\theta}_4 x_i)}{\exp(\bar{\alpha}_4 + \bar{\gamma}_4 \bar{v}_{4i} + \bar{\theta}_4 x_i) + \exp(\bar{\alpha}_2 + \bar{\gamma}_2 \bar{v}_{2i} + \bar{\theta}_2 x_i) + 1}
\]

\[
\hat{p}_{2i} = \frac{\exp(\bar{\alpha}_2 + \bar{\gamma}_2 \bar{v}_{2i} + \bar{\theta}_2 x_i)}{\exp(\bar{\alpha}_4 + \bar{\gamma}_4 \bar{v}_{4i} + \bar{\theta}_4 x_i) + \exp(\bar{\alpha}_2 + \bar{\gamma}_2 \bar{v}_{2i} + \bar{\theta}_2 x_i) + 1}
\]

\[
\hat{p}_{0i} = \frac{1}{\exp(\bar{\alpha}_4 + \bar{\gamma}_4 \bar{v}_{4i} + \bar{\theta}_4 x_i) + \exp(\bar{\alpha}_2 + \bar{\gamma}_2 \bar{v}_{2i} + \bar{\theta}_2 x_i) + 1}
\]

Table 1 shows the summary statistics for each of the control variables used in our analysis. In this table, we compare the characteristics of our ELS sample to the characteristics of schools included in the U.S. Department of Education’s Common Core of Data (CCD) and Private School Survey (PSS) for which we will apply the simulation. We find that the characteristics of schools and neighborhoods of ELS students are very comparable to those in the combination of the CCD and PSS.

[Insert Table 1]

### 2.3 Predicted educational attainment

We estimate the educational attainment of an individual by examining the number of postsecondary undergraduate credits earned nine years after on-time high school completion (June 2013). We estimate the number of credits that are expected to be earned by an individual who initially attends each level of institution: 4-year, 2-year, or no college. That is, we estimate the number of postsecondary undergraduate credits earned by an individual whose first

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11 To check the sensitivity of our results, we run the same model described above, but also include student-level covariates. These student-level covariates are individual gender/race indicators, normalized math/reading achievement scores from the ELS:2002 base-year student assessment, and a composite measure of family socioeconomic status constructed by ELS:2002. After the model was estimated, we compared the predicted values of both the school/zip code level covariates model with the student-level covariates model. Correlations among the predicted values ranged from 0.57-0.69. While this suggests that our school/zip code level model does not capture fully the variation at the individual-level outcomes, we feel that the coefficient estimates are sufficiently close for the purpose of our subsequent simulation exercise.
postsecondary institution by the second follow-up was a 4-year or 2-year college or who did not attend any college. The average number of postsecondary undergraduate credits earned 8 years after high school is 118.9 for students who begin at 4-year colleges, 77.9 for students who begin at 2-year colleges, and 22.5 for students who either attended a sub-2-year postsecondary institution or did not attend college. We predict credit levels by further conditioning on the same zip code and school level covariates listed above using tobit models to estimate the following specifications:

\[
\begin{align*}
(7a) & \quad c_{4i}^* = a_4 + \theta_4 X_i + \varepsilon_{4i} \\
(7b) & \quad c_{2i}^* = a_2 + \theta_2 X_i + \varepsilon_{2i} \\
(7c) & \quad c_{0i}^* = a_0 + \theta_0 X_i + \varepsilon_{0i} \\

\end{align*}
\]

\[c_{li} = \begin{cases} 
 c_{li}^* \text{ if } c_{li}^* > 0 \\
 0 \text{ if } c_{li}^* \leq 0 
\end{cases}\]

\[\varepsilon_l \sim N(0, \sigma^2)\]

where \(c_{li}\) is the number of credits earned by student \(i\) who chooses to initially enroll in a \(l\)-year institution (where a 0-year institution is for those who do not attend a college in the first two years post-high school). We use the ELS:2002 Postsecondary Education Transcripts Study (PETS), to estimate the above expected educational attainment.\(^{12}\) To keep consistent with the multinomial logit specifications described in the previous subsection, we limit our estimation to those who have completed high school.

Given that we can estimate the educational attainment for a student with a given set of characteristics from the equations above in attending different levels of postsecondary institutions, we can estimate the overall expected educational attainment as follows. Using the estimated probabilities of initially attending each level of institution (\(\hat{p}_{0i}, \hat{p}_{2i}, \text{and } \hat{p}_{4i}\)), we expect that a student will complete the following number of credits (\(EA_i\)):

\[EA_i = \hat{c}_0 \ast \hat{p}_{0i} + \hat{c}_2 \ast \hat{p}_{2i} + \hat{c}_4 \ast \hat{p}_{4i}\]

\(^{12}\) We use the variable F3TZPOSTERN which measures the number of undergraduate credits earned by June of 2013. The credit counts have been normalized such that they can be compared across institutions (Lauff & Ingels, 2015).
2.4 *Finding the optimal locations of public 4-year and 2-year colleges*

We use the parameters estimated in the above equations to assess the optimality of the current locations of U.S. public colleges included in the 2013 IPEDS.\(^{13,14}\) For each of the 50 states, we conduct the following process. First, we randomly sort the public colleges in the state and then loop through these colleges. We select college \(j\) and randomly select a new possible location somewhere within the state’s boundaries.\(^{15}\) We then calculate the new distance between that college and all public and private high schools within the state. We obtain data on the state’s high schools in 2012-13 (which contains the 12\(^{\text{th}}\) grade students who would be likely to attend college during Fall 2013) using the CCD and PSS.\(^{16}\) Next, we compute predicted educational attainment for the state’s youth based on the new college locations.\(^{17}\) Specifically, we calculate

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\(^{13}\) During this project, we came across an issue in the reporting of IPEDS data. For *some* institutions with branch campuses, the IPEDS attributes enrollment data for all campuses to the main campus. A notable example is the Washington State University (WSU) system. WSU has campuses in a number of cities throughout the state, but WSU – Pullman, the main campus, is the only one with reported data. Therefore, the enrollment downloaded from the IPEDS sums the enrollment of the main campus with that of its branches and attributes it to the main campus. Given that our project relies on the accurate locations and enrollments of campuses, we identified the main/branch campus relationships in IPEDS and searched for disaggregated enrollment numbers for each separate branch campus at the institution’s website. For those that we could not find, we assumed that the enrollment was equally distributed across the campuses. We should note that we did not do this for the IPEDS 2004-06 data where it was more difficult to identify main/branch campus relationships and find enrollment data for those years publicly available online.

\(^{14}\) Similarly to the IPEDS 2004-06 data, we eliminate distance learning-only campuses by netting from total enrollment the number of students “enrolled only in distance education.”

\(^{15}\) We first create a rectangle that extends north-south and east-west to the extremes of the state’s latitudes and longitudes. We then select a random location within that rectangle and assess whether the randomly selected location is within the state’s boundaries using the “point2poly” program written by Pisati (2014) and using spatial shape data on state boundaries provided by U.S. Department of Commerce (2014). If not, then we select a new random location and repeat until we find a location that lies within the state’s boundaries. We have modified the “point2poly” program slightly from the one posted in 2014 to handle the state shape files provided by the U.S. Department of Commerce.

\(^{16}\) The CCD provides latitude and longitude coordinates for all public high schools, but the PSS does not do so for private high schools. We once again use the geocode3 command in Stata to geocode these high schools based on their mailing address. To check the validity of this process, we once again make sure that the coordinate places the high school within the correct state.

\(^{17}\) Note that we keep the college’s enrollment constant during the simulation. A careful reader will note that college enrollments should change endogenously based on our models in sections 2.1 and 2.2. We acknowledge this fact. However, adding endogenous enrollment levels into our
the probability weighted utilities ($\hat{V}_{2i}$ and $\hat{V}_{4i}$) for each high school and use them along with the same neighborhood and school-level control variables described in the previous sections to estimate, for a typical student at each high school, the probability of initially attending each level of institution ($\hat{p}_{0i}$, $\hat{p}_{2i}$, and $\hat{p}_{4i}$). We then calculate the expected number of credits that that high school will produce per student using the parameters estimated in equation (8). We then aggregate this to the state level by taking the average of the number of credits across the high schools in the state and weighting by the number of the high school’s 12th grade students. This gives the average number of credits per student in the state. We repeat this process at least 100 times and we stop after this point if either the gain in predicted number of postsecondary credits per student is less than 0.01 credits earned or we reach 1,000 iterations.

After this process is completed, we characterize the change in the locations by computing the following: the change in the state’s predicted educational attainment, the change in the average distance of students to 2-year and 4-year colleges (weighted by the probability of attending each college), the Gini coefficient of the distribution of earned credits, and the change in the number of 12th grade students within 25 miles of 2-year and 4-year colleges. In addition, a separate simulation is run to find the locations of public colleges that minimize the educational attainment for the state. Finding the lowest possible educational attainment a state can obtain given their current supply of public colleges allows us to calculate the possible range of educational attainment that can be achieved by a state. With this, we can calculate how efficiently states have placed their colleges.

In addition to finding the locations of all public 4-year and 2-year colleges that maximize the expected educational attainment for a state, we run a separate simulation looking for the spatial distribution of colleges that provides the most equal distribution of postsecondary credits to students in a state. Similar to the simulation described above, we randomly move colleges within a state and only keep moves that lower the Gini coefficient (i.e., create a more equal

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model would require prohibitive computer processing time and would require estimation of endogenous changes by the colleges in their admissions policies. Colleges might partially or fully adapt to changes in the composition of their demand (e.g., increased applications from in-state students) by changing the relative shares of in-state versus out-of-state or foreign students who are admitted, and thereby maintain close to the same level of aggregate enrollment. Rather than add this complexity, we keep the model simple and the reader should understand that the results bear this limitation and are intended to produce heuristic results.
distribution of postsecondary credits to all 12th grade students in a state). Same as above, we repeat this process at least 100 times and then continue only if the predicted Gini coefficient lowers by 0.0001 or 1,000 iterations are reached.

2.5 Finding the optimal location for a new 4-year college that increases 4-year attendance by 5%

We next search for the location within a state that would provide the largest improvement in educational attainment if a new 4-year college were to be placed there. We start by creating a new 4-year college with an enrollment equal to 5% of the state’s total 4-year college enrollment (both public and private enrollment) and placing it in a random place within the state and calculating the expected educational attainment of placing the new college in that spot with all other colleges in the state remaining in their initial locations. Next, we move the new 4-year college to a different location and recalculate the expected number of postsecondary credits earned by the average student. If this new location improves the educational attainment for the state, then we keep the new 4-year college in the new location. If it does not, then we return the new college to the previous location. We continue this process until we reach 1,000 iterations. If, on the 1,000th or any subsequent iterations we see an improvement greater than 0.01 in the expected number of credits per student, then we continue repeating the process until we reach 10,000 repetitions. If we do not find an improvement of this size beyond the 1,000th iteration, then we stop the simulation.

