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The Politics of Community College Districts: A National Overview and Implications for Racial Gerrymandering in Texas

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ABSTRACT

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Abstract
At least 38 states have created service areas or "districts" for each of their community colleges. However, little is known about the geographic boundaries of community college districts, the political process that defines them, and how they relate to institutional racial segregation. Given this dearth of knowledge, we studied nearly 150 state policy documents nationally and the actual district boundaries of Texas community colleges in order to investigate the larger political process of determining boundaries and whether gerrymandering is present. We found significant variation across the United States, including in who determines the boundaries and whether the districts have associated tuition reductions. In our case study, we also found evidence that at least some of Texas's community college districts may exhibit evidence of gerrymandering.

The Politics of Community College Districts: A National Overview and Implications for Racial Gerrymandering in Texas

Despite extensive attention to racial segregation within K-12 education (see Reardon and Owens [2014] for a review), scholars have rarely examined segregation in postsecondary education (Baker, Solanki, & Kang, 2019). This is partially due to the fact that most theories of how students choose where to enroll in postsecondary education erroneously assume that students will choose from the entire population of institutions across the United States (e.g., González Canché, 2018a; Hillman, 2016). This assumption ignores the fact that one sector of postsecondary education has a significant share of its institutions geographically zoned for certain students: community colleges.

Based on our investigation of state education codes, policies, and direct communication with government officials, 38 states have created service areas or "districts" for each of their community colleges. Yet, little is known about the geographic boundaries of community college districts, the political process that defines them, and how they relate to institutional racial segregation. This lack of evidence is important for many reasons. For example, resources matter and are typically allocated via a political process incorporating these districts which may privilege certain institutions (thereby privileging certain students within a state). Given this dearth of knowledge, we studied state policy documents nationally and the actual district boundaries of Texas community colleges in order to investigate the larger political process that influences how boundaries are drawn. We were particularly interested in how frequently district boundaries are gerrymandered—which we define as the manipulation of the boundaries to benefit a group of individuals. Texas has a large, racially diverse population that is spread across several different metropolitan areas with a robust community college sector, making it a useful

state to study. This is the first step in a larger research project that analyzes the relationship between gerrymandering in community college districts and racial segregation. In the current study, we investigated the following questions:

1) What is the political process underlying the creation of community college districts across the United States?
2) Do the district boundaries of community colleges provide evidence of gerrymandering in Texas?

Due to the lack of research on community college districts, it is critical to include both a national and state-specific investigation. This article provides the first national list of states with community college districts. There is no national repository that tracks which states have these types of policies or the political process underlying the creation of the physical boundaries.[1] Further, there is no prior research, to our knowledge, that focuses on the politics involved in the creation of these district boundaries or whether these boundaries show evidence of gerrymandering. Therefore, our research provides a critical overview of the national political landscape regarding community college districts and a case study of a single state's district design.

The historic inattention to community college district boundaries by researchers, policymakers, and the public does not indicate their unimportance or lack of impact on students' lives. In fact, the large number of students who enroll in community colleges suggests that how students are zoned for community college has significant impact on the nation's current and future workforce. Therefore, the process of drawing community college district boundaries, as

[1] We have checked with federal (e.g., Association of Community College Trustees) and state (e.g., Education Commission of the States, State Higher Education Executive Officers Association) policy organizations and can find no nationwide list of states with these policies, much less more detailed information on how the policies are created and implemented.

well as its effect on the racial segregation of community college students, deserves the same consideration as K-12 attendance zones. The current study's findings regarding the varied state processes for creating community college district boundaries and the Texas case study, which indicates a potential for gerrymandering in several districts, further justify the continued study of community college boundaries.

We begin this article with an overview of our theoretical framework, then summarize the prior research on K-12 school attendance zones and how geography relates to community college access and success. Next, we detail our research methods including the multiple measures of gerrymandering that we calculate for the current study. We then present evidence on the national policy context surrounding community college districts, based on close to 150 policy documents, and an in-depth analysis of the geometric shape of Texas's community college districts.

Theoretical Framework

Typically, researchers have used three different theories to study attendance zones. Several scholars have used Tiebout's (1956) theory of public choice to guide their work (e.g., Bischoff, 2008; Clotfelter, 2004; Faw & Jabbar, 2020; Ganski, 2015; Holme & Finnigan, 2013; Orfield, 2002; Schmidt, 1991; Weiher, 1991). In the context of the public educational system, this theory asserts that attendance zone boundaries hold the potential to segregate "because individuals choose where to live in part of the basis of their neighbors – often opting to live near people more similar to them in terms of race/ethnicity – as well as on the basis of the school that their child will attend" (Richards, 2014, p. 1121). Saporito (2017a, 2017b) draws upon Tobler's (1970) First Law of geography, the second theory researchers often use, which Goodchild (2008) paraphrases as "nearby things are more similar than distant things." Applying this theory to school attendance zones, Saporito found that racially and economically segregated school

attendance zones are largely the outcome of residential segregation. According to Saporito (2017a, 2017b), most school districts draw compact attendance zones (perhaps to minimize transportation costs), which then reproduce residential segregation. Since people of the same race and income tend to live closer together than people of different races and income, often due to deliberate public policy choices (e.g., Rothstein, 2017), Tobler's (1970) First Law could also reasonably be applied to the racial segregation of schools.

Both Tiebot (1956) and Tobler (1970) help to contextualize the segregation of public K-12 schools, but they do not wholly apply to the question of community college segregation. For example, postsecondary institutions are typically not concerned with student transportation costs, as these generally fall directly on students. Additionally, Tiebot's premise that people make residential decisions based on the quality of the schools to which neigborhoods are zoned has significantly less relevance in a community college context; it is not a common occurrence for homebuyers to consider the local community college in their purchasing plans. Although they do not perfectly translate to a college-level context, both Tiebot and Tobler draw attention to the significant relation between residential and school segregation, which is present at all levels of education.

When scholars have been interested in examining school gerrymandering and segregation as phenomena distinct from residential segregation (e.g., Richards, 2014), they often use student exchange framework, a theory adapted from the political science "voter exchange" perspective on electoral gerrymandering. Richards and Stroub (2015) highlight that "[zone] compactness constitutes the single most important principle of gerrymandering, particularly for schools" (p. 6). Compactness can be measured in many ways (Chambers & Miller, 2010) but is often divided into two constructs: indentation (how smooth is the perimeter of the boundary?) and dispersion

(how dense is the area within the boundary?). Based on the prior literature, the less indentations and dispersion in a boundary, the more compactness and the less evidence for gerrymandering (Richards & Stroub, 2015).

Student exchange framework posits that indentations and dispersion occur when policymakers deliberately create attendance zone boundaries that encompass one racial group and exclude students from other racial groups (Richards, 2014). Therefore, gerrymandering would result from this systematic "exchange" of more desirable students for less desirable ones. This framework does not necessarily imply that gerrymandered attendance zones exacerbate segregation. As Richards (2014) argues, school districts could create student exchanges in order to diversify attendance zones. The potential for exacerbation or reduction in racial segregation is one of the reasons systematic research is needed to better understand the relationship between educational boundaries and segregation.

