Supreme Court of Ohio Clerk of Court - Filed April 25, 2022 - Case No. 2022-0298

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 2 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

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EX.	**DESCRIPTION**	**BATES RANGE**
24	Dr. Rodden's Expert Affidavit, *Adams v. DeWine*, Case No. 2021-1428 (submitted Dec. 10, 2021)	NEIMAN_EVID_00071-NEIMAN_EVID_00148
25	Dr. Chen's Expert Affidavit, *Adams v. DeWine*, Case No. 2021-1428 (submitted Dec. 10, 2021)	NEIMAN_EVID_00149-NEIMAN_EVID_00217
26	Dr. Imai's Expert Affidavit, *League of Women Voters of Ohio v. Ohio Redistricting Commission*, Case No. 2021-1449 (submitted Dec. 10, 2021)	NEIMAN_EVID_00218-NEIMAN_EVID_00276
27	Dr. Handley's Expert Affidavit, *League of Women Voters of Ohio v. Ohio Redistricting Commission*, Case No. 2021-1449 (submitted Dec. 10, 2021)	NEIMAN_EVID_00277-NEIMAN_EVID_00303
28	Dr. Warshaw's Expert Affidavit, *League of Women Voters of Ohio v. Ohio Redistricting Commission*, Case No. 2021-1449 (submitted Dec. 10, 2021)	NEIMAN_EVID_00304-NEIMAN_EVID_00340

CERTIFICATE OF SERVICE

I hereby certify that Neiman Petitioners' Evidence – Volume 2 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 24

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. For the purpose of this report, I have been asked to examine whether and how 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, and attached as Exhibit A ("2021 Congressional Plan" or the "Enacted Plan"), conforms 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 have also been asked to examine the extent to which the General Assembly's redistricting plan splits governmental units, and to assess the plan's adherence to other traditional redistricting criteria, including compactness. Finally, I have been asked to examine characterizations of the Enacted Plan made by Senate Majority Whip and primary sponsor of the Enacted Plan Senator Rob McColley.

2. I demonstrate that given the statewide support for the two parties, the 2021 Congressional Plan provides an extreme advantage to the Republican Party. With around 53.2 percent of the statewide vote in the last three general elections, the Republican Party can expect to win around 80 percent of the seats under the new plan. This is an increase over the map that was in effect from 2012 to 2020, under which Republican candidates were able to consistently win 75 percent of the seats. I also demonstrate that this level of partisan advantage is extremely unusual when compared with other states.

3. Comparing past statewide results with congressional results and considering the role of incumbency, I conclude that only two or three of the 15 districts in the Enacted Plan are likely to be competitive.

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4. I also examined the extent to which the General Assembly's plan disproportionately favors or disfavors the *incumbents* for one of the two parties. Under the previous plan, there were 12 Republican incumbents, one of whom has already announced his retirement. All the remaining districts with Republican incumbents continue to have Republican majorities—most of them quite comfortable. Of the four Democratic incumbents, only two continue to reside in districts where Democratic candidates receive majorities in statewide elections. The other two districts with Democratic incumbents have been dramatically reconfigured to the significant advantage of Republicans: in one district, Republican candidates win by large majorities in statewide races (although the Democratic incumbent in that district has announced he is running for U.S. Senate); in the other, they typically hold a narrow edge.

5. These outcomes were not forced upon the General Assembly by Ohio's political geography, or by the requirements of the Ohio Constitution. On the contrary, I demonstrate that it is possible to abide by the Constitution and achieve partisan fairness, while drawing districts that are more compact, introduce fewer splits in metropolitan counties and a similar number of county splits overall, introduce similar or even fewer splits to municipal subdivisions, and do a better job keeping communities together. I demonstrate that in contrast to plans that achieve greater partisan balance, the Enacted Plan achieves its extreme partisan advantage in large part by splitting geographically proximate communities of co-partisans (i.e., people who vote the same way)—extracting them from their geographic context and placing them in districts dominated by voters from very different types of communities.

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 F.

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. 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 B, C, and D.[2] I also consulted geographic boundary files of the Enacted Plan that were provided to me by Counsel. 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 comparative analysis, I collected data on U.S. Senate, U.S. House, and presidential elections from state election authorities of a number of states, as detailed below. I also consulted precinct-level presidential results, again from state election authorities, aggregated to the level of U.S. congressional districts.[4] I also used geographic boundary files of communities of Columbus, Ohio from the City of Columbus GIS department.[5] For the analysis conducted in this report, I use three software packages: Stata, Maptitude for Redistricting, and ArcGIS Pro.

12. Through counsel, I also had access to several Maptitude files produced in this case by Ray DiRossi, Finance and Budget Director for the Ohio Senate Majority and, to my understanding, the primary mapmaker for the Enacted Plan. These included .shp files for both the Enacted Plan as well as the plan introduced by Senator McColley on November 3, 2021, produced at Bates DiRossi_000003 and 000005, respectively. Using these files, I was able to reproduce the plans along with any data DiRossi had access to in Maptitude through a very simple process. First, I would open Maptitude and select Ohio from a drop-down menu in the "Plan Manager" section of Maptitude, which allowed me to view a map of Ohio in the program. Next, I would click on "Layers" under the "Map" dropdown, then click "add layer" and choose "County." This allowed me to view Ohio's county borders on the map display in Maptitude. Next, I would open the .shp file produced by DiRossi in Maptitude (I did this once for each .shp file produced by DiRossi to produce a separate map for each file). Next, I would navigate back to the "Layers" dropdown and select a box with the name of the plan produced and click "add layer." This enabled me to see the district lines of the plan produced. So, for example, by uploading the plan entitled "Enacted Plan SB 258 Final SHP," I was able to view the district lines for the Enacted Plan in Maptitude. Uploading this file also allowed me to view the data DiRossi had access to while drawing each of the two plans in Maptitude. To do this, I would navigate to the display manager and right click on the row with the name of the plan produced (in the case of the Enacted Plan, once again "Enacted Plan SB 258 Final SHP"). I would then click "New Dataview" from the right-click drop down menu. As soon as I did that, many columns populated at the top of my Maptitude screen in the "dataview," a table in the Maptitude window that displays information about a draft map including (in this case) target population, district number, total population within a district, a district's performance under certain partisan indices, as well as other pieces of data. This dataview presents the data DiRossi had uploaded into Maptitude while drawing maps. The screenshots of the results of this process were submitted to the court via USB and identified as Exhibit 5 to the affidavit submitted to this Court by Derek Clinger on December 10, 2021. I was also

[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.
[4] https://docs.google.com/spreadsheets/d/17yr9mcAtuUdNjI9NEPYKxXsEldzzQ2ZaDwEAbnPRyS4/edit?pref=2&pli=1#gid=1641247082.
[5] https://opendata.columbus.gov/datasets/c4b483507f374e62bd705450e116e017/explore.

able to export the data from this window into Microsoft Excel by going to File, export, and then table. This automatically generated an excel spreadsheet with all of the information contained in the dataview just described. I have attached excel spreadsheets extracted from two .shp files (including the file for the Enacted Plan) produced by DiRossi as Exhibits 7 and 8 to the Clinger Affidavit, also submitted via USB. I also performed the same process for the Maptitude files produced by Blake Springhetti, DiRossi's counterpart in the Ohio House, in that case in .BIN and .cdf format at Bates Springhetti_001042 and 001043. I have attached the results of that process as Exhibits 6 and 9 to the Clinger affidavit, both submitted via USB to the Court. Also, as specified in the Clinger affidavit, several of these files were used as exhibits at the depositions of DiRossi and Springhetti.

IV. THE PARTISANSHIP OF THE 2021 CONGRESSIONAL PLAN

13. I have been asked to determine whether the 2021 Congressional Plan favors one of the two major political parties in Ohio and, if so, to what extent. I proceed by first characterizing statewide partisanship in Ohio, and then examining the most likely partisan outcomes associated with the Enacted Plan.

14. Figure 1 provides a visualization of Ohio statewide general election results from 2012 to 2020. Ohio is a hotly contested state with a tradition of split-ticket voting and significant swings from one year to another. The Democratic candidate won the presidential contest in 2012, but the Republican candidate won in 2016 and 2020. Ohio's U.S. Senate delegation is typically split between the parties, and other statewide elections are often very competitive, although 2014 was an exception, as was the 2016 U.S. Senate race.

15. Figure 1 reveals that while Ohio statewide elections have been mostly quite close over the last decade, Republican candidates have held a narrow advantage. To quantify this, Table 1 provides the raw data. Including all the statewide general elections from 2012 to 2020, the Democratic share of the two-party vote (setting aside small parties and write-in candidates) was around 46 percent. If we focus on more recent elections, from 2016 to the present, the Democratic vote share is closer to 47 percent.

16. Next, in order to make inferences about what is likely to happen under the newly enacted districts, the best strategy is to begin by aggregating data from these recent elections, beginning with precinct-level results and calculating the number of votes received by the various candidates within the boundaries of the new districts. I have been able to obtain geo-coded precinct-level results for elections from 2016 to 2020. I calculate the Democratic and Republican shares of the two-party vote in each of the following races: 2016 President, 2016 U.S. Senate, 2018 U.S. Senate, 2018 Governor, 2018 Auditor, 2018 Secretary of State, 2018 Treasurer, 2018 Attorney General, and 2020 President. I then simply add up the votes cast for Democrats and Republicans in these races across all the precincts contained in each of the individual districts under the Enacted Plan, and divide by the total votes cast for the two parties in the respective district. The results of this exercise are displayed on the left side of Table 2.

Figure 1: Statewide General Election Outcomes, Ohio, 2012-2020

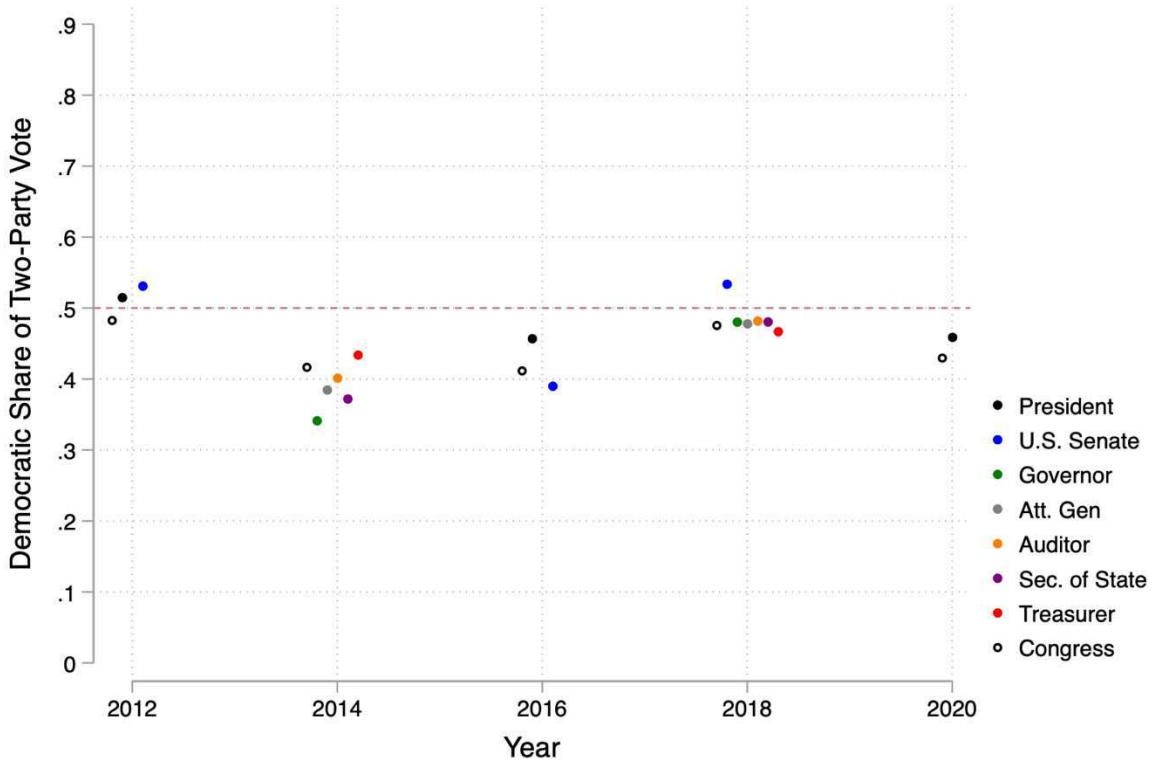

Table 1: Statewide General Election Outcomes, Ohio, 2012-2020

	Democratic Votes	Republican Votes	Other	Two-party Democratic Vote Share
2012 President	2,827,709	2,661,439	91,791	51.5%
2012 U.S. Senate	2,762,766	2,435,744	250,618	53.1%
2014 Governor	1,009,359	1,944,848	101,706	34.2%
2014 Att. Gen.	1,178,426	1,882,048		38.5%
2014 Auditor	1,149,305	1,711,927	143,363	40.2%
2014 Sec. of State	1,074,475	1,811,020	141,292	37.2%
2014 Treasurer	1,323,325	1,724,060		43.4%
2016 President	2,394,164	2,841,005	261,318	45.7%
2016 Senate	1,996,908	3,118,567	258,689	39.0%
2018 Senate	2,358,508	2,057,559	1,017	53.4%
2018 Governor	2,070,046	2,235,825	129,949	48.1%
2018 Att. Gen.	2,086,715	2,276,414		47.8%
2018 Auditor	2,008,295	2,156,663	175,962	48.2%
2018 Sec. of State	2,052,098	2,214,273	103,585	48.1%
2018 Treasurer	2,024,194	2,308,425		46.7%
2020 President	2,679,165	3,154,834	88,203	45.9%
Sum, all elections	30,995,458	36,534,651	1,747,493	**45.9%**
Sum, 2016-2020	19,670,093	22,363,565	1,018,723	**46.8%**

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Table 2: Shares of the Vote Obtained by the Two Major Parties from 2016 to 2020 in the Districts of the 2021 Congressional Plan and in the Districts of the Previous Plan

Newly Enacted Map			Map in Place from 2012 to 2020		
District	Democratic vote share	Republican vote share	District	Democratic vote share	Republican vote share
1	0.484	0.516	1	0.460	0.540
2	0.333	0.667	2	0.426	0.574
3	0.703	0.297	3	0.703	0.297
4	0.327	0.673	4	0.340	0.660
5	0.392	0.608	5	0.383	0.617
6	0.437	0.563	6	0.328	0.672
7	0.421	0.579	7	0.371	0.629
8	0.375	0.625	8	0.327	0.673
9	0.497	0.503	9	0.620	0.380
10	0.467	0.533	10	0.461	0.539
11	0.802	0.198	11	0.811	0.189
12	0.369	0.631	12	0.449	0.551
13	0.508	0.492	13	0.556	0.444
14	0.459	0.541	14	0.456	0.544
15	0.461	0.539	15	0.437	0.563
			16	0.431	0.569

17. As indicated in gray, when considering the specific data referenced above, there are only three districts with Democratic majorities in the Enacted Plan. Two of those districts have very comfortable Democratic majorities, and one has a very slight Democratic lean (District 13). There is one additional district (District 9) that leans just ever so slightly Republican.

18. This represents a considerable change in favor of Republicans from the status quo under the previous map, attached as Exhibit E. Table 2 also provides the results of the same exercise for the map that was in place from 2012 to 2020. That plan included four districts with relatively comfortable Democratic majorities. It is rather remarkable that the General Assembly was able to devise a plan that made the Democratic Party *worse* off, given that, as demonstrated below, the previous plan was one of the most favorable to the Republican Party in the United States in recent history.

19. There were five general elections for each of Ohio's 16 congressional districts from 2012 to 2020, for a total of 80 congressional races. In *every single* race, the candidate of the party with the higher vote share on the right-hand side of Table 2 was victorious.

20. If the same pattern continues, and the statewide aggregates continue to predict congressional outcomes, the Democrats can anticipate winning only 3 of 15 seats for the next four years (after which point a new map must be enacted under Ohio law). Recall from Table 1 that Democrats' statewide vote share was around 47 percent from 2016 to 2020, but their

anticipated seat share under the Enacted Plan is only 20 percent. Correspondingly, with around 53 percent of the statewide vote, the Republican Party can expect 80 percent of the seats.[6]

21. Districts 9 and 13 have statewide vote shares that are very close to 50 percent (within one percentage point). District 9 is a highly reconfigured district in which a Democratic incumbent will now be competing in very different territory with a slight Republican majority. Most of the new voters added to this district typically vote for Republicans. District 13 is an open seat with a slim Democratic majority. Even if one considers both Districts 9 and 13 in the Enacted Plan to be tossups and assigns a 50 percent probability of victory to Democratic candidates in each, the same conclusion holds: Republican candidates can expect to win around 12 of 15 seats.

22. In written remarks in support of the Enacted Plan, Ohio Senate Majority Whip Rob McColley stated that the Enacted Plan created 7 competitive districts.[7] To reach this figure, Senator McColley uses a rather peculiar alternative partisan index, and along with it, an alternative analysis of district competitiveness. Senator McColley presented an index based only on presidential and U.S. Senate elections. In order to understand how his index was constructed, it is useful to return to Figure 1 above. Senator McColley's index is composed of only six elections, represented by the 3 black (presidential) and 3 blue (U.S. Senate) dots in Figure 1. This means one third of the index is composed of elections in which U.S. Senator Sherrod Brown was the Democratic nominee. And one third of the index comes from 2012 alone—an election that took place a full decade before the new districts will come into effect.

23. According to Senator McColley's index, the statewide Democratic vote share in Ohio is 48 percent. Recall from Table 1 that when *all* statewide elections are used during the same period examined by Senator McColley (2012-2020), Ohio's statewide Democratic vote share is just under 46 percent. Using all statewide elections from 2016 to 2020—the years for which I was able to obtain geo-coded precinct-level data—the statewide Democratic vote share is a little under 47 percent.

24. Figure 1 also includes aggregate Democratic vote shares for Ohio's 16 congressional races in each of these elections, indicated with hollow dots with black boundaries.[8] It is important to note that these hollow dots fall well below the black and blue solid dots in every case but one (2016 U.S. Senate). We can see, then, that Senator McColley has chosen not only the most Democratic-skewed possible set of statewide elections, but also a set of elections that is systematically more Democratic-leaning than the *congressional* races that he is ostensibly trying to predict. It is also clear from Figure 1 that if one is trying to come up with a set of

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[6] Note that I refer to statewide results from 2016 to 2020 since those are the years for which I have precinct-level breakdowns that allow me to calculate district-level tallies.

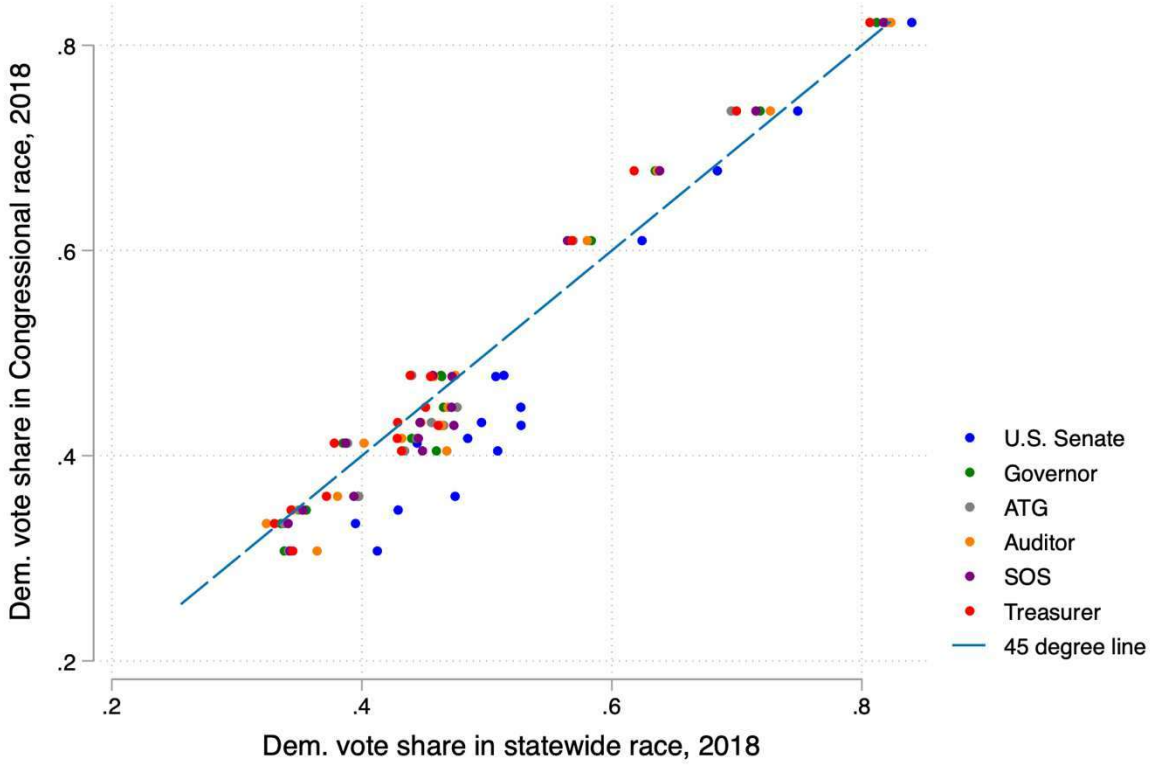
[7] See The Ohio Senate, Local Government and Elections Committee, https://www.ohiosenate.gov/committees/local-government-and-elections/document-archive (testimony of Senator Rob McColley on November 16, 2021).

[8] Note that there were three uncontested races during this period: districts 8 and 11 in 2012, and district 7 in 2014. I imputed the results of these races by taking the average vote shares experienced in these districts during all of the other years when they *were* contested.

races that predict congressional outcomes (the hollow dots), the most predictive races are those that McColley throws out: the statewide races for Governor (green), Attorney General (gray), Auditor (orange), Secretary of State (purple), and Treasurer (red). Note that the hollow dots—the congressional races—move up and down over time with the partisan waves that drive these statewide races. Thus, it is quite misleading to exclude so much of the valuable data—especially from recent years.

25. Moving beyond aggregate data, if we make comparisons across districts within specific elections, it is also notable that Senator McColley has excluded the races that hew most closely with each district's congressional results. He relies instead on an index of partisanship that draws disproportionately on high-turnout presidential races and Senate elections won by Senator Sherrod Brown. To demonstrate the latter problem, Figure 2 presents a scatter plot of district-level results of the 2018 election. On the horizontal axis is the Democratic vote share in statewide races, aggregated to the boundaries of the districts in place in 2018. On the vertical axis is the corresponding vote share of the Democratic candidate in the congressional race in each district in 2018. The dashed line is the 45-degree line.

Figure 2: Statewide Results Aggregated Within Boundaries of 2018 Districts and 2018 District-Level Congressional Results



26. Data markers directly on the 45-degree line are those where the results of the state-wide race are exactly the same as those in the congressional race. In other words, observations on the 45-degree line are districts where there is minimal split-ticket voting, so that the statewide

race perfectly predicts the congressional race. Note that in the four Democratic districts on the right side of the graph, the blue dots—where the horizontal axis represents Senator Sherrod Brown's vote share—are arranged almost exactly on the 45-degree line. However, in all 12 of the Republican-leaning districts, the blue dots are far below the 45-degree line, and far below all the other colored dots, which correspond to the vote shares of Democratic candidates in the other statewide races. In other words, Senator Sherrod Brown has drawn a substantial amount of support from voters who otherwise supported Republican candidates for all other offices. This means that by using Senator Sherrod Brown's vote share and ignoring the other data at his disposal in 2018, Senator McColley has chosen the one race in 2018 that is most out of sync with almost all congressional races in the state, and as a result, badly over-estimates the Democratic congressional vote share. He thereby inaccurately characterizes a number of rather reliable Republican voters as Democrats, and as a result, inaccurately characterizes comfortably Republican districts as "competitive."

Table 3: McColley Partisan Index in Comparative Perspective

District	Republican vote share, all statewide races, 2016-2020	Republican vote share, federal elections only, 2012-2020 (McColley's index)	Difference
1	0.516	0.515	0.001
2	0.667	0.651	0.016
3	0.297	0.304	-0.007
4	0.673	0.66	0.013
5	0.608	0.588	0.020
6	0.563	0.529	0.034
7	0.579	0.567	0.012
8	0.625	0.62	0.005
9	0.503	0.477	0.026
10	0.533	0.522	0.011
11	0.198	0.194	0.004
12	0.631	0.613	0.018
13	0.492	0.486	0.006
14	0.541	0.532	0.009
15	0.539	0.537	0.002

27. It is already clear from Figures 1 and 2 that Senator McColley's index is systematically more Democratic than an index that relies on a more representative set of races, but Table 3

quantifies the difference for each district. In the left-hand column, I reproduce the partisan index (from Table 2) that is based on all statewide races held from 2016 to 2020. In the next column, I reproduce Senator McColley's more limited index, and in the third column, I report the difference. In all districts but one, the McColley index makes districts appear to be more Democratic than the more expansive index. On average across districts, the difference is around 1.1 percentage points, but Senator McColley's index is especially misleading in District 6, where it over-estimates the Democratic vote share by 3.4 percentage points, and in District 9, where the over-estimate is 2.6 percentage points, and where McColley's index classifies the district as Democratic-leaning. Of particular note, McColley's chosen benchmark for competitiveness (46-54 percent) would treat District 6 as competitive under his index, but not under an index that takes account of all statewide races.

28. More generally, it is not clear why districts where average statewide vote shares fall in the rather wide range between 46 and 54 percent should be viewed as "competitive," since as described further below, Ohio congressional races in such districts have not been especially competitive in the past, and over the last decade, the party with the higher partisan index has always been victorious—almost always by a comfortable margin.

29. Even if we avoid Senator McColley's reliance on a biased sample of statewide races and use a more meaningful partisan index, we should not be so naïve as to assume that statewide races are straightforward predictors of congressional races. Even a better index that uses all the relevant statewide data from recent years will still substantially over-estimate the likely Democratic vote share in almost all the Republican-leaning districts. This is because of the role of incumbency advantage in congressional races. A large empirical literature in American politics establishes that, for a variety of reasons, incumbents typically enjoy a substantial advantage over challengers, especially in legislative elections.[9]

30. To demonstrate this problem, Figure 3 plots, on the horizontal axis, the data from the right-hand side of Table 2 above—the average Democratic vote share in all statewide races from 2016 to 2020—within each of the 16 Ohio congressional districts in use over the last decade. On the vertical axis, it plots the average vote share of the Democratic candidate in congressional races in the same district.[10] Again, the 45-degree line indicates a perfect correspondence between statewide races and congressional races. Blue data markers are districts with Democratic incumbents, and red data markers are districts with Republican incumbents.

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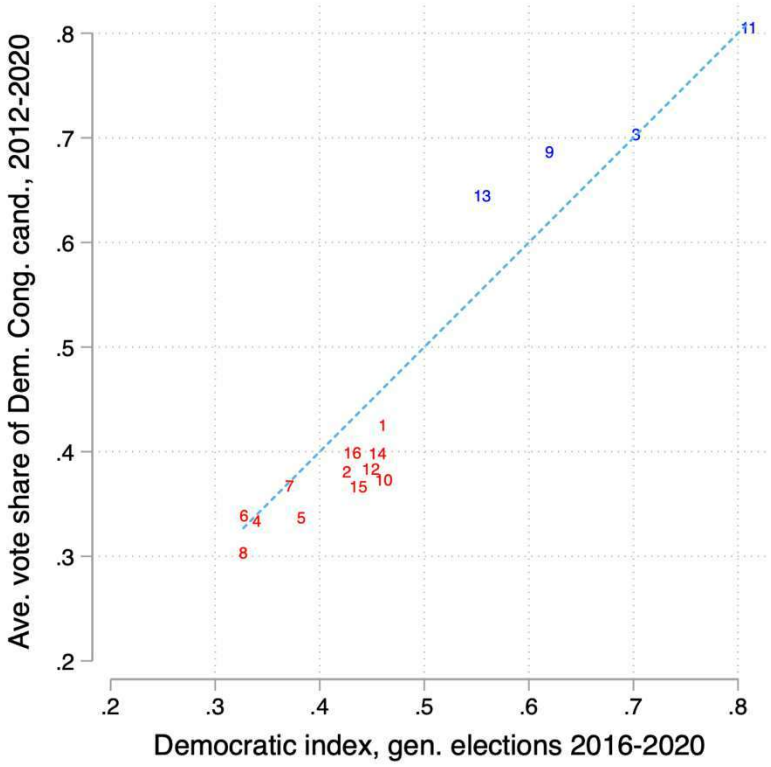
[9] See, for instance, Stephen Ansolabehere and James M. Snyder, 2004, "The Incumbency Advantage in U.S. Elections: An Analysis of State and Federal Elections, 1942-2000," *Election Law Journal* 1,3: 315-338.

[10] As above, I impute the results of the uncontested races (districts 8 and 11 in 2012, and district 7 in 2014) by taking the average vote shares experienced in these districts during all of the other years when they *were* contested.

Figure 3: Democratic Partisan Index Based on Statewide Races and Average Vote Share of Democratic Candidates in Congressional Races, 2012-2020

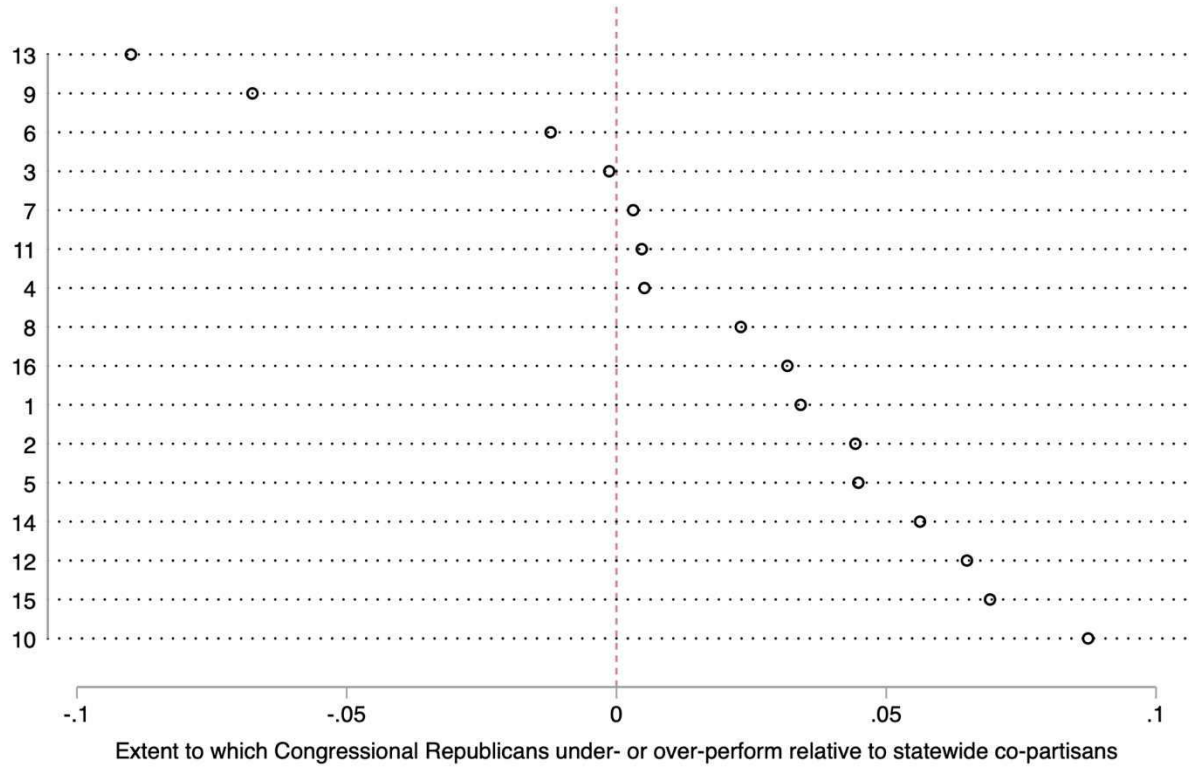


31. We can see that in races in the most overwhelmingly Democratic-leaning and Republican-leaning districts, on the far right and far left of the graph, the correspondence between statewide races and congressional races is quite strong. In the two overwhelmingly Democratic urban districts (3 and 11), for instance, congressional candidates do not significantly outperform their co-partisans in statewide races. The same is true in some of the most Republican districts (e.g., 4, 6, and 7). However, in the districts that are less imbalanced in terms of partisanship, the correspondence between statewide races and congressional races is far weaker, and in a very specific way: incumbents in congressional races outperform their statewide co-partisans. Visually, in Figure 3, we can see that the blue markers for Districts 9 and 13 are well above the 45-degree line, and the red markers for Republican incumbents in districts 1, 2, 5, 10, 12, 14, 15, and 16 are well below the line. The political science literature explores a variety of reasons for this advantage, including name recognition, an advantage in fundraising that translates into disproportionately large campaign war chests that facilitate effective campaigns and scare off challengers, the ability to use the perks of office to provide favors for local groups, and the ability to claim credit for public expenditures that take place in the district. It may also be the case that given the collective nature of legislatures vis-à-vis executive positions, it is easier for legislators to escape blame when things go wrong, either for the nation, the state, or their party. This is

related to a paradox attributed to Richard Fenno: Americans claim to hate Congress, but often express support for the member of Congress from their own district.[11]

32. To convey a better sense of what this means, Figure 4 simply plots the vertical distance between the data markers in Figure 3 and the 45-degree line—that is to say, the extent to which incumbent legislators outperformed their statewide co-partisans from 2012 to 2020. Positive numbers indicate that Republicans running in congressional races do better than their statewide co-partisans. Negative numbers indicate that they do worse.