3. Results

3.1 How geography affects the utility of 4-year and 2-year colleges

The conditional logit results are presented in Table 2. We present the raw coefficients which can be interpreted as changes in the utility of attending a particular level of college.18 As

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18 Note that it is impossible to compare the magnitudes across the two models as they are estimated separately and the coefficients represent changes in different “types” of utilities. That is, the specification for those that attend a 4-year college represents the estimation of the relative utilities of the choice set that includes only 4-year institutions. Similarly, the utility estimated for attending each of the 2-year institutions, represents only the utility for those who have already made the choice of attending a 2-year college.
expected, students prefer to attend 4-year and 2-year colleges that are nearby and in their state of residence. The preference for remaining in-state is particularly strong, particularly for 4-year colleges; student’s get the same utility from an in-state 4-year (2-year) college that is 92 (12.6) miles away as an out-of-state college of the same level that is 3 miles away. The allure of paying a lower price for in-state tuition is likely a major source for this result. There is also likely to be loyalty for in-state colleges (e.g., fandom) that increases the attraction of in-state 4-year colleges. As shown in Figure 1, the decrease in utility moving from a college 1 to 100 miles away is greater than the loss in utility moving from 100 to 2,500 miles away.

[Insert Table 2]
[Insert Figure 1]

3.2 Choice of attending a 4-year college, 2-year college, or neither

Table 3 presents the results of the multinomial logit. We present mean marginal effects that can be interpreted in terms of changes in the probability of attending each level of college. As expected, the coefficient estimates suggest that a larger local supply of 4-year colleges increases the probability of attending a 4-year college, and the same is true for 2-year colleges. Increases in the local availability of 4-year colleges reduce the likelihood of enrollment in a 2-year college and vice-versa, suggesting that the levels are in competition for one another and that students’ choices of level are malleable and influenced by relative local supply. We also find that, for the average student, having more 2-year and 4-year colleges nearby and in-state, and thereby increasing the probability weighted utility of either level of college, has no net impact on the probability of staying at home.

We find that a higher percentage of minority students in the high school is associated with a higher probability of staying home or attending a 2-year college, and a corresponding large decrease in the probability of attending a 4-year institution. Attending a school with a higher proportion of female students at a school is found to be correlated with a higher probability of attending a 4-year college and a lower probability of staying home. According to our results, increasing class sizes appears to push students towards 2-year colleges and away from 4-year universities. Attending a public magnet high school is associated with about a 9% increase (over a regular non-magnet high school) in the probability of initially enrolling in a 4-year college. Students attending private schools (of all types) are found to be more likely to
attend a 4-year college compared to students in regular (non-charter/non-magnet) public schools. Students living in an area with a denser population are more likely to attend a 4-year institution and less likely to attend a 2-year institution compared to students in less crowded areas. An increase in the educational attainment of the area in which a student lives is associated with a large increase in the probability of attending a 4-year institution and a decrease in the probability of attending a 2- or 0-year institution.

[Insert Table 3]

3.3 Predicted educational attainment

Table 4 presents the tobit regression results that predict the number of completed credits expected by around age 27 given initial enrollment in a certain college-level and as a function of community and school-level characteristics. We calculate the expected value from the tobit model as follows:

$$E[c_i] = \Phi \left( \frac{\hat{a}_i + \theta X_i}{\sigma} \right) \left( \hat{a}_i + \theta X_i + \sigma \lambda_i \right)$$

where

$$\lambda_i = \frac{\phi \left( (\hat{a}_i + \theta X_i) / \sigma \right)}{\Phi \left( (\hat{a}_i + \theta X_i) / \sigma \right)}$$

where $\Phi$ and $\phi$ are the normal distribution’s cumulative density and probability density functions, respectively.

As shown in Table 4, we find that students who attended high schools with a higher proportion of minority students tend to earn less college credits than students from high schools with smaller minority populations, and again this effect is roughly the same at 2-year and 4-year colleges. Surprisingly, increasing class sizes is associated with slight, yet significant, improvements in the educational attainment under each of the college levels. Students that attend a magnet high school tend to obtain a greater number of postsecondary credits compared to students that attend a regular public school. These improvements increase as the level of college decreases, where the gain from attending a magnet school over a regular non-magnet public school is largest for those students who initially stay home after their expected graduation. Living in a more educated neighborhood is associated with an increase in the expected number of credits across all levels of college.
Holding these neighborhood and school characteristics constant, as shown by the estimated constant in the results, students that initially attend 4-year colleges end up earning substantially more credits on average than those who initially enter 2-year colleges. Below the table we show the distribution in the predicted number of postsecondary credits earned by students initially attending different levels of college.

[Insert Table 4]

3.4 Finding the optimal locations of public 4-year and 2-year colleges

Given the parameters estimated in the previous section, we estimate the expected number of credits earned under the current spatial distribution of colleges relative to the location students in of public and private high schools in the United States. Table 5 presents the rankings of each of the 50 states in terms of the expected number of postsecondary credits per 12th grade student in the state.\footnote{We exclude Washington D.C. from our simulation as its very small size makes the location of colleges rather trivial for predicted educational attainment. The land area of Rhode Island, the smallest state, is 23 times the size of D.C.} We find some variation in educational attainment across the states with relatively more educated states like Massachusetts (88.83 credits per 12th grade student), Connecticut (85.66), and Maryland (84.99) landing in the top 5 of the highest expected number of postsecondary credits earned per student given the parameters of our model. Lower educated states like Arkansas (66.34) and Mississippi (63.06) or states with large minority populations like New Mexico (61.74) or Texas (66.72) show the lowest expected educational attainment.

[Insert Table 5]

For each of the 50 states, we run our algorithm to search for the optimal placement of public colleges within the state so as to maximize the expected number of credits earned. We show the changes in key statistics between the current and optimal locations of the state’s public colleges in Table 6.

The table is sorted from the state that has the most to gain by relocations (Minnesota) down to the smallest gain. The optimal locations of Minnesota’s public colleges is predicted to increase the educational attainment of Minnesota’s 12th grade students by 2.19 credits above their current predicted level of 83.06, which is a 2.6% increase. Overall, the typical state is expected to gain 1.13 credits per student. We describe this gain as modest; it appears that the
states have done moderately well, often by historical accident, in locating their public colleges. However, this potential gain in educational attainment is not inconsequential; Kane and Rouse (1995) find that each college credit is associated with a rise in the student’s subsequent earnings by 0.1% to 0.2% for each 2-year college credit and between 0.1% to 0.3% for each 4-year college credit, so the general effect on a state’s economy could be important. For all states except for Alaska we see that the optimal locations move 4-year colleges closer to students. Overall the changes lower the probability weighted average distance of 4-year colleges from students by an average of 12 miles. This raises their students’ likelihoods of attending a 4-year college by an average of 3.6 percentage points. In contrast, the optimal locations of public 2-year colleges are generally found to be much further away from students (almost 100 miles). This is found to lower their students’ likelihoods of attending a 2-year college by 3.1 percentage points. This result suggests that having proximate 2-year colleges has more of a diverting effect which lowers aggregate educational attainment.

In results not shown, we find that the average number of students within 25 miles of a 4-year college increases by an average of 369 students suggesting that 4-year colleges are being placed in more densely populated areas, whereas 2-year colleges are placed further away from these densely populated areas and have 1,469 fewer students, on average, within 25 miles of their campus.

[Insert Table 6]

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20 To put this result in context, in results not shown, we reverse our simulation and only accept relocations of colleges that reduce predicted educational attainment. This process identifies the state’s minimized educational attainment. For Minnesota, we find that predicted college credits would equal 81.42 if they chose college locations that minimized attainment. Thus, Minnesota’s public college placements are 42.7% efficient in terms of maximizing college credits earned (i.e., (actual-min)/(max-min) = (83.06-81.42)/(85.26-81.42) = 42.7%). The average state is 52% efficient. The last column of Table 6 shows the efficiency calculation for each state. On average, states are at about 50% efficiency in terms of their placement of public colleges.

21 In a highly related paper, Rouse (1995) instruments for initial attendance at a 2-year college or a 4-year college using “miles from the respondent's high school to the nearest two-year or four-year college and the average state two-year or four-year college tuition” (p. 221). She finds that initial attendance at a 2-year college instead of a 4-year college lowers years of education by 0.6 to 1.0 years and (insignificantly) lowers the likelihood of earning a bachelor’s degree by 7 to 11 percentage points.
We now focus on five cases, shown in Figures 2-6, to describe our results in more detail. The top panel of these figures show the distribution of students with symbol size proportionate to high school enrollment, orange denoting a high school with a high share of minority students (>30%) and triangles representing areas with less educated adults (percent of population over 25 with a BA <25%). The second panel of each of the figures shows the current locations of all 2- and 4-year public and private institutions within the state. The last panel shows where our simulation places these colleges in the optimal setup that maximizes educational attainment for the state.

Illinois, shown in Figure 2, illustrates the pattern that is typical for most states. The optimal locations of most of its 4-year public universities (green circles) are in or very close to the large urban areas of Chicago and East St. Louis. While the 4-year colleges are generally moved closer to the population, the 2-years (red diamonds) are pushed away from people, to the lightly populated southern border along the Ohio River. For most states, the optimal location for 2-year colleges are in the least populated part of the state, suggesting that the negative effect of 2-year colleges in dissuading students from starting at 4-year colleges has a more deleterious effect on expected college credit accumulation than the positive effect that occurs as these 2-year college attract students who would otherwise not attend college.

[Insert Figure 2]

As shown in Figure 3-6, Texas, New Mexico, Arizona, and Tennessee, illustrate atypical patterns that suggest a potential positive role for 2-year colleges in these states (given optimal placement). While the optimal placement of 4-year colleges in these states are still mostly in the most densely populated parts of the states, the 2-year colleges are found near lower-educated, high-percent minority regions of the state. Texas illustrates this result dramatically, with large concentrations of 2-year colleges being placed along the Rio Grande Valley, as well as in the densely populated Mexican border cities of El Paso, McAllen, and Brownsville in the western and southern extremes of the state that contain large concentrations of Hispanic immigrants and lower-educated adults. Similarly, in New Mexico and Arizona, we find that the optimal location of 2-year colleges is mostly near the Navajo Nation Reservation in the northwest (northeast) corner of New Mexico (Arizona) and around Las Cruces in the southern New Mexico and Yuma

These figures were produced using the “spmap” Stata program written by Pisati (2015) and described by Crow and Gould (2013).
in the southeast corner of Arizona where there are large concentrations of minority students and lower-educated adults. Finally, Tennessee’s optimal location of colleges places nearly all of the 2-year colleges along the western Mississippi River border with a sizable number near Memphis, which contains a large population of African Americans. Comparable figures for the remaining 45 states are included in the appendix.