The student exchange framework is applicable to community colleges' districts. Districts are generally tied to an institution's county or geographically determined by policymakers. Following student exchange, these boundary determinations allow for the potential of gerrymandering districts of community colleges, either directly through the creation of the boundaries or by linking the institution's boundaries to other geographic boundaries known to exhibit gerrymandering. For these reasons, we use the student exchange framework to guide our current research. Since students who live within a district boundary are more likely to attend their "zoned" community college (Acton, 2020; Waller, 2003), evidence of gerrymandering could be related to institutions' racial enrollment. Indeed, there is anecdotal evidence that some Texas community college district boundaries are created to ensure the institution has more advantaged students enroll (e.g., Reed, 2019). However, no systematic research has been

conducted to see if this is a rare occurrence or prevalent throughout the state. And there is no research, to our knowledge, that provides a national understanding of how these districts are created.

Literature Review

The majority of research focused on the politics of education boundaries—typically attendance zones—has investigated K-12 schools (Yoon & Lubienski, 2018). To our knowledge, there is little commensurate research in higher education. This lack of research is concerning as scholars posit that higher education can have segregation issues similar to K-12 (Baker et al., 2019), and community colleges in several states create district boundaries through political processes similar to attendance zones in the K-12 sector (Acton, 2020; Custer, 2020; Waller, 2003). These institutions also educate a significant share of the higher education students in the United States: approximately 8.4 million students or 33% of all students in 2017-2018 (Department of Education, 2019). Further, in Texas, community colleges educate more students than any other sector (TACC, 2019). It therefore has become increasingly important to examine student enrollment in this unique context (Cohen, Brawer, & Kisker, 2014). To motivate the current study, we provide an overview of prior research on the potential for gerrymandering of education attendance zones and review the evidence on community colleges and geography.

Gerrymandering and K-12 Attendance Boundaries

The majority of research on politically determined geographic boundaries relating to education focuses on K-12 school attendance zones.[2] The vast majority (92%) of K-12 school districts are independent districts whose boundaries are generally not forced to solely align with political jurisdictions (e.g., cities, counties). The goal of fiscal and administrative independence

[2] We only use attendance zones to refer to K-12 political boundaries to aid the reader in following when we are discussing K-12 schools versus community colleges.

from local government created a large number of districts nationwide; however, districts began to consolidate in the mid-twentieth century with the aim of administrative efficiency and instructional specialization (Tyack, 1974). Consolidation did not occur evenly across communities. Alesina, Baquir, and Hoxby (2004) identified an inverse relationship between the racial diversity of districts and their decisions to consolidate. Scholars provide mixed evidence on the current prevalence of gerrymandered attendance zones. Richards and Stroub (2015) analyzed data from the School Attendance Boundary Information System (SABINS) for the 2009-2010 school year and found that attendance zones were, on average, "substantially different than would be expected in the absence of gerrymandering" (Richards & Stroub, 2015, p. 16). Using the student exchange framework, these results support the theory that the exclusion of nearby students in lieu of other students residing farther away is a common occurrence. In contrast, Saporito and Van Riper (2016), analyzing SABINS data from the identical school year, found little evidence of gerrymandered school attendance zones.

One explanation for the diverging research conclusions could be the differences in approaches used to measure the presence and severity of gerrymandered zones. Both Richards and Stroub (2015) and Saporito and Van Riper (2016) employed multiple measures to assess attendance zone shape, though these measures differed slightly. The former relied on two measures of indentation (Schwartzberg and Polsby-Popper) and two measures of dispersion (Reock and Convex Hull). Saporito and Van Riper (2016), on the other hand, first measured indentation utilizing Polsby-Popper and convacity (when a line drawn between two points in a shape crosses the boundaries of that shape) and dispersion utilizing Convex Hull, and subsequently used principal component analysis to combine them into a single measure.

Both sets of researchers used their selected measures of gerrymandering to compare school attendance zones to U.S. Congressional Districts. Richards and Stroub (2015) included attendance zones for all regular schools in regular districts in their analyses, resulting in a sample of 23,945 public school attendance zones in 1,721 school districts. In contrast, Saporito and Van Riper (2016) limited their research to districts that have first-grade attendance zones and are among the largest 350 districts in the country, yielding a sample of 13,169 attendance zones in 307 school districts. In each study, these measures indicated that school attendance zones were less gerrymandered than congressional districts, with larger differences in indentation (measured by Polsby-Popper) than dispersion (measured by Convex Hull). However, the difference in gerrymandering between attendance zones and congressional districts calculated by Saporito and Van Riper (2016) is larger than the difference found by Richards and Stroub (2015). This may be why Richards and Stroub (2015) argued that the compactness of the attendance zones raised concerns for gerrymandering. Part of the reason it is difficult to find agreement on whether attendance zones are gerrymandered is that there is no accepted threshold to indicate that a geographic area is or is not gerrymandered, as we discuss further in the methods section.

Therefore, there is not clear evidence on whether K-12 attendance zones are gerrymandered. Gerrymandering of K-12 attendance zones matters as this could be one mechanism through which between-school segregation is produced. Due to this lack of clarity at the K-12 level, our current research incorporates several different methods of assessing the evidence indicating that a district may be the result of gerrymandering. It appears clear based on prior research that design and sample selection can play a significant role in the interpretation of the evidence indicating gerrymandering.

Community Colleges and Geography

Geography matters when students decide whether and where to enroll in higher education (e.g., Dache-Gerbino, 2018; De Oliver, 1998; González-Canché, 2018b; Hillman, 2016; Turley, 2009). Scholars have found that students are more likely to attend institutions near where they live (Hillman, 2016), can benefit from enrolling at in-state institutions that are further from their home (González-Canché, 2018b), and can live within the same county but have vastly different access to higher education opportunities (Dache-Gerbino, 2018). Typically, prior research has not focused specifically on the community college sector. Reyes and colleagues (2019) explored a Houston community college system's institutional administrative data and found that students who graduated from high schools near college campuses were more likely to attend that campus. The authors also found that the local labor market context strongly related to students' enrollment patterns. Similarly, Acton (Forthcoming) found that the local labor market directly affected the majors Michigan community college students chose.

Therefore, while understudied, scholars have used geography and space to explore access and success within higher education. Scholars have less frequently studied the political boundaries that drive access to higher education, such as community college districts. To our knowledge, only a small handful of studies engage with studying community college districts (e.g., Acton, 2020, Custer, 2020; Waller, 2003; Waller et al., 2007). Typically, these studies have focused on states with a type of "local taxing district" that provides additional funding to the community college and allows residents to receive a reduction in tuition. For example, Acton (2020) analyzed Michigan's districts and found that reductions in price at the local community college increased residents' enrollment at that institutions and decreased their enrollment at other institutions. More recently, the Center for American Progress published a policy report that investigated the relationship between Michigan's districts and racial segregation at local

community colleges (Custer, 2020). The policy report compared the share of White and Black adults in a district, respectively, to the share of White and Black students enrolled in the district's community college. Custer (2020) found a significant underrepresentation of White students enrolled in community colleges across the state and found an overrepresentation of Black students enrolling in community colleges near Detroit. While this policy report does not use conventional measures of segregation, there is clear evidence that the community college districts may play a role in racially segregating students enrolling in community colleges.

We build on this prior research focused on community college district boundaries by investigating the districts as actual artifacts of a political process. We explore the variation in political structures across states with community college districts. We also dive deeply into a case study of Texas's community college districts with statistical analysis of measures of gerrymandering. This type of research is essential for creating a nationwide understanding of the political processes that shape community college districts and for building the evidence base on the actual design of the districts and their boundaries.

Research Methods

Data Collection

The current study collected a novel set of political documents related to community college districts across the United States (research question one) and used a geospatial analysis case study to investigate whether the boundaries exhibit evidence of gerrymandering in Texas (research question two).