Figure 4: Extent to which Congressional Republicans Under- or Over-Performed Relative to their Statewide Co-Partisans



33. Three of the first four observations at the top (except District 6) are districts with *Democratic* incumbents, where these incumbents perform better, on average throughout the decade, than their statewide co-partisans. The remaining observations (except District 11) are the districts where Republican incumbents were running throughout the decade, and in every case, they out-perform their statewide co-partisans—often by a considerable margin.

34. Figures 3 and 4 indicate the folly of imagining that a district with a 52 percent statewide Republican vote share throughout the last decade, like District 1 in the new Enacted Plan, is

[11] Richard Fenno, *Home Style: House Members in their Disricts,* 1978, Longman.

a highly competitive district where a moderate statewide swing toward the Democrats might yield a toss-up election in which a Democratic candidate can hope for victory. As we can see in Figure 4, Representative Chabot typically receives an incumbency advantage of around four percentage points. Over the past decade, he 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.

35. In the Enacted Plan, much of Mr. Chabot's district remains unchanged, including parts of Cincinnati, its western suburbs, and Warren County. I have identified the census blocks that were common to both the old and new districts, summed up their current population, and divided by the population size of the new districts (786,630). This exercise reveals that around 81 percent of Mr. Chabot's current district is composed of people who were in the previous manifestation of District 1. As a result, there is no reason to anticipate that his incumbency advantage will suddenly disappear. If we consider incumbency, a more realistic projection of Mr. Chabot's likely vote share in the future, then, might approach 56 percent.

36. It would be even more misleading to characterize District 10 as competitive. For instance, the Republican vote share in statewide races (from 2016 to 2020) in District 10 is around 53 percent, down slightly from 54 percent in the previous redistricting cycle. However, the Republican incumbent, Mike Turner, won each general election from 2012 to 2020 with an average two-party vote share above 62 percent (see Figure 3). Once again, as with District 1, the incumbent enjoyed a massive incumbency advantage—around 8.7 percentage points. And District 10 is the only district in which the incumbent retained *more* of their old district than District 1: 89.7 percent of the population of District 10 in the new Enacted Plan was in Representative Turner's previous District 10. So again, there is no reason to anticipate that this advantage will suddenly disappear. Putting these facts together, one simply cannot characterize District 10 in the Enacted Plan as competitive.

37. Likewise, Districts 14 and 15 cannot be classified as competitive. As shown in Table 2, both are districts with Republican incumbents where the statewide 2016-2020 Republican vote share hovered around 54 percent. However, as we can see in Figure 4, both incumbents substantially outperformed their party's statewide vote share, by 5.6 percentage points in District 14, and 6.9 percentage points in District 15. District 14 retained 69 percent of the voters from its earlier manifestation, and District 15 retained 42 percent. Again, once we consider incumbency, as with District 10, even if we accept Senator McColley's rather unusual characterization of districts with an anticipated Republican vote share of 54 percent as "competitive," we cannot characterize Districts 14 and 15 as competitive.

38. In sum, it is quite difficult to oust a congressional incumbent in Ohio. Recall from Table 1 that the average Democratic vote share in statewide races from 2012 to 2020 was 45.9 percent. However, recall from Figure 1 that there were substantial year-to-year deviations in statewide results. If we take yearly averages, we see that the biggest pro-Democratic deviations were in 2012, where the average Democratic vote share in statewide offices was 52.3 percent, and in the "blue wave" of 2018, when it was 48.7 percent. There were also large pro-Republican deviations in 2014 (average Democratic vote share of 38.7 percent) and 2016 (42.4 percent). In spite of the presence of several districts that Senator McColley would designate as competitive—with a statewide Republican vote share between 46 and 54

percent—even shifts of 6 and 7 percentage points in statewide vote shares from the decade average did not dislodge a single incumbent.

39. With this fuller understanding of incumbency in hand, we can see that the only districts that appear to be competitive in the Enacted Plan are Districts 9 and 13—both district numbers that corresponded to what were comfortable Democratic districts in the old plan. In District 9, the district leans Republican in statewide races, but in the past, Representative Kaptur has outperformed her statewide co-partisans by over 6 percentage points (Figure 4). However, in contrast to Districts 1 and 10, where Republican incumbents in more competitive districts retained more than 80 percent of their old district population, only around 40 percent of the population of the new version of Representative Kaptur's district was part of her previous configuration of District 9, and the new population in her district is quite Republican. As a result, she may not be able to rely on a similar level of incumbency advantage as Representatives Chabot and Turner.

40. Finally, it is noteworthy in this regard that the Enacted Plan would be in place for only four years; meaning that it can be redrawn in short order if any incumbents retire. The short duration of the Enacted Plan thus allows the mapdrawers to more aggressively rely on incumbency advantages than may be prudent for a map that will remain in effect for a 10-year period.

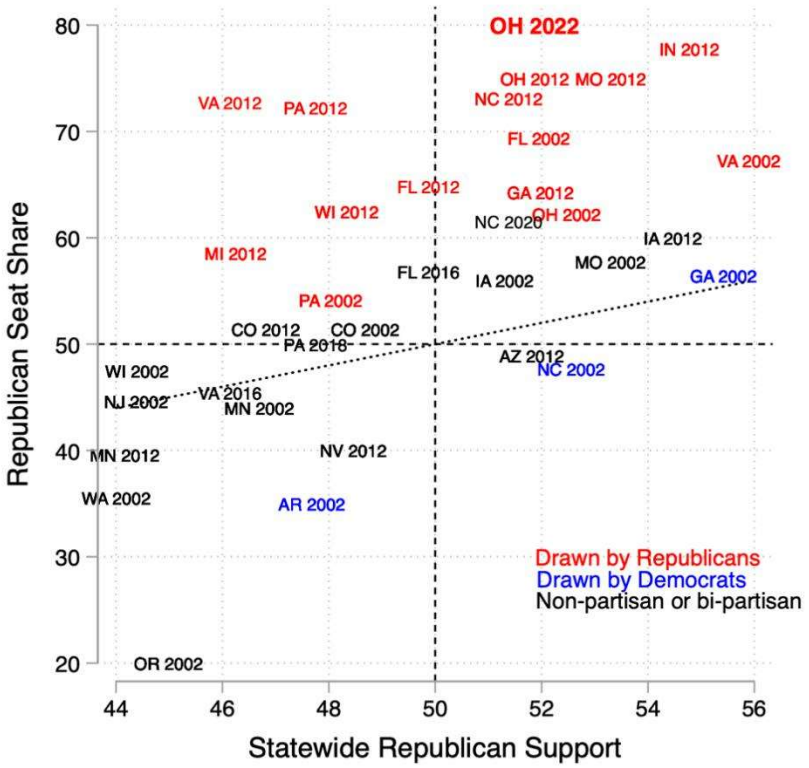
41. In sum, a reliable assessment of the likely partisan results associated with the Enacted Plan—considering all available statewide election results and accounting for the role of incumbency—indicates that the Enacted Plan creates 11 safe Republican districts, 2 safe Democratic districts, and 2 districts that are likely to be quite competitive. If we give each party a 50 percent probability of victory in each of the two competitive districts, we are left with the conclusion that the Democrats can expect to win only 3 of 15 seats under this plan, which corresponds to a 20 percent seat share.

V. PUTTING THE 2021 CONGRESSIONAL PLAN IN PERSPECTIVE

42. In any two-party democracy, it is not normal for a party with an average of 53.2 percent of the vote to receive 80 percent of the seats. In fact, even in the United States, which has maintained the idiosyncratic practice of allowing incumbent partisan majorities to draw their own districts without constraint, this is a highly unusual result. To see this, let us focus on a set of states that are comparable to Ohio in that they have seen relatively competitive statewide races in recent decades and are large enough to have four or more congressional districts. To measure statewide partisanship in a way that facilitates cross-state comparison, I have assembled data on presidential and U.S. Senate elections. For each redistricting cycle, I calculate the average Republican share of the two-party vote in Senate and presidential elections.[12] Next, for each redistricting cycle, I calculate the share of all congressional seats won by Republican candidates.

[12] In a few states, I also have access to data on statewide executive offices, e.g., Governor, Attorney General, Railroad Commissioner, Treasurer, and the like. However, the mix of elected offices

Figure 5: Vote Shares in Statewide Elections and Seat Shares in Congressional Elections, Evenly Divided States with Four or More Districts, 2000 through 2020 Redistricting Cycles



43. In Figure 5, the data markers indicate the state and the year that the relevant redistricting plan went into effect. States with districts drawn by legislatures under unified Republican control are indicated in red. States with districts drawn by independent commissions, courts, or divided legislatures are indicated in black. And states where districts were drawn under unified Democratic control are indicated in blue.[13] The dotted line indicates proportionality—where, for instance, 50 percent of the vote translates into 50 percent of the seats, 52 percent of the vote translates into 52 percent of the seats, and so on. In Figure 5, in order to focus on states most similar to Ohio and facilitate legibility, I zoom in on a group of

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varies from one state to another, and comparable data are unavailable in some states. I elect to use statewide races for *national* elections only (president and U.S. Senate) in order to facilitate cross-state comparison.

[13] Information about control of the redistricting process was obtained from https://redistricting.lls.edu/.

the most evenly divided states. I also include in the appendix a graph that presents the exact same information, but zooms out to include all the states with four or more districts—including those, like Massachusetts and Oklahoma—that are dominated by one party or the other, and where the dominant party ends up winning all, or nearly all, of the seats.

44. For the most part, districts drawn by courts, divided legislatures, and independent commissions come closer to proportionality than those drawn by legislatures with unified party control of state government. This can be seen most clearly *within* states where the districts were redrawn during a redistricting cycle due to litigation—including Virginia, Pennsylvania, North Carolina, and Florida. In these states, Republican-drawn maps led to Republican seat shares far beyond the party's statewide support, and plans drawn by courts came much closer to proportionality. While Democrats have controlled the redistricting process in very Democratic states like Maryland, Illinois, and Massachusetts (see the appendix), they have rarely done so in the relatively competitive states featured in Figure 5. But the Republican Party has been able to draw the districts over the last two redistricting cycles in a large number of relatively competitive states, including Florida, Michigan, Virginia, Pennsylvania, Wisconsin, North Carolina, Georgia, Missouri, Indiana, and Ohio. As can be seen in Figure 5, throughout the range of statewide vote shares—from Democratic-leaning states like Pennsylvania to Republican-leaning states like Indiana—Republican candidates have been able to win surprisingly large seat shares in the states where districts were drawn by unified Republican legislatures. This group includes notoriously gerrymandered states, including North Carolina, Pennsylvania, and Florida, where state courts eventually invalidated maps that favored Republicans in ways that violated state constitutions.

45. Even among this group of highly partisan maps, Ohio stands out. The data marker titled "Ohio 2012" corresponds to the observed seat share of Republican candidates throughout the 2010 redistricting cycle (12 of 16 seats in each election, or 75 percent). And the bold data marker titled "Ohio 2022" is the anticipated seat share, calculated as described above at 80 percent, for the 2021 Congressional Plan. It should be stressed that this data point is different in kind from the others. All of the other data markers in Figure 5 are *observed* congressional seat shares from the past. The "Ohio 2022" data marker is a *predicted* seat share based, as described above, on past statewide elections.

46. As can be visualized in Figure 5, with one exception, the absolute vertical distance from the dotted line of proportionality to the "Ohio 2022" data marker is larger than for all other relatively competitive states with four or more districts over the last two redistricting cycles.[14]

47. When attempting to assess the impact of a redistricting plan on the relative advantage or disadvantage it provides to the parties, it is important to go beyond simply calculating the difference between a party's statewide support and its seat share. For many realistic scenarios in which partisans are distributed across districts without political manipulation of the district

[14] The exception is Oregon between 2002 and 2010, where the Democratic candidates won the four coastal districts and the Republican candidate won the single interior district in spite of a statewide Republican vote share of around 45 percent.

boundaries, we can anticipate that the party with more votes will usually win more than a proportional share of seats. To see why this is true, imagine a simple example of a state with 15 districts, where there are 10 voters in each district, and party registration is distributed as displayed in the columns labeled "Example 1" in Table 4 below.

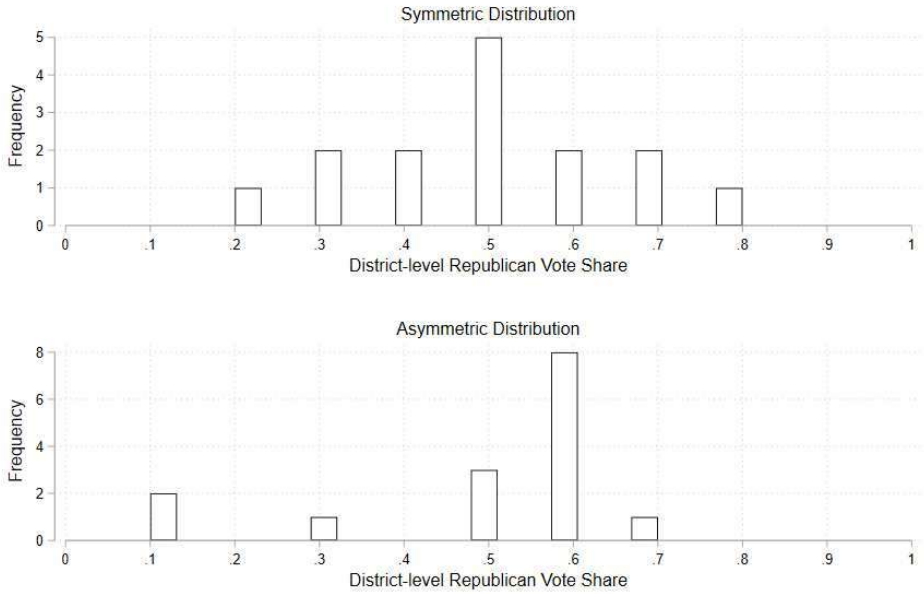
Table 4: Examples of Symmetric and Asymmetric Distributions of Votes Across Districts in a Hypothetical State

	Example 1: Symmetric Distribution		Example 2: Asymmetric Distribution	
District	Democrats	Republicans	Democrats	Republicans
1	2	8	3	7
2	3	7	4	6
3	3	7	4	6
4	4	6	4	6
5	4	6	4	6
6	5	5	4	6
7	5	5	4	6
8	5	5	4	6
9	5	5	4	6
10	5	5	5	5
11	6	4	5	5
12	6	4	5	5
13	7	3	7	3
14	7	3	9	1
15	8	2	9	1

48. In this example, there are 75 Democrats and 75 Republicans. Under normal circumstances, each party can expect to win 5 districts, but 5 districts are toss-ups containing even numbers of Democrats and Republicans.

49. The top panel of Figure 6 below uses a histogram—a simple visual display of the data from Table 4—to display the distribution of expected vote shares of the parties across districts in this hypothetical state, with its symmetric distribution of partisanship.

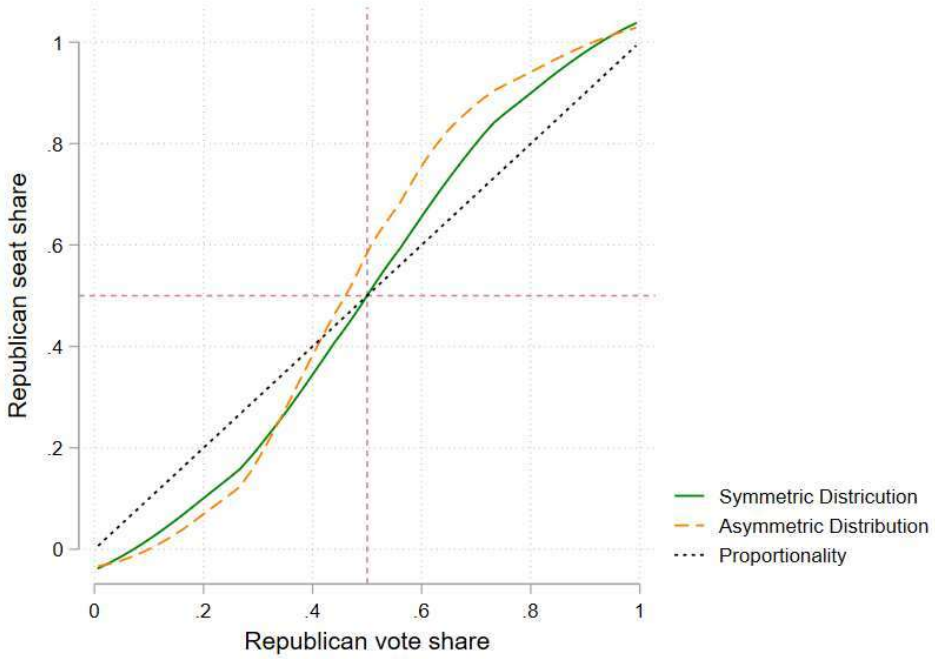
Figure 6: Distribution of Vote Shares Across Districts in Two Redistricting Plans in Hypothetical State



50. Let us assume that the partisanship of some of the individuals in this state is malleable, such that a successful campaign, a good debate performance by a candidate, or a strong economy leads some of the registered Democrats to vote for Republicans. Let us randomly choose one Democrat in the state and turn her into a Republican. Let us perform this random vote-flipping exercise 10,000 times, take the average, and see how this very small change in voting behavior—just one party-switcher out of 150—can be expected to affect the parties' seat shares. Let us do that with two of the Democrats, three, and so on, all the way until the overall Republican vote share approaches 100 percent. We can perform the same operation in the other direction, systematically turning random Republicans into Democrats.

51. How do these alternative scenarios affect the seat share? The result of these simulated scenarios is displayed with the green line in Figure 7. The horizontal axis is the Republican vote share, and the vertical axis is the corresponding seat share. The green line provides a plot of what happens to the seat share as the Republican vote share increases and decreases from 50 percent.

Figure 7: Hypothetical symmetric vote-seat curve



52. The green line in Figure 7 is a standard vote-seat curve associated with a symmetric distribution of partisanship across districts. It is a foundational observation in the literature on majoritarian elections that when the distribution of partisanship across districts approximates the normal distribution, with its bell-shaped appearance, the transformation of votes to seats will look something like the green line in Figure 7. With 50 percent of the vote, a party can expect 50 percent of the seats. However, note what happens when the Republican Party is able to obtain 55 percent of the votes—it receives around 60 percent of the seats. This phenomenon is known as the "winner's bonus." This happens because there are several districts where the underlying partisanship of the electorate is evenly divided, such that with 55 percent of the overall statewide vote, the Republican Party can win several of these pivotal districts, thus providing it with a disproportionate share of the seats.

53. When we observe a situation in which a party wins 55 percent of the vote but something like 59 or 60 percent of the seats, we cannot necessarily conclude, without further analysis, that the district boundaries have been drawn to help or harm a political party. The "winner's bonus" is a basic feature of majoritarian electoral systems. An important feature of the green line in Figure 7, however, is that it treats each party exactly the same. That is, the Democrats can expect the exact same "winner's bonus" as the Republicans when they are able to win over more votes. This partisan symmetry is a lower standard to meet than one that requires proportional outcomes, because it merely ensures that any "winner's bonus" could be applied to either party relatively evenly, and that thus, both parties have similar incentives to be responsive to voters.

54. Next, let us consider the same state, with the same even split in party registration, but with a different set of district boundaries, drawn strategically to favor the Republican Party. In this example, provided numerically on the right-hand side of Table 4 (labeled as "Example 2"), and visually with a histogram in the lower panel of Figure 6, Democrats are "packed" into three extremely Democratic districts, and districts have been drawn so as to avoid Democratic majorities to the extent possible elsewhere. There are fewer truly competitive districts, and there is a much larger number of districts that are comfortably, but not overwhelmingly, Republican. With this type of arrangement, with 50 percent of the vote, the Republicans can expect to win well over half the seats.

55. I apply the same simulation procedure as described above and display the resulting relationship between seats and votes with the orange dashed line in Figure 7. We can see that in this example, the Republican Party enjoys a substantial advantage in the transformation of votes to seats over Democrats. It can lose a majority of votes statewide but still win legislative majorities, and it receives a very large seat premium when it achieves even a slight victory in statewide votes. In this second example, the treatment of the two parties is far from symmetric.

56. Political scientists and geographers have attempted to measure this type of asymmetric distribution of partisans across districts—and the resulting asymmetry in the transformation of votes to seats. What has now become the most common approach is rooted in the work of British political geographers. In his 2000 Annual Political Geography Lecture, Ron Johnston described "wasted votes" as votes obtained in constituencies that a party loses, while "surplus votes" are additional votes obtained by a party in constituencies it wins beyond the number needed for victory.[15] In the example above, for instance, 6 is the number of votes required for victory in each district. Thus, if a party received 9 votes, 3 of them would be considered "surplus." In that same district of 10 voters, the losing party received 1 "wasted" vote. Johnston calculated wasted and surplus votes for the Labour and the Conservative parties in post-war British elections, as well as the share of "effective" votes received by each party: that is, votes that were neither "wasted" nor "surplus." The latter is a measure of the relative efficiency of support for the parties, and the gap between them is an indicator of the extent to which support for the Conservatives has been more efficient than support for Labour (or vice-versa).

57. More recently, Nicholas Stephanopoulos and Eric McGhee have adapted this concept to the context of redistricting and gerrymandering in the United States.[16] The terminology is slightly different. For Stephanopoulos and McGhee, the term "wasted votes" captures not just the votes obtained in a constituency the party lost, but also the surplus votes obtained in districts the party won: what Johnston called "ineffective votes." For Stephanopoulos and McGhee, "wasted votes" are all the votes received by a party in districts that it loses, combined with all the surplus votes beyond the winning threshold in districts it wins. They calculate the total wasted votes for each party in each district, tally them over all districts,

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[15] Ron Johnston. 2002. "Manipulating Maps and Winning Elections: Measuring the Impact of Malapportionment and Gerrymandering." *Political Geography* 21: pages 1-31.

[16] See Nicholas Stephanopoulos and Eric McGhee, 2015, "Partisan Gerrymandering and the Efficiency Gap." *University of Chicago Law Review* 82,831.

and divide by the total number of votes cast. They refer to this construct as the "efficiency gap." To see how this works, let us return to our examples.

58. Table 5 includes columns to capture wasted votes for the Republicans and Democrats in both hypothetical examples. In the first example, the Republicans win the first district in a landslide, 8-2. They waste two votes (since they only needed 6 to win), and the Democrats waste two votes in their losing effort. At the bottom of the table, I sum the wasted votes for each party. The Democrats and Republicans each waste the same number of votes, 20. Thus, the efficiency gap is zero.

59. Next, consider the second example. The Republicans have a very efficient distribution of support such that they received six votes in several districts, while the Democrats wasted votes in a handful of districts that they won by large majorities. In this example, the Republicans waste only three votes while the Democrats waste 42. Thus, there is an efficiency gap of 39, which amounts to 26 percent of all votes cast.

Table 5: Efficiency Gap Calculations in Hypothetical Examples

	Example 1: Symmetric Distribution				Example 2: Asymmetric Distribution			
District	Dem	Rep	Dem Wasted Votes	Rep Wasted Votes	Dem	Rep	Dem Wasted Votes	Rep Wasted Votes
1	2	8	2	2	3	7	3	1
2	3	7	3	1	4	6	4	0
3	3	7	3	1	4	6	4	0
4	4	6	4	0	4	6	4	0
5	4	6	4	0	4	6	4	0
6	5	5	0	0	4	6	4	0
7	5	5	0	0	4	6	4	0
8	5	5	0	0	4	6	4	0
9	5	5	0	0	4	6	4	0
10	5	5	0	0	5	5	0	0
11	6	4	0	4	5	5	0	0
12	6	4	0	4	5	5	0	0
13	7	3	1	3	7	3	1	0
14	7	3	1	3	9	1	3	1
15	8	2	2	2	9	1	3	1
Total	75	75	20	20	75	75	42	3

60. Let us now apply this approach to the 2021 Congressional Plan in Ohio. First, I have summed up all the votes received by Democratic and Republican candidates in each of the statewide races from 2016 to 2020 listed above, and use these sums to calculate the efficiency gap. Aggregating precinct-level data from these races to the level of districts in the Enacted Plan, we see the efficiency gap associated with the Enacted Plan is quite large—24 percent—indicating that Republicans' votes are distributed across districts with far greater efficiency than those of Democrats. In fact, the distribution of partisanship created by the General Assembly's plan is quite similar to that in the second hypothetical example of Table 4.

61. In order to put this in perspective, it is useful to engage in some simple cross-state comparisons. As a metric, the efficiency gap is known to be less reliable in non-competitive states, as well as states with few congressional districts. Thus, I calculate the efficiency gap for the districts used in the last redistricting cycle, focusing on states with more than four congressional districts among the relatively competitive states featured in Figure 5 above. One drawback of the efficiency gap is that the measure is not always stable for a set of districts when one switches from using data from one election to another, depending on the individual quirks of incumbents and challengers, and patterns of split-ticket voting. In order to compare apples with apples and mitigate candidate-specific effects, I use data from the 2016 and 2020 presidential elections, aggregated to the level of congressional districts.

62. Using data from the 2016 presidential election, the efficiency gap associated with the Enacted Plan is almost identical to what I calculated using all of the Ohio statewide elections from 2016 to 2020: 24 percent. I also calculated the efficiency gap using the 2016 presidential election for the other large, competitive states discussed above. The efficiency gap associated with the Enacted Plan is larger than those observed in Colorado, Florida, Missouri, Arizona, Virginia, Indiana, Minnesota, Michigan, Georgia, and Wisconsin, surpassed only by Pennsylvania's notorious (and ultimately invalidated) map, where the efficiency gap calculated using 2016 presidential data was 38 percent.

63. Using data from the 2020 presidential election, the efficiency gap associated with the Enacted Plan is around 16 percent. This is slightly lower than the 24 percent figure associated with all statewide races, largely because relative to a typical statewide race in Ohio, the Republican candidate, Donald Trump, won by larger margins in rural areas, hence producing more wasted votes for Republicans, and Democratic candidate Joseph Biden won by slightly smaller margins in urban core areas, leading to slightly fewer wasted votes for Democrats. A similar phenomenon occurred in other states, however, and 16 percent is larger than the efficiency gap calculated using 2020 data for any of the other states mentioned above, this time with the exception of Wisconsin, where the efficiency gap was 27 percent.[17]

64. In addition to the efficiency gap, another approach to measuring partisan asymmetry is to calculate so-called electoral bias.[18] This approach flows directly from the vote-seat curves in

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[17] Note that I do not have 2020 presidential data aggregated to the level of the court-invalidated Pennsylvania districts that were no longer in use in 2020.

[18] See Edward Tufte. 1973. "The Relationship Between Seats and Votes in Two-Party Systems," *American Political Science Review* 67: pages 540-554; Bernard Grofman. 1983. "Measures of Bias

Figure 7 above. Recall that because of the "winner's bonus" and the typical shape of vote-seat curves, if we observe that a party gets a seat share that is higher than its vote share, it could very well be the case that the other party would receive a similar bonus if it had received a similar vote share. We would like to know if, with a similar share of the vote, the parties can expect similar seat shares. If not, it indicates the presence of electoral bias favoring one party over the other.

65. From the observed distribution of district-level election results, one can simulate the relationship between votes and seats under other hypothetical vote shares than the one observed. Above all, it is useful to examine the hypothetical of a tied election: With 50 percent of the vote, can each party expect 50 percent of the seats? Or can one party expect a larger seat share due to its superior efficiency of support across districts? In the examples above, there is no electoral bias in the symmetric case, but in the asymmetric example, the (pro-Republican) electoral bias is 10 percent. This can be seen in Figure 7 above: a 50 percent vote share on the horizontal axis corresponds to a 60 percent seat share on the vertical axis.

66. I calculate the electoral bias based on all Ohio statewide elections from 2016 to 2020. This approach indicates that in a tied election, the Republican Party could nevertheless expect to win 10 of 15 seats, or around 66.7 percent, under the Enacted Plan. The measure of electoral bias, then, is 16.7 percent.

67. In recent years there has been a lively debate about whether courts should adopt a specific measure as a "talismanic" indicator of impermissible gerrymandering. The approach of this report is neither to contribute to this debate nor endorse a specific measure. For the most part, critics of the various measures often dwell on the prospect that they will produce false negatives. That is, they might fail to recognize a gerrymander when one is in fact present.[19]

68. As can be appreciated from the discussion above, these metrics are not always stable when we switch from the analysis of one type of election to another. Statewide results and the spatial distribution of support can vary across elections in ways that push pivotal districts above the 50 percent threshold in some races but not others—especially when we are simulating hypothetical tied elections in order to calculate electoral bias. Perhaps the most vexing problem with these indicators is that, when we are attempting to assess the likely seat share associated with future elections in the next redistricting cycle from a single statewide election—for instance a presidential election—we ignore the power of incumbency. As described above, Ohio's Republican congressional incumbents typically outperform

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and Proportionality in Seats-Votes Relationships," *Political Methodology* 9: pages 295-327; Gary King and R. Browning, 1987. "Democratic Representation and Partisan Bias in Congressional Elections," *American Political Science Review* 81: pages 1251-1273; Andrew Gelman and Gary King. 1994. "A Unified Method of Evaluation Electoral Systems and Redistricting Plans," *American Journal of Political Science* 38, pages 514-544; and Simon Jackman. 1994. "Measuring Electoral Bias: Australia 1949-1993," *British Journal of Political Science* 24: pages 319-357.