[Insert Figure 3-6]

As shown in the second to last column of Table 6, moving colleges to their optimal locations raises the inequality of the distribution of college credits. The Gini Coefficient increases for 41 of the 50 states, and the average increase is a modest 0.002 points. Thus, there is some tension between raising educational attainment and minimizing inequality in attainment.

This tradeoff is further illustrated in Table 7 which shows the expected changes to educational attainment and other statistics if states were to rearrange colleges in order to minimize the inequality of the distribution of postsecondary credits across the state. We find that when colleges are organized in this way, the Gini Coefficient for a typical state decreases by 0.006. However, this increase in equality comes with a decrease in the expected educational attainment for a state. We find that the typical state sees a decrease of 0.7 credits when equality of postsecondary credits is prioritized.

[Insert Table 7]

In order to achieve the “most equal” distribution of postsecondary credits in a state, unsurprisingly, colleges are generally moved away from the people. 4-year colleges are placed further away (almost 85 miles on average in a typical state) and into less densely populated areas. The new locations for the 4-year colleges have 705 fewer students within 25 miles of the campus. Generally, students are less likely to attend 4-year institutions under this setup; 47 out of the 50 states see a decrease in the probability of their students attending a 4-year institution. 2-year colleges are also generally moved further away from students, but the magnitude of the move is much smaller than was observed for 4-year universities (nearly 8 miles on average). Students are 1.3 percentage points more likely to attend a 2-year institution under this arrangement of colleges.

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23 Figures illustrating the locations that minimize inequality are available from the authors.
3.5 Finding the optimal location for a new 4-year college that increases 4-year attendance by 5%

Using the parameters estimated in the earlier sections, we find the location for a new 4-year college (with enrollment equal to 5% of the state’s total 4-year enrollment) that would most increase the state’s expected educational attainment. Table 8 shows these optimal locations for each state (latitude and longitude coordinates) along with a description of where they are found relative to the closest major city within the state. Nearly all of these optimal locations are within 25 miles of a major metropolitan area, mostly nearest the largest city in the state. This result suggests that states have underinvested in metropolitan universities. Given that the optimal location for a new 4-year college in California is located 7 miles northeast of Los Angeles (near Pasadena) suggests that the decision to add a new UC campus in Merced was not the best choice if the goal was maximizing the educational attainment of the state’s youth.

[Insert Table 8]

4. Conclusion

We have found that states can modestly increase the predicted college credits earned by their youth given careful and thoughtful choices about where the state locates its public colleges. In particular, we find that locating public 4-year colleges in the most densely populated areas, increases aggregate predicted educational attainment. For the most part, we find that locating 2-year colleges near populated areas lowers the attainment of youth in the state. However, in some states, the optimal locations of 2-year colleges are in modestly populated areas that have higher concentrations of low-income and minority youth. Locating a 2-year college in these parts of the state provides educational opportunity without substantially diverting students away from 4-year colleges.

We are, of course, not advocating for the wholesale relocation of colleges or the shuttering of 2-year colleges. Doing so would be utterly impractical and politically fraught. However, states do face future questions for which these results can give guidance. For example, Illinois should be advised to increase enrollment opportunities at the University of Illinois’ Chicago campus, while not expanding enrollment at its flagship Urbana-Champaign campus. States should be wary of increasing their enrollment of 2-year colleges in urban areas. Students
who begin at 2-year colleges are predicted to earn *substantially* fewer college credits than those who begin at 4-year colleges (conditional on the student’s neighborhood and high school characteristics). Our simulation results suggests that adding additional 2-year college capacity in most urban areas will lower aggregate educational attainment by diverting students away from 4-year colleges.
References


### Table 1: Descriptive Statistics for Control Variables

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<tr>
<th></th>
<th>ELS</th>
<th></th>
<th></th>
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<td>0.37</td>
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<td></td>
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<tr>
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<td>0.03</td>
<td>0.18</td>
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</tr>
<tr>
<td>Private Other Religious</td>
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<td>0.22</td>
<td>0.02</td>
<td>0.15</td>
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<td></td>
</tr>
<tr>
<td>Private Secular</td>
<td>0.04</td>
<td>0.19</td>
<td>0.02</td>
<td>0.12</td>
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<td></td>
</tr>
<tr>
<td>Median Family Income of Zip Code ($10,000s of constant 99$)</td>
<td>5.21</td>
<td>1.90</td>
<td>5.09</td>
<td>2.10</td>
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<td>Population Density of Zip Code (10,000 Pop. per Sq. Mile)</td>
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<td>0.86</td>
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<tr>
<td>Proportion of Population over 25 w/ a BA in Zip Code</td>
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<td>0.15</td>
<td>0.29</td>
<td>0.17</td>
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</tr>
<tr>
<td>Proportion of Families Below the Poverty Threshold in Zip Code</td>
<td>0.10</td>
<td>0.08</td>
<td>0.11</td>
<td>0.08</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: School level data comes from the U.S. Department of Education's Common Core of Data and Private School Survey. Zip code level data is from either the 2000 Census Summary File 3 or the American Community Survey 5-year estimates.
Table 2: Conditional Logit Results for Choosing to Enroll in Particular Colleges

<table>
<thead>
<tr>
<th></th>
<th>4-Year Colleges</th>
<th>2-Year Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Robust S.E.</td>
</tr>
<tr>
<td>Log of Distance of Student to College</td>
<td>-0.78</td>
<td>0.02</td>
</tr>
<tr>
<td>In-state Indicator</td>
<td>2.67</td>
<td>0.06</td>
</tr>
<tr>
<td>Log of Enrollment of the College</td>
<td>1</td>
<td>--</td>
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<tr>
<td>Number of Observations</td>
<td>14,766,060</td>
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</tr>
<tr>
<td>Pseudo R²</td>
<td>32.6%</td>
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Notes:
The coefficient on Log Enrollment is constrained to equal 1.
Robust standard errors are clustered by the student's zip code.
Significance is denoted by ***, **, or * when the p-value is ≤ 1%, 5%, or 10% respectively.
The numbers of observations have been rounded to the nearest 10.
Table 3: Marginal Effects from the Multinomial Logit for the Choice of the Level of College to Attend

<table>
<thead>
<tr>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Marginal Effect</th>
<th>S.E.</th>
<th>Significance</th>
</tr>
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<tbody>
<tr>
<td>Probability Weighted Utility of 2-year Colleges</td>
<td>-0.027</td>
<td>0.005</td>
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</tr>
<tr>
<td>Proportion Minority Students at School</td>
<td>0.013</td>
<td>0.002</td>
<td>***</td>
</tr>
<tr>
<td>Proportion of Female Students at School</td>
<td>-0.008</td>
<td>0.051</td>
<td>***</td>
</tr>
<tr>
<td>Pupil-Teacher Ratio</td>
<td>0.003</td>
<td>0.001</td>
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<table>
<thead>
<tr>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Marginal Effect</th>
<th>S.E.</th>
<th>Significance</th>
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<td>Proportion Minority Students at School</td>
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<td>Proportion of Female Students at School</td>
<td>-0.008</td>
<td>0.051</td>
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<td>Pupil-Teacher Ratio</td>
<td>0.003</td>
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</table>

<table>
<thead>
<tr>
<th>School Type (Base = Regular Public School)</th>
<th>Marginal Effect</th>
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<th>Significance</th>
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Number of Observations 15,360

Notes:
Standard errors are calculated using the delta-method.
Significance is denoted by ***, **, or * when the p-value is ≤ 1%, 5%, or 10% respectively.
The number of observations has been rounded to the nearest 10.
Table 4: Tobit Model Results for the Expected Number of Postsecondary Credits Earned in Particular Colleges

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<th>Coefficient</th>
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<th>Sig.</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>Sig.</th>
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<th>Sig.</th>
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<td>Pupil-Teacher Ratio</td>
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<td>0.17</td>
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<td>0.58</td>
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<td></td>
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<td>***</td>
<td>95.75</td>
<td>1.81</td>
<td>***</td>
</tr>
</tbody>
</table>

Number of Observations

4-year Colleges 2-year Colleges No College

Mean Predicted Postsecondary Credits:

4-year Colleges 2-year Colleges No College

Standard Deviation in Mean Predicted Postsecondary Credits:

4-year Colleges 2-year Colleges No College

Share with Mean Predicted Postsecondary Credits Between:

4-year Colleges 2-year Colleges No College

Notes:

Significance is denoted by ***, **, or * when the p-value is ≤ 1%, 5%, or 10% respectively.
The numbers of observations have been rounded to the nearest 10.
Table 5: Expected Number of Postsecondary Credits Earned per 12th Grade Student by State Given Current Locations

