IN THE SUPREME COURT OF OHIO

Meryl Neiman, *et al.*, **League of Women Voters of Ohio, *et al.*,** **Petitioners,** **v.** **Secretary of State Frank LaRose, *et al.*,** **Respondents.**	**Case No. 2022-298** **Case No. 2022-303** ***Consolidated*** Original Action Filed Pursuant to Ohio Constitution, Article XIX, Section 3(A)

NEIMAN PETITIONERS' EVIDENCE – VOLUME 3 OF EXHIBITS

Abha Khanna (PHV 2189-2022)
Ben Stafford (PHV 25433-2022)
ELIAS LAW GROUP, LLP
1700 Seventh Ave., Suite 2100
Seattle, WA 98101
(206) 656-0176
akhanna@elias.law

Jyoti Jasrasaria (PHV 25401-2022)
Spencer W. Klein (PHV 25432-2022)
Harleen K. Gambhir (PHV 25587-2022)
Raisa Cramer (PHV 25880-2022)
ELIAS LAW GROUP, LLP
10 G St. NE, Suite 600
Washington, DC 20002
(202) 968-4490
jjasrasaria@elias.law

Donald J. McTigue (0022849)
Counsel of Record
Derek S. Clinger (0092075)
MCTIGUE COLOMBO & CLINGER, LLC
545 East Town Street
Columbus, OH 43215
(614) 263-7000
dmctigue@electionlawgroup.com

Counsel for Neiman Petitioners
Freda J. Levenson (0045916)

Dave Yost
OHIO ATTORNEY GENERAL
Jonathan D. Blanton (0070035)
Julie M. Pfeiffer (0069762)
Michael A. Walton (0092201)
Allison D. Daniel (0096816)
Assistant Attorneys General
Constitutional Offices Section
30 E. Broad Street, 16th Floor
Columbus, OH 43215
(614) 466-2872
Jonathan.Blanton@OhioAGO.gov

Counsel for Respondent Ohio Secretary of State Frank LaRose

Phillip J. Strach
Thomas A. Farr
John E. Branch, III
Alyssa M. Riggins
NELSON MULLINS RILEY & SCARBOROUGH, LLP
4140 Parklake Ave., Suite 200
Raleigh, NC 27612
(919) 329-3812
phil.strach@nelsonmullins.com

Counsel for Respondents House Speaker Bob Cupp and Senate President Matt Huffman

ACLU of Ohio Foundation, Inc.
4506 Chester Avenue
Cleveland, Ohio 44103
Tel: 614-586-1972 x 125
flevenson@acluohio.org

David J. Carey (0088787)
ACLU of Ohio Foundation, Inc.
1108 City Park Avenue, Suite 203
Columbus, OH 43206
(614) 586-1972 x2004
dcarey@acluohio.org

Alora Thomas (PHV 22010-2022)
Julie A. Ebenstein (PHV 25423-2022)
American Civil Liberties Union Foundation
125 Broad Street
New York, NY 10004
(212) 519-7866
athomas@aclu.org
jebenstein@aclu.org

Robert D. Fram (PHV 25414-2022)
Donald Brown (PHV 25480-2022)
David Denuyl (PHV 25452-2022)
Covington & Burling LLP
Salesforce Tower
415 Mission Street, Suite 5400
San Francisco, CA 94105-2533
(415) 591 6000
rfram@cov.com

James Smith (PHV 25241-2022)
Sarah Suwanda (PHV 25602-2022)
Alexander Thomson (PHV 25462-2022)
Covington & Burling LLP
One CityCenter
850 Tenth Street, NW
Washington, DC 20001-4956
(202) 662-6000
jmsmith@cov.com

Erik J. Clark (0078732)
Ashley Merino (0096853)
ORGAN LAW LLP
1330 Dublin Road
Columbus, OH 43215
T: (614) 481-0900
F: (614) 481-0904
ejclark@organlegal.com
amerino@organlegal.com

Counsel for Respondent Ohio Redistricting Commission

Anupam Sharma (PHV 25418-2022)
Yale Fu (PHV 25419-2022)
Covington & Burling LLP
3000 El Camino Real
5 Palo Alto Square, 10th Floor
Palo Alto, CA 94306-2112
(650) 632-4700
asharma@cov.com
Counsel for League of Women Voters of Ohio Petitioners

VOLUME 3		
EX.	**DESCRIPTION**	**BATES RANGE**
29	Dr. Rodden's Expert Affidavit, *Adams v. DeWine*, Case No. 2021-1428 (submitted March 4, 2022)	NEIMAN_EVID_00341-NEIMAN_EVID_00386
30	Dr. Chen's Expert Affidavit, *Adams v. DeWine*, Case No. 2021-1428 (submitted March 4, 2022)	NEIMAN_EVID_00387-NEIMAN_EVID_00442
31	Dr. Imai's Expert Affidavit, *League of Women Voters of Ohio v. Ohio Redistricting Commission*, Case No. 2021-1449 (submitted March 7, 2022)	NEIMAN_EVID_00443-NEIMAN_EVID_00462
32	Dr. Warshaw's Expert Affidavit, *League of Women Voters of Ohio v. Ohio Redistricting Commission*, Case No. 2021-1449 (submitted March 7, 2022)	NEIMAN_EVID_00463-NEIMAN_EVID_00498

CERTIFICATE OF SERVICE

I hereby certify that Neiman Petitioners' Evidence – Volume 3 of Exhibits was sent via email this 25th day of April 2022 to the following:

Jonathan D. Blanton, Jonathan.Blanton@OhioAGO.gov
Julie M. Pfeiffer, Julie.Pfeiffer@OhioAGO.gov
Michael A. Walton, Michael.Walton@OhioAGO.gov
Allison D. Daniel, Allison.Daniel@OhioAGO.gov
Counsel for Secretary of State Frank LaRose

Phillip J. Strach, phil.strach@nelsonmullins.com
Thomas A. Farr, tom.farr@nelsonmullins.com
John E. Branch, john.branch@nelsonmullins.com
Alyssa M. Riggins, alyssa.riggins@nelsonmullins.com
W. Stuart Dornette, dornette@taftlaw.com
Beth A. Bryan, bryan@taftlaw.com
Philip D. Williamson, pwilliamson@taftlaw.com
Counsel for Senate President Huffman and House Speaker Cupp

Erik J. Clark, ejclark@organlegal.com
Ashely Merino, amerino@organlegal.com
Counsel for Ohio Redistricting Commission

Freda J. Levenson, flevenson@acluohio.org
David J. Carey, dcarey@acluohio.org
Alora Thomas, athomas@aclu.org
Julie A. Ebenstein, jebenstein@aclu.org
Robert D. Fram, rfram@cov.com
Donald Brown, dbrown@cov.com
David Denuyl, ddenuyl@cov.com
James Smith, jmsmith@cov.com
Sarah Suwanda, ssuwanda@cov.com
Alexander Thomson, ajthomson@cov.com
Anupam Sharma, asharma@cov.com
Yale Fu, yfu@cov.com

Counsel for League of Women Voters of Ohio Petitioners

/s/ Derek S. Clinger
Derek S. Clinger

Neiman Petitioners' Exhibit 29

IN THE SUPREME COURT OF OHIO

Regina Adams, *et al.* **Relators,** **v.** **Governor Mike DeWine, *et al.*** **Respondents.**	**Case No. 2021-1428** Original Action Filed Pursuant to Ohio Constitution, Article XIX, Section 3(A)

EXPERT AFFIDAVIT OF DR. JONATHAN RODDEN

I, Jonathan Rodden, 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

1. In a previous affidavit filed in this case, I examined whether the redistricting plan for the Ohio delegation to the United States House of Representatives, adopted by the Ohio General Assembly on November 18, 2021 and signed into law by Governor Mike DeWine two days later, conformed to the requirement set forth in Article XIX, Section 1(C)(3)(a), namely, that the plan does not "unduly favor[] or disfavor[] a political party or its incumbents." I presented evidence that the plan (the "Overturned Plan," attached as Exhibit A) unduly favored the Republican Party and its incumbents, elevating partisan advantage over traditional redistricting criteria like compactness and the preservation of communities.

2. I have now been asked to conduct a similar exercise with a new plan, passed by the Ohio Redistricting Commission on March 2, 2022 (the "New Plan," attached as Exhibit B). After doing so, I discovered that the key conclusions of my initial report still apply. The New Plan favors the Republican Party and its incumbents in rather obvious and consequential ways and disfavors the Democratic Party and its incumbents.

3. A comparison of the New Plan with the Overturned Plan reveals only small changes in the treatment of the two parties. Both the Overturned Plan and the New Plan produce two extremely Democratic districts: one in Columbus and one in Cleveland. And both produce three districts where the statewide Democratic vote share in recent years was rather close to 50 percent. This means that with around 47 percent of the statewide vote shares, Democratic Party can likely expect 20 or 27 percent of the seats. As with the Overturned Plan, even if Democratic candidates are very fortunate and win all three "swing" districts in a given year, the Democrats can expect no more than 33 percent of the seats. In fact, even if Democrats experience a large swing in their favor of 3 percentage points, so that the Democratic Party

wins 50 percent of the statewide vote, it still cannot anticipate winning more than 33 percent of the seats. By contrast, a similar 3 percentage point swing would result in the Republican Party winning roughly 56 percent of the statewide vote, and 87 percent of the seats.

4. As in my previous report, I seek to explain how the New Plan achieves this rather striking counter-majoritarian outcome. The answer is largely the same: subverting traditional redistricting principles by splitting communities in metro areas and strategically subsuming urban fragments in their surrounding rural areas, often relying on relatively non-compact districts. Specifically, the New Plan 1) splits the Cincinnati metro area in a way that prevents the emergence of a Democratic district; 2) splits the Columbus and Cleveland areas in ways that pack Democrats into a single district in each metro area, combining urban and suburban Democratic communities with far-flung rural areas so as to avoid the emergence of a second Democratic district; 3) separates Toledo from proximate metro areas and combines it with very rural counties; and 4) carves out Lorain County from its geographic environment and places it in a highly non-compact rural district that reaches to the Indiana border. All of these features were present in the Overturned Plan as well.

5. By examining alternative plans that were before the General Assembly and the Commission, it is clear to see that it is possible to achieve higher levels of compactness, greater respect for communities, and a better reflection of the partisan preferences of Ohio voters by drawing districts that are not crafted to advantage one political party and its incumbents. That is to say, drawing districts that adhere to Ohio's political and economic geography does not require the degree of advantage for the Republican Party exhibited in the New Plan.

II. QUALIFICATIONS

6. I am currently a tenured Professor of Political Science at Stanford University and the founder and director of the Stanford Spatial Social Science Lab—a center for research and teaching with a focus on the analysis of geo-spatial data in the social sciences. I am engaged in a variety of research projects involving large, fine-grained geo-spatial data sets including ballots and election results at the level of polling places, individual records of registered voters, census data, and survey responses. I am also a senior fellow at the Stanford Institute for Economic Policy Research and the Hoover Institution. Prior to my employment at Stanford, I was the Ford Professor of Political Science at the Massachusetts Institute of Technology. I received my Ph.D. from Yale University and my B.A. from the University of Michigan, Ann Arbor, both in political science. A copy of my current C.V. is included as Exhibit H.

7. In my current academic work, I conduct research on the relationship between the patterns of political representation, geographic location of demographic and partisan groups, and the drawing of electoral districts. I have published papers using statistical methods to assess political geography, balloting, and representation in a variety of academic journals including *Statistics and Public Policy, Proceedings of the National Academy of Science*, *American Economic Review Papers and Proceedings*, the *Journal of Economic Perspectives*, the *Virginia Law Review*, the *American Journal of Political Science*, the *British Journal of Political Science*, the *Annual Review of Political Science*, and the *Journal of Politics.* One of these papers was selected by the American Political Science Association as the winner of the

Michael Wallerstein Award for the best paper on political economy published in the last year, and another received an award from the American Political Science Association section on social networks. In 2021, I received a John Simon Guggenheim Memorial Foundation Fellowship, and received the Martha Derthick Award of the American Political Science Association for "the best book published at least ten years ago that has made a lasting contribution to the study of federalism and intergovernmental relations."

8. I have recently written a series of papers, along with my co-authors, using automated redistricting algorithms to assess partisan gerrymandering. This work has been published in the *Quarterly Journal of Political Science*, *Election Law Journal*, and *Political Analysis*, and it has been featured in more popular publications like the *Wall Street Journal*, the *New York Times*, and *Boston Review*. I have recently completed a book, published by *Basic Books* in June of 2019, on the relationship between political districts, the residential geography of social groups, and their political representation in the United States and other countries that use winner-take-all electoral districts. The book was reviewed in *The New York Times*, *The New York Review of Books*, *Wall Street Journal*, *The Economist*, and *The Atlantic*, among others.

9. I have expertise in the use of large data sets and geographic information systems (GIS), and I conduct research and teaching in the area of applied statistics related to elections. My PhD students frequently take academic and private sector jobs as statisticians and data scientists. I frequently work with geo-coded voter files and other large administrative data sets, including in recent papers published in the *Annals of Internal Medicine* and *The New England Journal of Medicine.* I have developed a national data set of geo-coded precinct-level election results that has been used extensively in policy-oriented research related to redistricting and representation.

10. I have been accepted and testified as an expert witness in several election law and redistricting cases: *Romo v. Detzner,* No. 2012-CA-000412 (Fla. Cir. Ct. 2012); *Mo. State Conference of the NAACP* v. *Ferguson-Florissant Sch. Dist.,* No. 4:2014-CV-02077 (E.D. Mo. 2014); *Lee v. Va. State Bd. of Elections,* No. 3:15-CV-00357 (E.D. Va. 2015); *Democratic Nat'l Committee et al. v. Hobbs et al.*, No. 16-1065-PHX-DLR (D. Ariz. 2016); *Bethune-Hill v. Virginia State Board of Elections*, No. 3:14-cv-00852-REP-AWA-BMK (E.D. Va. 2014); and *Jacobson et al. v. Lee*, No. 4:18-cv-00262 (N.D. Fla. 2018). I also worked with a coalition of academics to file Amicus Briefs in the Supreme Court in *Gill v. Whitford*, No. 16-1161, and *Rucho v. Common Cause*, No. 18-422. Much of the testimony in these cases had to do with geography, electoral districts, voting, ballots, and election administration. I recently worked as a consultant for the Maryland Redistricting Commission, and I drew a Pennsylvania Congressional redistricting plan, known as the "Carter Plan," that was chosen by the Pennsylvania Supreme Court for implementation. *Carter v. Chapman*, No. 7 MM 2022, 2022 WL 549106 (Pa. Feb. 23, 2022). I am being compensated at the rate of $550/hour for my work in this case. My compensation is not dependent upon my conclusions in any way.

III. DATA SOURCES

11. I have collected statewide election data for 2012 to 2020 from the Ohio Secretary of State. I also accessed precinct-level election results from the Ohio Secretary of State for statewide elections from 2016 to 2020 that were matched to 2020 Ohio vote tabulation districts by a team at Harvard University called the Algorithm-Assisted Redistricting Methodology Project.[1] Additionally, I accessed several proposed Ohio congressional plans uploaded to the web page of the Ohio Redistricting Commission as well as the websites for the Ohio House and Senate, true copies of which are attached as Exhibits C, D, E, F, and G.[2] I also consulted geographic boundary files of the New Plan that were provided to me by Counsel (and available on the Ohio Redistricting Commission's website). I also consulted the same U.S. Census redistricting data used by the General Assembly, as archived in the "Ohio University Common and Unified Redistricting Database."[3] For the analysis conducted in this report, I use three software packages: Stata, Maptitude for Redistricting, and ArcGIS Pro.

IV. THE PARTISANSHIP OF THE NEW CONGRESSIONAL PLAN

12. In my earlier report, I assembled data for the two major parties from statewide elections in Ohio from 2012 to 2020 and demonstrated that statewide support for Democratic candidates was around 46 percent in the period since 2012, but in more recent years, from 2016 to 2020, it was around 47 percent.

13. I then examined the plan that had been passed by the Ohio Legislature, but that has been subsequently overturned (the "Overturned Plan"). I summed up precinct-level results of elections from 2016 to 2020 within the boundaries of each of the districts of the overturned plan, and then demonstrated that Democratic candidates in statewide elections had comfortable majorities in only two districts—one in Cleveland and one in Columbus. Beyond those, the Overturned Plan included two districts in which the statewide vote share for the two parties was very evenly split, such that with 47 percent of the statewide vote, Democrats could anticipate only 20 percent of the seats (i.e., to win three of fifteen districts).

14. First, let us examine the new Congressional plan promulgated on March 2, 2022 ("the New Plan") using a similar approach. Again, there are two extremely Democratic districts, one in Cleveland and one in Columbus. In this plan, there are also three very evenly divided districts. In each of these districts, the Democratic statewide vote share from 2016 to 2020 is slightly above 50 percent. Specifically, in District 1, which combines urban parts of Cincinnati with rural Warren County, the Democratic vote share in statewide races aggregates to 51 percent. In District 9, in Northwest Ohio, the Democratic vote share was 50.2 percent. In District 13, which combines Summit County and the Northern part of Stark County, it was 52.2 percent. The remainder of the seats have relatively comfortable Republican majorities—all equal to or greater than 53.3 percent.

[1] https://alarm-redist.github.io/posts/2021-08-10-census-2020/.
[2] https://redistricting.ohio.gov/maps.
[3] https://www.redistricting.ohio.gov/resources.

15. If one wishes to assess the anticipated division of seats for the two parties under this plan, one must come up with a way to allocate these three evenly divided seats. As described in my previous report, District 1 has a longstanding Republican incumbent, Steve Chabot, who over the last decade, received around 58 percent of the votes cast for the two major parties in District 1, even though his statewide co-partisans had received, on average, around 54 percent of the votes in his district. If we consider his 4-point incumbency advantage, and the fact that around 70 percent of the population in the new version of District 1 was in the old version of District 1, this district should be viewed as having a Republican lean.

16. District 9 has been very evenly divided between the parties when we sum over all statewide races from 2016 to 2020. However, in the most recent election, Donald Trump won 51.5 percent of the vote. The Democratic incumbent, Marcy Kaptur, has outperformed her statewide co-partisans in the past, but her district has been redrawn so that only around half of the population of the new, more rural version of District 9 was in the old version of District 9. As a result, this district is probably best seen as a true tossup.

17. To my knowledge, District 13 does not include any incumbents. With a Democratic vote share of just over 52 percent in statewide races, and a Democratic vote share of 51.4 percent in the most recent presidential election, it is best understood as a district with a slight Democratic lean.

18. If one accepts this analysis, and considers that one of these districts leans Democratic, another leans Republican, and a third is a toss-up where the expected probability of a Democratic victory is .5, we would end up with the conclusion that Democratic candidates can anticipate 3.5 seats, or 23 percent.

19. Alternatively, we might simply classify all three seats as tossups in which Democratic candidates would win with probability .5. Summing over these probabilities, we would end up with the same expectation: 3.5 seats, or 23 percent.

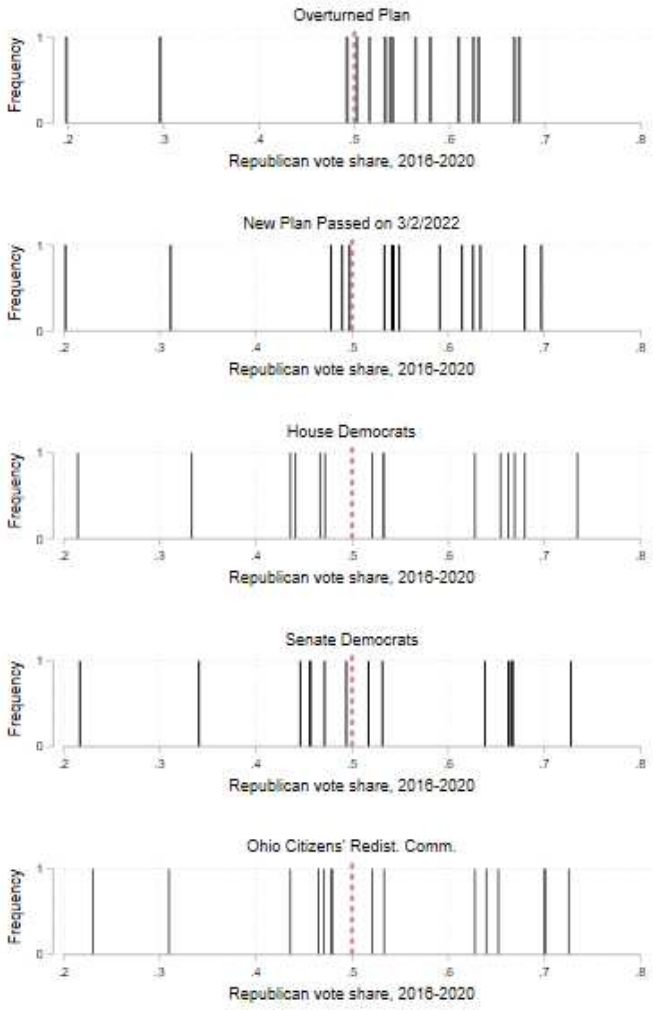
20. If one considered the seat with a 52.2 percent Democratic majority as a safer Democratic seat and focused only on the bare majority Districts 1 and 9 as toss-ups, Democrats would still win only 4 districts, giving them 27 percent of the seats.

21. Another approach might be to ignore these 3 evenly divided seats, and simply ask how many of the remaining 12 seats lean Democratic, and how many Republican. With this approach, we would view the Democratic seat share as 2 out of 12, or 17 percent. Even if we ignored only 2 of the seats (District 1 and 9), we would view the Democratic seat share as 3 out of 13, or 23 percent.

22. In the event of a pro-Democratic wave, if Democrats would win all three seats, giving them a total of 5, they would have a seat share of 33 percent.

23. In short, with around 47 percent of the statewide vote share, the Democrats could anticipate anywhere from 13 percent of the seats if they lose all three of the competitive districts, to 33 percent if they win all three. Perhaps the most reasonable (but still optimistic) expectation, ex ante, is 27 percent. In other words, the Democrats' expected seat share falls far short of their vote share.

Figure 1: Discrete Histograms for Several Ohio Congressional Redistricting Plans



24. Moreover, it is important to note that 33 percent is very likely the ceiling on the number of seats the Democratic Party could possibly win under the New Plan. This is because the other 10 seats have been drawn to be very comfortable for Republican candidates. To comprehend this, see the top two panels in Figure 1, which provides discrete histograms for the Overturned Plan, and then for the New Plan. A discrete histogram simply displays a bar for each district, arranged on the horizontal axis according to the Republican vote share, with a red dotted line indicating 50 percent.

25. Figure 1 demonstrates that the main difference between the Overturned Plan and the New Plan is that a couple of the bars have moved ever so slightly to the left, to the other (Democratic) side of the 50 percent line. Note that this leaves a large gap on the *right* side of 50 percent in the New Plan. That is to say, there are no highly competitive Republican-leaning districts that Democratic candidates might hope to capture in a pro-Democratic wave election.

26. The most competitive Republican-leaning district is District 10, where the statewide Democratic vote share aggregates to 46.7 percent. However, as explained in my previous report, the Republican incumbent, Mike Turner, won each general election from 2012 to 2020 with an average two-party vote share above 62 percent, outperforming his statewide co-partisans by around 8.7 percentage points. In the New Plan, Representative Turner keeps 90 percent of the population of his old district, so there is no reason to anticipate that District 10 would be competitive in a typical election scenario.

27. Due to the lack of competitive but Republican-leaning districts, it is difficult to envision a scenario in which the Democratic Party would be able to win more than 5 seats under this plan. Relative to their 47 percent vote share in the period from 2016 to 2020, imagine a very large uniform shift of 3 percentage points toward the Democratic Party in all districts, giving them 50 percent of the statewide vote. Democratic candidates could *still* only anticipate only 33 percent of the seats. If we take a naïve approach and ignore incumbency advantage, focusing only on statewide vote shares, we might imagine that a truly extraordinary 4-point uniform swing would be enough to tip District 10 to the Democrats, but it would be too little for the Democrats to gain majorities in any other districts. This would generate a highly counter-majoritarian result in which the Democrats received 51 percent of the votes but 40 percent of the seats.

28. In stark contrast, if the Republican Party experienced the same large uniform shift of 3 percentage points, it would win 56 percent of the statewide vote and all three of the competitive seats—just about *87 percent* of the congressional seats.

29. There is nothing about the geography of Ohio or the requirements of the Ohio Constitution that requires this type of counter-majoritarian redistricting plan. In my previous report, I discussed three alternative redistricting plans: one that was introduced by the House Democrats on November 5, 2021 (Exhibit C); one that was introduced by the Senate Democrats on November 10, 2021 (Exhibit D); and one that was introduced by the Ohio Citizens' Redistricting Commission on September 30, 2021 (Exhibit E).

30. Discrete histograms for these three plans have also been included in Figure 1. Note that the distribution of partisanship is quite different in these plans than in the Overturned Plan and the New Plan. Not only do they include a larger number of plans where the Democratic vote share is above 50 percent—7 districts in the Senate Democrats' and OCRC plans, 6 in the House Democrats' Plan—but the Democratic-leaning districts are not tightly clustered around the 50 percent line.

V. HOW DOES THE NEW PLAN TREAT INCUMBENTS?

31. In addition to analyzing the extent to which the New Plan favors or disfavors a party in the aggregate, I have also been asked to examine the extent to which it disproportionately favors or disfavors the *incumbents* for one of the two parties. Under the previous plan, there were 12 Republican incumbents. One of these, Anthony Gonzalez, has announced his retirement. Representative Brad Wenstrup has announced that he intends to seek re-election in District

2, which is a comfortably Republican district.[4] All the remaining districts with Republican incumbents continue to have Republican majorities—most of them quite comfortable. The only exception is District 1, where it was necessary to make changes due to the Ohio Constitution's requirement that Cincinnati be kept whole and the Ohio Supreme Court's opinion striking down the Overturned Plan. Nevertheless, as described above, though statewide races have been evenly divided in the redrawn version of the district, the incumbent has enjoyed a large incumbency advantage in recent years and has been able to retain most of the population of his old district. In all the other districts with Republican incumbents, as documented above, safe margins have been maintained so that incumbents are likely to survive even a significant statewide swing toward the Democratic Party.

32. In contrast, of the four Democratic incumbents, only two continue to reside in districts that are clearly Democratic. The other two reside in dramatically reconfigured districts. Marcy Kaptur represented a relatively urban and comfortably Democratic District 9 (drawn in 2011 to pair Kaptur with another Democratic incumbent). This district has been redrawn to separate Ohio's northern industrial cities, thus subsuming Toledo in a much more rural district that is now evenly divided. Only around half of the new version of District 9 was in her previous dIstrict. While the 2011 version of District 9 was rather non-compact, the version of District 9 in the alternative maps discussed in my previous report are markedly more compact than the 2011 version, while retaining more of the northern industrial cities that comprised the 2011 version. Tim Ryan, who has announced that he is running for the U.S. Senate, was the incumbent in the Youngstown-based District 13, which has been completely reconfigured, with Ryan now placed in the predominantly rural, safe Republican District 6 in the New Plan.

VI. HOW DOES THE NEW PLAN ACHIEVE THESE RESULTS?

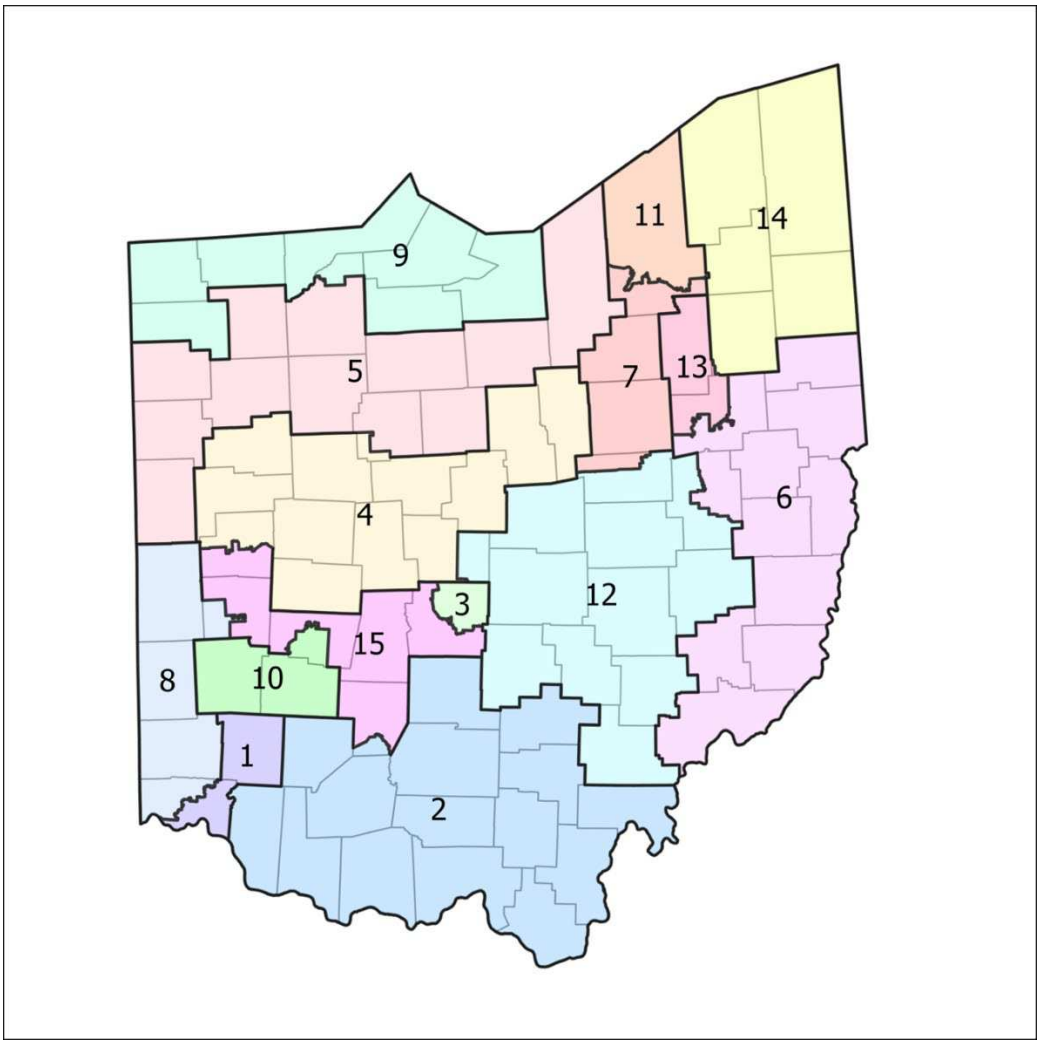
33. Like the Overturned Plan, the New Plan favors the Republican Party and its incumbents, while disfavoring the Democratic Party and its incumbents. My previous report demonstrated that in order to achieve this partisan advantage, the Overturned Plan subordinated traditional redistricting principles in several ways. Above all, the Overturned Plan contained needlessly non-compact districts and split metropolitan area communities in order to prevent the emergence of districts with Democratic majorities. The following decisions stood out most clearly: 1) the Cincinnati metro area was split in a way that prevented the emergence of an obvious, compact district with a clear Democratic majority, 2) Columbus and Cleveland-area districts were drawn to prevent the creation of a second metro-area Democratic district, 3) District 9 in Northwest Ohio was drawn so as to overwhelm Toledo and other Democratic communities on Lake Erie with more rural communities, and 4) rather than being combined with suburban Cleveland to its East or other proximate Democratic-leaning communities to its West on Lake Erie, Lorain County is extracted from Northeast Ohio and connected via a corridor of rural counties to the Western border of the state.

34. Each of these features remains in the New Plan. Before taking a closer look at specific regions, it is useful to view the overall architecture of the New Plan, along with several

[4] https://highlandcountypress.com/Content/In-The-News/In-The-News/Article/Rep-Wenstrup-announces-intent-to-seek-re-election-in-2nd-District/2/20/74059.

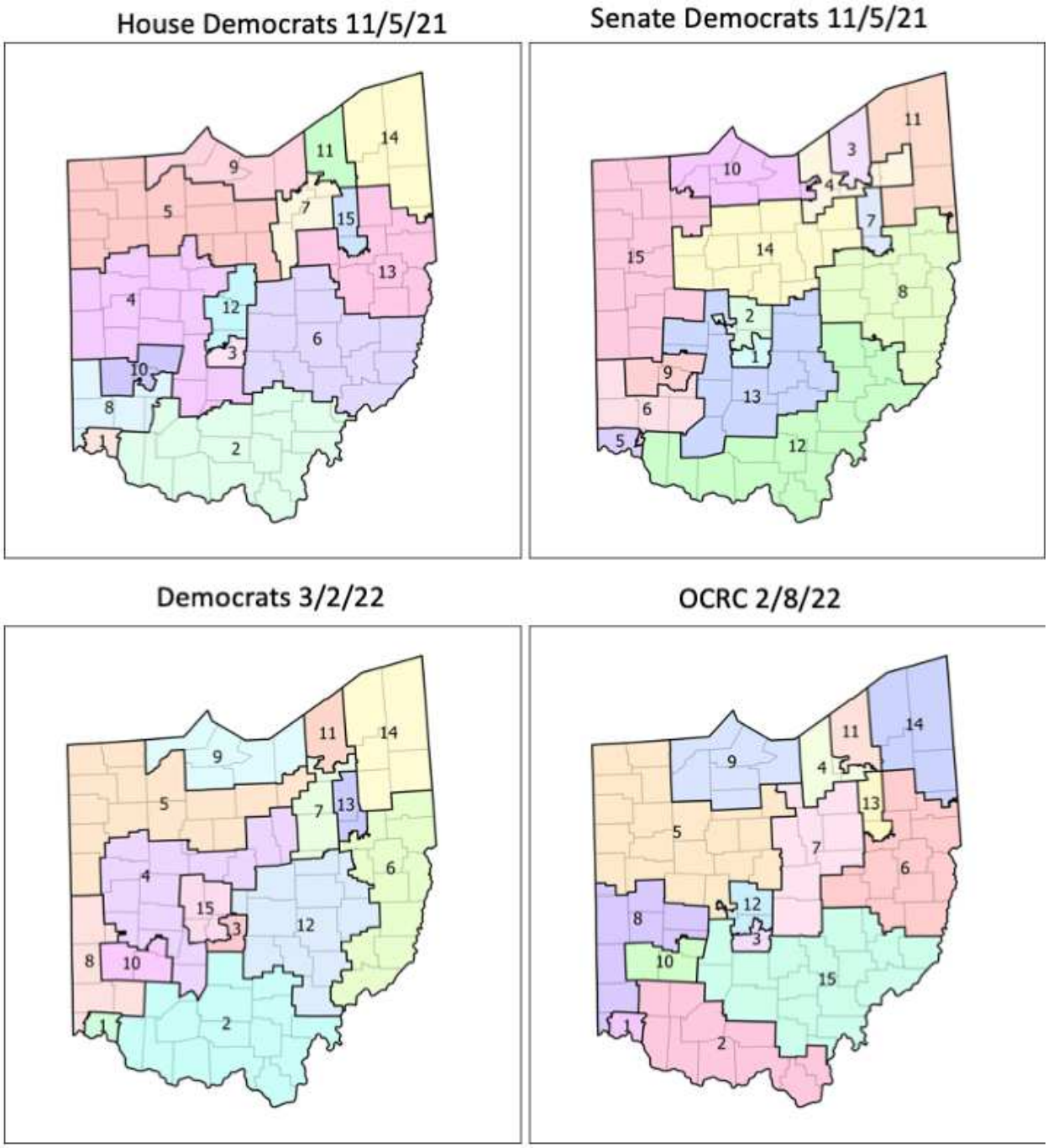
alternative plans. Figure 2 displays a map of the New Plan. For comparison, Figures 3 displays four alternative maps. First, it includes the maps produced by the Ohio House and Senate Democrats that were discussed in my previous report. Additionally, I have examined two additional redistricting plans that were submitted to the General Assembly and Commission: The first was proposed by the Senate Democrats on March 2 (Exhibit F), and the second was proposed by the Ohio Citizens' Redistricting Committee (OCRC) on February 8 (Exhibit G).[5] I note that the February 8 OCRC Plan is very similar to the earlier OCRC Plan that was discussed in my initial report, so in Figure 3 and subsequent figures, I only include the more recent OCRC map. It is not my intention to endorse any of these maps. Rather, they provide valuable comparisons that help illuminate certain features of the New Plan.

Figure 2: The New Plan



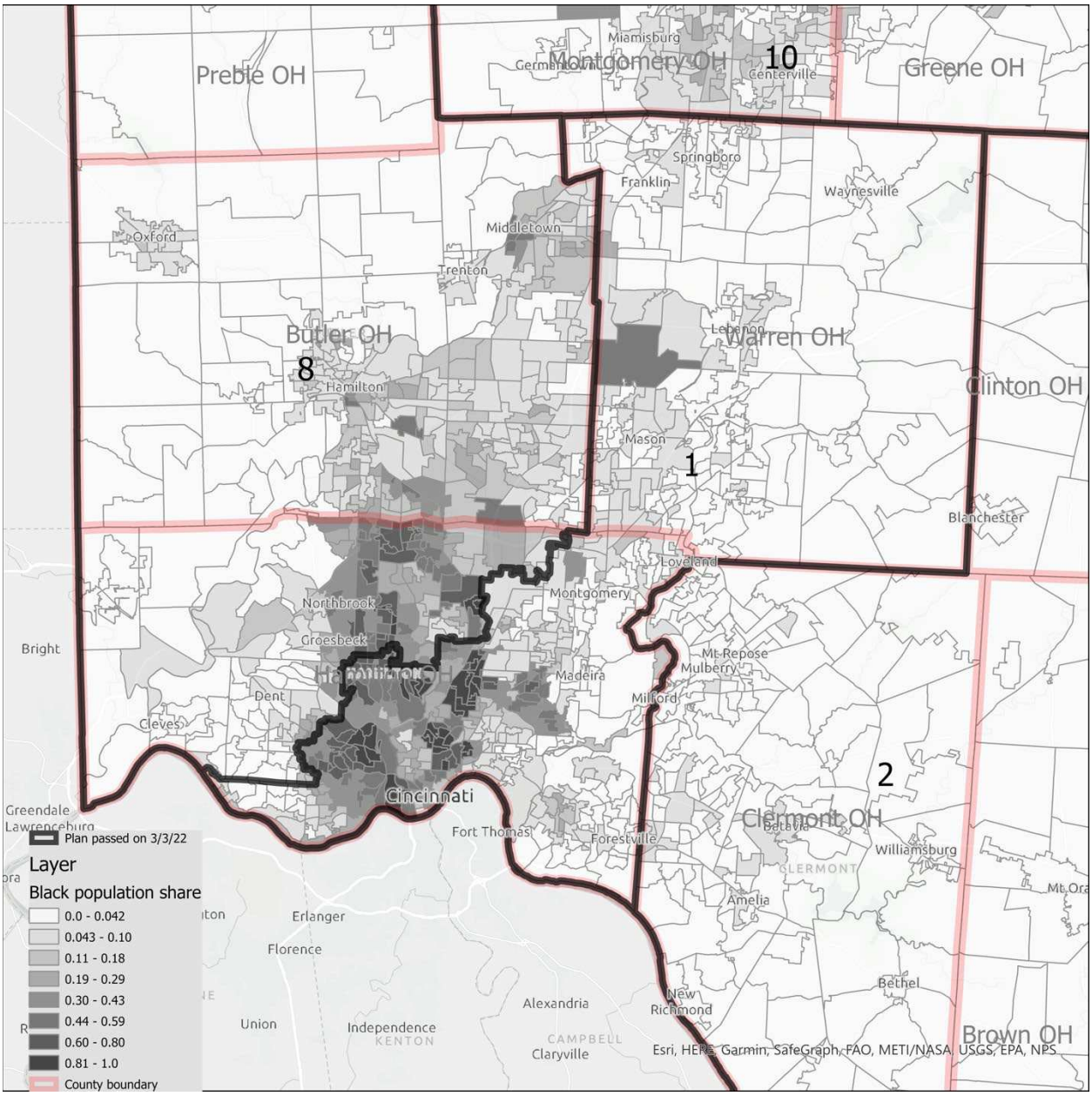
[5] I note that the OCRC Plan includes population deviations that may be greater than those allowed under equal population requirements. I nevertheless consider the OCRC Plan's partisanship and district configuration for demonstrative purposes.