[19] See, for instance, Jonathan Krasno, Daniel Magleby, Michael, D. McDonald, Shawn Donahue, and Robin Best. 2018. "Can Gerrymanders be Measured? An Examination of Wisconsin's State Assembly," *American Politics Research* 47,5: 1162-1201, arguing that the efficiency gap often produces false negatives.

statewide candidates by several percentage points. Thus, there is reason for deep skepticism about the notion that a statewide swing of 3 percentage points, for instance, would yield a Democratic victory in District 1 as drawn by the General Assembly, or that a statewide swing of four percentage points would yield a Democratic victory in District 15.

69. In any case, whether we analyze the map using 1) a simple comparison of the anticipated seat share with the statewide vote share, 2) a measure of the efficiency of support across districts, or 3) electoral bias, it is clear that the Enacted Plan's districts provide a very substantial benefit to the Republican Party. That is, under any of these measures, and with regard to any of the individual elections or aggregated election results considered above, the 2021 Congressional Plan significantly advantages the Republican Party.

VI. HOW DOES THE 2021 CONGRESSIONAL PLAN TREAT INCUMBENTS?

70. In addition to analyzing the extent to which the Enacted 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. All of the remaining districts with Republican incumbents continue to have Republican majorities—most of them quite comfortable.

71. The only district with a Republican incumbent worthy of further discussion is District 1. The district had previously been drawn to bisect Cincinnati, which had the effect of preventing the emergence of a majority-Democratic district in a heavily Democratic urban area by creating two districts in which parts of Cincinnati were subsumed into Republican exurban and rural areas. The Ohio Constitution now requires that Cincinnati be wholly contained within a single district, which, to my understanding, given their residential addresses, required that two Republican incumbents end up in the same district (although there is no in-district residency requirement for candidates for the U.S. House in Ohio). However, one of the ostensibly paired incumbents, Representative Brad Wenstrup, has announced that he intends to seek re-election in District 2, thereby eliminating the possibility of a double-bunking of incumbents in District 1.[20]

72. In the Enacted Plan, District 1 includes many of the suburban and rural areas that existed in the previous District 1, where Steve Chabot is a long-serving incumbent. By carving out the Democratic suburban areas north of Cincinnati and combining the city with extremely Republican rural areas, the legislature has managed to unify Cincinnati while only slightly increasing the district's Democratic vote share, thus likely keeping it safe for the Republican incumbent, who, as mentioned above, has benefited from a large incumbency advantage, and will compete in a new district where over 80 percent of the population was in his old district.

[20] 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.

73. 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.

74. In contrast, of the four Democratic incumbents, only two continue to reside in majority-Democratic districts. 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 now has a Republican majority. As described above, less than 40 percent of the new version of District 9 was in her previous district. 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 6th District in the Enacted Plan.

VII. HOW DOES THE 2021 CONGRESSIONAL PLAN ACHIEVE THESE RESULTS?

75. Without a doubt, the Enacted Plan favors the Republican Party and its many incumbents, while disfavoring the Democratic Party and its handful of incumbents. One might suspect, however, that this outcome was driven not by the choices of the map-drawers, but by the Ohio Constitution—with its requirements about keeping counties, cities, and townships whole—combined with Ohio's political geography. I have written extensively about the difficulties for parties of the left in majoritarian democracies like the United States in an era when population density is becoming highly correlated with votes for more progressive candidates.[21] Democrats are highly concentrated in cities and, increasingly, their suburbs. When cities are very large relative to the size of districts, this tends to create some districts in which Democrats win very large majorities. This can make their geographic distribution of support relatively less efficient if Republican majorities in rural areas are not correspondingly large. Thinking visually in terms of cross-district histograms, like those in Figure 6 above, the presence of overwhelmingly Democratic cities can pull out the left tail of the distribution, thus wasting some Democratic votes. Anyone drawing congressional districts—including a non-partisan computer algorithm or even a Democratic activist—is likely to draw a very Democratic district in Cleveland or Columbus. It is also the case that such a map-drawer cannot avoid creating some extremely Republican districts in rural areas.

76. However, the larger implication of this type of political geography for the transformation of votes to seats depends crucially on what is happening in the middle of the distribution of districts. This is precisely where those drawing the districts have maximum discretion. With a very Democratic city like Cincinnati that is *not* especially large relative to the size of congressional districts, it is possible to avoid the emergence of a Democratic district altogether by cutting off its most Democratic suburbs—splitting communities of interest along the way—and combining it with far-flung rural areas. If smaller Democratic cities are close to one another, as in northwestern Ohio, or as in the Canton/Akron/Youngstown area,

[21] Jonathan Rodden, 2019, *Why Cities Lose: The Deep Roots of the Urban-Rural Political Divide*. New York: Basic Books.

boundaries can be drawn to make sure they do not combine to form any district with an urban, and hence Democratic, majority. And when cities are sufficiently large that they must be subdivided, and can thus provide *two* Democratic majorities, as in Columbus, it is possible to conduct this subdivision in a way that prevents the emergence of a second Democratic district by packing as many Democratic votes into a single district as possible and subsuming the remaining Democrats in very Republican rural areas. The legislature has pursued each of these strategies to prevent the emergence of majority-Democratic districts in Ohio.

77. In my academic research, I have shown that residential geography can make life easier for those drawing districts with the intent of favoring Republicans. With maneuvers like those described in the preceding paragraph, a Republican map-drawer can produce a substantial advantage for Republican candidates without drawing highly non-compact or odd-shaped districts. My research has also pointed out that a mere concentration of Democrats in cities is insufficient to produce advantages for Republican candidates. It is clearly the case that in states where Republicans have controlled the redistricting process, districts have favored Republican candidates far more than what might be explained by residential geography alone. Recall the striking difference between the black and red data markers in Figure 5 above, indicating that with similar levels of partisanship, districts drawn by Republican legislatures have had far larger Republican seat shares than those drawn by courts, commissions, and divided legislatures. In fact, in my academic writings, I have used Ohio in the 2010 redistricting cycle as a leading example of this phenomenon.[22]

78. In order to verify that the extreme pro-Republican bias described above was not forced upon the legislature by the Ohio Constitution or the residential geography of Ohio, it is useful to conduct a simple exercise: we can examine the congressional maps submitted by Democrats and other groups to the state legislature. The purpose of this exercise is not to recommend these maps for adoption. Rather, these maps are useful because they were available to the legislature prior to adopting the Enacted Plan and, if they comply with the Constitution,[23] demonstrate similar or superior compactness, pursue fewer unnecessary county splits, and are less prone to splitting obvious communities of interest, we can conclude that the extreme pro-Republican slant of the Enacted Plan was not driven by residential geography or constitutional requirements, but by discretionary choices.

79. Figure 8 provides discrete histograms of the composite vote share of statewide Republican candidates from 2016 to 2020—the same measure used extensively above—aggregated to boundaries of proposed congressional districts. The top left panel represents the Enacted Plan. The panels on the right represent districts proposed by the House (top) and Senate (bottom) Democrats, attached as Exhibits C and B, respectively. In the lower left-hand

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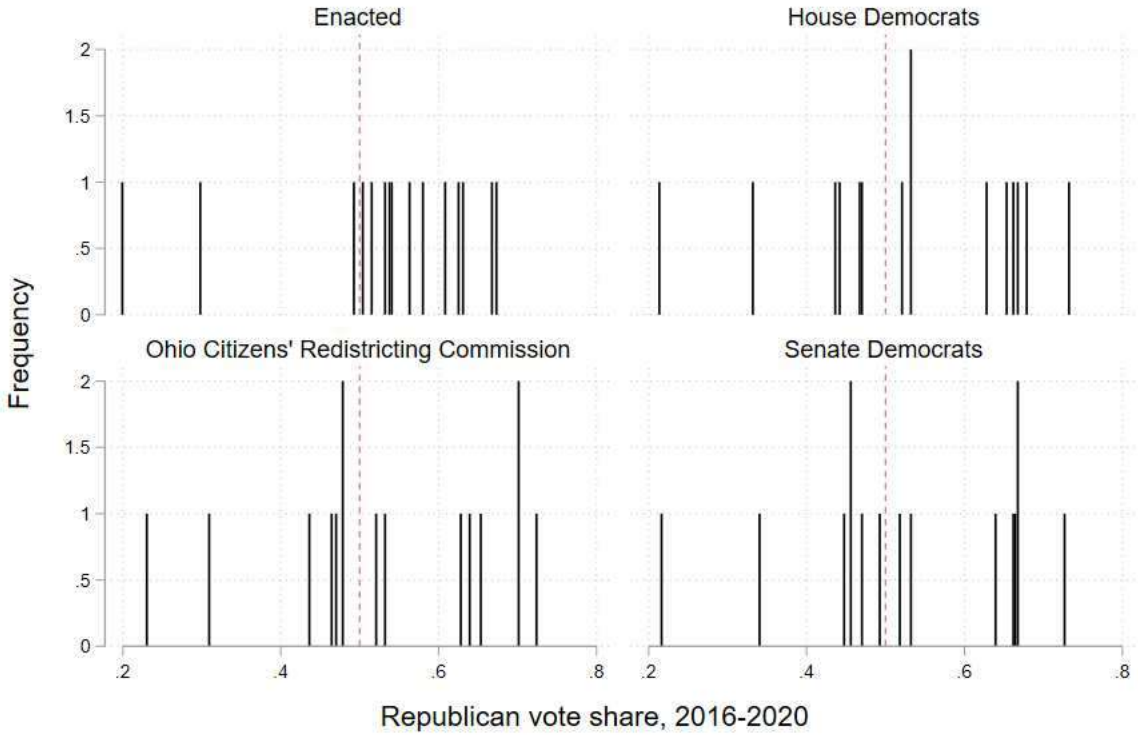
[22] See, for example, *Why Cities Lose*, op cit., Figure 6.2 on page 171 and the surrounding discussion, as well as Figure 6.8 on page 184 and the accompanying discussion in the text.

[23] I have carefully examined these plans, and according to my review, the only clear constitional compliance issue arises with the Senate Democrats' plan, where a single house on the border of Massillon City was mistakenly placed in District 8 rather than District 7, creating a very minor non-contiguity. See the appendix for an image of the misplaced fragment. Needless to say, this mistake does not undermine the usefulness of the map for comparative analysis.

corner, I include a districting plan submitted by a group called the Ohio Citizens Redistricting Committee (OCRC), attached as Exhibit D.

Figure 8: Histograms of Enacted and Alternative Maps



80. Note that all the histograms share something in common: each includes two extremely Democratic districts on the left-hand side of the graph. In each case, one is in Cleveland and one in Columbus. However, as described above, the Enacted Plan only includes a single additional district that is (barely) on the Democratic side of 50 percent, for a total of three. In the other comparison maps, there are seven districts with Democratic majorities in statewide races, six in the case of the House Democrats' plan. Thus, the Senate Democrats' plan and the OCRC plan, where 46.7 percent of the districts have Democratic majorities in statewide races, correspond almost exactly with the statewide aggregate vote share (see Table 1 above), while the House Democrats' plan falls short by one seat. In other words, if these maps were included in Figure 5 above, they would be on, or slightly below, the dotted line of proportionality, much like the court-drawn maps in Figure 5.

81. The Enacted Plan is also unique in that it avoids creating extremely Republican rural districts on the right side of the histogram. The vast majority of districts have comfortable but not staggering Republican majorities. As discussed above, Senator McColley has portrayed the presence of several solidly but not overwhelmingly Republican districts, all with longstanding Republican incumbents, as a virtue of the map, in that it introduces "competition." However, in a state where only 53 to 54 percent of the votes go to

Republicans, it is simply not possible to create 12 of 15 districts in which Republican candidates win with over 54 percent of the vote. In all, the cross-district distribution of support in the Enacted Plan is a textbook example not of a plan with highly competitive districts that may swing from one election to the next, but, rather, of a distribution that is extremely efficient for one party and inefficient for the other. As mentioned above, the efficiency gap (using composite statewide election results between 2016-2020) is 24 percent. The other maps are far more even-handed. For the House Democrats' plan, it is 3.5 percent (still favoring Republicans). For the Senate Democrats' plan and the OCRC plan, the distribution of support is slightly more efficient for the Democrats, with gaps that are swung in the other direction of 3.7 percent and 3.6 percent, respectively.

Table 6: Comparison of Enacted Plan with Alternative Plans	Seats in which statewide Democratic vote share exceeds 50 percent	Efficiency gap
Enacted	3	24%
Senate Democrats	7	-3.7%
House Democrats	6	3.5%
OCRC	7	-3.6%

Note: Efficiency gap is calculated so that a positive number indicates pro-Republican efficiency gap.

82. What accounts for these large differences in the efficiency of support for the two parties in the different maps? Above all, the remainder of this report demonstrates that the answer lies in the treatment of urban areas.

Cincinnati

83. First, consider the Enacted Plan's treatment of Hamilton County. Any treatment of Hamilton County that attempts to minimize splits and keep Cincinnati-area communities together would produce a majority-Democratic district. Any such district would keep northern suburbs with large Black populations together with similar neighborhoods across the Cincinnati boundary. Each of the alternative maps keeps Hamilton County mostly whole and keeps the Black community together in a relatively compact district contained entirely within the county.

84. However, the Enacted Plan traverses the Hamilton County boundary in *three* different places in order to overwhelm Cincinnati's Democratic population with a sufficient number of exurban and rural Republicans. The entire urban, Black population of Northern Hamilton County is carved out from its surroundings and combined with a rural Republican district, number 8, whose northern boundary is 85 miles away. Second, instead of being combined with its immediate inner-ring suburbs, for instance, linking neighborhoods like College Hill and North College Hill (see Figure 11), Cincinnati proper is combined with rural Warren

County via a very narrow corridor in District 1. Finally, Cincinnati's relatively Democratic eastern suburbs are also extracted from the city and combined with District 2, which is extremely rural and Republican.

Figure 9: Partisanship and the Enacted Plan's Districts, Hamilton County and Surroundings

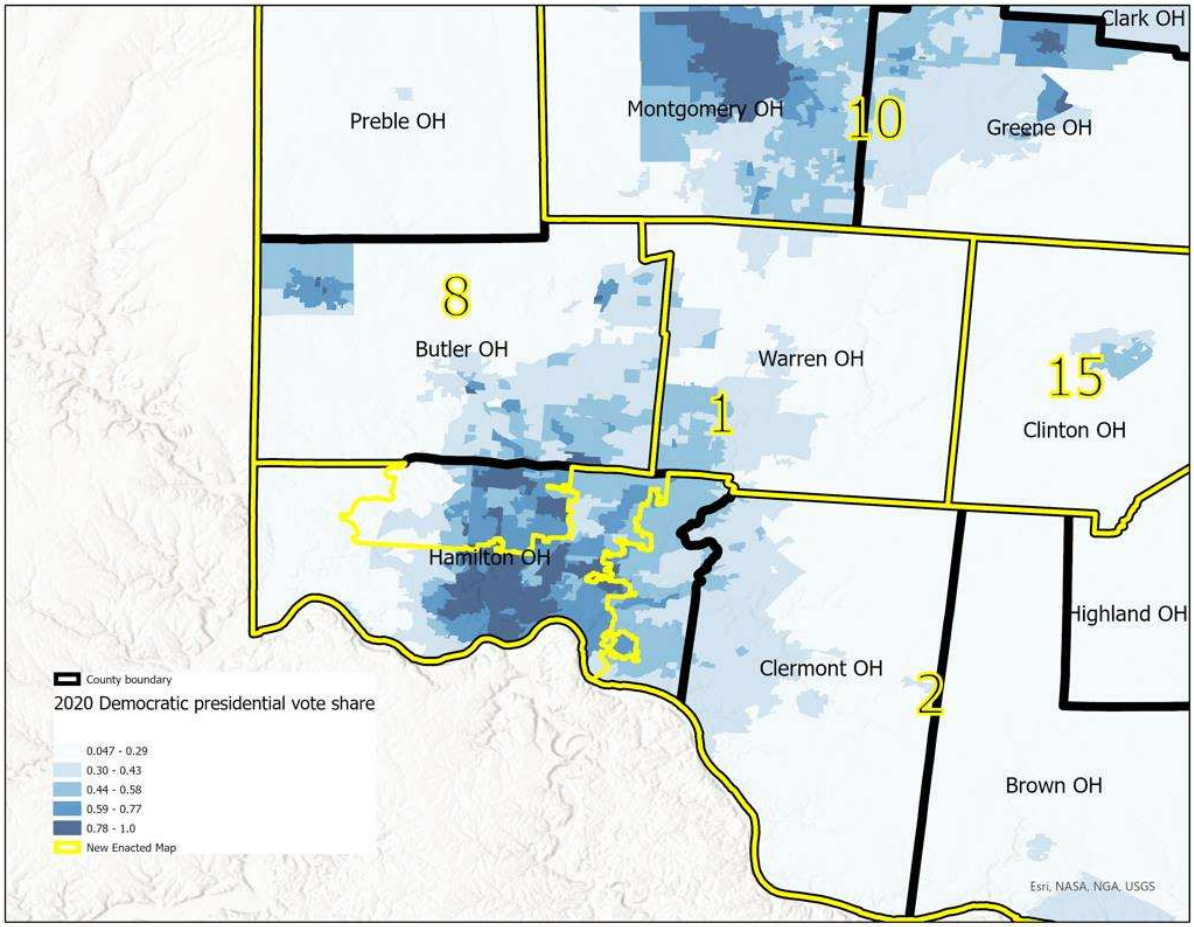


Figure 10: Race and the Enacted Plan's Districts, Hamilton County and Surroundings

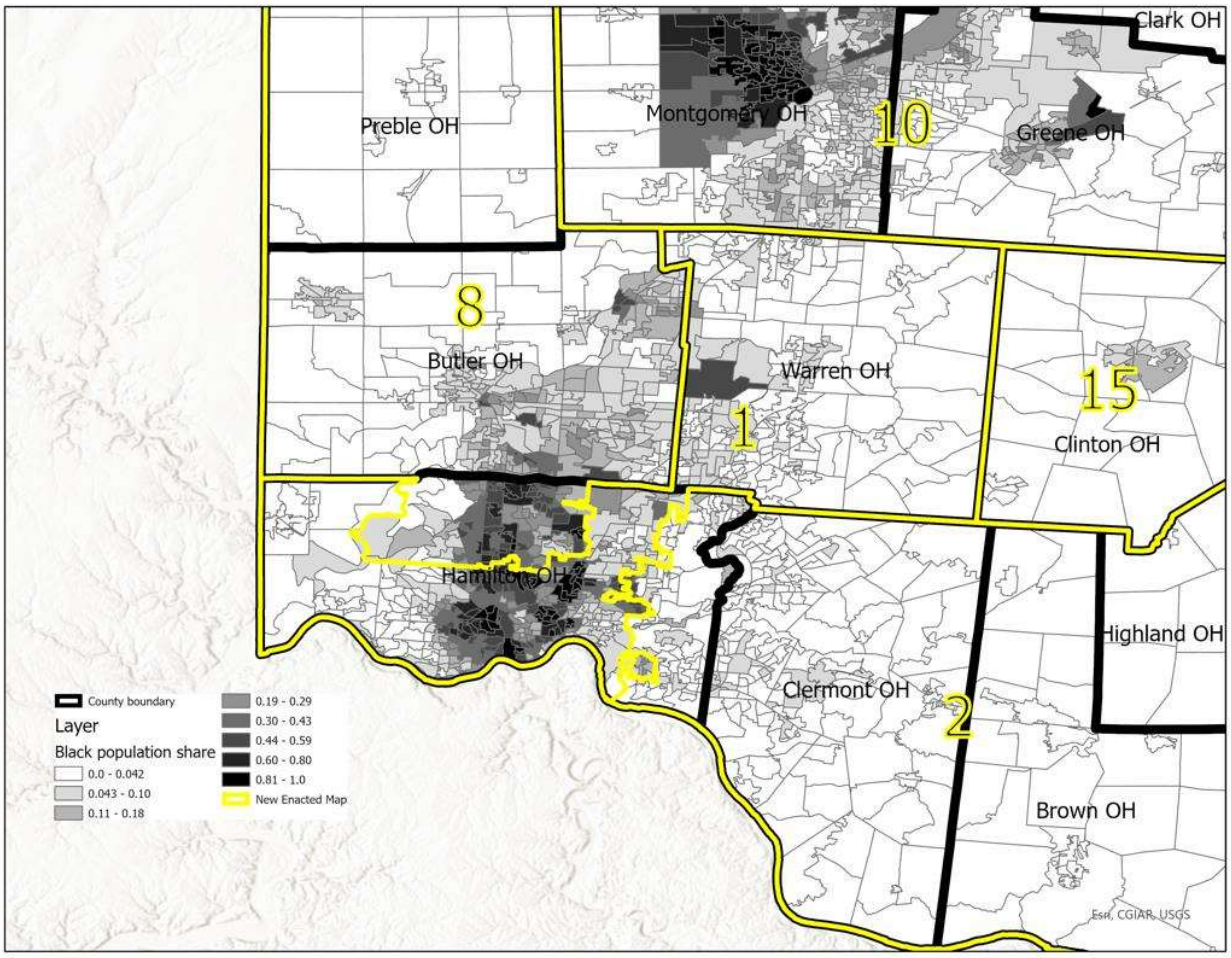
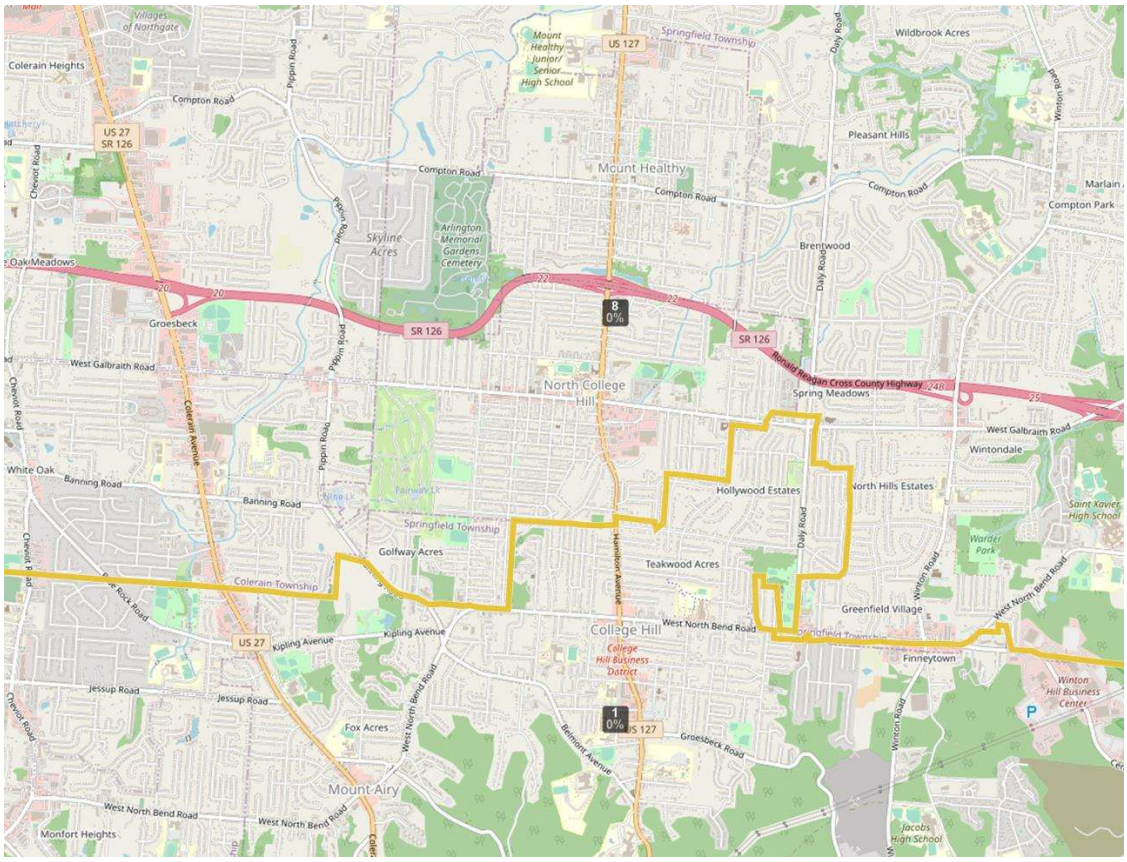


Figure 11: Cincinnati, College Hill Area



85. This can be visualized in Figure 9, which overlays the Enacted Plan on a map of partisanship, from precinct-level results of the 2020 presidential election. Figure 10 then overlays the district boundaries on a map that shows the area's racial composition. It highlights the extent to which the Enacted Plan splits Hamilton County's Black population—cutting the Black community essentially in half and cutting through neighborhoods.

86. Under any method of counting splits, the Enacted Plan's approach involves at least two splits of Hamilton County—a line running north-south on the east side of the county and another one that carves out the northern suburbs. These maneuvers are clearly not necessary for any reason other than partisan advantage. Each of the alternative plans keeps metro Cincinnati together in a compact district remaining within the county, avoids splitting the Black community, and splits the county only once.

87. The arrangement of these alternative plans can be seen in Figure 12. Clearly, it is quite straightforward to draw a district that is compact, minimizes splits, and keeps the Black community together. Notably, these arrangements all produce a majority-Democratic district (56.5 percent for the House Democrats' plan, 55.4 percent for the Senate Democrats' plan, and 56.4 percent for the OCRC plan).

88. These alternative plans are also more compact than the Enacted Plan, both in the areas in and around Hamilton County and (as discussed below) plan-wide. Higher Reock score values indicate greater compactness. The Reock score for the General Assembly's District 1 was .27. The Reock score for District 1 in the OCRC plan is .54, and the score for the comparable district (5) in the Senate Democrats' plan is .44. Summary information about Reock scores for all the districts in each of these plans is provided in Figure 13 below.

Figure 12: Partisanship and Districts of Alternative Plans, Hamilton County and Surroundings

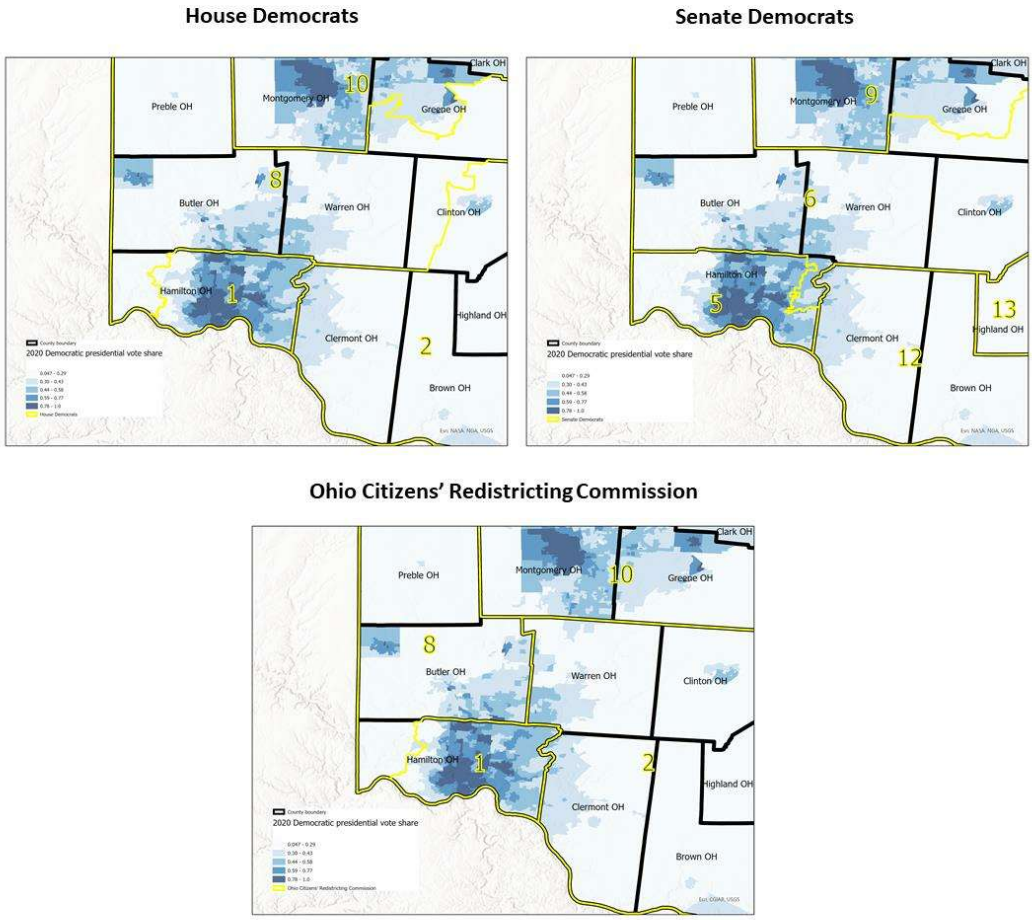
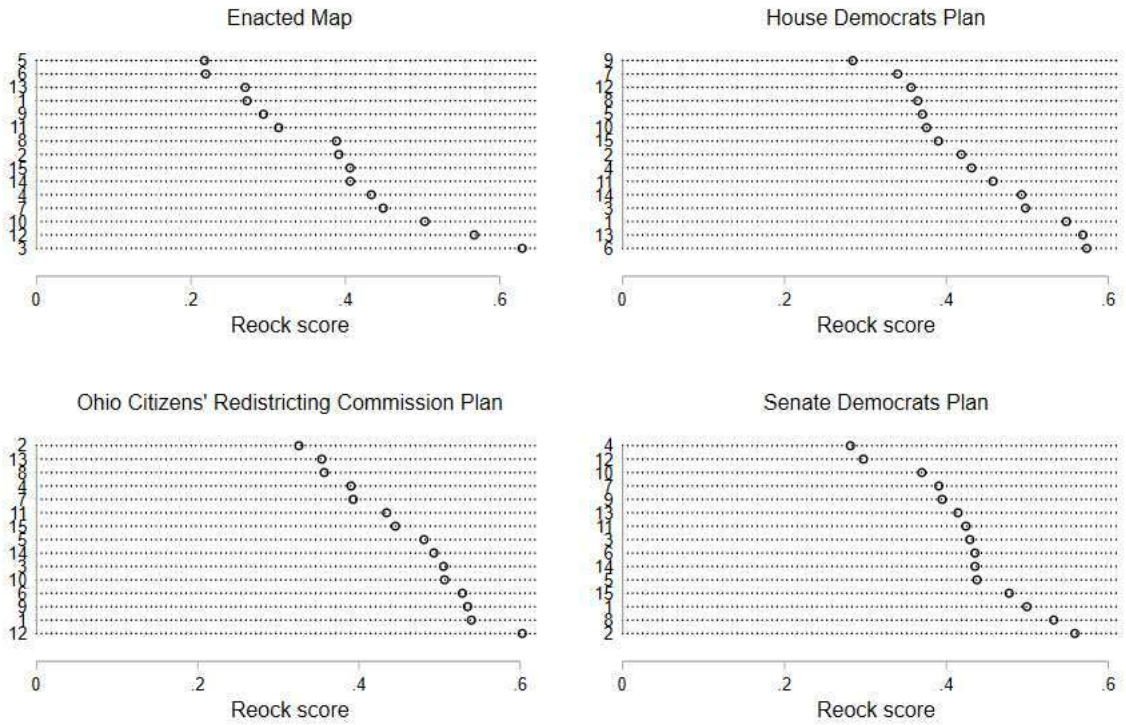