For research question one, the descriptive analysis of community college districts across the entire country, we investigated all states' constitutions, education codes, and additional policy documents for evidence of community college district areas, as well as details about how

those areas are defined. First, we used data from the U.S. Department of Education's Integrated Postsecondary Education Data System and compared the in-district to in-state tuition at public two-year institutions in each state. Any state that had a different amount for in-district tuition was one we considered to potentially have community college district boundaries. This led to a pilot group of 19 states.[3]

A member of the research team collected data on each of the 19 states to assess: 1) whether they had community college districts and; 2) if their state education codes had a policy regarding these districts. In order to make these assessments, the research team member went to each state legislature's website and accessed their statutes.[4] Going to the education section in each set of statutes, the team member then found every state's chapter on community colleges or postsecondary education and began searching within the chapter for any information regarding community college districts. The team member searched for keywords within these sections such as "service areas," "service districts," "college districts," "counties," and "college boundaries." If the team member could not find any information specific to college districts in the education code from the state websites, she then conducted a Google search using the state's name with the same aforementioned keywords. She categorized any states for which she could not find community college district-related information as not having a policy regarding college districts. Once the first 19 states were initially completed, the team reviewed the documentation and provided additional documents for the team member to review in an attempt to find policy details. Finally, once the team member conducted the final search, the data collection for

[3] We started with a pilot group of states to allow the research team to get familiar with the types of documents states maintained and where they might be located online.
[4] When states had separate systems for community and technical colleges, we evaluated the community college system only.

research question one expanded to the other 31 states (replicating the steps outlined in this paragraph). This led to a total of 37 potential states with community college districts.

Two research team members, one of whom did the original search, then independently coded each state by answering the questions outlined in Appendix Table A1. The questions broadly focused on the presence of a district, which political actors had a role in determining the boundaries, and whether institutions provided a tuition discount for students within the district. The two team members met frequently to resolve any differences between their independent coding. Coding was not considered complete until the two team members reached consensus. We contacted state higher education governing bodies with any questions relating to the items in Table A1 that could not be addressed by publicly available documents. We also contacted all of the states for which we were unable to find any information about districts in order to verify that no such policy boundaries existed. These additional explorations led to a final total of 38 states with a community college district policy. We collected approximately 150 documents for the 38 states with some type of community college district policy.

For research question two, we collected data on the 2017-2018 district boundaries for the 82 community colleges in Texas. Texas community college districts are outlined in Texas Education Code (chapter 130, generally §162 to §211) and are publicly available. For example, Texas Education Code §130.162 outlines the district for Alamo Community College as the following:

(1) Bexar, Bandera, Comal, Kendall, Kerr, and Wilson counties;

(2) Atascosa County, except the territory within the Pleasanton Independent School District; and

(3) Guadalupe County, except the territory within the San Marcos Consolidated Independent School District (Texas Education Code, n.d.).

We converted the text descriptions of the 50 boundaries into electronic maps which could be used within geographic information systems (GIS) analysis software using ArcGIS Pro software (2.5.2).

Texas community college districts are defined according to the intersections between city, county, taxing district, and independent school district borders. We obtained Texas city shapefiles from the United States Census Bureau and include the city limits of The Colony, Corpus Cristi, Frisco, Missouri City, Paris, Sugar Land, and Temple.[5] County shapefiles were obtained from the National Historical Geographic Information System (NHGIS) website (Manson et al., 2020).[6] The Texas Legislative Council, which creates the official maps for the state of Texas, provided the Independent School District (ISD) shapefiles. Taxing district boundaries impacted only two community college district boundaries, Borger and Texarkana. The taxing district for the Borger Junior College District Service Area includes the portion of Spring Creek ISD that is also within the community college district's service area. Since Spring Creek ISD was located within Hutchinson County during 2017, the taxing district boundary was irrelevant. Likewise, the Texarkana College District Service Area includes a taxing district that encompasses all of Bowie County. Therefore, the county shapefile was used to identify the boundary for the Texarkana District.

A member of the research team created the community college spatial boundaries using polygons in ArcGIS Pro. The boundaries of the polygons were compared to the appropriate city,

[5] We only include these cities because they are the only ones included in Texas community college boundaries. These files can be accessed at https://data.census.gov/cedsci/.
[6] These files can be accessed at https://www.nhgis.org/.

county, or ISD boundary depending on the district. This was done using the "Edit Vertices" tool after enabling the map topology (which ensures that feature contiguity is maintained while editing polygons). Since community colleges adhere to the academic year (e.g., fall to summer), the community college boundaries were compared to city and county shapefiles from the fall in a given academic year. In other words, we created the 2017-2018 community college boundaries based on the shapefiles from 2017. This created a spatial data set of all Texas community colleges and their corresponding district spatial coordinates. The final map used the projected coordinate system North American Albers Equal Area Conic. We shared these maps while they were in progress and once completed with experts in educational geospatial data and members of the Texas Legislative Council who noted that our maps appeared to be accurate (though this is not a legally binding assessment).

Once we finalized the district maps, we merged the district shapefiles with American Community Survey (ACS) census block group data, the smallest geographical unit for survey data, on the race of residents from NHGIS (Mason et al., 2020).[7] We used 5-year estimates merging based on the final year from ACS to the fall of the academic year for the district (ACS 5-year estimates for 2013-2017 merged to 2017-2018 academic year district areas). When census block groups were located in multiple districts, we created a spatial weight for the area of the block group in each of the districts and apportion residents based on that amount.[8] We applied that weight to all measures of population so that residents were spatially apportioned within districts.

[7] Survey data is required for the case study since the 2017-2018 map requires ACS estimates, which are based on a survey, instead of decennial census counts of residents.

[8] We create a union between the districts and census block groups and calculate the area of each individual polygon. We then divide that area by the area of each census block group, which creates a ratio that equals 1 if the census block group is solely located within a single district. Approximately 86% of all census block groups are solely located within a single district.

Analysis Method

For research question one, we conducted a descriptive analysis of the national data on community college districts with a focus on exploring who plays a role in this political process. It is critical to understand the broader policy context of how these boundaries are created as political objects in order to understand the potential for them to exhibit signs of gerrymandering.

For research question two, based on the theoretical framework of student exchange, we assessed both the indentation and dispersion of Texas's district boundaries in order to assess the level of gerrymandering of the district boundaries. To do this, we used one measure of indentation (Polsby-Popper index) and two measures of dispersion (Reock and Convex Hull indices). We purposefully incorporated methods used by both Richards and Stroub (2015) and Saporito and Van Riper (2016) in order to compare our results to prior research.

The Polsby-Popper index assesses how compact the district is by comparing the area of the district to its perimeter. The equation for the Polsby-Popper is:

$$PP(D_i) = \frac{4\pi A(D_i)}{P(D_i)^2}$$

For each individual district (indexed by *i*), we calculated the area (*A*) and the perimeter (*P*). From there, we calculated the Polsby-Popper ratio. The ratio can go from 0 to 1, with 0 being the least compact and 1 being the most compact. Lower Polsby-Popper scores provide evidence of potential gerrymandering.