Figure 3: Four Alternative Plans



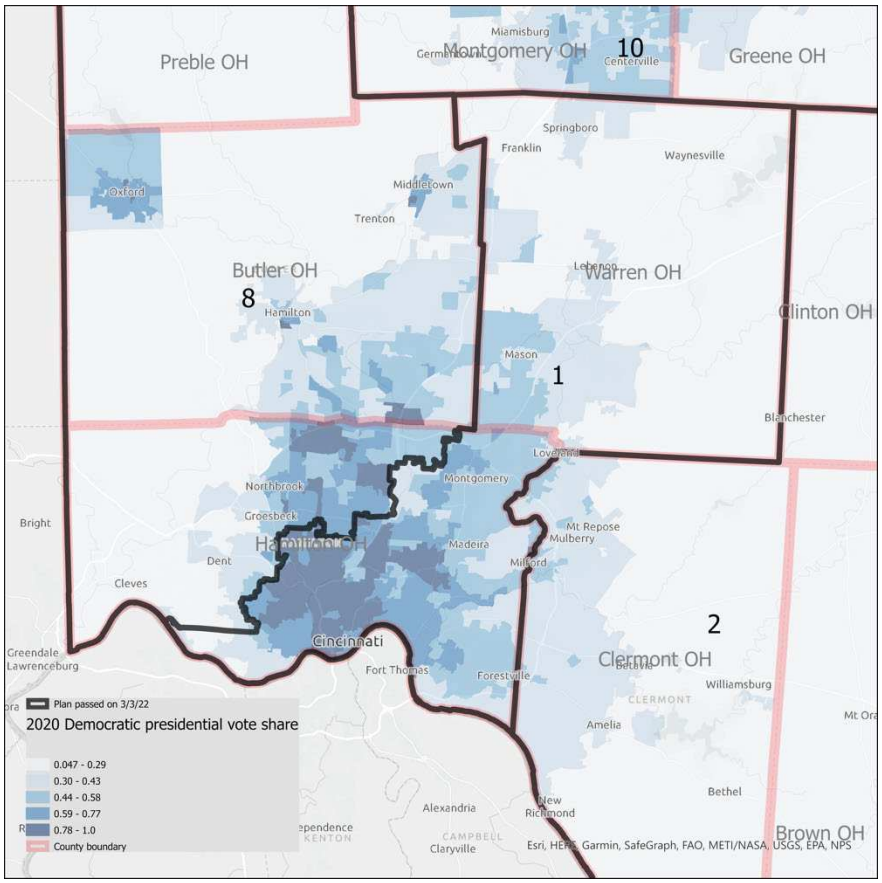
35. Already from this bird's eye view, it is possible to appreciate the non-compact arrangement of District 1 in the New Plan relative to the alternatives, the extraction of part of Columbus and its placement into a highly non-compact District 15, the non-compact arrangement of District 9 designed to add Republicans to the Toledo district, and the extraction of Lorain County from its geographic environment and placement in District 5. Let us now take a close look at each of these maneuvers.

Figure 4: Black Population and New Districts, Cincinnati Area



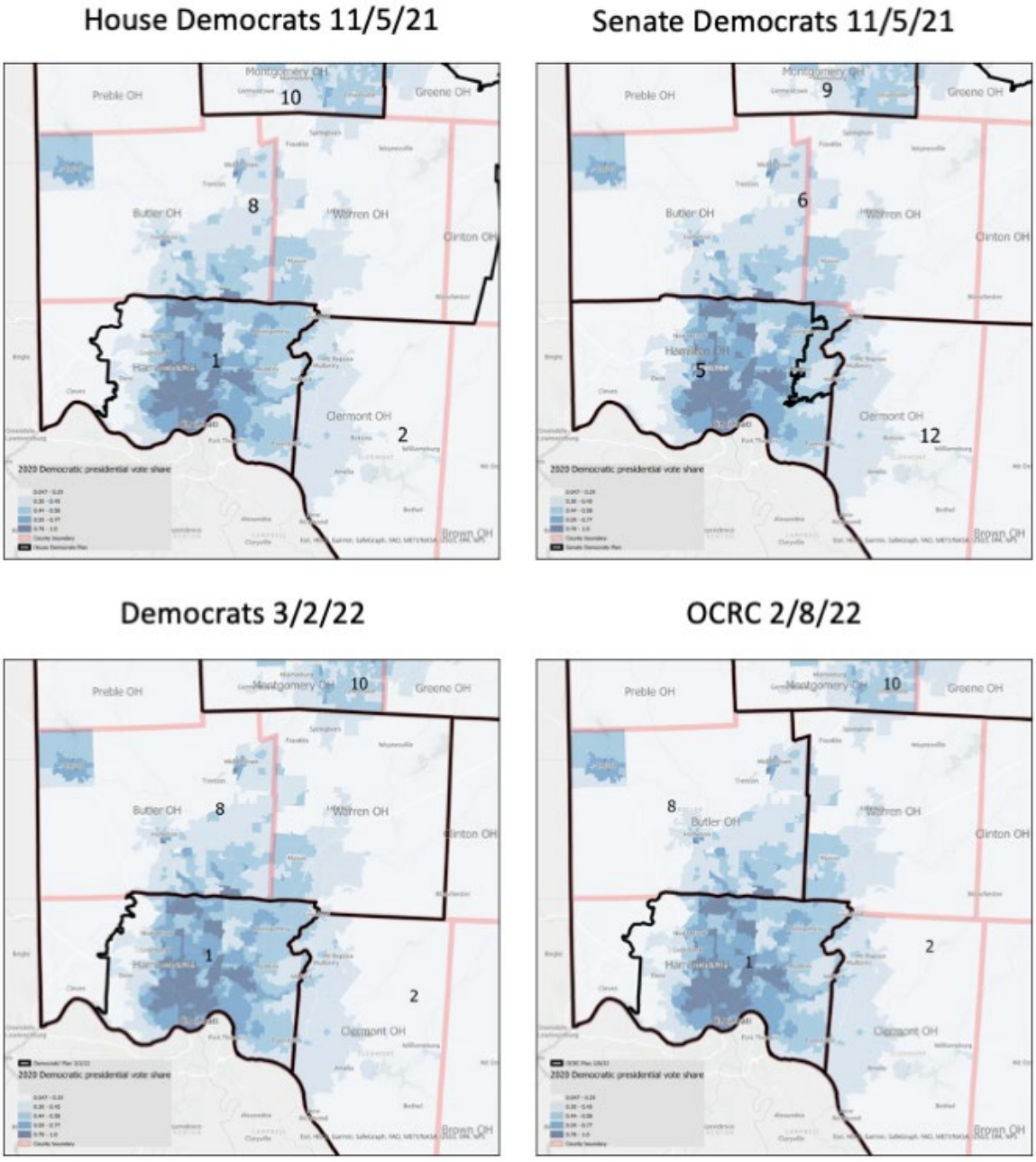
36. Figure 4 displays the boundaries of the New Plan, along with data from the most recent census on race. It shows that the boundary between Districts 1 and 8 bisect the Black community of Cincinnati, ensuring that it cannot contribute to the creation of a clear Democratic district. District 1 maintains its old architecture, splitting the Black community of Cincinnati from that of the Northern suburbs, combining the city of Cincinnati with exurban and rural white areas to the Northeast, traveling via a narrow corridor to Warren County.

Figure 5: Democratic Vote Share and Boundaries of the New Plan, Cincinnati Area



37. Figure 5 replaces the data on race with data on partisanship, using darker colors of blue to capture more Democratic precincts. A comparison of Figures 4 and 5 reveals that partisanship and race are highly correlated in the Cincinnati area, and demonstrates how the line between Districts 1 and 8 in the New Plan not only needlessly splits the Black community in two, but prevents the emergence of a clear Democratic district by generating a highly non-compact arrangement.

Figure 6: Democratic Vote Share and Boundaries of Alternative Plans, Cincinnati Area



38. Figure 6 present the boundaries of four alternative maps, demonstrating that it is quite straightforward to draw a compact Cincinnati district that keeps metro area communities together. For instance, the Reock compactness score for District 1 in the New Plan is .31, while it is .56 in the Democrats' most recent (3/2/2022) plan, and .55 in the most recent OCRC Plan. A higher Reock score indicates a greater level of compactness. The same is true for the Polsby-Popper score, which is .24 in the New Plan, .43 in the Democrats' 3/2/2022 Plan, and .46 in the OCRC 2/8/2022 Plan.

39. Next, Figure 7 displays the districts of the New Plan in the Columbus Area, again overlaying them on precinct-level partisanship. It demonstrates that District 3 is drawn to pack the most Democratic part of Columbus in one district, extracting Democratic-leaning parts of Columbus (including downtown Columbus) and its suburbs, and combining them with some of the most rural, Republican communities of West-Central Ohio, circumnavigating Springfield along the way, and splitting 4 counties to create a single, highly non-compact District 15. These maneuvers made it possible to avoid the emergence of a second Columbus-area Democratic district, creating a relatively comfortable Republican district with a Republican incumbent.

Figure 7: Columbus Area: New Plan

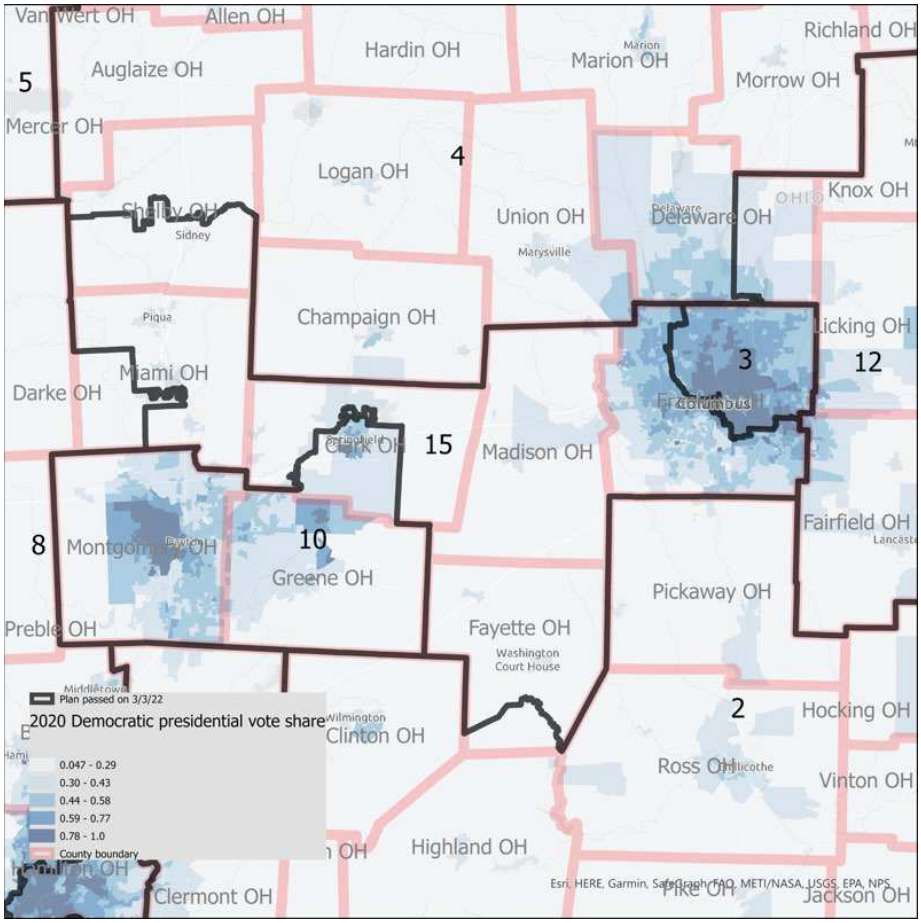
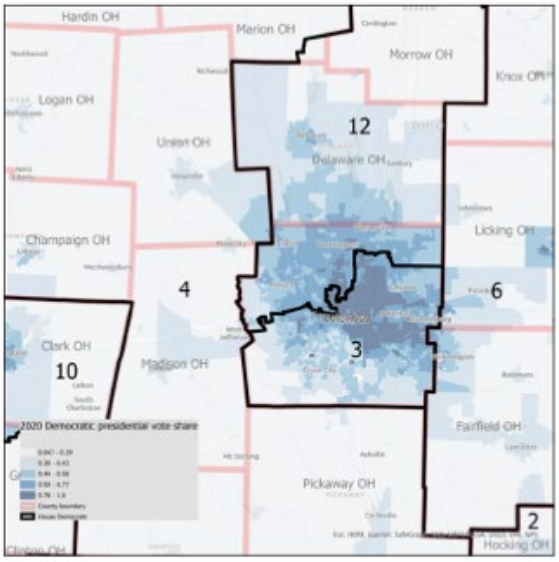
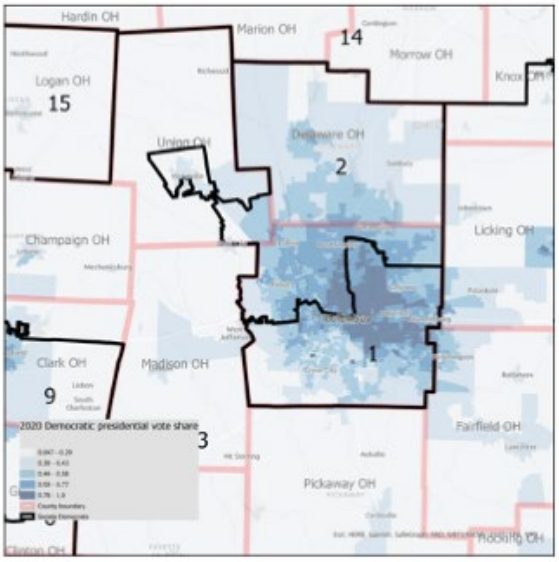


Figure 8: Columbus Area: Alternative Plans

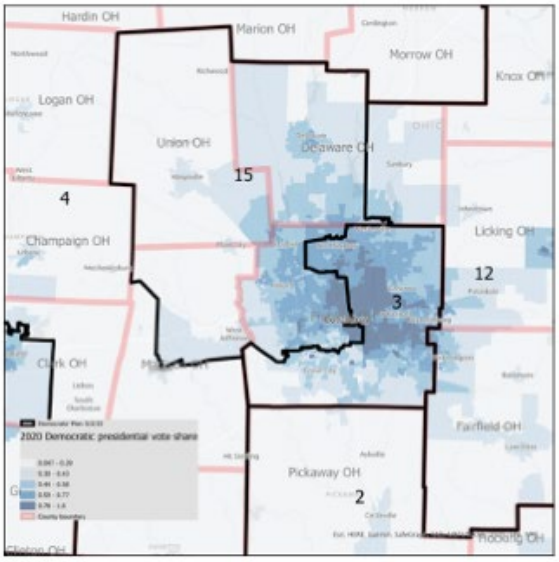
House Democrats 11/5/21



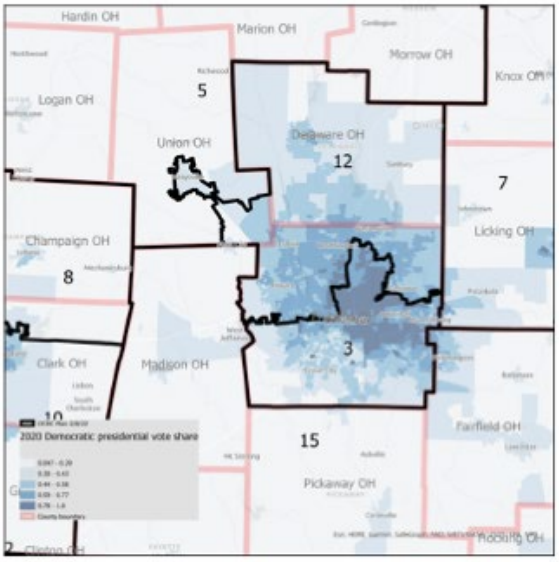
Senate Democrats 11/5/21



Democrats 3/2/22



OCRC 2/8/22



40. Figure 8 displays the Columbus-area districts for four alternative plans. Each demonstrates ways to split fewer counties and draw more compact districts while keeping metro area communities together. District 15 in the New Plan has a Reock score of .28, whereas District 15 in the Democrats' most recent plan is .56, and District 12 in the most recent OCRC Plan is .59. As for the Polsby-Popper Score, it is .14 for the New Plan, .42 for the Democrats' Plan, and .3 for the OCRC Plan.

41. Next, let us examine the Cleveland Area. Figure 9 provides a map of the districts of the New Plan, and Figure 10 examines the alternative plans. A familiar strategy emerges again in the New Plan. The most Democratic parts of metro Cleveland are packed into one district, District 11, with the district lines carefully following the precinct-level vote shares. Instead of keeping the Western suburbs together and extending District 7 into Lorain County, the district reaches to the South and combines Democratic-leaning suburban areas with very rural areas to produce a comfortable Republican district 7 with a Republican incumbent.

Figure 9: Cleveland Area, New Plan

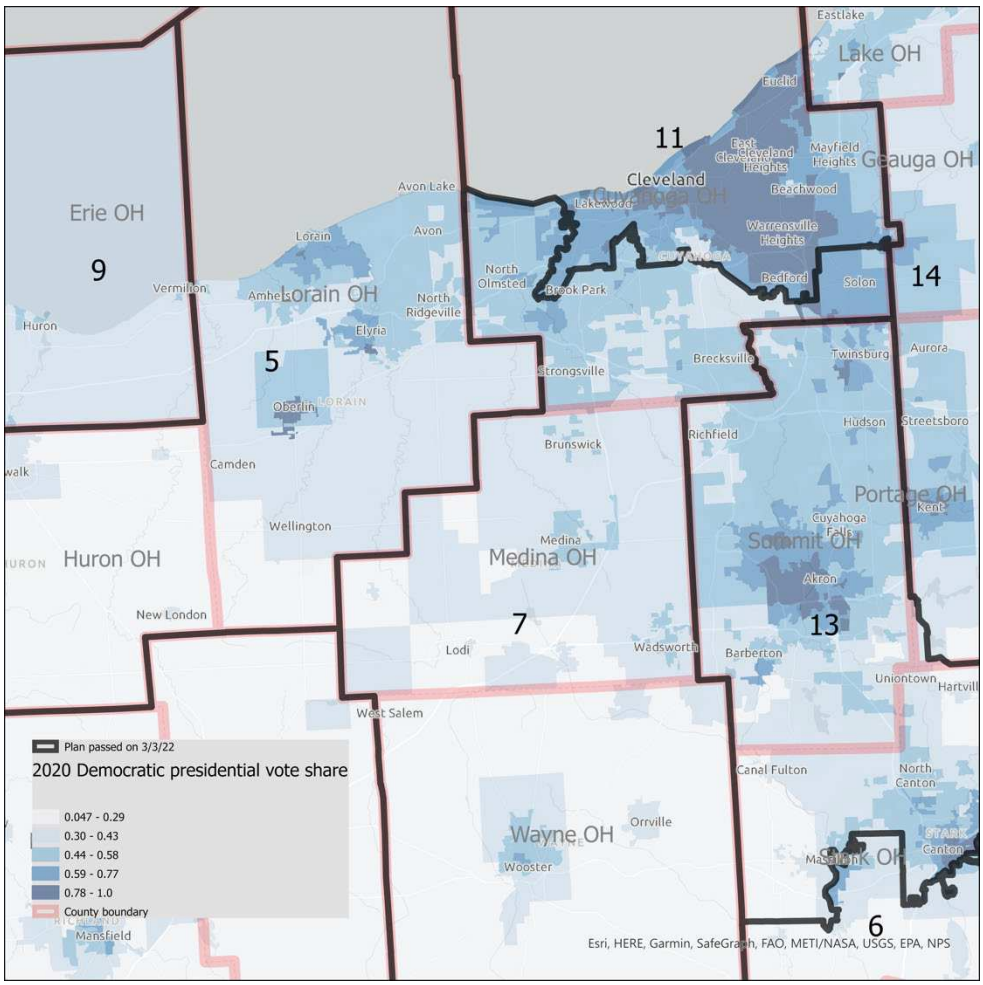
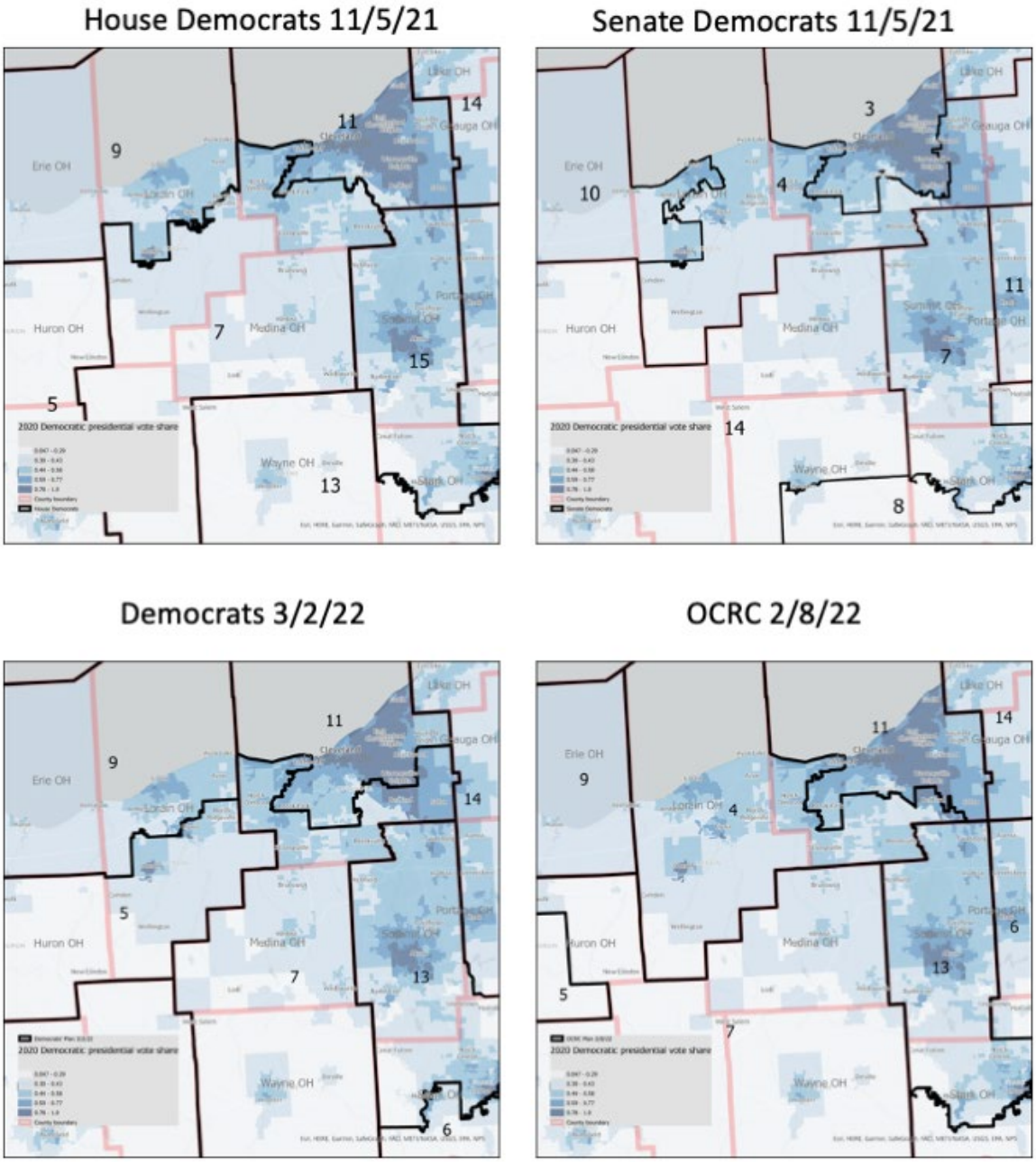


Figure 10: Cleveland Area: Alternative Plans



42. The alternative maps display a number of alternative approaches to the Cleveland area, several of which keep Democratic-leaning communities of Cuyahoga County together. For instance, using the most compact arrangement of the three, the OCRC Plan keeps the Western suburbs together, combining all of Lorain County with the suburban parts of Cuyahoga, creating a rather natural Western Cleveland district with a Democratic majority of the statewide vote.

43. Finally, let us consider Northwest Ohio. Figure 11 presents the districts of the New Plan, and Figure 12 displays the districts of alternative plans. The New Plan studiously avoids the creation of a clear Democratic district by combining metro Toledo with rural counties and avoiding a link to Lorain County. This results in a highly non-compact District 5, which extracts Lorain County and connects it via a narrow corridor of rural counties all the way to the Western border of the state.

44. In contrast, the alternative plans display more natural metro-oriented versions of District 9 that are also more compact. The Reock Score for District 9 in the New Plan is .26, compared with .33 for the Democrats' most recent plan, and .53 for the newest OCRC Plan. The Polsby-Popper Score for the New Plan is .27, compared with .34 for the Democrats' Plan and .58 for the OCRC Plan.

Figure 11: Northwest Ohio: New Plan

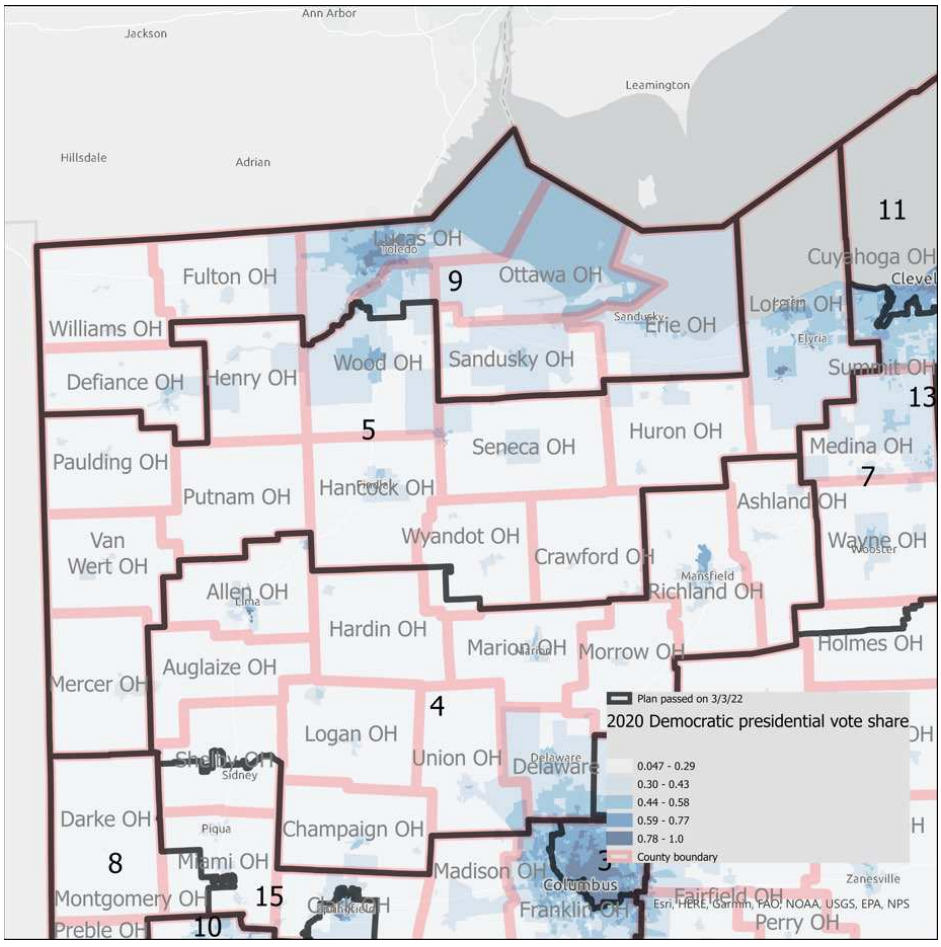
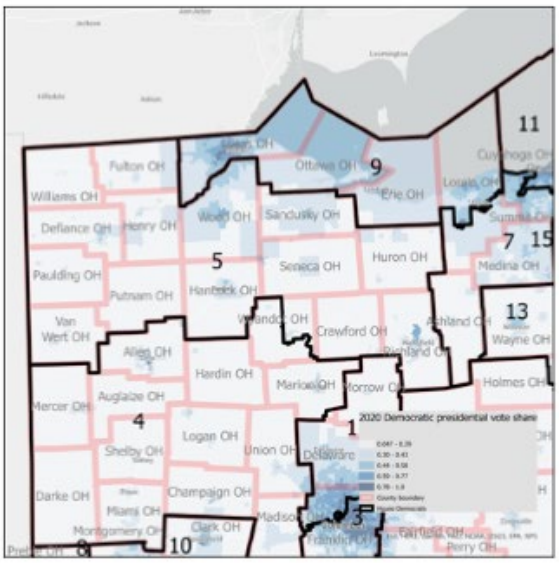
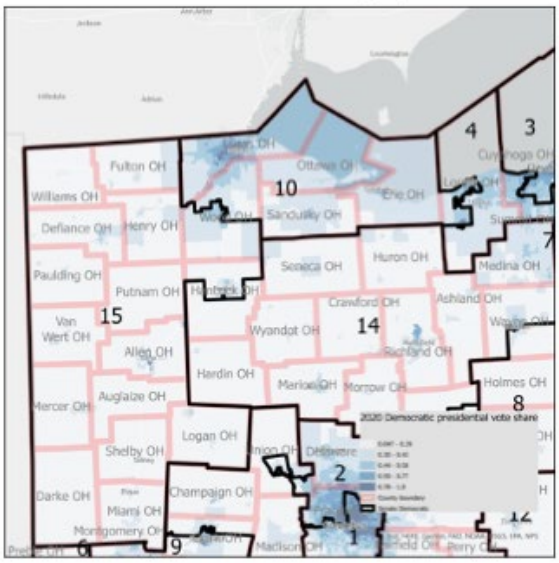


Figure 12: Northwest Ohio, Alternative Plans

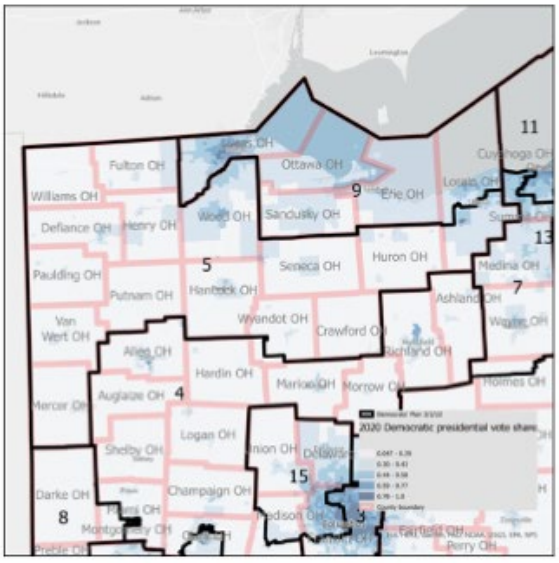
House Democrats 11/5/21



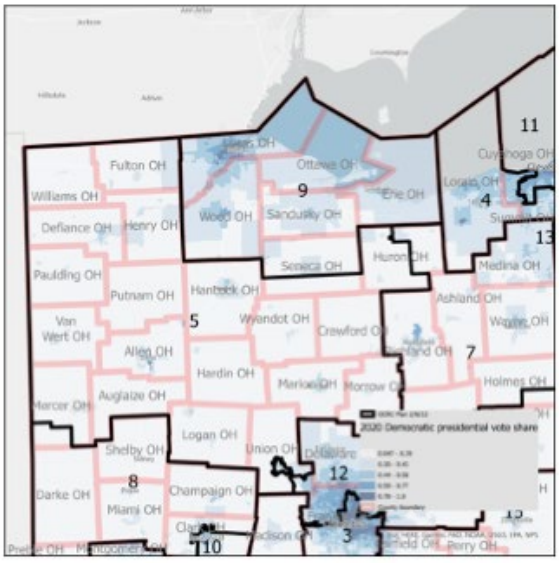
Senate Democrats 11/5/21



Democrats 3/2/22



OCRC 2/8/22



45. The House Democrats' approach to Northwest Ohio, also reflected in the Democrats' March 2 map, includes the cities of Lorain County in District 9, while the OCRC version, as described above, combines Lorain with Western Cleveland in District 4. Needless to say, not only do they produce more compact districts, but both are more respectful of communities of interest than the New Plan, which extracts Lorain County from its environment altogether.

Table 1: Average Compactness Scores

	Reock	Polsby-Popper	Area/Convex Hull
New Plan	0.4	0.32	0.75
House Democrats 11/5/21 Plan	0.43	0.33	0.78
Senate Democrats 11/5/21 plan	0.43	0.29	0.76
Democrats 3/2/22 Plan	0.42	0.33	0.77
OCRC 2/8/22 Plan	0.46	0.34	0.79

46. In the paragraphs above, I have shown that efforts to split Democratic-leaning metro-area neighborhoods from their communities and combine them with rural areas while keeping Republican incumbents in their old districts sometimes required rather obvious violations of traditional redistricting criteria and non-compact districts. This also leads to districts that are, on average, less compact than those of the alternative plans, as set forth in Table 1. On each of three common measures of compactness, the House Democrats' Plan, the most recent Democratic Plan of March 2, 2022, and especially the OCRC Plan are more compact than the New Plan. The only exception is the Senate Democrats' Plan on the Polsby-Popper metric.

47. In my earlier report, I also reported simple statistics on the efficiency gap and electoral bias. Recall that electoral bias involves imagining a hypothetical tied election, and asking whether, and by how much, a party would exceed 50 percent of the seat share. As discussed above, the Democratic Party could expect 5 seats in this scenario, which corresponds to 33 percent of the seats for Democrats, and 67 percent for Republicans, for a bias measure of around 17 percent. As discussed in my initial report, this is identical to the Overturned Plan.

48. Table 2 provides information on the efficiency gap, using the statewide aggregate district-level votes shares that have been described throughout this report. By making the three swing districts slightly more Democratic, the New Plan reduces the efficiency gap from 24% to 10%, but this is still relatively high in comparison to other states, and to alternative Ohio Congressional plans.

Table 2: Efficiency Gap

	Efficiency Gap
Overturned Plan	24%
New Plan	10%
House Democrats 11/5/21 Plan	3.5%
Senate Democrats 11/5/21 plan	-3.7%
Democrats 3/2/22 Plan	-3.6%
OCRC 2/8/22 Plan	-3.6%

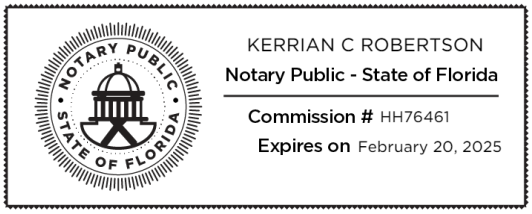
VII. CONCLUSION

49. Like the Overturned Plan, the New Plan is highly favorable to the Republican Party and its incumbents, and it disfavors the Democratic Party and its incumbents. This is true not because of the requirements of the Ohio Constitution or the political geography of Ohio, but because of discretionary choices made by those drawing the districts, which had the effect of "packing" Democrats into districts where they win by large majorities and "cracking" Democratic communities that would otherwise have produced majority-Democratic districts. In drawing districts to achieve partisan gain, the legislature sacrificed compactness, introduced unnecessary splits to urban counties, and divided a number of urban and suburban communities, including minority communities, throughout the state.

Jonathan Rodden

Jonathan Rodden

Sworn to before me this 4th day of March 2022.