<table>
<thead>
<tr>
<th>State</th>
<th>12th Grade Students</th>
<th>% of Population &gt;25 with a BA</th>
<th>Percent Minority</th>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Probability Weighted Utility of 2-year Colleges</th>
<th>Predicted Probability of Attending 4-year Colleges</th>
<th>Predicted Probability of Attending 2-year Colleges</th>
<th>Expected Postsecondary Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
<td>77,167</td>
<td>41%</td>
<td>21%</td>
<td>8.27</td>
<td>7.17</td>
<td>54.42%</td>
<td>17.16%</td>
<td>88.83</td>
</tr>
<tr>
<td>Vermont</td>
<td>7,078</td>
<td>37%</td>
<td>4%</td>
<td>5.86</td>
<td>3.11</td>
<td>52.44%</td>
<td>18.15%</td>
<td>87.73</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>16,673</td>
<td>36%</td>
<td>6%</td>
<td>6.33</td>
<td>5.14</td>
<td>50.17%</td>
<td>20.83%</td>
<td>87.47</td>
</tr>
<tr>
<td>Connecticut</td>
<td>46,319</td>
<td>40%</td>
<td>28%</td>
<td>7.50</td>
<td>6.99</td>
<td>50.61%</td>
<td>19.76%</td>
<td>85.66</td>
</tr>
<tr>
<td>Maryland</td>
<td>67,673</td>
<td>40%</td>
<td>43%</td>
<td>7.86</td>
<td>7.69</td>
<td>48.27%</td>
<td>21.67%</td>
<td>84.99</td>
</tr>
<tr>
<td>Hawaii</td>
<td>13,143</td>
<td>30%</td>
<td>7%</td>
<td>8.16</td>
<td>7.36</td>
<td>47.93%</td>
<td>21.64%</td>
<td>84.88</td>
</tr>
<tr>
<td>Utah</td>
<td>41,739</td>
<td>31%</td>
<td>18%</td>
<td>8.96</td>
<td>7.11</td>
<td>45.42%</td>
<td>21.41%</td>
<td>84.10</td>
</tr>
<tr>
<td>New Jersey</td>
<td>108,554</td>
<td>39%</td>
<td>33%</td>
<td>8.13</td>
<td>7.59</td>
<td>50.44%</td>
<td>19.04%</td>
<td>83.81</td>
</tr>
<tr>
<td>Virginia</td>
<td>94,894</td>
<td>36%</td>
<td>33%</td>
<td>7.41</td>
<td>7.05</td>
<td>46.30%</td>
<td>22.43%</td>
<td>83.19</td>
</tr>
<tr>
<td>Minnesota</td>
<td>74,534</td>
<td>33%</td>
<td>18%</td>
<td>7.72</td>
<td>6.85</td>
<td>45.54%</td>
<td>21.98%</td>
<td>83.06</td>
</tr>
<tr>
<td>Colorado</td>
<td>65,039</td>
<td>37%</td>
<td>36%</td>
<td>8.28</td>
<td>6.86</td>
<td>45.51%</td>
<td>20.78%</td>
<td>83.38</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>12,117</td>
<td>33%</td>
<td>26%</td>
<td>8.26</td>
<td>7.59</td>
<td>48.55%</td>
<td>19.60%</td>
<td>82.11</td>
</tr>
<tr>
<td>Maine</td>
<td>15,668</td>
<td>29%</td>
<td>5%</td>
<td>5.76</td>
<td>5.01</td>
<td>44.27%</td>
<td>23.27%</td>
<td>81.23</td>
</tr>
<tr>
<td>New York</td>
<td>217,970</td>
<td>35%</td>
<td>36%</td>
<td>8.66</td>
<td>7.92</td>
<td>49.14%</td>
<td>18.53%</td>
<td>80.85</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>147,303</td>
<td>30%</td>
<td>21%</td>
<td>7.76</td>
<td>6.21</td>
<td>45.31%</td>
<td>20.92%</td>
<td>80.32</td>
</tr>
<tr>
<td>Michigan</td>
<td>124,334</td>
<td>27%</td>
<td>22%</td>
<td>8.01</td>
<td>6.84</td>
<td>41.91%</td>
<td>23.32%</td>
<td>79.84</td>
</tr>
<tr>
<td>Washington</td>
<td>88,782</td>
<td>30%</td>
<td>23%</td>
<td>7.88</td>
<td>6.80</td>
<td>41.66%</td>
<td>24.19%</td>
<td>79.68</td>
</tr>
<tr>
<td>Oregon</td>
<td>46,371</td>
<td>29%</td>
<td>23%</td>
<td>7.72</td>
<td>7.28</td>
<td>39.24%</td>
<td>25.78%</td>
<td>78.87</td>
</tr>
<tr>
<td>North Dakota</td>
<td>7,537</td>
<td>28%</td>
<td>11%</td>
<td>6.11</td>
<td>2.31</td>
<td>44.85%</td>
<td>21.05%</td>
<td>78.69</td>
</tr>
<tr>
<td>Illinois</td>
<td>156,446</td>
<td>33%</td>
<td>37%</td>
<td>7.82</td>
<td>7.50</td>
<td>44.77%</td>
<td>21.52%</td>
<td>78.50</td>
</tr>
<tr>
<td>Ohio</td>
<td>128,840</td>
<td>27%</td>
<td>18%</td>
<td>7.82</td>
<td>6.44</td>
<td>42.64%</td>
<td>22.36%</td>
<td>78.23</td>
</tr>
<tr>
<td>Nebraska</td>
<td>25,202</td>
<td>29%</td>
<td>23%</td>
<td>6.86</td>
<td>6.27</td>
<td>42.35%</td>
<td>23.81%</td>
<td>77.89</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>72,086</td>
<td>28%</td>
<td>19%</td>
<td>7.46</td>
<td>6.24</td>
<td>41.98%</td>
<td>23.13%</td>
<td>77.82</td>
</tr>
<tr>
<td>Kansas</td>
<td>34,556</td>
<td>30%</td>
<td>22%</td>
<td>6.51</td>
<td>6.03</td>
<td>41.84%</td>
<td>24.16%</td>
<td>77.65</td>
</tr>
<tr>
<td>Florida</td>
<td>200,044</td>
<td>27%</td>
<td>50%</td>
<td>8.96</td>
<td>5.22</td>
<td>43.80%</td>
<td>19.62%</td>
<td>77.59</td>
</tr>
<tr>
<td>Montana</td>
<td>10,190</td>
<td>28%</td>
<td>13%</td>
<td>5.81</td>
<td>4.44</td>
<td>40.95%</td>
<td>24.68%</td>
<td>77.42</td>
</tr>
<tr>
<td>Delaware</td>
<td>9,783</td>
<td>32%</td>
<td>37%</td>
<td>6.85</td>
<td>6.68</td>
<td>42.52%</td>
<td>23.51%</td>
<td>77.35</td>
</tr>
<tr>
<td>Missouri</td>
<td>69,553</td>
<td>28%</td>
<td>20%</td>
<td>7.34</td>
<td>5.96</td>
<td>42.79%</td>
<td>22.47%</td>
<td>77.34</td>
</tr>
<tr>
<td>Iowa</td>
<td>38,538</td>
<td>26%</td>
<td>13%</td>
<td>6.50</td>
<td>5.76</td>
<td>40.60%</td>
<td>25.02%</td>
<td>76.98</td>
</tr>
<tr>
<td>South Dakota</td>
<td>9,360</td>
<td>27%</td>
<td>14%</td>
<td>5.36</td>
<td>2.79</td>
<td>40.69%</td>
<td>24.14%</td>
<td>76.59</td>
</tr>
</tbody>
</table>

(Table 5 is continued on the next page)
### Table 5: Expected Number of Postsecondary Credits Earned per 12th Grade Student by State Given Current Locations (Continued)

<table>
<thead>
<tr>
<th>State</th>
<th>12th Grade Students</th>
<th>% of Population &gt;25 with a BA</th>
<th>Percent Minority</th>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Probability Weighted Utility of 2-year Colleges</th>
<th>Predicted Probability of Attending 4-year</th>
<th>Predicted Probability of Attending 2-year</th>
<th>Expected Postsecondary Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indiana</td>
<td>79,655</td>
<td>24%</td>
<td>19%</td>
<td>7.60</td>
<td>5.98</td>
<td>40.17%</td>
<td>23.51%</td>
<td>75.28</td>
</tr>
<tr>
<td>Kentucky</td>
<td>47,786</td>
<td>22%</td>
<td>14%</td>
<td>6.91</td>
<td>5.80</td>
<td>39.40%</td>
<td>24.79%</td>
<td>75.27</td>
</tr>
<tr>
<td>Alaska</td>
<td>9,854</td>
<td>27%</td>
<td>31%</td>
<td>7.06</td>
<td>0.97</td>
<td>42.34%</td>
<td>19.64%</td>
<td>75.10</td>
</tr>
<tr>
<td>Idaho</td>
<td>19,597</td>
<td>25%</td>
<td>18%</td>
<td>6.82</td>
<td>5.52</td>
<td>37.91%</td>
<td>25.33%</td>
<td>74.85</td>
</tr>
<tr>
<td>Tennessee</td>
<td>71,318</td>
<td>25%</td>
<td>28%</td>
<td>6.98</td>
<td>5.83</td>
<td>39.11%</td>
<td>24.53%</td>
<td>74.52</td>
</tr>
<tr>
<td>Georgia</td>
<td>108,009</td>
<td>29%</td>
<td>46%</td>
<td>7.75</td>
<td>5.77</td>
<td>39.91%</td>
<td>22.45%</td>
<td>73.32</td>
</tr>
<tr>
<td>California</td>
<td>525,571</td>
<td>29%</td>
<td>57%</td>
<td>8.80</td>
<td>8.25</td>
<td>36.80%</td>
<td>24.49%</td>
<td>73.27</td>
</tr>
<tr>
<td>Nevada</td>
<td>32,801</td>
<td>23%</td>
<td>48%</td>
<td>9.09</td>
<td>5.83</td>
<td>37.79%</td>
<td>22.76%</td>
<td>73.23</td>
</tr>
<tr>
<td>North Carolina</td>
<td>100,171</td>
<td>28%</td>
<td>37%</td>
<td>7.29</td>
<td>6.51</td>
<td>38.03%</td>
<td>24.49%</td>
<td>72.42</td>
</tr>
<tr>
<td>South Carolina</td>
<td>47,209</td>
<td>25%</td>
<td>39%</td>
<td>6.67</td>
<td>6.30</td>
<td>35.33%</td>
<td>26.63%</td>
<td>71.22</td>
</tr>
<tr>
<td>West Virginia</td>
<td>19,309</td>
<td>19%</td>
<td>6%</td>
<td>5.83</td>
<td>3.97</td>
<td>36.17%</td>
<td>25.88%</td>
<td>71.12</td>
</tr>
<tr>
<td>Louisiana</td>
<td>46,271</td>
<td>23%</td>
<td>43%</td>
<td>7.22</td>
<td>6.10</td>
<td>36.56%</td>
<td>24.47%</td>
<td>69.38</td>
</tr>
<tr>
<td>Alabama</td>
<td>53,269</td>
<td>23%</td>
<td>37%</td>
<td>6.71</td>
<td>5.27</td>
<td>35.33%</td>
<td>25.50%</td>
<td>68.86</td>
</tr>
<tr>
<td>Wyoming</td>
<td>6,107</td>
<td>23%</td>
<td>15%</td>
<td>4.31</td>
<td>5.07</td>
<td>33.41%</td>
<td>29.59%</td>
<td>68.57</td>
</tr>
<tr>
<td>Arizona</td>
<td>84,167</td>
<td>26%</td>
<td>53%</td>
<td>8.50</td>
<td>7.90</td>
<td>34.25%</td>
<td>24.02%</td>
<td>68.42</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>40,980</td>
<td>23%</td>
<td>36%</td>
<td>6.95</td>
<td>5.61</td>
<td>34.95%</td>
<td>25.31%</td>
<td>68.30</td>
</tr>
<tr>
<td>Texas</td>
<td>316,528</td>
<td>27%</td>
<td>60%</td>
<td>8.11</td>
<td>7.12</td>
<td>35.70%</td>
<td>23.50%</td>
<td>66.72</td>
</tr>
<tr>
<td>Arkansas</td>
<td>32,014</td>
<td>20%</td>
<td>29%</td>
<td>6.52</td>
<td>4.84</td>
<td>34.44%</td>
<td>24.98%</td>
<td>66.34</td>
</tr>
<tr>
<td>Mississippi</td>
<td>32,511</td>
<td>21%</td>
<td>49%</td>
<td>5.89</td>
<td>4.45</td>
<td>30.70%</td>
<td>27.20%</td>
<td>63.06</td>
</tr>
<tr>
<td>New Mexico</td>
<td>21,390</td>
<td>25%</td>
<td>69%</td>
<td>6.66</td>
<td>7.39</td>
<td>28.65%</td>
<td>28.52%</td>
<td>61.74</td>
</tr>
</tbody>
</table>