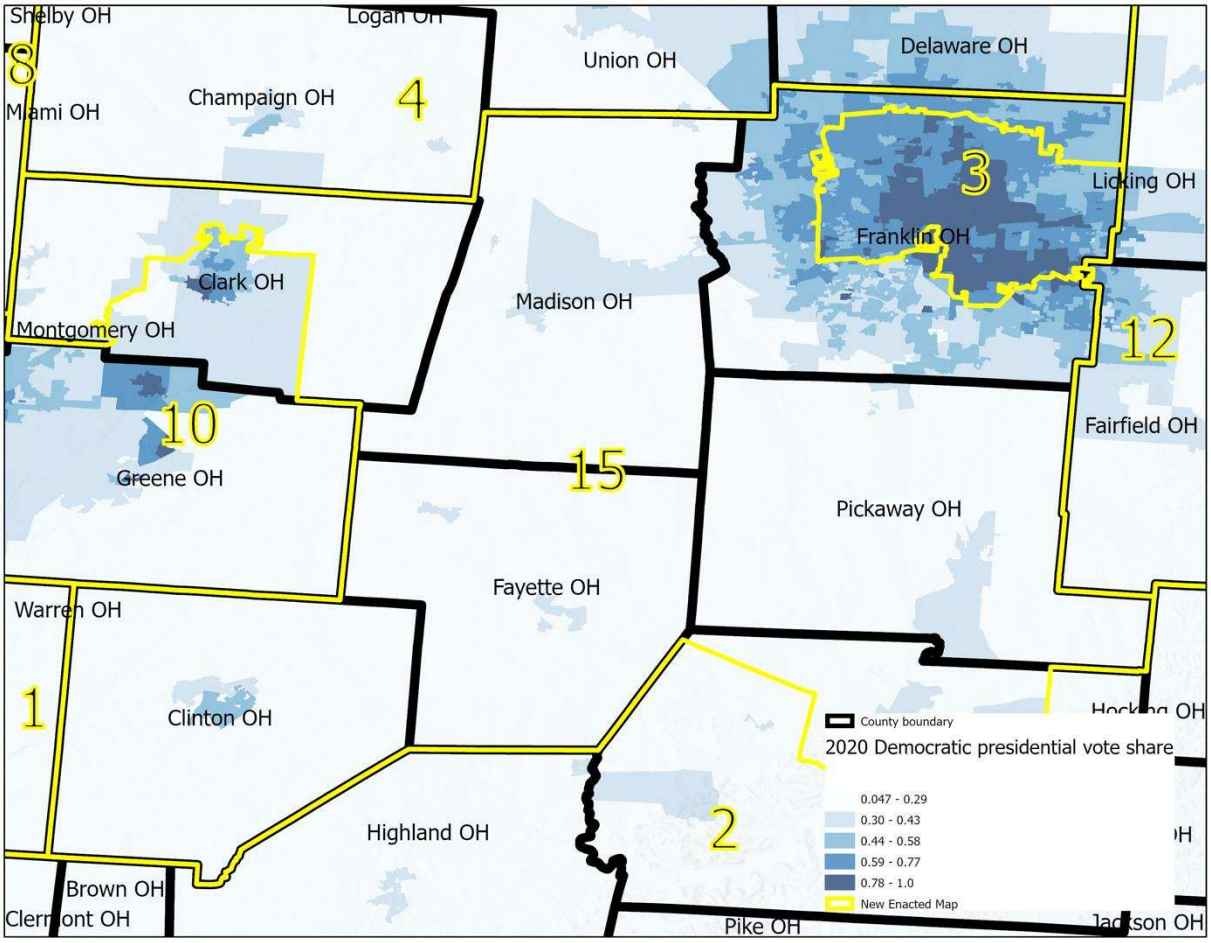
Figure 13: Reock Scores for Districts in Enacted and Alternative Plans



Columbus

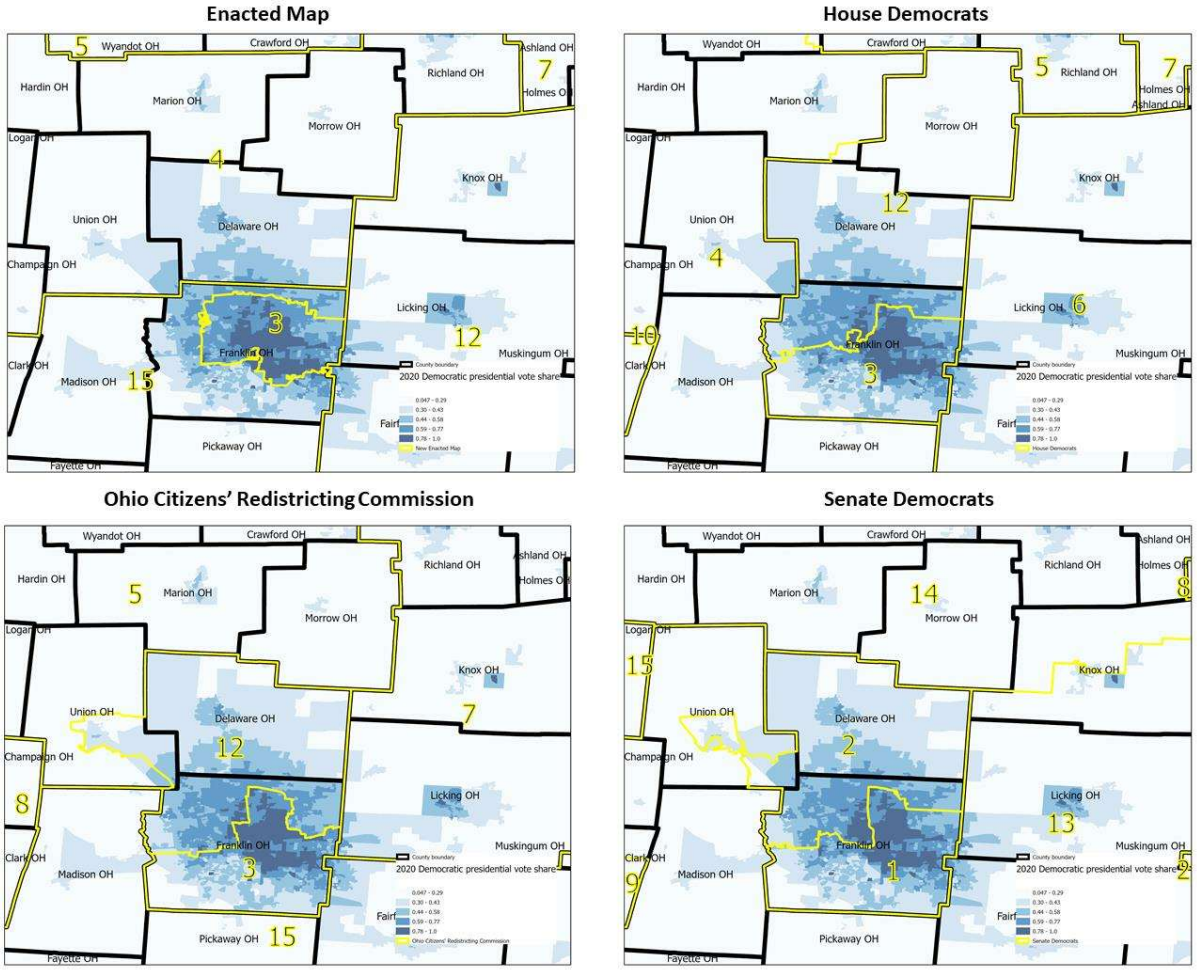
89. Next, consider the Columbus area in Franklin County. The city of Columbus is larger than a unit of congressional representation, so it must be split. In Cincinnati, it was possible to maneuver to avoid the creation of a Democratic district that would have otherwise emerged. But in Columbus, the number of Democratic voters was simply too large to pursue that strategy. Instead, the Enacted Plan in Franklin County packs Democrats into one very Democratic Columbus district (District 3). It then reaches around the city to extract its outer reaches and suburbs, connecting them with far-flung rural communities to the southwest—an arrangement that prevents the emergence of a second Democratic district by removing Democratic Columbus-area neighborhoods from their context and submerging them in rural Republican areas (see Figure 14).

Figure 14: Partisanship and Enacted Districts, Columbus and Surroundings



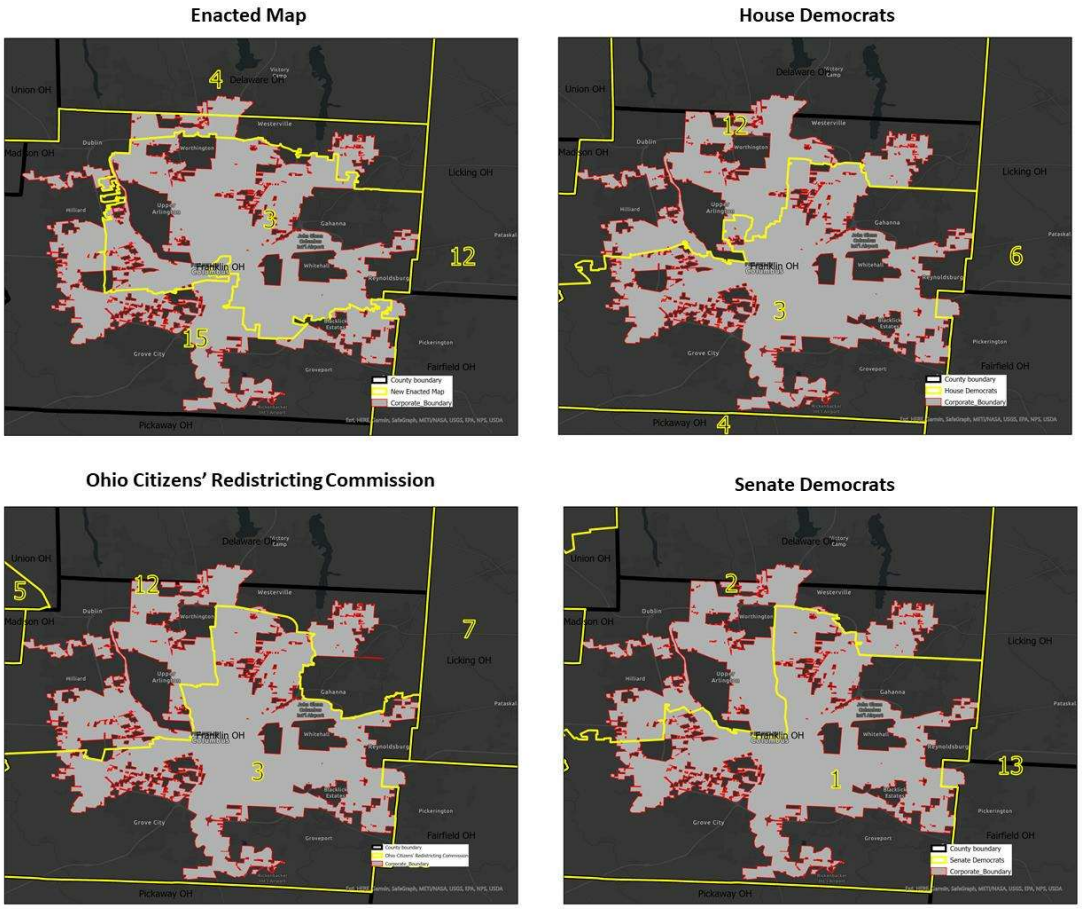
90. In contrast, the alternative plans split Columbus with a line that runs from west to east (see Figure 15). This arrangement creates a compact southern Columbus district that includes much of the city and its southern suburbs, and a relatively compact northern Columbus district that includes all the northern reaches of the city and its suburbs. In northern Franklin County, the cities of Westerville, Columbus, and Dublin all cross over into Delaware County, and these alternative plans keep them together. In fact, Dublin also extends into Union County, and the Senate Democrats' plan and the OCRC Plan extend into Union County and keep Dublin whole. Given the fact that Columbus and its suburbs spill into counties to the north, if one is attempting to keep communities together, the northern border—not the western border—is the obvious place to extend the second Franklin County/Columbus district.

Figure 15: Partisanship and Enacted and Alternative Districts, Columbus and Surroundings



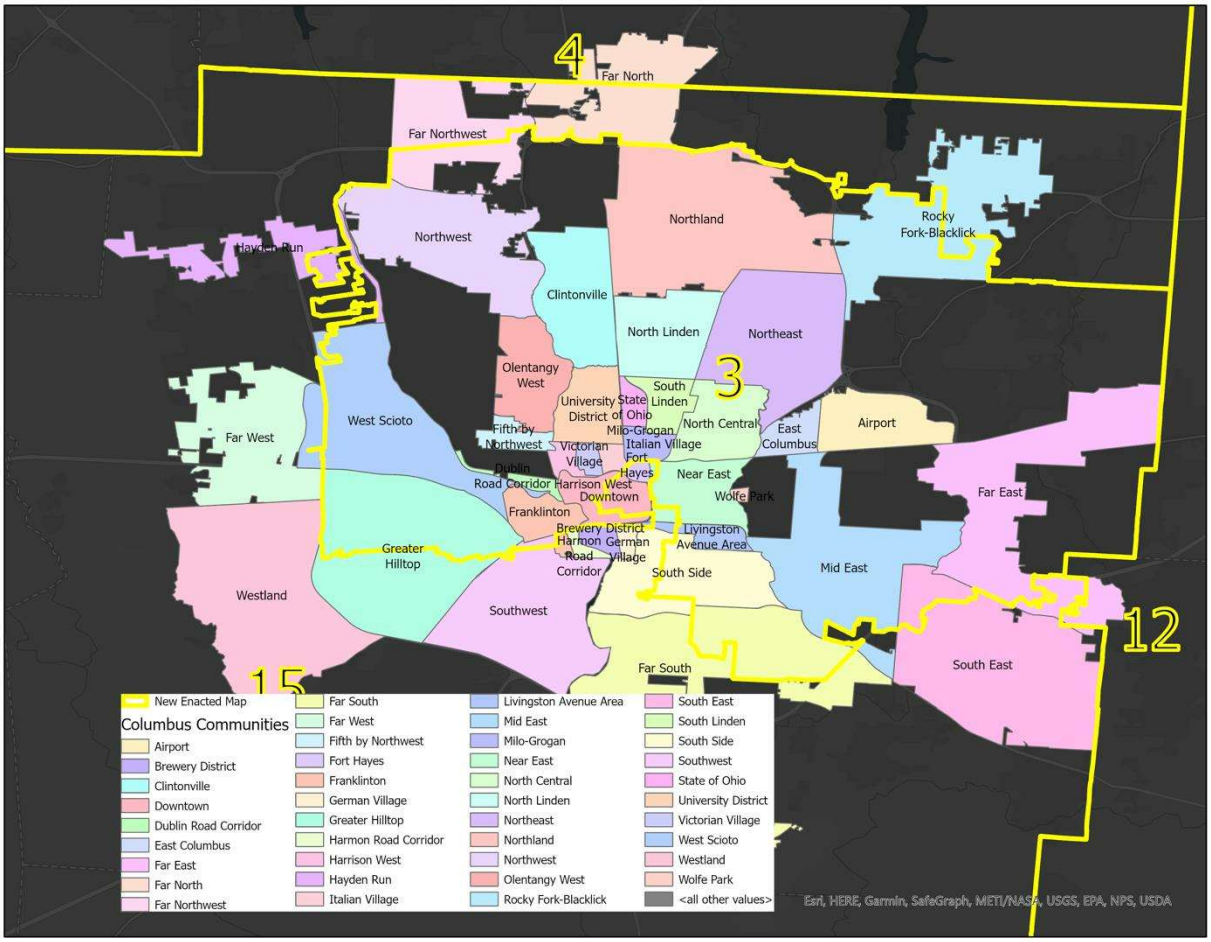
91. The Enacted Plan produces several non-contiguous chunks of Columbus that are removed from the city and placed in largely rural District 15. Figure 16 features the Columbus Corporate Boundary and its interaction with the Enacted Plan as well as the alternative plans. In the Enacted Plan, there are five chunks of non-contiguous territory that are carved away from Columbus and placed in District 15 (two in the north, one in the west, one in the southwest, and one in the southeast). In contrast, each of the alternative plans places two non-contiguous chunks of Columbus in its northern Columbus-oriented district, and the House Democrats' plan also includes a third tiny non-contiguous sliver of Columbus that abuts Upper Arlington and Grandview Heights.

Figure 16: The Boundary of the City of Columbus and Boundaries of the Enacted Plan and Alternative Plans



92. Perhaps a better way to contrast the way these redistricting plans treat Columbus is to examine its communities. The city of Columbus produces maps of areas recognized by the city as distinct communities. Figure 17 provides a map of Columbus communities and the boundaries of the Enacted Plan. Due to its circumnavigation of the city, the Enacted Plan splits 15 of Columbus' communities (16 if we include the Far North, which extends into Delaware County). For instance, the northern part of the Rocky Fork-Blacklick area is extracted and placed in a rural district that curls around the city and extends 100 miles to the southwest. On the south side of Columbus, the Hilltop neighborhood is cleaved down the middle. Residents on the north side of Sullivant Avenue are in an urban district with a large Democratic majority, while residents on the south side of the street are in a rural district that extends to the southwest part of the state. Along the eastern boundary of Franklin County in the southeast part of Columbus, several neighborhoods with large minority populations are split between the Columbus-based District 3 and the rural District 15.

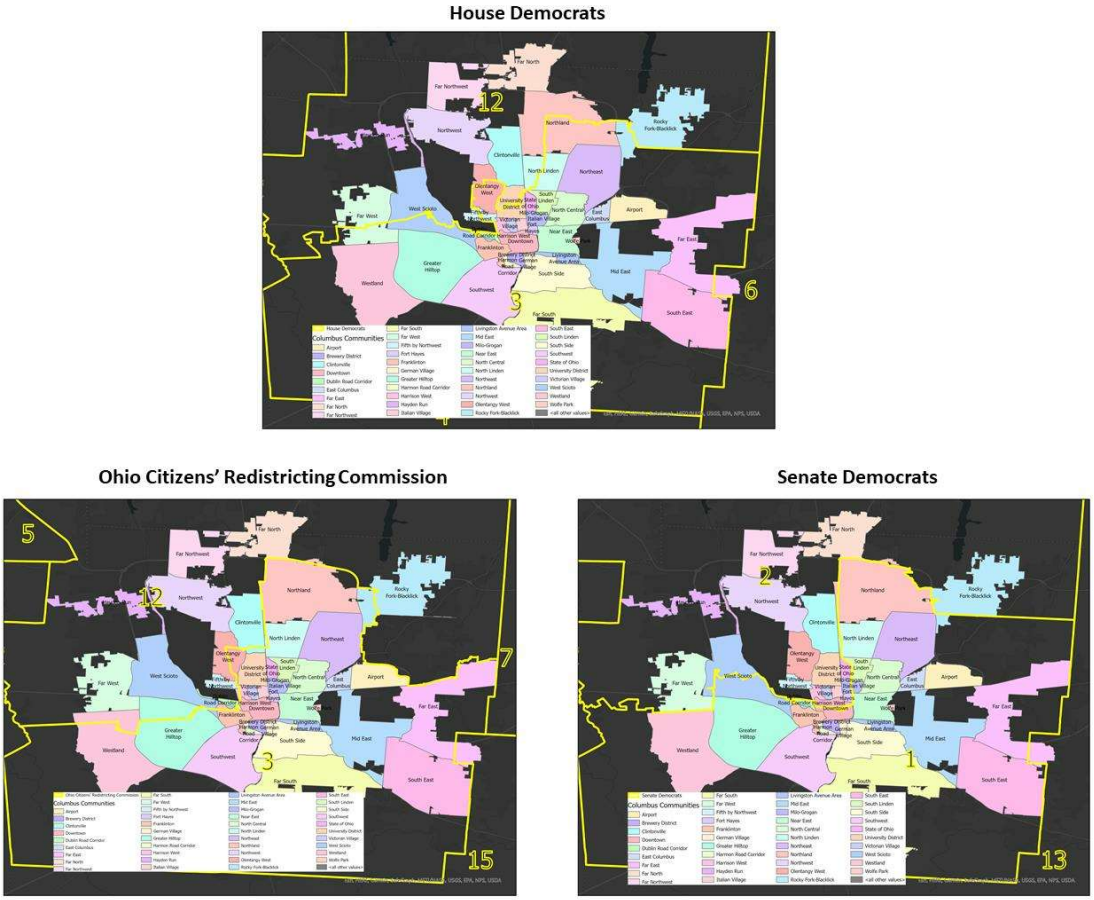
Figure 17: The Boundary of the Communities of the City of Columbus and Boundaries of the Enacted Plan



93. The approaches taken to dividing Columbus in the alternative plans produce fewer subdivisions of Columbus communities. The House Democrats' plan splits eight communities, while the Senate Democrats' plan splits five, and the OCRC plan splits 10 (see Figure 18).[24]

[24] In the Senate Democrats' and OCRC plans, one of these splits, to the community of Northland, involves a single small precinct that is separated from the rest of the community by Highway 270.

Figure 18: The Boundary of the Communities of the City of Columbus and Boundaries of the Alternative Plans



Northeast Ohio

94. Next, consider Summit County and the Akron area. As with Cincinnati, the Enacted Plan cuts off Akron's eastern suburbs from the city. In this case, the maneuver introduces a long, narrow north-south corridor that is, in one spot, less than one mile wide, connecting a number of relatively urban, Democratic-leaning precincts, removing them from their geographic context, and combining them with rural areas well to the southwest. For example, Twinsburg, a small city nestled between Cleveland and Akron near the northern border of Summit County, is in a district with neither of them. Rather, it is part of a rural district well to the south, whose southwest border is over 70 miles away, where Ashland, Knox, and Richland counties come together. And rather than combining Akron with its own suburbs, the Enacted Plan combines it with rural Medina County and the most Republican outer exurbs of Cleveland (see Figures 19 and 20).

Figure 19: Partisanship and the Boundaries of the Enacted Plan, Northeast Ohio

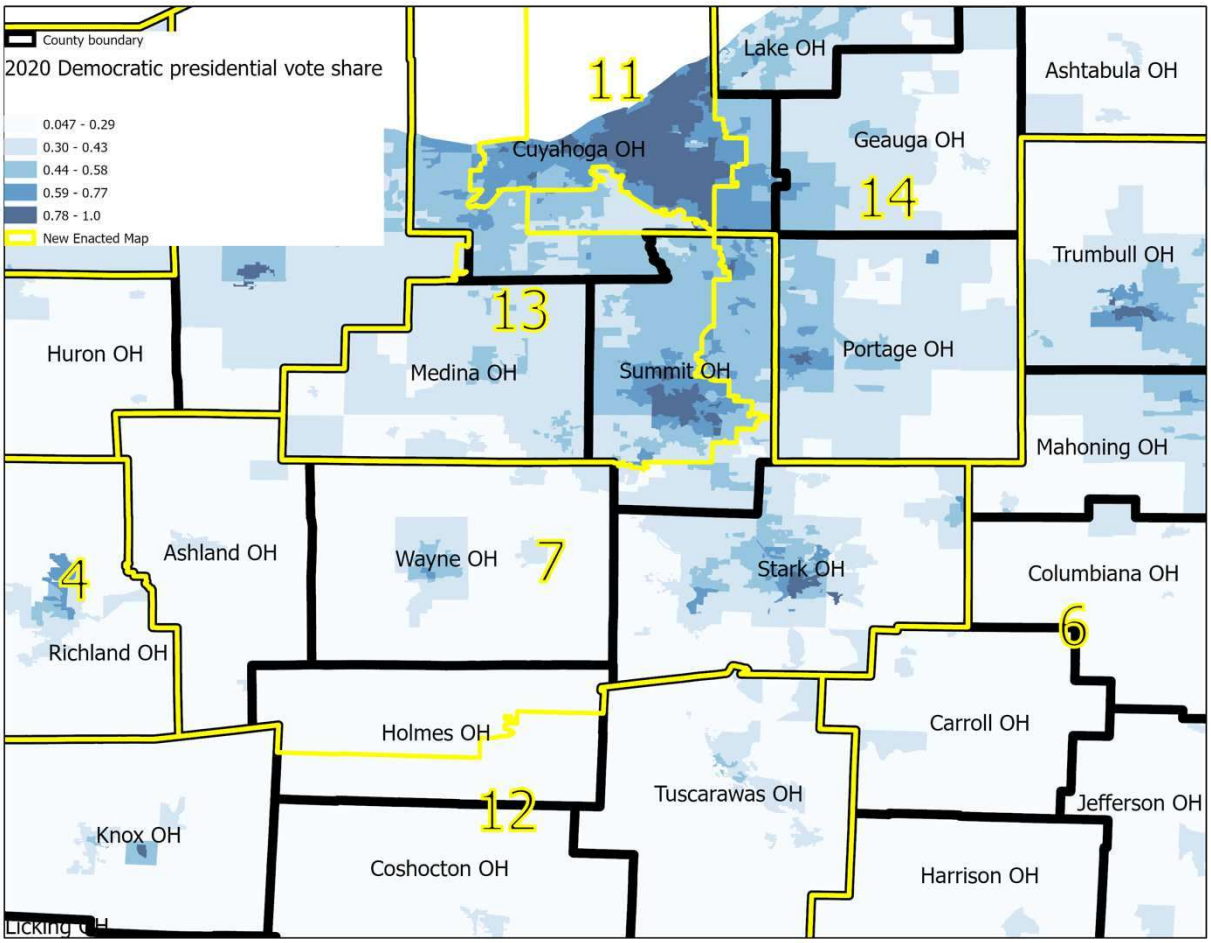


Figure 20: Partisanship and the Boundaries of the Enacted and Alternative Plans, Northeast Ohio

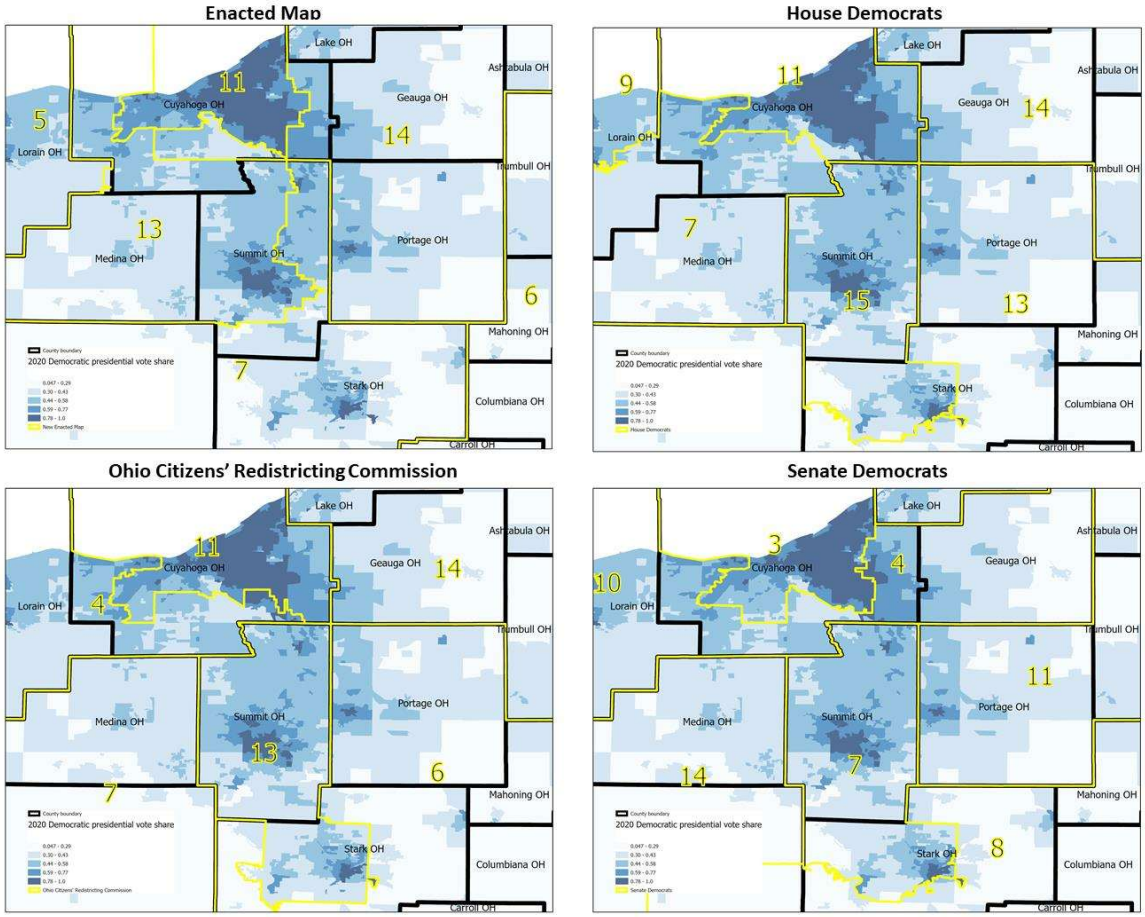
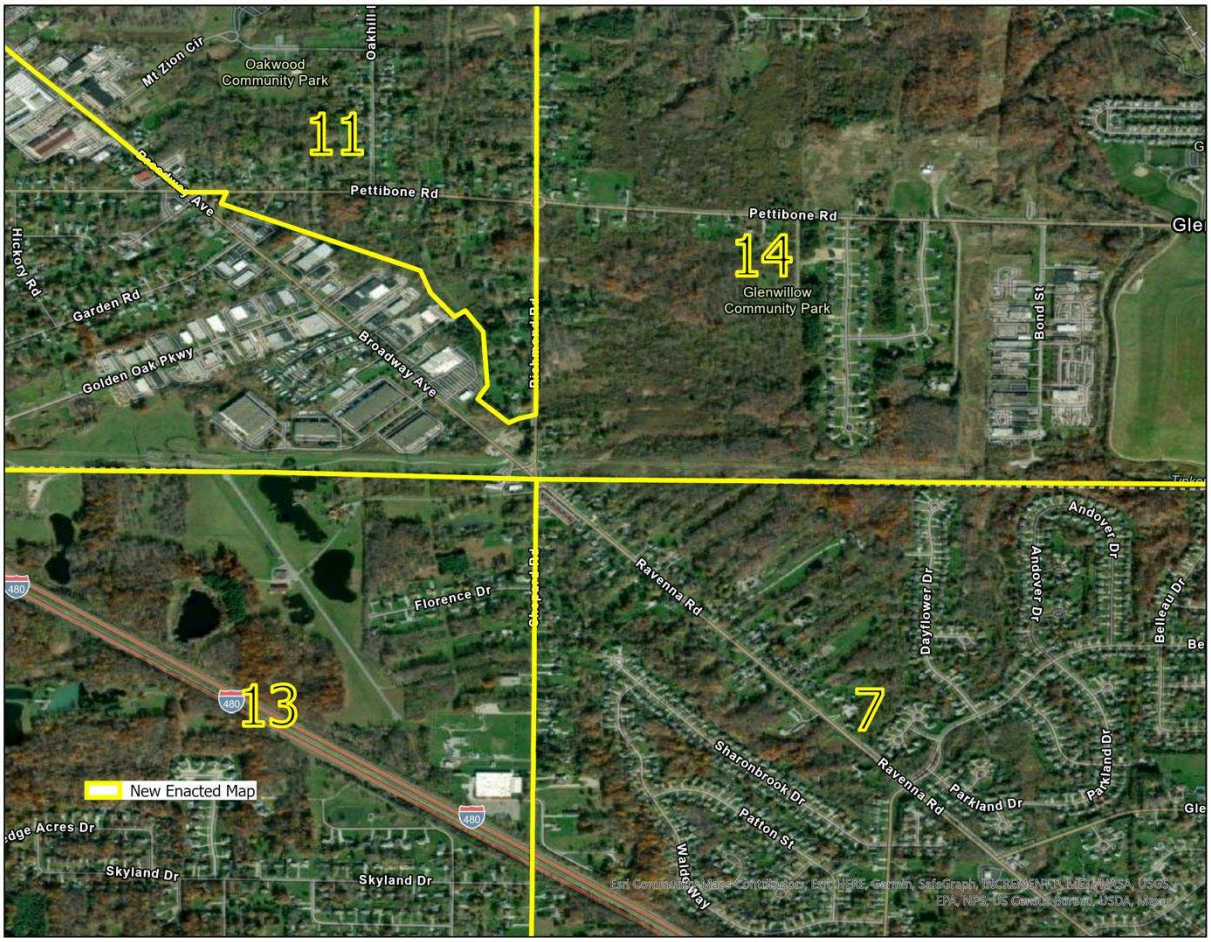


Figure 21: The Cuyahoga Corridor



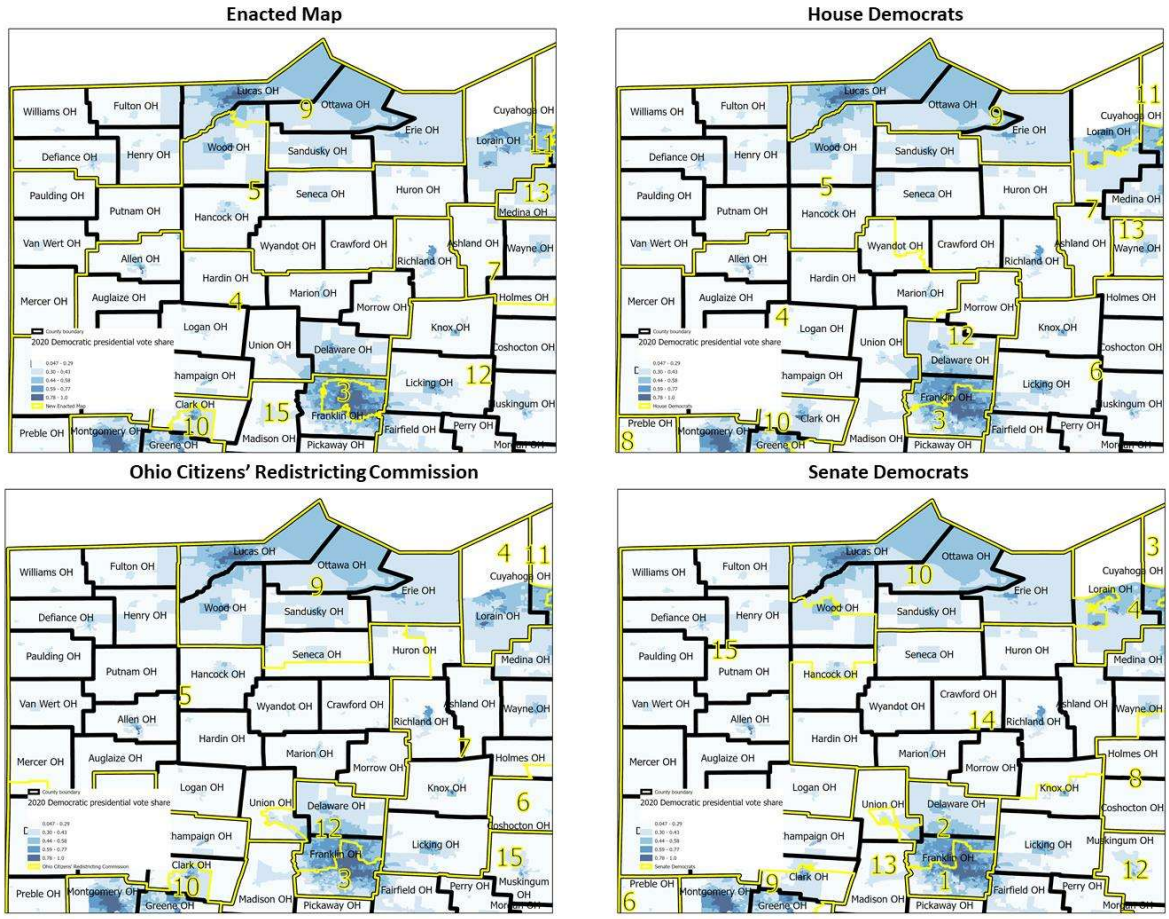
95. Next, consider Cuyahoga County and Cleveland. Here, the Enacted Plan produces multiple splits of Cuyahoga County—placing fragments in three different districts, and an arrangement featuring a narrow corridor (seen in Figure 21) that is, in one spot, the width of one census block, with no road connecting the fragments. In this area, four districts—7, 11, 13, and 14—converge upon an area spanning less than a square mile. The Cleveland-based District 11 nearly splits District 14 in half (i.e., making it noncontiguous), but for the grace of the one census block mentioned above.