Kerrian C Robertson
Notary Public

Broward County, FL
Jurat
Jonathan Andrew Rodden
DRIVER LICENSE

Notarized online using audio-video communication

My commission expires 02/20/2025

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Exhibit A

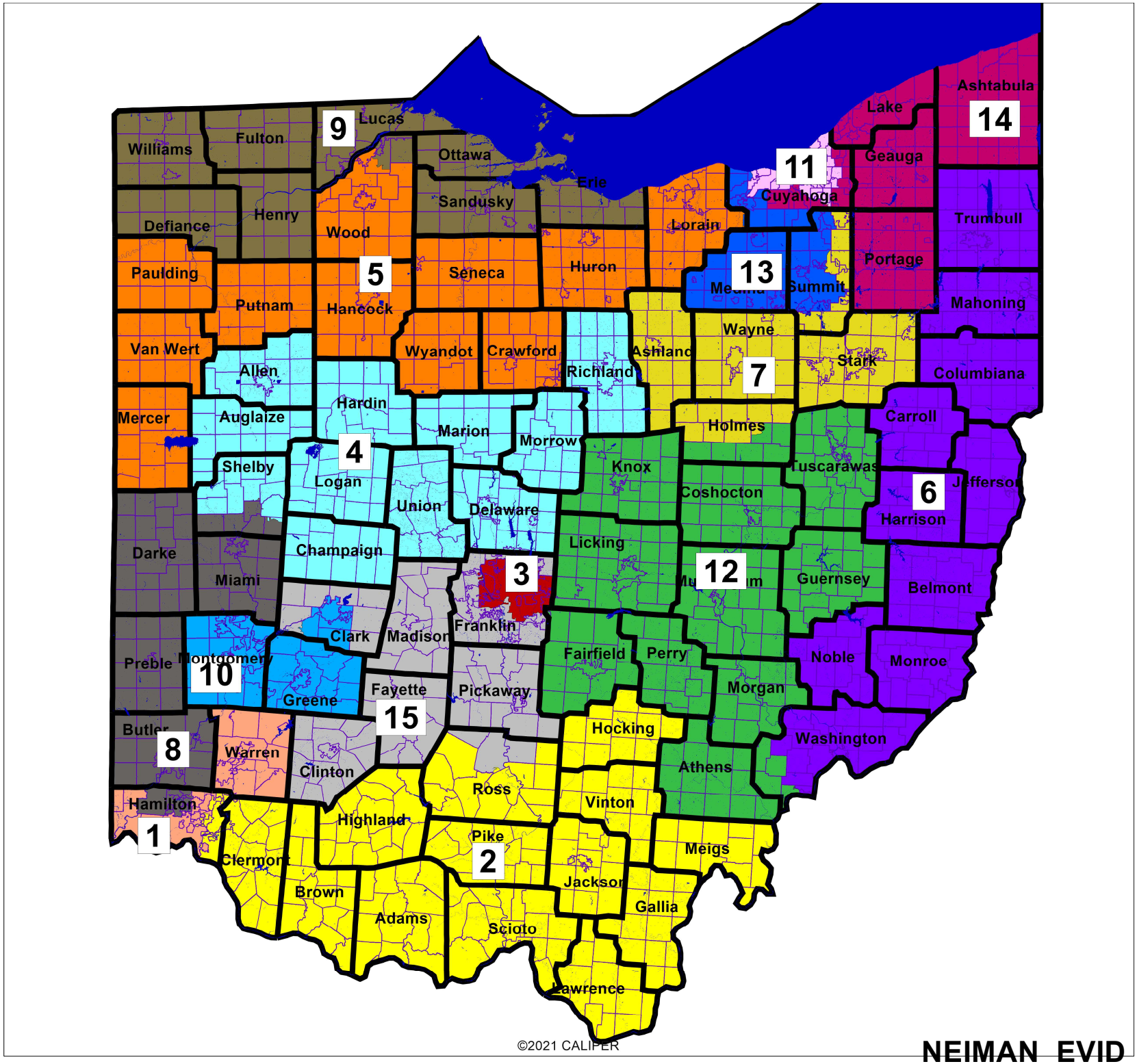

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Exhibit B

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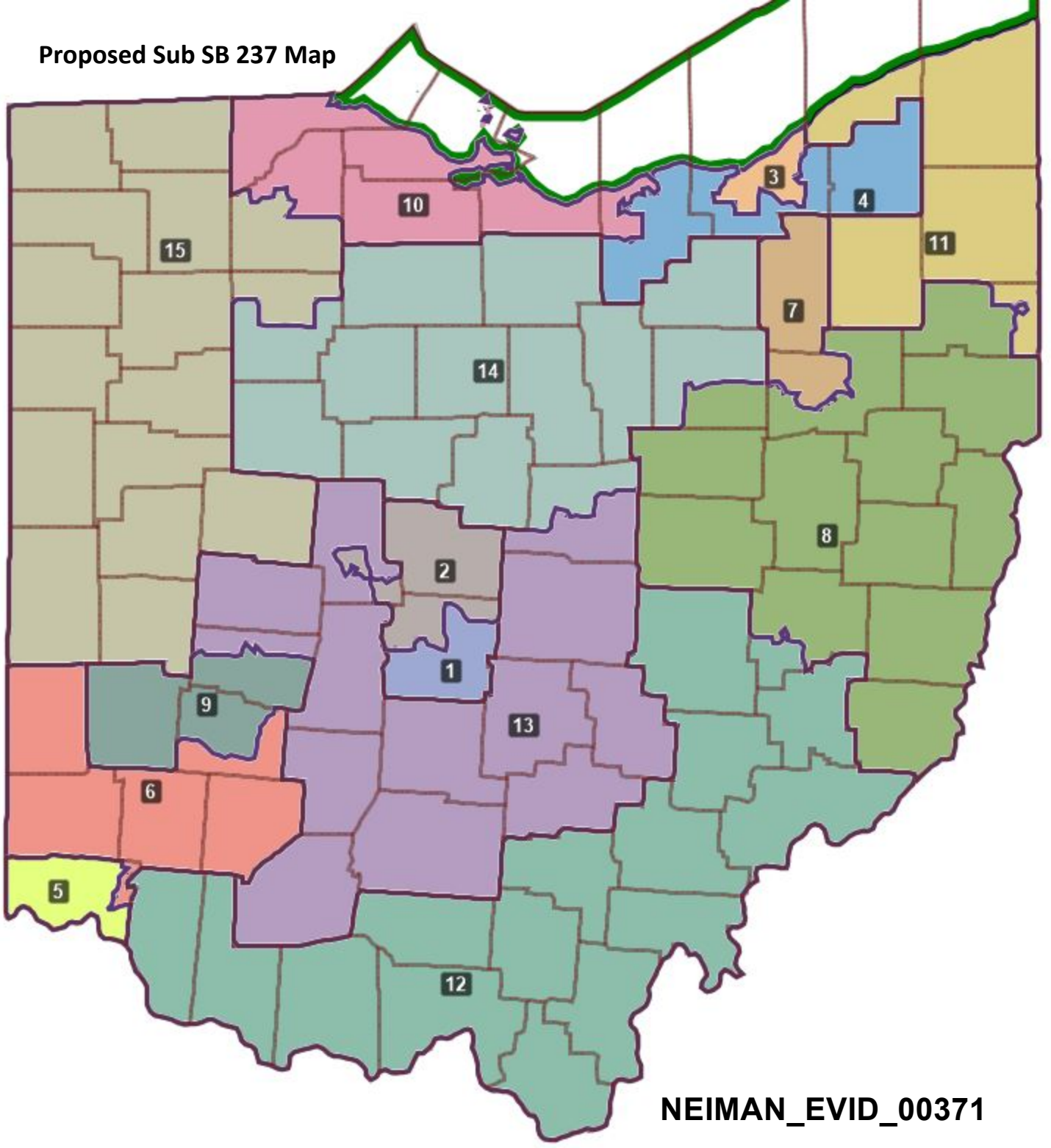
Exhibit C

Brown/Galonski Congressional District Proposal

Exhibit D

Proposed Sub SB 237 Map



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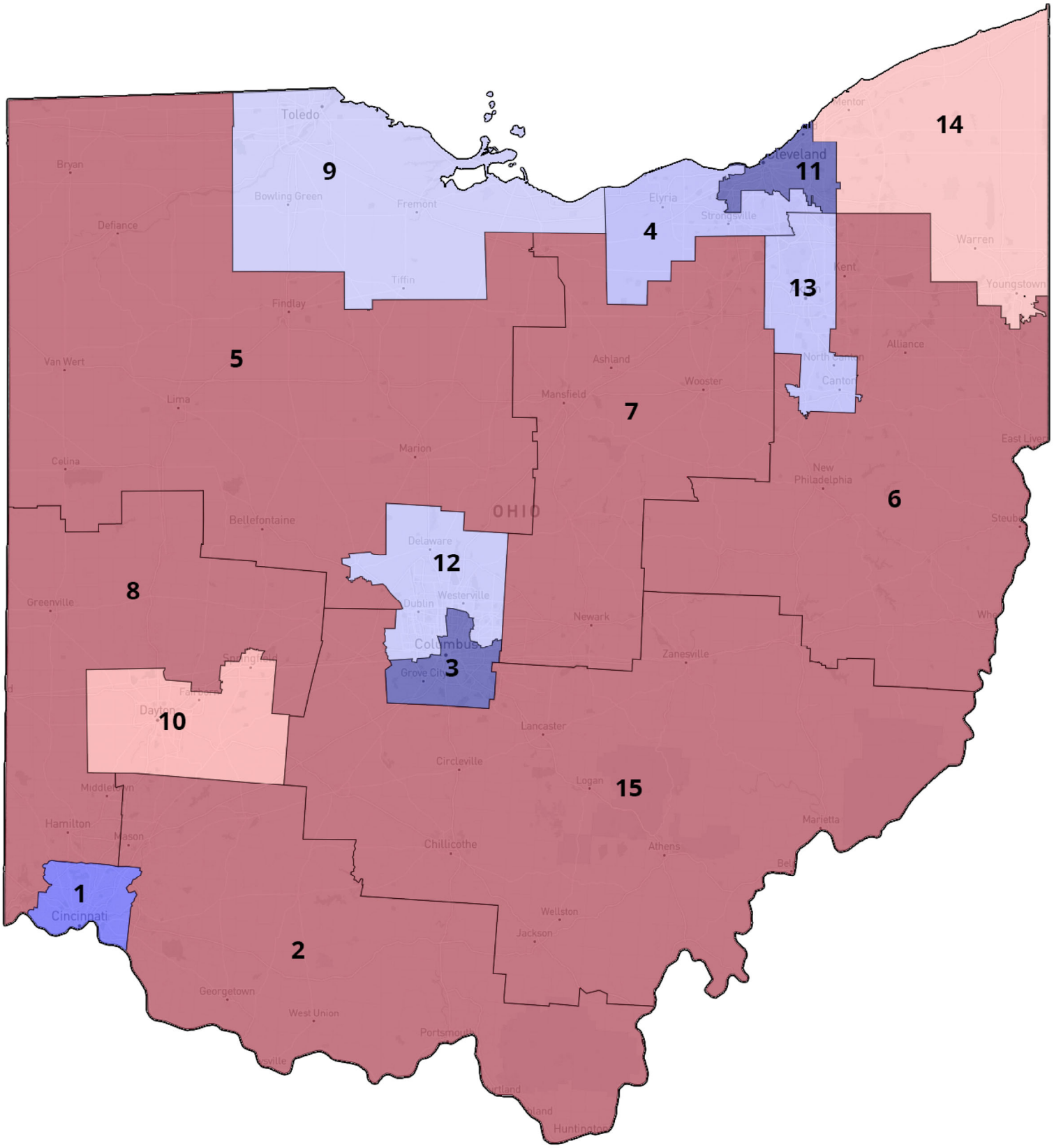

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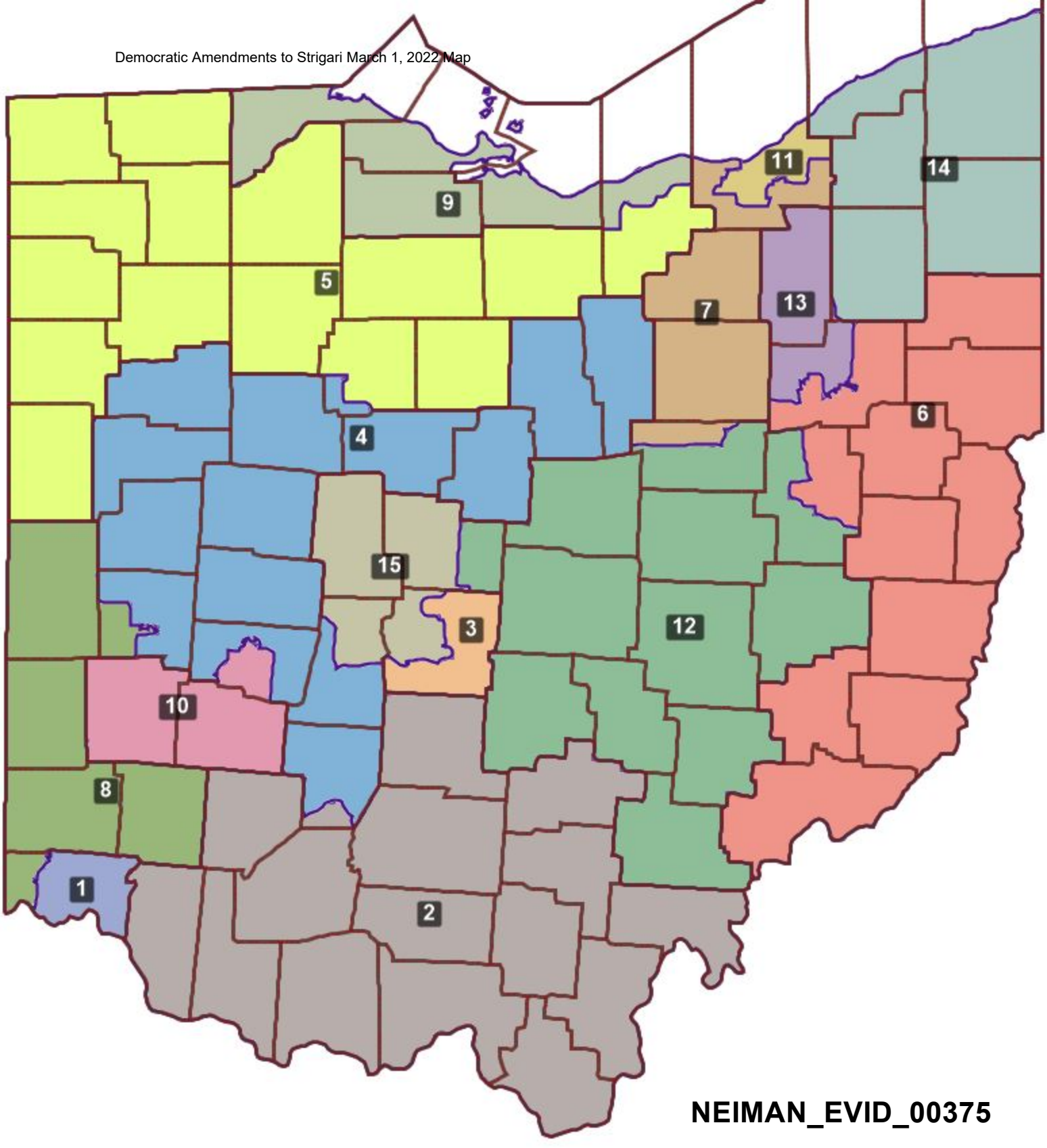
Democratic Amendments to Strigari March 1, 2022 Map
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Exhibit G

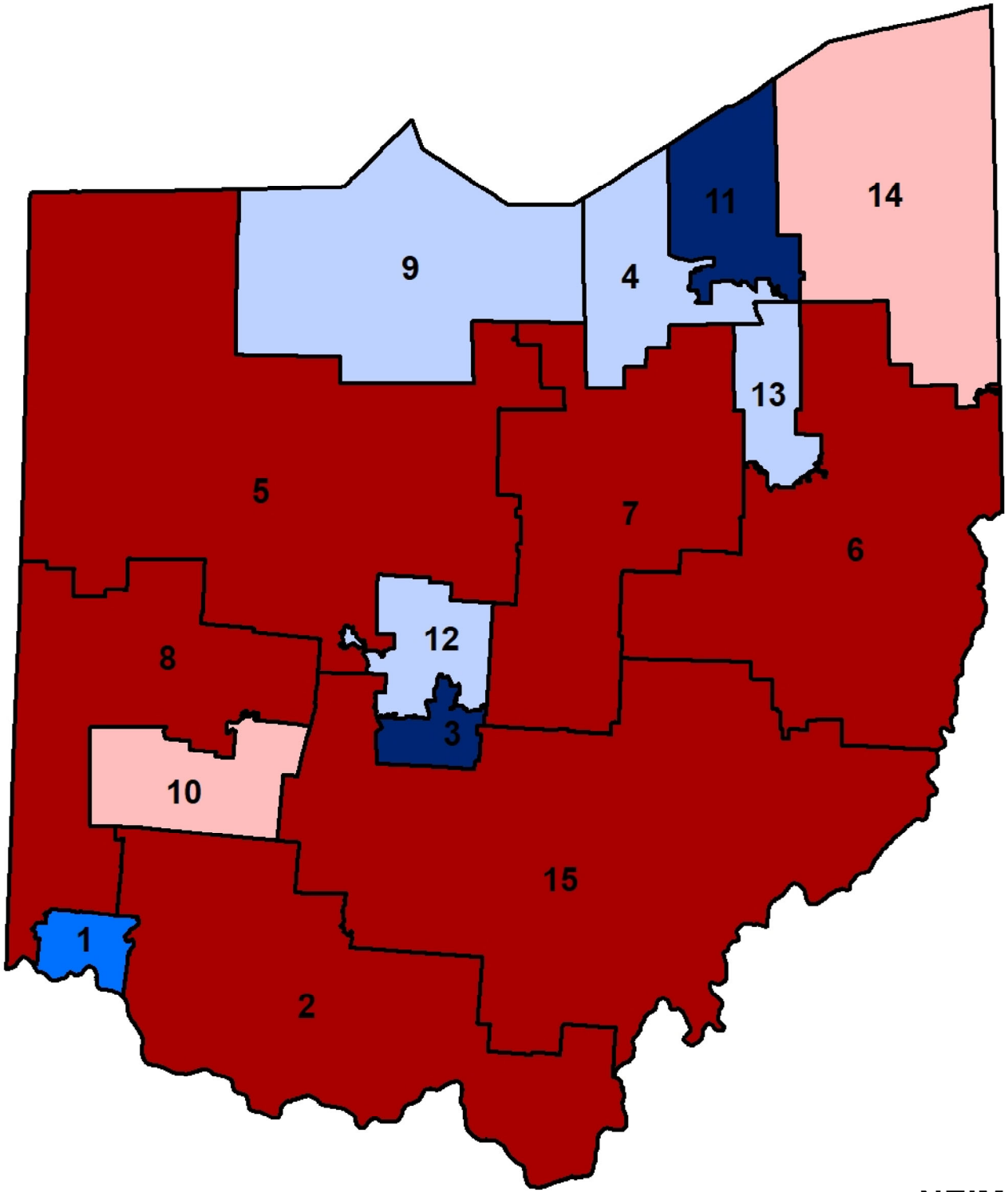

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Exhibit H

Jonathan Rodden

Stanford University
Department of Political Science
Encina Hall Central
616 Serra Street
Stanford, CA 94305

Phone: (650) 723-5219
Email: jrodden@stanford.edu
Homepage: http://www.jonathanrodden.com

Personal

Born on August 18. 1971, St. Louis, MO.

United States Citizen.

Education

Ph.D. Political Science, Yale University, 2000.

Fulbright Scholar, University of Leipzig, Germany, 1993–1994.

B.A., Political Science, University of Michigan, 1993.

Academic Positions

Professor, Department of Political Science, Stanford University, 2012–present.

Senior Fellow, Stanford Institute for Economic Policy Research, 2020–present.

Senior Fellow, Hoover Institution, Stanford University, 2012–present.

Director, Spatial Social Science Lab, Stanford University, 2012–present.

W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2010–2012.

Associate Professor, Department of Political Science, Stanford University, 2007–2012.

Fellow, Center for Advanced Study in the Behavioral Sciences, Palo Alto, CA, 2006–2007.

Ford Career Development Associate Professor of Political Science, MIT, 2003–2006.

Visiting Scholar, Center for Basic Research in the Social Sciences, Harvard University, 2004.

Assistant Professor of Political Science, MIT, 1999–2003.

Instructor, Department of Political Science and School of Management, Yale University, 1997–1999.

Publications

Books

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How America's Urban-Rural Divide has Shaped the Pandemic, 2020, *Foreign Affairs*, April 20, 2020.

An Evolutionary Path for the European Monetary Fund? A Comparative Perspective, 2017, Briefing paper for the Economic and Financial Affairs Committee of the European Parliament.

Representation and Regional Redistribution in Federations: A Research Report, 2009, in *World Report on Fiscal Federalism*, Institut d'Economia de Barcelona.

On the Migration of Fiscal Sovereignty, 2004, *PS: Political Science and Politics* July, 2004: 427–431.

Decentralization and the Challenge of Hard Budget Constraints, *PREM Note* 41, Poverty Reduction and Economic Management Unit, World Bank, Washington, D.C. (July).

Decentralization and Hard Budget Constraints, *APSA-CP* (Newsletter of the Organized Section in Comparative Politics, American Political Science Association) 11:1 (with Jennie Litvack).

Book Review of *The Government of Money* by Peter Johnson, *Comparative Political Studies 32,7: 897-900.*

Fellowships, Honors, and Grants

John Simon Guggenheim Memorial Foundation Fellowship, 2021.

Martha Derthick Award of the American Political Science Association for "the best book published at least ten years ago that has made a lasting contribution to the study of federalism and intergovernmental relations," 2021.

National Institutes of Health, funding for "Relationship between lawful handgun ownership and risk of homicide victimization in the home," 2021.

National Collaborative on Gun Violence Research, funding for "Cohort Study Of Firearm-Related Mortality Among Cohabitants Of Handgun Owners." 2020.

Fund for a Safer Future, Longitudinal Study of Handgun Ownership and Transfer (LongSHOT), GA004696, 2017-2018.

Stanford Institute for Innovation in Developing Economies, Innovation and Entrepreneurship research grant, 2015.

Michael Wallerstein Award for best paper in political economy, American Political Science Association, 2016.

Common Cause Gerrymandering Standard Writing Competition, 2015.

General support grant from the Hewlett Foundation for Spatial Social Science Lab, 2014.

Fellow, Institute for Research in the Social Sciences, Stanford University, 2012.

Sloan Foundation, grant for assembly of geo-referenced precinct-level electoral data set (with Stephen Ansolabehere and James Snyder), 2009-2011.

Hoagland Award Fund for Innovations in Undergraduate Teaching, Stanford University, 2009.

W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, beginning Fall 2010.

Research Grant on Fiscal Federalism, Institut d'Economia de Barcelona, 2009.

Fellow, Institute for Research in the Social Sciences, Stanford University, 2008.

United Postal Service Foundation grant for study of the spatial distribution of income in cities, 2008.

Gregory Luebbert Award for Best Book in Comparative Politics, 2007.

Fellow, Center for Advanced Study in the Behavioral Sciences, 2006-2007.

National Science Foundation grant for assembly of cross-national provincial-level dataset on elections, public finance, and government composition, 2003-2004 (with Erik Wibbels).

MIT Dean's Fund and School of Humanities, Arts, and Social Sciences Research Funds.

Funding from DAAD (German Academic Exchange Service), MIT, and Harvard EU Center to organize the conference, "European Fiscal Federalism in Comparative Perspective," held at Harvard University, November 4, 2000.

Canadian Studies Fellowship (Canadian Federal Government), 1996-1997.

Prize Teaching Fellowship, Yale University, 1998-1999.

Fulbright Grant, University of Leipzig, Germany, 1993-1994.

Michigan Association of Governing Boards Award, one of two top graduating students at the University of Michigan, 1993.

W. J. Bryan Prize, top graduating senior in political science department at the University of Michigan, 1993.

Other Professional Activities

Selection committee, best paper award, American Journal of Political Science.

International Advisory Committee, Center for Metropolitan Studies, Sao Paulo, Brazil, 2006–2010.

Selection committee, Mancur Olson Prize awarded by the American Political Science Association Political Economy Section for the best dissertation in the field of political economy.

Selection committee, Gregory Luebbert Best Book Award.

Selection committee, William Anderson Prize, awarded by the American Political Science Association for the best dissertation in the field of federalism and intergovernmental relations.

Courses

Undergraduate

Politics, Economics, and Democracy

Introduction to Comparative Politics

Introduction to Political Science

Political Science Scope and Methods

Institutional Economics

Spatial Approaches to Social Science

Graduate

Political Economy

Political Economy of Institutions

Federalism and Fiscal Decentralization

Politics and Geography

Consulting

2017. Economic and Financial Affairs Committee of the European Parliament.

2016. Briefing paper for the World Bank on fiscal federalism in Brazil.

2013-2018: Principal Investigator, SMS for Better Governance (a collaborative project involving USAID, Social Impact, and UNICEF in Arua, Uganda).

2019: Written expert testimony in *McLemore, Holmes, Robinson, and Woullard v. Hosemann*, United States District Court, Mississippi.

2019: Expert witness in *Nancy Corola Jacobson v. Detzner*, United States District Court, Florida.

2018: Written expert testimony in *League of Women Voters of Florida v. Detzner* No. 4:18-cv-002510, United States District Court, Florida.

2018: Written expert testimony in *College Democrats of the University of Michigan, et al. v. Johnson, et al.*, United States District Court for the Eastern District of Michigan.

2017: Expert witness in *Bethune-Hill v. Virginia Board of Elections*, No. 3:14-CV-00852, United States District Court for the Eastern District of Virginia.

2017: Expert witness in *Arizona Democratic Party, et al. v. Reagan, et al.*, No. 2:16-CV-01065, United States District Court for Arizona.

2016: Expert witness in *Lee v. Virginia Board of Elections*, 3:15-cv-357, United States District Court for the Eastern District of Virginia, Richmond Division.

2016: Expert witness in *Missouri NAACP v. Ferguson-Florissant School District*, United States District Court for the Eastern District of Missouri, Eastern Division.

2014-2015: Written expert testimony in *League of Women Voters of Florida et al. v. Detzner, et al.*, 2012-CA-002842 in Florida Circuit Court, Leon County (Florida Senate redistricting case).

2013-2014: Expert witness in *Romo v Detzner*, 2012-CA-000412 in Florida Curcuit Court, Leon County (Florida Congressional redistricting case).

2011-2014: Consultation with investment groups and hedge funds on European debt crisis.

2011-2014: Lead Outcome Expert, Democracy and Governance, USAID and Social Impact.

2010: USAID, Review of USAID analysis of decentralization in Africa.

2006–2009: World Bank, Independent Evaluations Group. Undertook evaluations of World Bank decentralization and safety net programs.

2008–2011: International Monetary Fund Institute. Designed and taught course on fiscal federalism.

1998–2003: World Bank, Poverty Reduction and Economic Management Unit. Consultant for *World Development Report*, lecturer for training courses, participant in working group for assembly of decentralization data, director of multi-country study of fiscal discipline in decentralized countries, collaborator on review of subnational adjustment lending.

Last updated: September 23, 2021

Neiman Petitioners' Exhibit 30

IN THE SUPREME COURT OF OHIO

Regina C. Adams, *et al.*, **Relators,** **v.** **Governor Mike DeWine, *et al.*,** **Respondents.**	**Case No. 2021-1428** Original Action Filed Pursuant to Ohio Constitution, Article XIX, Section 3(A)

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."

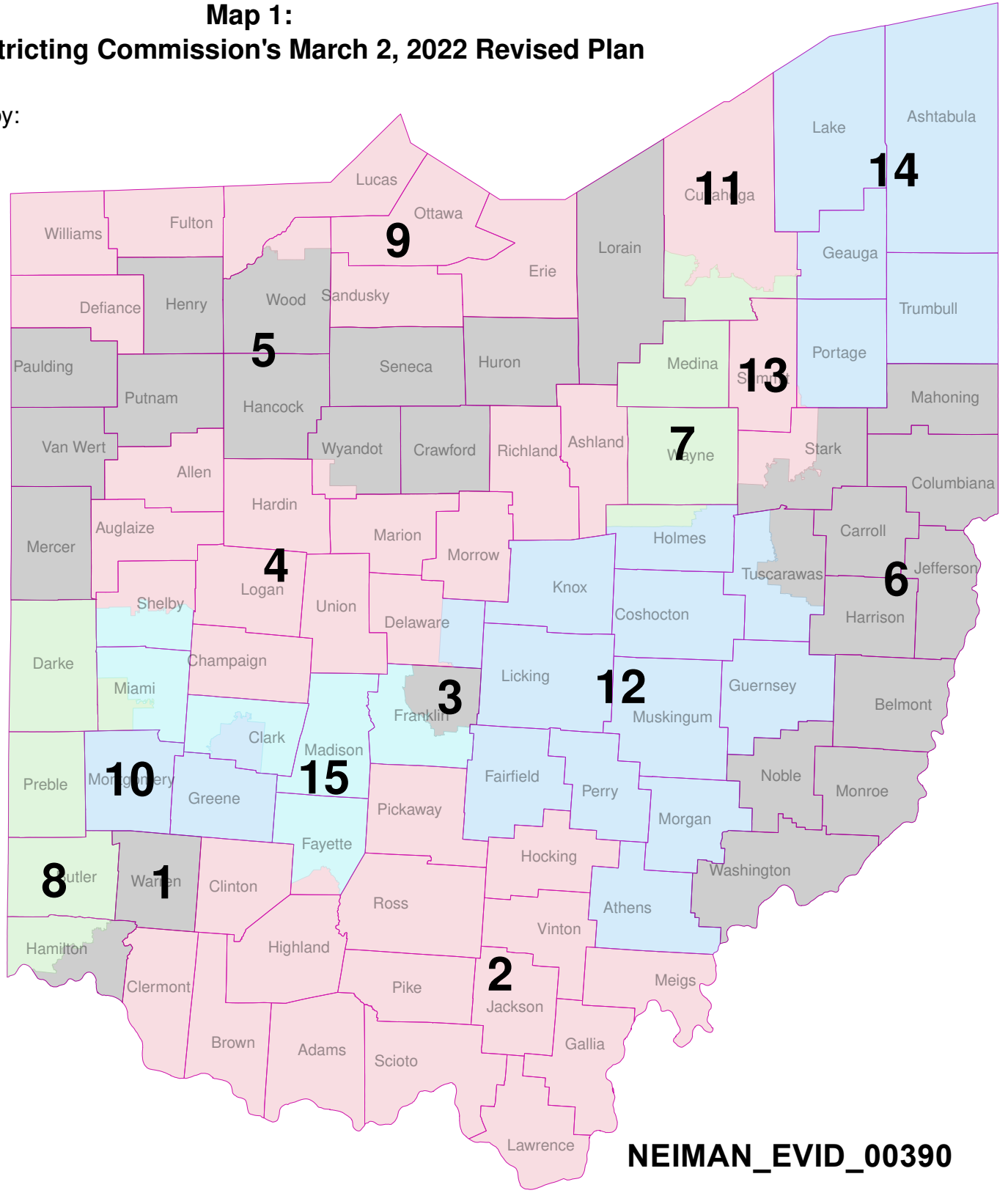
5. As explained in detail in my original December 10, 2021 expert report, I programmed a computer simulation algorithm to produce the 1,000 computer-simulated plans for Ohio's congressional districts by following the required districting criteria enumerated in Article XIX of the Ohio Constitution. Throughout 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.

[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)



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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

[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/

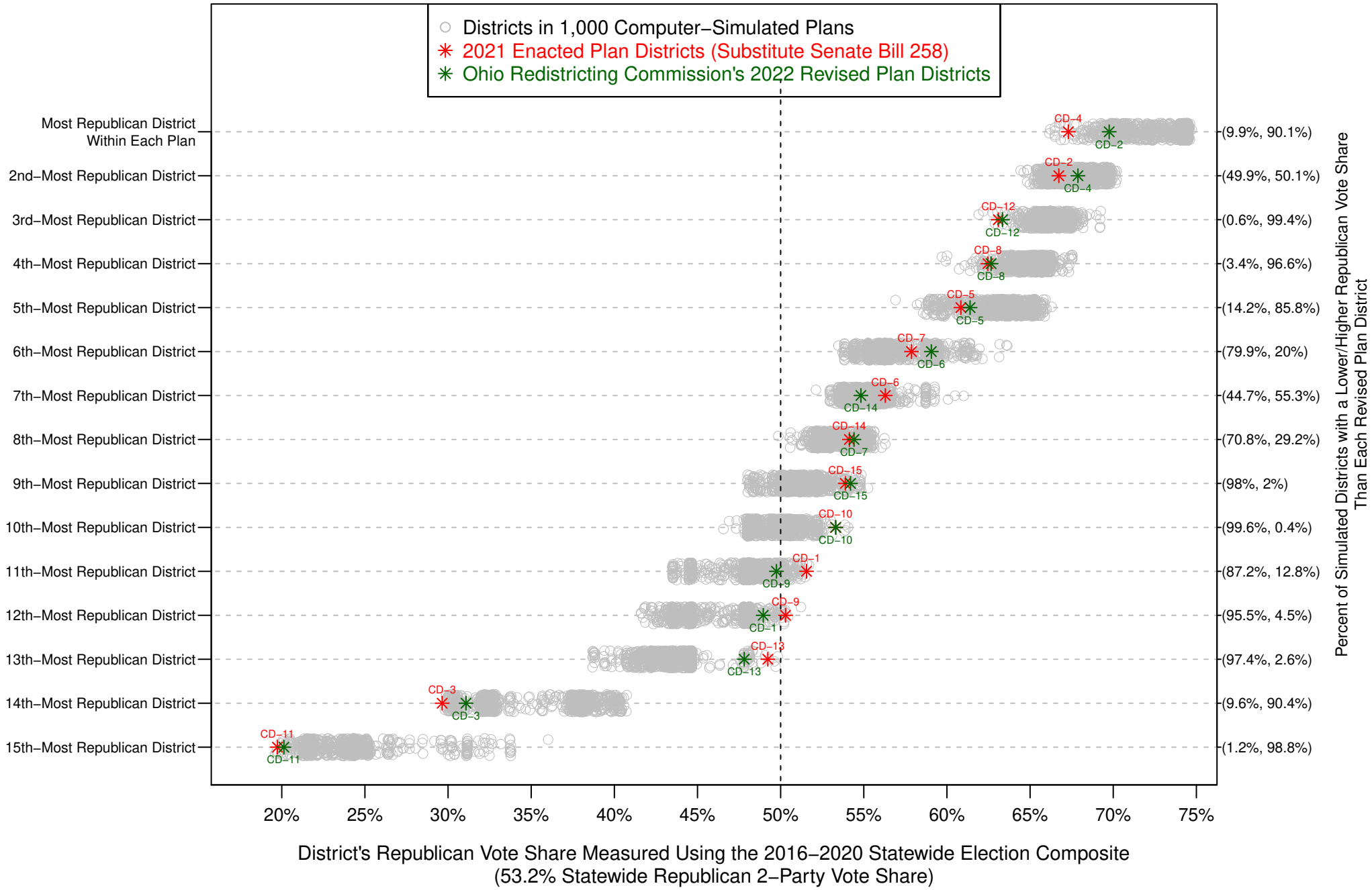
under each simulated plan to measure the number of districts Democrats or Republicans would win under that particular simulated districting map.

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



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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.

[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

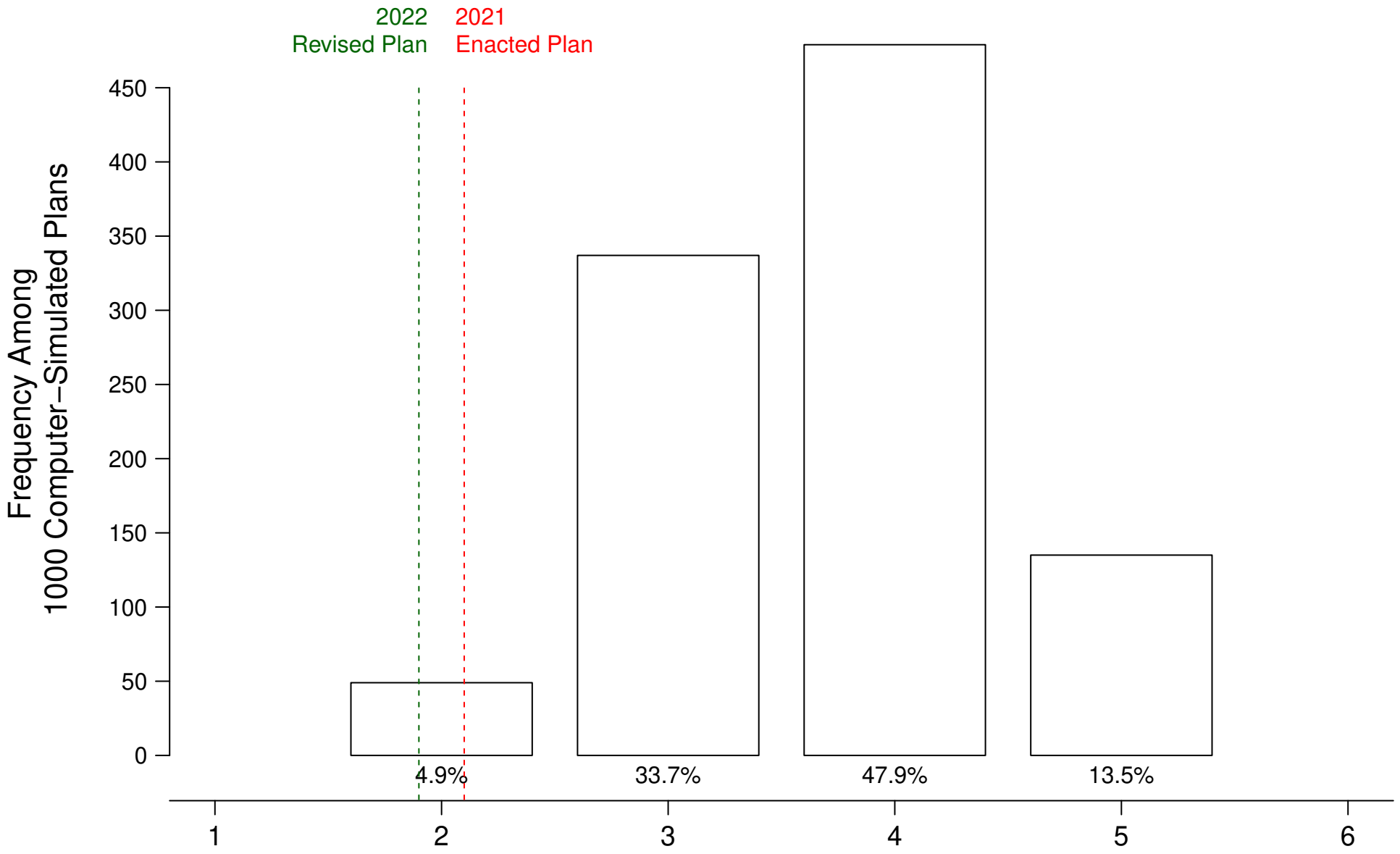

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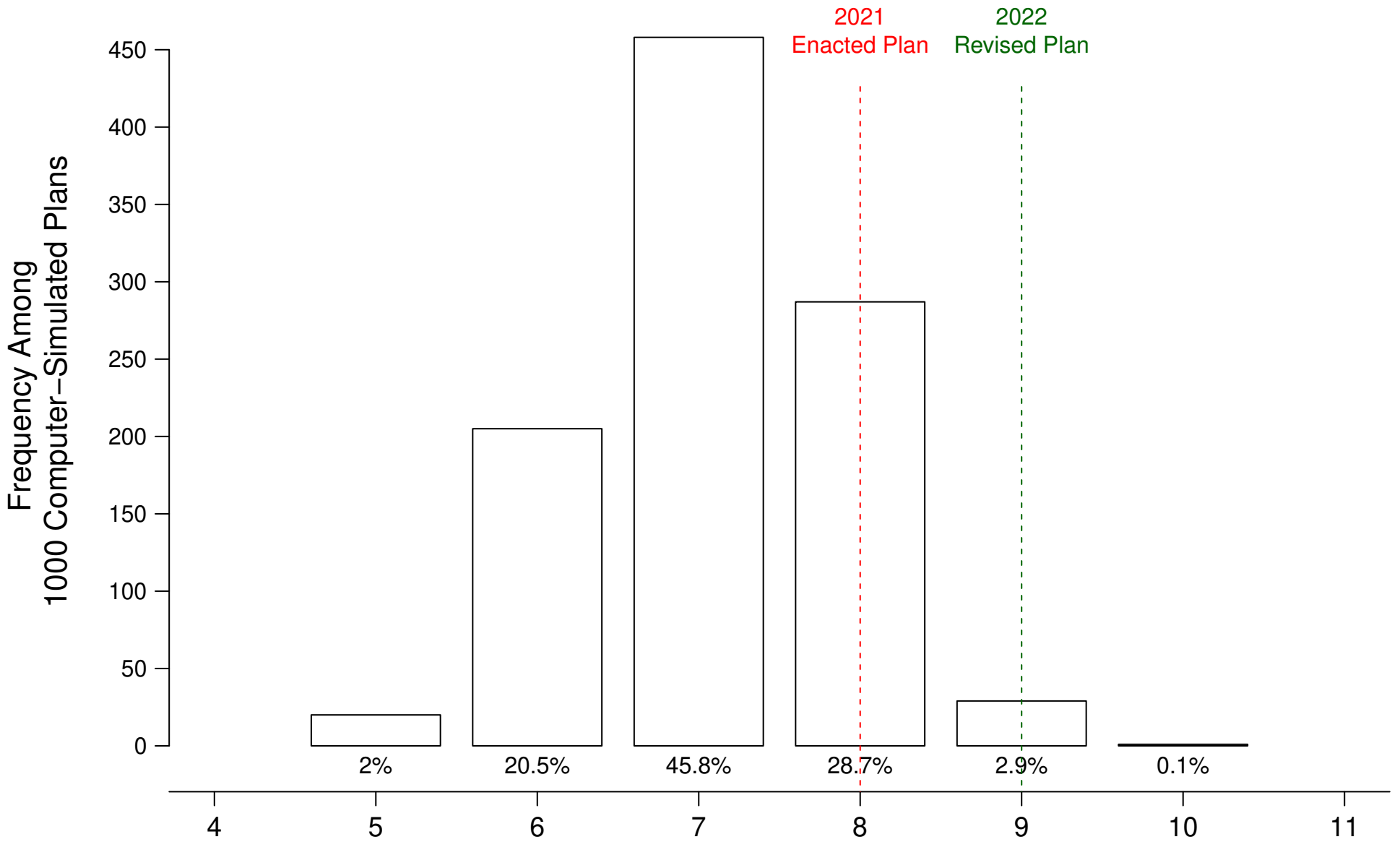
Figure 3:
Comparisons of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans



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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.