**Notes:**
- States are ranked by their expected number of credits per 12th grade student.
- Probability weighted utilities and predicted probabilities represent the weighted by student mean for the state.
- The control variables statistics are the weighted (by student) mean for the state.
Table 6: Changes in Educational Attainment and College Distance Given "Optimal" Spatial Distribution of Public Colleges

<table>
<thead>
<tr>
<th>State</th>
<th>Postsecondary Credits per Student</th>
<th>Probability Weighted Distance to 4-year Colleges</th>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Predicted Probability of Attending 4-year Colleges</th>
<th>Probability Weighted Distance to 2-year Colleges</th>
<th>Probability Weighted Utility of 2-year Colleges</th>
<th>Predicted Probability of Attending 2-year Colleges</th>
<th>Gini Coefficient (Ed. Attainment-Min)/(Max-Min)</th>
<th>Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>2.19</td>
<td>-20.72</td>
<td>0.19</td>
<td>6.07%</td>
<td>210.49</td>
<td>-5.18</td>
<td>-6.23%</td>
<td>0.0001</td>
<td>42.7%</td>
</tr>
<tr>
<td>Michigan</td>
<td>1.93</td>
<td>-11.55</td>
<td>0.20</td>
<td>6.24%</td>
<td>218.63</td>
<td>-5.66</td>
<td>-6.76%</td>
<td>0.0026</td>
<td>45.0%</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>1.90</td>
<td>-18.43</td>
<td>0.28</td>
<td>4.94%</td>
<td>123.81</td>
<td>-3.70</td>
<td>-4.85%</td>
<td>0.0002</td>
<td>37.1%</td>
</tr>
<tr>
<td>Maine</td>
<td>1.81</td>
<td>-16.48</td>
<td>0.14</td>
<td>5.10%</td>
<td>213.49</td>
<td>-4.35</td>
<td>-5.24%</td>
<td>0.0029</td>
<td>34.1%</td>
</tr>
<tr>
<td>Illinois</td>
<td>1.71</td>
<td>-16.17</td>
<td>0.35</td>
<td>5.00%</td>
<td>99.31</td>
<td>-4.06</td>
<td>-5.16%</td>
<td>0.0029</td>
<td>26.5%</td>
</tr>
<tr>
<td>Kansas</td>
<td>1.70</td>
<td>-28.14</td>
<td>0.40</td>
<td>4.99%</td>
<td>154.32</td>
<td>-3.67</td>
<td>-5.26%</td>
<td>0.0064</td>
<td>48.2%</td>
</tr>
<tr>
<td>Virginia</td>
<td>1.68</td>
<td>-17.13</td>
<td>0.29</td>
<td>4.90%</td>
<td>87.83</td>
<td>-3.79</td>
<td>-4.91%</td>
<td>0.0028</td>
<td>48.0%</td>
</tr>
<tr>
<td>Maryland</td>
<td>1.60</td>
<td>-8.28</td>
<td>0.13</td>
<td>4.82%</td>
<td>81.74</td>
<td>-4.22</td>
<td>-4.93%</td>
<td>0.0013</td>
<td>49.9%</td>
</tr>
<tr>
<td>Vermont</td>
<td>1.50</td>
<td>-7.59</td>
<td>0.08</td>
<td>3.24%</td>
<td>137.56</td>
<td>-2.91</td>
<td>-2.88%</td>
<td>0.0025</td>
<td>35.6%</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1.47</td>
<td>-10.43</td>
<td>0.12</td>
<td>4.54%</td>
<td>115.11</td>
<td>-4.03</td>
<td>-4.95%</td>
<td>0.0032</td>
<td>46.5%</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>1.38</td>
<td>-9.19</td>
<td>0.24</td>
<td>3.66%</td>
<td>35.31</td>
<td>-2.91</td>
<td>-3.63%</td>
<td>-0.0030</td>
<td>24.9%</td>
</tr>
<tr>
<td>Connecticut</td>
<td>1.32</td>
<td>-6.51</td>
<td>0.13</td>
<td>3.90%</td>
<td>54.93</td>
<td>-3.52</td>
<td>-4.02%</td>
<td>-0.0004</td>
<td>34.0%</td>
</tr>
<tr>
<td>North Carolina</td>
<td>1.32</td>
<td>-9.94</td>
<td>0.15</td>
<td>4.92%</td>
<td>144.00</td>
<td>-4.45</td>
<td>-5.69%</td>
<td>0.0031</td>
<td>44.9%</td>
</tr>
<tr>
<td>Delaware</td>
<td>1.31</td>
<td>-12.00</td>
<td>0.28</td>
<td>3.94%</td>
<td>50.14</td>
<td>-3.35</td>
<td>-4.11%</td>
<td>0.0045</td>
<td>45.6%</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>1.27</td>
<td>-4.36</td>
<td>0.11</td>
<td>3.38%</td>
<td>54.63</td>
<td>-3.18</td>
<td>-3.29%</td>
<td>-0.0010</td>
<td>27.1%</td>
</tr>
<tr>
<td>Indiana</td>
<td>1.27</td>
<td>-15.48</td>
<td>0.25</td>
<td>4.06%</td>
<td>82.59</td>
<td>-3.31</td>
<td>-4.43%</td>
<td>0.0032</td>
<td>42.7%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>1.26</td>
<td>-3.96</td>
<td>0.10</td>
<td>3.51%</td>
<td>36.44</td>
<td>-3.23</td>
<td>-3.47%</td>
<td>0.0008</td>
<td>47.1%</td>
</tr>
<tr>
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<td>-15.11</td>
<td>0.22</td>
<td>3.81%</td>
<td>90.92</td>
<td>-3.09</td>
<td>-4.14%</td>
<td>0.0016</td>
<td>35.7%</td>
</tr>
<tr>
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<td>3.71%</td>
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<td>-3.13</td>
<td>-3.97%</td>
<td>0.0045</td>
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<td>-3.02</td>
<td>-4.60%</td>
<td>0.0006</td>
<td>55.6%</td>
</tr>
<tr>
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<td>1.19</td>
<td>-3.55</td>
<td>0.09</td>
<td>3.62%</td>
<td>61.18</td>
<td>-3.36</td>
<td>-3.67%</td>
<td>-0.0001</td>
<td>36.8%</td>
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<td>1.18</td>
<td>-2.89</td>
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<td>4.03%</td>
<td>139.15</td>
<td>-3.81</td>
<td>-4.61%</td>
<td>0.0017</td>
<td>58.4%</td>
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<tr>
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<td>101.37</td>
<td>-3.78</td>
<td>-5.24%</td>
<td>0.0020</td>
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<td>-6.60</td>
<td>0.06</td>
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<td>61.18</td>
<td>-2.94</td>
<td>-3.62%</td>
<td>0.0009</td>
<td>64.9%</td>
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<td>4.40%</td>
<td>153.35</td>
<td>-3.69</td>
<td>-5.30%</td>
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<td>55.3%</td>
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(Table 6 is continued on the next page)
Table 6: Changes in Educational Attainment and College Distance Given "Optimal" Spatial Distribution of Public Colleges (Continued)