Reock and Convex Hull indices craft an "ideal" district that should be the most compact, and therefore not be the result of gerrymandering. The Reock measure uses the smallest circle that circumscribes a district. Convex Hull creates a convex polygon around a district. Think of a convex hull as the polygon created by stretching a rubber-band around a district. For such a convex polygon, a line drawn between two points in the shape would still reside within the

shape, and no angles within the polygon would be greater than 180 degrees. Regardless of the ideal shape, the formula for these two measures is:

$$Index(D_i) = \frac{A(D_i)}{A(Ideal_i)}$$

For both Reock and Convex Hull, the index is calculated for each district by dividing the area of the real district by the area of the "ideal" district (whether a circle or a polygon). An issue with the typical formula is that the "ideal" districts can go beyond the state's borders. Using Texas as an example, an "ideal" circular district for the Reock index near the Gulf of Mexico likely includes area that is solely water in which individuals would not be able to live. This issue also applies to state borders. Therefore, we adjusted the typical formulas and estimated the following:

$$Index(D_i) = \frac{Pop(D_i)}{Pop(Ideal_i)}$$

where we replaced the area of the real and ideal district with the total population. By making this adjustment, we should have reduced the amount of area in the ideal district that cannot actually be included in a real district. Similar to the Polsby-Popper, the index can be between 0 and 1, where a ratio closer to 0 indicates the district may be the result of gerrymandering.

While these three measures are the most frequently used to study evidence of gerrymandering (Barnes & Solomon, 2020), there are limitations and strengths in each. Each one requires the researcher determine what an ideal shape is (e.g., the Polsby-Popper assumes a circle with no indentations is the ideal shape) and to compare the real districts to the ideal ones. Also, there is no universally accepted threshold for when any of these indices indicate that a district is "officially gerrymandered."

In order to deal with these limitations, we took two additional steps. One, we explored which districts are in the bottom quartile across multiple indices in order to reduce our reliance

on a single measure. Two, we used a demographic approach to gerrymandering by comparing the racial composition of a district to the racial composition of the region in which a district is located. This comparison builds upon prior research that relies upon the concept of "local environments" (see Reardon and O'Sullivan [2004] and the appendix of Saporito [2017] for more details). A local environment is the area surrounding each person. We crafted a local environment for each person in a district that consisted of their nearest N residents (where N equals the number of people in a district). Since we do not access to the actual residential locations of individuals, we assume that people live in the middle of their census block group.

As an example, suppose District X contains 300,000 residents who live in 150 block groups. For each block group in District X, we determined their nearest 300,000 residents. Once the nearest 300,000 residents were identified for all block groups, referred to as the local environment, we calculated the percent of people in a district's region who are members of a particular racial group using the following equation (with Latinx as an example):

$$Latinx\ LE(D_i) = \sum_{b=1}^{n} \frac{Number\ of\ Latinx\ residents\ in\ LE_b}{Number\ of\ total\ residents\ in\ LE_b} * \frac{Number\ of\ residents\ in\ block\ group_b}{Number\ of\ total\ residents\ in\ district_i} * 100$$

We divided the total number of Latinx residents in each local environment of block group *b* by the total number of residents in the local environment of block group *b* and weighted that share by the proportion of residents in community college district *i* who live in a block group. In the above example, this denominator is 300,000. After weighting, we multiplied that ratio by 100, creating a percentage. We then summed all of the weighted percentages of Latinx residents for each block group within community college district *i.* Continuing the prior example, this would

involve summing the weighted percentage of Latinx residents for all 150 block groups. This created a district-level measure of the average percentage of Latinx people across all local environments. This result represents the racial composition of the region in which a district is located.

We then subtracted the percentage of residents in a district's region who belong to a given racial group (local environments) from the actual percentage of people in a community college district who are members of that racial group. For example, if the percentage of people in a district who are Latinx is 70 and the percentage of people in the district's region who are Latinx is 70, this difference of 0 suggests that the people who drew the district did not manipulate the district to make it more or less racially diverse than the region in which is was located. This additional gerrymandering analysis method allowed us to explore how many districts in Texas have racial compositions different from that of their surrounding region (while the other measures focus solely on who lives within the hypothetical boundaries, regardless of race). We calculated percentage-point differences for White, Black, Latinx, Asian, Pacific Islander, Native American/Alaskan Native, two or more race, and other race residents.

These two different levels of analysis, for research questions one and two, allowed the current study to investigate the political process that drives district boundary creation across the United States and whether there is evidence of gerrymandering in the creation of Texas community colleges' district boundaries. Throughout the entire research study, the research team has consulted with expert peer debriefers, such as the Texas Association of Community Colleges (an intermediary organization that represents all Texas community colleges) and the Texas Legislative Council (a nonpartisan legislative agency that provides research and all official state maps to the Texas state legislature) to allow our research team to create a deep understanding of

the political processes behind district formation in Texas, to ensure that maps are being created appropriately, and to incorporate field standards for design and sample decisions.

Results

National Overview

Our analysis of state constitutions, education codes, policy documents, and direct communications with government or higher education officials found that 38 states have community college districts that dictate a specific area of the state that the community college should focus on serving. Table 1 includes a full list of all 50 states and whether that state had a policy in academic year 2020-2021. There was no clear regional pattern to which states have a policy. It does appear that states with smaller populations (e.g., Rhode Island) or with greater geographic dispersion (e.g., Hawai'i) were less likely to have a policy. Due in part to some states having multiple geographic regions (e.g., local taxing districts and service areas), the terms for these areas varied widely. Fifteen states used the term "district" while sixteen used the term "service area" or "service region".[9] Some states used a combination of these terms. Single states used phrases like "geographic areas of responsibility" (New Mexico), "merged areas" (Iowa), and "sponsor areas" (Pennsylvania). On average, states had approximately 20 community college districts (ranging from 2 to 73). We also explored what underlying boundaries states used to create these districts. The majority of states created these districts using a combination of county (76%), K-12 school (37%), and city (26%) boundaries.[10] A small share of states also used local streets, highways/interstates, and waterways to define boundaries for the districts.

[9] As we note later in the results section, some states have multiple geographic areas. For the statistics in this sentence, we only explore the names for the most inclusive geographic area.
[10] We noted that boundaries were based on cities if states included cities, municipalities, or townships.

We found similar language detailing the districts and their purposes across the different states. In Arkansas, the legislative text mentioned that "'Community college' means an institution of higher education established or to be established under the provisions of this chapter dedicated primarily to the educational needs of the service area and offering a comprehensive program, including, but without limitation, vocational, trade, and technical specialty courses and programs, college transfer courses, and courses in general adult education" (Arkansas Code 6-53-103). Colorado's Revised Statutes notes that "The mission of the community colleges shall be to serve Colorado residents who reside in their service areas by offering a broad range of general, personal, career, and technical education programs" (Colorado Revised Statutes 23-60-201). In Texas's education code, community colleges are defined as "…two-year institutions primarily serving their local taxing districts and service areas in Texas and offering vocational, technical, and academic courses for certification or associate degrees" (Texas Education Code 130.011).

The Texas legislative language also provides an example of another trend. Of the states with districts, five had two different types of geographic areas to which community colleges were tasked with attending. When states had multiple areas, these geographic zones were typically a smaller taxing district and a larger service region. The institutions were tasked with crafting courses and majors based on the larger service regions while the taxing area drove additional funding for the institutions and provided taxing-area residents with reduced tuition rates. When investigating the states that only had one geographic area, we found that 11 additional states also had a tuition reduction based on residency within the district (which means 16 states total had some type of tuition reduction associated with residency within a region of the state). When there were multiple geographic zones associated with community colleges, we

focused our review on the larger service areas. We made this decision for several reasons, including the fact that these types of geographic areas were bigger, encompassed the smaller taxing districts generally, and dictated who institutions are supposed to target with their policies and curriculum.