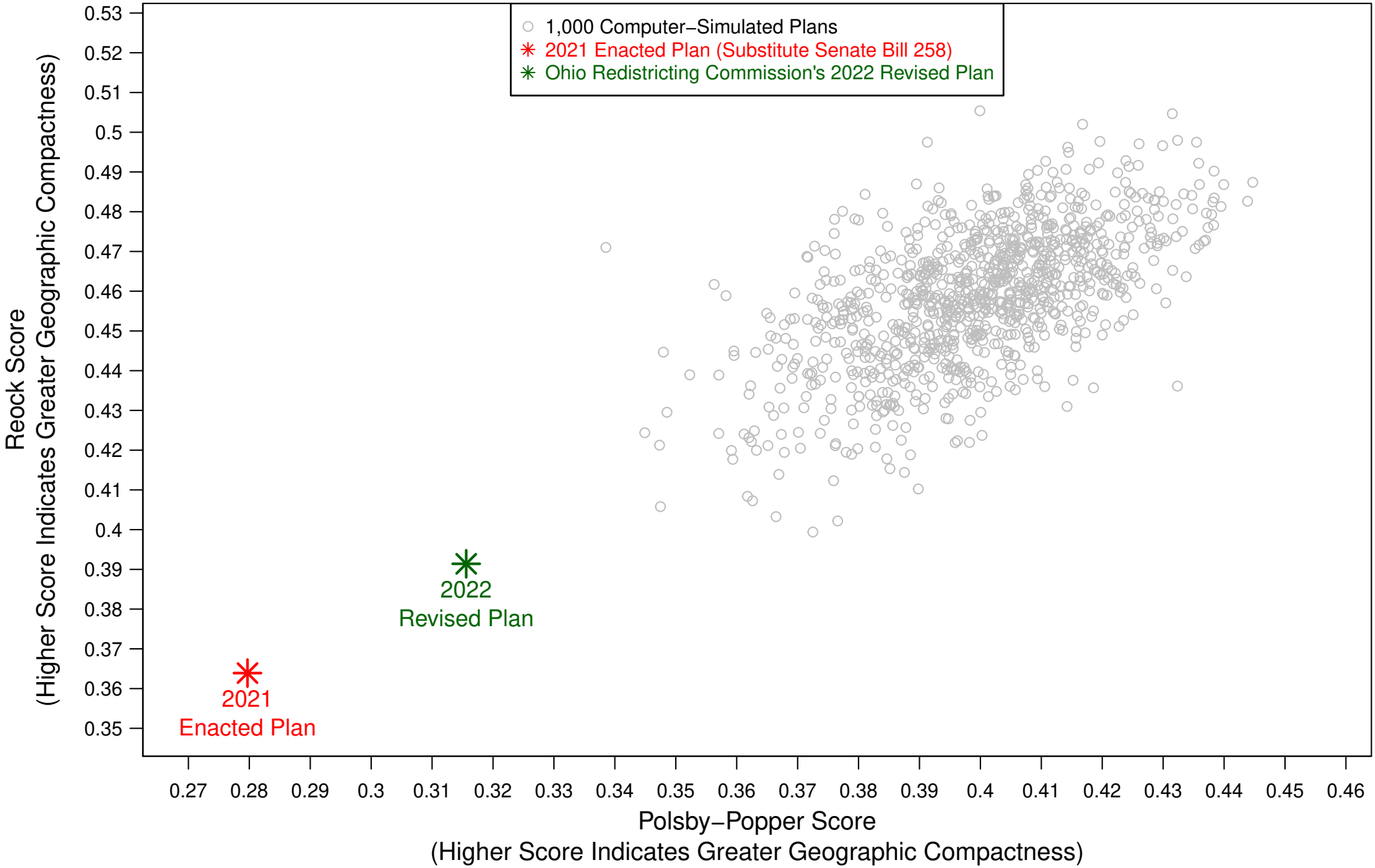
35. Article XIX, Section (1)(C)(3) of the Ohio Constitution requires that the General Assembly "shall attempt to draw districts that are compact." In evaluating whether the 2022 Revised Plan follows the compactness requirement of Section (1)(C)(3), it is useful to compare the compactness of the 2022 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



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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 County Districts (CD–3 and CD–15) in the 2022 Revised Plan:

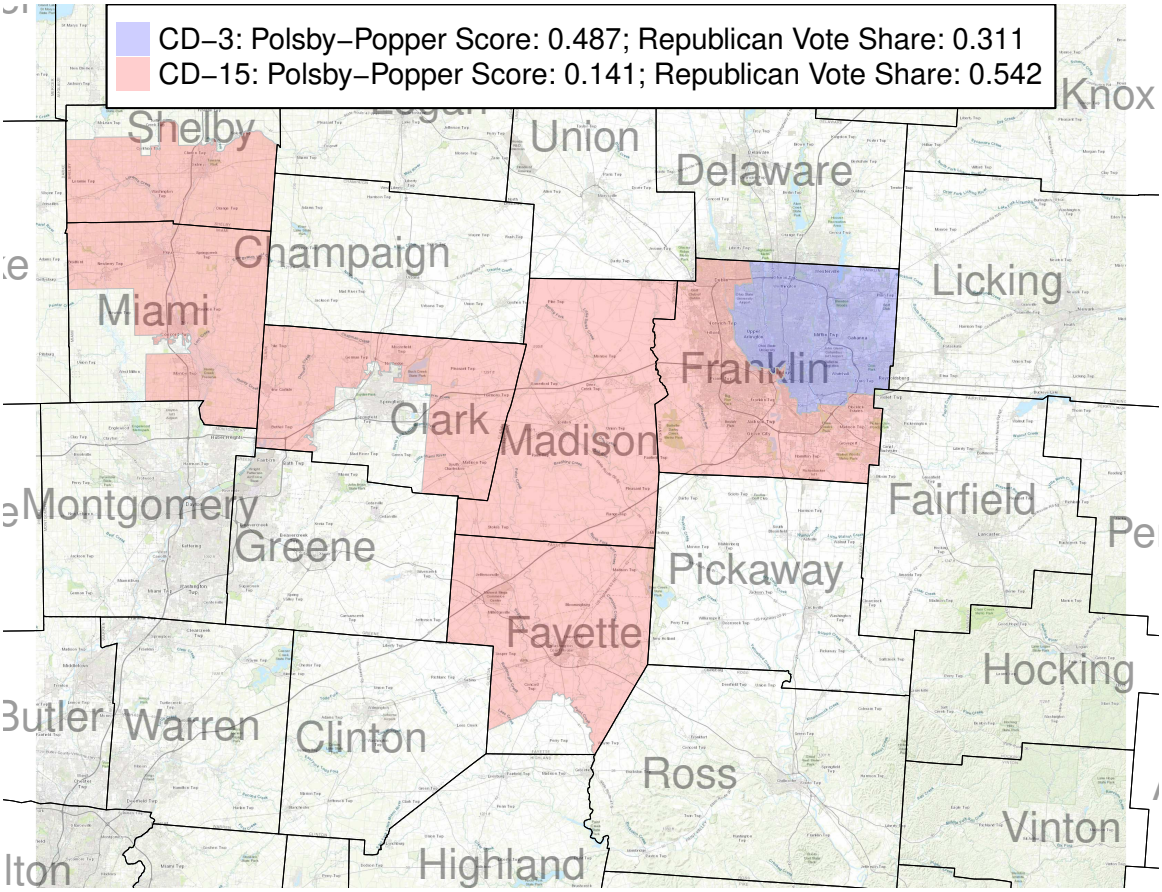
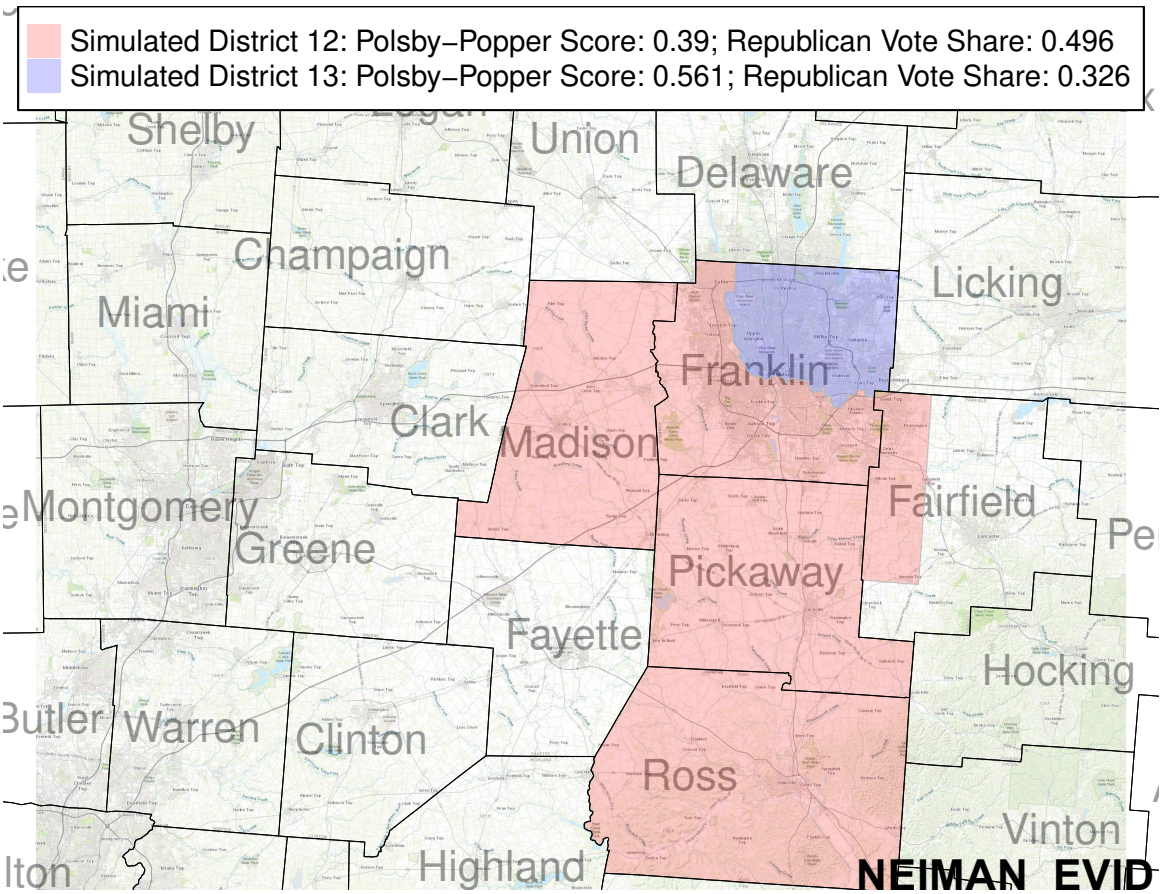


Figure 5b: Computer–Simulated Plan with the Most Compact Franklin County Districts (Computer–Simulated Plan #138 of 1000)

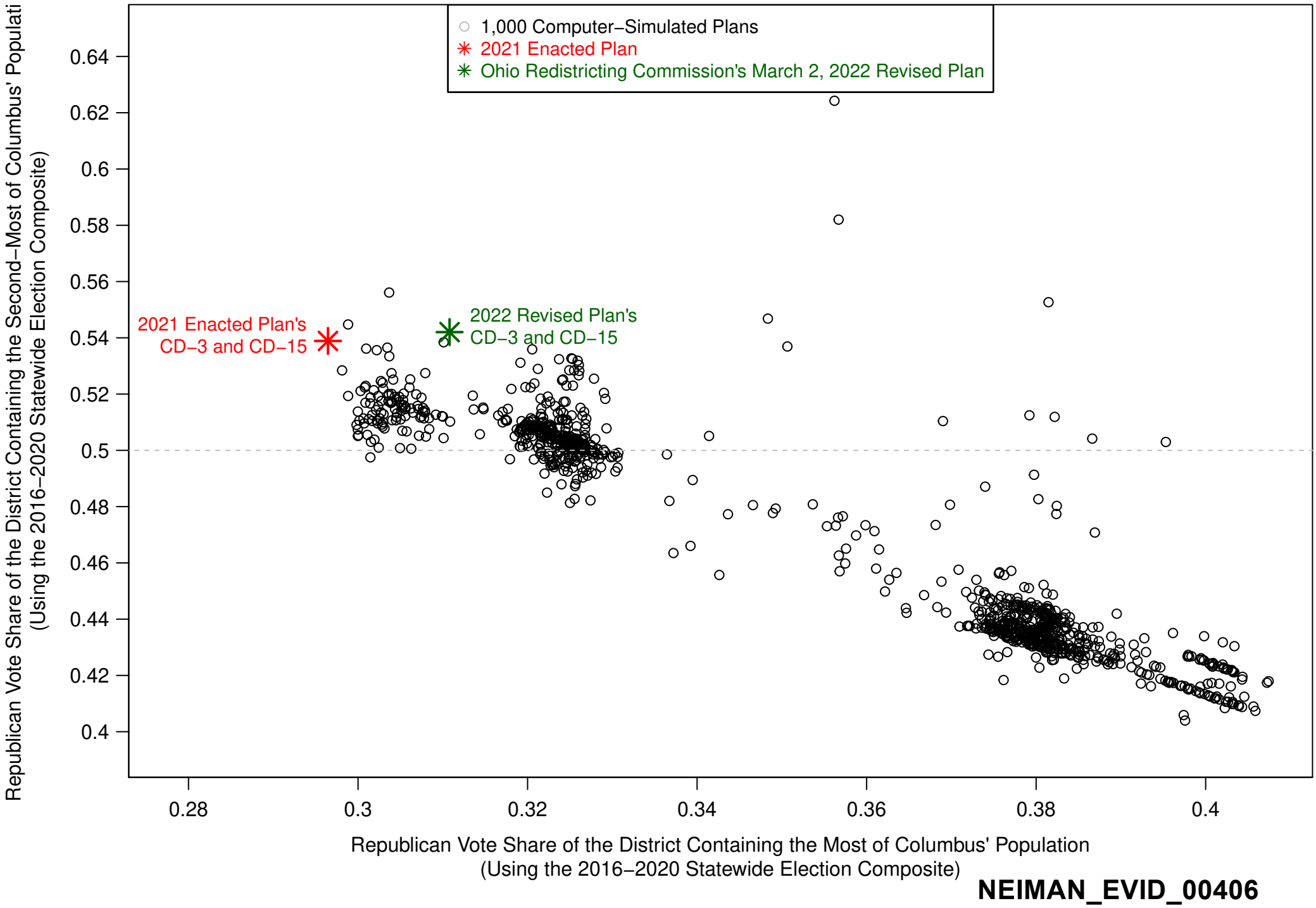


41. For the 2022 Revised Plan and the 1,000 simulated plans, Figure 6 compares the Republican vote share, as measured using the 2016-2020 Statewide Election Composite, of the two districts containing the most and second-most amount of Columbus' population. Figure 6 contains 1,000 black circles, indicating 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



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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

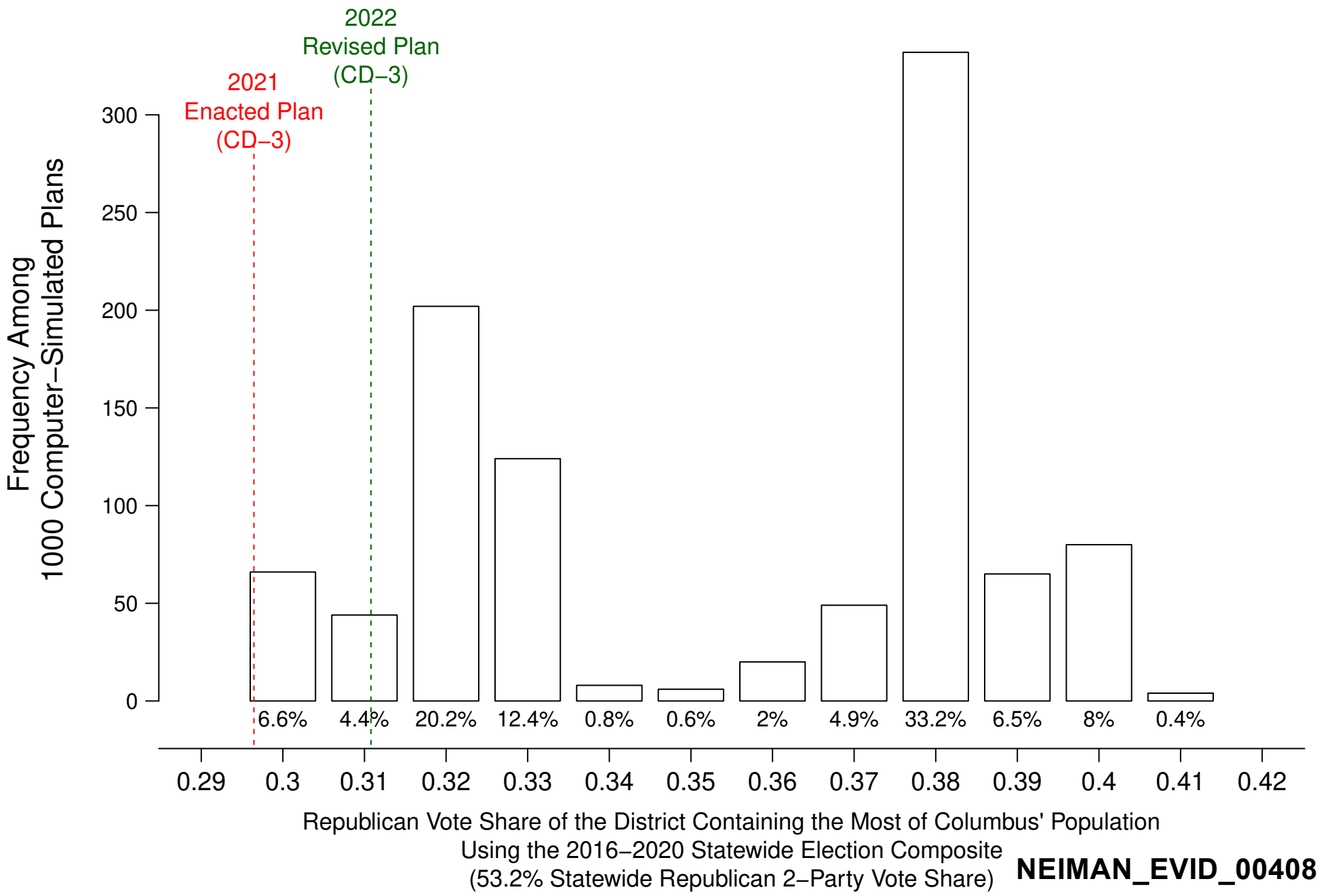

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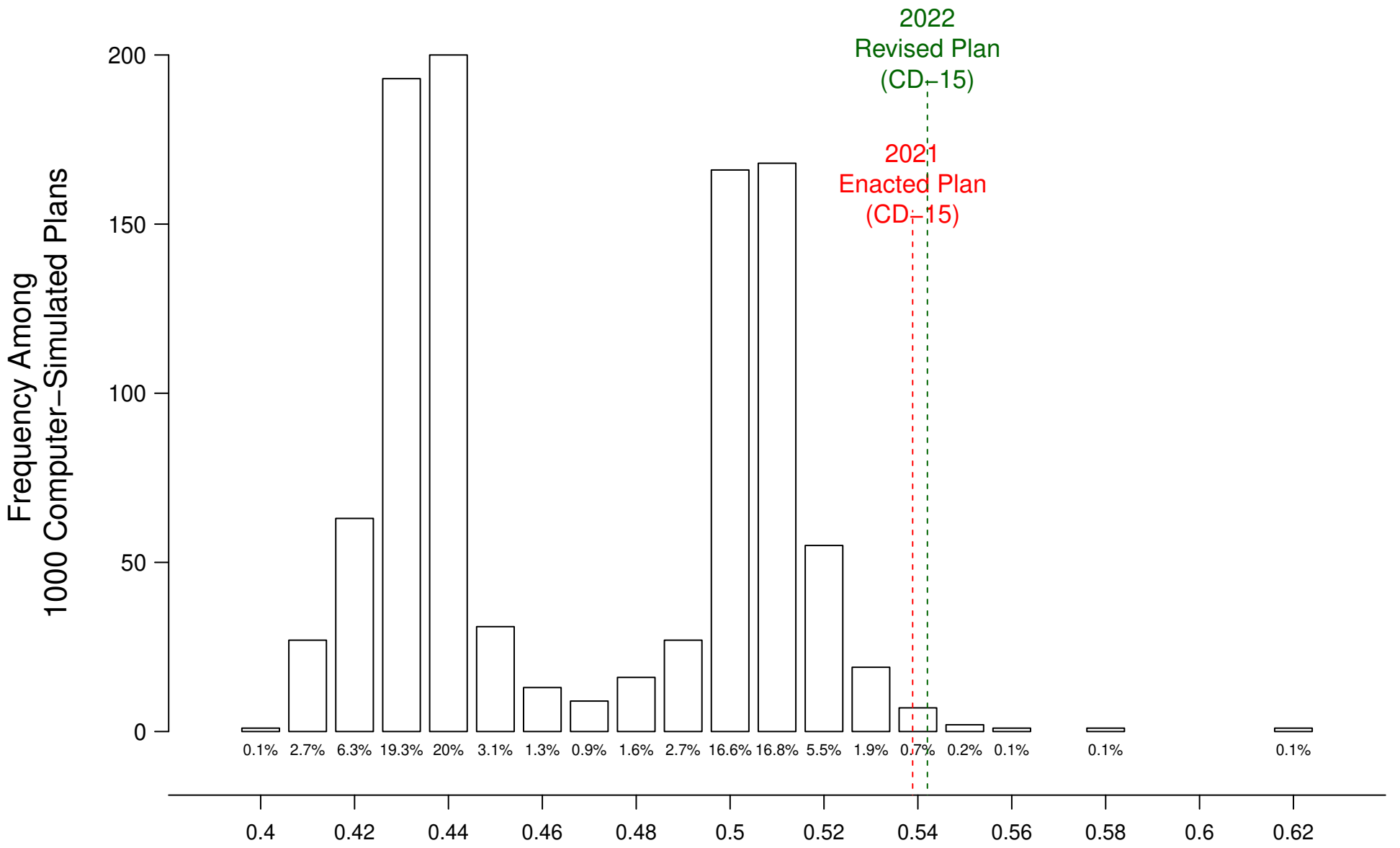
Figure 8: District Containing the Second−Most of Columbus' Population in the 2022 Revised Plan, the 2021 Enacted Plan and 1,000 Computer−Simulated Plans



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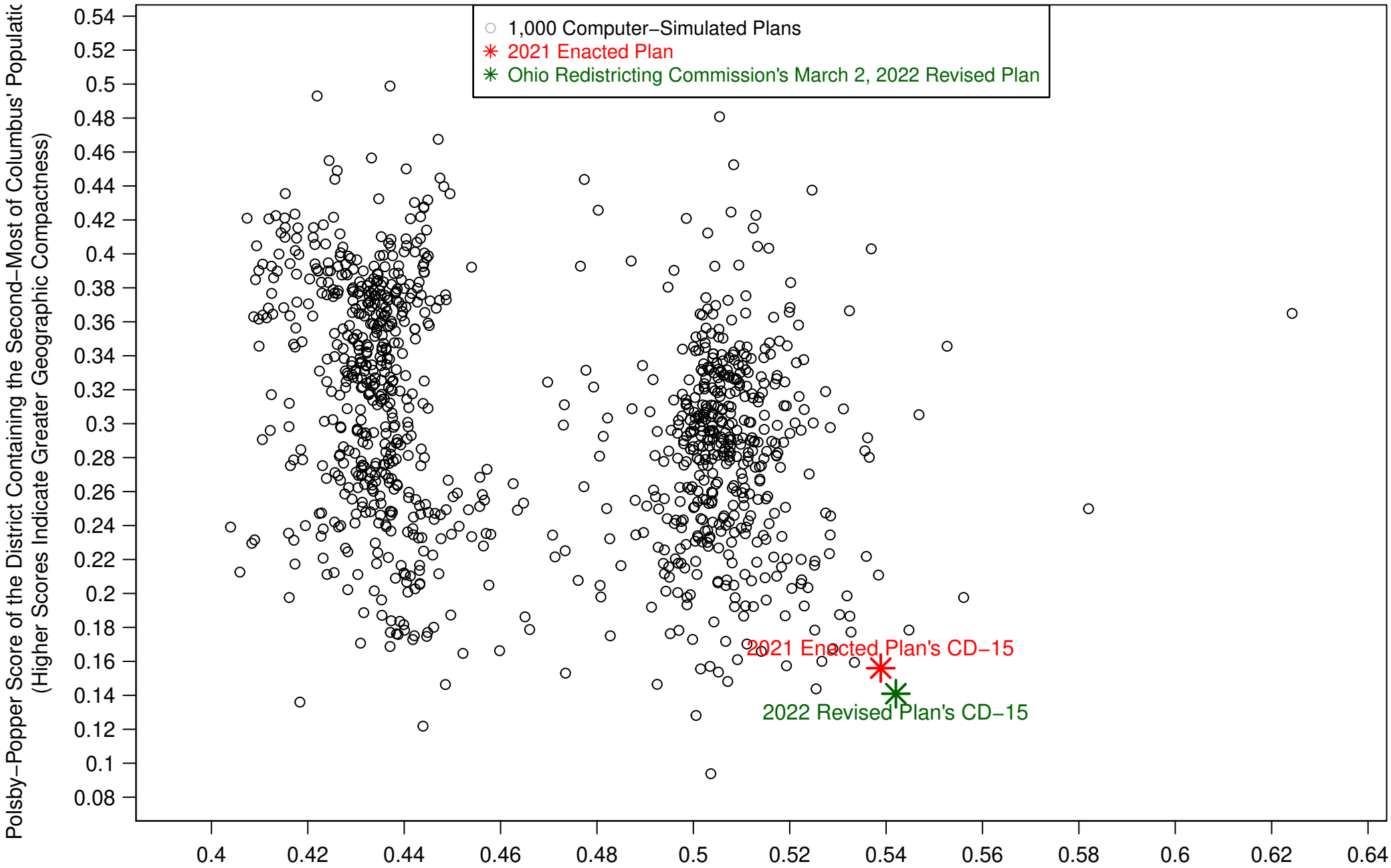
46. Finally, Figures 9 illustrates *how* the Ohio Redistricting Commission was able to create such a Republican-favorable outcome with respect to the partisan characteristics of the Columbus-area districts. In Figure 9, the vertical axis compares the Polsby-Popper compactness scores of the district containing 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



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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:

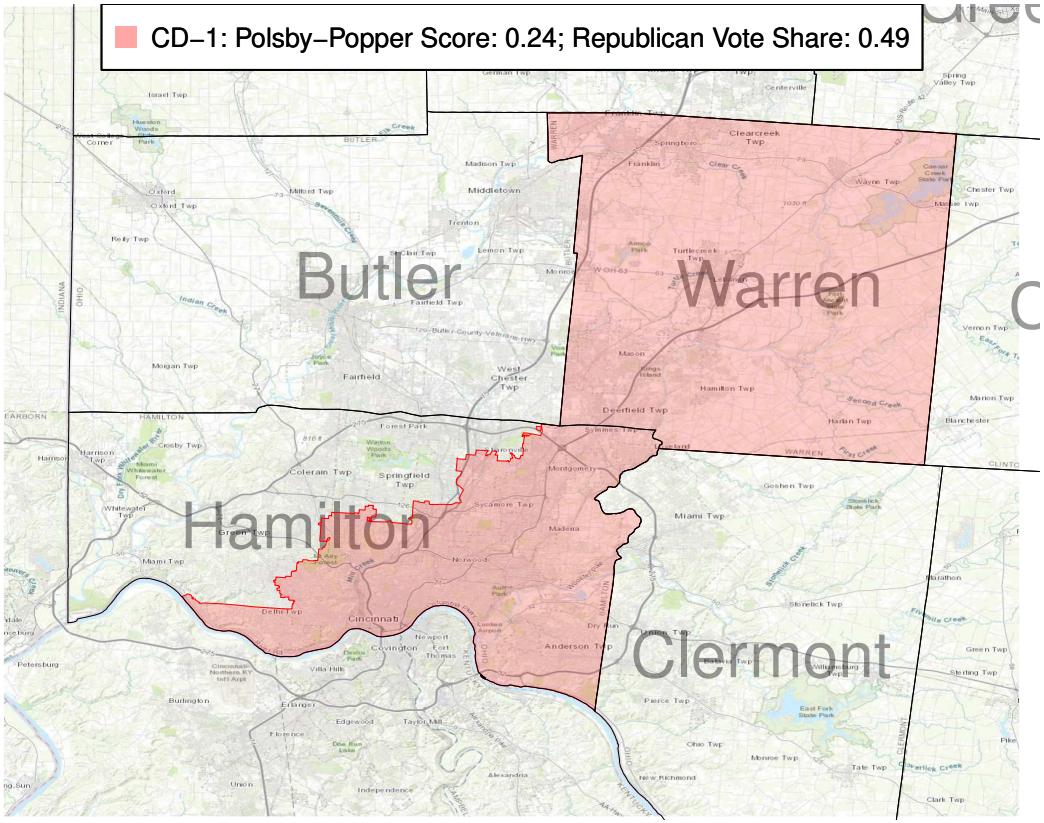
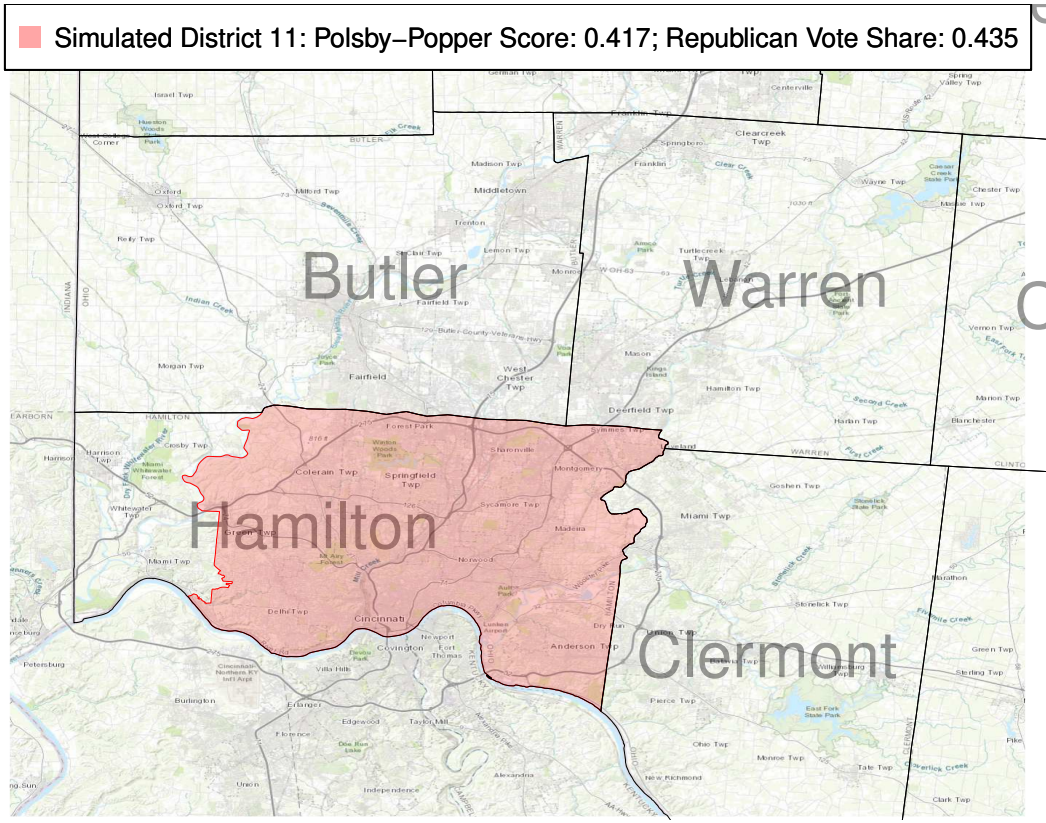


Figure 10b: Computer–Simulated Plan with the Most Compact Cincinnati District (Simulated Plan #311 of 1000):