<table>
<thead>
<tr>
<th>State</th>
<th>Postsecondary Credits per Student</th>
<th>Probability Weighted Distance to 4-Year Colleges</th>
<th>Probability Weighted Utility</th>
<th>Predicted Probability of Attending 4-Year</th>
<th>Probability Weighted Distance to 2-Year Colleges</th>
<th>Probability Weighted Utility</th>
<th>Predicted Probability of Attending 2-Year</th>
<th>Gini Coefficient</th>
<th>Efficiency (Ed. Attain-Min)/(Max-Min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>1.12</td>
<td>-13.79</td>
<td>0.21</td>
<td>3.39%</td>
<td>76.51</td>
<td>-2.80</td>
<td>-3.58%</td>
<td>0.0029</td>
<td>56.0%</td>
</tr>
<tr>
<td>Iowa</td>
<td>1.11</td>
<td>-7.06</td>
<td>0.13</td>
<td>3.71%</td>
<td>99.62</td>
<td>-3.02</td>
<td>-4.23%</td>
<td>0.0016</td>
<td>44.4%</td>
</tr>
<tr>
<td>Ohio</td>
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<td>-10.02</td>
<td>0.19</td>
<td>3.41%</td>
<td>54.63</td>
<td>-2.88</td>
<td>-3.74%</td>
<td>0.0022</td>
<td>49.3%</td>
</tr>
<tr>
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<td>1.03</td>
<td>-5.85</td>
<td>0.09</td>
<td>3.47%</td>
<td>111.83</td>
<td>-3.11</td>
<td>-3.83%</td>
<td>0.0019</td>
<td>46.4%</td>
</tr>
<tr>
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<td>1.02</td>
<td>-11.55</td>
<td>0.17</td>
<td>3.85%</td>
<td>87.47</td>
<td>-3.13</td>
<td>-4.49%</td>
<td>0.0028</td>
<td>42.3%</td>
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<td>240.33</td>
<td>-4.16</td>
<td>-6.36%</td>
<td>0.0006</td>
<td>46.2%</td>
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<td>46.67</td>
<td>-2.61</td>
<td>-2.97%</td>
<td>0.0019</td>
<td>67.5%</td>
</tr>
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<td>0.97</td>
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<td>0.15</td>
<td>3.18%</td>
<td>53.62</td>
<td>-2.91</td>
<td>-3.64%</td>
<td>0.0028</td>
<td>62.1%</td>
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<tr>
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<td>-28.20</td>
<td>0.24</td>
<td>2.97%</td>
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<td>-1.99</td>
<td>-3.31%</td>
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<td>51.3%</td>
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<td>0.93</td>
<td>-7.57</td>
<td>0.19</td>
<td>2.59%</td>
<td>25.00</td>
<td>-2.02</td>
<td>-2.68%</td>
<td>0.0015</td>
<td>40.4%</td>
</tr>
<tr>
<td>Montana</td>
<td>0.92</td>
<td>-8.31</td>
<td>0.03</td>
<td>3.04%</td>
<td>199.84</td>
<td>-2.61</td>
<td>-3.44%</td>
<td>0.0030</td>
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</tr>
<tr>
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<td>-6.76</td>
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<td>-3.60</td>
<td>-4.39%</td>
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<td>54.5%</td>
</tr>
<tr>
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<td>2.92%</td>
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<td>-2.39</td>
<td>-3.14%</td>
<td>-0.0010</td>
<td>67.2%</td>
</tr>
<tr>
<td>Arkansas</td>
<td>0.90</td>
<td>-11.46</td>
<td>0.12</td>
<td>3.50%</td>
<td>131.68</td>
<td>-3.21</td>
<td>-4.21%</td>
<td>0.0050</td>
<td>60.0%</td>
</tr>
<tr>
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<td>0.90</td>
<td>-6.16</td>
<td>0.12</td>
<td>3.32%</td>
<td>75.67</td>
<td>-2.86</td>
<td>-3.78%</td>
<td>0.0034</td>
<td>54.8%</td>
</tr>
<tr>
<td>Alabama</td>
<td>0.89</td>
<td>-7.73</td>
<td>0.10</td>
<td>3.75%</td>
<td>146.75</td>
<td>-3.51</td>
<td>-4.56%</td>
<td>0.0032</td>
<td>50.3%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>0.84</td>
<td>-6.37</td>
<td>0.10</td>
<td>3.24%</td>
<td>106.34</td>
<td>-3.07</td>
<td>-3.84%</td>
<td>0.0027</td>
<td>54.6%</td>
</tr>
<tr>
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<td>0.79</td>
<td>-19.27</td>
<td>0.30</td>
<td>2.90%</td>
<td>62.98</td>
<td>-1.96</td>
<td>-3.38%</td>
<td>0.0032</td>
<td>47.8%</td>
</tr>
<tr>
<td>New Mexico</td>
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<td>-10.96</td>
<td>0.05</td>
<td>3.11%</td>
<td>86.06</td>
<td>-2.95</td>
<td>-3.82%</td>
<td>0.0055</td>
<td>59.8%</td>
</tr>
<tr>
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<td>0.12</td>
<td>2.75%</td>
<td>90.23</td>
<td>-2.34</td>
<td>-3.48%</td>
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<td>72.1%</td>
</tr>
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<td>1.85%</td>
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<td>-1.52</td>
<td>-1.97%</td>
<td>-0.0001</td>
<td>75.8%</td>
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<td>-1.92</td>
<td>-3.09%</td>
<td>0.0026</td>
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<td>1.07%</td>
<td>73.83</td>
<td>-0.96</td>
<td>-1.43%</td>
<td>-0.0015</td>
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<td>-0.83%</td>
<td>0.0007</td>
<td>93.7%</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.22%</td>
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<td>-0.13</td>
<td>-0.16%</td>
<td>-0.0008</td>
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<td>Average Change</td>
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<td>3.63%</td>
<td>98.11</td>
<td>-3.09</td>
<td>-3.99%</td>
<td>0.0019</td>
<td>52.0%</td>
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</table>
Table 7: Changes in Educational Attainment and College Distance Given "Most Equal" Spatial Distribution of Public Colleges

<table>
<thead>
<tr>
<th>State</th>
<th>Gini Coefficient</th>
<th>Postsecondary Credits per Student</th>
<th>Probability Weighted Distance to 4-year Colleges</th>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Predicted Probability of Attending 4-year Colleges</th>
<th>Probability Weighted Distance to 2-year Colleges</th>
<th>Probability Weighted Utility of 2-year Colleges</th>
<th>Predicted Probability of Attending 2-year Colleges</th>
</tr>
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<tbody>
<tr>
<td>Montana</td>
<td>-0.0120</td>
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<td>137.55</td>
<td>-0.87</td>
<td>-1.58%</td>
<td>40.39</td>
<td>-0.86</td>
<td>0.82%</td>
</tr>
<tr>
<td>North Dakota</td>
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<td>-1.64</td>
<td>127.99</td>
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<td>-3.13%</td>
<td>18.27</td>
<td>-0.35</td>
<td>2.42%</td>
</tr>
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<td>Idaho</td>
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<td>-0.90</td>
<td>-2.03%</td>
<td>26.73</td>
<td>-0.68</td>
<td>1.41%</td>
</tr>
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<td>-8.45%</td>
<td>19.86</td>
<td>0.60</td>
<td>8.05%</td>
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<td>87.98</td>
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<td>-2.91%</td>
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<td>2.91%</td>
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<td>-0.58</td>
<td>3.89%</td>
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<td>-0.75</td>
<td>1.37%</td>
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<tr>
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<td>-0.38</td>
<td>0.03%</td>
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<td>1.91%</td>
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<td>28.35</td>
<td>-0.94</td>
<td>-0.23%</td>
</tr>
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<td>7.59</td>
<td>-0.55</td>
<td>-0.17%</td>
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<td>0.00</td>
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<td>2.45%</td>
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<td>-0.87%</td>
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<td>10.55</td>
<td>-0.31</td>
<td>0.66%</td>
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<td>-4.54%</td>
<td>-1.81</td>
<td>0.08</td>
<td>5.10%</td>
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<td>1.75%</td>
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<td>7.09</td>
<td>-0.44</td>
<td>0.40%</td>
</tr>
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<td>-0.78%</td>
<td>20.94</td>
<td>-0.85</td>
<td>0.34%</td>
</tr>
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<td>-2.99%</td>
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<td>-0.05</td>
<td>3.13%</td>
</tr>
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<td>-2.93%</td>
<td>2.90</td>
<td>-0.48</td>
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<td>-1.14%</td>
<td>7.02</td>
<td>-0.39</td>
<td>0.85%</td>
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</table>

(Table 7 is continued on the next page)
Table 7: Changes in Educational Attainment and College Distance Given "Most Equal" Spatial Distribution of Public Colleges (Continued)

<table>
<thead>
<tr>
<th>State</th>
<th>Gini Coefficient</th>
<th>Postsecondary Credits per Student</th>
<th>Probability Weighted Distance to 4-year Colleges</th>
<th>Probability Weighted Utility of 4-year Colleges</th>
<th>Predicted Probability of Attending 4-year Colleges</th>
<th>Probability Weighted Distance to 2-year Colleges</th>
<th>Probability Weighted Utility of 2-year Colleges</th>
<th>Predicted Probability of Attending 2-year Colleges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kansas</td>
<td>-0.0050</td>
<td>-0.91</td>
<td>75.53</td>
<td>-0.83</td>
<td>-1.74%</td>
<td>27.02</td>
<td>-0.65</td>
<td>1.24%</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>-0.0050</td>
<td>0.15</td>
<td>-0.87</td>
<td>-0.02</td>
<td>0.74%</td>
<td>14.98</td>
<td>-0.65</td>
<td>-0.97%</td>
</tr>
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<td>Iowa</td>
<td>-0.0049</td>
<td>-0.50</td>
<td>35.14</td>
<td>-0.45</td>
<td>-0.82%</td>
<td>6.62</td>
<td>-0.43</td>
<td>0.48%</td>
</tr>
<tr>
<td>Mississippi</td>
<td>-0.0049</td>
<td>-0.39</td>
<td>50.82</td>
<td>-0.44</td>
<td>-1.72%</td>
<td>-10.63</td>
<td>0.65</td>
<td>2.04%</td>
</tr>
<tr>
<td>Maine</td>
<td>-0.0049</td>
<td>-0.18</td>
<td>32.74</td>
<td>-0.35</td>
<td>0.03%</td>
<td>54.13</td>
<td>-1.01</td>
<td>-0.37%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>-0.0046</td>
<td>-0.54</td>
<td>41.77</td>
<td>-0.77</td>
<td>-0.54%</td>
<td>44.38</td>
<td>-1.52</td>
<td>-0.09%</td>
</tr>
<tr>
<td>Tennessee</td>
<td>-0.0046</td>
<td>-0.47</td>
<td>27.37</td>
<td>-0.44</td>
<td>-1.18%</td>
<td>7.05</td>
<td>-0.10</td>
<td>1.07%</td>
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<td>South Carolina</td>
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<td>-0.44</td>
<td>26.61</td>
<td>-0.37</td>
<td>-0.91%</td>
<td>5.37</td>
<td>-0.21</td>
<td>0.76%</td>
</tr>
<tr>
<td>Florida</td>
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<td>-0.44</td>
<td>18.52</td>
<td>-0.34</td>
<td>-0.96%</td>
<td>2.32</td>
<td>-0.06</td>
<td>0.71%</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>-0.0037</td>
<td>0.59</td>
<td>-8.70</td>
<td>0.20</td>
<td>1.75%</td>
<td>10.67</td>
<td>-1.24</td>
<td>-1.83%</td>
</tr>
<tr>
<td>California</td>
<td>-0.0039</td>
<td>-0.88</td>
<td>173.42</td>
<td>-1.38</td>
<td>-3.20%</td>
<td>1.12</td>
<td>-0.18</td>
<td>3.58%</td>
</tr>
<tr>
<td>Ohio</td>
<td>-0.0035</td>
<td>-0.55</td>
<td>25.43</td>
<td>-0.51</td>
<td>-1.22%</td>
<td>3.30</td>
<td>-0.18</td>
<td>1.03%</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>-0.0035</td>
<td>0.21</td>
<td>-0.19</td>
<td>0.04</td>
<td>0.81%</td>
<td>10.30</td>
<td>-0.71</td>
<td>-0.98%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>-0.0035</td>
<td>-0.15</td>
<td>12.24</td>
<td>-0.25</td>
<td>-0.03%</td>
<td>7.22</td>
<td>-0.63</td>
<td>-0.27%</td>
</tr>
<tr>
<td>Louisiana</td>
<td>-0.0034</td>
<td>-0.66</td>
<td>72.47</td>
<td>-0.73</td>
<td>-2.06%</td>
<td>2.55</td>
<td>0.08</td>
<td>2.18%</td>
</tr>
<tr>
<td>Maryland</td>
<td>-0.0034</td>
<td>-0.69</td>
<td>39.21</td>
<td>-0.69</td>
<td>-1.58%</td>
<td>4.87</td>
<td>-0.29</td>
<td>1.24%</td>
</tr>
<tr>
<td>Michigan</td>
<td>-0.0034</td>
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<td>77.57</td>
<td>-1.08</td>
<td>-2.80%</td>
<td>-1.10</td>
<td>-0.17</td>
<td>2.67%</td>
</tr>
<tr>
<td>Connecticut</td>
<td>-0.0033</td>
<td>0.38</td>
<td>-4.49</td>
<td>0.11</td>
<td>1.35%</td>
<td>11.66</td>
<td>-1.03</td>
<td>-1.59%</td>
</tr>
<tr>
<td>Indiana</td>
<td>-0.0033</td>
<td>-0.27</td>
<td>19.24</td>
<td>-0.35</td>
<td>-0.57%</td>
<td>8.32</td>
<td>-0.38</td>
<td>0.48%</td>
</tr>
<tr>
<td>Vermont</td>
<td>-0.0033</td>
<td>-0.51</td>
<td>25.21</td>
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<td>-1.06%</td>
<td>-4.85</td>
<td>0.09</td>
<td>0.88%</td>
</tr>
<tr>
<td>Missouri</td>
<td>-0.0029</td>
<td>-0.32</td>
<td>19.09</td>
<td>-0.28</td>
<td>-0.54%</td>
<td>11.09</td>
<td>-0.21</td>
<td>0.33%</td>
</tr>
<tr>
<td>Utah</td>
<td>-0.0029</td>
<td>-0.92</td>
<td>80.90</td>
<td>-0.82</td>
<td>-2.19%</td>
<td>4.80</td>
<td>-0.15</td>
<td>1.97%</td>
</tr>
<tr>
<td>New York</td>
<td>-0.0023</td>
<td>0.08</td>
<td>4.98</td>
<td>-0.11</td>
<td>0.64%</td>
<td>11.49</td>
<td>-0.99</td>
<td>-0.82%</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>-0.0023</td>
<td>-0.10</td>
<td>5.06</td>
<td>-0.14</td>
<td>0.01%</td>
<td>4.86</td>
<td>-0.41</td>
<td>-0.20%</td>
</tr>
<tr>
<td>Illinois</td>
<td>-0.0023</td>
<td>-0.11</td>
<td>13.02</td>
<td>-0.23</td>
<td>0.00%</td>
<td>17.68</td>
<td>-0.59</td>
<td>-0.24%</td>
</tr>
<tr>
<td>Average Change</td>
<td>-0.0054</td>
<td>-0.66</td>
<td>83.64</td>
<td>-0.71</td>
<td>-1.51%</td>
<td>7.95</td>
<td>-0.43</td>
<td>1.31%</td>
</tr>
</tbody>
</table>
Table 8: Optimal Placement of New 4-year College