The political actors who played a role in the formation of these districts varied across states. Approximately 28% of states involved the state legislature, 25% involved residents, and 84% involved at least one additional party (these numbers are not mutually exclusive). The additional party was typically a governing or coordinating board for education, higher education, or community colleges. Several states also included the county commissioners responsible for arranging a local election.

Case Study of Texas

Texas is a useful state for a case study for the second question for three reasons. First, the community college sector in Texas is robust and has significant racial variation. Texas has 82 community colleges that educate over 700,000 students, 70% of whom are students of color (THECB, 2018). Second, the results of this study are useful beyond Texas. Texas public community colleges have competitive average tuition and fees below the national average (THECB, 2018), which likely correlates with students including community colleges as part of the college search and enrollment process. Third, Texas has publicly available narrative information on each district's boundaries. As noted in the methods section, Texas enshrined community colleges' districts into the Texas Education Code and lists each geographic area in text. A case study of Texas's community college district boundaries provides evidence that can be used to create a national study or similar case study of another state, while providing grounds for the creation of better state and local policies in and outside of Texas.

In 1995, Senate Bill 397 created service area districts in Texas.[11] The state has 82 community colleges serving 50 districts. The legislature has ultimate control over the construction of the districts. The district boundaries have been changed 18 times, with the last changes adopted in 2015. Figure 1 shows the districts in our most recent year of data, 2017-2018, with shading highlighting how many residents are served (from yellow to red, where districts that are more red serve more residents). There is a clear trend that districts in the major metropolitan areas (Dallas-Fort Worth, Austin-San Antonio, Houston, and El Paso) serve the largest number of residents. To explore this further, we turn to the statistical analyses of gerrymandering.

Table 2 provides summary statistics on the three traditional measures of compactness. In general the Polsby-Popper and Reock ratios were fairly similar (logical as both create an "ideal" district that is a circle). These two measures had an average of 0.34 and 0.48, respectively and similar values at the 25th percentile (0.21 and 0.23 respectively). However, the Convex Hull ratios were substantially higher with an average of 0.82 and a 25th percentile threshold of 0.75. Since a ratio closer to 0 generally indicates a less compact district, these results mean that, on average, the Polsby-Popper and Reock indices indicated a larger share of the Texas districts may exhibit evidence of gerrymandering compared to the Convex Hull. As noted in the methods section, due to the varying limitations of each measure and lack of an accepted threshold, we focused on districts that are in the bottom quartile of at least two different measures.

Of the 50 districts, 8 were in the bottom quartile on two measures (Bee, Blinn, Borger, Houston, Howard, North Central Texas, Western Texas, Wharton County) and 2 were in the bottom quartile on all three (Galveston and Ranger). There was no clear pattern to the districts

[11] While the state refers to these areas as "service areas" in order to differentiate them from smaller, local taxing districts, we refer to them as districts for the rest of the paper to align with the national analysis.

that were consistently in the bottom of the different measures' distributions. For example, out of the 8 districts that were only in the bottom for two measures, 4 were in the bottom for Polsby-Popper, 6 were in the bottom for the Reock, and 6 were in the bottom for Convex Hull (which had a distribution centered at a significantly higher mean). Figure 2 provides a scatterplot of each measure for any institution in the bottom quartile on at least two measures. The x-axis includes a masked number identifying each district. Each district's three different indices are included in a vertical line to show the variation in the gap between measures for each district. We found significant variation across the districts in both the individual ratio for each measure as well as the differences across the measures. When we explored these 10 districts spatially, two districts include non-continguous portions of the state within their boundaries (North Central Texas College and Ranger College). Overall, while there was no threshold we could use to assess whether a district is or is not gerrymandered, the indices for several districts appear to suggest that further exploration is warranted.

When comparing the racial composition of a district to that of the region in which the district is located, we found that 12 community college districts had a difference in the share of residents compared with the local environment share that potentially indicates gerrymandering (typically five or more percentage points). Figure 3 shows a histogram of the differences for White, Latinx, Black, and Asian residents. Interpreting the top-left graph as an example, the x-axis represents the difference between the percentage of residents in the district who are White and the percentage of residents in a district's region who are White. Negative values for this difference mean that the district percentage was higher than the local environment percentage. The y-axis shows the number of districts with the respective values. We found that the majority of districts have small differences in the White resident share within districts and their region.

There were 10 districts that have differences that may indicate gerrymandering for White residents. Turning to the other panels in Figure 1, we similarly found that the majority of districts have small differences though there are some districts that merit further study (6 for Latinx residents, 4 for Black residents, and 1 for Asian residents). All other racial groups' differences were extremely small and do not provide evidence of racial gerrymandering (appendix Figure A1 shows the histogram for Pacific Islander, Native American/Alaskan Native, two or more races, or other race).

Table 3 shows the differences for all districts with at least one racial group that merits further exploration for gerrymandering. We found that Alvin Community College Service Area has an 11 percentage point differential for White residents and a -8 for Black residents. This means that the district had a larger share of White residents than its region while it also had a smaller share of Black residents. Four additional service areas had larger shares of White residents and smaller shares of either Black or Latinx residents when comparing districts to local environments (Hill and Navarro for Black residents and Lone Star and Trinity Valley for Latinx residents). Wharton County Junior College Service Area had a larger percentage of White and Latinx residents and a smaller share of Black and Asian residents. Finally, Dallas County Community College Service Area had a smaller percentage of White residents at the same time that Collin College Service Area (the neighboring district) had a larger percentage of White residents compared to their respective local environments. This is particularly of note as these differences were both approximately 7 percentage points, seeming to indicate a fairly even trade between the districts.

Interestingly, we found that only one Texas district, Wharton County, exhibited evidence of gerrymanding using the older (Polsby-Popper, Convex Hull, and Reock) and newer (local

environments) methods. We did not find a clear geographical pattern to our findings. These different conclusions based on the different analysis methods reinforces why we used several different methods to explore the case study of Texas's community college districts. Still, regardless of method, there does appear to be nascent evidence that some of the community college district boundaries may exhibit signs of gerrymandering.

Discussion

We found significant variation across states in their political structures for the creation of community college districts. We also found evidence that some of the districts in Texas may exhibit evidence of gerrymandering particularly along racial dimensions. While higher education research more commonly examines policy impacts than the political structures that undergird state higher education policy (McLendon, 2003), these structures themselves can have a lasting influence on the educational decisions and experiences of students. In Texas, it appears that there may be some districts that could be redrawn in a manner that would create more compact geographic areas. This possibility warrants further study by Texas policymakers. Further, the local environment analysis shows that the overwhelming majority of Texas districts with significant differences decreased their share of White residents (a notable exception being Dallas County which appears to tradeoff White residents for Collin County, a conservative suburb of Dallas).

The national analysis shows that the majority of states created some type of community college district to determine whom the institution targets. The majority of these districts' boundaries relied on other political geographic areas such as counties, cities, and K-12 school zones. Therefore, it is likely that gerrymandering in these other political boundaries could also play a role in determining which community colleges students choose to attend. Further, around

40% of the states with districts had some sort of tuition reduction for students who resided within a certain area of the state. Frequently, within states that had a tuition reduction, all geographic areas of the state were not included in the tuition reduction areas (meaning some residents within those states would still have to pay a higher "in-state" rate even if they attended their in-district institution). Therefore, even among states with community college districts, there can be a different incentive structure for residents to attend their in-district institution.