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

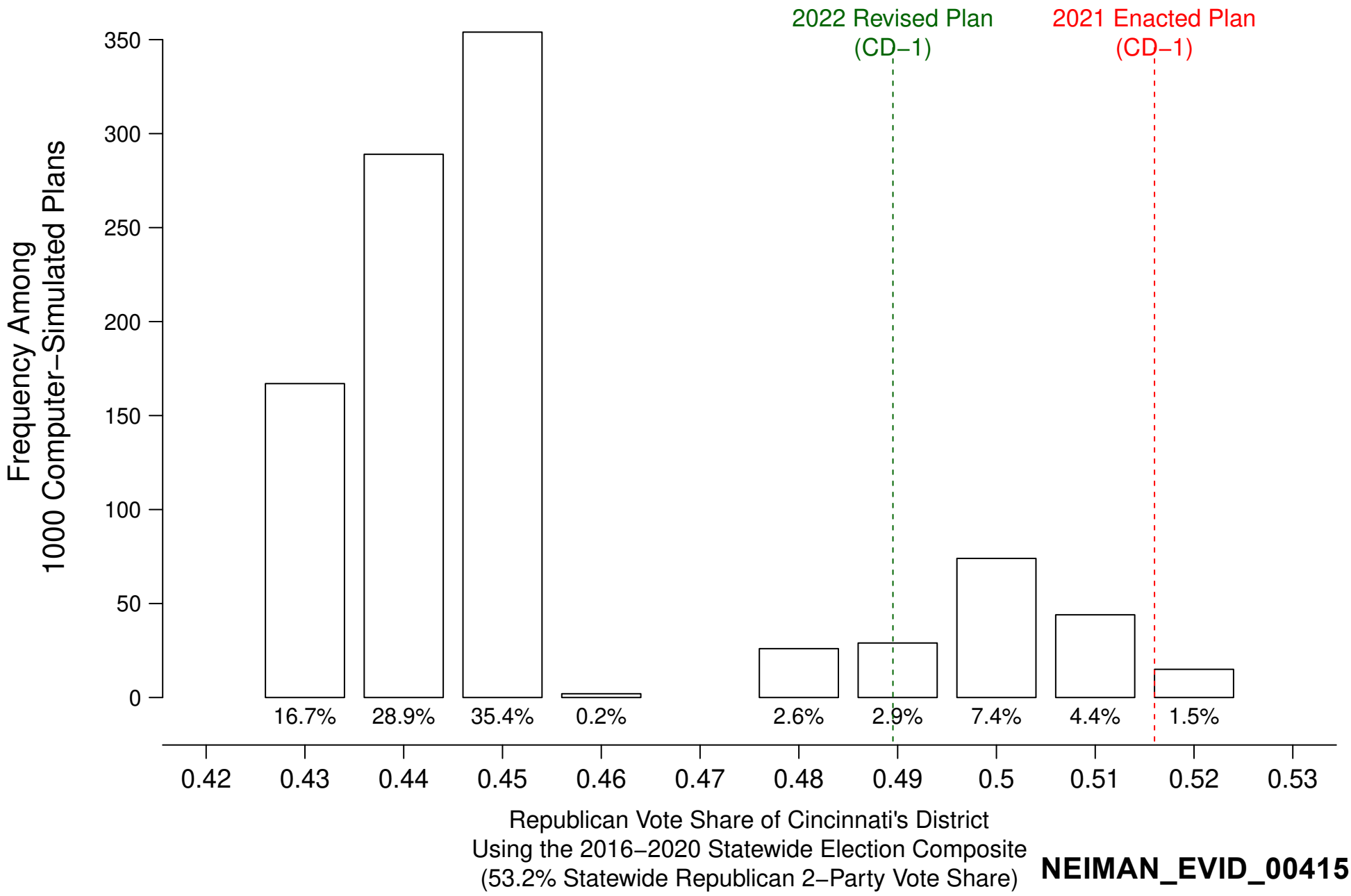


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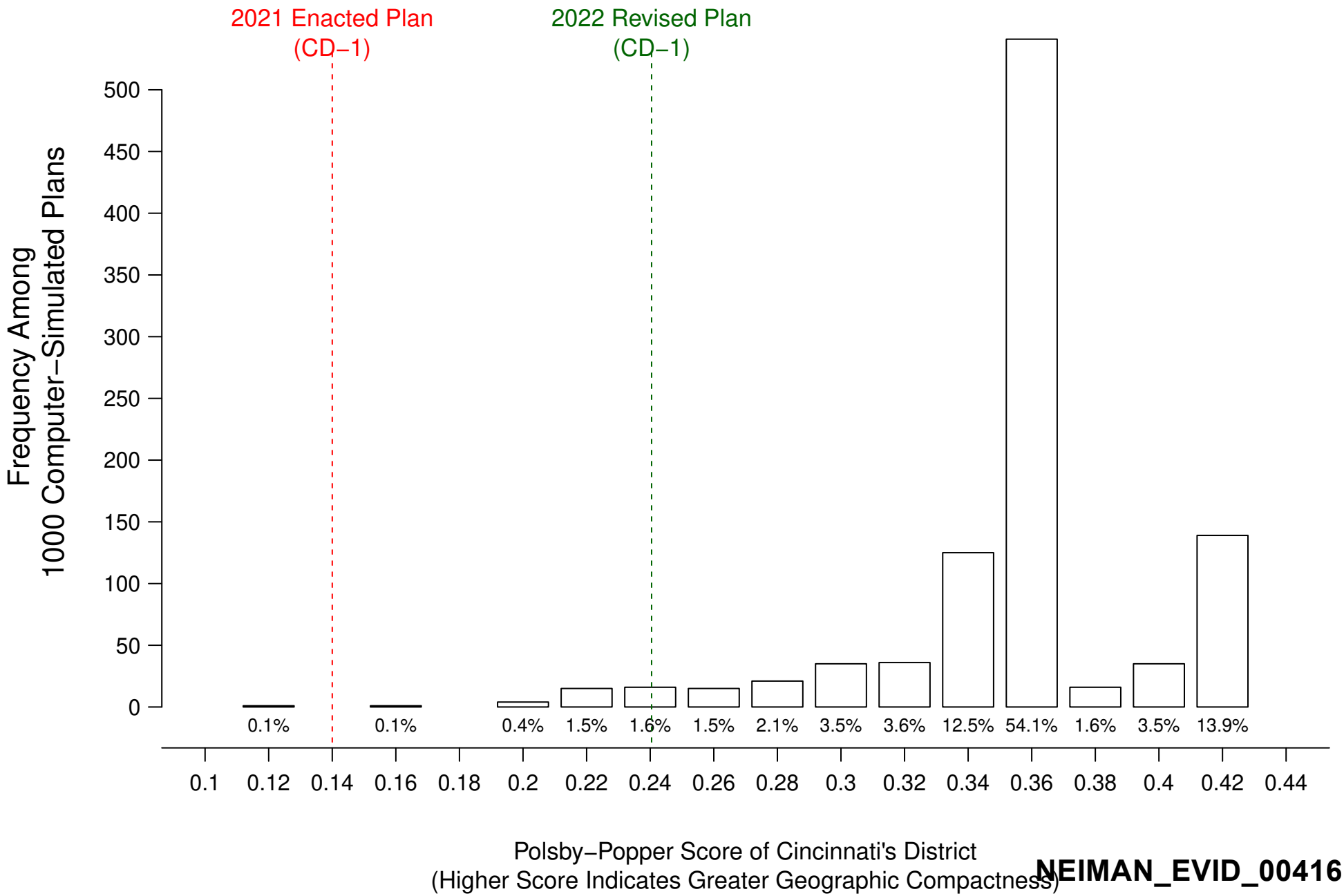
Figure 12:
Comparison of Cincinnati's District in the 2022 Revised Plan, the 2021 Enacted Plan, and 1,000 Computer–Simulated Plans



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:

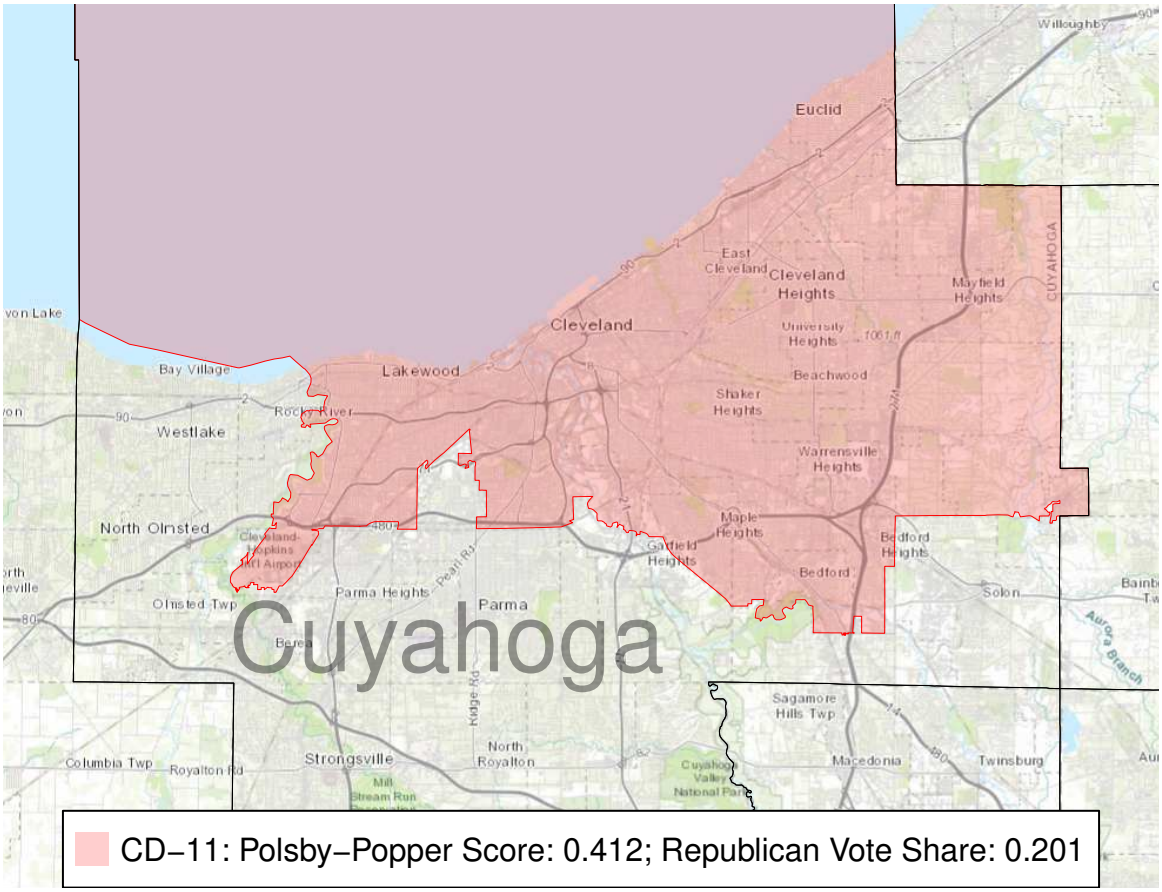
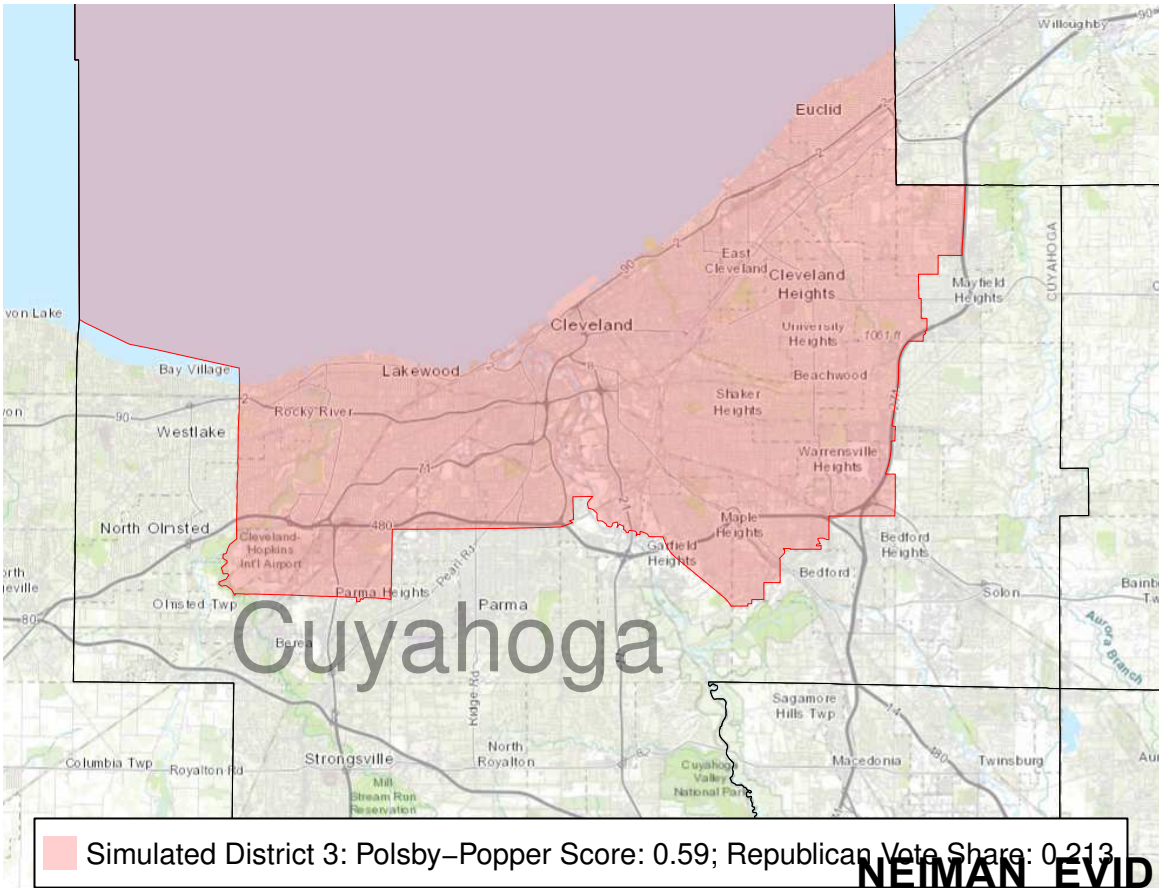


Figure 13b: Computer–Simulated Plan with the Most Compact Cleveland District (Simulated Plan #440 of 1000):



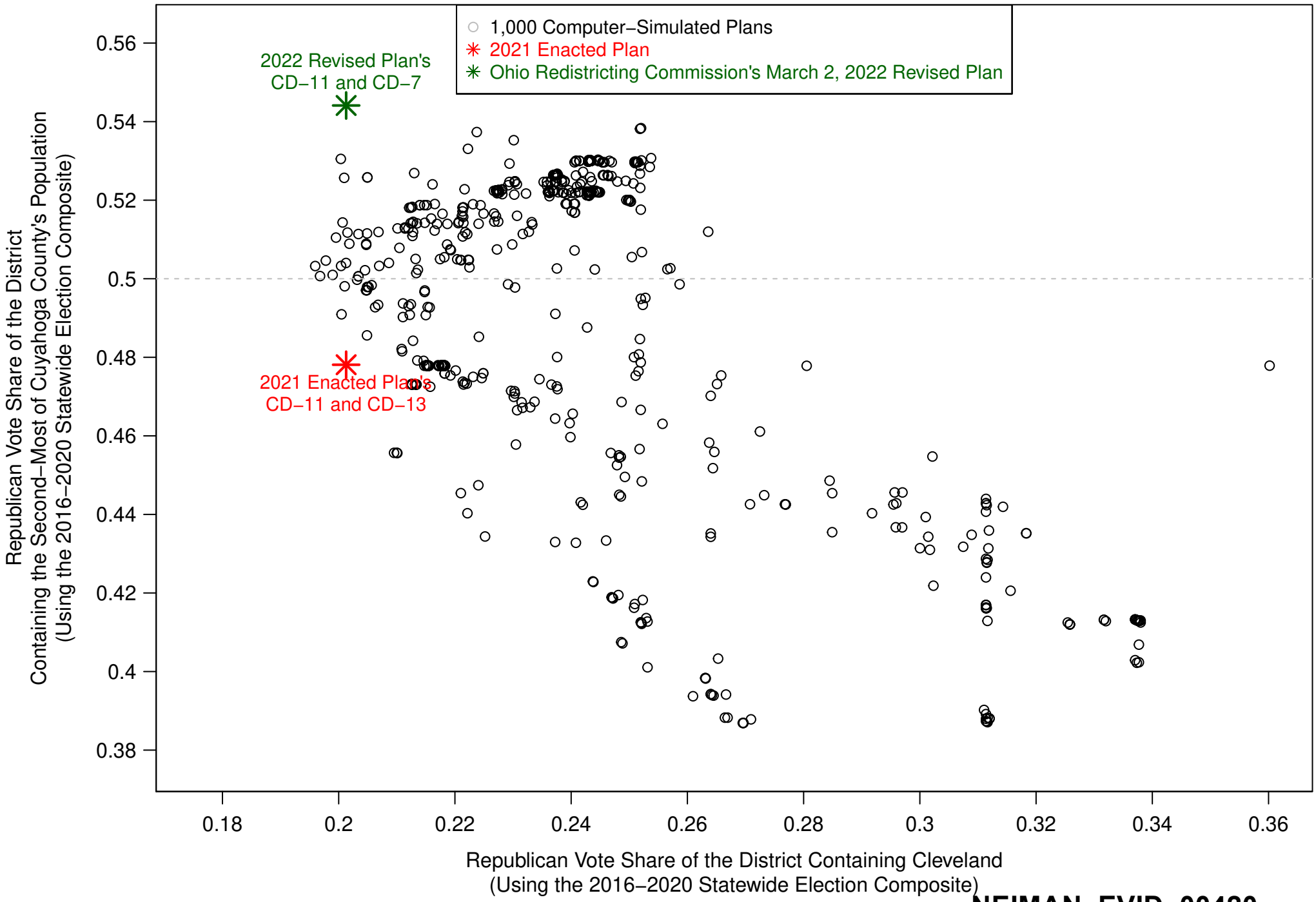
55. For the 2022 Revised Plan and the 1,000 simulated plans, Figure 14 compares the Republican vote share, as measured using the 2016-2020 Statewide Election Composite, of the Cleveland-based district and the district containing the second-most amount of Cuyahoga's population. Figure 14 contains 1,000 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



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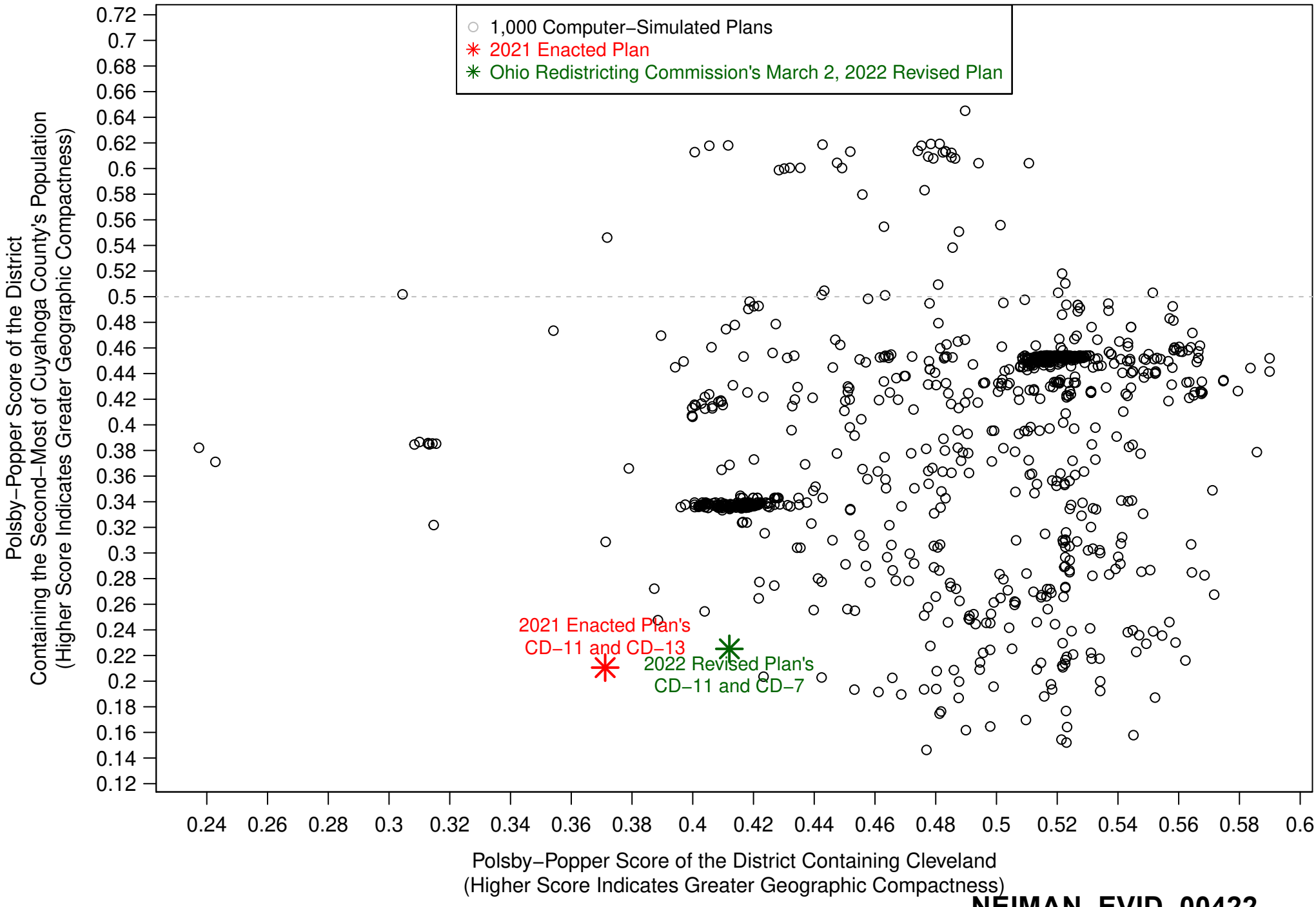
59. Finally, Figures 15 illustrates *how* the Ohio Redistricting Commission was able to create such a Republican-favorable outcome with respect to the partisan characteristics of the Cuyahoga-based districts. In Figure 15, the horizontal axis compares the Polsby-Popper compactness scores of the Cleveland-based 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



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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.

[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

JURAT STATE OF FLORIDA
COUNTY OF SAINT LUCIE

Sworn to before me this 4th day of March 2022.

By Jowei Chen

Produced Identification - Form of ID Produced: Driver's License

Notary Public Darrell Dwayne Evans

My commission expires 01/19/2025

DARRELL DWAYNE EVANS
Notary Public - State of Florida
Commission # HH 81836
Expires on January 19, 2025

Notarized online using audio-video communication

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

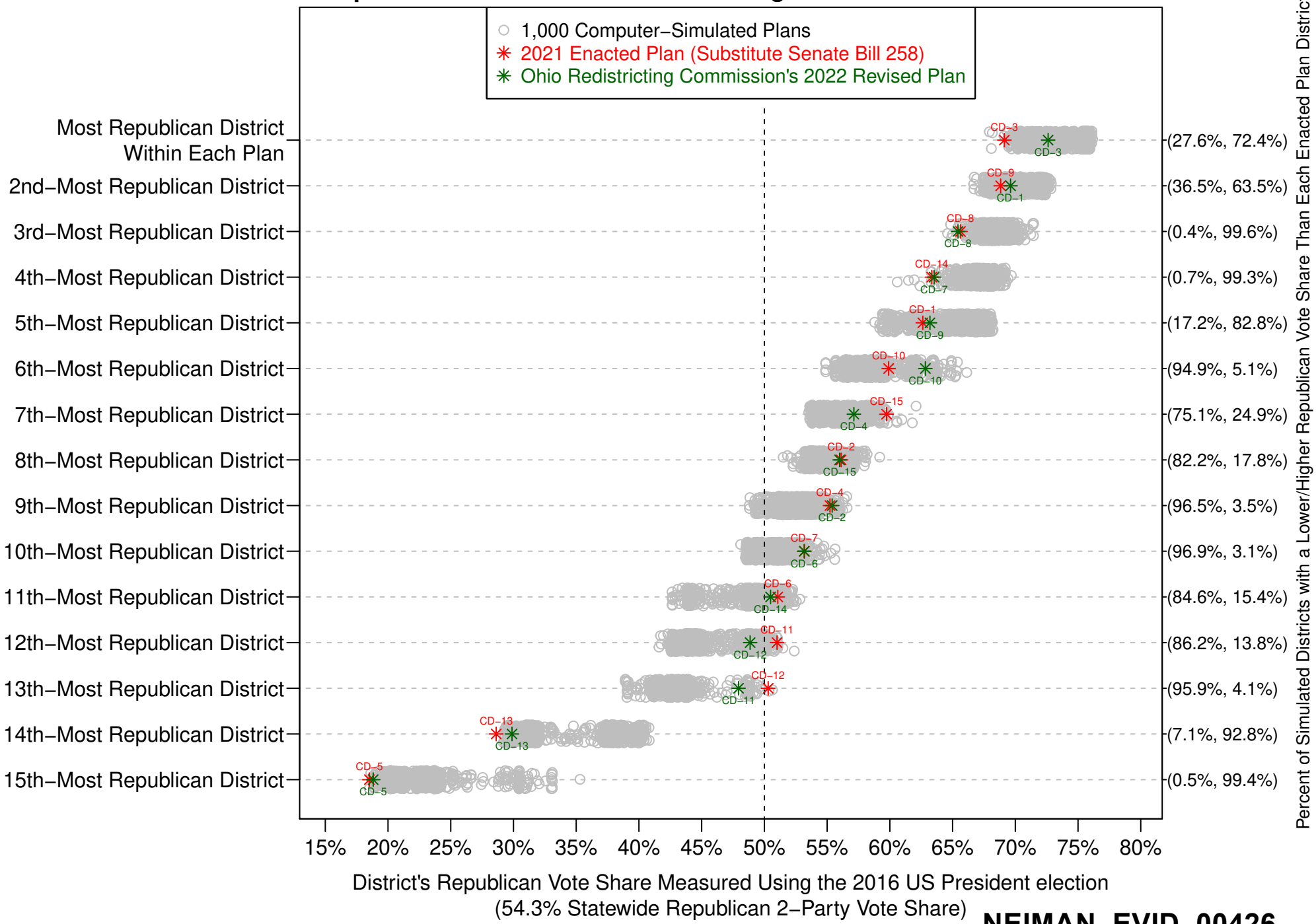

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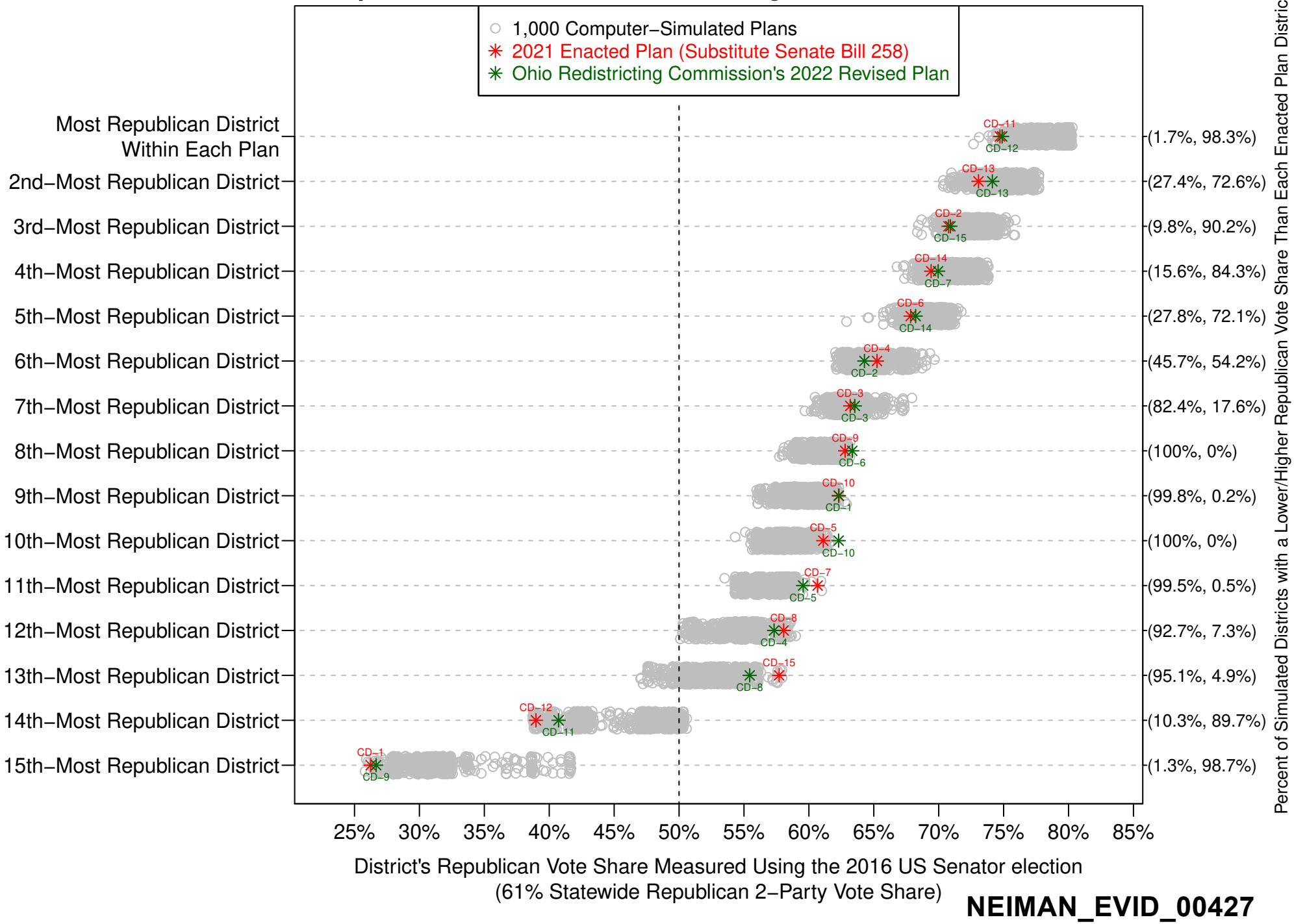
Figure A2:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results



NEIMAN_EVID_00427

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

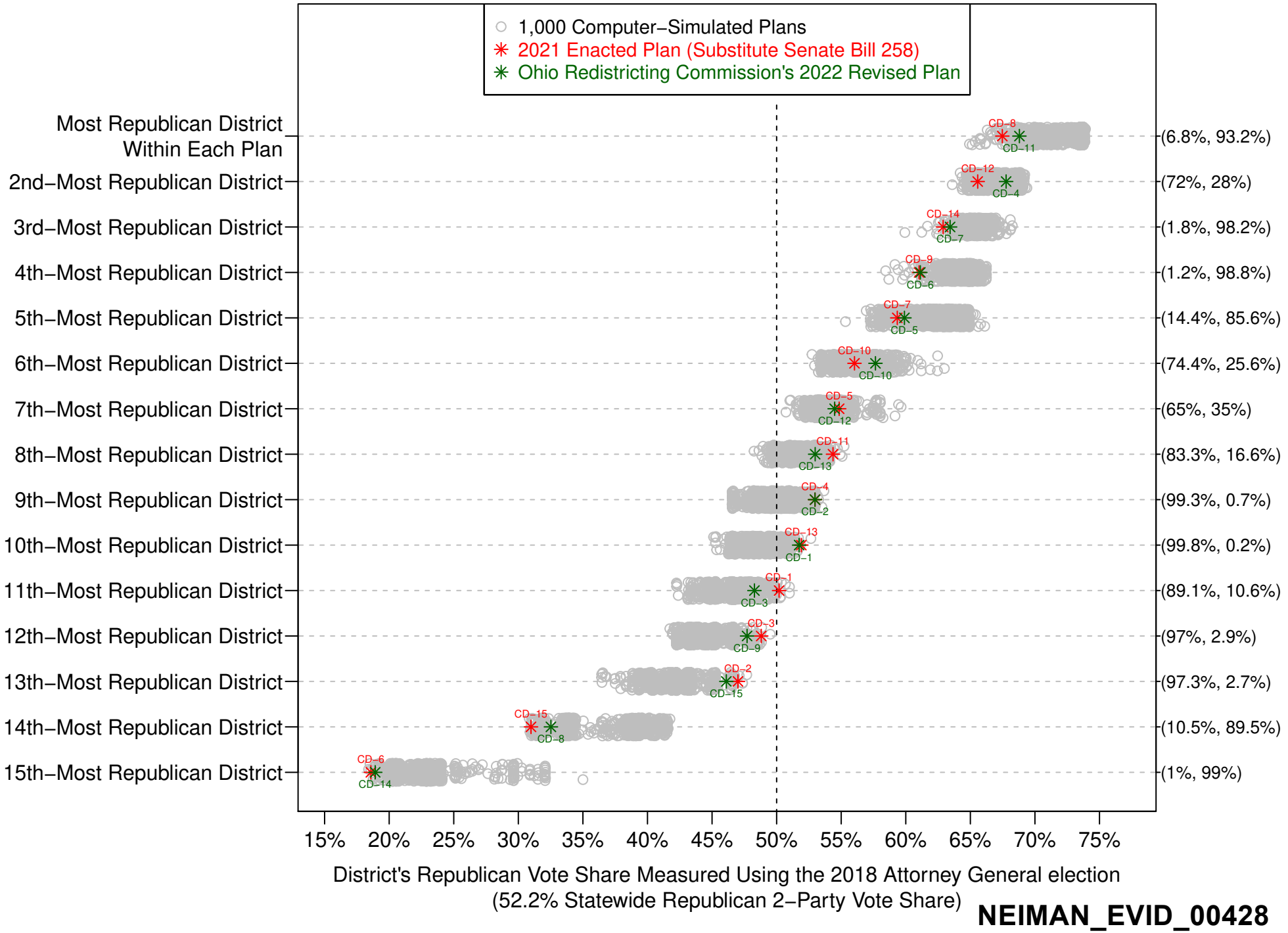


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Figure A4:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 Auditor Election Results

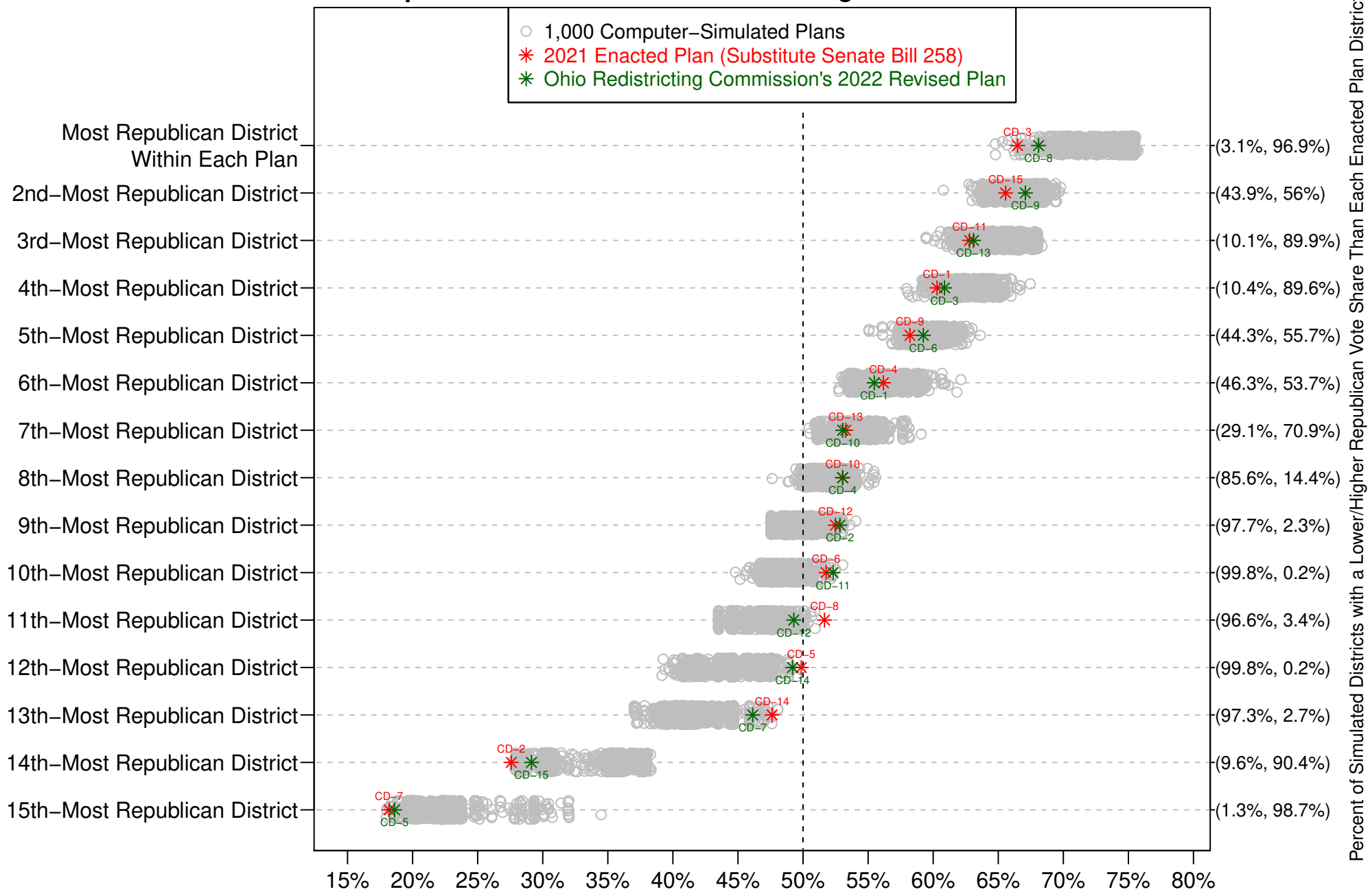

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Figure A5:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 Governor Election Results

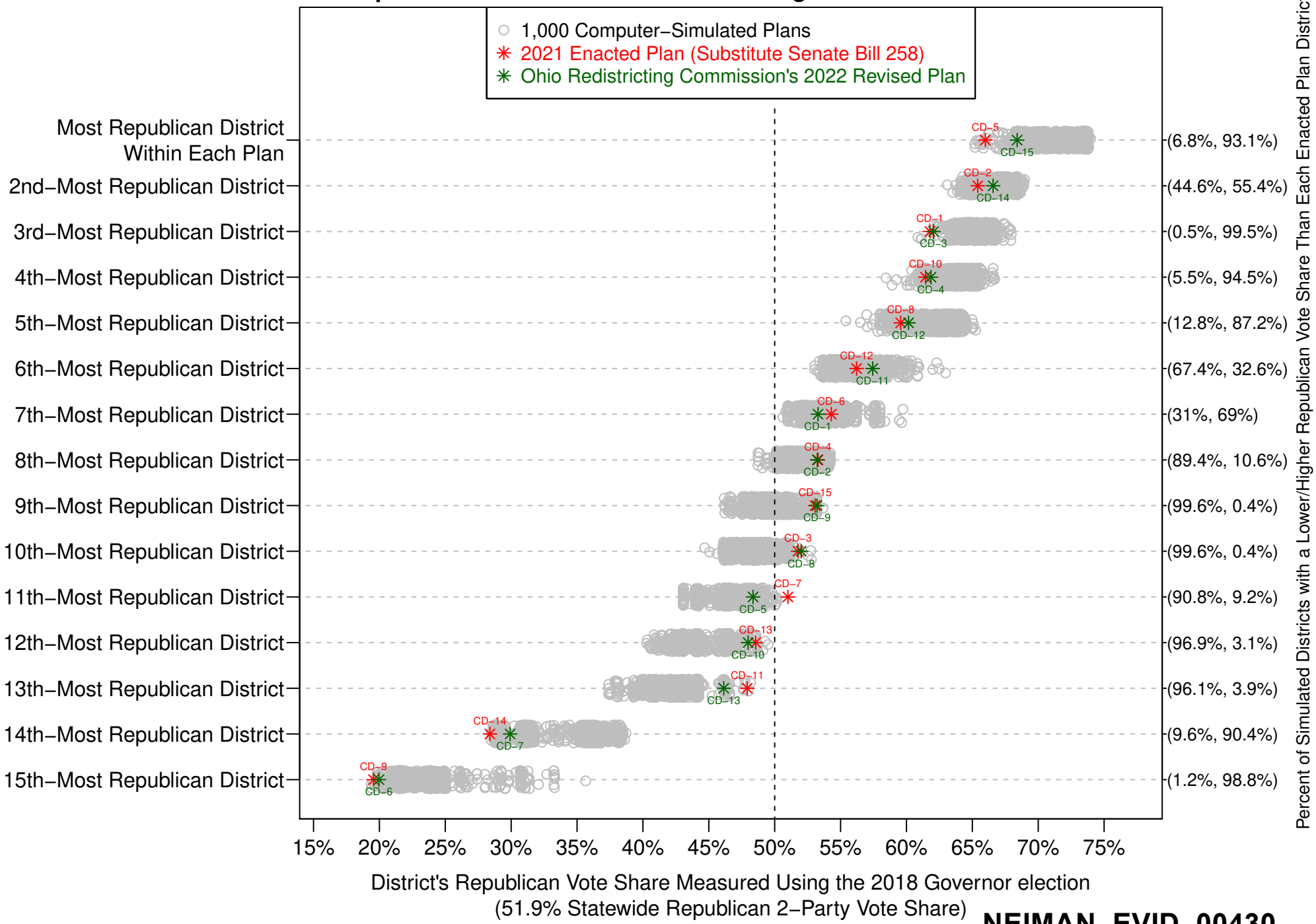

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Figure A6:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 Secretary of State Election Results