96. District 13 in the Enacted Plan appears to have been crafted as part of an effort to make sure there is only one very Democratic district in Northeast Ohio, such that what would otherwise be a comfortable Democratic Akron-based district is instead a toss-up. In addition to separating Akron from its Democratic suburbs, the map avoids a connection to Canton. Moreover, Democratic neighborhoods nestled between Cleveland and Lorain are prevented from joining with either of their surrounding Democratic strongholds and are instead combined with Medina County to the South.

Northwest Ohio

97. Finally, consider Northwest Ohio. The Enacted plan and the three alternative plans are depicted in Figure 22. Each of the plans includes Toledo and draws a relatively narrow district that runs from West to East along the Michigan border and Lake Erie. However, the General Assembly's plan stops short of Lorain County and its Democratic cities, extending instead all the way west to the Indiana border with an arrangement that, reminiscent of the Cincinnati strategy described above, combines Toledo with very rural areas. In this arrangement, the Democratic cities of Lorain County are removed from their geographic context and subsumed within a narrow rural District 5 that reaches all the way to Mercer County, along the Indiana border, which is 180 miles away, more than a 3-hour drive from downtown Lorain.

Figure 22: Partisanship and the Boundaries of the Enacted and Alternative Plans, Northwest Ohio



98. In contrast, the plans created by the House Democrats and Senate Democrats simply extend the district slightly to the East—leaving out the Western rural counties—keeping the string of proximate industrial towns along Lake Erie together. The Senate Democrats' plan and the OCRC plan also extend into Wood County to keep Toledo's Southern suburbs together with the city. In contrast with the General Assembly's plan, each of these plans creates a Democratic-leaning district. According to the Reock score, the Senate Democrats and OCRC version of District 9 is more compact than the General Assembly's version.

County and Municipal Splits

99. In sum, the 2021 Congressional Plan includes consequential extra county splits vis-à-vis the alternative plans in Hamilton, Summit, and Cuyahoga Counties. It includes two counties—Hamilton and Cuyahoga—that are split between three districts, whereas the alternative plans never do this. If we simply add up county splits, there are 12 split counties in the Enacted Plan, but since two of them are split multiple times, the total number of splits is 14. The Senate and House Democrats' plans split 14 individual counties, while the OCRC plan splits 13 individual counties.

100. While prioritizing counties first, the Ohio Constitution also instructs those drawing the districts as a secondary priority to attempt to avoid splits of townships and as a third priority, to avoid splits of municipal corporations. The Enacted Plan, along with those submitted by the Senate and House Democrats, achieved absolute population equality across districts. In order to do so, it was necessary to split a number of townships and/or cities. The General Assembly, along with the Senate and House Democrats, clearly placed considerable effort into minimizing these splits. OCRC did not attempt to achieve absolute population equality, and while its plan achieved fewer county splits than the other plans, it was less successful in avoiding township splits.

101. Of the four plans considered here, the plan submitted by the Senate Democrats performs the best when it comes to avoiding township splits. By my accounting, which is explained in Appendix B, this plan did not split one township, while producing 15 city splits.[25] The Enacted Plan created a total of 17 splits, 8 of which involved townships. The House Democrats' plan creates 19 splits, 13 of which involved townships. The OCRC plan produced 27 splits, all of which were townships except for the city of Columbus.

Compactness

102. In addition to providing guidance about county splits, the Ohio Constitution also calls for compact districts. As already indicated in the discussion above, the Enacted Plan produces a set of districts that are less compact than those of the alternative plans. Average compactness scores across all districts, including the Reock, Polsby-Popper, and Convex Hull scores, are set forth in Table 7. With each of these scores, a higher number indicates a higher level of compactness. On each indicator, the Enacted Plan is less compact than the alternative plans.

[25] Note that in an earlier affidavit I submitted in this case, I missed one instance of a split township—Prairie Township—in Franklin County.

Table 7: Average Compactness Scores

	Reock	Polsby-Popper	Convex Hull
Enacted Plan	0.38	0.28	0.73
House Democrats	0.43	0.33	0.78
Senate Democrats	0.43	0.29	0.76
OCRC	0.46	0.37	0.79

103. As described above, and as explained further elsewhere,[26] highly non-compact districts are sometimes an obvious manifestation of efforts by partisan map-drawers to favor a political party. Among the clearest examples are the notorious maps of Pennsylvania and North Carolina from the last redistricting cycle. In these cases, given the underlying political geography, such maps were necessary in order to generate the maximum possible number of Republican seats. However, it is a myth that such odd-shaped districts are the *sine qua non* of gerrymandering. Depending on the underlying political geography, it is sometimes possible to draw maps that are extremely favorable to a political party— maps that pack and crack one's opponents, divide communities, and maximize a party's seat share—without drawing long tendrils and comical shapes in every region. Likewise, sometimes relatively non-compact districts are forced upon district-drawers by natural geography and the specific rules governing the redistricting process in a state.

104. For this reason, one should approach average, plan-wide compactness scores like those in Table 7 with caution—especially for cross-state comparisons. However, the discussion above demonstrates that the extreme favorability of the Enacted Plan to the Republican Party and its incumbents required specific choices in certain urban areas, many of which clearly required non-compact districts, and a comparison with alternative maps clarifies that these choices were not forced by political geography or constitutional rules. The same is true about the General Assembly's decisions to unnecessarily split several urban counties and the communities within them.

Splits of Partisan Communities

105. It is clear from the maps and analysis above that in the vicinity of Ohio's major cities, the Enacted Plan achieves an unusually large advantage in the efficiency of its support across districts by inserting district boundaries that split geographically proximate groups of Democrats in order to prevent them from forming districts with Democratic majorities, while trying to place as many Republicans as possible in majority-Republican districts. In order to

[26] Rodden, *Why Cities Lose*, op cit.

visualize this type of intentional "cracking" of co-partisans, along with co-authors, I have developed a simple measure that we call "partisan dislocation."[27]

106. We begin with geo-spatial precinct-level geographic boundaries of each precinct, associated with outcomes of past elections—in this case, all the statewide races from 2016 to 2020. We create a series of points within each precinct, where each point is represents a voter, and each representative voter is classified as either a Democrat or Republican, with these classifications made in proportion to the precinct-level vote shares of the parties. For each point, based on the size of an Ohio congressional district, we also find the representative voter's 786,630 nearest neighbors, and then calculate the partisanship of that voter's bespoke "neighborhood." This is akin to asking, for each representative voter: if a congressional district was built with this voter at the absolute center, what would be the vote share of Democrats and Republicans in that district? For a resident of the urban core of Cleveland, Cincinnati, or Columbus, it would be very Democratic. For a resident of a rural county who is far away from a city, it would be quite Republican. For many suburban residents, this bespoke district would be more heterogeneous, but would lean more Democratic as we move closer to the city, and more Republican in the outer exurbs.

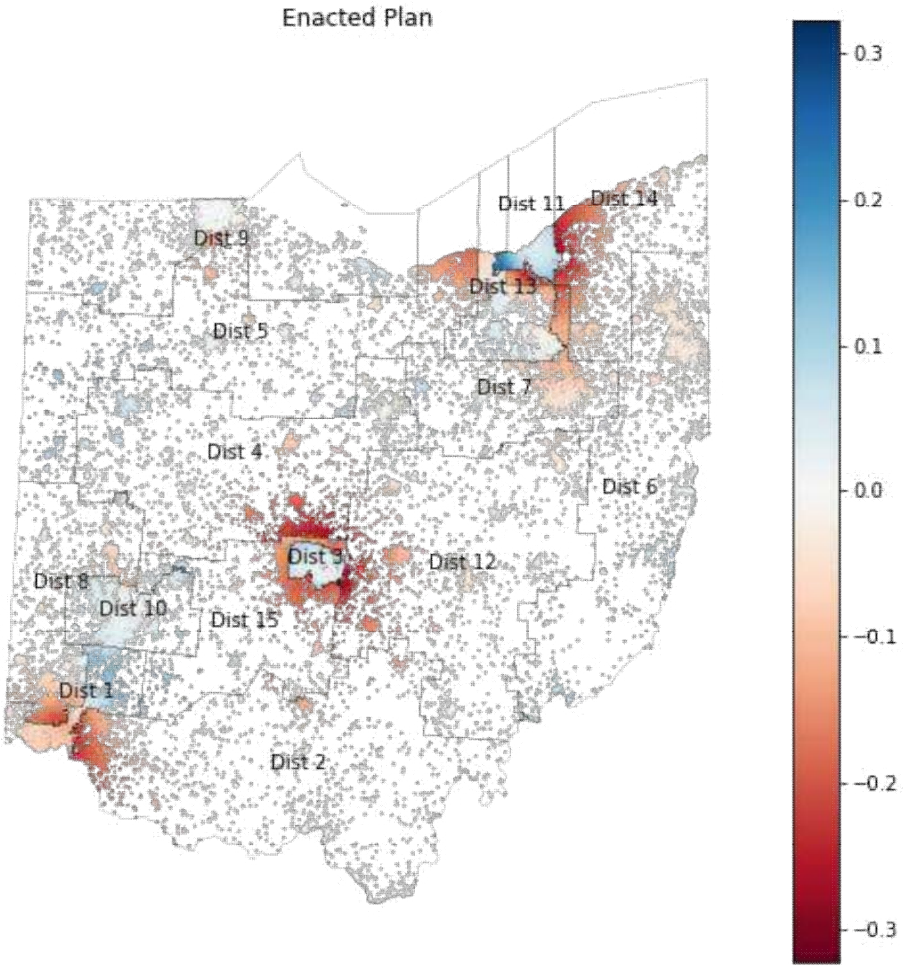
107. An interesting question, then, is whether in an enacted redistricting plan, people end up in districts where the partisanship is roughly similar to that of their geographic neighborhood, or if they end up in districts where the partisanship is quite different. To examine this, for each representative voter, we simply calculate the difference between the partisanship of the district in which they have been placed, and the partisanship of their geographic neighborhood. We refer to this difference as "partisan dislocation." We have discovered that in maps where districts have been drawn to provide an advantage for a political party, we can see telltale patterns of "dislocated" voters clustered near district boundaries. Specifically, when map-drawers are attempting to create an advantage for their in-party, they will produce large numbers of "dislocated" members of the out-party, often near district boundaries—that is to say, large clusters of voters whose nearest neighbors, at the relevant geographic scale for drawing districts, strongly support the opposite party, but have nevertheless been placed in districts where the in-party is a majority.

108. This type of analysis is illuminating in Ohio. In Figure 23, I present a map of the districts in the Enacted Plan, with dots for representative voters, where the dots are colored according to the level of partisan dislocation. A dark red color indicates that the partisanship of the enacted district is much more *Republican* than the representative voter's 786,630 nearest neighbors. A dark blue color indicates that the district is much more *Democratic* than the

[27] Daryl DeFord, Nicholas Eubank, and Jonathan Rodden, 2021, "Partisan Dislocation: A Precinct-Level Measure of Representation and Gerrymandering." *Political Analysis*. Online early view available here: https://doi.org/10.1017/pan.2021.13. Nicolas Eubank provided assistance with the generation of the Ohio partisan dislocation map presented below.

representative voter's neighborhood. Figure 23 brings to life the extent to which the districts of the Enacted Plan cut up geographic communities of co-partisans.

Figure 23: Partisan Dislocation Associated with the Enacted Congressional Redistricting Plan in Ohio



Note: Dots are representative voters. Darker shades of red indicate the extent to which the voter's district in the Enacted Plan is more Republican than their nearest 786,630 neighbors. Darker shares of blue indicate the extent to which the voter's district is more Democratic than their nearest neighbors.

109. The area around Cincinnati is especially interesting. As discussed above, the Enacted Plan carves out an extremely Democratic section of Northern Hamilton County with a large Black population and places it in the rural-dominated 8th District. And the Democratic-leaning

Eastern suburbs of Cincinnati have been cleaved from the city and placed in the rural-dominated 2nd district. In Figure 23, we can see that levels of partisan dislocation are relatively high for these voters; they have been extracted from their geographic setting and placed in a district where the partisanship is completely different from that of their surrounding neighborhood. Democratic, relatively densely populated neighborhoods have been placed in extremely non-competitive rural districts where they have virtually no chance to elect their preferred candidates.

110. The story in Columbus is similar. As described above, the Democratic suburbs that fall within Franklin County have been pulled from their geographic context and placed in relatively rural District 15, which means that residents of Columbus suburbs are in a district whose partisanship is quite different from that of their neighborhood. The same is true of the suburban communities to the North of Columbus in Delaware County, which have been placed in an even more rural and Republican District 4.

111. Likewise, Figure 23 illuminates the impact of the Enacted districts in Northeast Ohio, where there is a large concentration of Democratic neighborhoods that have been placed in majority-Republican districts. District 14 extracts large numbers of Democrats in suburban areas from Cuyahoga County that are in a largely Democratic geographic context, and places them in the 14th District, where voting behavior is far more Republican. Also, Figure 23 clarifies how the long, narrow appendage of District 7, which extracts Akron's suburbs, removes them from their Democrat-leaning partisan context and places them in a highly Republican district. Likewise, we can see that the partisanship of the enacted 5th district is far more Republican than the partisan neighborhood in the Democratic cities of Lorain County.

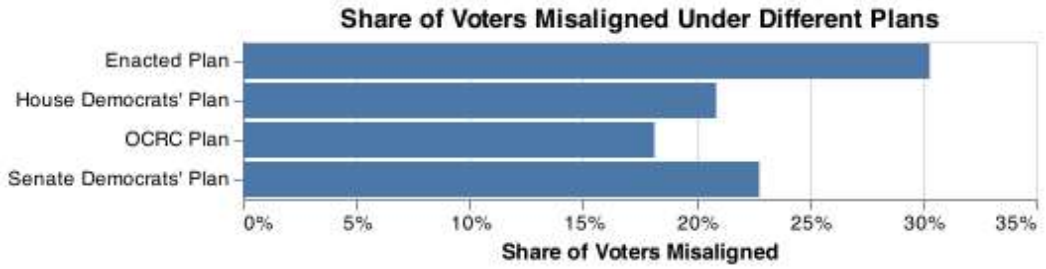
112. Each of these areas shows up as relatively dark red dots in Figure 23. Note, however, that there are very few places on the map where the dots are dark blue; that is, where the partisanship of the Enacted Plan is much more Democratic than the geographic neighborhood. The only exception is part of the Western suburbs of Cleveland within Cuyahoga County, where relatively evenly divided (but still Democratic leaning) neighborhoods are contained in a district that is mostly composed of extremely Democratic parts of Cleveland.

113. There are light blue dots throughout the map. Some of these are in the two very Democratic urban districts, where the partisanship of the district is slightly more Democratic than that of the geographic neighborhood. And Warren County, which was connected via a narrow corridor to Cincinnati, is in a district that is somewhat more Democratic than its neighborhood. The other areas with light-blue dots correspond to places where very Republican rural areas are placed in districts that include college towns, suburbs, or small cities that make the district as a whole more Democratic than the region in question. However, in every case like this, the district remains comfortably Republican.

114. In sum, we can see that the Enacted Plan tended to extract Democratic neighborhoods in and around cities from their partisan geographic context and place them in districts that were far more Republican, while keeping Republican exurban and rural neighborhoods in safely Republican districts.

115. This pattern of partisan dislocation was not forced upon the General Assembly by Ohio's political geography, or by the requirements of the Ohio Constitution. Again, this is made clear through analysis of the alternative plans described above. I have conducted the same dislocation analysis for these alternative maps. Let us consider a simpler, binary rather than continuous notion of dislocation, such that a representative voter is said to be living in a "misaligned" neighborhood if the partisan majority among their 786,630 nearest neighbors is not the same as that in the district to which they were assigned. In the Enacted Plan, over 30 percent of all Ohio residents are living in such misaligned neighborhoods (see Figure 24).

Figure 24:



116. As shown in Figure 24, far fewer voters reside in such misaligned neighborhoods in the alternative plans: around 22.5 percent in the Senate Democrats' Plan, 21 percent in the House Democrats' Plan, and only 18 percent in the OCRC Plan. Of course, not everyone can be in an electoral district where the partisan majority matches their bespoke neighborhood. This is especially true when those drawing the districts must minimize county splits, and thus cannot easily keep groups of co-partisans together, as is the case where a city's Democratic suburbs spill into surrounding counties. It is therefore not surprising that some voters would also live in "misaligned" neighborhoods in the alternative plans. However, the large difference in the percentage of misaligned voters between the Enacted Plan and the alternative plans makes it abundantly clear that the far more efficient Republican support distribution in the Enacted plan relative to the alternative plans was achieved by carving up clusters of geographically proximate Democratic communities and removing them from their neighborhood context. The choices outlined above in the alternative plans—such as splitting Hamilton and Cuyahoga Counties only once, drawing two Columbus-oriented districts rather than one, and keeping Summit County together—achieved greater Democratic representation by keeping such communities of co-partisans in the same district.

VIII. CONCLUSION

117. The 2021 Congressional 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

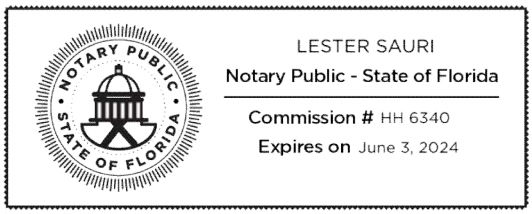
unnecessary splits to urban counties, and divided a number of urban and suburban communities, including minority communities, throughout the state.

Jonathan Rodden

Jonathan Rodden

Sworn to before me this 10th day of December 2021.

Notary Public

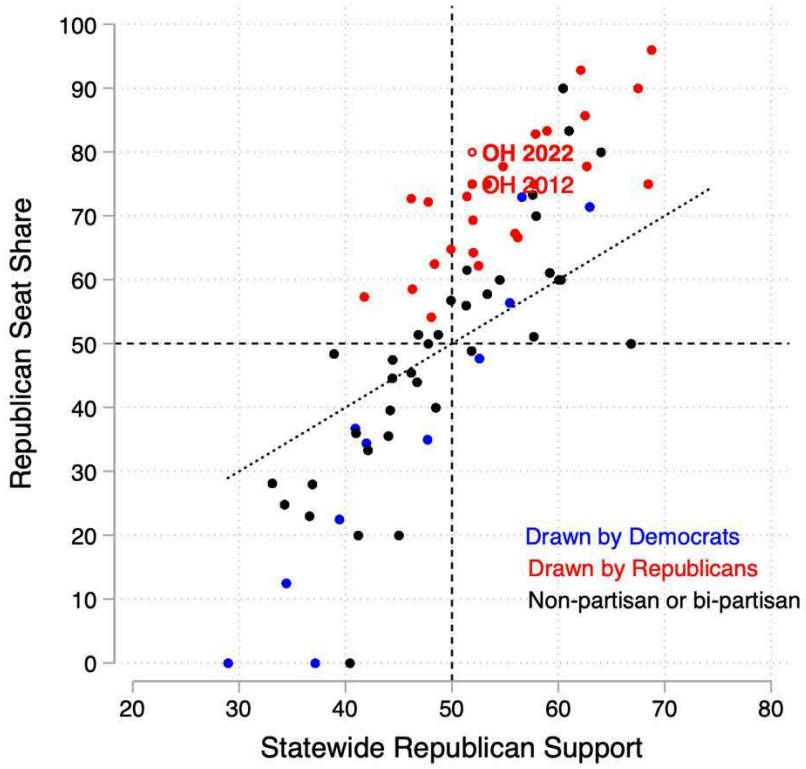


My commission expires 06/03/2024

Notarized online using audio-video communication

Appendix A

Figure A1: Vote Shares in Statewide Elections and Seat Shares in Congressional Elections, 2000 and 2020 Redistricting Cycles, All States with 4 or More Seats



Appendix B: Splits of Municipal Subdivisions

I have attempted to assemble information on all the splits of townships and municipal corporations in the Enacted Plan and the three alternative plans. A complication is that cities and villages sometimes spill slightly over the boundary of a township, such that a district-drawer must choose between splitting the municipal corporation or the township. In such instances, I do not count a township that was clearly split in order to keep a municipal corporation whole, and likewise, I do not count splits of small fragments of cities that were clearly made in order to keep a township whole. I document these decisions in italics below. Furthermore, I attempt to avoid double-counting. If a single split of a municipal corporation also appears to split a township in which it is embedded, I only count a single split. As I discuss in the text, each of the plans introduces multiple splits of the City of Columbus, and I count each of these as a distinct split.

Enacted Plan

Sycamore Township and Kenwood CDP, Hamilton County
(This also splits Rossmoyne CDP, which is also in Sycamore Township, so count once).
Glendale Village, Hamilton County
Union Township, Ross County
City of Columbus, Franklin County (5 splits total, see main text)
Norwich Township is split, but this can potentially be explained by an effort to follow the Hilliard City line. Do not count
Green Township, Shelby County
Perrysburg Township, Wood County
Columbia Township, Lorain County
Belpre Township, Washington County
Berlin Township, Holmes County
Cuyahoga Falls City, Summit County
Stony Ridge CDP, but presumably this was done to keep Lake Township whole, so do not count.
Mad River Township and Green Meadows CDP (only count once), Clark County
Rocky River City, Cuyahoga County
Oakwood Village, Cuyahoga County

Total splits: 17, 8 of which are townships.

Senate Democratic Plan

Columbus City (two splits, see main text)
Prairie Township, Franklin County
Marysville City, Union County
Millcreek Township does not count as a split, as it was split in order to prevent the introduction of an additional split to Marysville City.
Berea City, Cuyahoga County
Madeira City, Hamilton County

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Beavercreek City, Greene County
Massillon City, Stark County
Cambridge City, Guernsey County
Campbell City, Mahoning County
Wooster City, Wayne County
Springfield City, Clark County
Pike Township split to keep New Carlisle City together, so do not count
Amherst City, Lorain County
Amherst Township split to keep South Adams Village together, so do not count
Bowling Green City, Wood County
Mount Vernon City, Knox County
Findlay City, Hancock County

Total splits: 16, 1 township and 15 cities.

House Democratic Plan

Mack CDP, Hamilton County
This is a single split that also simultaneously can be viewed as a bisecting the boundary between Green and Miami Townships, Hamilton County; only count once.
Union Township, Clinton County
Liberty Township, Clinton County
Buckskin Township, Ross County
Concord Township, Ross County
According to the Ohio Constitution, the small fragment of Greenfield Village on the Ross County side of the county boundary should not be considered a split.
Dunham Township, Washington
Columbus City (3 splits, see text, see main text), Franklin County
Prairie Township is nominally split, but to keep Lake Darby CDP whole, so do not count
Waldo Township, Marion County
Antrim Township, Wyandot County
Pitt and Salem Townships nominally split in Wyandot County, but to keep the City of Upper Sandusky together, so do not count.
Walnut Creek Township, Holmes County
Dunham Township, Washington County
Fairfield Township, Washington County
Lake Township, Ashland County
Seven Hills City, Cuyahoga County
North Ridgeville City, Lorain County
Beavercreek City, Greene County
Do not double-count Beavercreek Township.
Canton Township, Stark County
Poland Township, Mahoning County

Total splits: 20 total splits, 14 are townships

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Ohio Citizens Redistricting Commission

Colerain Township, Hamilton County
Racoon Township, Gallia County
Prairie Township, Franklin County
Columbus City, Franklin County (2 splits)
Blendon Township, Franklin County
Jefferson Township, Franklin County
Hartland Township, Huron
Fitchville Township, Huron
Greenwich Township, Huron
Dover Township, Union County
Paris Township, Union County
Jerome Township, Union County
Granville Township, Mercer County
Recovery Township, Mercer County
Big Spring Township, Seneca County
Richland Township, Guernsey County
Killbuck Township, Holmes County
Tuscarawas Township, Stark County
Lake Township, Stark County
Boardman Township, Mahoning County
Poland Township, Mahoning County
Coitsville Township, Mahoning County
Moorefield Township, Clark County
German Township, Clark County
Bethel Township, Clark County
Mad River Township, Clark County

Total splits: 27, all townships except Columbus

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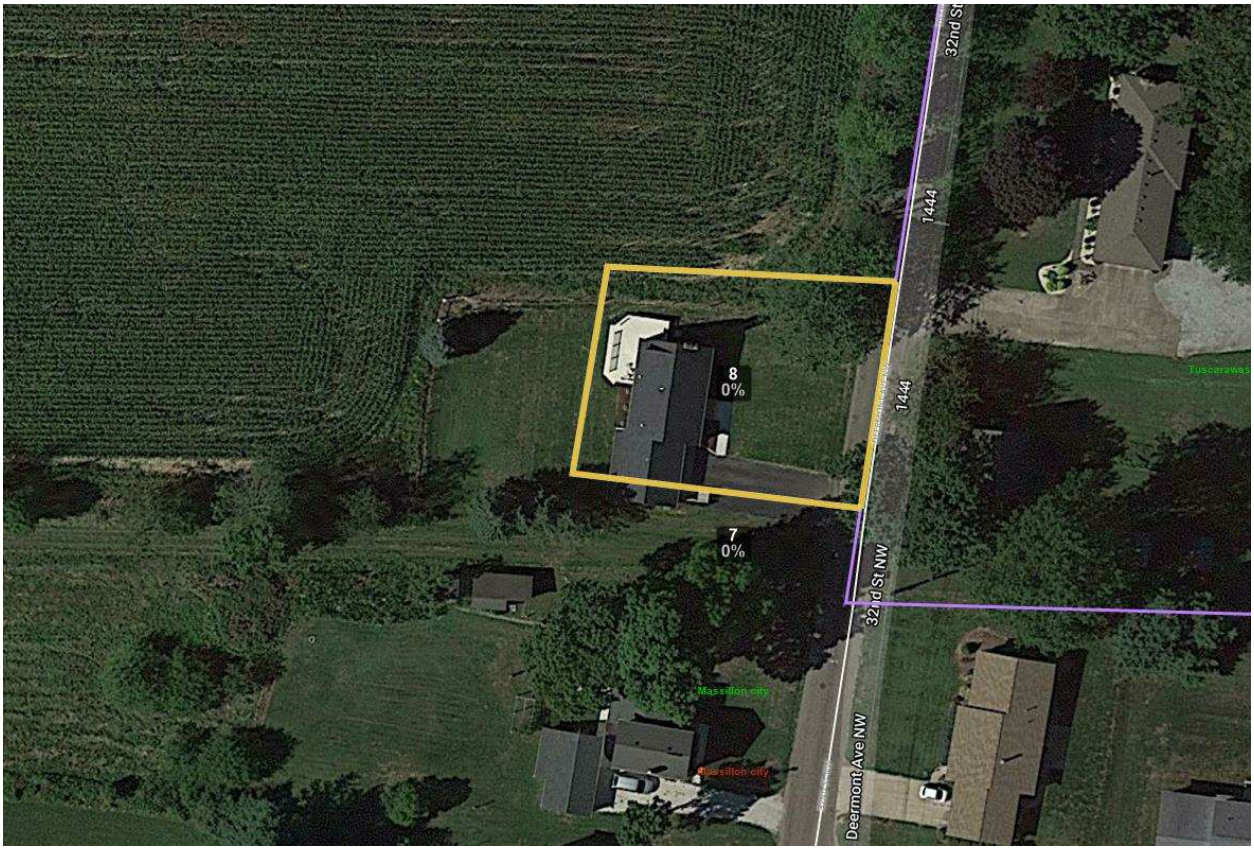
Appendix C: Image of Mistake in Senate Democrats' Redistricting Plan