<table>
<thead>
<tr>
<th>State</th>
<th>5% of 4-year Enrollment</th>
<th>Optimal Location Coordinates</th>
<th>Optimal Location Description</th>
<th>Expected Increase in Postsecondary Credits per Student</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pennsylvania</td>
<td>21,443</td>
<td>40.24, -75.32</td>
<td>21 miles northwest of Philadelphia.</td>
<td>0.66</td>
</tr>
<tr>
<td>Virginia</td>
<td>11,821</td>
<td>38.85, -77.3</td>
<td>In Fairfax County.</td>
<td>0.66</td>
</tr>
<tr>
<td>Illinois</td>
<td>14,567</td>
<td>42.03, -88.09</td>
<td>26 miles northwest of Chicago.</td>
<td>0.65</td>
</tr>
<tr>
<td>Indiana</td>
<td>13,151</td>
<td>39.88, -86.13</td>
<td>8 miles north of Indianapolis.</td>
<td>0.59</td>
</tr>
<tr>
<td>Minnesota</td>
<td>8,209</td>
<td>44.94, -93.25</td>
<td>3 miles south of Minneapolis.</td>
<td>0.59</td>
</tr>
<tr>
<td>Georgia</td>
<td>14,653</td>
<td>34.84, -81.1</td>
<td>24 miles northeast of Atlanta.</td>
<td>0.57</td>
</tr>
<tr>
<td>Kansas</td>
<td>4,502</td>
<td>38.85, -94.73</td>
<td>19 miles southwest of Kansas City.</td>
<td>0.57</td>
</tr>
<tr>
<td>New York</td>
<td>33,064</td>
<td>40.64, -73.92</td>
<td>In Brooklyn.</td>
<td>0.56</td>
</tr>
<tr>
<td>Ohio</td>
<td>18,481</td>
<td>41.36, -81.68</td>
<td>10 miles south of Cleveland.</td>
<td>0.55</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>13,088</td>
<td>42.32, -71.09</td>
<td>3 miles southwest of Boston.</td>
<td>0.55</td>
</tr>
<tr>
<td>Missouri</td>
<td>10,845</td>
<td>38.6, -90.43</td>
<td>13 miles west of St Louis.</td>
<td>0.55</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>2,123</td>
<td>42.89, -71.34</td>
<td>10 miles south of Manchester.</td>
<td>0.54</td>
</tr>
<tr>
<td>Texas</td>
<td>30,408</td>
<td>32.98, -86.83</td>
<td>14 miles north of Dallas.</td>
<td>0.52</td>
</tr>
<tr>
<td>Idaho</td>
<td>3,097</td>
<td>43.82, -116.41</td>
<td>10 miles west of Boise.</td>
<td>0.49</td>
</tr>
<tr>
<td>Florida</td>
<td>23,710</td>
<td>27.97, -82.51</td>
<td>3 miles west of Tampa.</td>
<td>0.48</td>
</tr>
<tr>
<td>Iowa</td>
<td>5,200</td>
<td>41.6, -93.64</td>
<td>2 miles west of Des Moines.</td>
<td>0.48</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>10,116</td>
<td>43.1, -88.21</td>
<td>16 miles northwest of Milwaukee.</td>
<td>0.48</td>
</tr>
<tr>
<td>North Carolina</td>
<td>12,292</td>
<td>35.36, -80.77</td>
<td>10 miles northeast of Charlotte.</td>
<td>0.46</td>
</tr>
<tr>
<td>Colorado</td>
<td>8,131</td>
<td>39.73, -105.01</td>
<td>1 mile southeast of Denver.</td>
<td>0.44</td>
</tr>
<tr>
<td>Washington</td>
<td>9,241</td>
<td>47.29, -122.29</td>
<td>7 miles northeast of Tacoma.</td>
<td>0.44</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>2,745</td>
<td>41.81, -71.42</td>
<td>1 mile south of Providence.</td>
<td>0.44</td>
</tr>
<tr>
<td>Delaware</td>
<td>1,536</td>
<td>39.12, -75.54</td>
<td>3 miles south of Dover.</td>
<td>0.43</td>
</tr>
<tr>
<td>Nebraska</td>
<td>3,078</td>
<td>41.27, -96.17</td>
<td>9 miles west of Omaha.</td>
<td>0.43</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>5,997</td>
<td>36.02, -95.9</td>
<td>11 miles southeast of Tulsa.</td>
<td>0.42</td>
</tr>
<tr>
<td>Maryland</td>
<td>6,216</td>
<td>39.07, -77.18</td>
<td>2 miles southwest of Rockville.</td>
<td>0.42</td>
</tr>
<tr>
<td>Hawaii</td>
<td>2,123</td>
<td>19.67, -156</td>
<td>2 miles north of Kailua-Kona.</td>
<td>0.41</td>
</tr>
<tr>
<td>Utah</td>
<td>7,430</td>
<td>40.55, -112.04</td>
<td>16 miles southwest of Salt Lake City.</td>
<td>0.41</td>
</tr>
<tr>
<td>Connecticut</td>
<td>5,015</td>
<td>41.49, -72.83</td>
<td>14 miles north of New Haven.</td>
<td>0.41</td>
</tr>
<tr>
<td>South Dakota</td>
<td>1,700</td>
<td>43.57, -96.8</td>
<td>6 miles west of Sioux Falls.</td>
<td>0.40</td>
</tr>
<tr>
<td>Kentucky</td>
<td>6,216</td>
<td>39.18, -85.68</td>
<td>6 miles southeast of Louisville.</td>
<td>0.40</td>
</tr>
<tr>
<td>Oregon</td>
<td>5,275</td>
<td>45.46, -122.28</td>
<td>8 miles southwest of Portland.</td>
<td>0.39</td>
</tr>
<tr>
<td>Tennessee</td>
<td>8,882</td>
<td>36.02, -86.62</td>
<td>13 miles southeast of Nashville.</td>
<td>0.39</td>
</tr>
<tr>
<td>New Jersey</td>
<td>9,019</td>
<td>40.81, -74.19</td>
<td>5 miles north of Newark.</td>
<td>0.39</td>
</tr>
<tr>
<td>Vermont</td>
<td>1,940</td>
<td>42.89, -73.19</td>
<td>1 mile north of Bennington.</td>
<td>0.38</td>
</tr>
<tr>
<td>Maine</td>
<td>1,903</td>
<td>43.68, -70.34</td>
<td>4 miles northwest of Portland.</td>
<td>0.38</td>
</tr>
<tr>
<td>Michigan</td>
<td>16,243</td>
<td>42.91, -85.7</td>
<td>4 miles southwest of Grand Rapids.</td>
<td>0.37</td>
</tr>
<tr>
<td>South Carolina</td>
<td>6,288</td>
<td>34.9, -82.28</td>
<td>7 miles northeast of Greenville.</td>
<td>0.37</td>
</tr>
<tr>
<td>Alabama</td>
<td>6,958</td>
<td>33.44, -86.79</td>
<td>6 miles south of Birmingham.</td>
<td>0.37</td>
</tr>
<tr>
<td>California</td>
<td>40,582</td>
<td>34.14, -118.19</td>
<td>7 miles northeast of Los Angeles.</td>
<td>0.35</td>
</tr>
<tr>
<td>North Dakota</td>
<td>1,687</td>
<td>46.87, -100.73</td>
<td>5 miles northeast of Bismarck.</td>
<td>0.33</td>
</tr>
<tr>
<td>Arkansas</td>
<td>4,575</td>
<td>34.61, -92.5</td>
<td>15 miles southwest of Little Rock.</td>
<td>0.33</td>
</tr>
<tr>
<td>Arizona</td>
<td>7,008</td>
<td>33.38, -111.8</td>
<td>2 miles north of Gilbert.</td>
<td>0.33</td>
</tr>
<tr>
<td>West Virginia</td>
<td>3,129</td>
<td>38.4, -81.8</td>
<td>11 miles northwest of Charleston.</td>
<td>0.32</td>
</tr>
<tr>
<td>Louisiana</td>
<td>6,762</td>
<td>29.97, -90.21</td>
<td>8 miles west of New Orleans.</td>
<td>0.30</td>
</tr>
<tr>
<td>Montana</td>
<td>1,755</td>
<td>45.83, -108.44</td>
<td>4 miles northwest of Billings.</td>
<td>0.25</td>
</tr>
<tr>
<td>Mississippi</td>
<td>3,547</td>
<td>32.25, -89.97</td>
<td>13 miles southeast of Jackson.</td>
<td>0.24</td>
</tr>
<tr>
<td>New Mexico</td>
<td>2,623</td>
<td>35.31, -106.66</td>
<td>16 miles north of Albuquerque.</td>
<td>0.20</td>
</tr>
<tr>
<td>Nevada</td>
<td>3,987</td>
<td>36.32, -115.21</td>
<td>11 miles north of Las Vegas.</td>
<td>0.19</td>
</tr>
<tr>
<td>Alaska</td>
<td>1,202</td>
<td>61.09, -149.79</td>
<td>10 miles south of Anchorage.</td>
<td>0.15</td>
</tr>
<tr>
<td>Wyoming</td>
<td>455</td>
<td>43.46, -110.79</td>
<td>In Jackson.</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Note: All distances in the optimal location description refer to the distance from the center of each city. States are ordered by how much they are expected to gain by placing a new 4-year college in this location.
Figure 1: Utility of Enrollment as a Function of Distance, Conditional on Attending this Level of College
Figure 2: Illinois’ Student Population and Current and Optimal College Locations