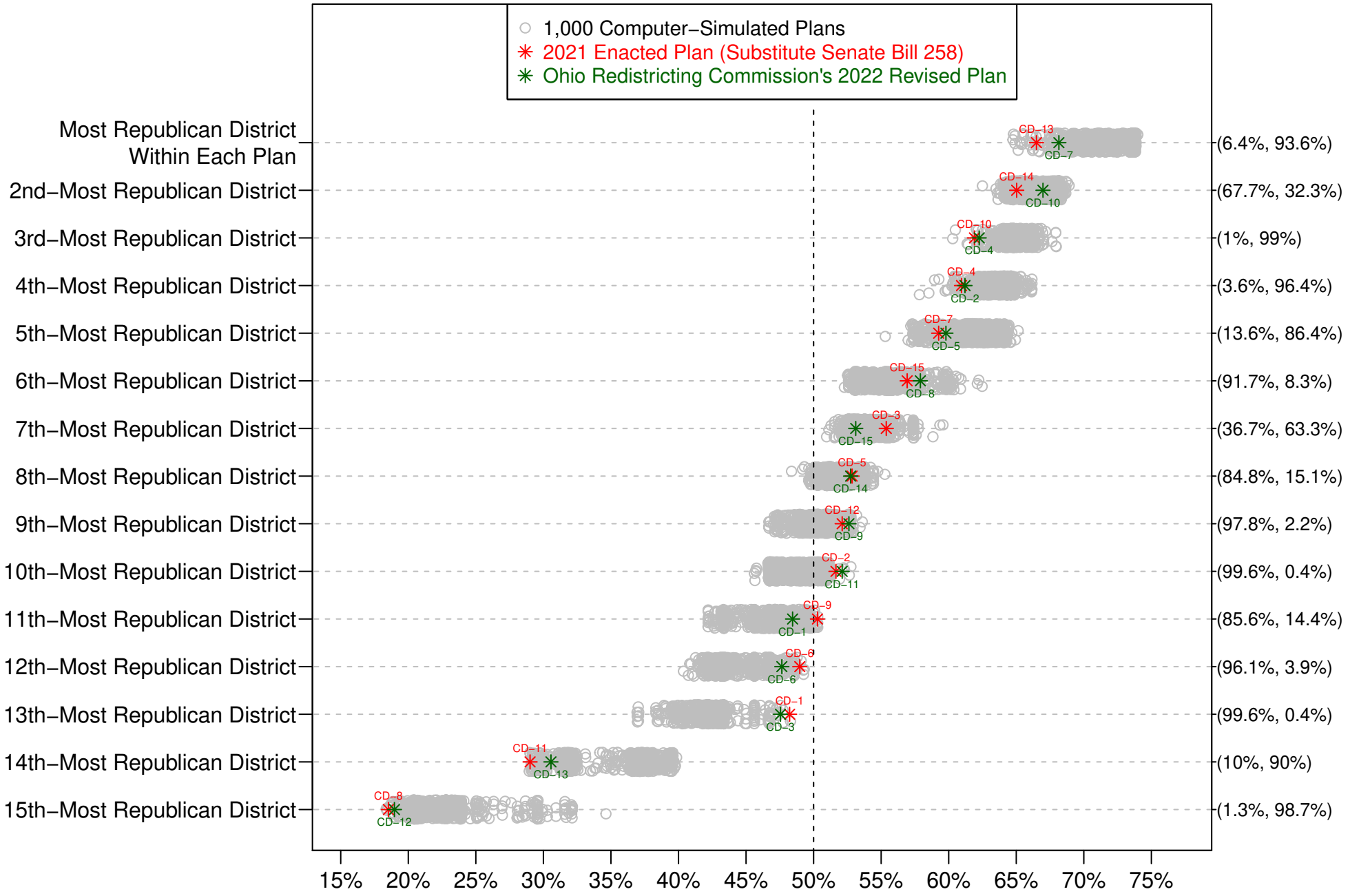

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Figure A7:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 Treasurer Election Results

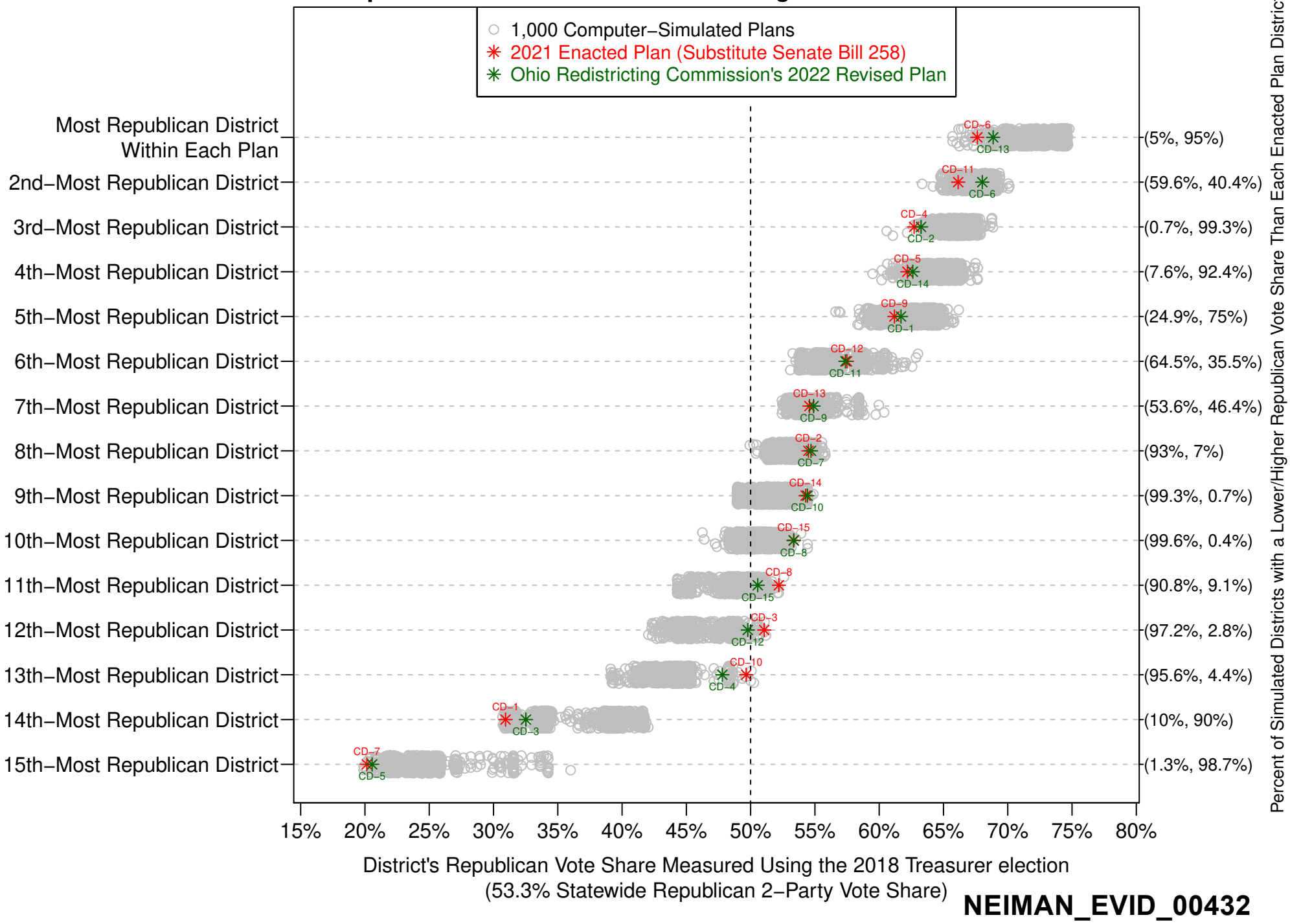

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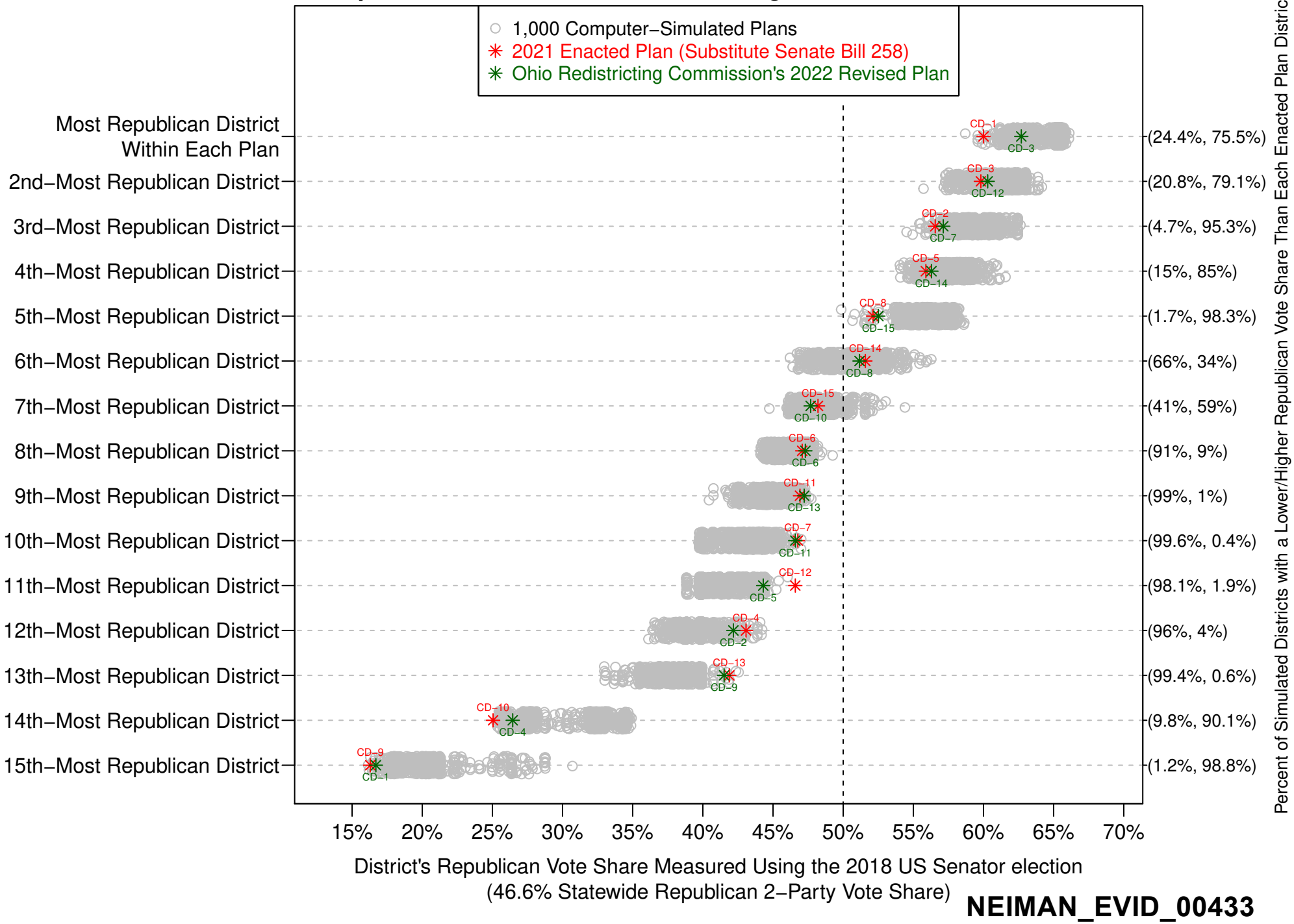
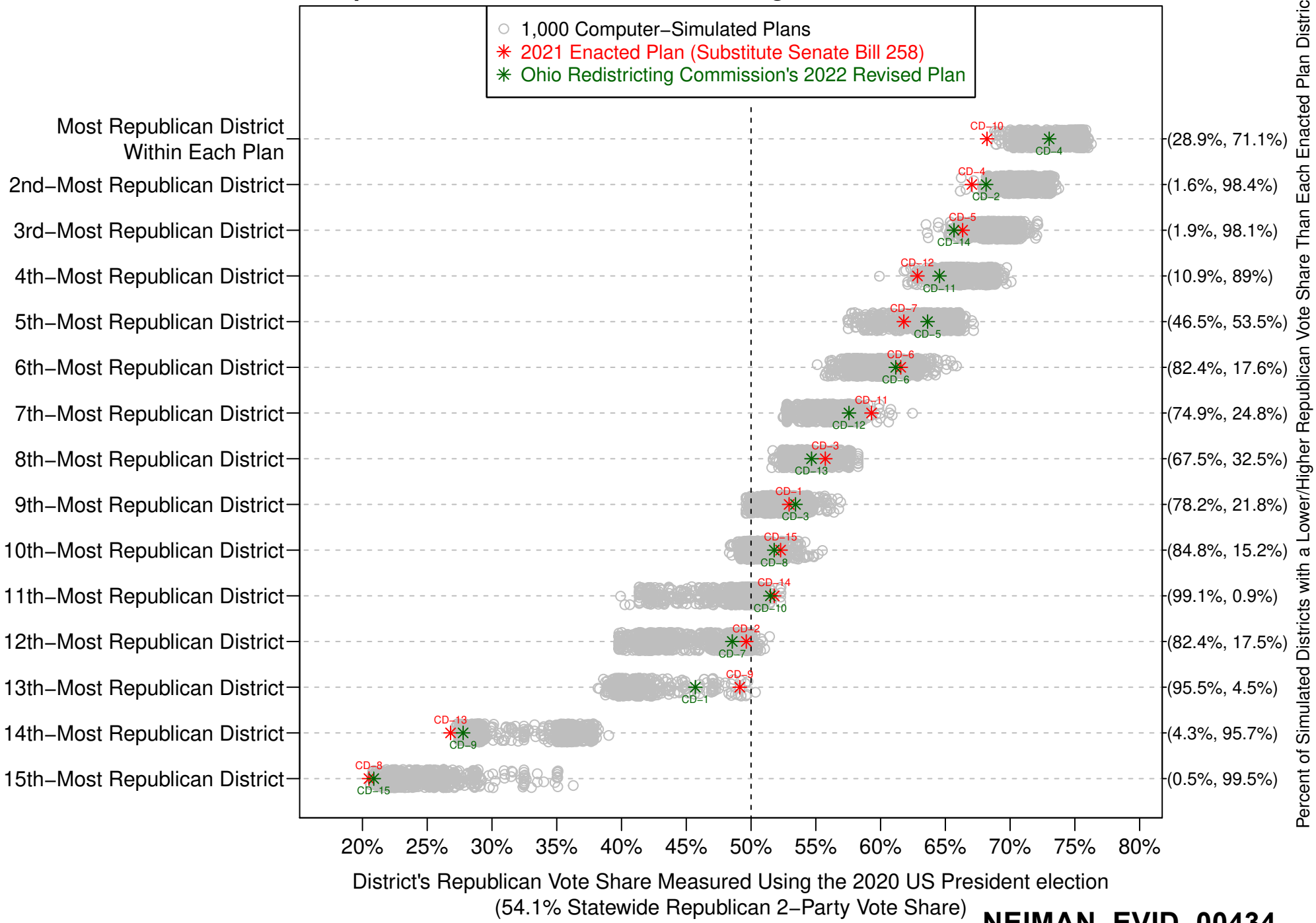
Figure A8:
Comparison of 2022 Revised Plan and 2021 Enacted Plan to 1,000 Computer–Simulated Plans:
Districts' Republican Vote Share Measured Using the 2018 US Senator Election Results



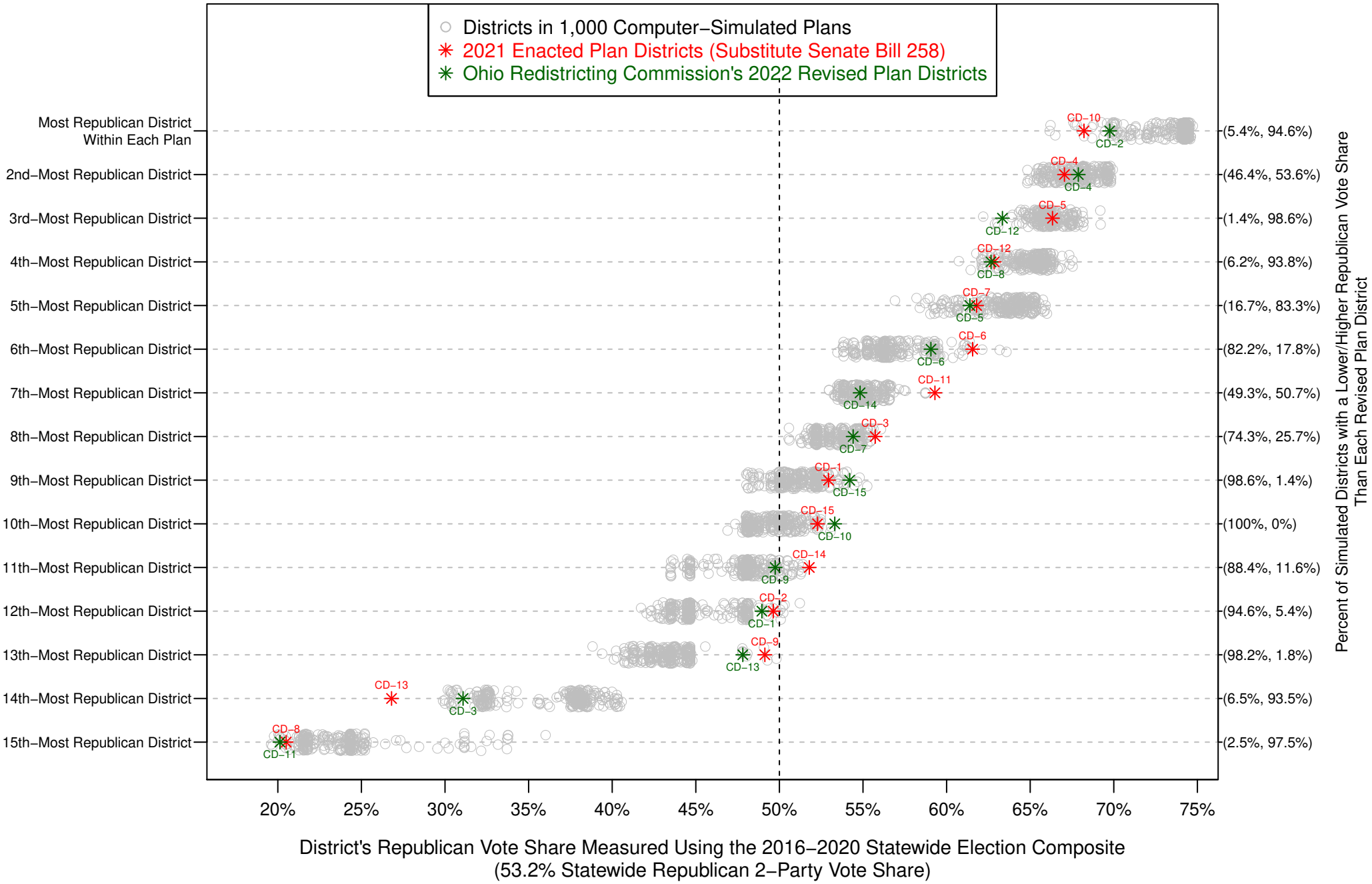
NEIMAN_EVID_00433

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



NEIMAN_EVID_00434

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



NEIMAN_EVID_00435

Jowei Chen
Curriculum Vitae

Department of Political Science
University of Michigan
5700 Haven Hall
505 South State Street
Ann Arbor, MI 48109-1045
Phone: 917-861-7712, Email: jowei@umich.edu
Website: http://www.umich.edu/~jowei

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).

Reviewer Service:

American Journal of Political Science
American Political Science Review
Journal of Politics
Quarterly Journal of Political Science
American Politics Research
Legislative Studies Quarterly
State Politics and Policy Quarterly
Journal of Public Policy
Journal of Empirical Legal Studies
Political Behavior
Political Research Quarterly
Political Analysis
Public Choice
Applied Geography

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Neiman Petitioners' Exhibit 31

Imai Affadavit.pdf

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Created:	March 06, 2022 17:02:16 -8:00
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E-Signature Summary

E-Signature 1: Kosuke Imai (KI)
March 06, 2022 17:05:54 -8:00 [7EDA8D976B76] [108.26.227.252]
imai@harvard.edu (Principal) (Personally Known)

E-Signature Notary: Theresa M Sabo (TMS)
March 06, 2022 17:05:54 -8:00 [193A8906B96C] [96.27.183.41]
tess.sabo@gmail.com
I, Theresa M Sabo, did witness the participants named above electronically sign this document.

IN THE SUPREME COURT OF OHIO

LEAGUE OF WOMEN VOTERS OF OHIO, *et al.*, **Petitioners,** **v.** **OHIO REDISTRICTING COMMISSION, *et al.*,** **Respondents.**	**Case No. 2021-1449** **Original Action Filed Pursuant to Ohio Const., Art. XI**

AFFIDAVIT OF KOSUKE IMAI

Franklin County
/ss
State of Ohio

Now comes affiant Kosuke Imai, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and fully competent to make this declaration. I have personal knowledge of the statements and facts contained herein.
2. For the purposes of this litigation, I have been asked by counsel for Petitioners to analyze relevant data and provide my expert opinions.
3. To that end, I have personally prepared the report attached to this affidavit as Exhibit B, and swear to its authenticity and to the faithfulness of the opinions expressed, and, to the best of my knowledge, the accuracy of the factual statements made therein.

FURTHER AFFIANT SAYETH NAUGHT

Executed on 03/06/2022, 2022.

Kosuke Imai
Signed on 2022/03/06 17:05:54 -8:00

Kosuke Imai

Sworn and subscribed before me this day of 03/06/2022, 2022

Theresa M Sabo
Signed on 2022/03/06 17:05:54 -8:00

Notary Public

NOTARY PUBLIC STATE OF OHIO

Theresa M Sabo
Commission # 2016-RE-619622
Electronic Notary Public
State of Ohio
My Comm Exp. Nov 28, 2026

Notary Stamp 2022/03/06 18:05:54 PST 193A8906B96C

Notarial act performed by audio-visual communication

EXHIBIT B

IN THE SUPREME COURT OF OHIO

League of Women Voters of Ohio, *et al.* *Relators*, v. Ohio Redistricting Commission, *et al.* *Respondents*.	Original Action Filed Pursuant to Ohio Const., Art. XIX, Sec. 3(A)

EXPERT REPORT
Kosuke Imai, Ph.D.
March 6, 2022

Table of Contents

I. INTRODUCTION AND SCOPE OF WORK

1. My name is Kosuke Imai, Ph.D., and I am a Professor in the Department of Government and the Department of Statistics at Harvard University. I specialize in the development of statistical methods and computational algorithms for and their applications to social science research. I am also affiliated with Harvard's Institute for Quantitative Social Science. My qualifications and compensation are described in my initial report that was submitted to this court.

2. I have been asked by counsel representing the relators in this case to analyze relevant data and provide my expert opinions related to whether Ohio's recently revised congressional districting plan (which I will refer to as the "revised plan" in this report) meets the criteria in Article XIX, Section 1(C)(3)(a) of Ohio's Constitution. More specifically, I have been asked to statistically analyze the revised plan's compliance with Article XIX, Section 1(C)(3)(a)'s requirement that "[t]he general assembly shall not pass a plan that unduly favors or disfavors a political party or its incumbents" by comparing it against the 5,000 alternative plans that were generated as the basis of simulation analysis in my initial report for this case.

II. SUMMARY OF OPINIONS

3. My analysis yields the following findings:

- The revised plan exhibits a significant partisan bias in favor of the Republican Party. Under the revised plan, the vote share margins for three nominally Democratic-leaning districts are unusually narrow when compared to my 5,000 simulated plans. In contrast, Republican-leaning districts are much safer under the revised plan than the corresponding districts in the simulated plans. These differences are substantial in magnitude and statistically significant.

- This partisan bias of the revised plan originates from the Congressional districts in Hamilton and Franklin Counties. In Hamilton County, the revised plan cracks Democratic voters into Districts 1 and 8, reducing the Democratic advantage of District 1. In Franklin County, the revised plan packs a disproportionately large number of Democratic voters into District 3, increasing the Republican advantage of the surrounding districts.

- The revised plan's decision to favor the Republican party in Hamilton and Franklin Counties led to highly non-compact districts. District 1, which combines a part of Cincinnati and its environs with Warren County, is much less compact than the corresponding county under the simulated plans. Similarly, District 15, which combines a part of Franklin County with five other counties in the western part of the state, splits a total of five counties and is much less compact than the corresponding districts under the simulated plans.

- I submitted an example plan to the Ohio Redistricting Commission on February 22, 2022 that is compliant with Article XIX of the Ohio Constitution. This example plan is less biased, has fewer county splits, and is more compact than the revised plan.

III. METHODOLOGY

4. In my initial expert report for this case, I conducted simulation analyses to evaluate the enacted plan (SB 258; hereafter "enacted plan"). As explained in that report, the redistricting simulation analysis has the ability to directly account for political geography and redistricting rules specific to the state. By comparing a proposed plan with simulated plans that are generated using a set of redistricting criteria, it is possible to assess the partisan bias of the plan relative to the set of alternative plans one could have drawn by following those specified criteria.

5. I evaluate the revised plan's compliance with Article XIX, Section 1(C)(3)(a) by comparing it with the same set of 5,000 simulated plans as those used in my initial report to evaluate the enacted plan. Recall that these simulated plans are equally or more compliant with other relevant requirements of Article XIX than the enacted plan (see the initial report for details). In Appendices A and B, I show that my simulated plans are also more compact and have fewer county splits than the revised plan. I present the evaluation of the revised plan based on a total of nine statewide elections from 2016 to 2020, which were used by the Commission.

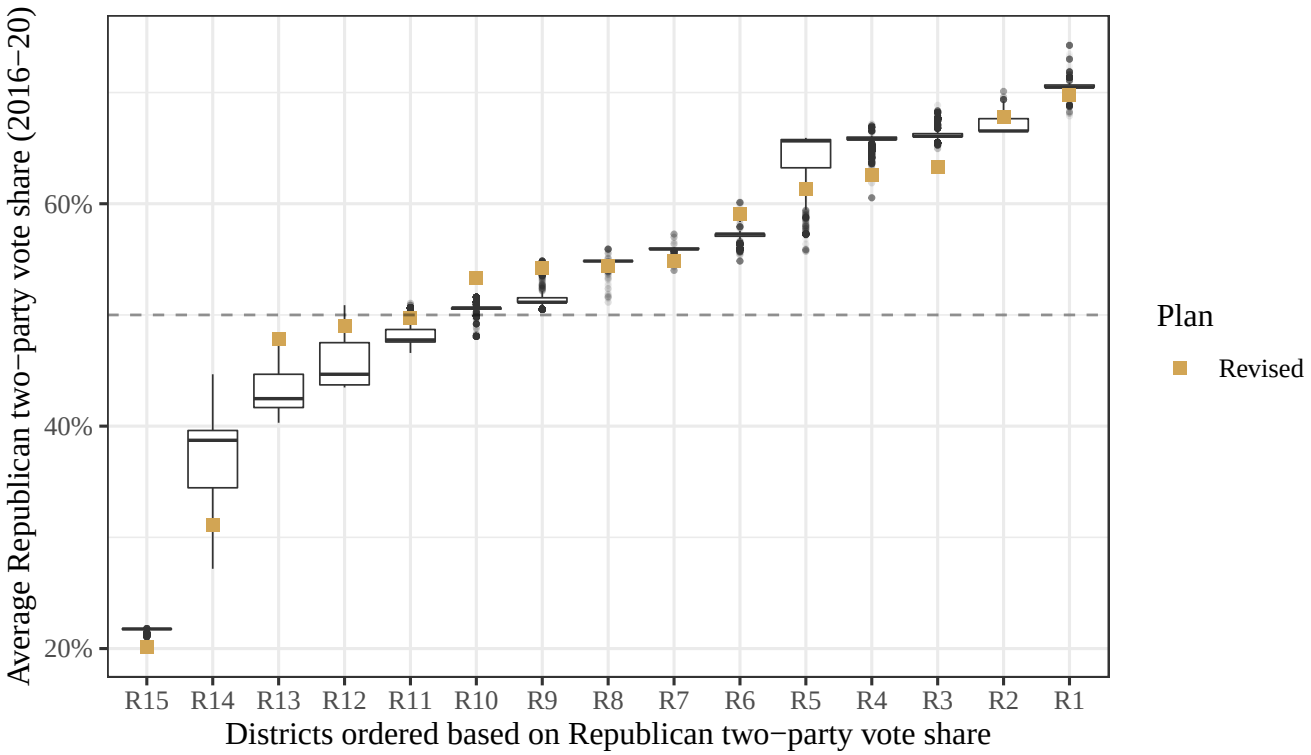

Figure 1: Expected Republican vote share for districts using the statewide elections from 2016 to 2020. For any given plan, the districts are ordered based on their expected Republican vote share. Boxplots represent the distribution of the expected Republican vote share across the simulated plans, whereas the orange square correponds to the expected Republican vote share under the revised plan.

IV. OUTLIER ANALYSIS

6. I evaluate the partisan bias of the revised plan by comparing its district-level vote shares against those under my 5,000 simulated plans. In Figure 1, for any given plan (revised or simulated), I ordered the districts based on the magnitude of their expected Republican vote share. This means that under any given plan, district R1 yields the highest expected vote share while district R15 is expected to give the least support to the Republican candidate (to be clear, the R1 through R15 district identifiers do not correspond to the Congressional district numbers in the revised or enacted plan). If the expected Republican vote share of each ordered district under the revised plan (red square) diverges from the corresponding distribution of the simulated plans (boxplot), it constitutes evidence of possible partisan bias. Note that in a boxplot, the "box"

contains 50% of the data points (those from 25 percentile to 75 percentile to be exact) with the horizontal line indicating the median value whereas the vertical lines coming out of the box, called "whiskers", indicate the range, which contains most data. Any data points that are beyond these whiskers are considered as outliers according to the most common definition, which was also used in my initial report.[1]

7. The figure shows clear evidence that the revised plan favors the Republican party. For all of my 5,000 simulated plans, districts R9 and R10 (the 9th and 10th most Republican-leaning districts, respectively) slightly lean toward the Republican party with narrow margins. The expected median Republican vote shares for these districts are equal to 51.1% and 50.6%, respectively. In other words, they are toss-up districts under the simulated plans. Yet under the revised plan, both of these districts are safely Republican with the expected Republican vote shares equal to 54.2% and 53.3%. According to the aforementioned definition, these two points associated with the revised plan are clear statistical outliers, with the vote shares of district R9 and R10 under the revised plan being 3.4 and 5.5 standard deviations away from the simulation median, respectively.

8. Furthermore, under the revised plan, districts R11, R12, and R13 lean much less strongly towards the Democratic party than under a vast majority of the simulated plans. For example, the expected median Republican vote share for R11 under the simulated plans is 47.8%. In other words, this district strongly leans towards the Democratic party under the simulated plans. Under the revised plan, however, it becomes a toss-up district. Its expected Republican vote share is 49.7%, which is 1.9 percentage points (or 1.9 standard deviations) higher than the simulation median. Indeed, 86.6% of my 5,000 simulated plans have a lower expected Republican vote share for R11 than the revised plan.

9. Similarly, the expected median Republican vote shares for R12 and R13 are 44.7% and 42.5%, respectively, under my simulated plans, implying that these are safe Democratic dis-

1. According to this definition (Tukey, John W. 1977. *Exploratory Data Analysis*. Pearson), an outlier represents a data point that is beyond a distance of 1.5 interquartile range (IQR) below the first quartile or above the third quartile. If the data based on the simulated plans were normally distributed, the revised plan is regarded as an outlier if it is at least 2.70 standard deviations away from the average simulated plan.

tricts. Under the revised plan, however, the expected vote shares for R12 and R13 are 49.0% and 47.8%, respectively, which are 4.3 and 5.3 percentage points (or 2.8 and 3.5 standard deviations) higher than the corresponding simulation median. That is, the Democratic advantages of these districts are substantially reduced under the revised plan. Indeed, for these two districts, less than 0.25% of my 5,000 simulated plans yield as high levels of expected Republican vote share as the revised plan.

10. Lastly, the revised plan packs Democratic voters in districts R14 and R15, which are the two most Democratic-leaning districts. This is indicated by the fact that these districts have much lower levels of expected Republican vote shares under the revised plan than under the simulated plans. In contrast, the revised plan avoids packing Republican voters in the five safest Republican districts (districts R1 to R5). Indeed, R3, R4, and R5 have much lower levels of expected Republican vote shares under the revised plan than under the simulated plans. The expected Republican vote shares for districts R3 and R4 are also statistical outliers, which are 5.0 and 5.1 standard deviations away from the simulation median, respectively.

11. In sum, my outlier analysis shows that the revised plan clearly favors the Republican party in comparison with my 5,000 simulated plans. The revised plan does so by turning Democratic-leaning districts into toss-up districts while making slightly Republican-leaning districts into safe Republican districts.

V. LOCAL ANALYSIS

12. Next, as done in my initial report, I conduct a detailed analysis of the Congressional districts in Hamilton and Franklin Counties. I show that the partisan bias of the revised plan identified in my outlier analysis above originates in these districts. In Hamilton County, the revised plan cracks Democratic voters into Districts 1 and 8, substantially reducing the Democratic advantage of District 1. In Franklin County, the revised plan packs Democratic voters into District 3, increasing the Republican advantage of the surrounding districts.

13. My analysis of each county proceeds as follows. For each precinct, I first compute the expected two-party vote share of the district to which the precinct is assigned under the revised

plan. I then perform the same calculation under each simulated plan and average these expected vote shares across all of the simulated plans. Comparison of these two numbers reveals whether the revised plan assigns a precinct to a district whose political leaning is different from what would be expected under the simulated plans.

A. Hamilton County

14. I begin by illustrating the above calculation through an example. Precinct 061031BEZ of Cincinnati lies within District 1 of the revised map, which has an expected Republican two-party vote share of 49.00%. The same precinct, however, belongs to different districts in most of the simulated maps, each with their own Republican vote share. The average Republican vote share for the districts to which this precinct is assigned across all of the simulated plans is 44.42%, which is 5.48 percentage points lower than under the revised plan. So, based on the representative set of simulated plans that have less partisan bias, precinct 061031BEZ is assigned to a more Republican-leaning district under the revised plan than under the average simulation plan.

15. The left map of Figure 2 presents the expected vote shares of districts under the revised plan, while the right map shows, for each precinct, the average expected two-party vote share of districts to which the precinct is assigned across the simulated plans. Under the revised plan, Democratic areas are cracked to yield two Republican-leaning districts and one highly competitive district, despite a significant concentration of Democratic voters in and around Cincinnati. As the right figure indicates, a large part of the area north of the city of Cincinnati, which is part of District 8 under the revised plan, would normally be expected to belong to a safe Democratic district. Because the revised plan lumps it with District 8, this area instead belongs to safely Republican districts.

16. Similarly, voters in Cincinnati would normally be expected to belong to a strongly Democratic-leaning district under the simulated plans, as indicated by its darker blue color in the right map. The unusual pairing of Hamilton and Warren counties in the revised plan's District 1, however, makes these voters part of a much less Democratic-leaning district.

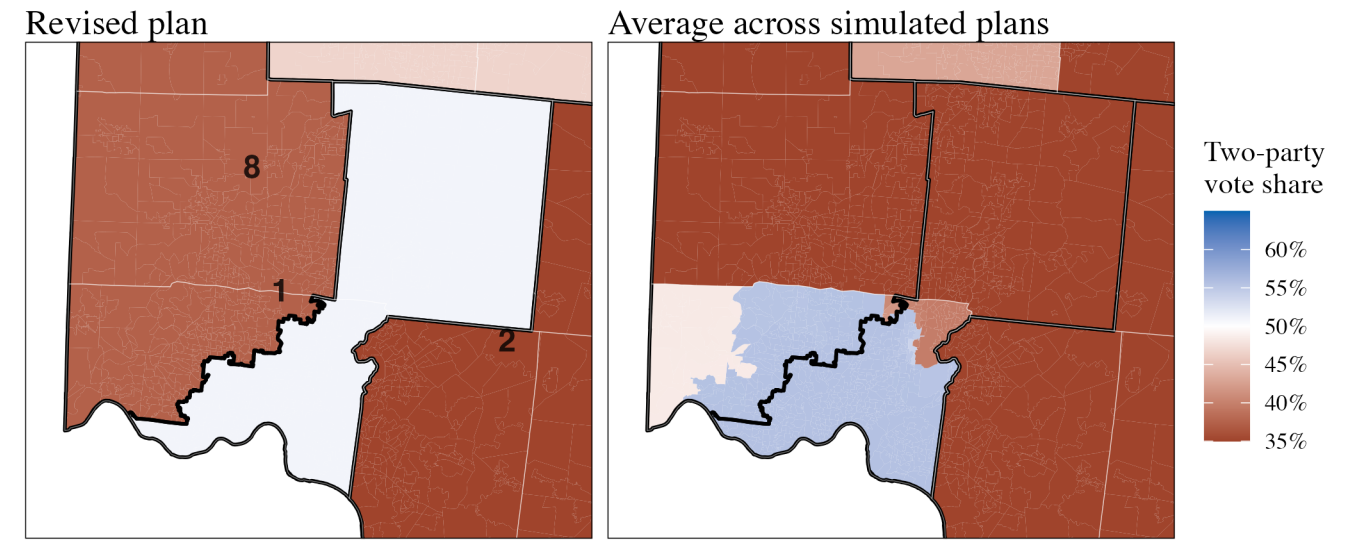

Figure 2: Congressional districts in Hamilton County. The left map presents the expected two-party vote shares of districts under the revised plan, while the right map shows, for each precinct, the average expected two-party vote share of districts to which the precinct is assigned across the simulated plans. The revised plan's district boundaries are shown with thick black lines. While under the simulated plans, Cincinnati and its environs are expected to belong to a safe Democratic-leaning district, the revised plan cracks Democratic voters, resulting in a toss-up district.

17. As a result of these manipulations and additional splits of Hamilton County, the revised plan has no safe Democratic seats under the average statewide contest, whereas the simulated plans are expected to yield a relatively safe Democratic seat. In sum, in Hamilton County, the revised plan turns one safe Democratic district into a toss-up district by cracking Democratic voters.