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Notarize

AFFIDAVIT OF DR. JONATHAN RODDEN – APPENDIX OF EXHIBITS

Index of Documents

ITEM	DESCRIPTION	BATES RANGE
A	2021 Congressional Plan	RODDEN_0001-02
B	Proposed Senate Democratic Caucus Plan	RODDEN_0003-04
C	Proposed House Democratic Caucus Plan	RODDEN_0005-06
D	Proposed Ohio Citizens Redistricting Committee Plan	RODDEN_0007-08
E	2011 Congressional Plan	RODDEN_0009-10
F	Curriculum Vitae of Dr. Jonathan Rodden	RODDEN_0011-19

Exhibit A

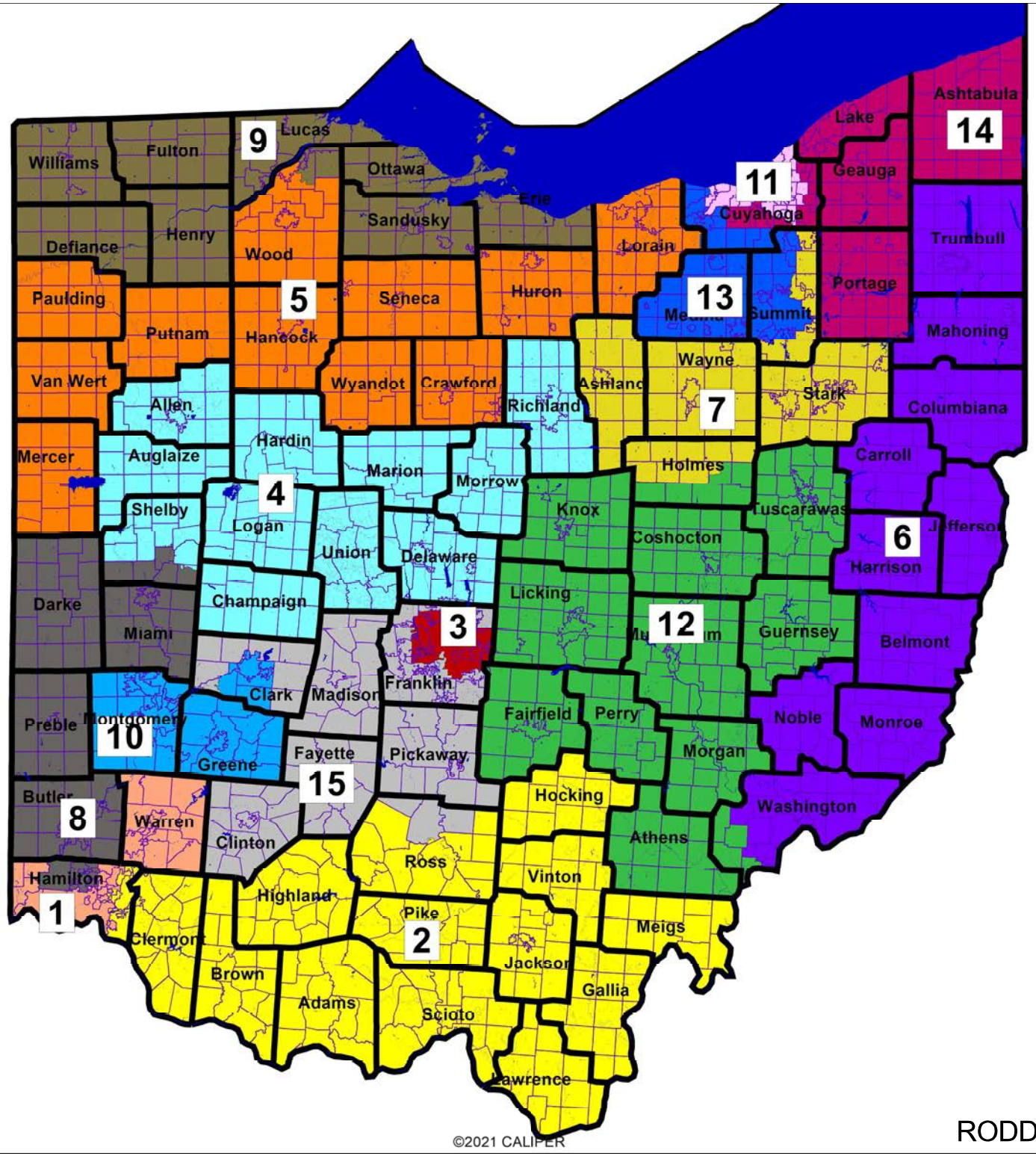

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Exhibit B

Proposed Sub SB 237 Map

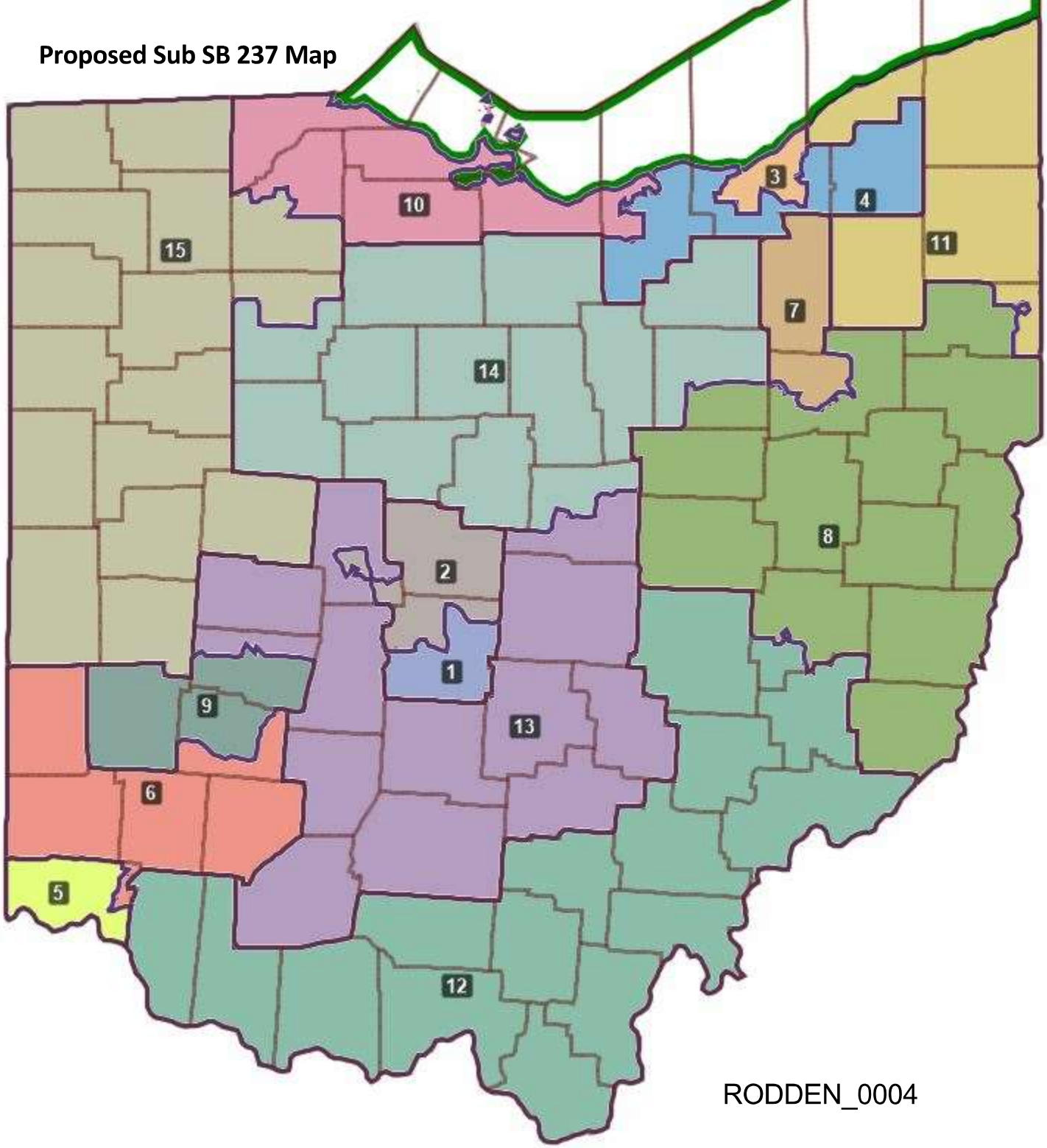

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Exhibit C

Brown/Galonski Congressional District Proposal

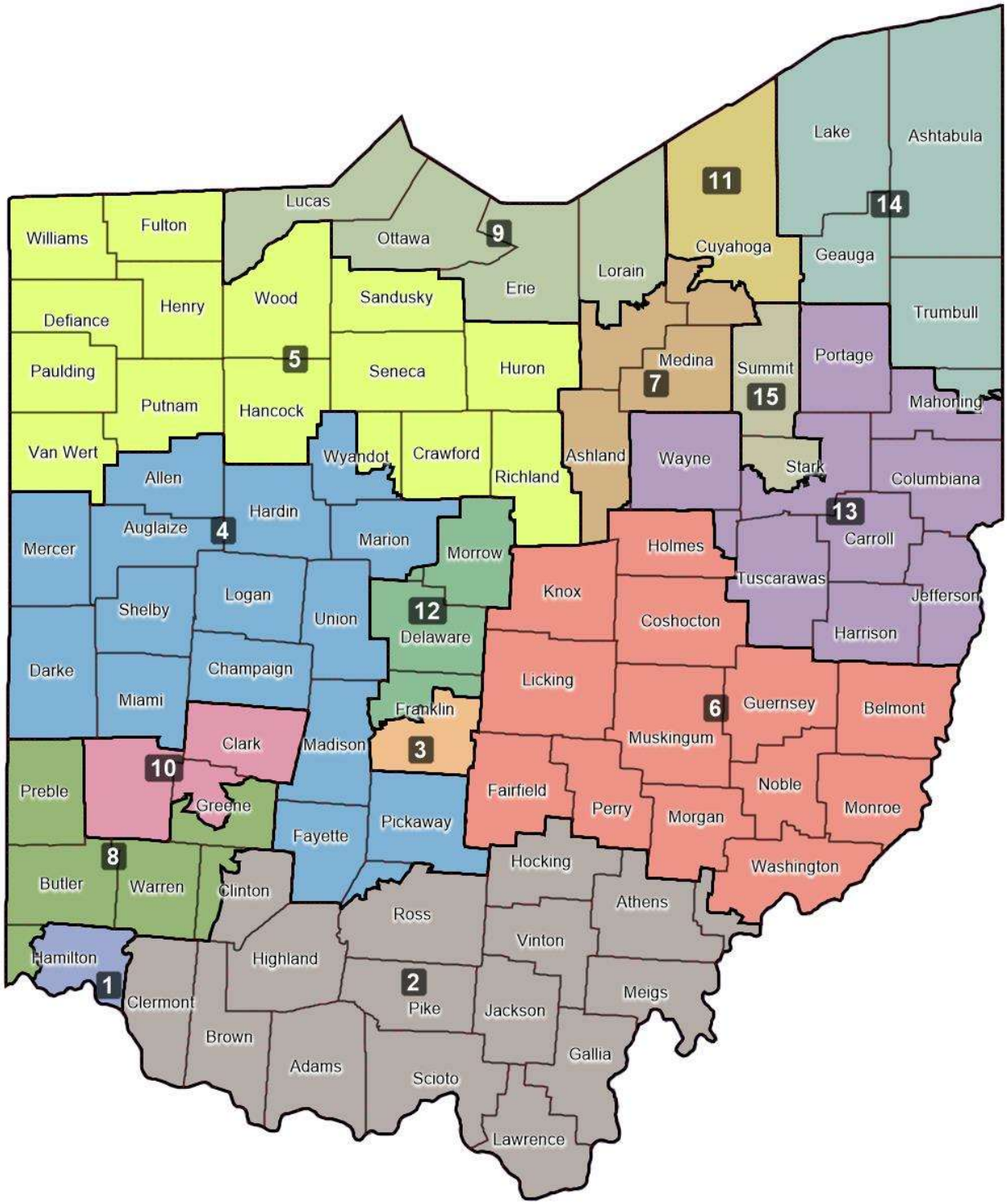

Exhibit D

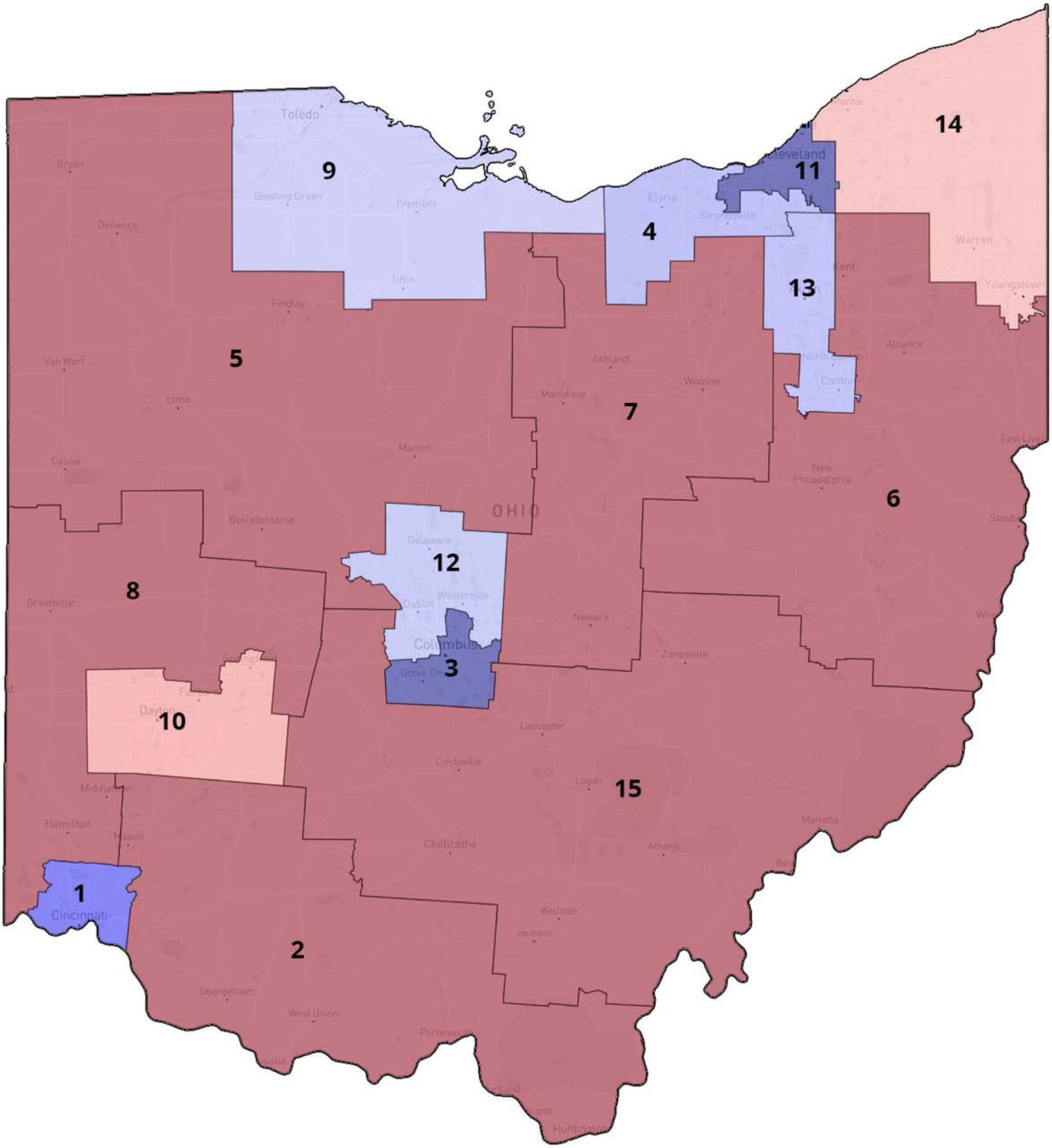
Toledo
9
Bowling Green
Fremont
Tiffin
Findlay
Bryan
Defiance
Van Wert
Lima
Celina
5
Marion
Elyria
4
Cleveland
11
14
Warren
Youngstown
13
Kent
Alliance
Canton
Ashland
Wooster
Mansfield
7
New Philadelphia
6
OHIO
Bellefontaine
Delaware
12
Westerville
Dublin
Columbus
3
Newark
Zanesville
8
Greenville
Springfield
Dayton
10
Lancaster
Circleville
Logan
15
Middletown
Hamilton
Nelson
Chillicothe
Athens
Marietta
1
Cincinnati
Wellston
Jackson
2
Georgetown
West Union
Portsmouth
Huntington

Exhibit E

Frank LaRose
Ohio Secretary of State

U.S. Congressional Districts 2012-2022 in Ohio

(As Adopted 2012)

For the most up-to-date and detailed information on each district, please contact the local county board of elections.

Last Revised 02/2018

RODDEN_0010

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Exhibit F

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.

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RODDEN_0012

Publications

Books

Why Cities Lose: The Deep Roots of the Urban-Rural Divide. Basic Books, 2019.

Decentralized Governance and Accountability: Academic Research and the Future of Donor Programming. Co-edited with Erik Wibbels, Cambridge University Press, 2019.

Hamilton's Paradox: The Promise and Peril of Fiscal Federalism, Cambridge University Press, 2006. Winner, Gregory Luebbert Award for Best Book in Comparative Politics, 2007; Martha Derthick Award for lasting contribution to the study of federalism, 2021.

Fiscal Decentralization and the Challenge of Hard Budget Constraints, MIT Press, 2003. Co-edited with Gunnar Eskeland and Jennie Litvack.

Peer Reviewed Journal Articles

Who Registers? Village Networks, Household Dynamics, and Voter Registration in Rural Uganda, 2021, *Comparative Political Studies* forthcoming (with Romain Ferrali, Guy Grossman, and Melina Platas).

Partisan Dislocation: A Precinct-Level Measure of Representation and Gerrymandering, 2021, *Political Analysis* forthcoming (with Daryl DeFord Nick Eubank).

Who is my Neighbor? The Spatial Efficiency of Partisanship, 2020, *Statistics and Public Policy* 7(1):87-100 (with Nick Eubank).

Handgun Ownership and Suicide in California, 2020, *New England Journal of Medicine* 382:2220-2229 (with David M. Studdert, Yifan Zhang, Sonja A. Swanson, Lea Prince, Erin E. Holsinger, Matthew J. Spittal, Garen J. Wintemute, and Matthew Miller).

Viral Voting: Social Networks and Political Participation, 2020, *Quarterly Journal of Political Science* (with Nick Eubank, Guy Grossman, and Melina Platas).

It Takes a Village: Peer Effects and Externalities in Technology Adoption, 2020, *American Journal of Political Science* (with Romain Ferrali, Guy Grossman, and Melina Platas). Winner, 2020 Best Conference Paper Award, American Political Science Association Network Section.

Assembly of the LongSHOT Cohort: Public Record Linkage on a Grand Scale, 2019, *Injury Prevention* (with Yifan Zhang, Erin Holsinger, Lea Prince, Sonja Swanson, Matthew Miller, Garen Wintemute, and David Studdert).

Crowdsourcing Accountability: ICT for Service Delivery, 2018, *World Development* 112: 74-87 (with Guy Grossman and Melina Platas).

Geography, Uncertainty, and Polarization, 2018, *Political Science Research and Methods* doi:10.1017/psrm.2018.12 (with Nolan McCarty, Boris Shor, Chris Tausanovitch, and Chris Warshaw).

Handgun Acquisitions in California after Two Mass Shootings, 2017, *Annals of Internal Medicine* 166(10):698-706. (with David Studdert, Yifan Zhang, Rob Hyndman, and Garen Wintemute).

Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders, 2015, *Election Law Journal* 14,4:1-15 (with Jowei Chen).

The Achilles Heel of Plurality Systems: Geography and Representation in Multi-Party Democracies, 2015, *American Journal of Political Science* 59,4: 789-805 (with Ernesto Calvo). Winner, Michael Wallerstein Award for best paper in political economy, American Political Science Association.

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

How Should We Measure District-Level Public Opinion on Individual Issues?, 2012, *Journal of Politics* 74, 1: 203-219 (with Chris Warshaw).

Representation and Redistribution in Federations, 2011, *Proceedings of the National Academy of Sciences* 108, 21:8601-8604 (with Tiberiu Dragu).

Dual Accountability and the Nationalization of Party Competition: Evidence from Four Federatons, 2011, *Party Politics* 17, 5: 629-653 (with Erik Wibbels).

The Geographic Distribution of Political Preferences, 2010, *Annual Review of Political Science* 13: 297–340.

Fiscal Decentralization and the Business Cycle: An Empirical Study of Seven Federations, 2009, *Economics and Politics* 22,1: 37–67 (with Erik Wibbels).

Getting into the Game: Legislative Bargaining, Distributive Politics, and EU Enlargement, 2009, *Public Finance and Management* 9, 4 (with Deniz Aksoy).

The Strength of Issues: Using Multiple Measures to Gauge Preference Stability, Ideological Constraint, and Issue Voting, 2008. *American Political Science Review* 102, 2: 215–232 (with Stephen Ansolabehere and James Snyder).

Does Religion Distract the Poor? Income and Issue Voting Around the World, 2008, *Comparative Political Studies* 41, 4: 437–476 (with Ana Lorena De La O).

Purple America, 2006, *Journal of Economic Perspectives* 20,2 (Spring): 97–118 (with Stephen Ansolabehere and James Snyder).

Economic Geography and Economic Voting: Evidence from the U.S. States, 2006, *British Journal of Political Science* 36, 3: 527–47 (with Michael Ebeid).

Distributive Politics in a Federation: Electoral Strategies, Legislative Bargaining, and Government Coalitions, 2004, *Dados* 47, 3 (with Marta Arretche, in Portuguese).

Comparative Federalism and Decentralization: On Meaning and Measurement, 2004, *Comparative Politics* 36, 4: 481-500. (Portuguese version, 2005, in *Revista de Sociologia e Politica* 25).

Reviving Leviathan: Fiscal Federalism and the Growth of Government, 2003, *International Organization* 57 (Fall), 695–729.

Beyond the Fiction of Federalism: Macroeconomic Management in Multi-tiered Systems, 2003, *World Politics* 54, 4 (July): 494–531 (with Erik Wibbels).

The Dilemma of Fiscal Federalism: Grants and Fiscal Performance around the World, 2002, *American Journal of Political Science* 46(3): 670–687.

Strength in Numbers: Representation and Redistribution in the European Union, 2002, *European Union Politics* 3, 2: 151–175.

Does Federalism Preserve Markets? *Virginia Law Review* 83, 7 (with Susan Rose-Ackerman). Spanish version, 1999, in *Quorum* 68.

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RODDEN_0014

Working Papers

Elections, Political Polarization, and Economic Uncertainty, NBER Working Paper 27961 (with Scott Baker, Aniket Baksy, Nicholas Bloom, and Steven Davis).

Federalism and Inter-regional Redistribution, Working Paper 2009/3, Institut d'Economia de Barcelona.

Representation and Regional Redistribution in Federations, Working Paper 2010/16, Institut d'Economia de Barcelona (with Tiberiu Dragu).

Chapters in Books

Political Geography and Representation: A Case Study of Districting in Pennsylvania (with Thomas Weighill), in *Political Geometry*, edited by Moon Duchin and Olivia Walch, forthcoming 2021, Springer.

Keeping Your Enemies Close: Electoral Rules and Partisan Polarization, in *The New Politics of Insecurity*, edited by Frances Rosenbluth and Margaret Weir, forthcoming 2021, Cambridge University Press.

Decentralized Rule and Revenue, 2019, in Jonathan Rodden and Erik Wibbels, eds., *Decentralized Governance and Accountability*, Cambridge University Press.

Geography and Gridlock in the United States, 2014, in Nathaniel Persily, ed. *Solutions to Political Polarization in America*, Cambridge University Press.

Can Market Discipline Survive in the U.S. Federation?, 2013, in Daniel Nadler and Paul Peterson, eds, *The Global Debt Crisis: Haunting U.S. and European Federalism*, Brookings Press.

Market Discipline and U.S. Federalism, 2012, in Peter Conti-Brown and David A. Skeel, Jr., eds, *When States Go Broke: The Origins, Context, and Solutions for the American States in Fiscal Crisis*, Cambridge University Press.

Federalism and Inter-Regional Redistribution, 2010, in Nuria Bosch, Marta Espasa, and Albert Sole Olle, eds., *The Political Economy of Inter-Regional Fiscal Flows*, Edward Elgar.

Back to the Future: Endogenous Institutions and Comparative Politics, 2009, in Mark Lichbach and Alan Zuckerman, eds., *Comparative Politics: Rationality, Culture, and Structure* (Second Edition), Cambridge University Press.

The Political Economy of Federalism, 2006, in Barry Weingast and Donald Wittman, eds., *Oxford Handbook of Political Economy*, Oxford University Press.

Fiscal Discipline in Federations: Germany and the EMU, 2006, in Peter Wierts, Servaas Deroose, Elena Flores and Alessandro Turrini, eds., *Fiscal Policy Surveillance in Europe*, Palgrave MacMillan.

The Political Economy of Pro-cyclical Decentralised Finance (with Erik Wibbels), 2006, in Peter Wierts, Servaas Deroose, Elena Flores and Alessandro Turrini, eds., *Fiscal Policy Surveillance in Europe*, Palgrave MacMillan.

Globalization and Fiscal Decentralization, (with Geoffrey Garrett), 2003, in Miles Kahler and David Lake, eds., *Governance in a Global Economy: Political Authority in Transition*, Princeton University Press: 87-109. (Updated version, 2007, in David Cameron, Gustav Ranis, and Annalisa Zinn, eds., *Globalization and Self-Determination: Is the Nation-State under Siege?* Routledge.)

Introduction and Overview (Chapter 1), 2003, in Rodden et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

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Soft Budget Constraints and German Federalism (Chapter 5), 2003, in Rodden, et al, *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Federalism and Bailouts in Brazil (Chapter 7), 2003, in Rodden, et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Lessons and Conclusions (Chapter 13), 2003, in Rodden, et al., *Fiscal Decentralization and the Challenge of Hard Budget Constraints* (see above).

Online Interactive Visualization

Stanford Election Atlas, 2012 (collaboration with Stephen Ansolabehere at Harvard and Jim Herries at ESRI)

Other Publications

Supporting Advanced Manufacturing in Alabama, Report to the Alabama Innovation Commission, Hoover Institution, 2021.

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.

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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.

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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.

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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

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Neiman Petitioners' Exhibit 25

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. Relators' counsel asked me to analyze Ohio's 2021 Congressional Plan (the "Enacted Plan"), as created by the General Assembly's Substitute Senate Bill 258. Specifically, I was asked to analyze:

    a. Does the 2021 Enacted 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 2021 Enacted Plan's treatment of Ohio's most populous counties be explained by the redistricting criteria required by the Ohio Constitution?

    c. Is the 2021 Enacted Plan a product of an attempt to draw districts that are compact?

    d. How do the 2021 Enacted Plan's competitive districts affect the partisan characteristics of the map, if at all?

    e. Can the partisan characteristics of the 2021 Enacted Plan be explained by Ohio's political geography?

2. 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

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may not unduly split counties, townships, and municipal corporations. Third, the General Assembly "shall attempt to draw districts that are compact."

3. In summary, I found that the Enacted 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 Enacted Plan is an extreme partisan outlier, both at a statewide level and with respect to the partisan characteristics of its individual districts. The Enacted 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 Enacted Plan were enabled by the drawing of districts that are far less geographically compact than was reasonably possible across the state, particularly in Hamilton, Franklin, and Cuyahoga Counties. Most notably, the Enacted Plan creates an extreme partisan outcome in its Cincinnati-based district (CD-1) by splitting Hamilton County excessively and sacrificing geographic compactness in this district. Similarly, the Enacted Plan creates an extreme partisan outcome in Cuyahoga County by unnaturally packing Democratic voters, and in Franklin County by sacrificing geographic compactness to create anomalously partisan districts.

II. QUALIFICATIONS

4. I am an Associate Professor in the Department of Political Science at the University of Michigan, Ann Arbor. I am also a Research Associate Professor at the Center for Political Studies of the Institute for Social Research at the University of Michigan. In 2004, I received a B.A. in Ethics, Politics, and Economics from Yale University. In 2007, I received a M.S. in Statistics from Stanford University, and in 2009, I received a Ph.D. in Political Science from Stanford University. A copy of my current C.V. is included in the Appendix.

5. I have published academic papers on legislative districting and political geography in several political science journals, including *The American Journal of Political Science*, *The American Political Science Review*, and *Election Law Journal*. My academic areas of expertise include legislative elections, spatial statistics, geographic information systems (GIS) data, redistricting, racial politics, legislatures, and political geography. I have expertise in the use of computer simulations of legislative districting and in analyzing political geography, elections, and redistricting.

6. I have authored expert reports in the following redistricting court cases: *The League of Women Voters of Florida v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County*

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

Board of Election Commissioners (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); Brown v. Detzner (N.D. Fla. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Harper v. Lewis* (N.C. Super. 2019); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021). I have testified either at deposition or at trial in the following cases: *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013*); Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C. 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP* v. *The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021).

7. I have been retained by Relators in the above-captioned matter. I am being compensated $550 per hour for my work in this case.

III. DATA SOURCES

8. 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, Relators' counsel provided me with a block assignment file depicting the geographic boundaries of the 2021 Enacted Plan.

IV. THE USE OF COMPUTER-SIMULATED DISTRICTING PLANS

9. In conducting my academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed various computer simulation programming techniques that allow me to produce a large number of non-partisan districting plans that adhere to traditional districting criteria using U.S. Census geographies

[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/

as building blocks. This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to draw districting plans following various traditional districting goals, such as equalizing population, avoiding county, municipal, and township splits, and attempting to draw geographically compact districts.

10. By randomly generating a large number of districting plans that adhere to these nonpartisan districting criteria, I am able to assess an enacted plan drawn by a state legislature and determine whether the partisan characteristics of the enacted plan are within the normal range of districting plans produced by a districting process following these criteria. If the enacted plan is a statistical outlier compared to the partisan characteristics of the computer-simulated plans, then I can conclude that the enacted plan's partisanship is not the product of following the non-partisan districting criteria. By holding constant the application of the nonpartisan districting criteria through the simulations, I am able to determine whether the enacted plan could have been the product of something other than partisan considerations. With respect to Ohio's 2021 Congressional Enacted Plan, I determined that it could not.

11. I produced a set of 1,000 valid computer-simulated plans for Ohio's congressional districts using a computer algorithm programmed to follow the required districting criteria enumerated in Article XIX of the Ohio Constitution. In following these constitutional criteria, the computer algorithm uses the same general approach that I employed in creating the simulated congressional and legislative districting plans that I analyzed as an expert witness in several prior partisan gerrymandering redistricting cases, including *Common Cause v. Lewis* (2019), *Harper v. Lewis* (2019), *Whitford v. Gill* (2018), *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (2017), *The League of Women Voters of Michigan v. Johnson* (2017), *Common Cause v. Rucho* (2016), *City of Greensboro v. Guilford County Board of Elections* (2016), and *Raleigh Wake Citizens Association v. Wake County Board of Elections* (2015).

12. By randomly drawing districting plans with a process designed to strictly follow non-partisan districting criteria, the computer simulation process gives us an indication of the range of districting plans that plausibly and likely emerge when map-drawers are not motivated primarily by partisan goals. By comparing the Enacted Plan against the distribution of simulated plans with respect to partisan measurements, I am also able to determine the extent to which the map-drawer deviated from non-partisan districting criteria, such as geographic compactness, thereby enabling the map-drawer to produce an enacted plan with extreme partisan characteristics.

