IN THE SUPREME COURT OF OHIO

Regina C. Adams, *et al.*,

              Petitioners,

   v.

Governor Mike DeWine, *et al.*,

             Respondents.

Case No. 2021-1428

Original Action Filed Pursuant to Ohio Const., Art. XIX, Sec. 3(A)

EVIDENCE TO MOTION TO ENFORCE COURT'S ORDER – VOLUME 4
(Expert Affidavit of Dr. Jowei Chen & Exhibits)

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Regina C. Adams, *et al.*,	
Relators,	
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Governor Mike DeWine, *et al.*,	Constitution, Article XIX, Section 3(A)
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EXPERT AFFIDAVIT OF DR. JOWEI CHEN

I, Jowei Chen, having been duly sworn and cautioned according to law, hereby state that I am over the age of eighteen years and am competent to testify to the facts set forth below based on my personal knowledge and having personally examined all records referenced in this affidavit, and further state as follows:

I.   INTRODUCTION AND SUMMARY OF FINDINGS

1. Petitioners' counsel asked me to analyze the Ohio Redistricting Commission's Revised Congressional Plan (the "2022 Revised Plan"), as adopted by the Commission on March 2, 2022. Specifically, I was asked to analyze:

    a. Does the 2022 Revised Plan favor either the Democratic or Republican party in a manner that cannot be explained by the redistricting criteria required by the Ohio Constitution?

    b. Can the 2022 Revised Plan's treatment of Ohio's most populous counties be explained by the redistricting criteria required by the Ohio Constitution?

    c. Is the 2022 Revised Plan a product of an attempt to draw districts that are compact?

    d. Can the partisan characteristics of the 2022 Revised Plan be explained by Ohio's political geography?

2. In my December 10, 2021 expert report in this case, I answered these same questions with respect to Ohio's 2021 Congressional Plan (the "2021 Enacted Plan"), as created by the General Assembly's Substitute Senate Bill 258. To answer these questions in my December 10, 2021 report, I compared the 2021 Enacted Plan to 1,000 computer-simulated districting plans drawn according to the nonpartisan criteria specified by the Ohio Constitution. I found that the 2021 Enacted Plan is an extreme partisan outlier, both at a statewide level and with respect to the partisan characteristics of its individual districts. The 2021 Enacted Plan exhibited partisan characteristics that are more favorable to the Republican Party than the partisan characteristics of nearly all of the computer-simulated plans. These partisan

characteristics of the Enacted Plan were enabled by the drawing of districts across the state that are far less geographically compact than was reasonably necessary given Ohio's political geography and the requirements of the Ohio Constitution.

3.   In this report, I again used these same 1,000 computer-simulated congressional plans as a baseline for comparing the characteristics of the Commission's 2022 Revised Plan. Map 1 displays the geographic boundaries of the 2022 Revised Plan and reports the populations, compactness scores, and split counties for each of its 15 districts. In summary, I found that the 2022 Revised Plan (a) does clearly and decidedly favor the Republican Party; (b) contains certain splits of political subdivisions that are unnecessary to achieve compliance with any districting requirements; and (c) contains districts that are less compact than those in other plans drawn in compliance with the Ohio Constitution. When compared to 1,000 computer-simulated districting plans drawn according to the nonpartisan criteria specified by the Ohio Constitution,[1] the Revised Plan is an extreme partisan outlier, both at a statewide level and with respect to the partisan characteristics of its individual districts. The 2022 Revised Plan exhibits partisan characteristics that are more favorable to the Republican Party than the partisan characteristics of nearly all of the computer-simulated plans. These partisan characteristics of the Revised Plan were enabled by the drawing of districts across the state that are far less geographically compact than was reasonably necessary given Ohio's political geography and the requirements of the Ohio Constitution.

4.   Article XIX, Section (1)(C)(3) of the Ohio Constitution mandates three requirements for a congressional plan passed by a simple majority of each house of the General Assembly. First, the plan may not "unduly favor[] or disfavor[] a political party." Second, the plan may not unduly split counties, townships, and municipal corporations. Third, the General Assembly "shall attempt to draw districts that are compact."

5.   As explained in detail in my original December 10, 2021 expert report, I programmed a computer simulation algorithm to produce the 1,000 computer-simulated plans for Ohio's congressional districts by following the required districting criteria enumerated in Article XIX of the Ohio Constitution. Throughout this report, I evaluate the Commission's compliance with these three mandates by comparing the 2022 Revised Plan to the 1,000 computer-simulated plans. By comparing the 2022 Revised Plan to the computer-simulated plans, I am able to assess whether the 2022 Revised Plan's partisan characteristics, governmental division splits, and compactness can be explained by other redistricting criteria. I determined that they cannot.

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[1] Block assignments files for each of the 1,000 plans were submitted to the Court under separate cover. *See* Affidavit of Derek S. Clinger (December 10, 2021).

Map 1:
Ohio Redistricting Commission's March 2, 2022 Revised Plan

District:	Population:	Reock:	Popper–Polsby:
1	786,630	0.287	0.24
2	786,629	0.383	0.3
3	786,630	0.593	0.487
4	786,630	0.297	0.294
5	786,630	0.205	0.191
6	786,630	0.328	0.217
7	786,630	0.338	0.225
8	786,629	0.366	0.302
9	786,630	0.203	0.244
10	786,630	0.432	0.408
11	786,630	0.548	0.412
12	786,630	0.611	0.298
13	786,630	0.494	0.285
14	786,630	0.554	0.689
15	786,630	0.231	0.141
Average:	786,629.9	0.391	0.316

14 Split Counties:
Clark (Districts 10, 15)
Cuyahoga (Districts 11, 7)
Delaware (Districts 12, 4)
Fayette (Districts 15, 2)
Franklin (Districts 15, 3)
Hamilton (Districts 1, 8)
Holmes (Districts 12, 7)
Miami (Districts 15, 8)
Portage (Districts 13, 14)
Shelby (Districts 15, 4)
Stark (Districts 13, 6)
Tuscarawas (Districts 12, 6)
Wood (Districts 5, 9)
Wyandot (Districts 4, 5)
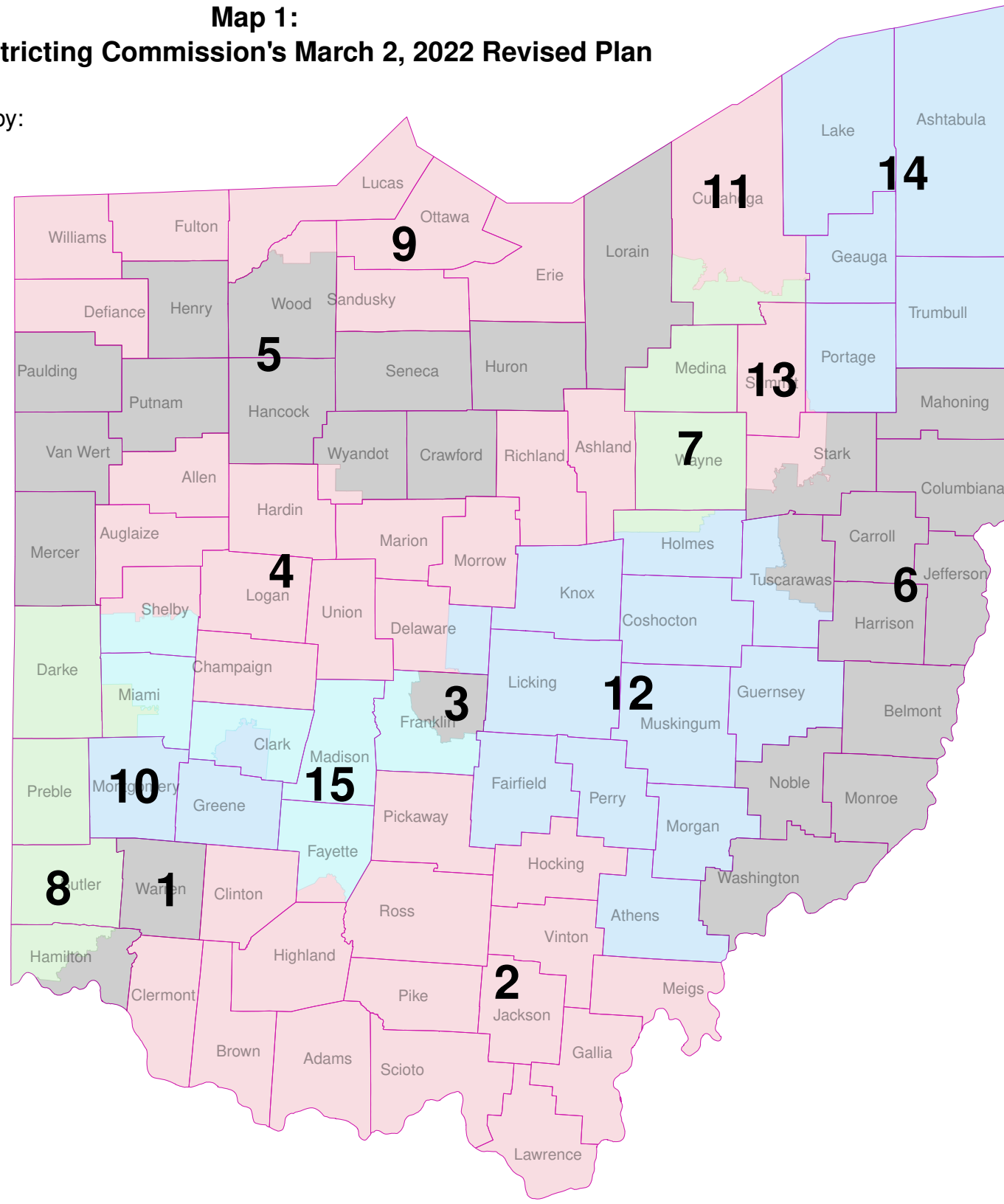
II. DATA SOURCES

6. I relied upon the following data files. First, I downloaded the 2020 decennial Census PL 94-171 redistricting data files[2] reporting population at the Census block level in Ohio, as released in the Census Bureau's "legacy format data" on August 12, 2021. Second, I downloaded Census Bureau shapefiles[3] depicting the 2020 boundaries of Ohio's Census geographies, including Ohio's Census blocks, cities, villages, townships, and counties. Third, I downloaded shapefiles reporting the precinct-level election results of Ohio's 2016, 2018, and 2020 statewide election contests from Redistricting Data Hub.[4] Finally, Petitioners' counsel provided me with block assignment files depicting the geographic boundaries of the 2021 Enacted Plan and the 2022 Revised Plan.

III. MEASURING THE PARTISAN CHARACTERISTICS OF OHIO CONGRESSIONAL DISTRICTS

7. As explained in my original December 10, 2021 expert report, I use actual election results from recent, statewide election races in Ohio to assess the partisan performance of every congressional plan I analyzed. Overlaying these past election results onto a districting plan enables me to calculate the Republican (or Democratic) share of the votes cast from within each district in the 2022 Revised Plan and in each simulated plan. I am also able to count the total number of Republican and Democratic-favoring districts within each simulated plan and within the 2022 Revised Plan. All of these calculations thus allow me to directly compare the partisanship of the 2022 Revised Plan and the simulated plans.

8. ***The 2016-2020 Statewide Election Composite:*** To measure the partisanship of all districts in the computer-simulated plans and the 2022 Revised Plan, I used the results of all statewide election contests held in Ohio for political (non-judicial) offices during 2016-2020. There were nine such elections: The 2016 US President, 2016 US Senator, 2018 Attorney General, 2018 Auditor, 2018 Governor, 2018 Secretary of State, 2018 Treasurer, 2018 US Senator, and 2020 US President elections.

9. I obtained precinct-level results for these nine elections, and I disaggregated these election results down to the Census block level. I then aggregated these block-level election results to the district level within each computer-simulated plan and the 2022 Revised Plan, and I calculated the number of districts within each plan that cast more votes for Republican than Democratic candidates. I use these calculations to measure the partisan performance of each simulated plan analyzed in this report and of the 2022 Revised Plan. In other words, I look at the census blocks that would comprise a particular district in a given simulation and, using the actual election results from those census blocks, I calculate whether voters in that simulated district collectively cast more votes for Republican or Democratic candidates in the 2016-2020 statewide election contests. I performed such calculations for each district

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[2] Available at: https://www2.census.gov/programs-surveys/decennial/2020/data/01-Redistricting_File--PL_94-171/Ohio/

[3] Available at: https://www2.census.gov/geo/tiger/TIGER2020PL/STATE/39_OHIO/39/

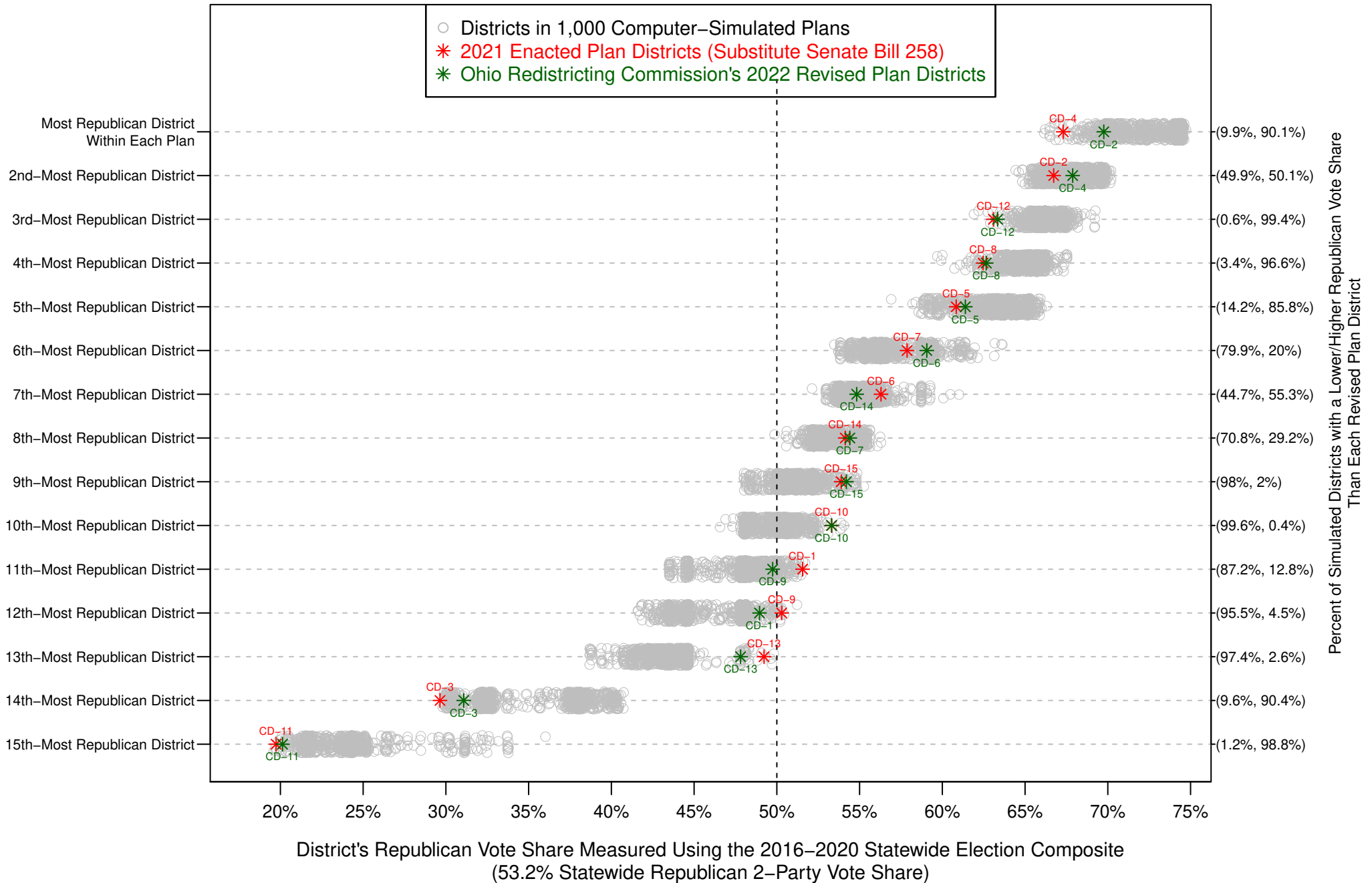[4] Available at: https://redistrictingdatahub.org/state/ohio/

under each simulated plan to measure the number of districts Democrats or Republicans would win under that particular simulated districting map.

10. I refer to the aggregated election results from these nine statewide elections as the "2016-2020 Statewide Election Composite." For the 2022 Revised Plan districts and for all districts in each of the 1,000 computer-simulated plans, I calculate the percentage of total two-party votes across these nine elections that were cast in favor of Republican candidates in order to measure the average Republican vote share of the district. In the following section, I present district-level comparisons of the 2022 Revised Plan and simulated plan districts in order to identify whether any individual districts in the 2022 Revised Plan are partisan outliers. I also present plan-wide comparisons of the 2022 Revised Plan and the simulated plans in order to identify the extent to which the 2022 Revised Plan is a statistical outlier in terms of common measures of districting plan partisanship.

IV.   PARTISAN CHARACTERISTICS OF THE 2022 REVISED PLAN

11. In this section, I present partisan comparisons of the 2022 Revised Plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level using several common measures of districting plan partisanship. First, I compare the district-level Republican vote share of the 2022 Revised Plan's districts and the districts in the computer-simulated plans. Next, I compare the number of Republican-favoring districts (that is, the number of districts with a two-party Republican vote share of greater than 50%) in the 2022 Revised Plan and in the computer-simulated plans. Included for reference are comparable values for the 2021 Enacted Plan. Overall, I find that several individual districts in the 2022 Revised Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely observed in the computer-simulated plan districts drawn according to the Ohio Constitution's districting requirements. The partisan characteristics of the 2022 Revised Plan are consistent with an effort to favor the Republican party by packing Democratic voters into a small number of districts that very heavily favor the Democratic party. While several districts have become slightly less Republican-favoring under the 2022 Revised Plan as compared to the Enacted Plan, the overall effect of the plan is to dilute Democratic voting power by packing an unusually large number of Democrats into safely Democratic districts. Moreover, I find that at the plan-wide level, the 2022 Revised Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans, and which is unchanged from the 2021 Enacted Plan to the 2022 Revised Plan. I describe these findings in detail below:

Figure 1: Comparisons of 2022 Revised Plan and 2021 Enacted Plan Districts to 1,000 Computer–Simulated Plans' Districts

Legend:
- ○ Districts in 1,000 Computer–Simulated Plans
- ✳ (red) 2021 Enacted Plan Districts (Substitute Senate Bill 258)
- ✳ (green) Ohio Redistricting Commission's 2022 Revised Plan Districts

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Y-axis (right) — Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Revised Plan District:
- (9.9%, 90.1%)
- (49.9%, 50.1%)
- (0.6%, 99.4%)
- (3.4%, 96.6%)
- (14.2%, 85.8%)
- (79.9%, 20%)
- (44.7%, 55.3%)
- (70.8%, 29.2%)
- (98%, 2%)
- (99.6%, 0.4%)
- (87.2%, 12.8%)
- (95.5%, 4.5%)
- (97.4%, 2.6%)
- (9.6%, 90.4%)
- (1.2%, 98.8%)

X-axis: District's Republican Vote Share Measured Using the 2016–2020 Statewide Election Composite (53.2% Statewide Republican 2–Party Vote Share)

12. ***Partisan Outlier Districts in the 2022 Revised Plan***: In Figure 1, I directly compare the partisan distribution of districts in the 2022 Revised Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the 2022 Revised Plan's districts from the most- to the least-Republican district, as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The most-Republican district appears on the top row, and the least-Republican district appears on the bottom row of Figure 1. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district. I then directly compare the most-Republican 2022 Revised Plan district (CD-2) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the 2022 Revised Plan to 1,000 computer-simulated districts, and I compare these districts based on their Republican vote share. I then directly compare the second-most-Republican district in the 2022 Revised Plan to the second-most-Republican district from each of the 1,000 simulated plans. I conduct the same comparison for each district in the 2022 Revised Plan, comparing the 2022 Revised Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

13. Thus, the top row of Figure 1 directly compares the partisanship of the most-Republican 2022 Revised Plan district (CD-2) to the partisanship of the most-Republican district from each of the 1,000 simulated plans. The two percentages (in parentheses) in the right margin of this Figure report the percentage of these 1,000 simulated districts that are less Republican than, and more Republican than, the 2022 Revised Plan district. Similarly, the second row of this Figure compares the second-most-Republican district from each plan, the third row compares the third-most-Republican district from each plan, and so on. In each row of this Figure, the 2022 Revised Plan's district is depicted with a green star and labeled in green with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row. Corresponding districts from the 2021 Enacted Plan are treated similarly and indicated with red stars and red labels.

14. In the 2022 Revised Plan, as well as in most computer-simulated plans, the most Democratic district in Ohio is the district containing Cleveland and surrounding areas. As the bottom row of Figure 1 illustrates, the most-Democratic district in the 2022 Revised Plan (CD-11) is *more* heavily Democratic than 98.8% of the most-Democratic districts in each of the 1,000 computer-simulated plans. This calculation is numerically reported in the right margin of the Figure. Almost every single one of the computer-simulated counterpart districts would have been more politically moderate than CD-11 in terms of partisanship: CD-11 exhibits a Republican vote share of 20.1%, while nearly all of the 1,000 most Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share. In other words, CD-11 packs together Democratic voters in the Cleveland area to a more extreme extent than the most-Democratic district in nearly all of the computer-simulated plans. I therefore identify CD-11 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

15. The next-to-bottom row of Figure 1 reveals a similar finding regarding the 2022 Revised Plan's CD-3, which is located in and around Columbus. This row illustrates that the second-most Democratic district in the 2022 Revised Plan (CD-3) is *more* heavily Democratic than

90.4% of the second-most Democratic districts in each of the 1,000 computer-simulated plans. The vast majority of its computer-simulated counterpart districts would have been more politically moderate than CD-3 in terms of partisanship: CD-3 exhibits a Republican vote share of 31.1%, while more than 90% of the second-most-Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share. In other words, CD-3 packs together Democratic voters to a more extreme extent than the second-most-Democratic district in the vast majority of the computer-simulated plans. I therefore identify CD-3 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts.