B. Franklin County

18. Analogous to the above analysis of Hamilton county, Figure 3 compares the revised plan with the average across the simulated plans in Franklin County. In this county, the revised plan packs Democratic voters into a single, heavily Democratic, District 3, leaving Districts 4, 12, and 15 to be safely Republican. Much of the area inside Franklin County belongs to District 15, which is a safe Republican district, under the revised plan. In contrast, under the simulated plans, the entire area of Franklin County is expected to belong to a Democratic-leaning district, as is

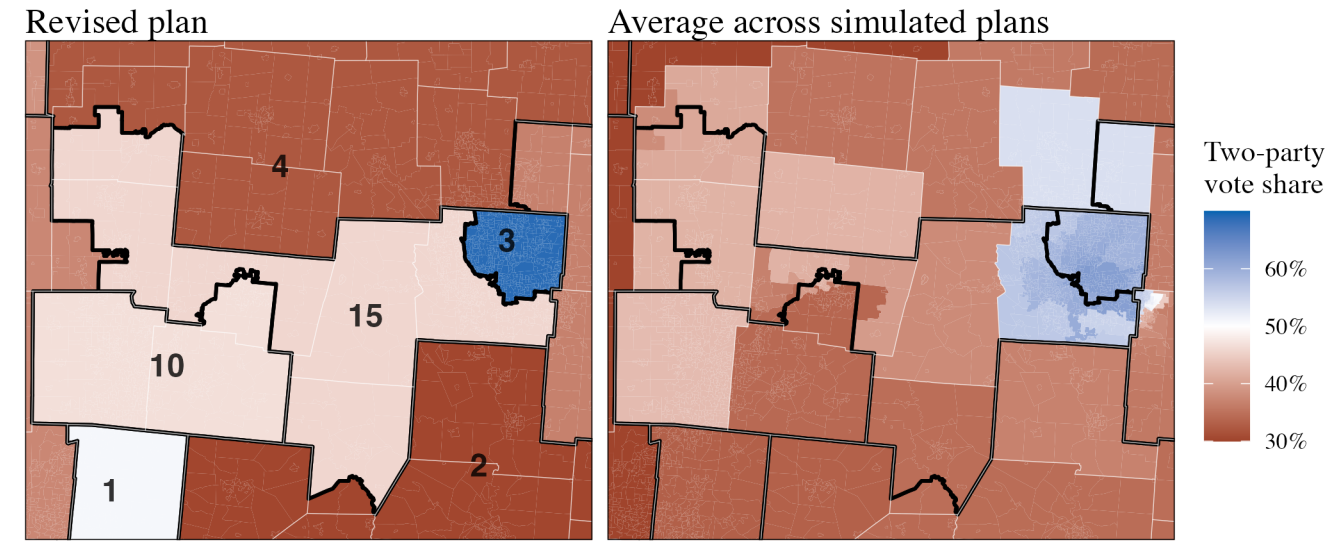

Figure 3: Congressional districts in Franklin County. The left map presents the expected two-party vote shares of districts under the revised plan, while the right map shows, for each precinct, the average expected two-party vote share of districts to which the precinct is assigned across the simulated plans. The revised plan's district boundaries are shown with thick black lines. While under the simulated plans, all of Franklin County are expected to belong to a Democratic district, the revised plan packs Democratic voters, leaving much of the city of Columbus in a Republican district stretching most of the way to Cincinnati.

Delaware County and part of Fairfield County.

19. In other words, the revised plan packs Democratic voters into District 3 and sub-merges the Democratic voters in the rest of Franklin County into District 15 that stretches out to the west. By doing so, the revised plan creates a safe Republican district and deprives Democratic voters in the rest of the county of a reasonable opportunity to elect a Democratic candidate.

VI. COMPACTNESS ANALYSIS

20. The signs of partisan biases in Hamilton and Franklin Counties under the revised plan manifest as highly non-compact districts in these counties. I analyze the compactness of two relevant districts, Districts 1 and 15 of the revised plan, by comparing them with the average compactness under my simulated plans. My analysis shows that these two districts are highly non-compact in comparison to the corresponding districts in my simulated plans.

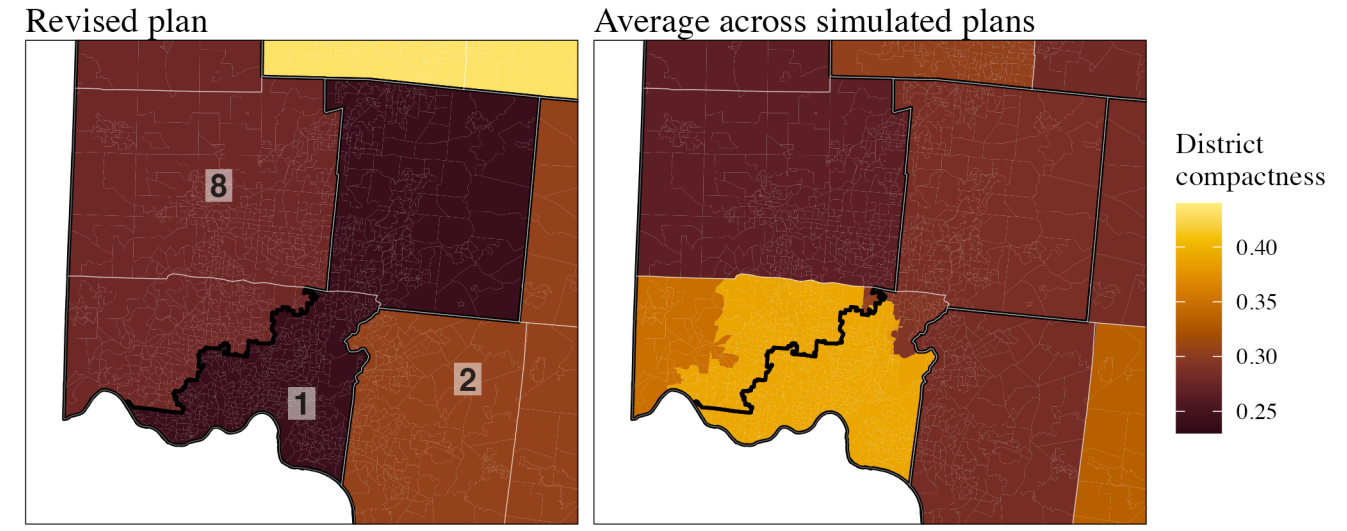

Figure 4: Compactness of District 1 under the Revised Plan. The left map presents the Polsby-Popper compactness score of each district under the revised plan, while the right map shows, for each precinct, the average compactness of districts to which the precinct is assigned across the simulated plans. The revised plan's district boundaries are shown with thick black lines. District 1 is highly non-compact as indicated by a dark color while under the simulated plans the precincts of District 1 are expected to belong to much more compact districts as indicated by a much lighter color.

A. District 1 of the Revised Plan

21. The left map of Figure 4 shows the compactness of District 1 under the revised plan. This district combines part of Cincinnati and its environs with Warren County, resulting in a highly non-compact shape with the Polsby-Popper compactness score of 0.241. In contrast, as shown in the right map of the figure, the simulated plans on average assign the precincts of District 1 to much more compact districts. In particular, because a majority of my simulated plans keep Cincinnati and its environs in the same district, these areas are expected to belong to a more compact district (indicated by a lighter color). In fact, the average district compactness score for these precincts under the simulated plans is 0.341, which is 42% higher than the compactness score of District 1 under the revised plan.

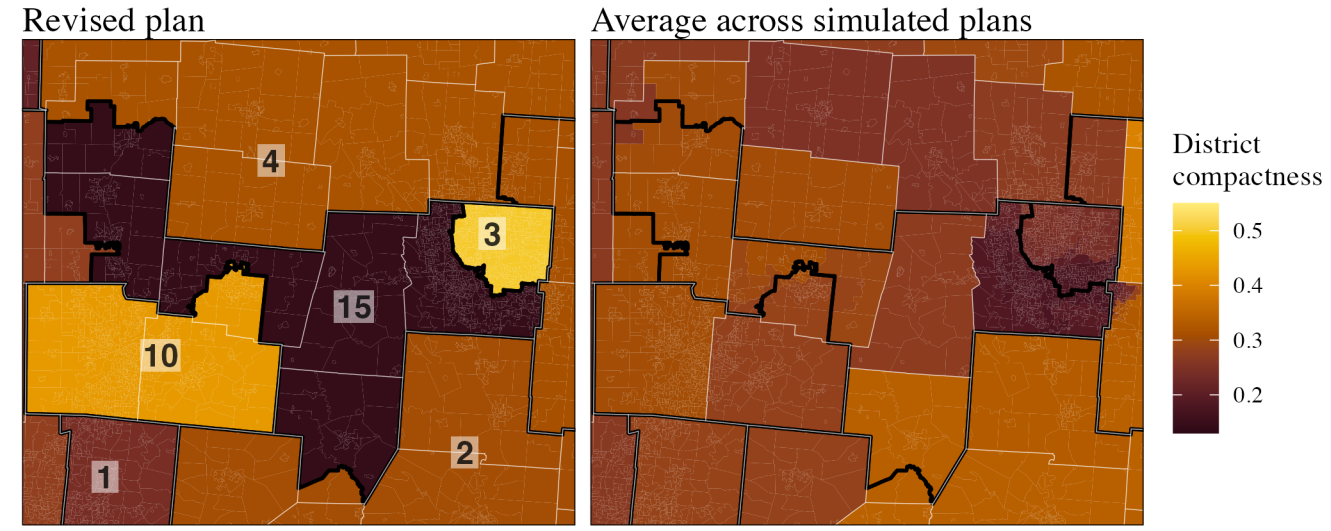

Figure 5: Compactness of District 15 under the Revised Plan. The left map presents the Polsby-Popper compactness score of each district under the revised plan, while the right map shows, for each precinct, the average compactness of districts to which the precinct is assigned across the simulated plans. The revised plan's district boundaries are shown with thick black lines. District 15 is highly non-compact as indicated by a dark color while under the simulated plans the precincts of District 15 are expected to belong to much more compact districts as indicated by a much lighter color.

B. District 15 of the Revised Plan

22. The left map of Figure 5 shows the compactness of District 15 under the revised plan. This district combines part of Columbus and its environs with Madison County and extends into five other counties in the west. As a result, the district splits a total of five counties and has a highly non-compact shape with the Polsby-Popper compactness score of 0.144, the lowest of all fifteen districts under the revised plan (though District 3 that packs Democratic voters of Columbus is highly compact). In contrast, as shown in the right map of the figure, the simulated plans on average assign the precincts of District 15 to much more compact districts (indicated by a lighter color). In fact, the average district compactness score for these precincts under the simulated plans is 0.224, which is 56% higher than the compactness score of District 15 under the revised plan.

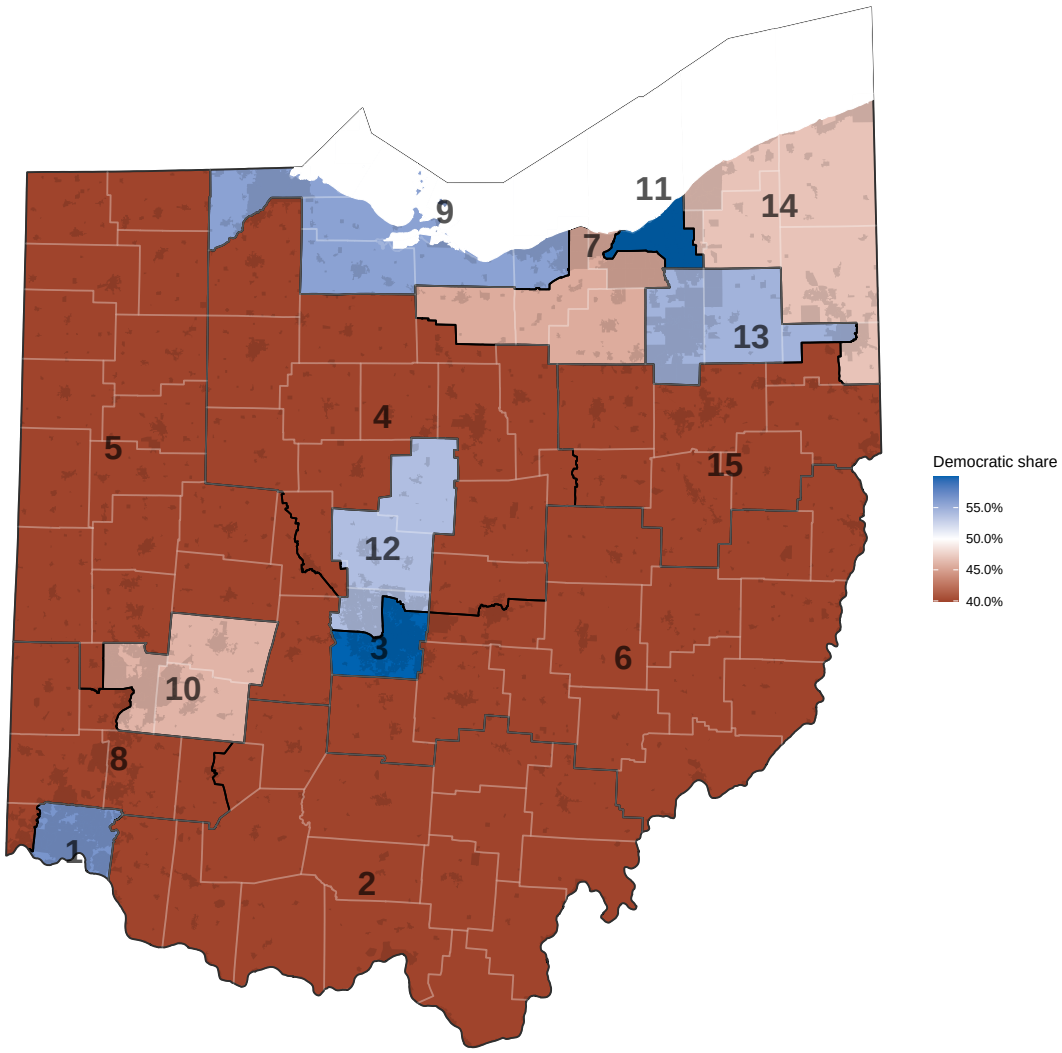

Figure 6: Example Congressional Plan Submitted to the Ohio Redistricting Commission on February 22, 2022.

VII. EXAMPLE PLAN

23. On February 22, 2022, I submitted an example plan (hereafter "example plan") that is more compliant with Article XIX of the Ohio constitution than the enacted plan. This example plan, shown in Figure 6, demonstrates that it is possible to generate a redistricting plan, which is free of the partisan bias and compactness problems while complying with the other redistricting requirements of the Ohio Constitution.

24. One important difference between the example plan and the revised plan is how Hamilton County is treated. Under the example plan, District 1 is wholly contained in Hamilton County without spilling into Warren County as done in the revised plan. As a result, District 1 does not cross a county line and is much more compact under the example plan (Polsby-Popper compactness score of 0.474) than under the revised plan (compactness score of 0.241). Unlike the revised plan, which cracks Democratic voters in Cincinnati and its northern environs into two districts (Districts 1 and 8), the example plan keeps these areas together in a single compact district (District 1). This makes District 1 a safer Democratic district under the example plan (Democratic vote share of 56.3%) than under the revised plan (Democratic vote share of 51.0%).

25. Another key difference lies in Franklin County. Under the example plan, this county is split into two districts. District 3 contains the southern part of Franklin County while the northern part of the county is included in District 12. This way of splitting Franklin County is consistent with a majority of my simulated plans and avoids creating a highly non-compact district. The revised plan's decision to spill into Madison County rather than Delaware County led to the creation of District 15, which splits five counties and has an extremely low compactness score of 0.144. In contrast, District 12 of the example plan is much more compact with a compactness score of 0.250. The partisan implication of this difference is clear. Under the example plan, both Districts 3 and 12 are Democratic-leaning with Democratic vote shares of 65.7% and 53.7%, respectively, whereas the revised plan ends up with one packed Democratic district (District 3 with the Democratic vote share of 68.9%) and one safe Republican district (District 15 with the Democratic vote share of 45.8%).

26. Beyond these two key differences, the example plan is much more compact than the revised plan. Indeed, the example plan is even more compact than the simulated plans (see Appendix A). The example plan also has fewer county splits than the revised plan (see Appendix B).

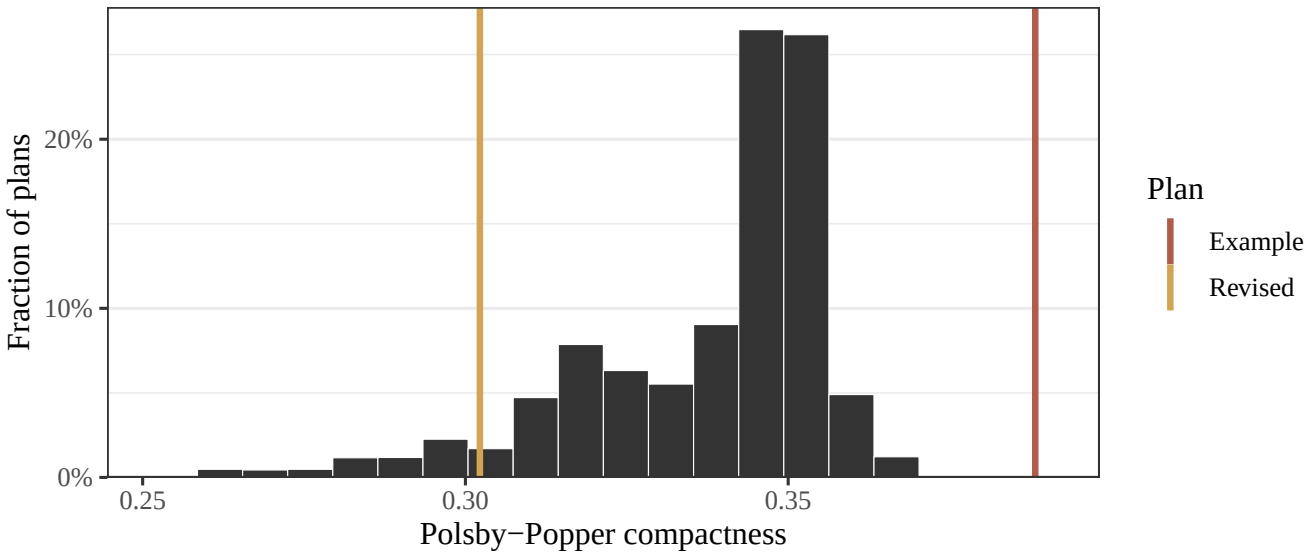

Figure 7: Polsby–Popper compactness scores for the simulated redistricting plans. Overlaid are scores for the revised plan (orange) and example plan (red). Larger values indicate more compact districts.

VIII. APPENDIX

A. Compactness of the Revised, Simulated and Example Plans

1. In this appendix, I show that the simulated plans are more compliant with Section 2(B)(2), which requires districts to be compact, than the revised plan. I also show that the example plan is more compact than either the revised plan or simulated plans. I use the Polsby–Popper score, a commonly-used quantitative measures of district compactness. Figure 7 shows that a vast majority (roughly 93%) of the simulated plans are more compact than the revised plan according to the Polsby–Popper score. Moreover, the example plan is more compact than any of the simulated plans. The result clearly implies that it is possible to be compliant with Section 1(C)(3)(a) without sacrificing compliance with Section 2(B)(2).

B. County Splits of the Revised, Simulated and Example Plans

2. Similar to compactness, it is possible to be compliant with Section 1(C)(3)(a) without splitting counties more than the revised plan. The left plot of Figure 8 shows that the number of counties split once is much less under any of the simulated plans than under the revised plan. The bulk of the simulated plans, as well as the revised plan, do not split any counties twice. As a

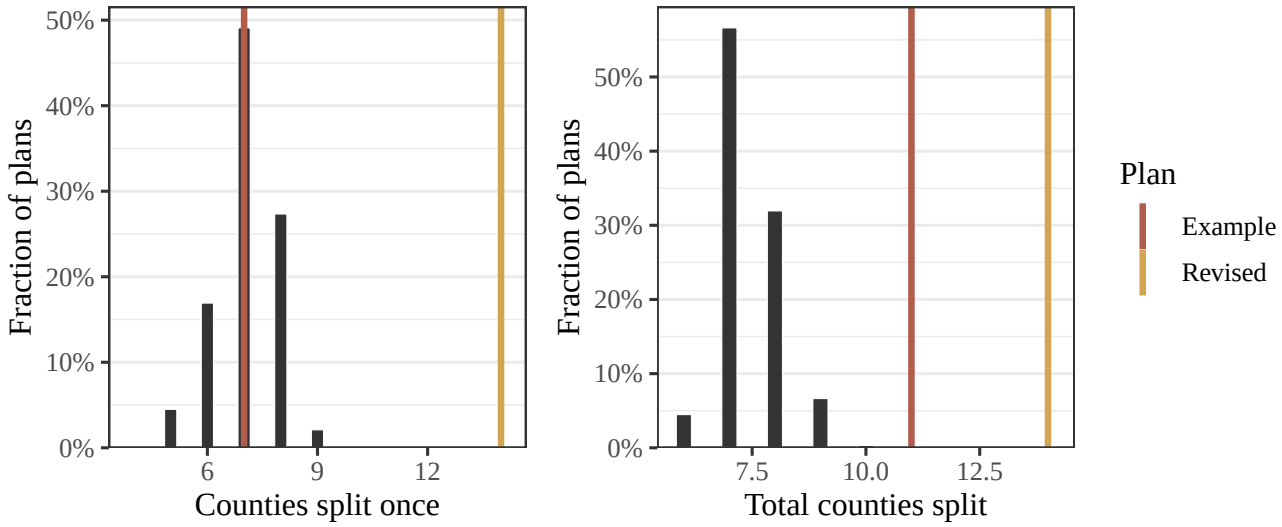

Figure 8: The number of county splits for the simulated redistricting plans. Overlaid are the scores for the revised plan (orange) and example plan (red). The left plot shows the number of counties that are split once under each plan, whereas the right plot shows the number of counties that are split either once or twice. No county is split more than twice under the revised plan, the example plan, or any of the simulated plans.

result, the total number of counties split under the revised plan is much greater than that under any of the simulated plans, and is also greater than the total number of counties split under my example plan (see the right plot of the figure).

Neiman Petitioners' Exhibit 32

IN THE SUPREME COURT OF OHIO

LEAGUE OF WOMEN VOTERS OF OHIO, *et al.*, ***Petitioners,*** ***v.*** **OHIO REDISTRICTING COMMISSION, *et al.*,** ***Respondents.***	**Case No. 2021-1449** **Original Action Filed Pursuant to Ohio Const., art. XIX, Sec. 3(A)**

EVIDENCE TO MOTION TO ENFORCE COURT'S ORDER
(Affidavit of Dr. Christopher Warshaw)

Freda J. Levenson (0045916)
Counsel of Record
ACLU OF OHIO FOUNDATION, INC.
4506 Chester Avenue
Cleveland, Ohio 44103
(614) 586-1972 x125
flevenson@acluohio.org

David J. Carey (0088787)
ACLU OF OHIO FOUNDATION, INC.
1108 City Park Avenue, Suite 203
Columbus, Ohio 43206
(614) 586-1972 x2004
dcarey@acluohio.org

Alora Thomas (PHV 22010-2022)*
Julie A. Ebenstein (PHV 25423-2022)
AMERICAN CIVIL LIBERTIES UNION
125 Broad Street
New York, New York 10004
(212) 519-7866
athomas@aclu.org

Robert D. Fram (PHV 25414-2022)
Donald Brown (PHV 25480-2022)
David Denuyl (PHV 25452-2022)

Dave Yost
OHIO ATTORNEY GENERAL

Bridget C. Coontz (0072919)
Julie M. Pfeiffer (0069762)
Michael A. Walton (0092201)
Assistant Attorneys General
Constitutional Offices Section
30 E. Broad Street, 16th Floor
Columbus, Ohio 43215
(614) 466-2872
bridget.coontz@ohioago.gov

Counsel for Respondent Ohio Secretary of State LaRose

Phillip J. Strach
Thomas A. Farr
John E. Branch, III
Alyssa M. Riggins
NELSON MULLINS RILEY & SCARBOROUGH, LLP
4140 Parklake Ave., Suite 200
Raleigh, North Carolina 27612
(919) 329-3812
phil.strach@nelsonmullins.com

Joshua González (PHV 25424-2022)
Juliana Goldrosen (PHV 25193-2022)
COVINGTON & BURLING, LLP
Salesforce Tower
415 Mission Street, Suite 5400
San Francisco, California 94105
(415) 591-6000
rfram@cov.com

James M. Smith (PHV 25421-2022)
Sarah Suwanda (PHV 25602-2022)
Alex Thomson (PHV 25462-2022)
COVINGTON & BURLING, LLP
One CityCenter
850 Tenth Street, NW
Washington, District of Columbia 20001
(202) 662-6000
jmsmith@cov.com

Anupam Sharma (PHV 25418-2022)
Yale Fu (PHV 25419-2022)
COVINGTON & BURLING, LLP
3000 El Camino Real
5 Palo Alto Square, 10th Floor
Palo Alto, California 94306
(650) 632-4700
asharma@cov.com

Counsel for Petitioners

** Pro hac vice application forthcoming*

W. Stuart Dornette (0002955)
Beth A. Bryan (0082076)
Philip D. Williamson (0097174)
TAFT STETTINUS & HOLLISTER, LLP
425 Walnut St., Suite 1800
Cincinnati, OH 45202
(513) 381-2838
dornette@taftlaw.com

Counsel for Respondents House Speaker Robert R. Cupp and Senate President Matt Huffman

Warshaw Affidavit.pdf

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E-Signature 1: Christopher Warshaw (CSW)
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warshaw@email.gwu.edu (Principal) (Personally Known)

E-Signature Notary: Theresa M Sabo (TMS)
March 06, 2022 17:09:34 -8:00 [56BE908CE6AF] [96.27.183.41]
tess.sabo@gmail.com
I, Theresa M Sabo, did witness the participants named above electronically sign this document.

IN THE SUPREME COURT OF OHIO

LEAGUE OF WOMEN VOTERS OF OHIO, et al.,	
Petitioners	**Case No. 2021-1449**
v.	**Original Action Pursuant to Ohio Const., Art. XI**
OHIO REDISTRICTING COMMISSION, et al.,	
Respondents.	

AFFIDAVIT OF CHRISTOPHER WARSHAW

Franklin County
/ss
State of Ohio

Now comes affiant Christopher Warshaw, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and fully competent to make this declaration. I have personal knowledge of the statements and facts contained herein.
2. For the purposes of this litigation, I have been asked by counsel for Relators to analyze relevant data and provide my expert opinions.
3. To that end, I have personally prepared the report attached to this affidavit as Exhibit A, and swear to its authenticity and to the faithfulness of the opinions expressed and, to the best of my knowledge, the accuracy of the factual statements made therein.

FURTHER AFFIANT SAYETH NAUGHT.

Executed on 03/06/2022, 2022.

Christopher Warshaw
Signed on 2022/03/06 17:09:34 -8:00

Christopher Warshaw

Sworn and subscribed before me this 03/06/2022 day of _____, 2022.

Theresa M Sabo
Signed on 2022/03/06 17:09:34 -8:00

Notary Public

Theresa M Sabo
Commission # 2016-RE-619622
Electronic Notary Public
State of Ohio
My Comm Exp. Nov 28, 2026

Notary Stamp 2022/03/06 18:09:34 PST 56BE908CE6AF

Notarial act performed by audio-visual communication

EXHIBIT A

An Evaluation of the Partisan Bias in Ohio's Enacted March 2, 2022 Congressional Districting Plan

Christopher Warshaw*

March 6, 2022

*Associate Professor, Department of Political Science, George Washington University. warshaw@gwu.edu. Note that the analyses and views in this report are my own, and do not represent the views of George Washington University.

Contents

1 Introduction

My name is Christopher Warshaw. I am an Associate Professor of Political Science at George Washington University. Previously, I was an Associate Professor at the Massachusetts Institute of Technology from July 2016 - July 2017, and an Assistant Professor at MIT from July 2012 - July 2016.

I have been asked by counsel representing the relators in this case to analyze relevant data and provide my expert opinions about whether Ohio's enacted congressional districting plan meets the requirement in Article XIX.01, Section 3(A) of Ohio's Constitution that "If the general assembly passes a congressional district plan under division (C)(1) of this section by a simple majority of the members of each house of the general assembly, and not by the vote described in division (C)(2) of this section", then "The general assembly shall not pass a plan that unduly favors or disfavors a political party or its incumbents."

2 Qualifications, Publications and Compensation

My Ph.D. is in Political Science, from Stanford University, where my graduate training included courses in political science and statistics. I also have a J.D. from Stanford Law School. My academic research focuses on public opinion, representation, elections, and polarization in American Politics. I have written over 20 peer reviewed papers on these topics. Moreover, I have written multiple papers that focus on elections and two articles that focus specifically on partisan gerrymandering. I also have a forthcoming book that includes an extensive analysis on the causes and consequences of partisan gerrymandering in state governments.

My curriculum vitae is attached to this report. All publications that I have authored and published appear in my curriculum vitae. My work is published or forthcoming in peer-reviewed journals such as: the *American Political Science Review*, the *American Journal of Political Science*, the *Journal of Politics*, *Political Analysis*, *Political Science Research and Methods*, the *British Journal of Political Science*, the *Annual Review of Political Science*, *Political Behavior*, *Legislative Studies Quarterly*, *Science Advances*, the *Election Law Journal*, *Nature Energy*, *Public Choice*, and edited volumes from Cambridge University Press and Oxford University Press. My book entitled *Dynamic Democracy in the American States* is forthcoming from the University of Chicago Press. My non-academic writing has been published in the *New York Times* and the *Washington Post*. My work has also been discussed in the *Economist* and many other prominent media

outlets.

My opinions in this case are based on the knowledge I have amassed over my education, training and experience, including a detailed review of the relevant academic literature. They also follow from statistical analysis of the following data:

- In order to calculate partisan bias in congressional elections on the enacted, March 2 plan in Ohio, I examined:
  - GIS Files with the 2012-2020 Ohio Congressional plan and the enacted plan): I obtained the 2012-2020 plan from the state website, the original plan from Counsel in this case, and the March 2 enacted plan from the Ohio Redistricting Commission's website
  - Precinct-level data on recent statewide Ohio elections: I use precinct-level data on Ohio's statewide elections between 2016-20 from the Voting and Election Science Team (University of Florida, Wichita State University). I obtained these data from the Harvard Dataverse.[1]
  - Precinct-level data on recent statewide Ohio elections: I use a GIS file with precinct-level data on the results of the 2020 congressional elections in Ohio that I obtained from Counsel in this case.
  - The PlanScore website: PlanScore is a project of the nonpartisan Campaign Legal Center (CLC) that enables people to score proposed maps for their partisan, demographic, racial, and geometric features. I am on the social science advisory team for PlanScore.
- In order to compare the maps in Ohio to other congressional elections across the nation over the past five decades, I examined:
  - A large data set on candidacies and results in Congressional elections: I obtained results from 1972-2018 collected by the Constituency-Level Elections Archive (CLEA) (Kollman et al. 2017). The results from 1972-1990 are based on data collected and maintained by the Inter-university Consortium for Political and Social Research (ICPSR) and adjusted by CLEA. The data from 1992-2018 are based on data collected by CLEA from the Office of the Clerk at the House of the Representatives. I supplemented this dataset with recent election results collected by the MIT Election and Data Science Lab (MIT Election and Data Science Lab 2017) and Dave Leip's Atlas of U.S. Presidential Elections.

1. See `https://dataverse.harvard.edu/dataverse/electionscience`.

- Data on presidential election returns and incumbency status in Congressional elections. I used data on elections in congressional districts from 1972-2020 collected by Professor Gary Jacobson (University of California, San Diego). This dataset has been used in many Political Science studies and has canonical status in the Political Science profession (Jacobson 2015).
- Information on who controlled each redistricting plan in Congressional elections (e.g., Democrats, Republicans, or a Commission) from 1972-2012 assembled by the Brennan Center (Brennan Center 2017).
- I imputed vote shares and turnout in uncontested districts and then calculated the partisan bias metrics described on pp. 6-14 of this report using the methodology described in Stephanopoulos and Warshaw (2020).

I have previously provided expert reports in this case, as well as six other redistricting-related cases and several Census-related cases (see my CV for a current list). I am being compensated at a rate of $325 per hour. The opinions in this report are my own, and do not represent the views of George Washington University.

3 Summary

This report examines whether the Ohio Redistricting Commission's March 2 plan meets the criteria in the Ohio Constitution. Article XIX.01, Section 3(A) of Ohio's Constitution requires that "If the general assembly passes a congressional district plan under division (C)(1) of this section by a simple majority of the members of each house of the general assembly, and not by the vote described in division (C)(2) of this section", then "The general assembly shall not pass a plan that unduly favors or disfavors a political party or its incumbents."

Ohio's Constitutional criteria, which require that congressional districting plans passed without bipartisan support not unduly favor or disfavor a political party, are related to a long-line of Political Science literature on partisan gerrymandering and democratic representation. The relationship between the distribution of partisan support in the electorate and the partisan composition of the government—what Powell (2004) calls "vote–seat representation"—is a critical link in the longer representational chain between citizens' preferences and governments' policies. If the relationship between votes and seats systematically advantages one party over another, then some citizens will enjoy more influence—more "voice"—over elections and political outcomes than others (Caughey, Tausanovitch, and Warshaw 2017).

I use three complementary methodologies to project future election results in order to evaluate whether Ohio's newly enacted, March 2 Congressional map meets the requirements of Article XIX.01, Section 3(A) in its Constitution. First, I analyze the results of the 2020 Congressional election on the newly enacted, March 2 map. Second, I use a composite of previous statewide election results between 2016-2020 to analyze the new map.[2] Third, I complement this approach using the open source PlanScore.org website, which is a project of the Campaign Legal Center.[3] PlanScore uses a statistical model to estimate district-level vote shares for a new map based on the relationship between presidential election results and legislative results between 2012-2020.[4] Based on these three approaches, I characterize the bias in Ohio's plans based on a large set of established metrics of partisan fairness. I also place the bias in Ohio's plans into historical perspective. Finally, I analyze the compactness of the districts in the enacted plan.

All of these analyses indicate an extreme level of pro-Republican bias in Ohio's enacted, March 2 Congressional plan. There are 10 strongly Republican districts, 2 strongly Democratic districts, and 3 potentially competitive districts, two of which lean toward Republicans. In the average election, Republicans are likely to get about 55% of the statewide vote and about 75-80% of the seats in Ohio's congressional delegation. Thus, the plan clearly unduly favors the Republican party. Moreover, it favors Republicans nearly as much as the Commission's initial, enacted plan did.

In the actual 2020 congressional election, Democrats received 43% of the two-party vote (and Republicans 57%), but Democrats only won 25% (4) of the seats (and Republicans won 75%). This was already one of the most extreme partisan gerrymanders of a congressional map in modern history (See *APRI et al.* v. *Smith et al.*, No. 18-cv-357 (S.D. Ohio)). Based on the congressional election results, the new plan is just as extreme. On the new map, Democrats would only win 20% (3) of the seats using the precinct-level results of the 2020 congressional election while Republicans would win 80% (12) of the seats.

The new plan also displays an extreme level of partisan bias when I evaluate it based on the results of recent statewide elections. In the 2020 presidential election, Democrat Joe Biden received about 46% of the two-party vote.[5] However, he would have only won 27% (4) of the Congressional districts under the March 2 plan. In the 2018 gubernatorial

2. These include the following elections: 2016 Presidential, 2016 Senate, 2018 Senate, 2018 gubernatorial, 2018 attorney's general, 2018 Secretary of State, 2018 Auditor, 2018 Treasurer, and 2020 Presidential.

3. I am on the social science advisory board of Plan Score, but do not have any role in PlanScore's evaluation of individual maps.

4. See `https://planscore.campaignlegal.org/models/data/2021D/` for more details.

5. Following standard convention, throughout my analysis I focus on two-party vote shares.

election, Democrat Richard Cordray did a little bit better. He received about 48% of the two-party vote. Yet again, however, he would have only won 33% of the districts under the enacted, March 2 plan. In the 2016 presidential election, Democrat Hillary Clinton received about 46% of the two-party vote. But she would too have only won 27% of the revised plan's seats.

Based on all the available statewide elections in Ohio between 2016-2020, I find that the enacted, March 2 Congressional plan leads to a much higher Republican share of the seats than their share of the statewide vote. Indeed, across all statewide elections during this period, the Democrats' statewide two-party vote share averaged about 45% of the vote, but they are only likely to win about 28% of the seats.[6]

I reach the same conclusion using the predictive model on the PlanScore website. It indicates that the enacted, March 2 plan favors Republican candidates in 97% of scenarios. Even though Republicans only get about 56% of the statewide vote in recent elections (and Democrats get 44%), PlanScore analysis indicates that Republicans are expected to win 76% of the seats in Ohio's Congressional delegation (and Democrats would win 24% of the seats).[7] Based on generally accepted Political Science metrics (the Efficiency Gap and the Declination), PlanScore indicates that Ohio's enacted, March 2 plan would have historically extreme levels of pro-Republican bias. In fact, the pro-Republican bias in Ohio's Congressional plan is larger than 96% of previous plans in the United States from 1972-2020.

Overall, this analysis indicates that the Commission's plan unduly favors the Republican party. This conclusion is based on a wide variety of approaches to project future election results and to estimate the partisan bias of the plan. Regardless of the approach I use, it is clear that the map has an extreme level of bias in favor of the Republican party. Moreover, the March 2 plan is almost as biased in favor of Republicans as the Commission's original, enacted plan that I evaluated in my report on November 30, 2021.

The rest of this report proceeds as follows. First, I provide a brief overview of par-

6. There are a variety of ways we could aggregate previous statewide elections to create a composite index (see the discussion on p. 7-8 of my January 25th report in the parallel case about the constitutionality of the state legislative plans in Ohio). In my main analysis, I weight the composite scores to give each election cycle equal weight in the index. This ensures that the composite index is not overly influenced by whatever election year happens to have the most elections (2018 in the case of Ohio). This is important because much of the uncertainty in projecting future elections comes from variation across electoral cycles rather than across contests within cycles. So, in my view, it is useful to not disproportionately weight the index toward any particular election year. In the appendix, however, I show that I reach similar conclusions using a composite index that weights each statewide contest equally (rather than each year equally).

7. This is a probabilistic estimate based on 1000 simulations of possible elections using a model of the elections between 2012-2020.

tisan gerrymandering and how social scientists measure the degree of partisan bias in a districting plan. I then provide a systematic evaluation of the partisan fairness of Ohio's enacted, March 2 congressional districting plan. Finally, I discuss the compactness of the districts on the Commission's plan.

4 Background on Partisan Gerrymandering

The goal of partisan gerrymandering is to create legislative districts that are as "efficient" as possible in translating a party's vote share into seat share (McGhee 2014, 2017; Caughey, Tausanovitch, and Warshaw 2017). In practice, this entails drawing districts in which the supporters of the advantaged party constitute either a slim majority (e.g., 55% of the two-party vote) or a small minority (e.g., 20%). The former is achieved by "cracking" local opposing-party majorities across multiple districts and the latter by "packing" them into a few overwhelming strongholds. In a "cracked" district, the disadvantaged party narrowly loses, while in a "packed" district, the disadvantaged party wins overwhelmingly (Buzas and Warrington 2021). The resulting *asymmetry* or *advantage* in the efficiency of the vote–seat relationships of the two parties lies at the core of normative critiques of partisan gerrymandering. Asymmetries in the translation of votes to seats "offer a party a means of increasing its margin of control over policy without winning more votes from the public" (McGhee 2014).