13. These computer simulation methods are widely used by academic scholars to analyze districting maps. For over two decades, political scientists have used such computer-simulated districting techniques to analyze the racial and partisan intent of legislative map-

drawers.[5] In recent years, several courts have also relied upon computer simulations to assess partisan bias in enacted districting plans.[6]

V. DISTRICTING CRITERIA REQUIRED BY THE OHIO CONSTITUTION

14. I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following districting criteria, which are required by Article XIX of the Ohio Constitution:

    a) Population Equality: Because Ohio's 2020 Census population was 11,799,448, districts in every 15-member congressional plan have an ideal population of 786,629.9. Accordingly, the computer simulation algorithm populated each districting plan such that precisely two districts have a population of 786,629, while the remaining thirteen districts have a population of 786,630 (Article XIX, Section 2(B)(3)).

    b) Contiguity: The simulation algorithm required districts to be composed of geographically contiguous territory (Article XIX, Section 2(B)(3)).

    c) Minimizing County Splits: The simulation algorithm avoided splitting any of Ohio's 88 counties, except when doing so was necessary to avoid violating one of the aforementioned criteria. When a county is divided into two districts, the county is considered to have one split. A county divided into three districts is considered to have two splits. For the purpose of creating equally populated districts, each newly drawn congressional district requires only one county split. But the fifteenth and final district drawn in Ohio need not create an additional county split, since this final district should simply be the remaining area unassigned to the first fourteen districts. Therefore, an entire plan of 15 congressional districts requires only 14 county splits. Accordingly, the algorithm required that every simulated plan contain only 14 county splits, which is exactly the same number of county splits the 2021 Enacted Plan contains. Article XIX, Section 2(B)(5) of the Ohio Constitution allows a county to be split up to twice, so I allow some of these 14 county splits to occur within the same county. As a result, the total number of counties containing one or more splits may be fewer than 14.

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[5] *See, e.g.*, Carmen Cirincione, Thomas A. Darling, Timothy G. O'Rourke. "Assessing South Carolina's 1990s Congressional Districting," Political Geography 19 (2000) 189–211; Jowei Chen, "The Impact of Political Geography on Wisconsin Redistricting: An Analysis of Wisconsin's Act 43 Assembly Districting Plan." Election Law Journal _____.

[6] *See, e.g.*, *League of Women Voters of Pa. v. Commonwealth*, 178 A. 3d 737, 818-21 (Pa. 2018); *Raleigh Wake Citizens Association v. Wake County Board of Elections*, 827 F.3d 333, 344-45 (4th Cir. 2016); *City of Greensboro v. Guilford County Board of Elections*, No. 1:15-CV-599, 2017 WL 1229736 (M.D.N.C. Apr 3, 2017); *Common Cause v. Rucho*, No. 1:16-CV-1164 (M.D.N.C. Jan 11, 2018*); The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Common Cause v. David Lewis* (N.C. Super. 2018).

d) Township and Municipal Corporation Boundaries: The simulation algorithm avoided splitting any of Ohio's townships, cities, and villages, except when doing so was necessary to avoid violating one of the aforementioned criteria. In doing so, the algorithm followed several principles described in the Ohio Constitution. First, Cleveland and Cincinnati are never split into multiple districts (Article XIX, Section 2(B)(4)(b)). Second, a non-contiguous fragment of a township or municipal corporation that is assigned to a different district than the main portion of that township or municipal corporation does not count as a township or municipal split (Article XIX, Section 2(C)(1)). Third, a township or municipal corporation that crosses a county border can be split at that county border without counting as a split township or municipal corporation (Article XIX, Section 2(C)(2)). Finally, following the Census Bureau's depiction of Ohio's township boundaries, any area that has been annexed into a municipal corporation is considered part of that municipal corporation, rather than part of the township.[7]

e) Geographic Compactness: Following the Ohio Constitution's requirements for a congressional map passed by a simple majority of each house of the General Assembly, the simulation algorithm favors geographic compactness in the drawing of districts whenever doing so does not violate any of the aforementioned criteria (Article XIX, Section 1(C)(3)(c)).

f) Prohibiting Double Traversals: At the conclusion of the districting simulation algorithm, the computer is instructed to reject any plan containing a double traversal. In other words, a district containing non-contiguous area within any single county is prohibited, as specified in Article XIX, Section 2(B)(6).

15. On the following page of this report, Figure 1 displays an example of one of the computer-simulated plans produced by the computer algorithm. The left half of this Figure also reports the population of each district, the compactness scores for each district, and the counties split by the plan.

[7] The number of township and municipal corporation splits in the simulated plans range from 13-19, with the vast majority of plans including 14-16 splits. The map-drawers of the Enacted Plan purport that it has 14 such splits. A histogram showing the number of split townships and municipal corporations in the 1,000 computer-simulated plans is included in the Appendix. Also included in the Appendix are figures showing that, even considering only those simulated plans with 13 or 14 township and municipal corporation splits, the Enacted Plan is a partisan outlier.

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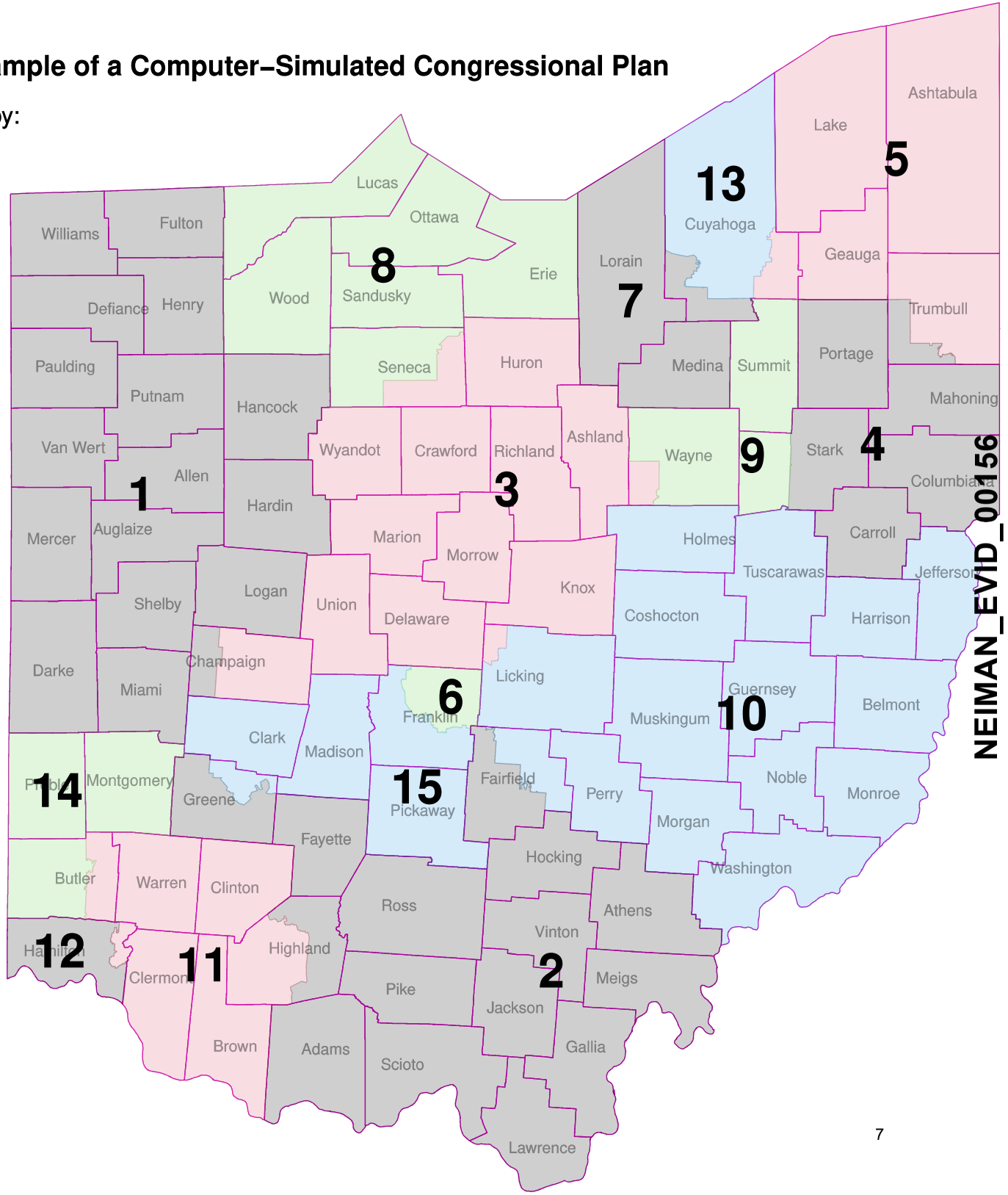
Figure 1: Example of a Computer–Simulated Congressional Plan

District:	Population:	Reock:	Popper–Polsby:
1	786,630	0.62	0.562
2	786,630	0.37	0.216
3	786,630	0.412	0.377
4	786,630	0.642	0.559
5	786,630	0.558	0.58
6	786,630	0.55	0.527
7	786,629	0.554	0.452
8	786,629	0.435	0.507
9	786,630	0.461	0.409
10	786,630	0.502	0.403
11	786,630	0.513	0.415
12	786,630	0.391	0.348
13	786,630	0.536	0.525
14	786,630	0.459	0.483
15	786,630	0.308	0.307
Average:	786,629.9	0.487	0.445

13 Split Counties:
Butler (Districts 11, 14)
Champaign (Districts 1, 3)
Cuyahoga (Districts 13, 5, 7)
Fairfield (Districts 10, 2)
Franklin (Districts 15, 6)
Greene (Districts 15, 2)
Hamilton (Districts 11, 12)
Highland (Districts 11, 2)
Licking (Districts 10, 3)
Seneca (Districts 3, 8)
Stark (Districts 4, 9)
Trumbull (Districts 4, 5)
Wayne (Districts 3, 9)



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VI. DISTRICTING REQUIREMENTS UNDER ARTICLE XIX, SECTION (1)(C)(3)

16. 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."

17. Throughout the remainder of this report, I evaluate the General Assembly's compliance with these three mandates by comparing the 2021 Enacted Plan to the 1,000 computer-simulated plans, which were produced by a computer algorithm following the constitutional districting criteria outlined above. By comparing the Enacted Plan to the computer-simulated plans, I am able to assess whether the Enacted Plan's partisan characteristics, governmental division splits, and compactness can be explained by other redistricting criteria. I determined that they cannot.

VII. MEASURING THE PARTISAN CHARACTERISTICS OF OHIO CONGRESSIONAL DISTRICTS

18. I use actual election results from recent, statewide election races in Ohio to assess the partisan performance of the Enacted Plan and the computer-simulated plans analyzed in this report. 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 Enacted 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 Enacted Plan. All of these calculations thus allow me to directly compare the partisanship of the Enacted Plan and the simulated plans. These partisan comparisons allow me to determine whether or not the partisanship of individual districts and the partisan distribution of seats in the Enacted Plan could reasonably have arisen from a districting process adhering to the Ohio Constitution and its explicit prohibition on unduly favoring either political party. Voting history in federal and statewide elections is a strong predictor of future voting patterns. Mapmakers thus can and do use past voting history to identify the class of voters, at a precinct-by-precinct level, who are likely to vote for Republican or Democratic congressional candidates.

19. In general, a reliable method of comparing the partisanship of different congressional districts within a state is to calculate the percentage of votes from these districts favoring Republican (or Democratic) candidates in recent, competitive *statewide* elections, such as the Presidential, Gubernatorial, Attorney General, and U.S. Senate elections. Recent statewide elections provide reliable bases for comparisons of different precincts' partisan tendencies because in any statewide election, the anomalous candidate-specific effects that shape the election outcome are equally present in all precincts across the state. Statewide elections are thus a better basis for comparison than the results of congressional (or "endogenous") elections because the particular outcome of any congressional election may deviate from the long-term partisan voting trends of that district, due to factors idiosyncratic to the district as currently constructed. Such factors can include the presence or absence of a quality challenger, anomalous difference between the candidates in

campaign efforts or campaign finances, incumbency advantage, candidate scandals, and coattail effects.[8] Because these idiosyncratic factors would change if the district were drawn differently, it is particularly unsuitable to use election results from an existing district when comparing the partisanship of districts in a newly-enacted plan or a computer-simulated plan that would have different boundaries than those used in past congressional elections.

20. Moreover, statewide elections are also a more reliable indicator of a district's partisanship than partisan voter registration counts. Voter registration by party is a uniquely unreliable method of comparing districts' partisan tendencies because many voters who consistently support candidates from one party nevertheless do not officially register with either major party, while others vote for candidates of one party while registering with a different party.[9] As a result, based on my expertise and my experience studying redistricting practices across many states, legislative map-drawers generally do not rely heavily on voter registration data in assessing the partisan performance of districts.

21. ***The 2016-2020 Statewide Election Composite:*** To measure the partisanship of all districts in the computer-simulated plans and the 2021 Enacted 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 U.S. President, 2016 U.S. Senator, 2018 Attorney General, 2018 Auditor, 2018 Governor, 2018 Secretary of State, 2018 Treasurer, 2018 U.S. Senator, and 2020 U.S. President elections.

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

23. I refer to the aggregated election results from these nine statewide elections as the "2016-2020 Statewide Election Composite." For the Enacted 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 Enacted Plan and simulated plan districts in order

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[8] *E.g.*, Alan Abramowitz, Brad Alexander, and Matthew Gunning. "Incumbency, Redistricting, and the Decline of Competition in U.S. House Elections." *The Journal of Politics.* Vol. 68, No. 1 (February 2006): 75-88.

[9] Kenneth J. Meier, "Party Identification and Vote Choice: The Causal Relationship" Vol. 28, No. 3 (Sep., 1975):496-505.

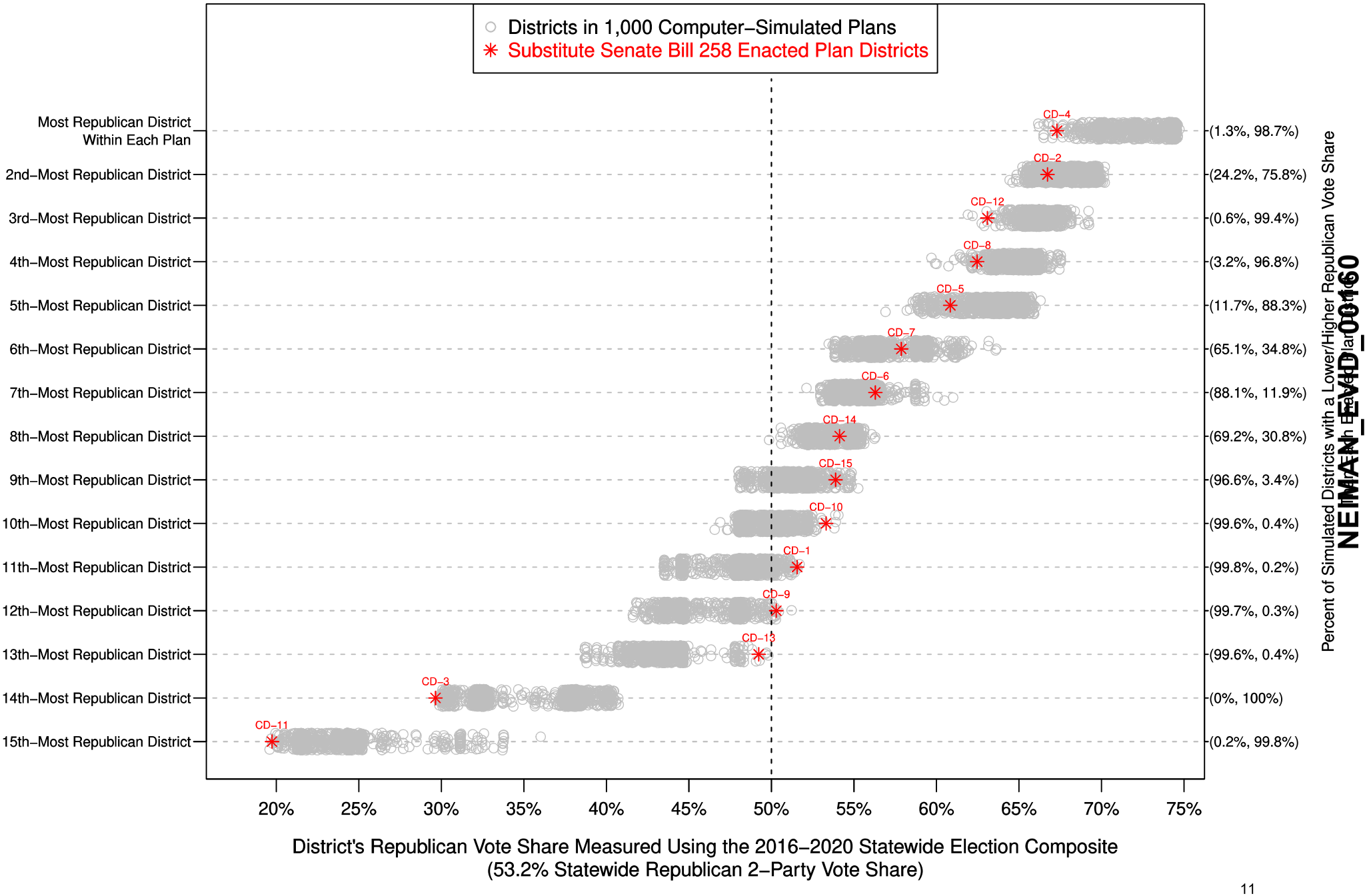
to identify whether any individual districts in the Enacted Plan are partisan outliers. I also present plan-wide comparisons of the Enacted Plan and the simulated plans in order to identify the extent to which the Enacted Plan is a statistical outlier in terms of common measures of districting plan partisanship.

VIII. PARTISAN CHARACTERISTICS OF THE ENACTED PLAN

24. In this section, I present partisan comparisons of the Enacted 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 Enacted 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 Enacted Plan and in the computer-simulated plans. Finally, I use several common measures of partisan bias to compare the Enacted Plan to the computer-simulated plans. Overall, I find that several individual districts in the Enacted Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely or never observed in the computer-simulated plan districts drawn according to the Ohio Constitution's districting requirements. The partisan characteristics of the Enacted 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. Moreover, I find that at the plan-wide level, the Enacted Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans. I describe these findings in detail below:

25. ***Partisan Outlier Districts in the Enacted Plan***: In Figure 2, I directly compare the partisan distribution of districts in the Enacted Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the Enacted 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 2. 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 Enacted Plan district (CD-4) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the Enacted 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 Enacted 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 Enacted Plan, comparing the Enacted Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

Figure 2: Comparisons of Enacted Plan Districts to 1,000 Computer–Simulated Plans' Districts



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26. Thus, the top row of Figure 2 directly compares the partisanship of the most-Republican Enacted Plan district (CD-4) 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 Enacted 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 Enacted Plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

27. In the Enacted 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 2 illustrates, the most-Democratic district in the Enacted Plan (CD-11) is *more* heavily Democratic than 100% 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. 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 19.7%, while all 1,000 of the 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 100% 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.

28. The next-to-bottom row of Figure 2 reveals a similar finding regarding the Enacted Plan's CD-3, which is located in and around Columbus. This row illustrates that the second-most Democratic district in the Enacted Plan (CD-3) is *more* heavily Democratic than 100% of the second-most Democratic districts in each of the 1,000 computer-simulated plans. Every single one 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 29.6%, while 100% 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 100% of the computer-simulated plans. I therefore identify CD-3 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

29. Meanwhile, the top row of Figure 2 reveals a similar finding: As the top row illustrates, the most Republican district in the Enacted Plan (CD-4) is *less* heavily Republican than 98.7% of the most Republican districts in each of the 1,000 computer-simulated plans. It is thus clear that CD-4 "cracks" Democratic voters who would otherwise reside in surrounding districts by placing them into CD-4.

30. It is especially notable that these three aforementioned Enacted Plan districts – the most-Republican district (CD-4) and the two most-Democratic districts (CD-3 and CD-11) in the

Enacted Plan – were drawn to include more Democratic voters than virtually all of their counterpart districts in the 1,000 computer-simulated plans. These "extra" Democratic voters in the three most partisan-extreme districts in the Enacted Plan had to come from the remaining twelve more moderate districts in the Enacted Plan. Having fewer Democratic voters in these more moderate districts enhances Republican candidate performance in these districts.

31. Indeed, the ninth through thirteenth rows in Figure 2 confirm this precise effect. These five rows in Figure 2 compare the partisanship of districts in the ninth, tenth, eleventh, twelfth, and thirteenth-most Republican districts within the Enacted Plan and the 1,000 computer-simulated plans. In all five of these rows, the Enacted Plan district is a partisan outlier. In each of these five rows, the Enacted Plan's district is more heavily Republican than over 95% of its counterpart districts in the 1,000 computer-simulated plans. The five Enacted Plan districts in these five rows (CD-1, 9, 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 Enacted Plan (CD-3, 4, and 11) are more heavily Democratic than nearly all of their counterpart districts in the computer-simulated plans.

32. I therefore identify the five Enacted Plan districts in the ninth through thirteenth rows (CD-1, 9, 10, 13, and 15) of Figure 2 as partisan statistical outliers. Each of these five districts has a Republican vote share that is higher than over 95% of the computer-simulated districts in its respective row in Figure 2. I also identify the three Enacted Plan districts in the top row and in the bottom two rows (CD-3, 4, and 11) of Figure 2 as partisan statistical outliers. Each of these three districts has a Republican vote share that is lower than over 95% of the computer-simulated districts in its respective row in Figure 2.

33. In summary, Figure 2 illustrates that eight of the 15 districts in the Enacted Plan are partisan outliers: Five districts (CD-1, 9, 10, 13, and 15) in the Enacted Plan are more heavily Republican than over 95% of their counterpart computer-simulated plan districts, while three districts (CD-3, 4, and 11) are more heavily Democratic than over 98% of their counterpart districts in the computer-simulated plans.

34. The Appendix of this report contains nine additional Figures (Figures A1 through A9) that each contain a similar analysis of the Enacted 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 2 are also present when district partisanship is measured using any one of the nine statewide elections held in Ohio during 2016-2020.

35. ***Number of Democratic and Republican Districts:*** I compared the partisan breakdown of the computer-simulated plans to the partisanship of the Enacted Plan, using the 2016-2020 Statewide Election Composite to measure the number of Republican-favoring districts created in each of the 1,000 simulated plans. Across the entire state, Republican candidates collectively won a 53.2% share of the votes in the nine elections in the 2016-2020 Statewide Election Composite. But among the 15 districts in the Enacted Plan, Republicans have over a 50% vote share in 12 out of 15 districts. In other words, the Enacted Plan

created 12 Republican-favoring districts, as measured using the 2016-2020 Statewide Election Composite. By contrast, only 1.3% of the computer-simulated plans create 12 Republican-favoring districts, and no computer-simulated plan ever creates more than 12 Republican districts.

36. Hence, in terms of the total number of Republican-favoring districts created by the plan, the 2021 Enacted Plan is a statistical outlier when compared to the 1,000 computer-simulated plans. The Enacted Plan creates the maximum number of Republican districts that ever occurs in any computer-simulated plan, and the Enacted Plan creates more Republican districts than 98.7% of the computer-simulated plans, which were drawn using a nonpartisan process adhering to the districting requirements in the Ohio Constitution. I characterize the Enacted Plan's creation of 12 Republican districts as a statistical outlier among the computer-simulated plans because the Enacted Plan exhibits an outcome that is more favorable to Republicans than over 98.7% of the simulated plans.

37. ***The Efficiency Gap:*** Another commonly used measure of a districting plan's partisan bias is the efficiency gap.[10] To calculate the efficiency gap of the Enacted Plan and every computer-simulated plan, I first measure the number of Republican and Democratic votes within each Enacted Plan district and each computer-simulated district, as measured using the 2016-2020 Statewide Election Composite. Using this measure of district-level partisanship, I then calculate each districting plan's efficiency gap using the method outlined in *Partisan Gerrymandering and the Efficiency Gap.*[11] Districts are classified as Democratic victories if, using the 2016-2020 Statewide Election Composite, the sum total of Democratic votes in the district during these elections exceeds the sum total of Republican votes; otherwise, the district is classified as Republican. For each party, I then calculate the total sum of surplus votes in districts the party won and lost votes in districts where the party lost. Specifically, in a district lost by a given party, all of the party's votes are considered lost votes; in a district won by a party, only the party's votes exceeding the 50% threshold necessary for victory are considered surplus votes. A party's total wasted votes for an entire districting plan is the sum of its surplus votes in districts won by the party and its lost votes in districts lost by the party. The efficiency gap is then calculated as total wasted Democratic votes minus total wasted Republican votes, divided by the total number of two-party votes cast statewide across all nine elections.

38. Thus, the importance of the efficiency gap is that it tells us the degree to which more Democratic or Republican votes are wasted across an entire districting plan. A significantly positive efficiency gap indicates far more Democratic wasted votes, while a significantly negative efficiency gap indicates far more Republican wasted votes.

39. I analyze whether the Enacted Plan's efficiency gap arises naturally from a map-drawing process adhering to the required districting criteria in the Ohio Constitution, or rather,

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[10] Eric McGhee, "Measuring Partisan Bias in Single-Member District Electoral Systems." Legislative Studies Quarterly Vol. 39, No. 1: 55–85 (2014).

[11] Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap,* 82 University of Chicago Law Review 831 (2015).

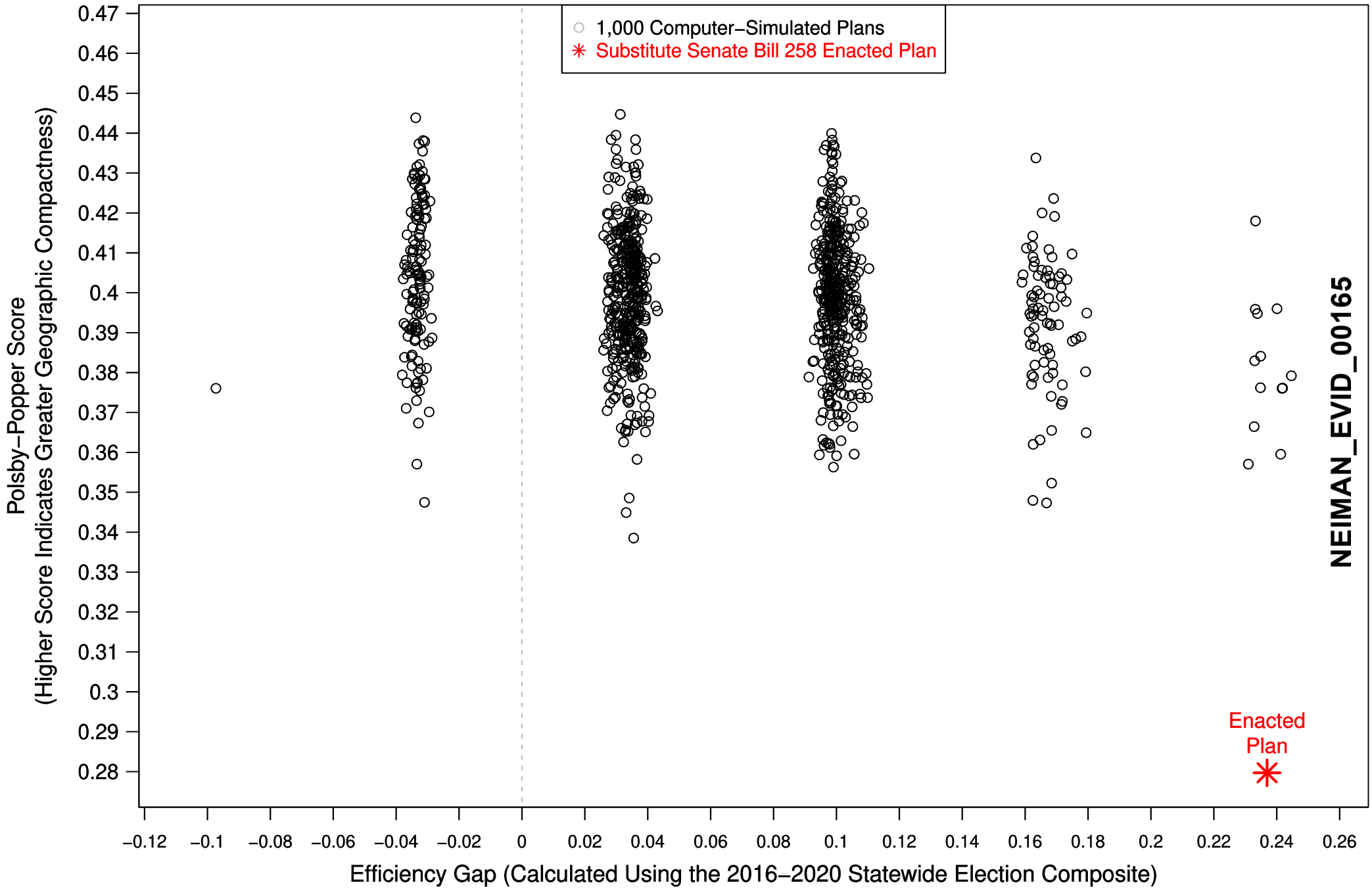
whether the skew in the Enacted Plan's efficiency gap is explainable only as the product of a map-drawing process that intentionally favored one party over the other. By comparing the efficiency gap of the Enacted Plan to that of the computer-simulated plans, I am able to evaluate whether or not such the Enacted Plan's efficiency gap could have realistically resulted from adherence to the Ohio Constitution.

40. Figure 3 compares the efficiency gaps of the Enacted Plan and of the 1,000 computer-simulated plans. As before, the 1,000 circles in this Figure represent the 1,000 computer-simulated plans, while the red star in the lower right corner represents the Enacted Plan. Each plan is plotted along the horizontal axis according to its efficiency gap, while each plan is plotted along the vertical axis according to its Polsby-Popper score.[12]

41. The results in Figure 3 illustrate that the Enacted Plan exhibits an efficiency gap of +23.7%, indicating that the plan results in far more wasted Democratic votes than wasted Republican votes. Specifically, the difference between the total number of wasted Democratic votes and wasted Republican votes amounts to 23.7% of the total number of votes statewide. The Enacted Plan's efficiency gap is larger than the efficiency gaps exhibited by 99.5% of the computer-simulated plans. This comparison reveals that the significant level of Republican bias exhibited by the Enacted Plan cannot be explained alone by Ohio's political geography or the redistricting criteria in the Ohio Constitution.

[12] See paragraph 57, *infra*, for a definition of the Polsby-Popper score.