There is still a significant amount of information the field and policymakers do not know about these policies. One of the central contributions of this study is Table 1, which provides an overview of each state and whether it has a community college district policy. We hope that our paper will help provide a basis for other scholars to explore the process stakeholders use to change these district boundaries, the motivations behind changes, how frequently changes are enacted across the country, as well as the causal impact of these policies on students' higher education enrollment and success. In some states, community college district policies are more of a historical fact or considered a "gentleman's agreement" as one state representative shared with the research team. In others, these boundaries are vigorously contested and being changed even as we collected the data for this research project. The current study provides an overview of the national landscape of community college districts while also shining a light on areas that are still understudied.

Based on our findings, two areas of future research are of particular importance. First, it would be useful to understand how the differences in who has political ownership of this policy relate to other political or education characteristics of states. It could be that states that include the legislature in boundary decision-making drastically differ from states that give authority to the higher education governing board. Knowing this could expand the field's understanding of

the political dynamics relating to these policies. Second, a deeper understanding of how states decide to provide a tuition discount and how that is funded is necessary. Prior scholarship has focused on whether these tuition discounts incentivize students to attend their designated institution, which they appear to do (e.g., Acton, 2020). However, there is no systematic evidence surrounding how these tuition discounts are funded nor is there a clear explanation of why some states choose to have multiple geographic areas (separating the target population for the institution from who receives a tuition discount) and others have a single area (defining both who is the target population and receives tuition discounts). Future research addressing these points would both expand the field's understanding of community college districts and provide state policymakers and policy intermediary organizations with a stronger understanding of the policy practices and motivations of other states.

The case study of Texas provides evidence that there are some districts that appear to merit further consideration for whether racial gerrymandering is present. Similar to the conclusions drawn by Richards and Stroub (2015) regarding K-12 attendance zones, we note that there is suggestive evidence that the boundaries of the Texas districts may have been created to concentrate certain groups of residents within certain districts. It appears that there may be a "student exchange" occurring with tradeoffs in residents between districts. We found this evidence using both older and newer analysis methods assessing gerrymandering. This work is part of a larger research project that also analyzes the relationship between the political decisions driving district boundary creation and racial segregation across community colleges within the state of Texas. Therefore, while we cannot posit on whether this relates to segregation in Texas community college enrollment, we note that future research must consider how these districts are crafted when including them in research. Community college district boundaries are not neutral;

in fact, we found evidence that the drawing of several of these boundaries in Texas, or the boundaries they are based on, may relate to the racial demographics of residents. Our findings emphasize that district boundaries are political artifacts; future research and policy must treat them as such.

Understanding how states determine who the "community" is for a community college is a vital undertaking. There is real potential that the manner in which these districts are crafted directly relates to racial segregation between community colleges. Given that community colleges educate a significant share of the US postsecondary education population, it is profoundly important to understand whether the policies determining who is served by certain community colleges are politically driven to exacerbate racial segregation.

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Table 1. List of all states with policy status.

	State has a CC district
Alabama	1[a]
Alaska	0
Arizona	1
Arkansas	1
California	1
Colorado	1
Connecticut	1[b]
Delaware	0
Florida	1
Georgia	0
Hawaii	0
Idaho	1
Illinois	1
Indiana	1
Iowa	1
Kansas	1
Kentucky	1
Louisiana	0
Maine	1
Maryland	1
Massachusetts	1
Michigan	1
Minnesota	0
Mississippi	1
Missouri	1
Montana	1
Nebraska	1
Nevada	0
New Hampshire	0
New Jersey	1
New Mexico	1
New York	1[c]
North Carolina	1
North Dakota	0
Ohio	1
Oklahoma	1
Oregon	1
Pennsylvania	1
Rhode Island	0
South Carolina	1
South Dakota	0
Tennessee	1

Texas	1
Utah	1
Vermont	0
Virginia	1
Washington	1
West Virginia	1
Wisconsin	1
Wyoming	1

[a] Alabama historically had community college districts. In the 2015 state reorganization, a Board of Trustees was created which is now responsible for all community colleges and is currently reviewing the district policy that was adopted by the former governing body (as of July 2021).
[b] Connecticut is currently pursuing a merger of its community colleges which will likely make its districts obsolete (though that has not been determined as of July 2021).
[c] New York has two different community college systems (the State University of New York System and the City University of New York). As both systems include community college districts for residents, we consider this state to have a district policy.

Table 2. Summary statistics of compactness indices.

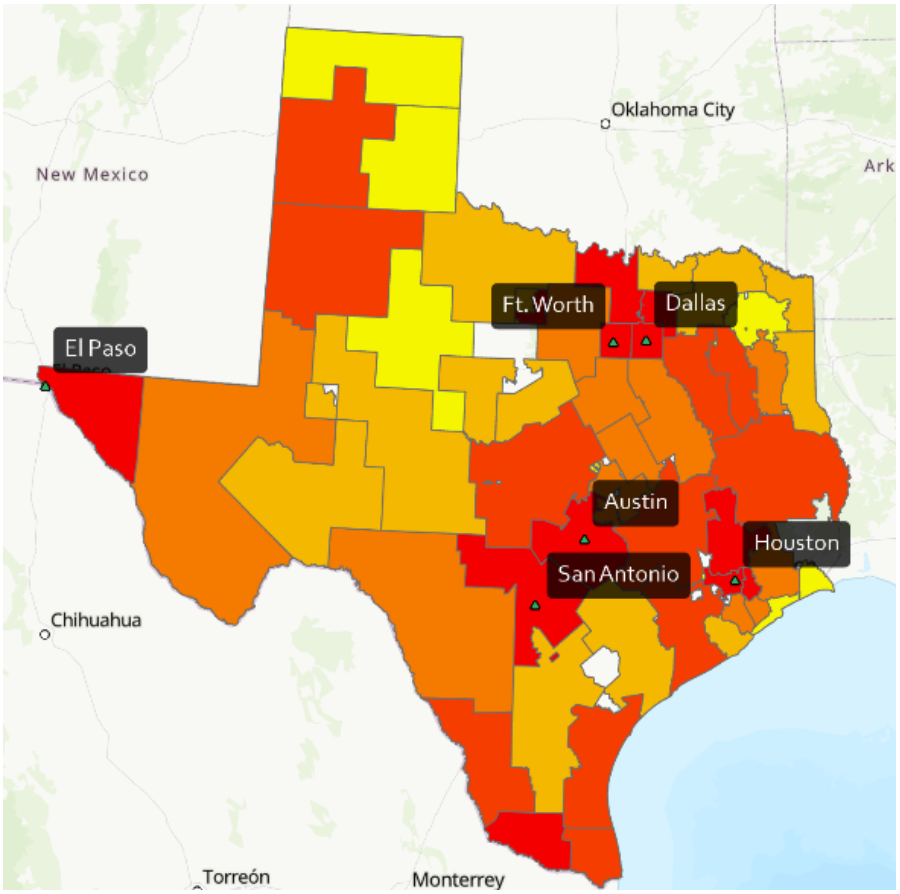
	Mean	SD	Minimum	25th Percentile	Maximum
Polsby-Popper	0.34	0.16	0.10	0.21	0.78
Reock	0.48	0.27	0.02	0.23	1.00
Convex Hull	0.82	0.18	0.05	0.75	1.00
N	50	50	50	50	50

Table 3. Community college districts with local environments substantially different from the district.