16. Meanwhile, the top row of Figure 1 reveals a similar finding: As the top row illustrates, the most Republican district in the 2022 Revised Plan (CD-2) is *less* heavily Republican than 90.1% of the most Republican districts in each of the 1,000 computer-simulated plans. It is thus clear that CD-2 "cracks" Democratic voters who would otherwise reside in surrounding districts by placing them into CD-2.

17. It is especially notable that these three aforementioned 2022 Revised Plan districts – the most-Republican district (CD-2) and the two most-Democratic districts (CD-3 and CD-11) in the 2022 Revised Plan – were drawn to include more Democratic voters than the vast majority of their counterpart districts in the 1,000 computer-simulated plans. These "extra" Democratic voters in the three most partisan-extreme districts in the 2022 Revised Plan had to come from the remaining twelve more moderate districts in the 2022 Revised Plan. Having fewer Democratic voters in these more moderate districts enhances Republican candidate performance in these districts.

18. Indeed, the ninth, tenth, twelfth and thirteenth rows in Figure 1 confirm this precise effect. These four rows in Figure 1 compare the partisanship of districts in the ninth, tenth, twelfth, and thirteenth-most Republican districts within the 2022 Revised Plan and the 1,000 computer-simulated plans. In all four of these rows, the 2022 Revised Plan district is a partisan outlier.

19. In the ninth and tenth rows, the 2022 Revised Plan's district is more heavily Republican than over 97% of its counterpart districts in the 1,000 computer-simulated plans. While the computer-simulated plans show a range of approximately 48% to 54% of Republican vote share for those districts, the 2022 Revised Plan's districts are at 53.3% and 54.2%, creating relatively safe Republican seats.

20. Similarly, in the twelfth and thirteenth rows, the 2022 Revised Plan's districts are more heavily Republican than over 95% of the counterpart districts in the 1,000 computer-simulated plans. While the majority of the computer-simulated plans create relatively safe Democratic seats in the twelfth- and thirteenth-most Republican districts, the 2022 Revised Plan creates two highly competitive districts in which the Democratic vote share is 51.0% and 52.2%.

21. In each of these four rows, the 2022 Revised Plan's districts are more heavily Republican than over 95% of its counterpart districts in the 1,000 computer-simulated plans. The four 2022 Revised Plan districts in these four rows (CD-1, 10, 13, and 15) are more heavily

Republican than nearly all of their counterpart computer-simulated plan districts because the three most partisan-extreme districts in the 2022 Revised Plan (CD-2, 3, and 11) are more heavily Democratic than nearly all of their counterpart districts in the computer-simulated plans.

22. I therefore identify the four 2022 Revised Plan districts in the ninth, tenth, twelfth, and thirteenth rows (CD-1, 10, 13, and 15) of Figure 1 as partisan statistical outliers. Each of these four districts has a Republican vote share that is higher than over 95% of the computer-simulated districts in its respective row in Figure 1. I also identify the three 2022 Revised Plan districts in the top row and in the bottom two rows (CD-2, 3, and 11) of Figure 1 as partisan outliers. Each of these three districts has a Republican vote share that is lower than over 90% of the computer-simulated districts in its respective row in Figure 1.

23. In summary, Figure 1 illustrates that seven of the 15 districts in the 2022 Revised Plan are partisan outliers: Four districts (CD-1, 10, 13, and 15) in the 2022 Revised Plan are more heavily Republican than over 95% of their counterpart computer-simulated plan districts, while three districts (CD-2, 3, and 11) are more heavily Democratic than over 90% of their counterpart districts in the computer-simulated plans.

24. The Appendix of this report contains nine additional Figures (Figures A1 through A9) that each contain a similar analysis of the 2022 Revised Plan districts and the computer-simulated plan districts. Each of these nine Figures in the Appendix measures the partisanship of districts using one of the individual nine elections included in the 2016-2020 Statewide Election Composite. These nine Figures generally demonstrate that the same extreme partisan outlier patterns observed in Figure 1 are also present when district partisanship is measured using any one of the nine statewide elections held in Ohio during 2016-2020.

25. ***Number of Safe Democratic, Safe Republican, and Competitive Districts:*** I also analyzed the number of Revised Plan districts favoring each party that are electorally safe, rather than competitive. For the purpose of this inquiry, I used the 2016-2020 Statewide Election Composite and defined a "competitive district" the same way that the map-drawers of the 2021 Enacted Plan did: that is, a "competitive district" is one with a two-party Republican vote share between 46% and 54%.[5] This definition of a "competitive district" implies that a "safe" Republican district is one with a Republican vote share over 54%, while a "safe" Democratic district is one with a Republican vote share under 46%.

26. The 2022 Revised Plan contains four competitive districts using this definition: CD-1 (49.0% Republican vote share), CD-9 (49.7%), CD-10 (53.3%), and CD-13 (47.8%). The 2022 Revised Plan thus contains one fewer competitive district than the 2021 Enacted Plan, which contains five competitive districts, using this same definition, as explained in Paragraph 86 of my December 10, 2021 expert report.

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[5] *See* The Ohio Senate, Local Government and Elections Committee, https://www.ohiosenate.gov/committees/local-government-and-elections/document-archive (testimony of Senator Rob McColley on November 16, 2021). URL: https://search-prod.lis.state.oh.us/cm_pub_api/api/unwrap/chamber/134th_ga/ready_for_publication/committee_docs/cmte_s_local_govt_1/testimony/cmte_s_local_govt_1_2021-11-16-1030_990/sb258mccolley.pdf

27. By contrast, the 2022 Revised Plan contains nine safe Republican districts with a Republican vote share over 54%: CD-2 (69.8% Republican vote share), CD-4 (67.9%), CD-5 (61.4%), CD-6 (59.1%), CD-7 (54.4%), CD-8 (62.7%), CD-12 (63.3%), CD-14 (54.8%), and CD-15 (54.2%). The 2022 Revised Plan thus contains one additional safe Republican district than the 2021 Enacted Plan, which contains eight safe Republican districts, using this same definition. Specifically, CD-15, which contains the southern and western portions of Franklin County, accounts for this difference between the 2022 Revised Plan and the 2021 Enacted Plan. Under the 2021 Enacted Plan, CD-15 was a competitive, Republican-leaning district, but 2022 Revised Plan increased CD-15's Republican vote share, turning it into a safe Republican district.

28. The 2022 Revised Plan contains only two safe Democratic districts with a Republican vote share under 46%: CD-3 (31.1% Republican vote share) and CD-11 (20.1% Republican vote share). The 2022 Revised Plan thus contains the same number of safe Democratic districts as the 2021 Enacted Plan, in which CD-3 and CD-11 were also the only two safe Democratic districts.

29. How does the number of safe Republican and safe Democratic districts compare to the number of such districts in the 1,000 computer-simulated plans? To analyze this question, I counted the number of competitive, safe Republican, and safe Democratic districts in each computer-simulated plan, using the same definition of competitive districts.

30. Figure 2 contains a histogram reporting the number of safe Democratic-favoring districts (with 0% to 46% Republican vote share) across each of the 1,000 computer-simulated plans. The green dashed line represents the 2022 Revised Plan's number of safe Democratic districts, while the red dashed line represents the 2021 Enacted Plan. Overall, this histogram reveals that the vast majority of the simulated plans contain three to five safe Democratic districts. By contrast, the 2022 Revised Plan, as well as the 2021 Enacted Plan, contains only two safe Democratic districts. In terms of the total number of safe Democratic districts created by the plan, the 2022 Revised Plan is a statistical outlier when compared to the 1,000 computer-simulated plans. The Revised Plan creates the minimum number of safe Democratic districts that ever occurs in any computer-simulated plan, and the Revised Plan creates fewer safe Democratic districts than 95.1% of the computer-simulated plans, which were drawn using a nonpartisan process adhering to the districting requirements in the Ohio Constitution. I characterize the 2022 Revised Plan's creation of two safe Democratic districts as a statistical outlier among the computer-simulated plans because the 2022 Revised Plan exhibits an outcome that is less favorable to Democrats than over 95% of the simulated plans.

Figure 2:
Comparisons of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer−Simulated Plans
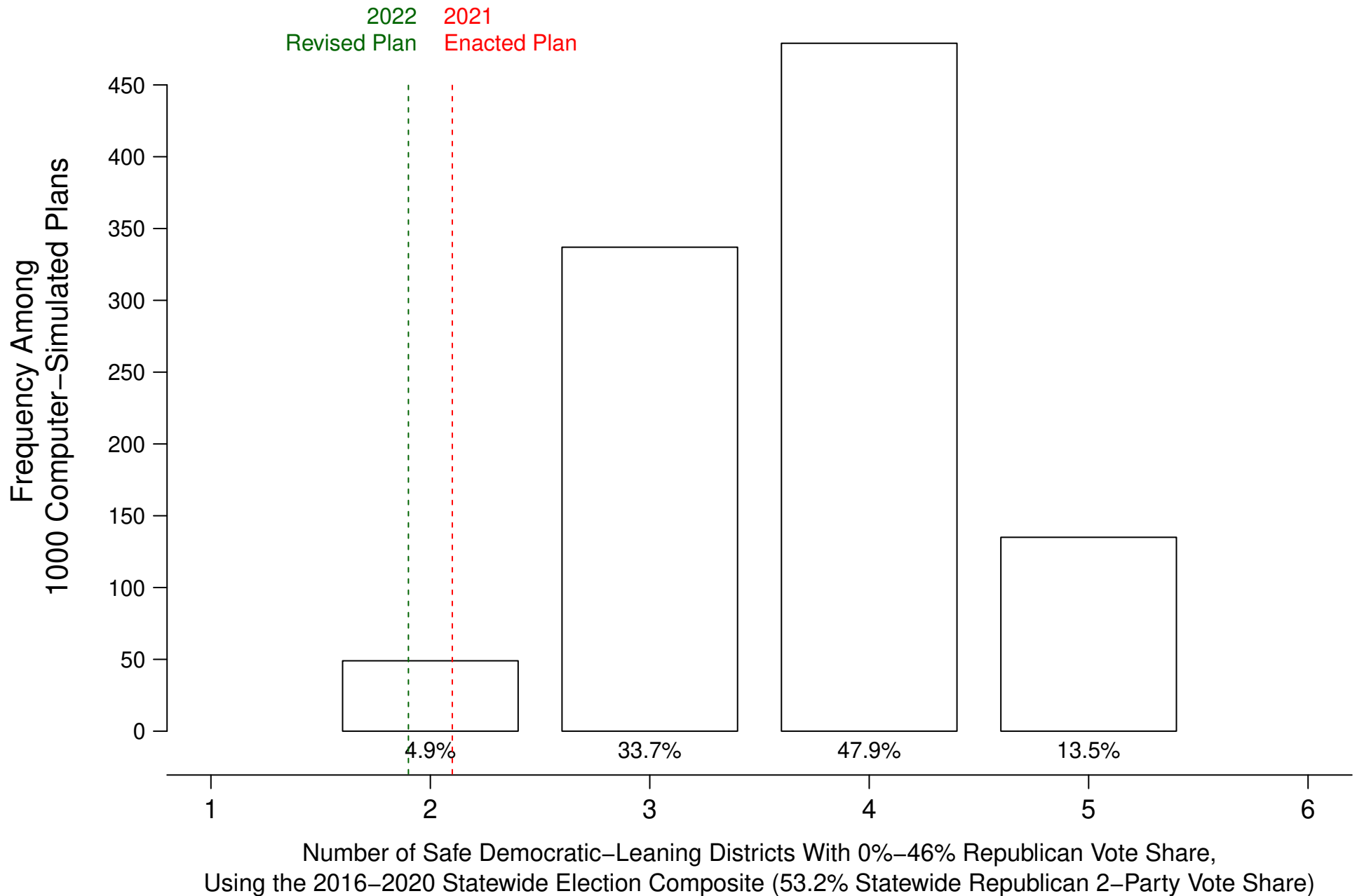
Figure 3:
Comparisons of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans

Number of Safe Republican Districts With 54%–100% Republican Vote Share,
Using the 2016–2020 Statewide Election Composite (53.2% Statewide Republican 2–Party Vote Share)
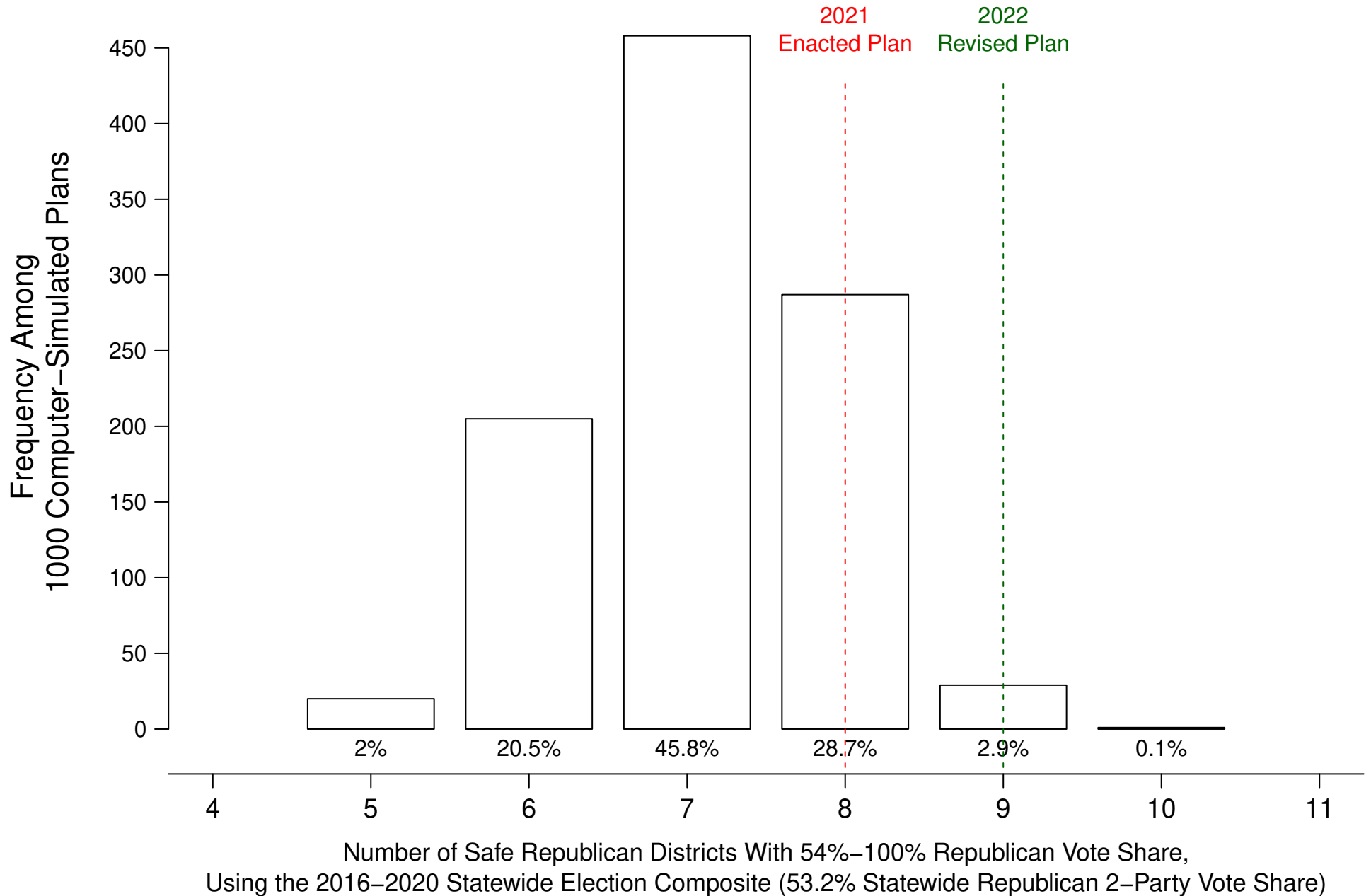
31. Figure 3 contains a histogram reporting the number of safe Republican-favoring districts (with 54% to 100% Republican vote share) across each of the 1,000 computer-simulated plans. The green dashed line represents the 2022 Revised Plan's number of safe Republican districts, while the red dashed line represents the 2021 Enacted Plan. Overall, this histogram reveals that the vast majority of the simulated plans contain six to eight safe Republican districts. By contrast, the 2022 Revised Plan contains nine safe Republican districts, one more than the 2021 Enacted Plan contains. In terms of the total number of safe Republican districts created by the plan, the 2022 Revised Plan is a statistical outlier when compared to the 1,000 computer-simulated plans. The 2022 Revised Plan creates more safe Republican districts than 97% of the computer-simulated plans, which were drawn using a nonpartisan process adhering to the districting requirements in the Ohio Constitution. I characterize the 2022 Revised Plan's creation of nine safe Republican districts as a statistical outlier among the computer-simulated plans because the 2022 Revised Plan exhibits an outcome that is more favorable to Republicans than over 95% of the simulated plans.

V. PARTISAN OUTLIER DISTRICTS IN FRANKLIN, CUYAHOGA, AND HAMILTON COUNTIES

32. I have thus far compared the 2022 Revised Plan to the 1,000 simulated plans at a statewide level using common measures of partisan bias and by identifying individual districts that are partisan outliers. However, I also analyzed the extent to which partisan favoritism affected the map-drawing process within Ohio's three largest counties: Franklin, Cuyahoga, and Hamilton Counties. I analyzed the extent to which individual districts in these counties favor a certain political party and lack compactness. I found that 2022 Revised Plan districts in these areas are outliers in terms of compactness and partisanship, in ways that systematically favor the Republican Party.

33. Specifically, I found that the 2022 Revised Plan's districts in each of Franklin, Cuyahoga, and Hamilton Counties exhibit more favorable partisan characteristics for the Republican Party than the vast majority of districts covering the same local areas in the 1,000 computer-simulated plans.

34. By comparing the compactness of these computer-simulated districts within these three counties to the 2022 Revised Plan's districts, I found that the 2022 Revised Plan achieved extreme partisan characteristics in these three counties by sacrificing geographic compactness. The compactness scores of the 2022 Revised Plan's districts in these three counties are significantly lower than the compactness scores of virtually all the simulated districts within these same three counties. Thus, it is clear the 2022 Revised Plan's districts in these counties were not drawn to favor compactness. Instead, the districts in these counties were clearly drawn to create the most favorable outcome possible for the Republican Party.

35. Article XIX, Section (1)(C)(3) of the Ohio Constitution requires that the General Assembly "shall attempt to draw districts that are compact." In evaluating whether the 2022 Revised Plan follows the compactness requirement of Section (1)(C)(3), it is useful to compare the compactness of the 2022 Revised Plan and the 1,000 computer-simulated plans, both at a plan-wide level and for individual districts in particular counties. The computer-simulated plans were produced by a computer algorithm adhering to the Ohio Constitution's required

districting criteria in Article XIX, including ignoring partisan considerations. Thus, the compactness scores of these computer-simulated plans illustrate the statistical range of compactness scores that could be reasonably expected to emerge from a districting process that solely seeks to follow the required constitutional criteria while ignoring partisan considerations.

36. First, I calculate the average Polsby-Popper score of each plan's districts. The Polsby-Popper score for each individual district is calculated as the ratio of the district's area to the area of a hypothetical circle whose circumference is identical to the length of the district's perimeter; thus, higher Polsby-Popper scores indicate greater district compactness. The 2022 Revised Plan has an average Polsby-Popper score of 0.316 across its 15 congressional districts. As illustrated in Figure 4, every single one of the 1,000 computer-simulated plans in this report exhibits a higher Polsby-Popper score than the 2022 Revised Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Polsby-Popper score ranging from 0.39 to 0.41, and the most compact computer-simulated plan has a Polsby-Popper score of 0.44. Hence, it is clear that the 2022 Revised Plan is significantly less compact, as measured by its Polsby-Popper score, than what could reasonably have been expected from a districting process adhering to the Ohio Constitution's requirements.

37. Second, I calculate the average Reock score of the districts within each plan. The Reock score for each individual district is calculated as the ratio of the district's area to the area of the smallest bounding circle that can be drawn to completely contain the district; thus, higher Reock score indicate more geographically compact districts. The 2022 Revised Plan has an average Reock score of 0.391 across its 15 congressional districts. As illustrated in Figure 4, every single one of the 1,000 computer-simulated House plans in this report exhibits a higher Reock score than the 2022 Revised Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Reock score ranging from 0.46 to 0.47, and the most compact computer-simulated plan has an average Reock score of 0.50. Hence, it is clear that the 2022 Revised Plan is significantly less compact, as measured by its Reock score, than what could reasonably have been expected from a districting process adhering to the Ohio Constitution's requirements.