Location of High School Students

Notes:
- Marker size given by HS enrollment.
- Purple (Orange) denotes HS with < (≥) 30% Minority Students.
- Circle (Triangle) denotes HSs in Zip Codes with > (≤) 25% of over 25 pop with BA.

Current College Locations

Notes:
- Marker size given by College enrollment.
- Green Circle denotes public 4-year college.
- Red Diamond denotes public 2-year college.
- Blue Square (Triangle) denotes private 4-year (2-year) college.

Optimal College Locations
Figure 3: Texas’ Student Population and Current and Credit-Maximizing College Locations

<table>
<thead>
<tr>
<th>Location of High School Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
</tr>
<tr>
<td>• Marker size given by HS enrollment.</td>
</tr>
<tr>
<td>• Purple (Orange) denotes HSs with &lt; (≥) 30% Minority Students.</td>
</tr>
<tr>
<td>• Circle (Triangle) denotes HSs in Zip Codes with &gt; (≤) 25% of over 25 pop with BA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current College Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
</tr>
<tr>
<td>• Marker size given by College enrollment.</td>
</tr>
<tr>
<td>• Green Circle denotes public 4-year college.</td>
</tr>
<tr>
<td>• Red Diamond denotes public 2-year college.</td>
</tr>
<tr>
<td>• Blue Square (Triangle) denotes private 4-year (2-year) college.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Optimal College Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>
Figure 4: New Mexico’s Student Population and Current and Credit-Maximizing College Locations

<table>
<thead>
<tr>
<th>Location of High School Students</th>
<th><img src="image" alt="Location of High School Students" /></th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
<td></td>
</tr>
<tr>
<td>• Marker size given by HS</td>
<td></td>
</tr>
<tr>
<td>enrollment.</td>
<td></td>
</tr>
<tr>
<td>• Purple (Orange) denotes HS with</td>
<td></td>
</tr>
<tr>
<td>&lt; (≥) 30% Minority</td>
<td></td>
</tr>
<tr>
<td>Students.</td>
<td></td>
</tr>
<tr>
<td>• Circle (Triangle) denotes HSs in</td>
<td></td>
</tr>
<tr>
<td>Zip Codes with &gt; (≤) 25% of</td>
<td></td>
</tr>
<tr>
<td>over 25 pop with BA.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current College Locations</th>
<th><img src="image" alt="Current College Locations" /></th>
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</thead>
<tbody>
<tr>
<td>Notes:</td>
<td></td>
</tr>
<tr>
<td>• Marker size given by College</td>
<td></td>
</tr>
<tr>
<td>enrollment.</td>
<td></td>
</tr>
<tr>
<td>• Green Circle denotes public</td>
<td></td>
</tr>
<tr>
<td>4-year college.</td>
<td></td>
</tr>
<tr>
<td>• Red Diamond denotes public</td>
<td></td>
</tr>
<tr>
<td>2-year college.</td>
<td></td>
</tr>
<tr>
<td>• Blue Square (Triangle) denotes</td>
<td></td>
</tr>
<tr>
<td>private 4-year (2-year)</td>
<td></td>
</tr>
<tr>
<td>college.</td>
<td></td>
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<table>
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<th>Optimal College Locations</th>
<th><img src="image" alt="Optimal College Locations" /></th>
</tr>
</thead>
</table>
Figure 5: Arizona’s Student Population and Current and Credit-Maximizing College Locations

<table>
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<th>Location of High School Students</th>
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<tbody>
<tr>
<td>Notes:</td>
</tr>
<tr>
<td>• Marker size given by HS enrollment.</td>
</tr>
<tr>
<td>• Purple (Orange) denotes HS with &lt; (≥) 30% Minority Students.</td>
</tr>
<tr>
<td>• Circle (Triangle) denotes HSs in Zip Codes with &gt; (≤) 25% of over 25 pop with BA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current College Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes:</td>
</tr>
<tr>
<td>• Marker size given by College enrollment.</td>
</tr>
<tr>
<td>• Green Circle denotes public 4-year college.</td>
</tr>
<tr>
<td>• Red Diamond denotes public 2-year college.</td>
</tr>
<tr>
<td>• Blue Square (Triangle) denotes private 4-year (2-year) college.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Optimal College Locations</th>
</tr>
</thead>
</table>
Figure 5: Tennessee’s Student Population and Current and Credit-Maximizing College Locations

Location of High School Students

Notes:
- Marker size given by HS enrollment.
- Purple (Orange) denotes HS with < (≥) 30% Minority Students.
- Circle (Triangle) denotes HSs in Zip Codes with > (≤) 25% of over 25 pop with BA.

Current College Locations

Notes:
- Marker size given by College enrollment.
- Green Circle denotes public 4-year college.
- Red Diamond denotes public 2-year college.
- Blue Square (Triangle) denotes private 4-year (2-year) college.

Optimal College Locations
Appendix:

Student Population and Current and Credit-Maximizing College Locations for the Remaining 45 States
### Location of High School Students

**Notes:**
- Marker size given by HS enrollment.
- Purple (Orange) denotes HS with < (≥) 30% Minority Students.
- Circle (Triangle) denotes HSs in Zip Codes with > (≤) 25% of over 25 pop with BA.

### Current College Locations

**Notes:**
- Marker size given by College enrollment.
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### Optimal College Locations
Alabama

Location of High School Students

Notes:
- Marker size given by HS enrollment.
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Notes:
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Optimal College Locations
### Location of High School Students

**Notes:**
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### Current College Locations

**Notes:**
- Marker size given by College enrollment.
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### Optimal College Locations
California

**Location of High School Students**

Notes:
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- Purple (Orange) denotes HS with < (≥) 30% Minority Students.
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Notes:
- Marker size given by College enrollment.
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**Optimal College Locations**
### Colorado

#### Location of High School Students

**Notes:**
- Marker size given by HS enrollment.
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#### Current College Locations

**Notes:**
- Marker size given by College enrollment.
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#### Optimal College Locations
Connecticut

**Location of High School Students**

Notes:
- Marker size given by HS enrollment.
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**Current College Locations**

Notes:
- Marker size given by College enrollment.
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**Optimal College Locations**
Delaware

**Location of High School Students**

Notes:
- Marker size given by HS enrollment.
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Notes:
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**Optimal College Locations**
Florida Location of High School Students

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Current College Locations

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Optimal College Locations
Location of High School Students

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Optimal College Locations
Hawaii

Location of High School Students

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Current College Locations

Notes:
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Optimal College Locations
Location of High School Students

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### Optimal College Locations
## Location of High School Students

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## Current College Locations

Notes:
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## Optimal College Locations
Kansas

Location of High School Students

Notes:
- Marker size given by HS enrollment.
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Current College Locations

Notes:
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Optimal College Locations
Kentucky

Location of High School Students

Notes:
• Marker size given by HS enrollment.
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Current College Locations

Notes:
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Optimal College Locations
Louisiana

### Location of High School Students

**Notes:**
- Marker size given by HS enrollment.
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### Current College Locations

**Notes:**
- Marker size given by College enrollment.
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### Optimal College Locations
**Massachusetts**

**Location of High School Students**

Notes:
- Marker size given by HS enrollment.
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**Current College Locations**

Notes:
- Marker size given by College enrollment.
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**Optimal College Locations**
Maryland

Location of High School Students

Notes:
- Marker size given by HS enrollment.
- Purple (Orange) denotes HS with < (≥) 30% Minority Students.
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Optimal College Locations
### Location of High School Students

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### Optimal College Locations
Michigan

Location of High School Students

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Optimal College Locations
### Location of High School Students

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### Optimal College Locations
Missouri

Location of High School Students

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Optimal College Locations
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### Optimal College Locations
North Dakota

Location of High School Students

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Optimal College Locations
Nebraska

Location of High School Students

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Optimal College Locations
### Location of High School Students

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Optimal College Locations
New York

Location of
High School
Students

Notes:
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Students.
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denotes HSs in
Zip Codes with >
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25 pop with BA.

Current
College
Locations

Notes:
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• Green Circle
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Optimal
College
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### Optimal College Locations
Location of High School Students

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Optimal College Locations
Oregon

Location of High School Students

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Optimal College Locations
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# Current College Locations

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# Optimal College Locations
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Optimal College Locations
Virginia

Location of High School Students

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- Marker size given by HS enrollment.
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Optimal College Locations
Vermont

Location of High School Students

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Optimal College Locations
Washington

Location of High School Students

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Optimal College Locations
Wisconsin

**Location of High School Students**

Notes:
- Marker size given by HS enrollment.
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- Marker size given by College enrollment.
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**Optimal College Locations**
West Virginia

Location of High School Students

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- Marker size given by HS enrollment.
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Optimal College Locations
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