	White	Latinx	Black	Asian
Alvin	11.13		-8.10	
Collin	6.51			
Dallas	-7.15			
Hill	9.28		-7.26	
Lone Star	7.54	-5.41		
Navarro	13.77		-14.00	
Northeast Texas	-8.00	7.05		
Odessa		5.12		
Southwest Texas		6.34		
Trinity Valley	8.46	-5.81		
Weatherford	6.80			
Wharton	8.13	6.32	-5.45	-8.67

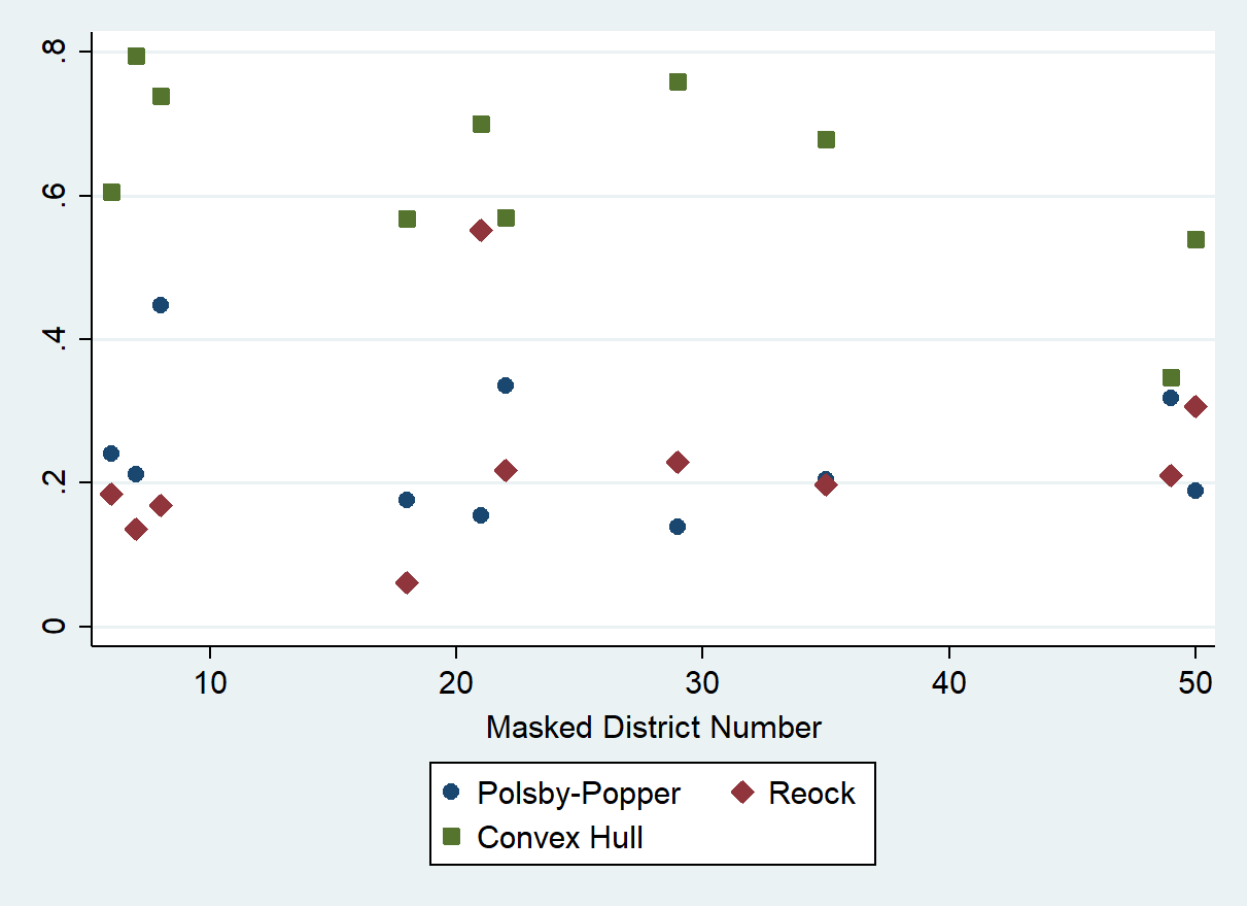
Note: Substantial difference is measured as five percentage points difference in either direction. Positive values reflect a district percentage that is higher than the local environment. Negative values reflect a district percentage that is lower than the local environment.

Figure 1. Texas community college districts shaded by number of residents served.



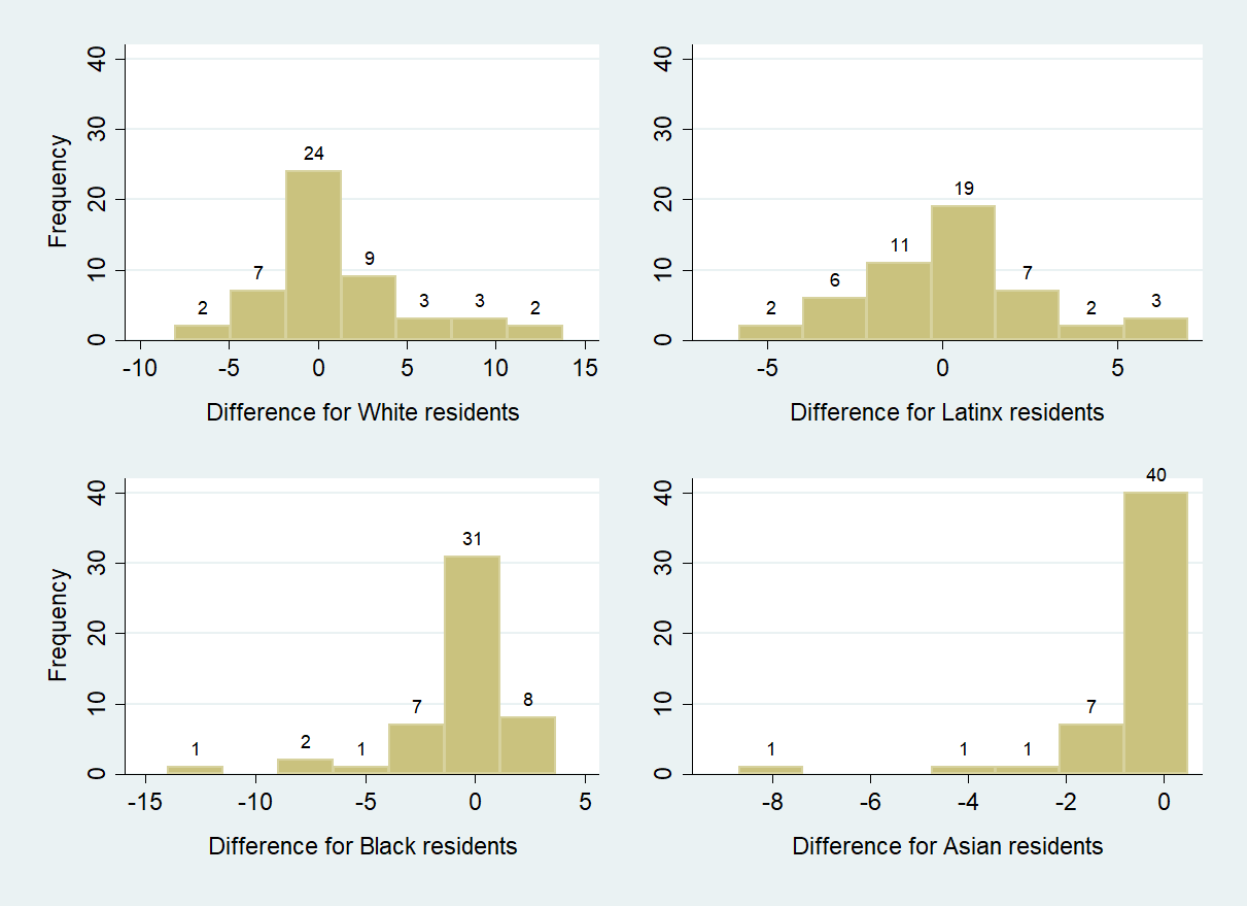
Note: District shading goes from yellow (fewer residents served) to dark red (more residents served). White areas are parts of Texas that are not located within a district. Green triangles represent the major metropolitan areas.