Figure 4: Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans on Polsby–Popper and Reock Compactness Scores

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

2022 Revised Plan

2021 Enacted Plan

Reock Score
(Higher Score Indicates Greater Geographic Compactness)

Polsby–Popper Score
(Higher Score Indicates Greater Geographic Compactness)
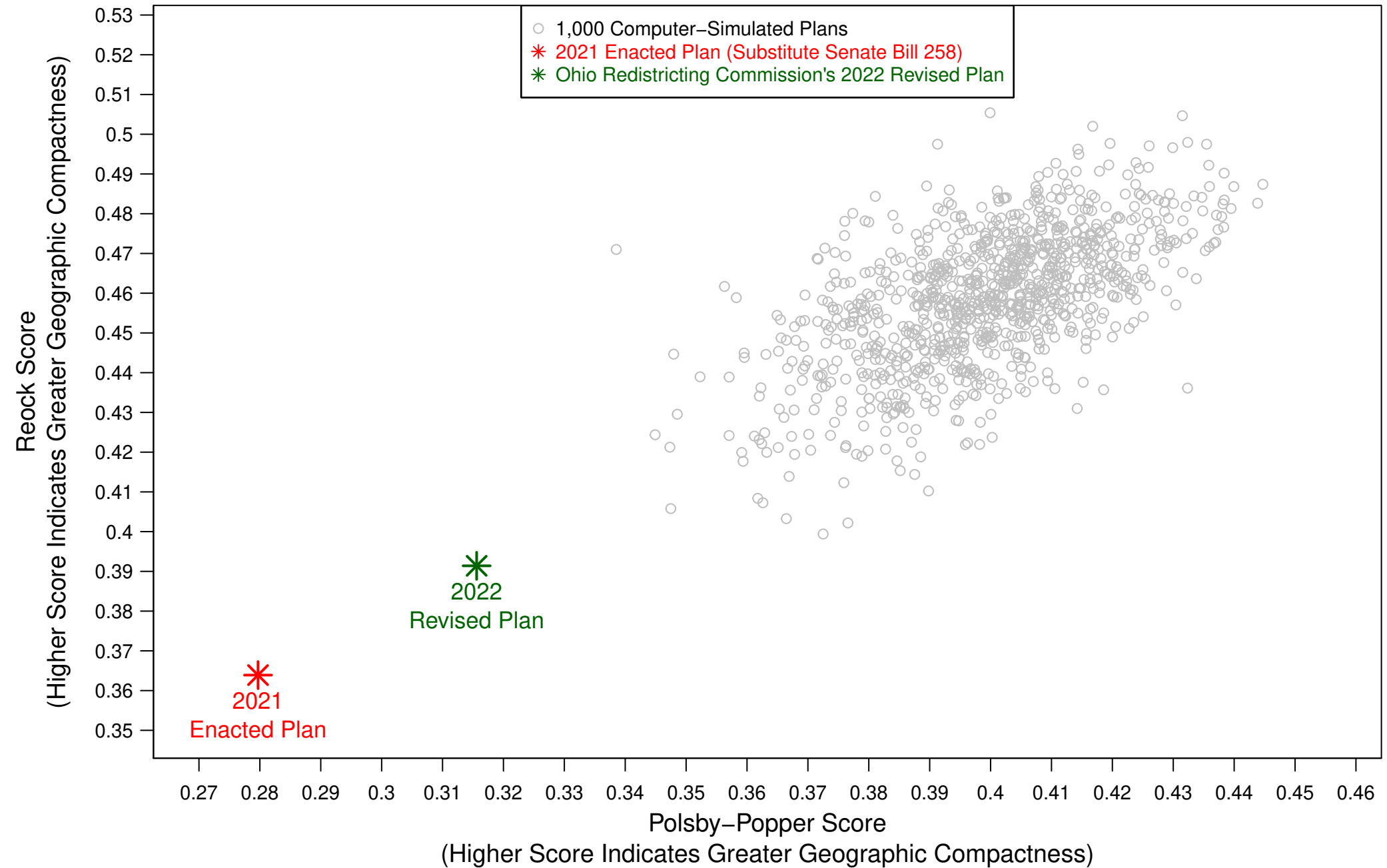
38. Beyond these statewide comparisons, it is also clear that in Franklin, Hamilton, and Cuyahoga Counties, the 2022 Revised Plan contains individual districts that are significantly less compact than the simulated plans' districts in these same counties. Furthermore, I found that the lower compactness of these individual districts enabled the General Assembly to draw these districts in ways that were more favorable to the Republican Party. Below, I describe and illustrate my findings for these three counties in detail:

VI.   THE 2022 REVISED PLAN'S DISTRICTS IN FRANKLIN COUNTY

39. Franklin County's population exceeds the required population for a single congressional district. A congressional plan must contain one district that lies fully within Franklin County, and one district must contain a significant portion of Columbus. For the 2022 Revised Plan and each of the 1,000 computer-simulated plans, I analyze two relevant districts:

    a. The district that contains the largest amount of Columbus' population, which is generally also the required district lying fully within Franklin County; and

    b. The district that contains the second-most amount of Columbus' population.

40. Figure 5a and Figure 5b contain two maps. The map in Figure 5a depicts the boundaries of the 2022 Revised Plan's two Columbus-area districts. The map in Figure 5b depicts the boundaries of the Columbus-area districts that had the highest average Polsby-Popper compactness scores among all 1,000 computer-simulated plans. Figures 5a and 5b also report the Polsby-Popper scores and Republican vote shares of these two districts in the 2022 Revised Plan and in the computer-simulated plan.

Figure 5a: Franklin Districts (CD-3 and CD-15) in the 2022 Revised Plan:

CD-3: Polsby-Popper Score: 0.487; Republican Vote Share: 0.311
CD-15: Polsby-Popper Score: 0.141; Republican Vote Share: 0.542
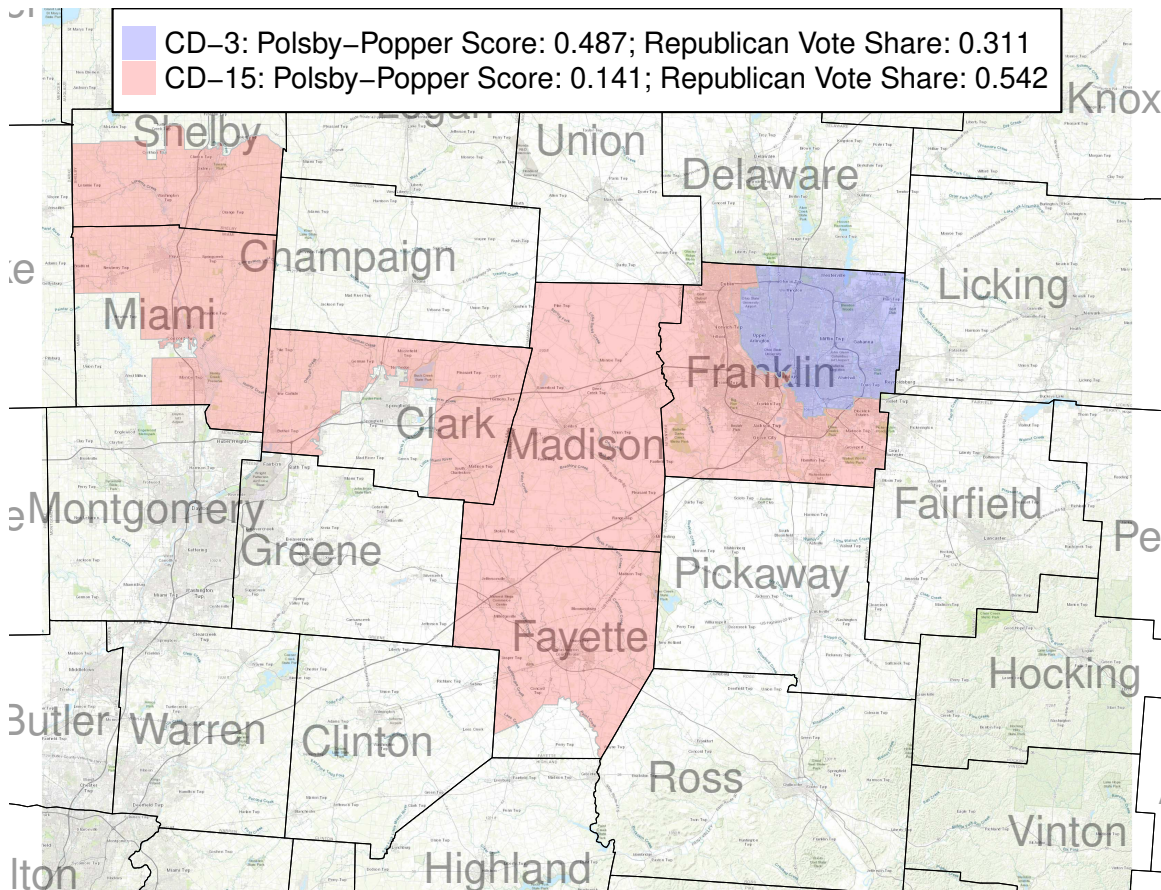
Figure 5b: Computer-Simulated Plan with the Most Compact Franklin Districts (Computer-Simulated Plan #138 of 1000)

Simulated District 12: Polsby-Popper Score: 0.39; Republican Vote Share: 0.496
Simulated District 13: Polsby-Popper Score: 0.561; Republican Vote Share: 0.326
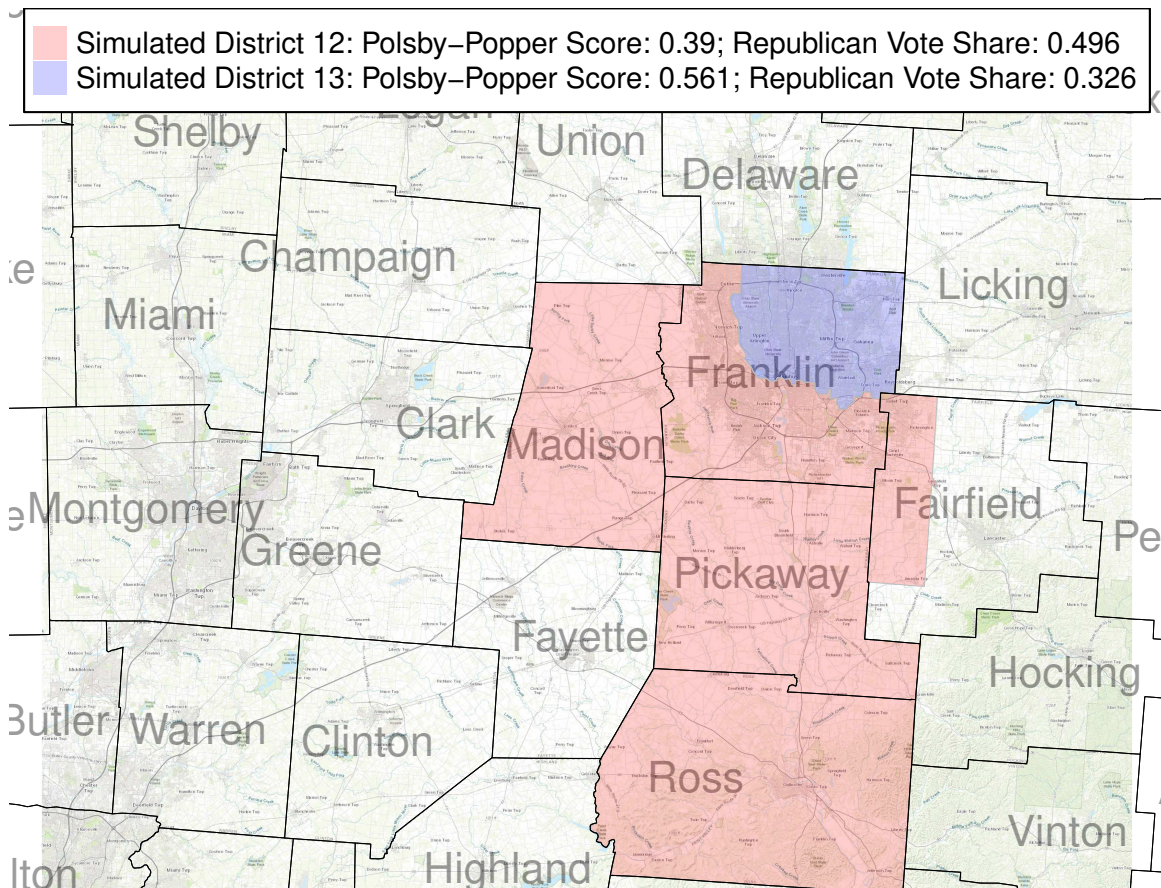
41.   For the 2022 Revised Plan and the 1,000 simulated plans, Figure 6 compares the Republican vote share, as measured using the 2016-2020 Statewide Election Composite, of the two districts containing the most and second-most amount of Columbus' population. Figure 6 contains 1,000 black circles, indicating the 1,000 simulated plans, a green star representing the 2022 Revised Plan, and a red star representing the 2021 Enacted Plan. Each plan is plotted in this Figure along the horizontal axis according to the Republican vote share of the plan's district containing the most amount of Columbus' population. The vertical axis then reports the Republican vote share of the plan's district containing the second-most amount of Columbus' population.

42.   Columbus' voters are heavily Democratic, while the surrounding suburbs in Franklin County are more Republican. As Figure 6 makes clear, there is a direct tradeoff between the Republican vote shares of the two Columbus districts in any congressional plan. Increasing the number of Republican voters in one Columbus district necessarily means decreasing Republican voters in the other Columbus district. Figure 6 also illustrates that among the 1,000 simulated plans, the district containing the most sizeable portion of Columbus' population is more heavily Democratic, with a Republican vote share of generally between 30-40%, while the district containing the second-most sizeable portion of Columbus' population contains a Republican vote share of generally between 41-51%.

43.   Figure 6 reveals that the 2022 Revised Plan's two Columbus-area districts are clearly more favorable to Republicans than the two Columbus-area districts in the vast majority of the simulated plans. In the 2022 Revised Plan, CD-3, which contains most of Columbus' population, is more heavily Democratic than 89.6% of the 1,000 of the simulated plans' districts with the most Columbus population. Consequently, the 2022 Revised Plan's CD-15, which contains the second-most of Columbus' population, is more heavily Republican than 99.4% of the simulated plans' districts with the second-most Columbus population. Specifically, CD-15 has a 54.2% Republican vote share, while by contrast, the vast majority of the simulated districts with the second-most Columbus population are either Democratic-favoring districts or have Republican vote shares very close to 50%.

Figure 6:
Comparisons of Columbus–Area Districts in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans
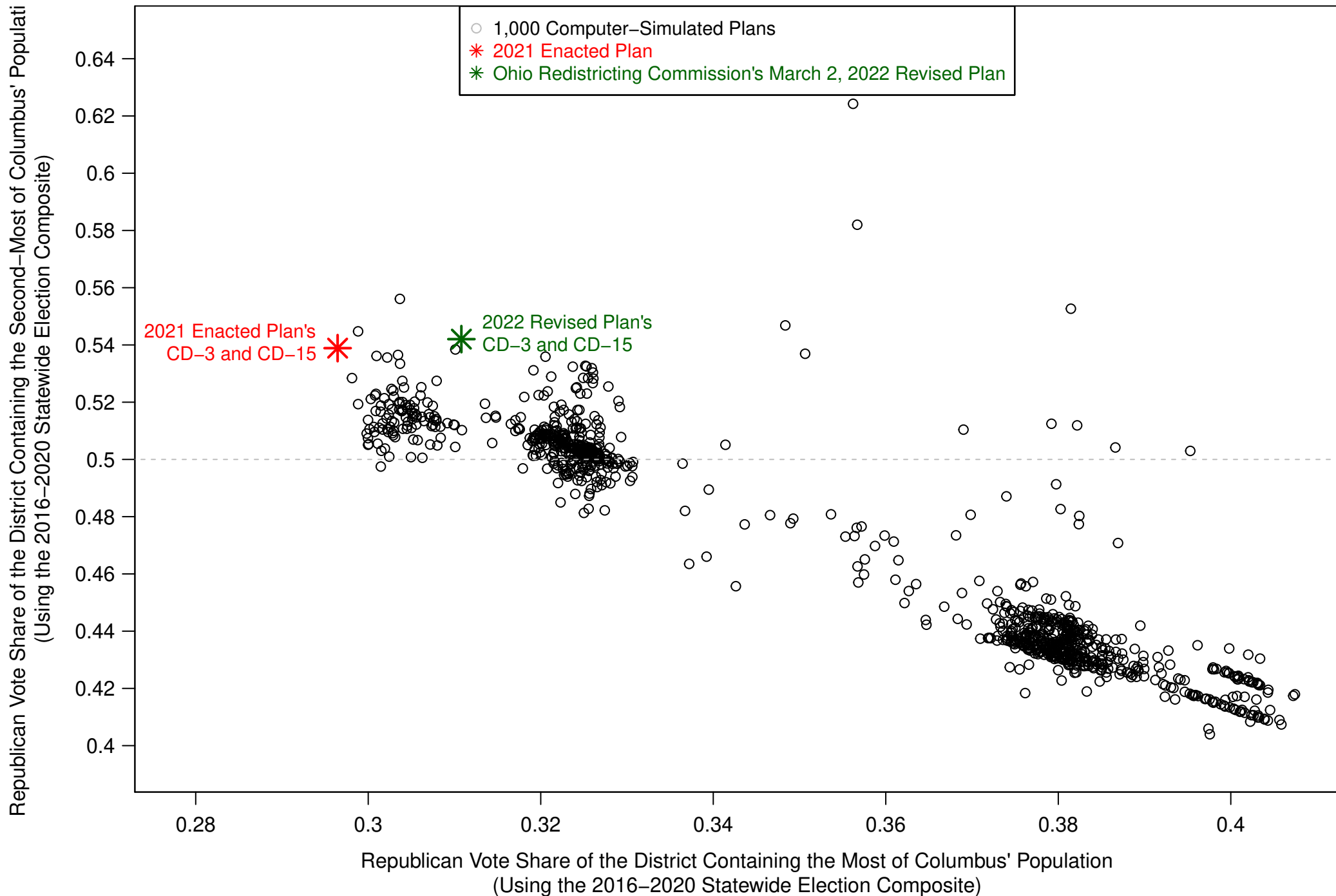
44. Figures 7 and 8 illustrate in detail how much the Revised Plan's two Columbus-area districts differ in partisanship from the simulated plans' Columbus-area districts: Figure 7 shows that the 2022 Revised Plan's CD-3 packs together Democratic voters to a more extreme extent than almost 90% of the simulated plans' districts containing the most Columbus population. In most simulated plans, this district would generally range from 32% to 40% Republican vote share. The 2022 Revised Plan's CD-3 has a Republican vote share of 31.1%, which is lower than 89.6% of the simulated plans.

45. Figure 8 similarly illustrates how statistically extreme the partisanship of the 2022 Revised Plan's CD-15 is. CD-15 contains a Republican vote share of 54.2%, while the most common outcome in the simulated plans' districts containing the second-most of Columbus' population is 43%-44%. Over 99% of these simulated districts are less Republican-favorable than the 2022 Revised Plan's CD-15. It is therefore clear that the 2022 Revised Plan's Columbus-area districts were drawn in order to create a more Republican-favorable outcome than would normally emerge from a districting process following the Ohio Constitution's Article XIX requirements.

**Figure 7: District Containing the Most of Columbus' Population
in the 2022 Revised Plan, the 2021 Enacted Plan and 1,000 Computer–Simulated Plans**

2022
Revised Plan
(CD–3)

2021
Enacted Plan
(CD–3)

Frequency Among
1000 Computer–Simulated Plans

300

250

200

150

100

50

0

6.6% 4.4% 20.2% 12.4% 0.8% 0.6% 2% 4.9% 33.2% 6.5% 8% 0.4%

0.29 0.3 0.31 0.32 0.33 0.34 0.35 0.36 0.37 0.38 0.39 0.4 0.41 0.42

Republican Vote Share of the District Containing the Most of Columbus' Population
Using the 2016–2020 Statewide Election Composite
(53.2% Statewide Republican 2–Party Vote Share)
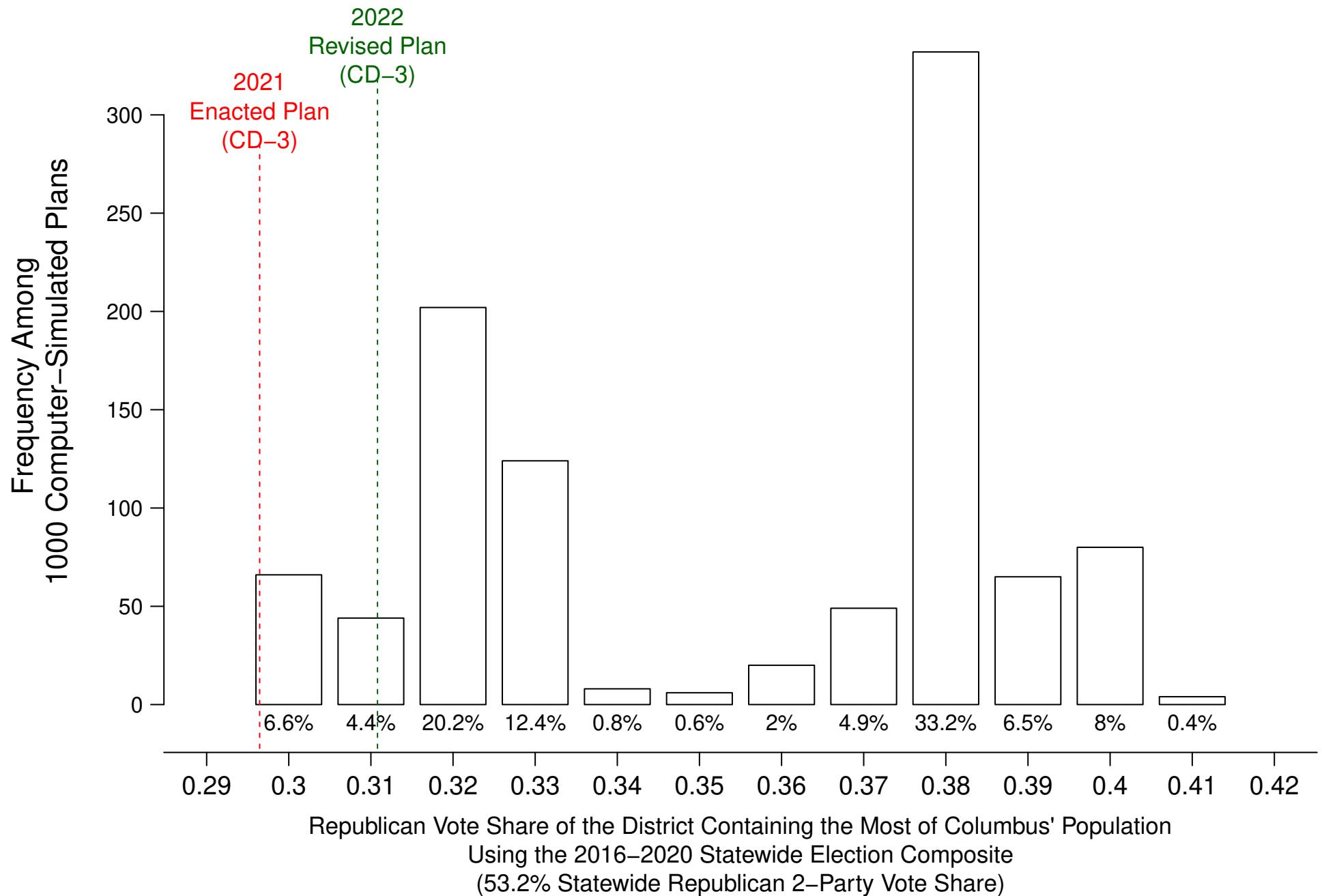
Figure 8: District Containing the Second-Most of Columbus' Population in the 2022 Revised Plan, the 2021 Enacted Plan and 1,000 Computer-Simulated Plans