In addition to creating a plan that skews the vote-seat curve toward their party, the advantaged party also often seeks to build a map that is *insulated* against changes in the public's preferences. This type of unresponsive map enables the advantaged party to continue to win the majority of seats even in the face of large gains in the disadvantaged party's statewide vote share. It ensures that the gerrymander is durable over multiple election cycles.

There are a number of approaches that have been proposed to measure partisan advantage in a districting plan. These approaches focus on asymmetries in the efficiency of the vote–seat relationships of the two parties. In recent years, at least 10 different approaches have been proposed (McGhee 2017). While no measure is perfect, much of the recent literature has focused on a handful of related approaches that I described in my November 30th report.[8] I utilize these approaches to quantify the partisan fairness of

8. These metrics are described in depth on pp. 6-13 of my November 30, 2021 report on the Commission's original enacted congressional plan. Note that the exact calculation methods for the efficiency gap and declination differ slightly across sources. To calculate the efficiency gap I use the formula:

$$EG = S_D^{margin} - 2 * V_D^{margin} \quad (1)$$

the Commission's enacted congressional plan.

5 Partisan Bias in Ohio's Enacted, March 2 Congressional Map

In this section, I will provide a more systematic evaluation of the partisan fairness of Ohio's enacted, March 2 congressional districting plan (see Figure 1 for a map of the plan). In order to evaluate the enacted plan, we need to predict future election results on this map. Unfortunately, there is no way to know, with certainty, the results of future elections. Thus, I use three complementary methodologies to predict future congressional elections in Ohio and generate the various metrics I discussed earlier. I compare the Commission's March 2 plan to the 2012-2020 plan and the original enacted plan from November.

Figure 1: Map of Enacted, March 2 Congressional Districts from PlanScore.org

5.1 2020 Congressional election results

First, I use the 2020 precinct-level congressional results on both the 2012-20 map and re-aggregated to the enacted, March 2 map to estimate the various metrics. This approach implicitly assumes that future elections will look like the 2020 election. These endogenous elections are likely to be an excellent predictor of future voting patterns in congressional

where S_D^{margin} is the Democratic Party's seat margin (the seat share minus 0.5) and V_D^{margin} is the Democratic Party's vote margin (McGhee 2017, 11-12). I use the declination formula discussed in Warrington (2018, 42).

elections. Based on these results, Republicans would win 57% of the votes, but 80% of the seats on the March 2 plan. In other words, Republicans would win 23 percentage points more seats than votes.

Metric	Value	More Biased than this % Historical Plans	More Pro-Republican than this % Historical Plans
2012-2020 Plan			
Republican Seat Share	75%		
Efficiency Gap	-11%	78%	91%
Declination	-.51	85%	91%
Mean-Median Diff	-4%	57%	78%
Symmetry Bias	-12%	78%	87%
Average		75%	87%
Commission's Original, Enacted Plan			
Republican Seat Share	87%		
Efficiency Gap	-23%	98%	99%
Declination	-.90	97%	97%
Mean-Median Diff	-3%	42%	72%
Symmetry Bias	-10%	69%	83%
Average		77%	88%
Commission's Enacted March 2 Plan			
Republican Seat Share	80%		
Efficiency Gap	-16%	91%	96%
Declination	-.61	92%	95%
Mean-Median Diff	-3%	36%	70%
Symmetry Bias	-17%	91%	93%
Average		77%	89%

Table 1: Partisan bias metrics for Congressional plan based on 2020 Congressional election results re-aggregated onto enacted, March 2 map

The average efficiency gap of the enacted, March 2 plan based on the precinct-level 2020 House results is -16% in a pro-Republican direction (see Table 1). This is more extreme than 91% of previous Congressional plans nationwide over the past five decades (1972-2020) and more pro-Republican than over 96% of previous plans. The plan is more pro-Republican than 95% of prior plans in the country using the declination metric. The other metrics also show that Ohio's enacted, March 2 plan has a large pro-Republican bias. When we average across all four metrics, the plan is more extreme than 77% of previous plans and more pro-Republican than 89% of previous plans (which is nearly identical to the Commission's original, enacted plan).

5.2 Composite of previous statewide elections

Next, I use a composite of previous statewide election results between 2016-2020 re-aggregated to the enacted, March 2 map. For each year, I estimate each party's vote share, seat share, and the average of the partisan bias metrics across races. I then average them together to produce a composite result. This approach implicitly assumes that future voting patterns will look like the average of these recent statewide elections.

		2016-2020 Composite	
Metric	Value	More Biased than this % Historical Plans	More Pro-Republican than this % Historical Plans
2012-2020 Plan			
Republican Seat Share	74%		
Efficiency Gap	-16%	90%	96%
Declination	-.56	89%	93%
Mean-Median Diff	-3%	39%	71%
Symmetry Bias	-17%	91%	93%
Average		77%	88%
Commission's Original, Enacted Plan			
Republican Seat Share	76%		
Efficiency Gap	-18%	93%	97%
Declination	-.59	92%	95%
Mean-Median Diff	-2%	24%	63%
Symmetry Bias	-10%	69%	83%
Average		70%	85%
Commission's Enacted March 2 Plan			
Republican Seat Share	72%		
Efficiency Gap	-14%	86%	94%
Declination	-.44	81%	88%
Mean-Median Diff	-1%	17%	59%
Symmetry	-11%	73%	84%
Average		70%	85%

Table 2: Composite bias metrics for enacted, March 2 Congressional plan based on statewide elections

When I average across these statewide elections from 2016-2020, Democrats win 45% of the votes and 28% of the seats (see Table 2). The average efficiency gap of the enacted, March 2 plan based on these previous election results is -14%. This is more extreme than 86% of previous plans and more pro-Republican than 94% of previous plans. The plan is also more pro-Republican than 88% of previous plans using the declination metric. The mean-median and symmetry also show that Ohio's plan has a substantial pro-Republican bias. When I average across all four metrics, the plan is more extreme than 70% of previous plans and more pro-Republican than 85% of previous plans.[9]

9. In the Appendix, I show that I reach very similar results if I average previous elections across

5.3 PlanScore

Third, I evaluate the enacted, March 2 plan using a predictive model from the PlanScore.org website. PlanScore uses a statistical model of the relationship between districts' latent partisanship and election outcomes. This enables it to estimate district-level vote shares for a new map and the corresponding partisan gerrymandering metrics.[10] It then calculates various partisan bias metrics. In this case, PlanScore provides estimates of the efficiency gap and declination.[11]

PlanScore also indicates that the Congressional plan has a substantial pro-Republican bias (Table 3). According to PlanScore, the enacted, March 2 plan has a pro-Republican efficiency gap of 13%. The plan favors Republicans in 99% of the scenarios estimated by PlanScore.[12] Moreover, it is more extreme than 91% of previous plans and more pro-Republican than 97% of previous plans.

Metric	Value	Favors Rep's in this % of Scenarios	More Biased than this % Historical Plans	More Pro-Republican than this % Historical Plans
2012-2020 Plan				
Republican Seat Share	74%			
Efficiency Gap	-12%	96%	90%	97%
Declination	-.42	95%	87%	93%
Average		96%	89%	95%
Commission's Original, Enacted Plan				
Republican Seat Share	79%			
Efficiency Gap	-16%	99%	97%	97%
Declination	-.58	99%	95%	98%
Average		99%	96%	98%
Commission's Enacted March 2 Plan				
Republican Seat Share	76%			
Efficiency Gap	-13%	99%	91%	97%
Declination	-.47	98%	90%	95%
Average		99%	91%	96%

Table 3: PlanScore partisan bias metrics for enacted, March 2 Congressional plan

contests rather than weighting each year equally.

10. See `https://planscore.campaignlegal.org/models/data/2021D/` for more details.

11. The partisan symmetry and mean-median difference scores are only shown when the parties' statewide vote shares fall between 45% and 55% because outside this range the metrics' assumptions are less plausible (McGhee 2017, 9). In the PlanScore model, the Democrats' two-party vote share is just below 45%.

12. See `https://planscore.campaignlegal.org/plan.html?20220303T200000.374167789Z`

6 Competitiveness of Districts

In this section, I use a variety of approaches to estimate the number of competitive districts in both the 2012-20 congressional plan, the original enacted plan, and the March 2 plan (see Table 4). My analysis indicates that the enacted, March 2 plan has just one more competitive district than the 2012-2020 plan.

Data:	2020 House Results		Composite (2012-20)	PlanScore			**Mean**
Metric:	45-55	Historical Swing	45-55	45-55	20%+ Prob. of Each Party Win.	50%+ Prob. Flip in Dec.	
Plan	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2012-20 Plan	2	1	3	3	2	5	2
Commission's Original Plan	3	3	5	4	2	4	3.5
Commission's March 2 Plan	3	2	4	4	2	4	3

Table 4: Number of competitive districts using various data sources and metrics.

First, I use the actual 2020 House results to examine the number of competitive districts. In column 1 of Table 4, I begin by tallying the number of districts where each party's two-party vote share was between 45 and 55%. This approach indicates there are 2 competitive districts on the 2012-20 plan and 3 competitive districts on the enacted March 2 plan. As I discussed earlier, however, it is not clear that a sharp threshold at 55% is the best measure of competitiveness.

Based on the approach in Henderson, Hamel, and Goldzimer (2018, Appendix, p. 2), we can also define competitiveness based on whether a district is likely to switch parties at least once per decade based on the maximal swing in the two-party vote. In column 2 of Table 4, I use this approach to tally the number of districts that each party would win at least once over the course of the decade based on the historical range of statewide election results between 2016-2020. Specifically, I conduct a uniform swing to simulate what would happen if the 2020 congressional election were held in the best year for Democrats (2012).[13] I then examine the number of districts that would have been won at least once by each party. This approach indicates there was 1 competitive district on the 2012-20 plan and 2 competitive districts on the enacted March 2 plan.

Next, I use a composite of the 2016-2020 statewide election results to estimate the number of competitive districts. Once again, in column 3 of Table 4, I tally the number of districts where each party's two-party vote share was between 45 and 55%. This approach indicates there was 1 competitive district on the 2012-20 plan and 4 competitive districts on the March 2 plan.

13. It is worth noting, however, that 2012 appears to have been a high-water mark for Democrats in Ohio, and their electoral performance has not come close to this level in subsequent elections.

Lastly, I use PlanScore to estimate the potential competitiveness of individual districts on the enacted, March 2 plan. In column 4 of Table 4, I show the number of districts where PlanScore estimates that each party's two-party vote share is expected to be between 45 and 55%. This approach indicates there were 3 competitive districts on the 2012-20 plan and 4 competitive districts on the enacted, March 2 plan.

It is also possible to use PlanScore to evaluate whether a district is likely to switch parties at least once per decade (Henderson, Hamel, and Goldzimer 2018). PlanScore conducts 1,000 simulations of possible electoral scenarios based on the results of the 2012-2020 congressional and state legislative elections in every state. Using these simulations, PlanScore provides an estimate of the probability that each party will win each seat as well as whether they are likely to have at least a 50% chance of winning each seat once over the course of the decade. In column 5 of Table 4, I estimate the number of districts where each party has at least a 20% chance of winning according to PlanScore. This approach indicates there were 2 competitive districts on the 2012-20 plan and 2 competitive districts on the enacted, March 2 plan. In column 6 of Table 4, I conduct a similar analysis where I tally the number of districts that each party would have at least a 50% chance of winning at least once over the course of the decade. This approach indicates there are 5 competitive districts on the 2012-20 plan and 4 competitive districts on the enacted, March 2 plan.

Finally, column 7 of Table 4 averages across all of these approaches. It indicates there are about 2 competitive districts on the 2012-2020 plan and 3 competitive seats on the March 2 plan.

Moreover, it is important to note that the fact that there are about three potentially competitive districts on the enacted, March 2 plan does not mean that each party has a 50-50 chance at winning these districts. In fact, Republicans are favored in two of these districts. We can see this using each of the predictive approaches I've used in this report that are summarized in Table 5. The table shows that only one of the three competitive districts (shown in grey) slightly leans toward Democrats. So Republicans are likely to win at least two of these districts in the average election. This is especially true if Republicans also have an incumbency advantage in most of these districts (see Jacobson 2021, for more on the incumbency advantage in 2020). Overall, 12 of the 15 districts on the enacted plan lean toward Republicans.

	Projected Democratic Vote Share			
District	House 2020	Composite (2016-2020)	PlanScore	Average Dem. Share
1	0.50	0.51	0.52	0.51
2	0.25	0.29	0.25	0.26
3	0.69	0.69	0.69	0.69
4	0.29	0.31	0.30	0.30
5	0.34	0.37	0.34	0.35
6	0.34	0.39	0.33	0.36
7	0.41	0.44	0.43	0.43
8	0.37	0.37	0.37	0.37
9	0.47	0.49	0.46	0.47
10	0.42	0.46	0.46	0.45
11	0.78	0.79	0.75	0.78
12	0.31	0.35	0.32	0.33
13	0.49	0.51	0.49	0.49
14	0.40	0.43	0.40	0.41
15	0.43	0.45	0.44	0.44

Table 5: Democratic Vote Share Projections for Each District on Commission's March 2 Plan using a Variety of Methods. Competitive districts in grey, Democratic districts in blue, and Republican districts in red.

7 Compactness

In this section, I examine the compactness of the districts on the Commission's March 2 plan. I focus on two commonly used compactness metrics to evaluate the compactness of the plans. First, the Reock Score is the ratio of the area of the district to the area of a minimum bounding circle that encloses the district's geometry. Second, the Polsby-Popper measure is the ratio of the area of the district to the area of a circle whose circumference is equal to the perimeter of the district (See Figure 2 for illustrations of each metric from Ansolabehere and Palmer (2016, 751)). Each of these metrics falls within the range of [0,1] and a score closer to 1 indicates a more compact district.

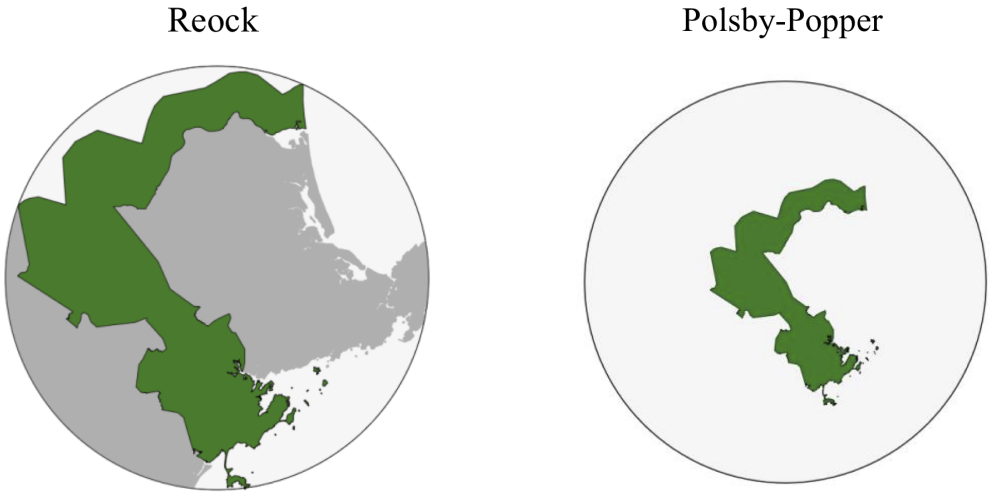

Figure 2: Illustration of Compactness Measures from Ansolabehere and Palmer (2016)

Table 6 shows the compactness metrics for the Commission's enacted, March 2 plan.[14] The districts vary widely in their compactness levels.

District	Reock	Polsby-Popper
1	0.31	0.25
2	0.49	0.31
3	0.69	0.51
4	0.37	0.31
5	0.23	0.20
6	0.29	0.22
7	0.33	0.22
8	0.29	0.28
9	0.27	0.27
10	0.51	0.44
11	0.46	0.40
12	0.59	0.31
13	0.41	0.27
14	0.48	0.65
15	0.28	0.14
Mean	0.40	0.32

Table 6: Compactness Metrics for Districts on Commission's Enacted, March 2 Plan. Higher scores indicate higher levels of compactness.

District 15 receives the lowest compactness scores. Its Reock score is 0.28 and its Polsby-Popper score is 0.14. Both of these scores rank in the bottom quintile of the compactness scores for all congressional districts over the past 200 years (see Figure 3 which shows the distribution of compactness measures for all congressional districts from

14. The compactness scores were calculated in the software program, R, using the `redistmetrics` package.

1789-2013 from Ansolabehere and Palmer (2016)).[15] They also rank in the bottom quintile of the compactness scores for congressional districts around the country in the 2020 cycle. Figure 4 shows how district 15's Reock score compares to other districts around the country in 2020, illustrating that it is an outlier in its level of non-compactness.[16]

			Percentile				
Measure	Mean	SD	10%	25%	50%	75%	90%
Reock	0.405	0.110	0.260	0.326	0.408	0.481	0.546
Polsby-Popper	0.293	0.158	0.080	0.178	0.287	0.400	0.511

Figure 3: Distribution of Compactness Measures for All Congressional Districts from Ansolabehere and Palmer (2016)

District 1 also receives relatively low compactness scores. Its Reock score is 0.31 and its Polsby-Popper score is 0.25. Its Reock score is in the bottom quartile for all congressional districts over the past 200 years (see Figure 3), and its Polsby-Popper is well below the average for all congressional districts over the past two centuries. Moreover, Figure 4 shows that its Reock score is in the bottom tercile of the compactness scores for congressional districts around the country in the 2020 cycle.

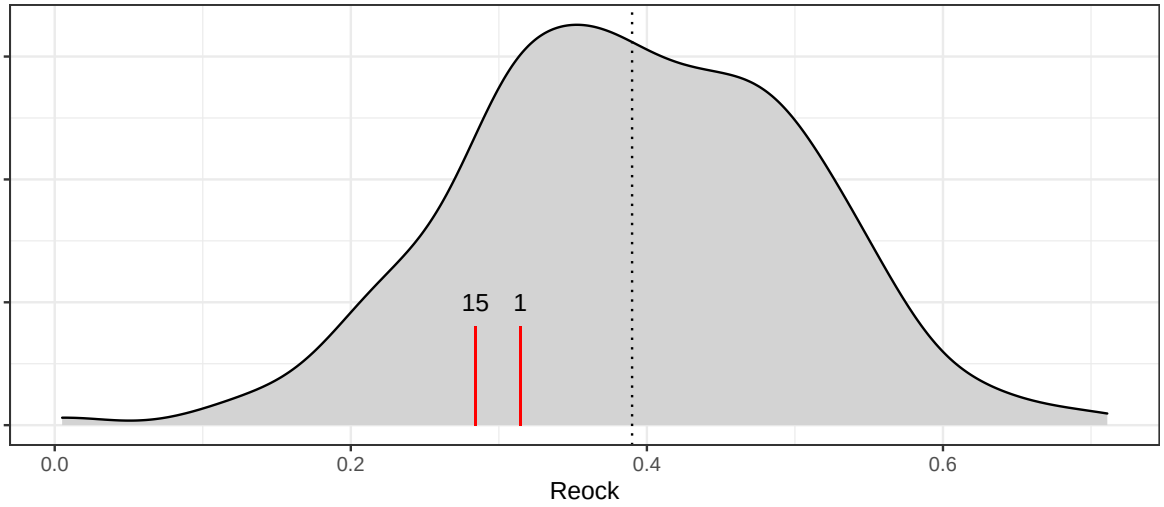

Figure 4: Comparison of District 1 and 15's Reock Score to All 435 Congressional Districts in 2020. Higher scores indicate higher levels of compactness. The dotted line shows the average Reock score of districts in 2020.

15. It includes data on 9,276 different districts and 34,996 district-Congress dyads (i.e. the Congressional elections each district was used for).

16. The Reock scores for all 435 districts in use in 2020 were calculated using PlanScore.org.

8 Conclusion

Overall, there is a substantial Republican bias in the translation of votes to seats in the newly enacted, March 2 congressional plan in Ohio. Based on a variety of metrics, the pro-Republican bias in Ohio's congressional districting plan is very large relative to other states over the past 50 years. It is also nearly as unfair as the original, enacted plan. Moreover, the new map does not contain significantly more competitive districts than the 2012-2020 plan and has fewer than the original, enacted plan. Overall, the Commission's March 2 plan unduly favors congressional candidates from the Republican Party.

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Supplementary Appendix

A Alternative Composite Indices

Metric	Value	More Biased than this % Historical Plans	More Pro-Republican than this % Historical Plans
2012-2020 Plan			
Efficiency Gap	-16%	91%	96%
Declination	-.57	89%	93%
Mean-Median Diff	-3%	41%	72%
Symmetry	-22%	97%	98%
Average		80%	90%
Enacted Plan			
Efficiency Gap	-17%	93%	97%
Declination	-.55	88%	93%
Mean-Median Diff	-2%	19%	61%
Symmetry	-12%	78%	86%
Average		70%	84%
March 2 Plan			
Efficiency Gap	-12%	82%	93%
Declination	-.36	74%	83%
Mean-Median Diff	-1%	16%	59%
Symmetry	-14%	84%	89%
Average		64%	81%

Table A1: Composite partisan bias metrics for Congressional plan based on all elections from 2016-2020, averaging across contests rather than across years

Christopher S. Warshaw

Department of Political Science
2115 G Street, N.W.
Monroe Hall 440
Washington, D.C. 20052

Office: 202-994-6290
Fax: 202-994-1974
Email: warshaw@gwu.edu
Homepage: www.chriswarshaw.com

Academic Employment

George Washington University, Washington, DC

Associate Professor (2020-present)

Assistant Professor, 2017 - 2020

Massachusetts Institute of Technology, Cambridge, MA

Associate Professor of Political Science (without tenure), 2016 - 2017

Assistant Professor of Political Science, 2012 - 2016

Education

Stanford University, Ph.D., Political Science, 2012

Fields: American Politics, Comparative Politics, and Political Methodology (Statistics)

Stanford Law School, Juris Doctorate, 2011

Williams College, B.A., *magna cum laude*, 2002

Research Interests

American Politics, Representation, Elections, Public Opinion, State & Local Politics, Environmental Politics and Policy, Statistical Methodology

Research

Publications

Book

"Dynamic Democracy: Public Opinion, Elections, and Policy Making in the American States." Forthcoming. University of Chicago Press. (with Devin Caughey)

Peer Reviewed Articles

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20. "Accountability for the Local Economy at All Levels of Government in United States Elections." 2020. *American Political Science Review*. 114(3): 660-676. (with Justin de Benedictis-Kessner)
19. "Politics in Forgotten Governments: The Partisan Composition of County Legislatures and County Fiscal Policies." 2020. *Journal of Politics*. 82(2): 460-475. (with Justin de Benedictis-Kessner)
18. "On the Representativeness of Primary Electorates." 2020. *British Journal of Political Science*. 50(2): 677-685. (with John Sides, Chris Tausanovitch, and Lynn Vavreck)
17. "Geography, Uncertainty, and Polarization." 2019. *Political Science Research and Methods*. 7(4): 775-794. (with Nolan McCarty, Jonathan Rodden, Boris Shor, and Chris Tausanovitch)
16. "Policy Ideology in European Mass Publics, 1981–2016." 2019. *American Political Science Review*. 113(3): 674-693. (with Devin Caughey and Tom O'Grady).
15. "Does Global Warming Increase Public Concern About Climate Change?" 2019. *Journal of Politics*. 81(2): 686-691. (with Parrish Bergquist)
14. "Local Elections and Representation in the United States." 2019. *Annual Review of Political Science*. 22(1): 461-479.
13. "The Ideological Nationalization of Party Constituencies in the American States". 2018. *Public Choice*. Keith Poole Symposium. 176(1-2): 133-151. (with James Dunham and Devin Caughey)
12. "Policy Preferences and Policy Change: Dynamic Responsiveness in the American States, 1936-2014." 2018. *American Political Science Review*. 112(2): 249-266. (with Devin Caughey)
11. "Does the Ideological Proximity Between Candidates and Voters Affect Voting in U.S. House Elections?" 2018. *Political Behavior*. 40(1): 223-245. (with Chris Tausanovitch)
10. "Partisan Gerrymandering and the Political Process: Effects on Roll-Call Voting and State Policies." *Election Law Journal.* December, 2017. 16(4): 453-469. Symposium on Partisan Gerrymandering and the Efficiency Gap. (with Devin Caughey and Chris Tausanovitch)
9. "Incremental Democracy: The Policy Effects of Partisan Control of State Government." 2017. *Journal of Politics*. 79(4): 1342-1358. (with Devin Caughey and Yiqing Xu)
8. "Renewable energy policy design and framing influences public support in the United States." 2017. *Nature Energy*. 2(17107). (with Leah Stokes)
7. "Estimating Candidates' Political Orientation in a Polarized Congress." 2017. *Political Analysis*. 25(2): 167-187. (with Chris Tausanovitch)
6. "The Dynamics of State Policy Liberalism, 1936-2014." 2016. *American Journal of Political Science*. 60(4): 899-913. (with Devin Caughey)
5. "Mayoral Partisanship and Municipal Fiscal Policy." 2016. *Journal of Politics*. 78(4): 1124-1138. (with Justin de Benedictis-Kessner)

4. "Dynamic Estimation of Latent Opinion Using a Hierarchical Group-Level IRT Model." 2015. *Political Analysis*. 23(2): 197-211. (with Devin Caughey)
3. "Representation in Municipal Government." 2014. *American Political Science Review*. 108(3): 605-641. (with Chris Tausanovitch)
2. "Measuring Constituent Policy Preferences in Congress, State Legislatures and Cities." 2013. *Journal of Politics*. 75(2): 330-342. (with Chris Tausanovitch)
1. "How Should We Measure District-Level Public Opinion on Individual Issues?" 2012. *Journal of Politics*. 74(1): 203-219. (with Jonathan Rodden)

Editor Reviewed Articles in Journals and Law Reviews

4. "A preference for constant costs." 2020. *Nature Climate Change*. News & Views. 10: 978–979
3. "Public Opinion in Subnational Politics." 2019. *Journal of Politics*. 81(1): 352-363. Editor reviewed for Symposium on Subnational Policymaking. (with Devin Caughey)
2. "Spatial variation in messaging effects." 2018. *Nature Climate Change*. News & Views. April, 2018.
1. "Business as Usual? Analyzing the Doctrinal Development of Environmental Standing Doctrine since 1976." 2011. *Harvard Law and Policy Review*. Volume 5.2. (with Gregory Wannier).

Book Chapters

5. "Elections and Parties in Environmental Politics." 2020. *Handbook on U.S. Environmental Policy*. David Konisky, ed. (with Parrish Bergquist)
4. "Latent Constructs in Public Opinion." 2018. *Oxford Handbook on Polling and Polling Methods*. R. Michael Alvarez and Lonna Atkeson, ed. Oxford: Oxford University Press.
3. "The Application of Big Data in Surveys to the Study of Elections, Public Opinion, and Representation." 2016. *Data Analytics in Social Science, Government, and Industry*. R. Michael Alvarez, ed. Cambridge: Cambridge University Press.
2. "The Political Economy of Expropriation and Privatization in the Oil Sector." 2012. *Oil and Governance: State-Owned Enterprises and the World Energy Supply*. David G. Victor, David Hults, and Mark Thurber, eds. Cambridge: Cambridge University Press.
1. "Democratization and Countermajoritarian Institutions: The Role of Power and Constitutional Design In Self-Enforcing Democracy." 2012. *Comparative Constitutional Design*. Cambridge: Cambridge University Press. (with Susan Alberts and Barry R. Weingast).

Policy Reports

1. "Reforming Baltimore's Mayoral Elections." 2020. Abell Foundation Report. `https://www.abell.org/publications/reforming-baltimores-mayoral-elections`

Articles Under Review

"The Effect of Fox News Channel on U.S. Elections: 2000-2020" (with Elliott Ash, Sergio Galletta, and Matteo Pinna)
(Invited to revise and resubmit at the *American Political Science Review*)

"Moderates" (with Anthony Fowler, Seth Hill, Jeff Lewis, Chris Tausanovitch, Lynn Vavreck)
(Invited to revise and resubmit at the *American Political Science Review*)

"Partisan Polarization in the Mass Public in South Korea and the United States"

"How Partisanship in Cities Influences Housing Policy" (with Justin de Benedictis-Kessner and Dan Jones)

Works in Progress

"Electoral Accountability for Ideological Extremism in American Elections" (with Devin Caughey)

"Gerrymandering in Local Governments" (with Yamil Valez)

"When Mass Opinion Goes to the Ballot Box: A National Assessment of State Level Issue Opinion and Ballot Initiative Results" (with Jonathan Robinson and John Sides)

"Inequalities in Participation, Voting, and Representation in Local Governments" (with Justin de Benedictis-Kessner and John Sides)

"The Ideology of State Party Platforms " (with Justin Phillips and Gerald Gamm)

Non-Academic Writing

"Here are six big takeaways from the 2020 elections." *Washington Post*. November 7, 2020. (with Emily Thorson)

"TV ads still win elections. And Democrats are buying a lot more of them." *Washington Post*. October 28, 2020. (with John Sides and Lynn Vavreck)

"How Local Covid Deaths Are Affecting Vote Choice." *New York Times*. July 28, 2020. (with Lynn Vavreck)

"Allowing Only Older Americans to Vote by Mail Leads to Severe Racial Disparities." *Election Law Blog*. July 1, 2020.

"A coronavirus recession would hurt all kinds of Republican candidates – not just Trump." *Washington Post*, Monkey Cage. March 18, 2020. (with Justin de Benedictis-Kessner).

"The Supreme Court is deciding a gerrymandering case. Here's the social science that the Justices need to know." *Washington Post*, Monkey Cage. June 1, 2019.

"New research shows just how badly a citizenship question would hurt the 2020 Census." *Washington Post*, Monkey Cage. April 22, 2019. (with Matt Barreto, Matthew A. Baum, Bryce J. Dietrich, Rebecca Goldstein, and Maya Sen)

"G.O.P. Senators Might Not Realize It, but Not One State Supports the Health Bill." *New York Times*. June 14, 2017. (with David Broockman)

Invited Talks

2021-2022: American University

2020-2021: University of Maryland; Stony Brook University

2019-2020: Princeton; UC Berkeley

2018-2019: Stanford; Northeast Political Methodology Meeting at NYU; University of Maryland

2017-2018: USC PIPE Symposium on Studying Subnational Policy Making; BYU; University of Chicago Conference on Political Polarization

2016-2017: University of Virginia; UCLA

2015-2016: Washington University in St. Louis; Texas A&M; Arizona State University Conference on Campaigns, Elections and Representation

2014-2015: Yale; Columbia; Duke

2013-2014: Princeton; Boston University; Rochester University

2012-2013: MIT American Politics Conference; Columbia Representation Conference; Princeton Media & Politics Conference; Annual Meeting of the Society for Political Methodology

Grants

Russell Sage Foundation, 2019-2021 ($119,475)

GW UFF, 2019-2020 ($14,433)

MIT Elections Lab, 2019-2020 ($14,000)

Jeptha H. and Emily V. Wade Award, 2014-2016 ($59,686)

MIT Energy Institute (MITEI) Seed Grant, 2014-2016 ($137,147)

MIT SHASS Research Fund, 2012-2014 ($8,734)

Software

dgo: Dynamic Estimation of Group-Level Opinion. 2017. R package. `https://CRAN.R-project.org/package=dgo`. (with James Dunham and Devin Caughey)

Awards and Honors

OVPR Early Career Scholar at George Washington University, 2019.

APSA award for best journal article on State Politics & Policy in 2016.

Award for best paper on State Politics & Policy at the 2014 American Political Science Conference.

Graduate Fellowship, Dept. of Political Science, Stanford University, 2006-2012

David A. Wells Prize in Political Economy for Best Undergraduate Economics Thesis, Williams College, 2002

Phi Beta Kappa, Williams College, 2002

Teaching Experience

Instructor:

Measurement Models (Graduate-level) (GW), 2020

Political Representation (Graduate-level) (GW), 2019

Elections (GW), 2018, 2019, 2021

Multi-level and Panel Models (Graduate-level) (GW), 2017, 2018, 2019, 2021

Public Opinion (GW), 2017

American Political Institutions (Graduate-level) (MIT), 2014, 2016

Public Opinion and Elections (MIT), 2016

Energy Policy (MIT), 2013

Democracy in America (MIT), 2013, 2014

Constitutional Law & Judicial Politics (MIT), 2013, 2015

Making Public Policy (MIT), 2012, 2014

Teaching Assistant:

Introduction to American Law (Stanford University), 2010

Judicial Politics and Constitutional Law (Stanford University), 2009

Political Economy of Energy Policy (Stanford University), 2008

Introduction to International Relations (Stanford University), 2008

Introduction to Public Policy (Stanford University), 2007

Introduction to Econometrics (Williams College), 2002

Graduate Advising

George Washington University:

Alex Beck (Dissertation committee chair)

Dickson Su (Dissertation committee chair)

Kerry Synan (Dissertation committee co-chair)

Jared Heern (Dissertation committee member)

Colin Emrich (Graduates in 2021, Dissertation committee member)

Massachusetts Institute of Technology:

Leah Stokes (Graduated in 2015, Dissertation committee member)

Krista Loose (2016, Dissertation committee member)

Tom O'Grady (2017, Dissertation committee member)

Justin de Benedictis-Kessner (2017, Dissertation committee member)

Alex Copulsky (2017, Masters thesis committee member)

James Dunham (2018, Dissertation committee member)

Parrish Bergquist (2018, Dissertation committee member)

Meg Goldberg (2019, Dissertation committee member)

University Service

George Washington University:

Member, Academic Program Review Committee, Sociology Dept., 2021

Coordinator, Graduate Political Science Admissions Committee, 2019-2020

Coordinator, American Politics Workshop, 2018-2020

Member, Methods Exam Committee, 2017-2020

Member, Graduate Political Science Admissions Committee, 2018-2019

Massachusetts Institute of Technology:

Member, Energy Education Task Force, 2012-2017

Parking and Transit Committee, 2013-2017

Member, Graduate Political Science Admissions Committee, 2013-2015

Faculty Fellow, Burchard Scholars, 2013-2015

Stanford University (as graduate student):

President, Stanford Environmental Law Society, 2009-2010

Executive Board Member, Stanford Environmental Law Society 2008-2010

Member, University Committee on Graduate Studies, 2007-2009

Member, University Library Committee, 2007-2008

President, Political Science Graduate Students Association, 2007-2008

Professional Service

Reviewer: American Political Science Review, American Journal of Political Science, Journal of Politics, Political Analysis, Political Behavior, Econometrica, Quarterly Journal of Political Science, Legislative Studies Quarterly, Political Research Quarterly, American Politics Research, British Journal of Political Science, Journal of Law and Courts, Public Opinion Quarterly, Political Science Research and Methods, State Politics and Policy Quarterly, Journal of Experimental Political Science, Nature Climate Change, Urban Affairs Review, Journal of Health Politics, Policy and Law, Perspectives on Politics, Review of Economics and Statistics, Cambridge University Press

Member, Best Dissertation Committee, Urban Politics Section of the American Political Science Assoc., 2021

Member, Program Committee, Midwest Political Science Association Conference, 2020

Lead Organizer, Local Political Economy APSA Pre-Conference at George Washington University, 2019

Member, Planning Committee, Cooperative Congressional Election Study (CCES), 2018

Member, Best Paper Committee, State Politics Section of the American Political Science Assoc., 2018

Editorial Board, Journal of Politics, 2017-18

Executive Committee, Urban Politics Section of the American Political Science Association, 2015-2017

Organizing Committee, Conference on Ideal Point Models at MIT, http://idealpoint.tahk.us, 2015

Member, Best Paper Committee, Urban Politics Section of the American Political Science Assoc., 2015

Consulting

Partisan Gerrymandering:

Expert, *League of Women Voters of Michigan* vs *Michigan Independent Citizens Redistricting Commission* (2022), State House Districts

Expert, *League of Women Voters of Ohio* v. *Ohio Redistricting Commission* (2021), Congressional districts

Expert, *League of Women Voters of Ohio* v. *Ohio Redistricting Commission* (2021), State Legislative Districts

Expert, *League of Women Voters* vs. *Kent County Apportionment Commission* (2021)

Expert, *APRI et al.* v. *v. Smith et al.* (2018-2019)

Expert, *League of Women Voters of Michigan* v. *Johnson* (2018-2019)

Expert, *League of Women Voters of Pennsylvania* v. *the Commonwealth of Pennsylvania* (2017-18)

Census:

Expert, *La Union del Pueblo Entero , et al.* v. *Trump*, Effect of Excluding Undocumented Immigrants from Census on Apportionment (2020)

Expert, *Common Cause et al.* v. *Trump*, Effect of Excluding Undocumented Immigrants from Census on Apportionment (2020)

Expert, *State of New York* v. *Trump*, Effect of Excluding Undocumented Immigrants from Census on Apportionment (2020)

Expert, *New York Immigration Coalition* v. *US Dept of Commerce* & *State of NY* v. *US Dept of Commerce*, Effects of Undercount on Census due to Citizenship Question (2018)

Policy Reports:

Consultant, *Abell Foundation*, Report on Potential Institutional Reforms for Baltimore's City Elections

Community Service

PlanScore: Social Science Advisory Team (2020-2021)

Sierra Club: National Board of Directors (2009-2015)

Last updated: February 27, 2022

CERTIFICATE OF SERVICE

I, Freda J. Levenson, hereby certify that on this 7th day of March 2022, I caused a true and correct copy of the following documents to be served by email upon the counsel listed below:

Petitioners' Evidence to Motion to Enforce Court's Order - Affidavit of Dr. Christopher Warshaw

Bridget C. Coontz, bridget.coontz@ohioago.gov
Julie M. Pfeiffer, julie.pfeiffer@ohioago.gov
Michael Walton, michael.walton@ohioago.gov

Counsel for Respondent Secretary of State LaRose, Ohio

Phillip J. Strach, phil.strach@nelsonmullins.com
Thomas A. Farr, tom.farr@nelsonmullins.com
John E. Branch, III, john.branch@nelsonmullins.com
Alyssa M. Riggins, alyssa.riggins@nelsonmullins.com

W. Stuart Dornette, dornette@taftlaw.com
Beth A. Bryan, bryan@taftlaw.com
Philip D. Williamson, pwilliamson@taftlaw.com

Counsel for Respondents House Speaker Robert R. Cupp and Senate President Matt Huffman

/s/ Freda J. Levenson
Freda J. Levenson (0045916)
Counsel for Petitioners