Figure 2. Comparison of three traditional measures of compactness for districts in the bottom quartile of at least two measures.



Note: The x-axis includes a masked district number. The ten districts included in the figure are in the bottom quartile of at least two measures of compactness. Each district's three different ratios are included in a vertical line.

Figure 3. Histogram of the frequency of differences in district residents and local environment residents.



Note: Each panel shows the difference between the share of each racial group in the Texas community college district and the weighted share of each racial group in the local environment of the district. Estimated separately for White, Latinx, Black, and Asian residents.

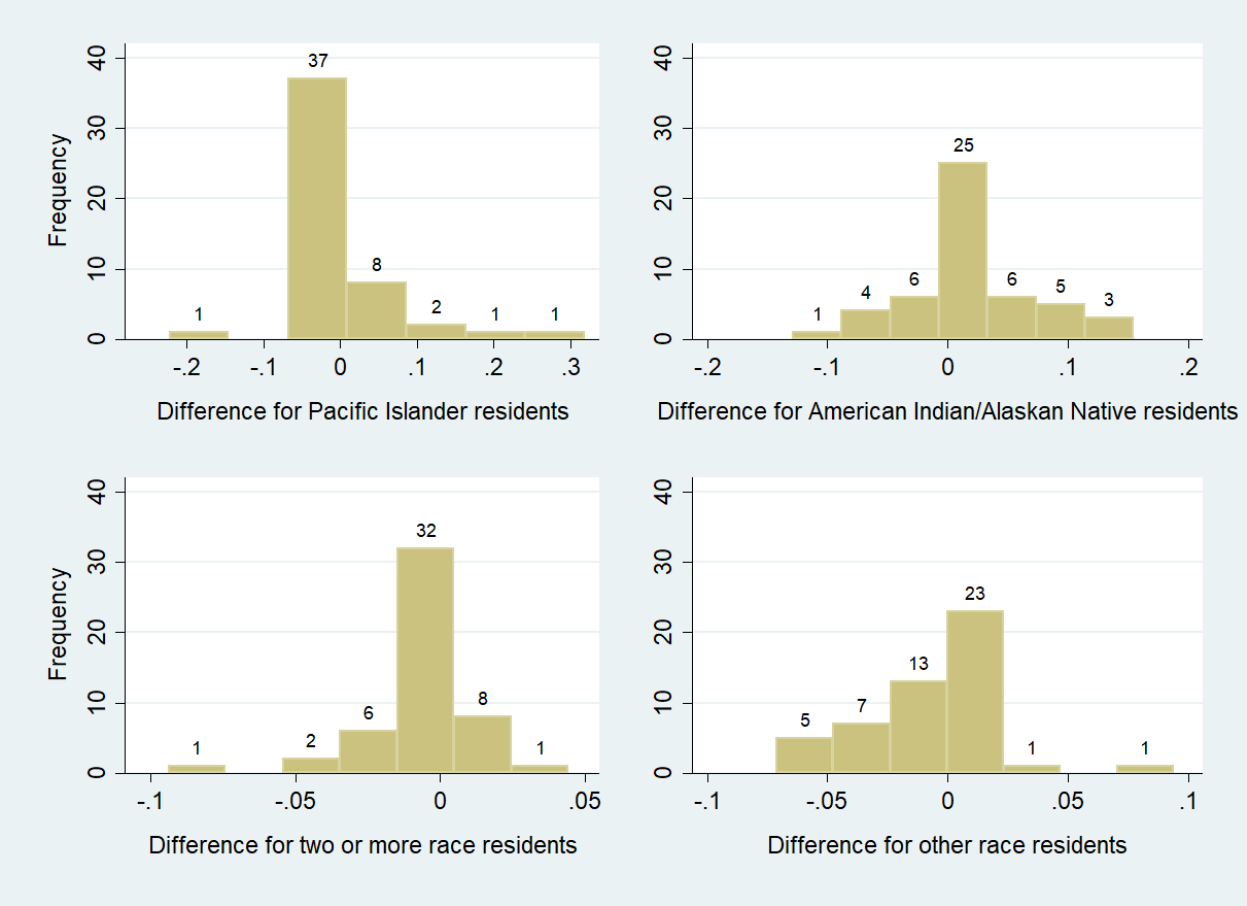
Appendix

Table A1. Coding frame for nationwide data collection.

ITEM	Question	Rules for responses
item1	Do this state's community colleges have some type of service area?	**1**=YES **0**=NO
item2	Are areas within boundaries explained in narrative?	**1**=YES **0**=NO **-3**=N/A because no service areas (0 for item1)
item3	Does the legislature have a role in setting the policy?	**1**=YES **0**=NO **-3**=N/A because no service areas (basically a 0 for item1)
item4	If yes, then which part of the legislature?	**TEXT**=If item3 equals 1, then fill this in **-3**=N/A because item3 equals 0 or -3
item5	If yes, then what is the role?	**TEXT**=If item3 equals 1, then fill this in **-3**=N/A because item3 equals 0 or -3
item6	Do residents have a role in setting the policy?	**1**=YES **0**=NO **-3**=N/A because no service areas (basically a 0 for item1)
item7	If yes, then which part of the legislature?	**TEXT**=If item6 equals 1, then fill this in **-3**=N/A because item6 equals 0 or -3
item8	If yes, then what is the role?	**TEXT**=If item6 equals 1, then fill this in **-3**=N/A because item6 equals 0 or -3
item9	Who else has a role to play in determining the boundaries?	**TEXT**=Write in the answer to this question if someone else has a role **-3**=N/A because no one else has a role

item10	What is their role?	**TEXT**=Write in the answer to this question if someone else has a role **-3**=N/A because no one else has a role
item11	Is there a tuition reduction for the service area?	**1**=YES **0**=NO **-3**=N/A because no service areas (basically a 0 for item 1)
item12	If not, is there an additional service area only for the tuition differences?	**1**=YES & there's a 0 on item11 **0**=NO & there's a 0 on item11 **-3**=N/A because no service areas (0 for item1) OR there's a tuition reduction in the service area (1 for item11)
item13	Is there a map that goes along with the legislation for the districts in each state?	**1**=YES **0**=NO **-3**=N/A because no service areas (basically a 0 for item1)
item14	What terms are used to refer to "college districts" in the legislation?	**TEXT**=Write in the terms if there are service areas (so a 1 for item1) **-3**=if there are no service areas (so 0 for item1)
item15	How many CC school districts do states have?	**NUMBER**=Count however many service areas there are if there are any (so a 1 for item1) **-3**=N/A because no service areas (0 for item1)
item16	What are the service area boundaries based on?	**TEXT**=Write in what the service area boundaries are based on (for example, county lines, school district lines) **-3**=if there are no service areas (so 0 for item1)

Figure A1. Histogram of the frequency of differences in district residents and local environment residents.



Note: Each panel shows the difference between the share of each racial group in the Texas community college district and the weighted share of each racial group in the local environment of the district. Estimated separately for Pacific Islander, American Indian/Alaskan Native, two or more race, and other race residents.