2022
Revised Plan
(CD-15)

2021
Enacted Plan
(CD-15)

0.1% 2.7% 6.3% 19.3% 20% 3.1% 1.3% 0.9% 1.6% 2.7% 16.6% 16.8% 5.5% 1.9% 0.7% 0.2% 0.1% 0.1% 0.1%

Frequency Among
1000 Computer-Simulated Plans

Republican Vote Share of the District Containing the Second-Most of Columbus' Population
Using the 2016-2020 Statewide Election Composite
(53.2% Statewide Republican 2-Party Vote Share)
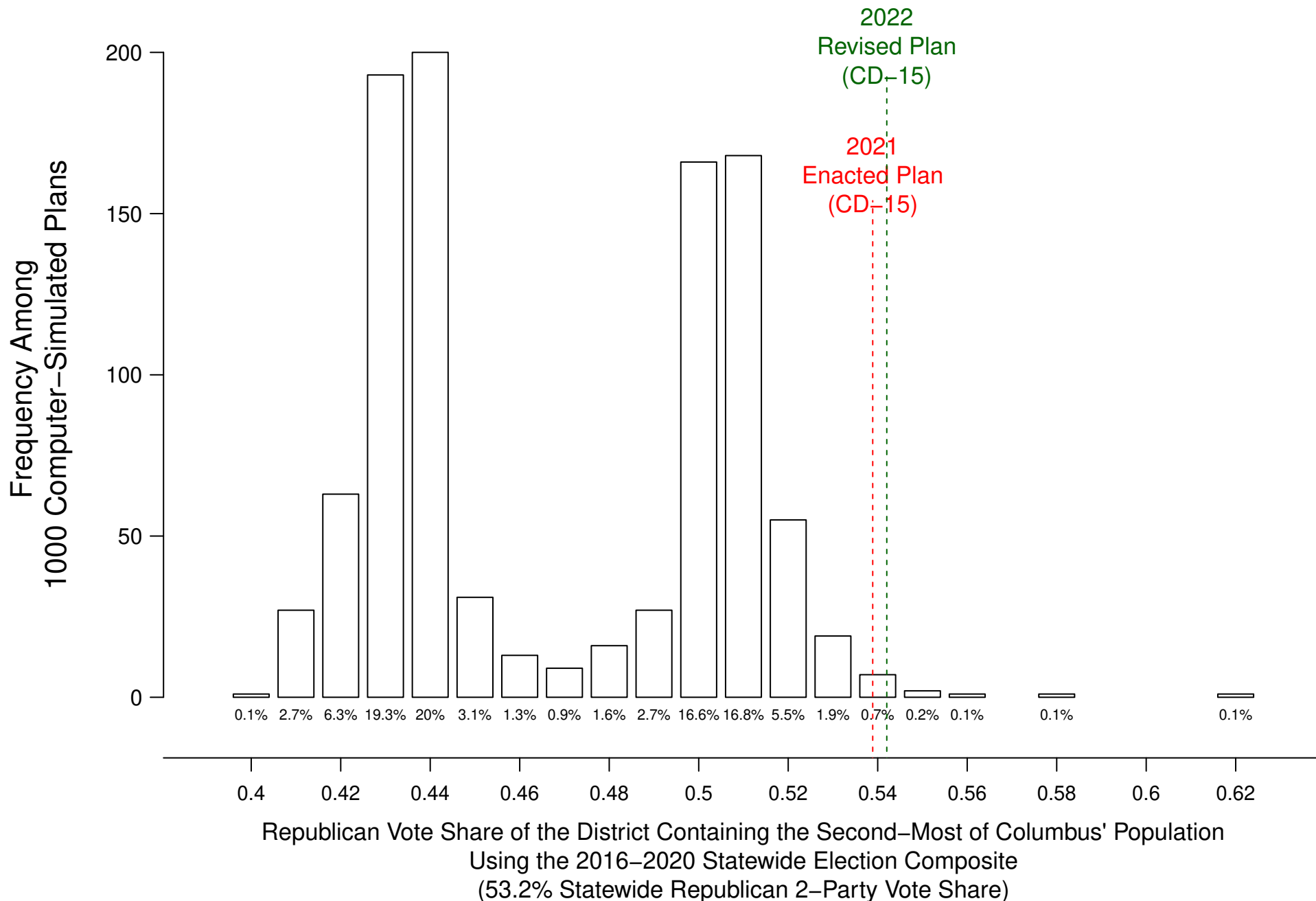
46. Finally, Figures 9 illustrates *how* the Ohio Redistricting Commission was able to create such a Republican-favorable outcome with respect to the partisan characteristics of the Columbus-area districts. In Figure 9, the vertical axis compares the Polsby-Popper compactness scores of the district containing the second-most of Columbus' population in the 2022 Revised Plan and in the computer-simulated plans. As explained earlier, higher Polsby-Popper scores indicate greater district compactness. The horizontal axis reports the Republican vote shares of these districts containing the second-most of Columbus' population. As before, the green star depicts the 2022 Revised Plan, while the red star represents the 2021 Enacted Plan. Figure 9 reveals that the 2022 Revised Plan's CD-15 is less geographically compact than nearly every computer-simulated district containing the second-most of Columbus' population. Hence, it is clear that the 2022 Revised Plan was able to create an anomalously Republican-favorable district in CD-15 (54.2% Republican vote share) by sacrificing the geographic compactness of the district. It is also clear that CD-15 is much less compact than the districts in the area that would reasonably emerge from a map-drawing process following the Ohio Constitution's Article XIX requirements.

47. I therefore conclude that the Revised Plan's Columbus-area districts were collectively drawn in a manner that favors the Republican Party by subordinating geographic compactness. These two Columbus-area districts in the 2022 Revised Plan are clearly much less geographically compact than one could reasonably expect from a districting process that follows the districting requirements of the Ohio Constitution.

Figure 9:
Comparisons of the District Containing the Second−Most of Columbus' Population in the 2022 Revised Plan, the 2021 Enacted Plan and 1,000 Computer−Simulated Plans

Legend:
- ○ 1,000 Computer−Simulated Plans
- ✳ 2021 Enacted Plan
- ✳ Ohio Redistricting Commission's March 2, 2022 Revised Plan

2021 Enacted Plan's CD−15

2022 Revised Plan's CD−15

Y-axis: Polsby−Popper Score of the District Containing the Second−Most of Columbus' Population (Higher Scores Indicate Greater Geographic Compactness)

X-axis: Republican Vote Share of the District Containing the Second−Most of Columbus' Population (Using the 2016−2020 Statewide Election Composite)
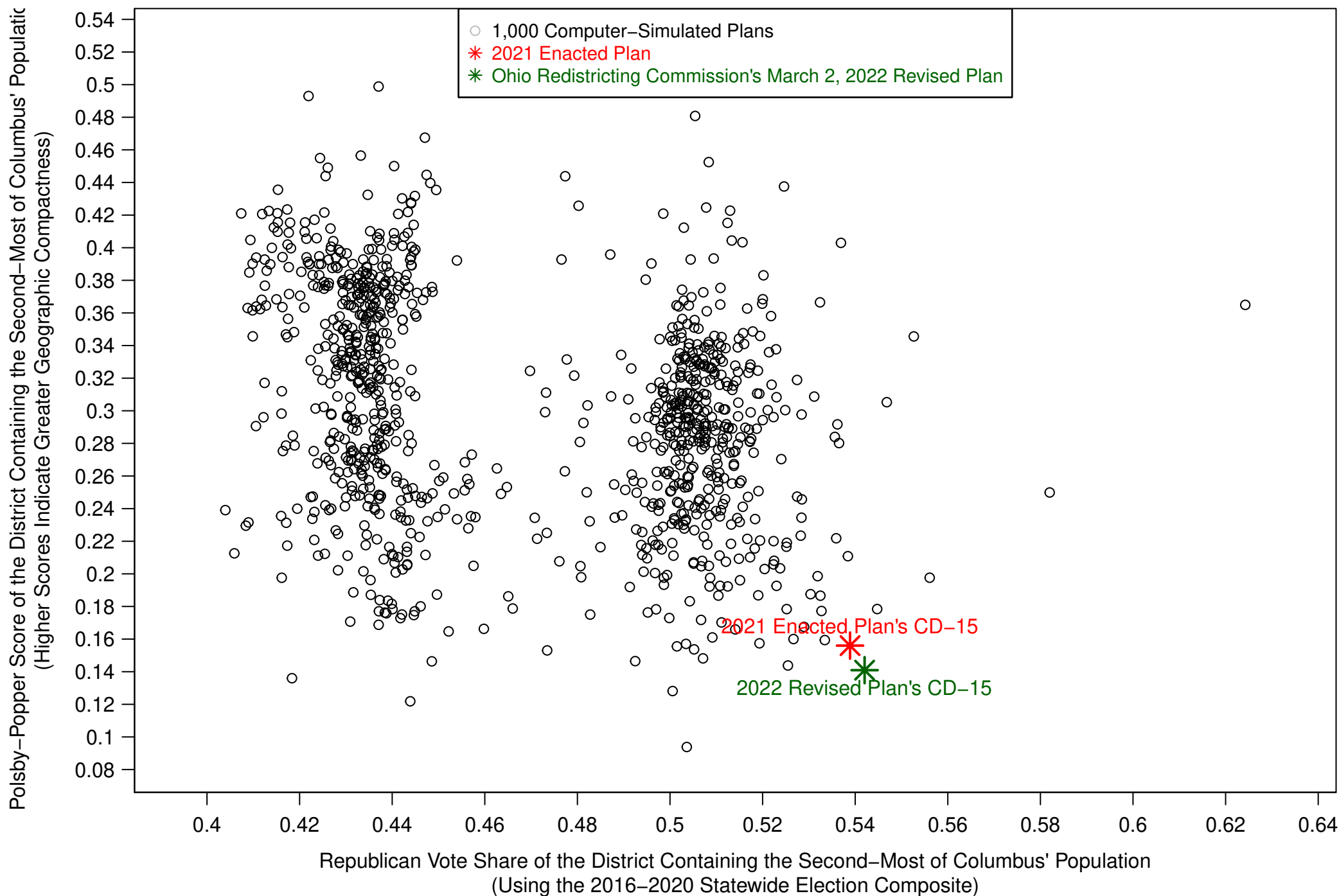
VII.   THE 2022 REVISED PLAN'S DISTRICTS IN HAMILTON COUNTY

48.   In the 2022 Revised Plan, as in all 1,000 computer-simulated plans, Cincinnati is always kept together in a single district, following Article XIX, Section 2(B)(4)(b) of the Ohio Constitution. I analyzed and compared these Cincinnati-based districts in the simulated plans and in the 2022 Revised Plan with respect to their partisan characteristics and their compactness scores.

49.   Figure 10a and Figure 10b contain two maps. The map in Figure 10a depicts the boundaries of the 2022 Revised Plan's CD-1. The map in Figure 10b depicts the boundaries of the Cincinnati-based district that had the highest average Polsby-Popper compactness scores among all 1,000 computer-simulated plans. Figures 10a and 10b also report the Polsby-Popper scores and Republican vote shares of these two districts in the 2022 Revised Plan and in the computer-simulated plan.

Figure 10a:
CD–1 of the 2022 Revised Plan:

CD–1: Polsby–Popper Score: 0.24; Republican Vote Share: 0.49
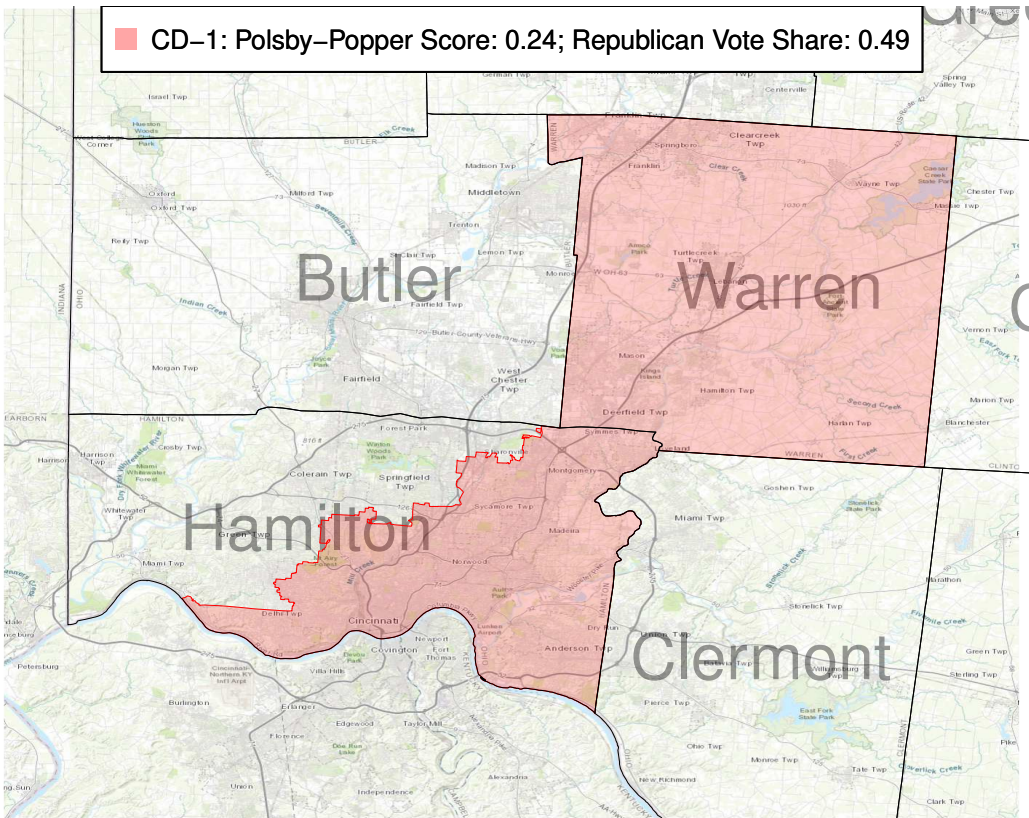
Figure 10b: Computer–Simulated Plan with the Most Compact Cincinnati District (Simulated Plan #311 of 1000):

Simulated District 11: Polsby–Popper Score: 0.417; Republican Vote Share: 0.435
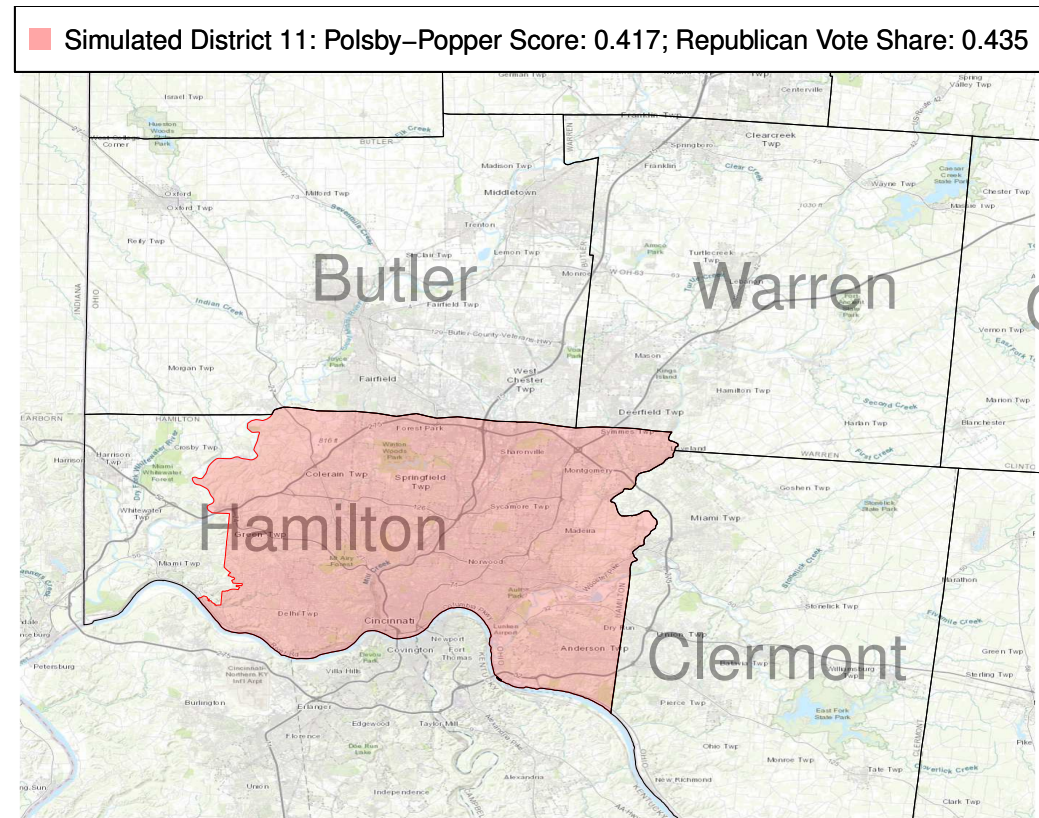
50.   Figure 11 reports the Republican vote share of every computer-simulated district containing Cincinnati. The green dashed line depicts the 2022 Revised Plan's Cincinnati-based district (CD-1), while the red dashed line depicts the 2021 Enacted Plan's Cincinnati-based district (CD-1). Cincinnati is a heavily Democratic city surrounded by Republican suburbs in Hamilton County. Thus, it should not be surprising that the vast majority of the simulated districts containing all of Cincinnati are also Democratic-favoring districts. In fact, over 80% of the Cincinnati-based simulated districts have a Republican vote share of 45% or lower, indicating that they clearly favor Democratic candidates by a safe margin. The vast majority of these computer-simulated districts containing Cincinnati are also fully within Hamilton County, following the Section (1)(C)(3) prohibition against unduly splitting counties.

51.   However, the 2022 Revised Plan's CD-1 has a significantly higher Republican vote share than the vast majority of the computer-simulated Cincinnati districts. The 2022 Revised Plan's CD-1 has a Republican vote share of 49.0%, which is higher than over 84.2% of the simulated districts containing Cincinnati. The 2022 Revised Plan's CD-1 achieves this unnaturally high Republican vote share by combining the Cincinnati portion of Hamilton County with Warren County, whose voters are far more Republican than Cincinnati's, thereby increasing the Republican vote share of CD-1 to a significantly higher level than if the Cincinnati-based district had been drawn entirely within Hamilton County.

52.   By connecting Warren County with the fragmented portion of Hamilton County containing Cincinnati, CD-1 of the 2022 Revised Plan also exhibits a very non-compact shape, as evidenced by a compactness score much lower than the Cincinnati-based district in virtually all of the computer-simulated districts. Figure 12 compares the Polsby-Popper compactness score of the 2022 Revised Plan's CD-1 to the Polsby-Popper score of all 1,000 of the Cincinnati-based simulated districts. This Figure illustrates that the vast majority of the simulated plans create a Cincinnati district with a Polsby-Popper score of 0.34 to 0.42. By contrast, the 2022 Revised Plan's CD-1 has a lower Polsby-Popper score than 96.9% of the simulated districts containing Cincinnati. Hence, it is clear that the geographic shape of the 2022 Revised Plan's CD-1 does not reflect a reasonable attempt to draw geographically compact districts in the Cincinnati area. Instead, by subordinating geographic compactness, the 2022 Revised Plan created a Cincinnati-based district that was more favorable to the Republican Party than the Cincinnati district in over 84.2% of the computer-simulated plans.

Figure 11:
Comparison of Cincinnati's District in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans
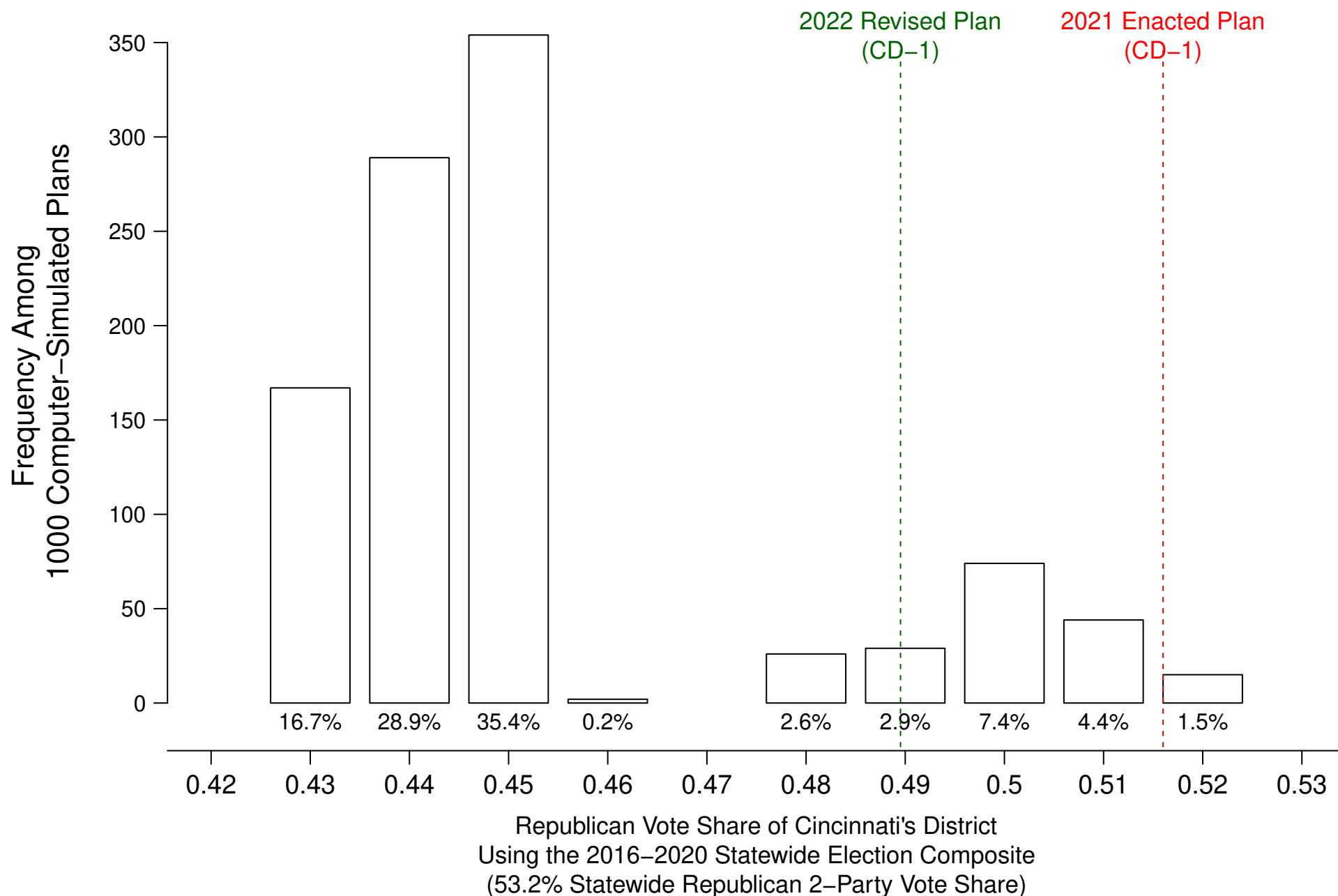
Figure 12:
Comparison of Cincinnati's District in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans

2021 Enacted Plan
(CD–1)

2022 Revised Plan
(CD–1)

Frequency Among
1000 Computer–Simulated Plans

0.1% 0.1% 0.4% 1.5% 1.6% 1.5% 2.1% 3.5% 3.6% 12.5% 54.1% 1.6% 3.5% 13.9%

Polsby–Popper Score of Cincinnati's District
(Higher Score Indicates Greater Geographic Compactness)
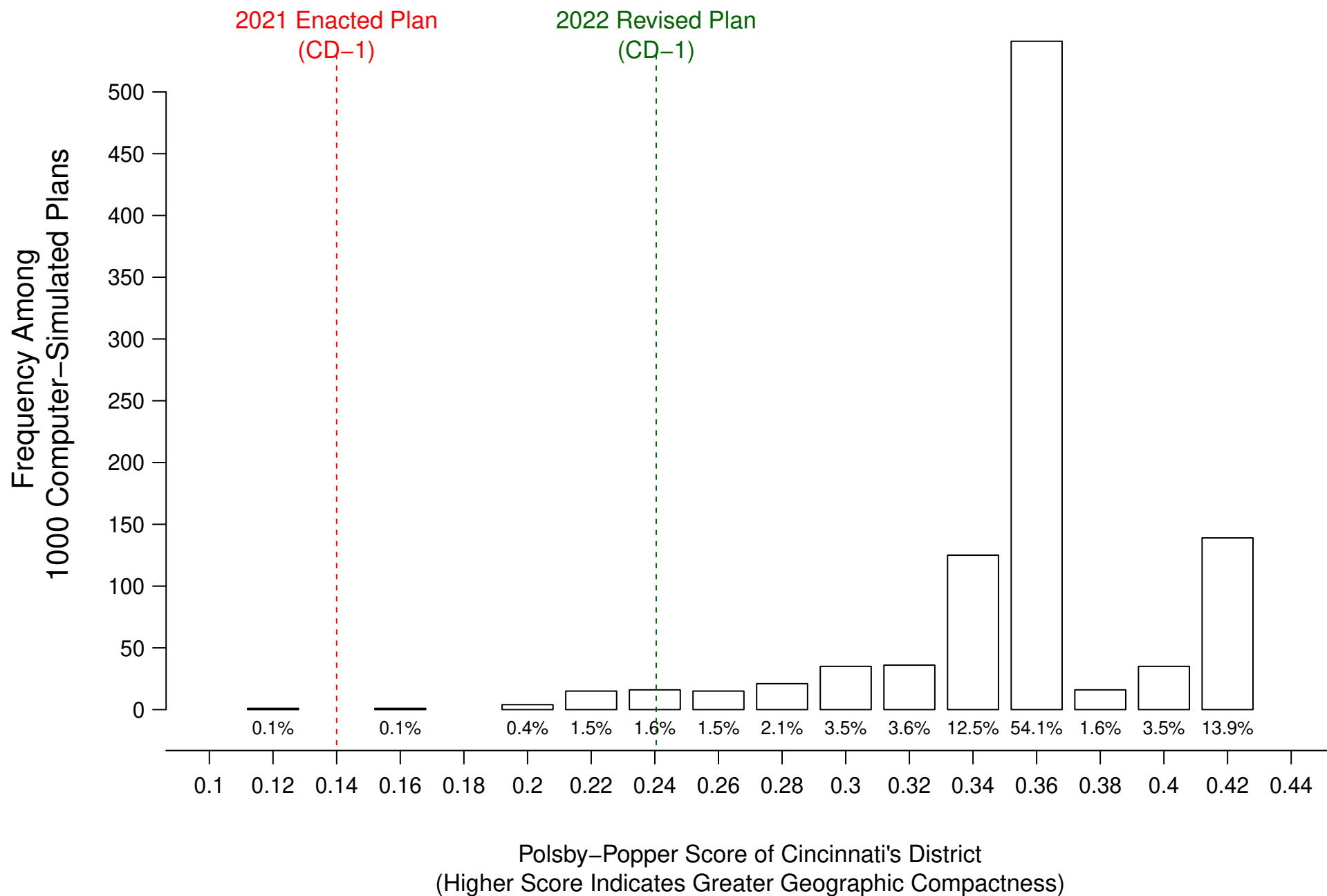
VIII.   THE 2022 REVISED PLAN'S DISTRICTS IN CUYAHOGA COUNTY

53.   Cuyahoga County's population exceeds the required population for a single congressional district, so the county will generally be split into multiple districts, with one of these districts containing all of Cleveland (Article XIX, Section 2(B)(4)(b)). Across the 2022 Revised Plan and each of the 1,000 computer-simulated plans, I compare the one district in each plan containing all of Cleveland. Additionally, across the 2022 Revised Plan and each of the 1,000 computer-simulated plans, I compare the district containing the second-most of Cuyahoga County's population. This district containing the second-most of Cuyahoga County's population will always be different from the district containing Cleveland.

54.   Figure 13a and Figure 13b contain two maps. The map in Figure 13a depicts the boundaries of the 2022 Revised Plan's Cleveland-based district, CD-11. The map in Figure 13b depicts the boundaries of the Cleveland-based district that had the highest Polsby-Popper compactness score among all 1,000 computer-simulated plans. Figures 13a and 13b also report the Polsby-Popper scores and Republican vote shares of these districts from the 2022 Revised Plan and the computer-simulated plan.

Figure 13a: CD–11 of the 2022 Revised Plan:

CD–11: Polsby–Popper Score: 0.412; Republican Vote Share: 0.201
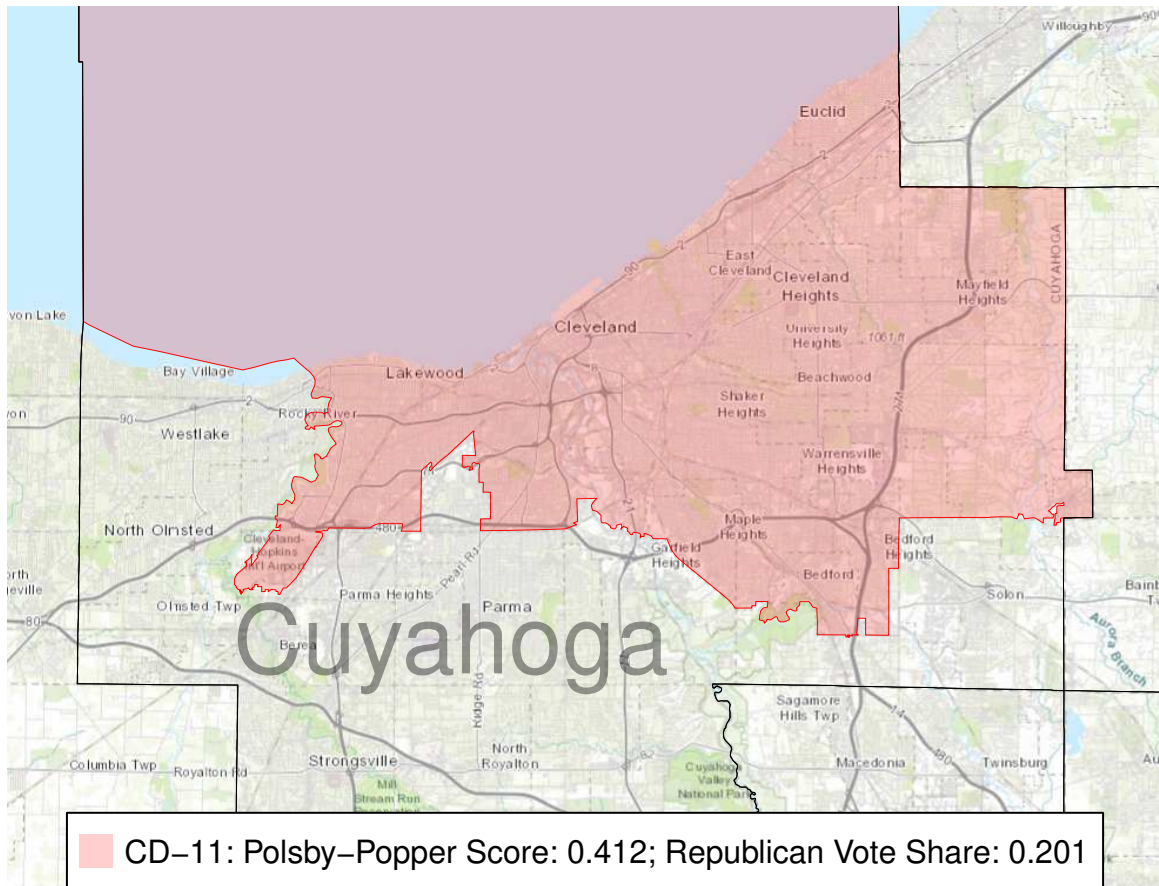
**Figure 13b: Computer–Simulated Plan with the
Most Compact Cleveland District (Simulated Plan #440 of 1000):**

Simulated District 3: Polsby–Popper Score: 0.59; Republican Vote Share: 0.213
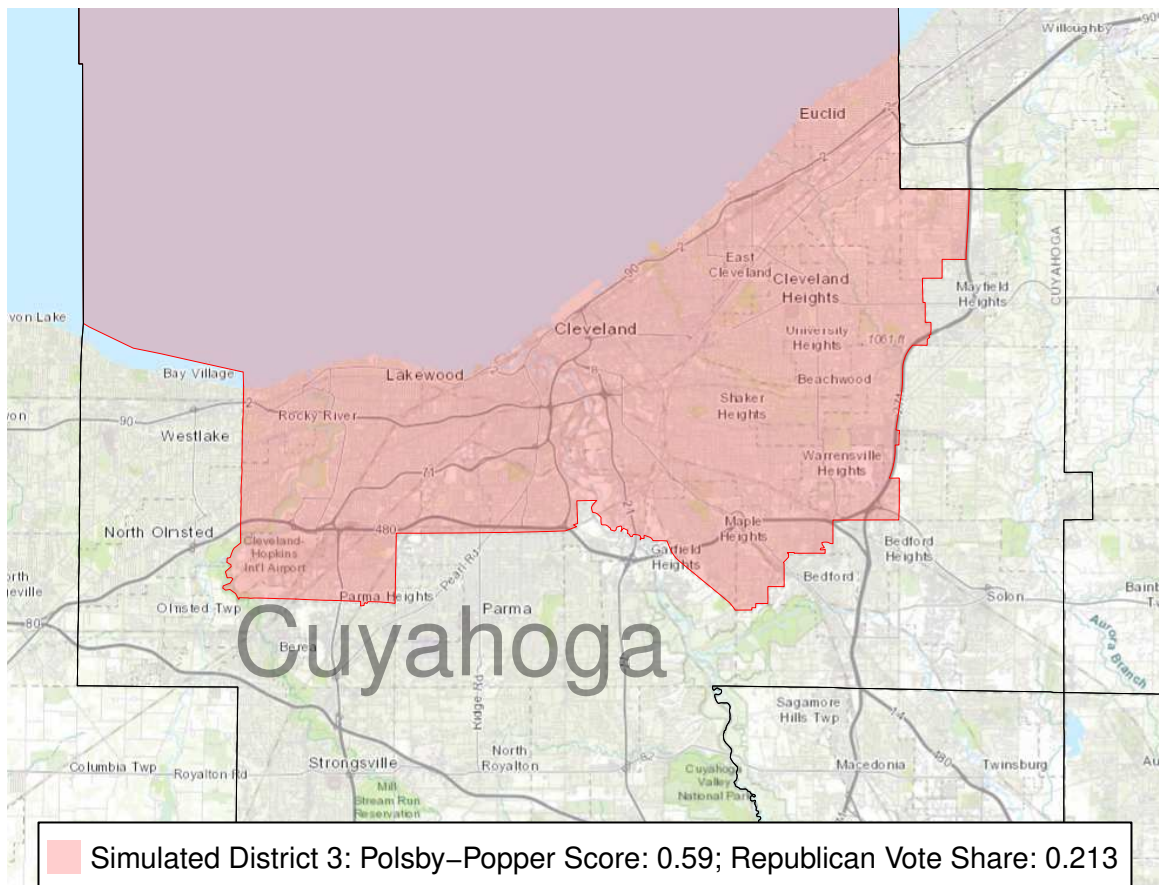
55. For the 2022 Revised Plan and the 1,000 simulated plans, Figure 14 compares the Republican vote share, as measured using the 2016-2020 Statewide Election Composite, of the Cleveland-based district and the district containing the second-most amount of Cuyahoga's population. Figure 14 contains 1,000 black circles, indicating the 1,000 simulated plans, a green star representing the 2022 Revised Plan, and a red star representing the 2021 Enacted Plan. Each plan is plotted in this Figure along the horizontal axis according to the Republican vote share of the plan's Cleveland-based district. The vertical axis then reports the Republican vote share of the plan's district containing the second-most amount of Cuyahoga's population.

56. Cleveland's voters are heavily Democratic, while the surrounding suburbs are more Republican. As Figure 14 makes clear, there is a tradeoff between the Republican vote shares of the two Cuyahoga-based districts in any congressional plan. Increasing the number of Republican voters in one Cuyahoga-based district necessarily means decreasing Republican voters in the other district. Figure 14 also illustrates that among the 1,000 simulated plans, the Cleveland-based district is more heavily Democratic and generally has a Republican vote share under 35%, while the district containing the second-most sizeable portion of Cuyahoga County's population contains a Republican vote share of generally between 39-53%.

57. Figure 14 reveals that the 2022 Revised Plan's two Cuyahoga County districts are clearly more favorable to Republicans than the two Cuyahoga-based districts in the vast majority of the simulated plans. In the 2022 Revised Plan, CD-11, which contains Cleveland, is more heavily Democratic than 98.8% of the 1,000 of the simulated plans' Cleveland-based districts. Consequently, the 2022 Revised Plan's CD-7, which contains the second-most of Cuyahoga's population, is more heavily Republican than all 100% of the simulated plans' districts with the second-most Cuyahoga population. Specifically, CD-7 has a 54.4% Republican vote share, while by contrast, the vast majority of the simulated districts with the second-most Cuyahoga population are either Democratic-favoring districts or have Republican vote shares closer to 50%.

58. In other words, every one of the 1,000 simulated plans contains one safe Democratic district based in Cleveland, as well as a second Cuyahoga-based district that is electorally competitive or Democratic-leaning. But the 2022 Revised Plan creates a Cleveland-based district that is more packed with Democrats than 98.8% of the simulated plans' Cleveland-based district. In doing so, the 2022 Revised Plan was able to increase the Republican vote share of CD-7 to 54.4%, which is more safely Republican than any of the simulated plans' districts containing the second-most of Cuyahoga County's population.

Figure 14:
Comparisons of Cuyahoga County–Area Districts in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans
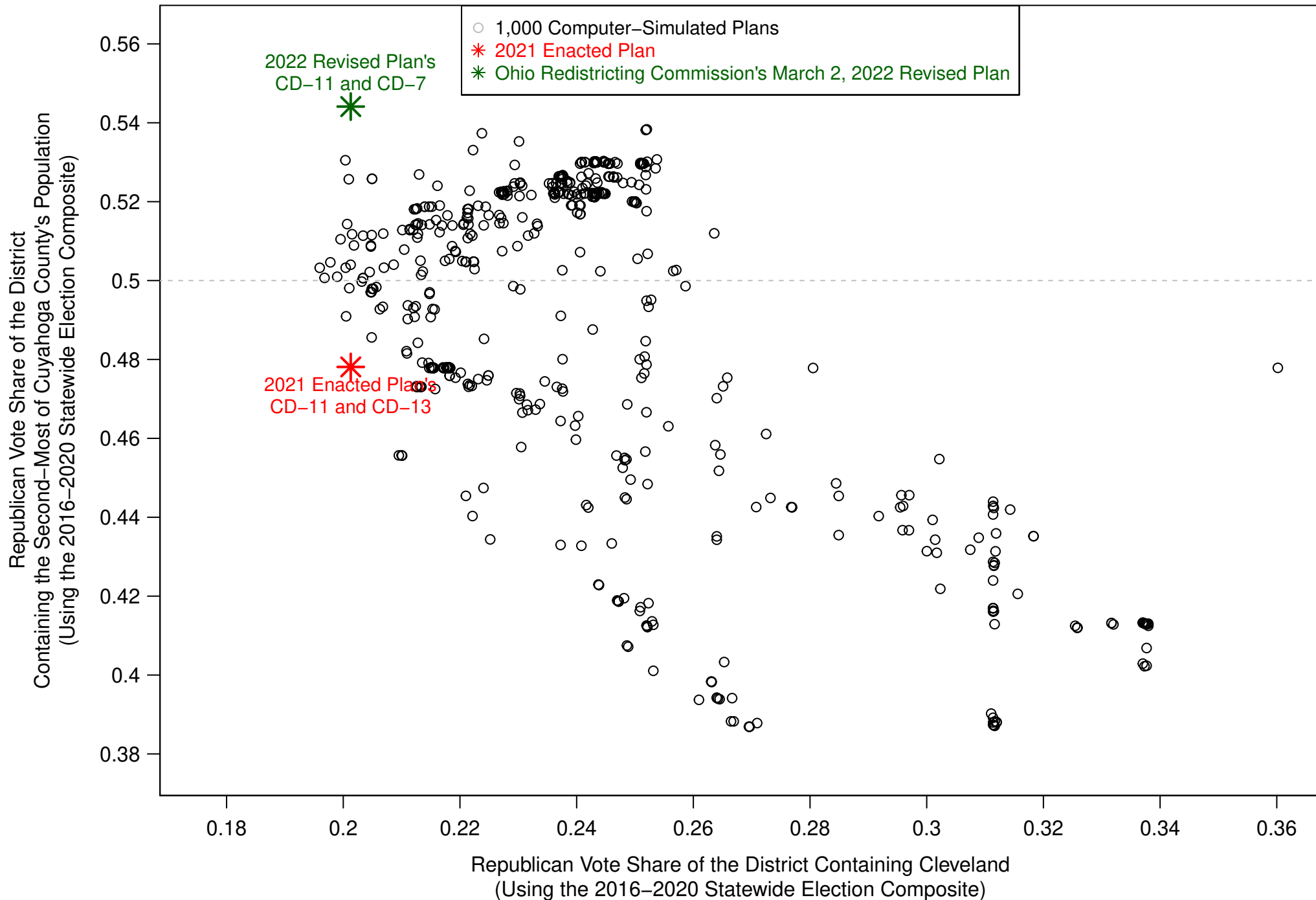
59.   Finally, Figures 15 illustrates *how* the Ohio Redistricting Commission was able to create such a Republican-favorable outcome with respect to the partisan characteristics of the Cuyahoga-based districts. In Figure 15, the horizontal axis compares the Polsby-Popper compactness scores of the Cleveland-based district in the 2022 Revised Plan and in the 1,000 computer-simulated plans. The vertical axis compares the Polsby-Popper compactness scores of the district containing the second-most of Cuyahoga County's population in the 2022 Revised Plan and in the 1,000 simulated plans. This Figure reveals that both CD-7 and CD-11 in the 2022 Revised Plan are significantly less geographically compact than the vast majority of their geographically analogous districts in the simulated plans. The 2022 Revised Plan's CD-11 exhibits a Polsby-Popper score of 0.412, which is lower than 89.7% of the Cleveland-based districts in the 1,000 simulated plans. And similarly, the 2022 Revised Plan's CD-7 exhibits a Polsby-Popper score of 0.225, which is lower than 95.3% of the districts containing the second-most of Cuyahoga's population in the 1,000 simulated plans.

60.   Hence, it is clear that the 2022 Revised Plan was able to create an anomalously Republican-favorable district in CD-7 (54.4% Republican vote share) by sacrificing the geographic compactness of the Cuyahoga-based districts. It is also clear that CD-7 is less compact than the districts in the area that would reasonably emerge from a map-drawing process following the Ohio Constitution's Article XIX requirements.

61.   I therefore conclude that the 2022 Revised Plan's Cuyahoga County-area districts were collectively drawn in a manner that favors the Republican Party by subordinating geographic compactness. These two Cleveland-area districts in the Revised Plan are less geographically compact than one could reasonably expect from a districting process that follows the districting requirements of the Ohio Constitution. The 2022 Revised Plan's CD-11 unnaturally packs together Democratic voters to an extent that is not explained by Cuyahoga County's political geography and the requirements of the Ohio Constitution. This unnatural packing of Democratic voters in CD-11 enabled the creation of a neighboring district (CD-7) that is more safely Republican than would have reasonably emerged from a map-drawing process following the Ohio Constitution's Article XIX requirements.

Figure 15:
Comparisons of Cuyahoga County–Area Districts in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans
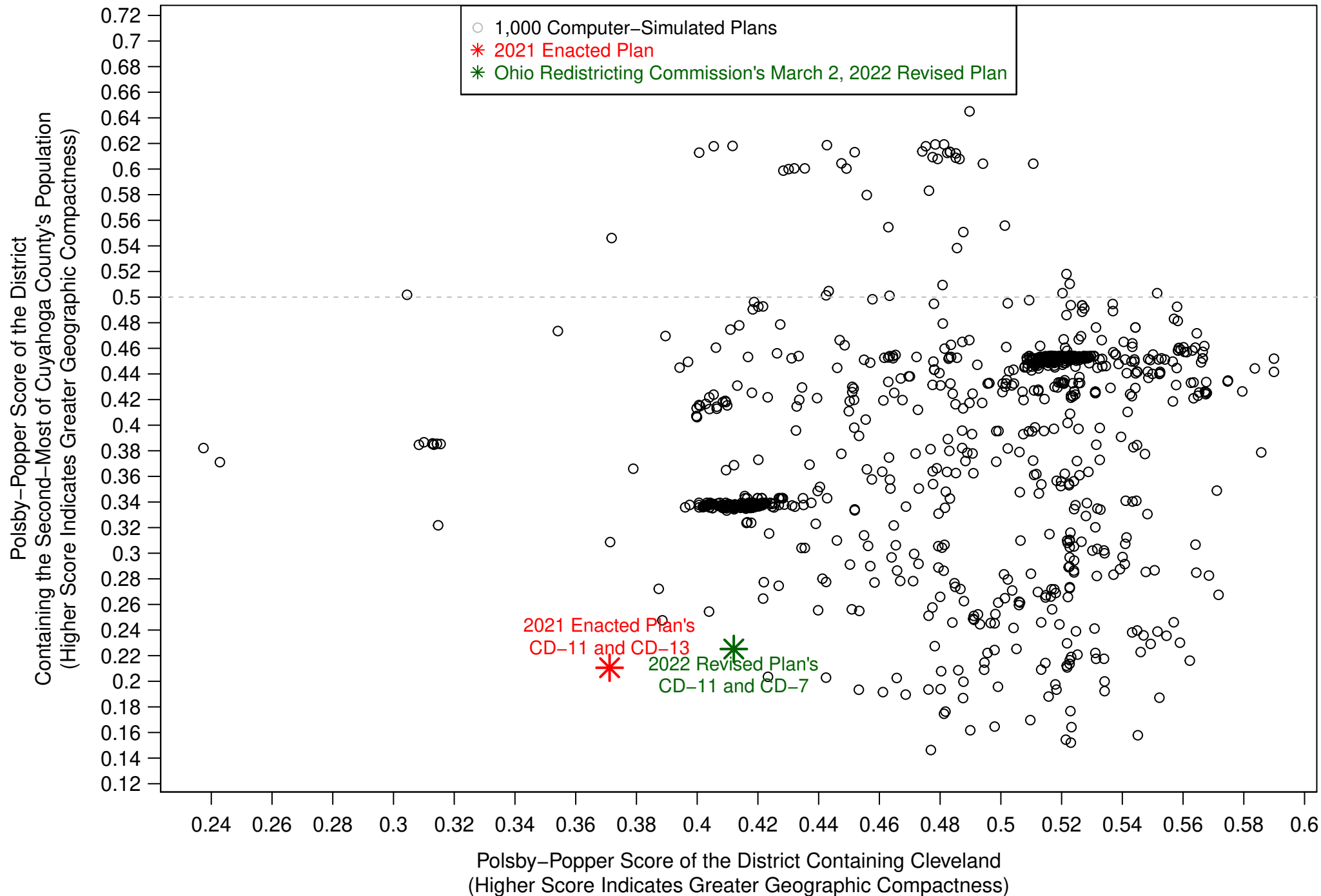
IX.   OHIO'S POLITICAL GEOGRAPHY DID NOT CAUSE THE REVISED PLAN'S EXTREME PARTISAN BIAS

62.   How does Ohio's political geography affect the partisan characteristics of the 2022 Revised Plan? Democratic voters tend to be geographically concentrated in the urban cores of several of the state's largest cities, including Columbus, Cleveland, Cincinnati, Toledo, Akron, and Dayton. As I have explained in my prior academic research,[6] these large urban clusters of Democratic voters, combined with the common districting principle of drawing geographically compact districts, can sometimes result in urban districts that "naturally" pack together Democratic voters, thus boosting the Republican vote share of other surrounding suburban and rural districts.

63.   More importantly, my prior academic research explained how I can estimate the precise level of electoral bias in districting caused by a state's unique political geography: I programmed a computer algorithm that draws districting plans using Ohio's unique political geography, including the state's census population data and political subdivision boundaries. In this report, I have also programmed the algorithm to follow the Ohio Constitution's Article XIX districting criteria. I then analyzed the partisan characteristics of the simulated districting plans using Ohio's precinct-level voting data from past elections. Hence, the entire premise of conducting districting simulations is to fully account for Ohio's unique political geography, its political subdivision boundaries, and its unique constitutional districting requirements.

64.   This districting simulation analysis allowed me to identify how much of the electoral bias in the 2022 Revised Plan is caused by Ohio's political geography and how much is caused by the map-drawer's intentional efforts to favor one political party over the other. Ohio's natural political geography, combined with the Ohio's Constitution's Article XIX districting requirements, almost never resulted in simulated congressional plans containing nine safe Republican districts of over 54% Republican vote share.

65.   The 2022 Revised Plan's creation of nine such safe Republican districts goes well beyond any "natural" level of electoral bias caused by Ohio's political geography or the political composition of the state's voters. The 2022 Revised Plan is a statistical outlier in terms of its partisan characteristics when compared to the 1,000 computer-simulated plans. The 2022 Revised Plan also creates fewer safe Democratic districts (under 46% Republican vote share) than 95.1% of the simulated plans. This extreme, additional level of partisan bias in the 2022 Revised Plan can be directly attributed to the map-drawer's clear efforts to favor the Republican Party. This additional level of partisan bias was not caused by Ohio's political geography.

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[6] Jowei Chen and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures" Quarterly Journal of Political Science, 8(3): 239-269; Jowei Chen and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House." Electoral Studies, Vol. 44, No. 4: 329-430.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.
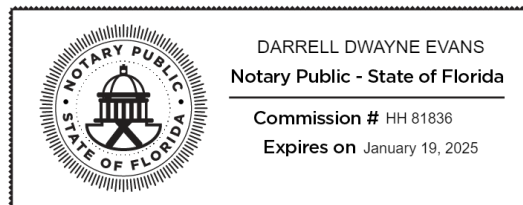
Jowei Chen
_____
Dr. Jowei Chen

Appendix

Figure A1:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2016 US President Election Results

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

Left axis (top to bottom):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Right axis label: Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District

Right axis values (top to bottom):
- (27.6%, 72.4%)
- (36.5%, 63.5%)
- (0.4%, 99.6%)
- (0.7%, 99.3%)
- (17.2%, 82.8%)
- (94.9%, 5.1%)
- (75.1%, 24.9%)
- (82.2%, 17.8%)
- (96.5%, 3.5%)
- (96.9%, 3.1%)
- (84.6%, 15.4%)
- (86.2%, 13.8%)
- (95.9%, 4.1%)
- (7.1%, 92.8%)
- (0.5%, 99.4%)

X-axis: District's Republican Vote Share Measured Using the 2016 US President election
(54.3% Statewide Republican 2–Party Vote Share)

X-axis values: 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%, 75%, 80%

District labels (red = 2021 Enacted, green = 2022 Revised):
- Most Republican: CD-3 (red), CD-3 (green)
- 2nd: CD-9 (red), CD-1 (green)
- 3rd: CD-8 (red), CD-8 (green)
- 4th: CD-14 (red), CD-7 (green)
- 5th: CD-1 (red), CD-9 (green)
- 6th: CD-10 (red), CD-10 (green)
- 7th: CD-15 (red), CD-4 (green)
- 8th: CD-2 (red), CD-15 (green)
- 9th: CD-4 (red), CD-2 (green)
- 10th: CD-7 (red), CD-6 (green)
- 11th: CD-6 (red), CD-14 (green)
- 12th: CD-11 (red), CD-12 (green)
- 13th: CD-12 (red), CD-11 (green)
- 14th: CD-13 (red), CD-13 (green)
- 15th: CD-5 (red), CD-5 (green)

Figure A2:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Y-axis (right) — Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District:
- (1.7%, 98.3%)
- (27.4%, 72.6%)
- (9.8%, 90.2%)
- (15.6%, 84.3%)
- (27.8%, 72.1%)
- (45.7%, 54.2%)
- (82.4%, 17.6%)
- (100%, 0%)
- (99.8%, 0.2%)
- (100%, 0%)
- (99.5%, 0.5%)
- (92.7%, 7.3%)
- (95.1%, 4.9%)
- (10.3%, 89.7%)
- (1.3%, 98.7%)

X-axis: District's Republican Vote Share Measured Using the 2016 US Senator election
(61% Statewide Republican 2–Party Vote Share)

Figure A3:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 Attorney General Election Results

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Right axis labels (Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District):
- (6.8%, 93.2%)
- (72%, 28%)
- (1.8%, 98.2%)
- (1.2%, 98.8%)
- (14.4%, 85.6%)
- (74.4%, 25.6%)
- (65%, 35%)
- (83.3%, 16.6%)
- (99.3%, 0.7%)
- (99.8%, 0.2%)
- (89.1%, 10.6%)
- (97%, 2.9%)
- (97.3%, 2.7%)
- (10.5%, 89.5%)
- (1%, 99%)

X-axis: District's Republican Vote Share Measured Using the 2018 Attorney General election
(52.2% Statewide Republican 2–Party Vote Share)

Figure A4:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Auditor Election Results

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

District Rank	2021 Enacted	2022 Revised	(Lower%, Higher%)
Most Republican District Within Each Plan	CD-3	CD-8	(3.1%, 96.9%)
2nd–Most Republican District	CD-15	CD-9	(43.9%, 56%)
3rd–Most Republican District	CD-11	CD-13	(10.1%, 89.9%)
4th–Most Republican District	CD-1	CD-3	(10.4%, 89.6%)
5th–Most Republican District	CD-9	CD-6	(44.3%, 55.7%)
6th–Most Republican District	CD-4	CD-1	(46.3%, 53.7%)
7th–Most Republican District	CD-13	CD-10	(29.1%, 70.9%)
8th–Most Republican District	CD-10	CD-4	(85.6%, 14.4%)
9th–Most Republican District	CD-12	CD-2	(97.7%, 2.3%)
10th–Most Republican District	CD-6	CD-11	(99.8%, 0.2%)
11th–Most Republican District	CD-8	CD-12	(96.6%, 3.4%)
12th–Most Republican District	CD-5	CD-14	(99.8%, 0.2%)
13th–Most Republican District	CD-14	CD-7	(97.3%, 2.7%)
14th–Most Republican District	CD-2	CD-15	(9.6%, 90.4%)
15th–Most Republican District	CD-7	CD-5	(1.3%, 98.7%)

X-axis: District's Republican Vote Share Measured Using the 2018 Auditor election
(51.8% Statewide Republican 2–Party Vote Share)

Right axis: Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District

Figure A5:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Governor Election Results

○ 1,000 Computer−Simulated Plans
✳ 2021 Enacted Plan (Substitute Senate Bill 258)
✳ Ohio Redistricting Commission's 2022 Revised Plan

Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District

Most Republican District Within Each Plan	(6.8%, 93.1%)
2nd−Most Republican District	(44.6%, 55.4%)
3rd−Most Republican District	(0.5%, 99.5%)
4th−Most Republican District	(5.5%, 94.5%)
5th−Most Republican District	(12.8%, 87.2%)
6th−Most Republican District	(67.4%, 32.6%)
7th−Most Republican District	(31%, 69%)
8th−Most Republican District	(89.4%, 10.6%)
9th−Most Republican District	(99.6%, 0.4%)
10th−Most Republican District	(99.6%, 0.4%)
11th−Most Republican District	(90.8%, 9.2%)
12th−Most Republican District	(96.9%, 3.1%)
13th−Most Republican District	(96.1%, 3.9%)
14th−Most Republican District	(9.6%, 90.4%)
15th−Most Republican District	(1.2%, 98.8%)

District's Republican Vote Share Measured Using the 2018 Governor election
(51.9% Statewide Republican 2−Party Vote Share)

Figure A6:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Secretary of State Election Results

Legend:
- ○ 1,000 Computer−Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd−Most Republican District
- 3rd−Most Republican District
- 4th−Most Republican District
- 5th−Most Republican District
- 6th−Most Republican District
- 7th−Most Republican District
- 8th−Most Republican District
- 9th−Most Republican District
- 10th−Most Republican District
- 11th−Most Republican District
- 12th−Most Republican District
- 13th−Most Republican District
- 14th−Most Republican District
- 15th−Most Republican District

Y-axis (right) — Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District:
- (6.4%, 93.6%)
- (67.7%, 32.3%)
- (1%, 99%)
- (3.6%, 96.4%)
- (13.6%, 86.4%)
- (91.7%, 8.3%)
- (36.7%, 63.3%)
- (84.8%, 15.1%)
- (97.8%, 2.2%)
- (99.6%, 0.4%)
- (85.6%, 14.4%)
- (96.1%, 3.9%)
- (99.6%, 0.4%)
- (10%, 90%)
- (1.3%, 98.7%)

Data point labels (red = 2021 Enacted, green = 2022 Revised):
- CD−13 / CD−7
- CD−14 / CD−10
- CD−10 / CD−4
- CD−4 / CD−2
- CD−7 / CD−5
- CD−15 / CD−8
- CD−3 / CD−15
- CD−5 / CD−14
- CD−12 / CD−9
- CD−2 / CD−11
- CD−9 / CD−1
- CD−6 / CD−6
- CD−1 / CD−3
- CD−11 / CD−13
- CD−8 / CD−12

X-axis: 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75%

District's Republican Vote Share Measured Using the 2018 Secretary of State election
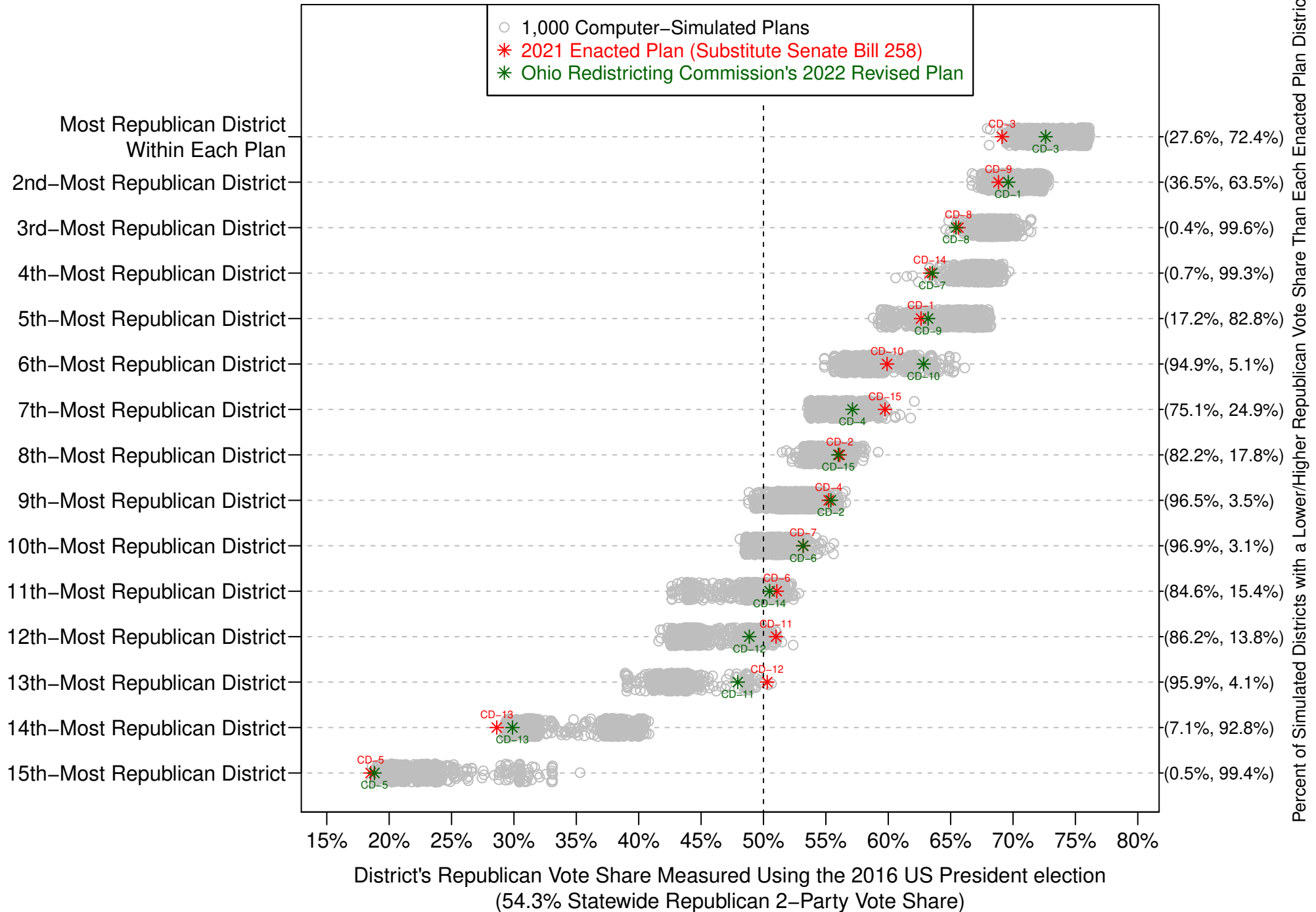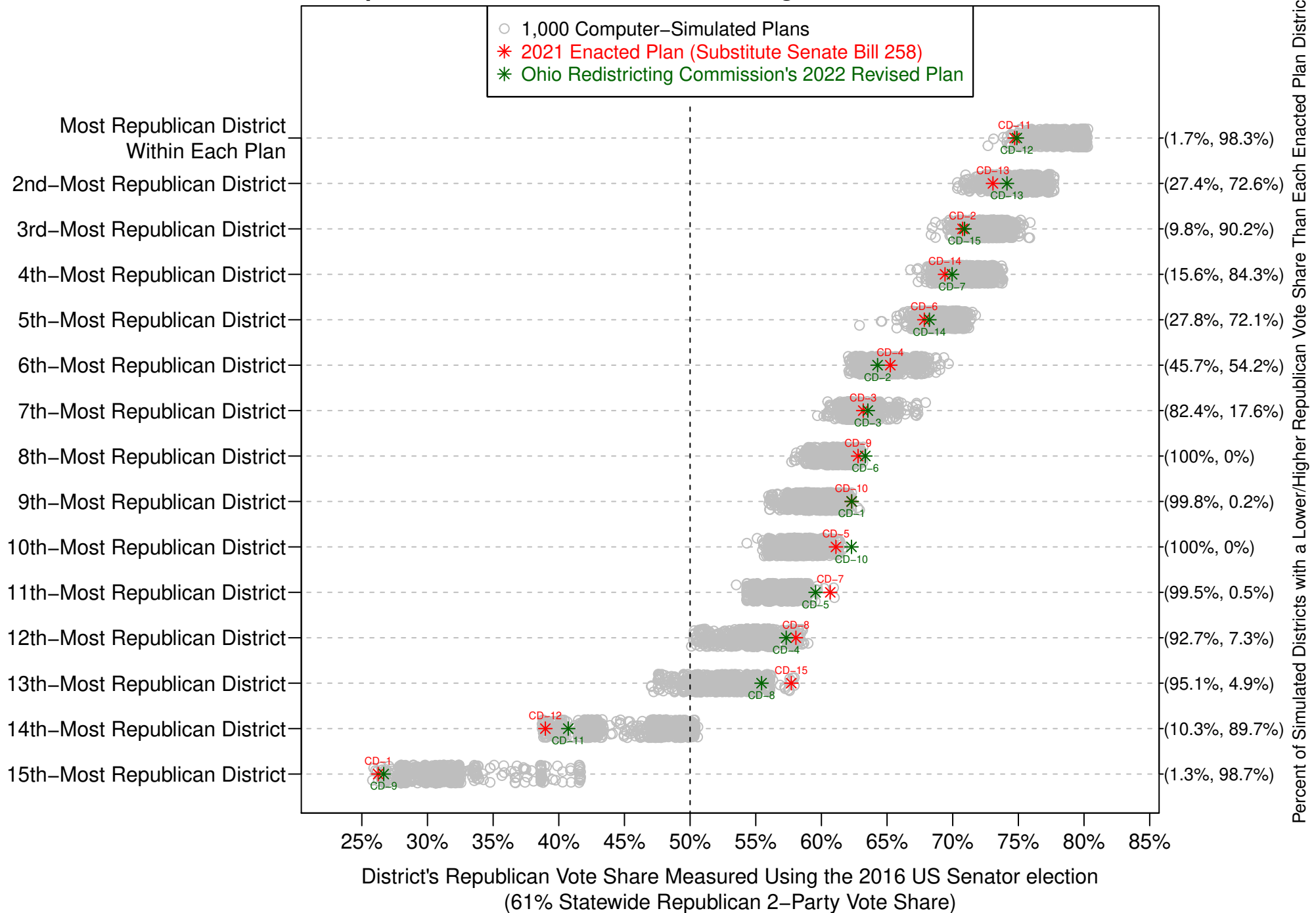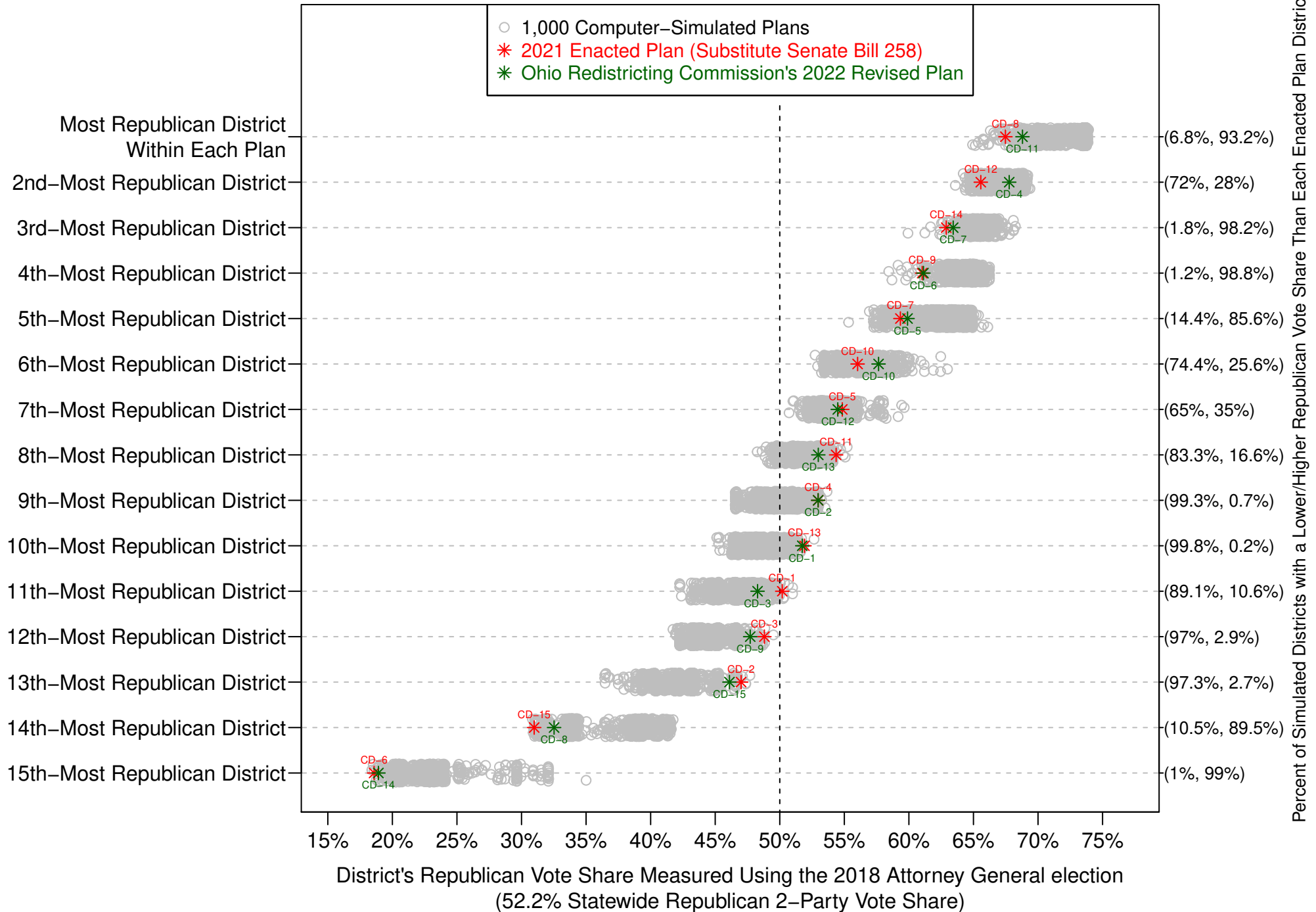(51.9% Statewide Republican 2−Party Vote Share)

Figure A7:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2018 Treasurer Election Results

○ 1,000 Computer–Simulated Plans
✳ 2021 Enacted Plan (Substitute Senate Bill 258)
✳ Ohio Redistricting Commission's 2022 Revised Plan

Most Republican District Within Each Plan — CD–6 / CD–13 — (5%, 95%)
2nd–Most Republican District — CD–11 / CD–6 — (59.6%, 40.4%)
3rd–Most Republican District — CD–4 / CD–2 — (0.7%, 99.3%)
4th–Most Republican District — CD–5 / CD–14 — (7.6%, 92.4%)
5th–Most Republican District — CD–9 / CD–1 — (24.9%, 75%)
6th–Most Republican District — CD–12 / CD–11 — (64.5%, 35.5%)
7th–Most Republican District — CD–13 / CD–9 — (53.6%, 46.4%)
8th–Most Republican District — CD–2 / CD–7 — (93%, 7%)
9th–Most Republican District — CD–14 / CD–10 — (99.3%, 0.7%)
10th–Most Republican District — CD–15 / CD–8 — (99.6%, 0.4%)
11th–Most Republican District — CD–8 / CD–15 — (90.8%, 9.1%)
12th–Most Republican District — CD–3 / CD–12 — (97.2%, 2.8%)
13th–Most Republican District — CD–10 / CD–4 — (95.6%, 4.4%)
14th–Most Republican District — CD–1 / CD–3 — (10%, 90%)
15th–Most Republican District — CD–7 / CD–5 — (1.3%, 98.7%)

Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District

District's Republican Vote Share Measured Using the 2018 Treasurer election
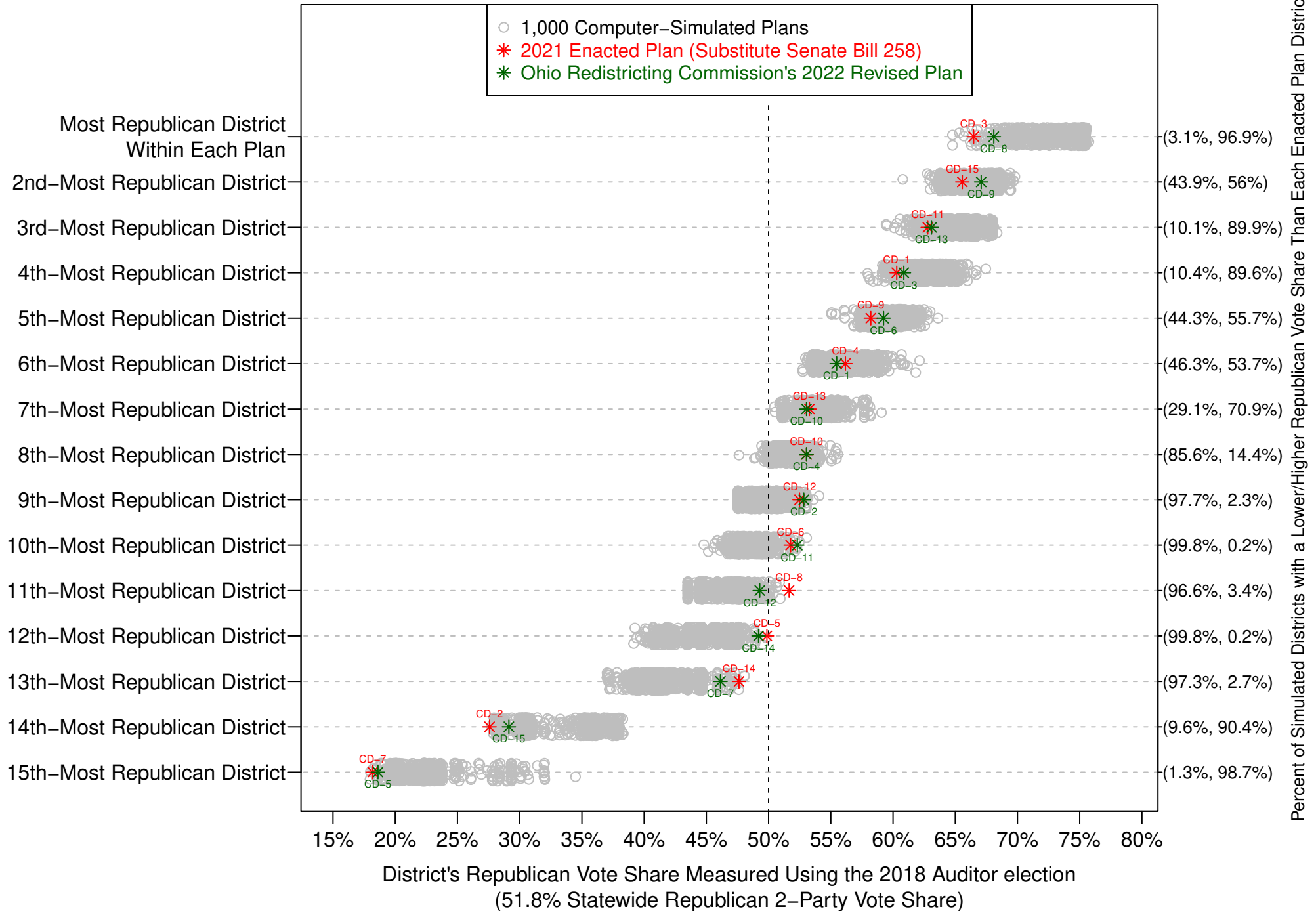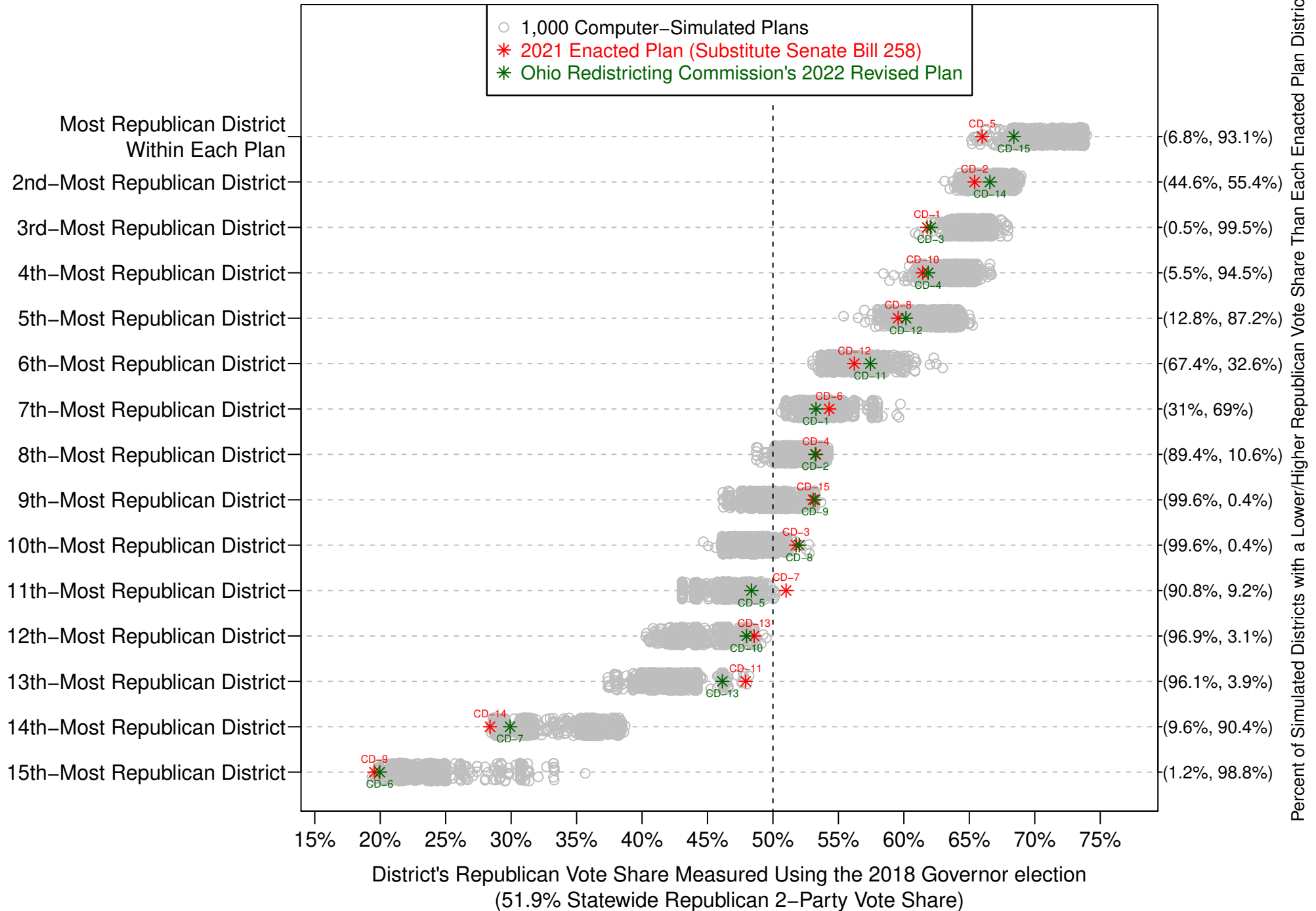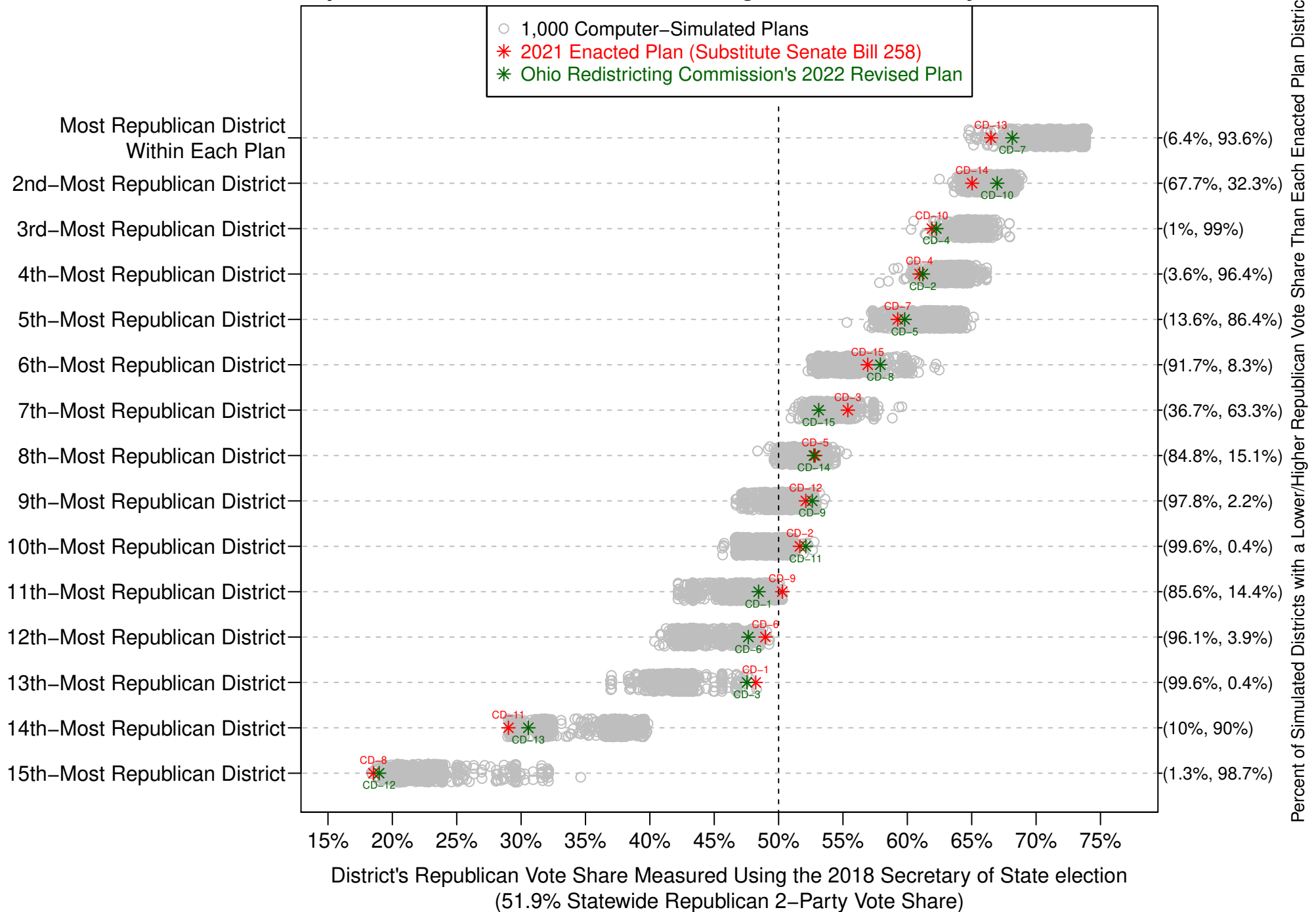(53.3% Statewide Republican 2–Party Vote Share)

Figure A8:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 US Senator Election Results

Legend:
- ○ 1,000 Computer–Simulated Plans
- ✳ 2021 Enacted Plan (Substitute Senate Bill 258)
- ✳ Ohio Redistricting Commission's 2022 Revised Plan

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Y-axis (right) — Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District:
- (24.4%, 75.5%)
- (20.8%, 79.1%)
- (4.7%, 95.3%)
- (15%, 85%)
- (1.7%, 98.3%)
- (66%, 34%)
- (41%, 59%)
- (91%, 9%)
- (99%, 1%)
- (99.6%, 0.4%)
- (98.1%, 1.9%)
- (96%, 4%)
- (99.4%, 0.6%)
- (9.8%, 90.1%)
- (1.2%, 98.8%)

District labels: CD-1, CD-3, CD-3, CD-12, CD-2, CD-7, CD-5, CD-14, CD-8, CD-15, CD-14, CD-8, CD-15, CD-10, CD-6, CD-6, CD-11, CD-13, CD-7, CD-11, CD-12, CD-5, CD-4, CD-2, CD-13, CD-9, CD-10, CD-4, CD-9, CD-1

X-axis: District's Republican Vote Share Measured Using the 2018 US Senator election
(46.6% Statewide Republican 2–Party Vote Share)

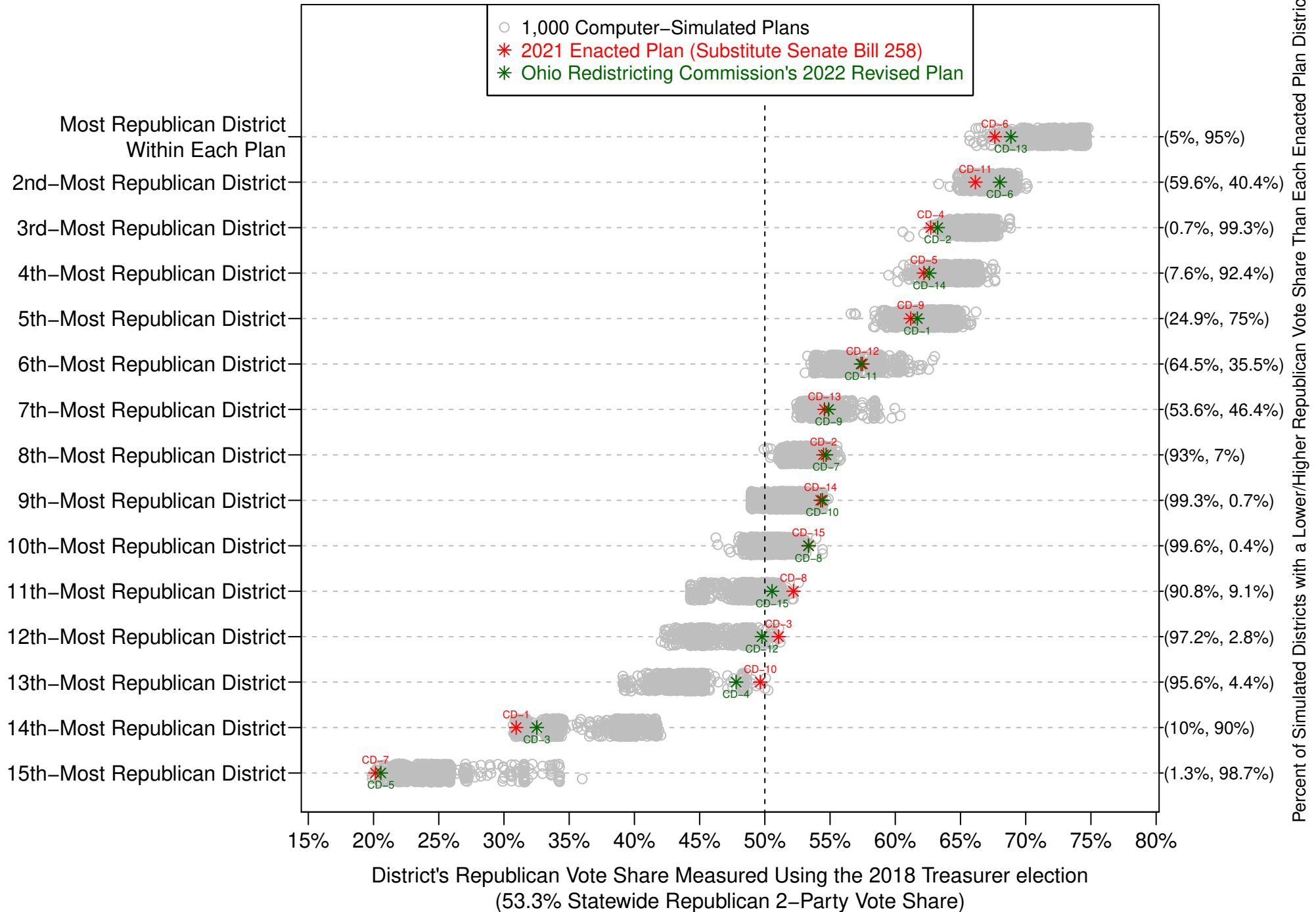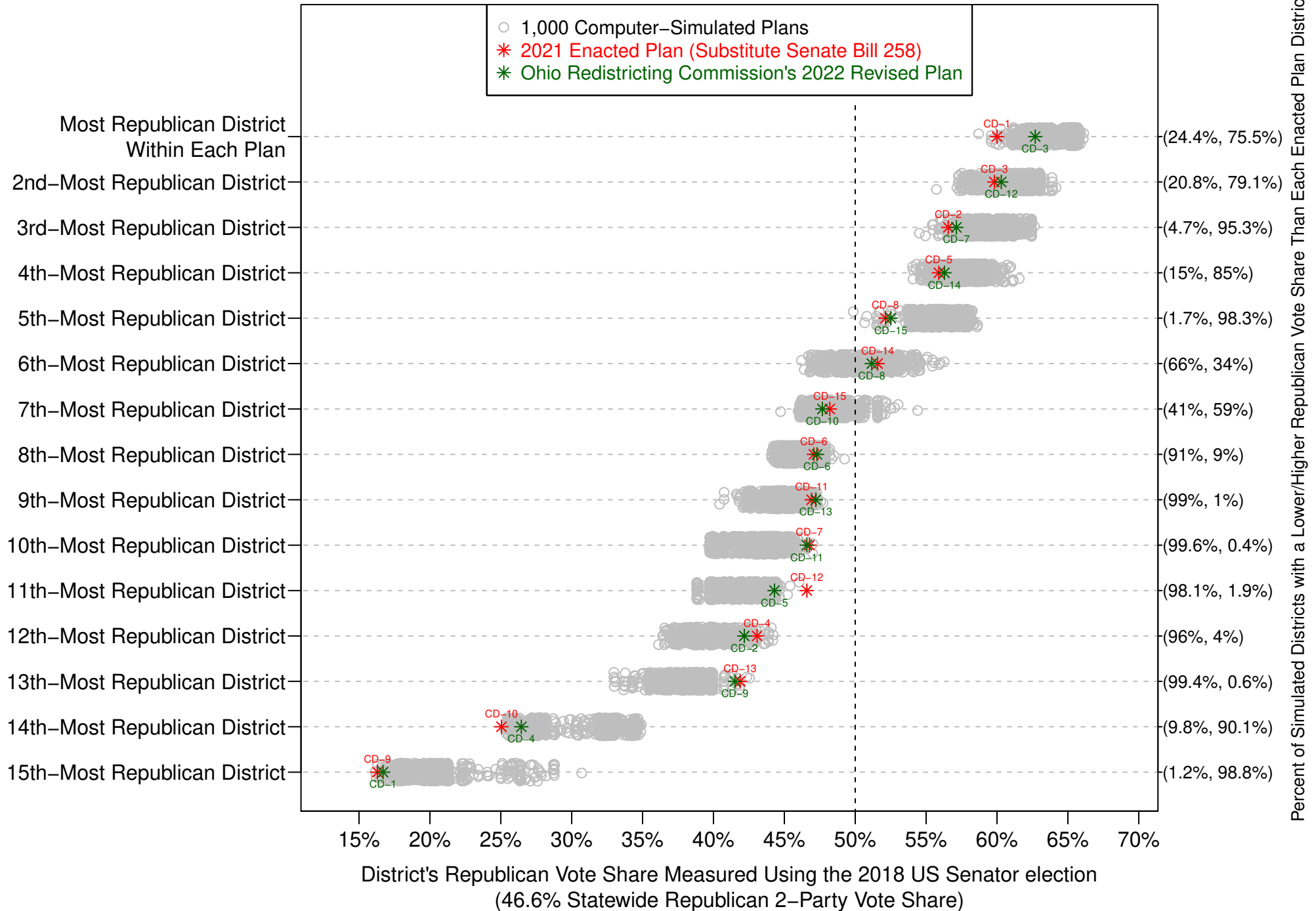X-axis values: 15%, 20%, 25%, 30%, 35%, 40%, 45%, 50%, 55%, 60%, 65%, 70%

Figure A9:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2020 US President Election Results

○ 1,000 Computer–Simulated Plans
✳ 2021 Enacted Plan (Substitute Senate Bill 258)
✳ Ohio Redistricting Commission's 2022 Revised Plan

Most Republican District Within Each Plan — (28.9%, 71.1%)
2nd–Most Republican District — (1.6%, 98.4%)
3rd–Most Republican District — (1.9%, 98.1%)
4th–Most Republican District — (10.9%, 89%)
5th–Most Republican District — (46.5%, 53.5%)
6th–Most Republican District — (82.4%, 17.6%)
7th–Most Republican District — (74.9%, 24.8%)
8th–Most Republican District — (67.5%, 32.5%)
9th–Most Republican District — (78.2%, 21.8%)
10th–Most Republican District — (84.8%, 15.2%)
11th–Most Republican District — (99.1%, 0.9%)
12th–Most Republican District — (82.4%, 17.5%)
13th–Most Republican District — (95.5%, 4.5%)
14th–Most Republican District — (4.3%, 95.7%)
15th–Most Republican District — (0.5%, 99.5%)

Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Enacted Plan District

District's Republican Vote Share Measured Using the 2020 US President election
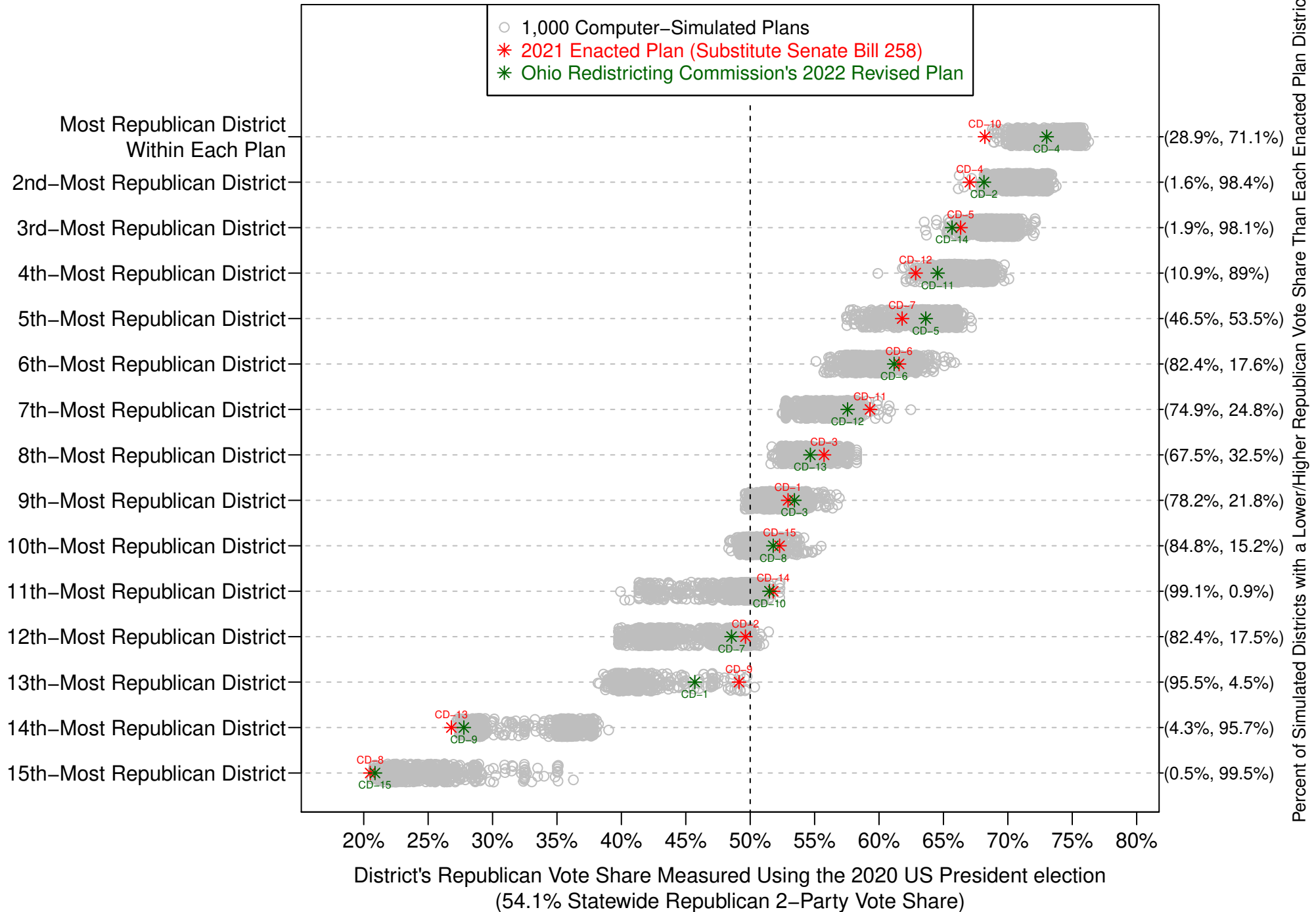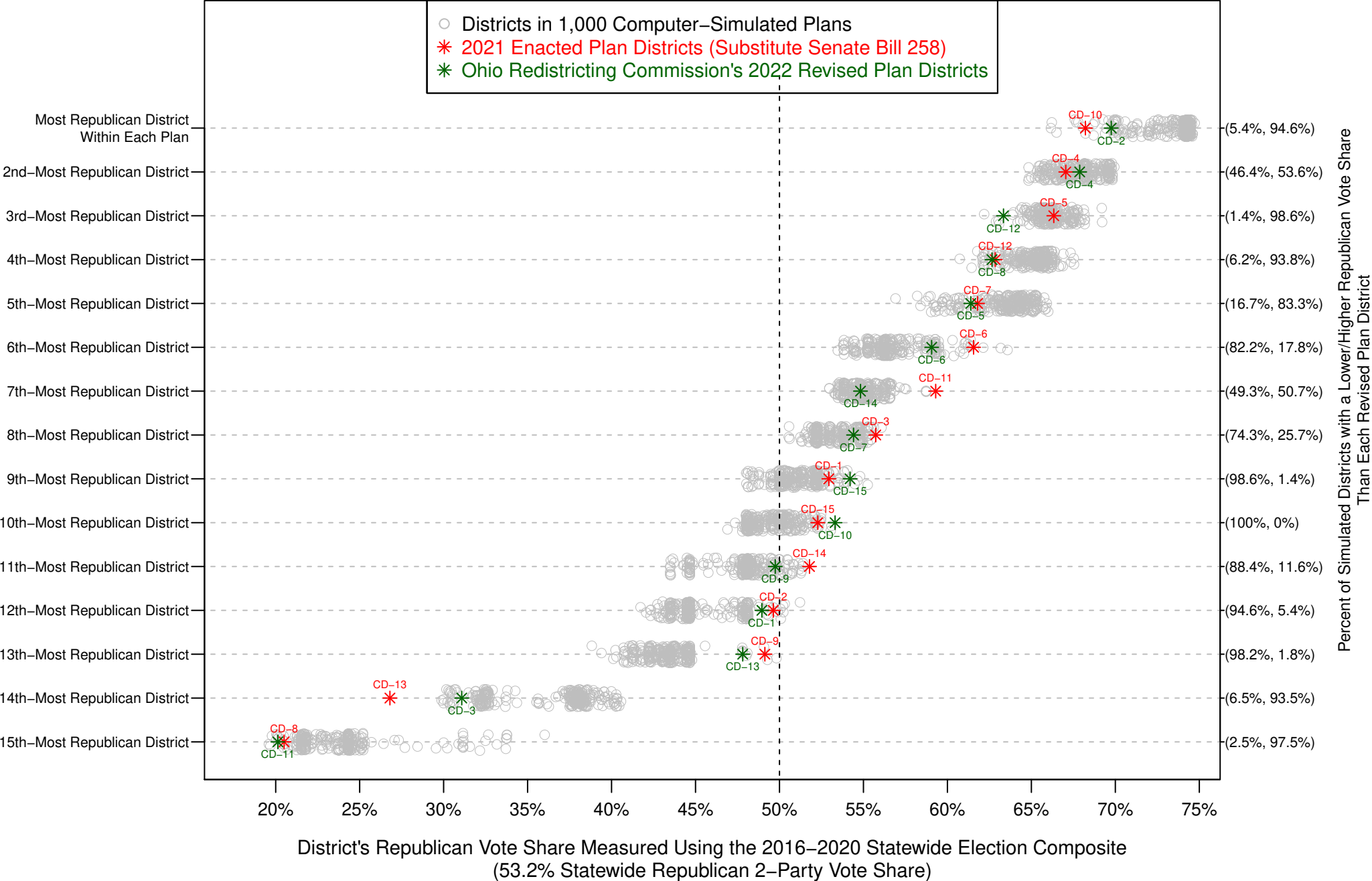(54.1% Statewide Republican 2–Party Vote Share)

Figure B2: Comparisons of 2022 Revised Plan and 2021 Enacted Plan Districts to Districts in the 276 Computer–Simulated Plans Containing 14 or Fewer Split Townships and Municipal Corporations

Legend:
- Districts in 1,000 Computer–Simulated Plans
- 2021 Enacted Plan Districts (Substitute Senate Bill 258)
- Ohio Redistricting Commission's 2022 Revised Plan Districts

Y-axis (left):
- Most Republican District Within Each Plan
- 2nd–Most Republican District
- 3rd–Most Republican District
- 4th–Most Republican District
- 5th–Most Republican District
- 6th–Most Republican District
- 7th–Most Republican District
- 8th–Most Republican District
- 9th–Most Republican District
- 10th–Most Republican District
- 11th–Most Republican District
- 12th–Most Republican District
- 13th–Most Republican District
- 14th–Most Republican District
- 15th–Most Republican District

Y-axis (right): Percent of Simulated Districts with a Lower/Higher Republican Vote Share Than Each Revised Plan District
- (5.4%, 94.6%)
- (46.4%, 53.6%)
- (1.4%, 98.6%)
- (6.2%, 93.8%)
- (16.7%, 83.3%)
- (82.2%, 17.8%)
- (49.3%, 50.7%)
- (74.3%, 25.7%)
- (98.6%, 1.4%)
- (100%, 0%)
- (88.4%, 11.6%)
- (94.6%, 5.4%)
- (98.2%, 1.8%)
- (6.5%, 93.5%)
- (2.5%, 97.5%)

X-axis: District's Republican Vote Share Measured Using the 2016–2020 Statewide Election Composite
(53.2% Statewide Republican 2–Party Vote Share)

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Curriculum Vitae

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Academic Positions:

Associate Professor (2015-present), Assistant Professor (2009-2015), Department of Political Science, University of Michigan.
Research Associate Professor (2016-present), Faculty Associate (2009-2015), Center for Political Studies, University of Michigan.
W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2013.
Principal Investigator and Senior Research Fellow, Center for Governance and Public Policy Research, Willamette University, 2013 – Present.

Education:

Ph.D., Political Science, Stanford University (June 2009)
M.S., Statistics, Stanford University (January 2007)
B.A., Ethics, Politics, and Economics, Yale University (May 2004)

Publications:

Chen, Jowei and Neil Malhotra. 2007. "The Law of k/n: The Effect of Chamber Size on Government Spending in Bicameral Legislatures."
> ***American Political Science Review*. 101(4): 657-676.**

Chen, Jowei, 2010. "The Effect of Electoral Geography on Pork Barreling in Bicameral Legislatures."
> ***American Journal of Political Science*. 54(2): 301-322.**

Chen, Jowei, 2013. "Voter Partisanship and the Effect of Distributive Spending on Political Participation."
> ***American Journal of Political Science*. 57(1): 200-217.**

Chen, Jowei and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures"
> ***Quarterly Journal of Political Science*, 8(3): 239-269.**

Bradley, Katharine and Jowei Chen, 2014. "Participation Without Representation? Senior Opinion, Legislative Behavior, and Federal Health Reform."
Journal of Health Politics, Policy and Law. 39(2), 263-293.

Chen, Jowei and Tim Johnson, 2015. "Federal Employee Unionization and Presidential Control of the Bureaucracy: Estimating and Explaining Ideological Change in Executive Agencies."
Journal of Theoretical Politics, Volume 27, No. 1: 151-174.

Bonica, Adam, Jowei Chen, and Tim Johnson, 2015. "Senate Gate-Keeping, Presidential Staffing of 'Inferior Offices' and the Ideological Composition of Appointments to the Public Bureaucracy."
Quarterly Journal of Political Science. Volume 10, No. 1: 5-40.

Chen, Jowei and Jonathan Rodden, 2015. "Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders."
Election Law Journal. Volume 14, Number 4: 331-345.

Chen, Jowei and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House."
Electoral Studies. Volume 44 (December 2016): 329-340.

Chen, Jowei, 2017. "Analysis of Computer-Simulated Districting Maps for the Wisconsin State Assembly."
Election Law Journal. Volume 16, Number 4 (December 2017): 417-442.

Chen, Jowei and Nicholas Stephanopoulos, 2020. "The Race-Blind Future of Voting Rights."
Yale Law Journal, Forthcoming. Volume 130, Number 4: 778-1049.

Kim, Yunsieg and Jowei Chen, 2021. "Gerrymandered by Definition: The Distortion of 'Traditional' Districting Principles and a Proposal for an Empirical Redefinition."
Wisconsin Law Review, Forthcoming, Volume 2021, Number 1.

Chen, Jowei and Nicholas Stephanopoulos, 2021. "Democracy's Denominator."
California Law Review, Accepted for Publication, Volume 109.

Non-Peer-Reviewed Publication:

Chen, Jowei and Tim Johnson. 2017. "Political Ideology in the Bureaucracy."
Global Encyclopedia of Public Administration, Public Policy, and Governance.

Research Grants:

"How Citizenship-Based Redistricting Systemically Disadvantages Voters of Color". 2020 ($18,225). Combating and Confronting Racism Grant. University of Michigan Center for Social Solutions and Poverty Solutions.

Principal Investigator. National Science Foundation Grant SES-1459459, September 2015 – August 2018 ($165,008). "The Political Control of U.S. Federal Agencies and Bureaucratic Political Behavior."

"Economic Disparity and Federal Investments in Detroit," (with Brian Min) 2011. Graham Institute, University of Michigan ($30,000).

"The Partisan Effect of OSHA Enforcement on Workplace Injuries," (with Connor Raso) 2009. John M. Olin Law and Economics Research Grant ($4,410).

Invited Talks:

September, 2011. University of Virginia, American Politics Workshop.
October 2011. Massachusetts Institute of Technology, American Politics Conference.
January 2012. University of Chicago, Political Economy/American Politics Seminar.
February 2012. Harvard University, Positive Political Economy Seminar.
September 2012. Emory University, Political Institutions and Methodology Colloquium.
November 2012. University of Wisconsin, Madison, American Politics Workshop.
September 2013. Stanford University, Graduate School of Business, Political Economy Workshop.
February 2014. Princeton University, Center for the Study of Democratic Politics Workshop.
November 2014. Yale University, American Politics and Public Policy Workshop.
December 2014. American Constitution Society for Law & Policy Conference: Building the Evidence to Win Voting Rights Cases.
February 2015. University of Rochester, American Politics Working Group.
March 2015. Harvard University, Voting Rights Act Workshop.
May 2015. Harvard University, Conference on Political Geography.
Octoer 2015. George Washington University School of Law, Conference on Redistricting Reform.
September 2016. Harvard University Center for Governmental and International Studies, Voting Rights Institute Conference.
March 2017. Duke University, Sanford School of Public Policy, Redistricting Reform Conference.
October 2017. Willamette University, Center for Governance and Public Policy Research
October 2017, University of Wisconsin, Madison. Geometry of Redistricting Conference.
February 2018: University of Georgia Law School
September 2018. Willamette University.
November 2018. Yale University, Redistricting Workshop.
November 2018. University of Washington, Severyns Ravenholt Seminar in Comparative Politics.
January 2019. Duke University, Reason, Reform & Redistricting Conference.

February 2019. Ohio State University, Department of Political Science. Departmental speaker series.
March 2019. Wayne State University Law School, Gerrymandering Symposium.
November 2019. Big Data Ignite Conference.
November 2019. Calvin College, Department of Mathematics and Statistics.
September 2020 (Virtual). Yale University, Yale Law Journal Scholarship Workshop

Conference Service:

Section Chair, 2017 APSA (San Francisco, CA), Political Methodology Section
Discussant, 2014 Political Methodology Conference (University of Georgia)
Section Chair, 2012 MPSA (Chicago, IL), Political Geography Section.
Discussant, 2011 MPSA (Chicago, IL) "Presidential-Congressional Interaction."
Discussant, 2008 APSA (Boston, MA) "Congressional Appropriations."
Chair and Discussant, 2008 MPSA (Chicago, IL) "Distributive Politics: Parties and Pork."

Conference Presentations and Working Papers:

"Ideological Representation of Geographic Constituencies in the U.S. Bureaucracy," (with Tim Johnson). 2017 APSA.

"Incentives for Political versus Technical Expertise in the Public Bureaucracy," (with Tim Johnson). 2016 APSA.

"Black Electoral Geography and Congressional Districting: The Effect of Racial Redistricting on Partisan Gerrymandering". 2016 Annual Meeting of the Society for Political Methodology (Rice University)

"Racial Gerrymandering and Electoral Geography." Working Paper, 2016.

"Does Deserved Spending Win More Votes? Evidence from Individual-Level Disaster Assistance," (with Andrew Healy). 2014 APSA.

"The Geographic Link Between Votes and Seats: How the Geographic Distribution of Partisans Determines the Electoral Responsiveness and Bias of Legislative Elections," (with David Cottrell). 2014 APSA.

"Gerrymandering for Money: Drawing districts with respect to donors rather than voters." 2014 MPSA.

"Constituent Age and Legislator Responsiveness: The Effect of Constituent Opinion on the Vote for Federal Health Reform." (with Katharine Bradley) 2012 MPSA.

"Voter Partisanship and the Mobilizing Effect of Presidential Advertising." (with Kyle Dropp) 2012 MPSA.

"Recency Bias in Retrospective Voting: The Effect of Distributive Benefits on Voting Behavior." (with Andrew Feher) 2012 MPSA.

"Estimating the Political Ideologies of Appointed Public Bureaucrats," (with Adam Bonica and Tim Johnson) 2012 Annual Meeting of the Society for Political Methodology (University of North Carolina)

"Tobler's Law, Urbanization, and Electoral Bias in Florida." (with Jonathan Rodden) 2010 Annual Meeting of the Society for Political Methodology (University of Iowa)

"Unionization and Presidential Control of the Bureaucracy" (with Tim Johnson) 2011 MPSA.

"Estimating Bureaucratic Ideal Points with Federal Campaign Contributions" 2010 APSA. (Washington, DC).

 "The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," Vanderbilt University Conference on Bicameralism, 2009.

"When Do Government Benefits Influence Voters' Behavior? The Effect of FEMA Disaster Awards on US Presidential Votes," 2009 APSA (Toronto, Canada).

"Are Poor Voters Easier to Buy Off?" 2009 APSA (Toronto, Canada).

"Credit Sharing Among Legislators: Electoral Geography's Effect on Pork Barreling in Legislatures," 2008 APSA (Boston, MA).

"Buying Votes with Public Funds in the US Presidential Election," Poster Presentation at the 2008 Annual Meeting of the Society for Political Methodology (University of Michigan).

"The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," 2008 MPSA.

 "Legislative Free-Riding and Spending on Pure Public Goods," 2007 MPSA (Chicago, IL).

"Free Riding in Multi-Member Legislatures," (with Neil Malhotra) 2007 MPSA (Chicago, IL).

"The Effect of Legislature Size, Bicameralism, and Geography on Government Spending: Evidence from the American States," (with Neil Malhotra) 2006 APSA (Philadelphia, PA).

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CERTIFICATE OF SERVICE

I hereby certify that the foregoing was sent via email this 4th day of March, 2022 to the following:

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