Figure 3:
Comparisons of Substitute Senate Bill 258 Enacted Plan to 1,000 Computer–Simulated Plans on Efficiency Gap and Compactness



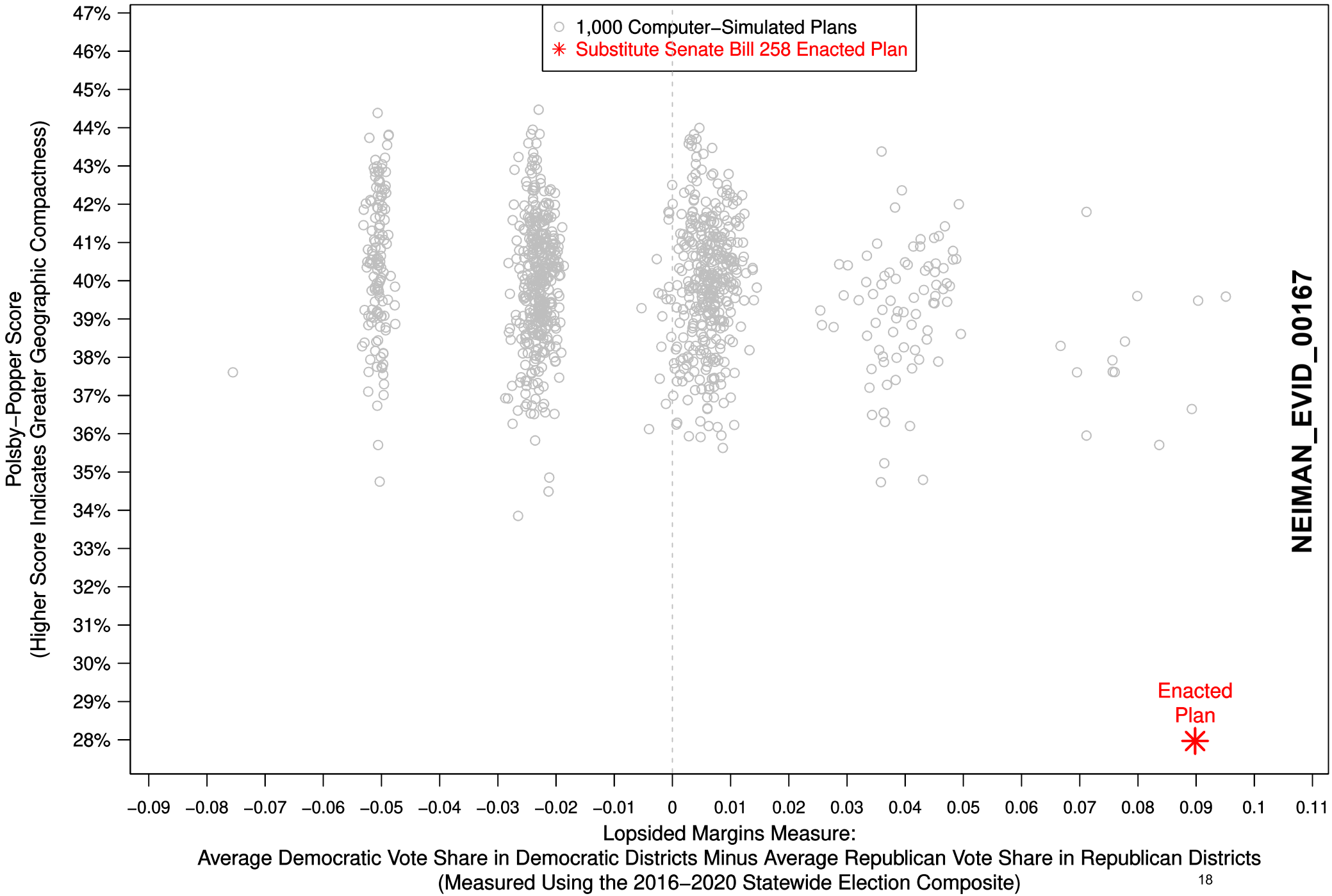
42. ***The Lopsided Margins Measure:*** Another measure of partisan bias in districting plans is the "lopsided margins" test. The basic premise captured by this measure is that a partisan-motivated map-drawer may attempt to pack the opposing party's voters into a small number of extreme districts that are won by a lopsided margin. Thus, for example, a map-drawer attempting to favor Party A may pack Party B's voters into a small number of districts that very heavily favor Party B. This packing would then allow Party A to win all the remaining districts with relatively smaller margins. This sort of partisan manipulation in districting would result in Party B winning its districts by extremely large margins, while Party A would win its districts by relatively small margins. In other words, by packing most of Party B's voters into a handful of districts, and drawing remaining districts as nominally "competitive" but favoring Party A, Party A can maximize its expected performance in an election.

43. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. The 2021 Enacted Plan contains three Democratic-favoring districts (CD-3, 11, and 13), and these three districts have an average Democratic vote share of 67.1%, as measured using the 2016-2020 Statewide Election Composite. By contrast, the Enacted Plan contains twelve Republican-favoring districts (CD-1, 2, 4, 5, 6, 7, 8, 9, 10, 12, 14, and 15), and these twelve districts have an average Republican vote share of 58.1%. Hence, the difference between the average Democratic margin of victory in Democratic-favoring districts and the average Republican margin of victory in Republican-favoring districts is +9.0%, which is calculated as 67.1% - 58.1%. I refer to this calculation of +9.0% as the Enacted Plan's lopsided margins measure.

44. How does this +9.0% lopsided margins measure of the Enacted Plan compare to the same calculation for the 1,000 computer-simulated plans? Figure 4 reports the lopsided margins calculations for the Enacted Plan and for the simulated plans. In Figure 4, each plan is plotted along the horizontal axis according to its lopsided margins measure and along the vertical axis according to its Polsby-Popper score.[13]

[13] *Id.*

Figure 4:
Comparisons of Substitute Senate Bill 258 Enacted Plan to 1,000 Computer–Simulated Plans on Lopsided Margins Measure and Compactness



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45. Figure 4 reveals that the Enacted Plan's +9.0% lopsided margins measure is an extreme outlier compared to the lopsided margins measures of the 1,000 computer-simulated plans. Over 99.8% of the simulated plans have a smaller lopsided margins measure than the Enacted Plan. In fact, a significant minority (40.6%) of the 1,000 simulated plans have a lopsided margins measure of between -2% to +2%, indicating a plan in which Democrats and Republicans win their respective districts by similar average margins.

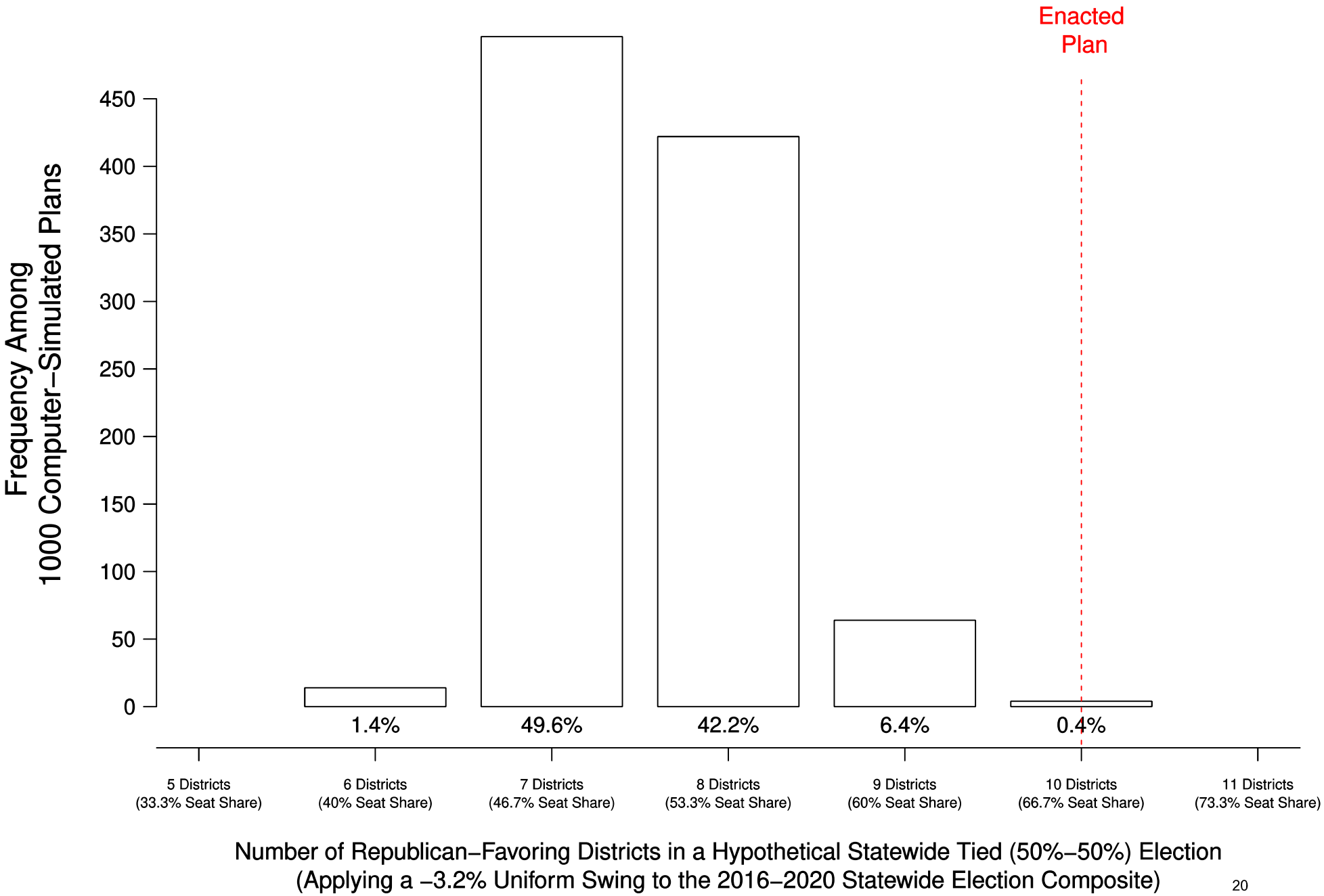
46. By contrast, the Enacted Plan's lopsided margins measure of +9.0% indicates that the Enacted Plan creates districts in which Democrats are extremely packed into their districts, while the margin of victory in Republican districts is significantly smaller. The "lopsidedness" of the two parties' average margin of victory is extreme when compared to the computer-simulated plans. The finding that all 1,000 simulated plans have a smaller lopsided margins measure indicates that the Enacted Plan's extreme packing of Democrats into Democratic-favoring districts was not simply the result of Ohio's political geography, combined with adherence to the districting criteria in the Ohio Constitution.

47. ***Partisan Symmetry Based on Uniform Swing:*** Another common measure of partisan bias is based on the concept of partisan symmetry and asks the following question: Under a given districting plan and given a particular election-based measure of district partisanship, what share of seats would each party win in a hypothetical tied election (i.e., 50% vote share for each of two parties). To approximate the district-level outcomes in a hypothetical tied election, one normally uses a uniform swing in order to simulate a tied statewide election. We then calculate whether each party would receive more than or less than 50% of the seats under this hypothetical tied election in a given districting plan. This particular measure is often referred to in the academic literature as "partisan bias." In order to avoid confusion with other measures of partisan bias described in this report, I will refer to this measure as "Partisan Symmetry Based on Uniform Swing."

48. Specifically, I use the 2016-2020 Statewide Election Composite to calculate the Partisan Symmetry measure for both the Enacted Plan and for the computer-simulated plans. The 2016-2020 Statewide Election Composite produces a statewide Republican vote share of 53.2%. Therefore, I use a uniform swing of -3.2% in order to estimate the partisanship of districts under a hypothetical tied election in which each party wins exactly 50% of the statewide vote. In other words, this uniform swing subtracts 3.2% from the Republican vote share in every district, both in the Enacted Plan and in all simulated plans.

49. After applying this -3.2% uniform swing, I compare the number of Republican-favoring districts in the Enacted Plan and the simulated plans. In the Enacted Plan, 67.7% of the districts (10 out of 15) are Republican-favoring after applying the uniform swing. I then report the Republicans' seat share (67.7%) under this hypothetical tied election in Figure 5 as the "Partisan Symmetry Based on Uniform Swing" measure for the Enacted Plan. Figure 5 also reports the calculations for all 1,000 simulated plans using this identical method.

Figure 5:
Comparisons of Substitute Senate Bill 258 Enacted Plan to 1,000 Computer–Simulated Plans On Partisan Symmetry Based on Uniform Swing



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50. Figure 5 reveals that in over 90% of the 1,000 simulated plans, the "Partisan Symmetry Based on Uniform Swing" measure would be quite close to 50%, either at 46.7% or 53.3%. This measure is close to 50% in over 90% of the simulated plans because the Republicans would win either 7 or 8 districts in a hypothetical tied election, and the Democrats would win the remaining 7 or 8 districts. In other words, each party would win approximately 50% of the districts in a hypothetical election in which each party's statewide vote share is exactly 50%.

51. By contrast, the Enacted Plan's measure of 66.7% in Figure 5 would be a statistical outlier and is more favorable to Republicans than in over 99% of the simulated plans. Substantively, this 66.7% measure reflects the Enacted Plan's creation of a durable Republican majority for Ohio's congressional delegation, such that even when Democrats win 50% of the statewide vote, Republicans will still be favored in two-thirds (10 out of 15) of the congressional districts, while Democrats will only be favored in one-third (5 out of 15) of the districts.

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

52. I have thus far compared the Enacted Plan to the simulated plans at a statewide level using several 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, split political subdivisions, or lack compactness. I found that the Enacted Plan districts in these three counties are outliers on each of these three metrics, in ways that systematically favor the Republican Party.

53. Specifically, I found that the Enacted 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.

54. In particular, the Enacted Plan splits Hamilton County excessively, thereby placing Cincinnati into a district that is more Republican than in virtually all of the 1,000 computer-simulated districts containing Cincinnati. The Enacted Plan's splitting of Hamilton County into three districts is an outcome that occurs in under 2% of the computer-simulated plans. Over 98% of the simulated plans split Hamilton County into just two districts. By excessively splitting up voters in Hamilton County, the Enacted Plan managed to combine Cincinnati with more Republican voters in Warren County, thereby splitting Hamilton County into three Republican-favoring districts.

55. Moreover, by comparing the compactness of these computer-simulated districts within these three counties to the Enacted Plan's districts, I found that the Enacted Plan achieved extreme partisan characteristics in these three counties by sacrificing geographic compactness. The compactness scores of the Enacted Plan's districts in these three counties are significantly lower than the compactness scores of virtually all the simulated districts

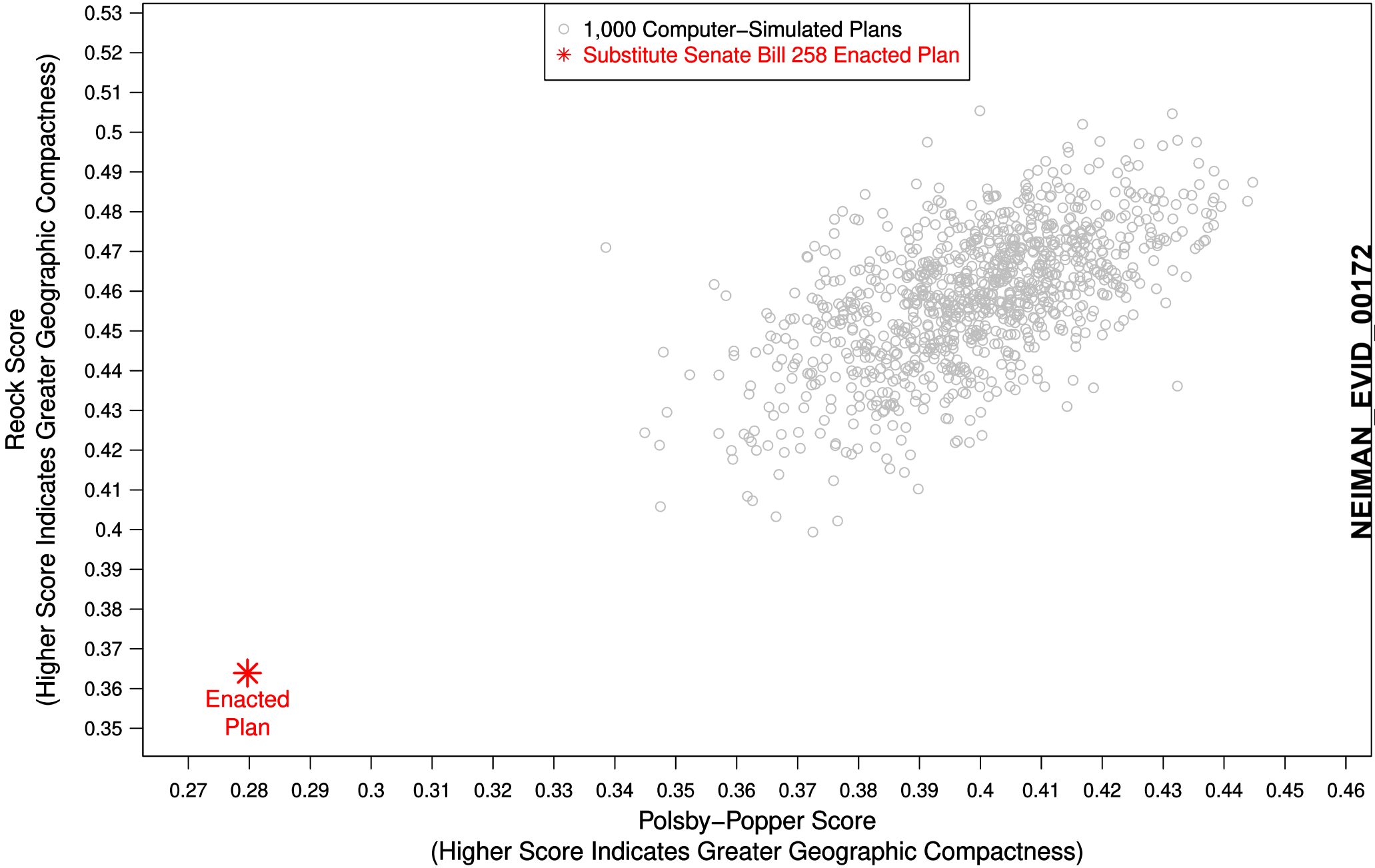
within these same three counties. Thus, it is clear the Enacted Plan's districts in these counties were not drawn in an attempt to favor compactness. Instead, the districts in these counties were clearly drawn to create the most favorable outcome possible for the Republican Party.

56. 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 Enacted Plan follows the compactness requirement of Section (1)(C)(3), it is useful to compare the compactness of the Enacted 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.

57. 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 2021 Enacted Plan has an average Polsby-Popper score of 0.28 across its 15 congressional districts. As illustrated in Figure 6, every single one of the 1,000 computer-simulated plans in this report exhibits a higher Polsby-Popper score than the Enacted 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 Enacted 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.

58. 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 2021 Enacted Plan has an average Reock score of 0.36 across its 14 congressional districts. As illustrated in Figure 6, every single one of the 1,000 computer-simulated House plans in this report exhibits a higher Reock score than the Enacted 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 Enacted 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 6:
Comparisons of Substitute Senate Bill 258 Enacted Plan to 1,000 Computer–Simulated Plans on Polsby–Popper and Reock Compactness Scores



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59. Beyond these statewide comparisons, it is also clear that in Franklin, Hamilton, and Cuyahoga Counties, the Enacted 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 with extreme partisan characteristics. Below, I describe and illustrate my findings for these three counties in detail:

X. THE ENACTED PLAN'S DISTRICTS IN FRANKLIN COUNTY

60. 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 Enacted 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.

61. Figure 7a and Figure 7b contain two maps. The map in Figure 7a depicts the boundaries of the Enacted Plan's two Columbus-area districts. The map in Figure 7b 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 7a and 7b also report the Polsby-Popper scores and Republican vote shares of these two districts in the Enacted Plan and in the computer-simulated plan.

Figure 7a: Franklin County Districts (CD−3 and CD−15) in the 2021 Enacted Plan:

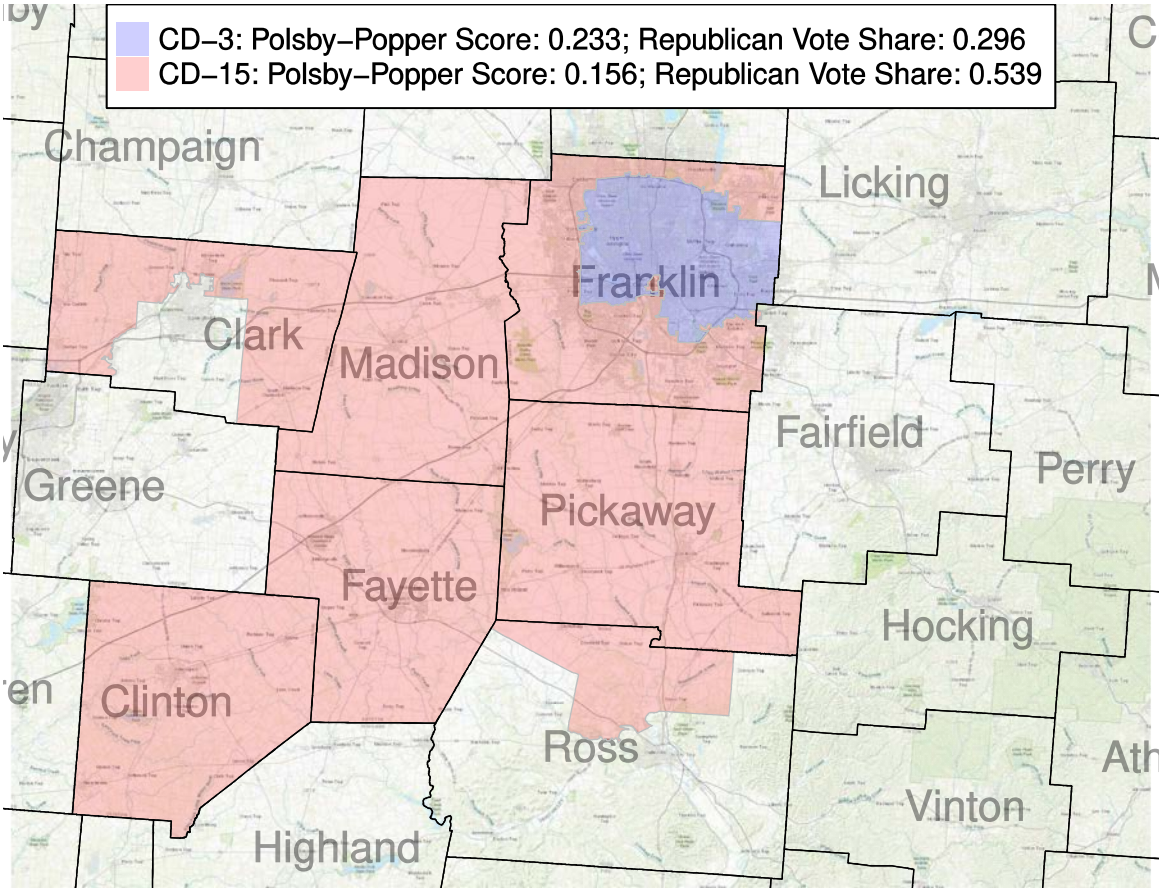
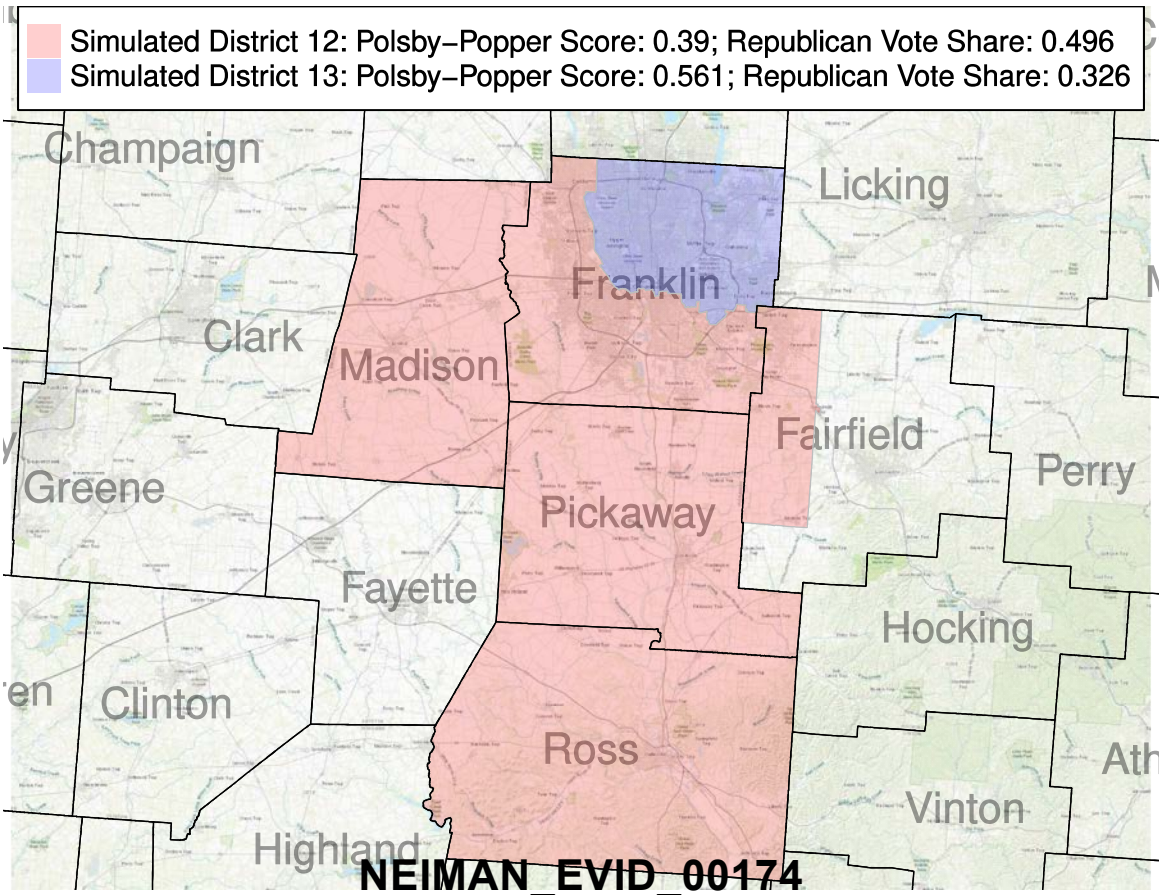


Figure 7b: Computer−Simulated Plan with the Most Compact Franklin County Districts (Computer−Simulated Plan #138 of 1000)

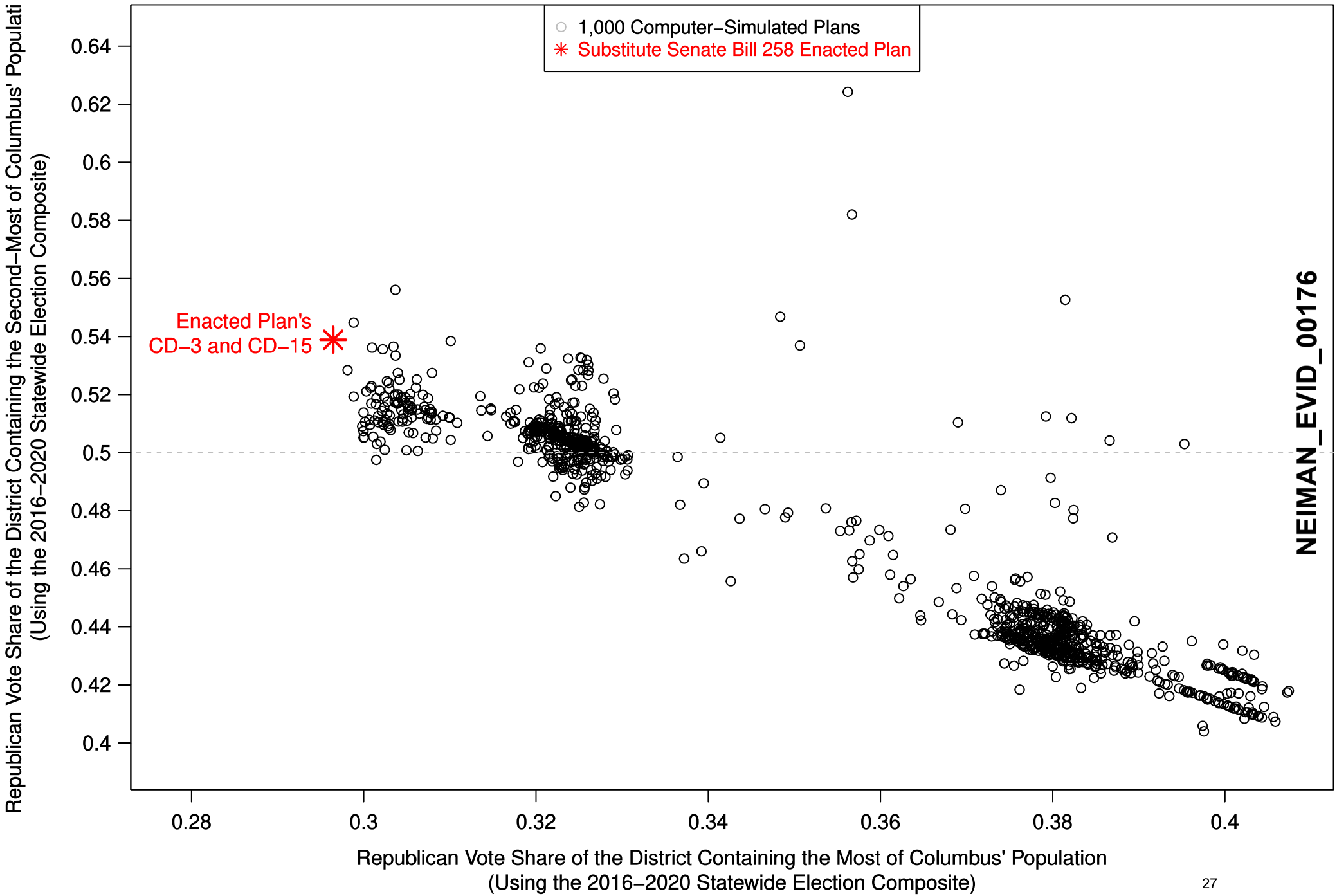


62. For the Enacted Plan and the 1,000 simulated plans, Figure 8 compares the Republican vote share, as measured using the 2016-2020 Statewide Election Composite, of the two districts containing the most and second-most amount of Columbus' population. Figure 8 contains 1,000 black circles, indicating the 1,000 simulated plans, and a red star representing the 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.

63. Columbus' voters are heavily Democratic, while the surrounding suburbs in Franklin County are more Republican. As Figure 8 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 8 also illustrates that among the 1,000 simulated plans, the district containing the most sizeable portion of Columbus' population is more heavily Democratic, with around a 30-40% Republican vote share, while the district containing the second-most sizeable portion of Columbus' population contains a Republican vote share of generally between 41-51%.

64. Figure 8 reveals that the Enacted Plan's two Columbus-area districts are clear partisan outliers: CD-3, which contains most of Columbus' population, is more heavily Democratic than all 1,000 of the simulated plans' districts with the most Columbus population. Consequently, the Enacted Plan's CD-15, which contains the second-most of Columbus' population, is more heavily Republican than 98% of the simulated plans' districts with the second-most Columbus population. Specifically, CD-15 has a 53.9% 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 8:
Comparisons of Columbus–Area Districts in the Enacted Plan and 1,000 Computer–Simulated Plans



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65. Figures 9 and 10 illustrate in detail how statistically extreme the partisanship of the Enacted Plan's two Columbus-area districts are: Figure 9 shows that the Enacted Plan's CD-3 packs together Democratic voters to a more extreme extent than every simulated plan's district containing the most Columbus population. In most simulated plans, this district would generally range from 32% to 40% Republican vote share. The Enacted Plan's CD-3 has a Republican vote share of 29.7%, which is lower than in all 1,000 of the simulated plans.

66. Figure 10 similarly illustrates how statistically extreme the partisanship of the Enacted Plan's CD-15 is. CD-15 contains a Republican vote share of 53.9%, while the most common outcome in the simulated plans' districts containing the second-most of Columbus' population is 43%-44%. Over 98% of these simulated districts are less Republican-favorable than the Enacted Plan's CD-15. It is therefore clear that CD-15 and CD-3 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 9: District Containing the Most of Columbus' Population in the Enacted Plan and 1,000 Computer–Simulated Plans

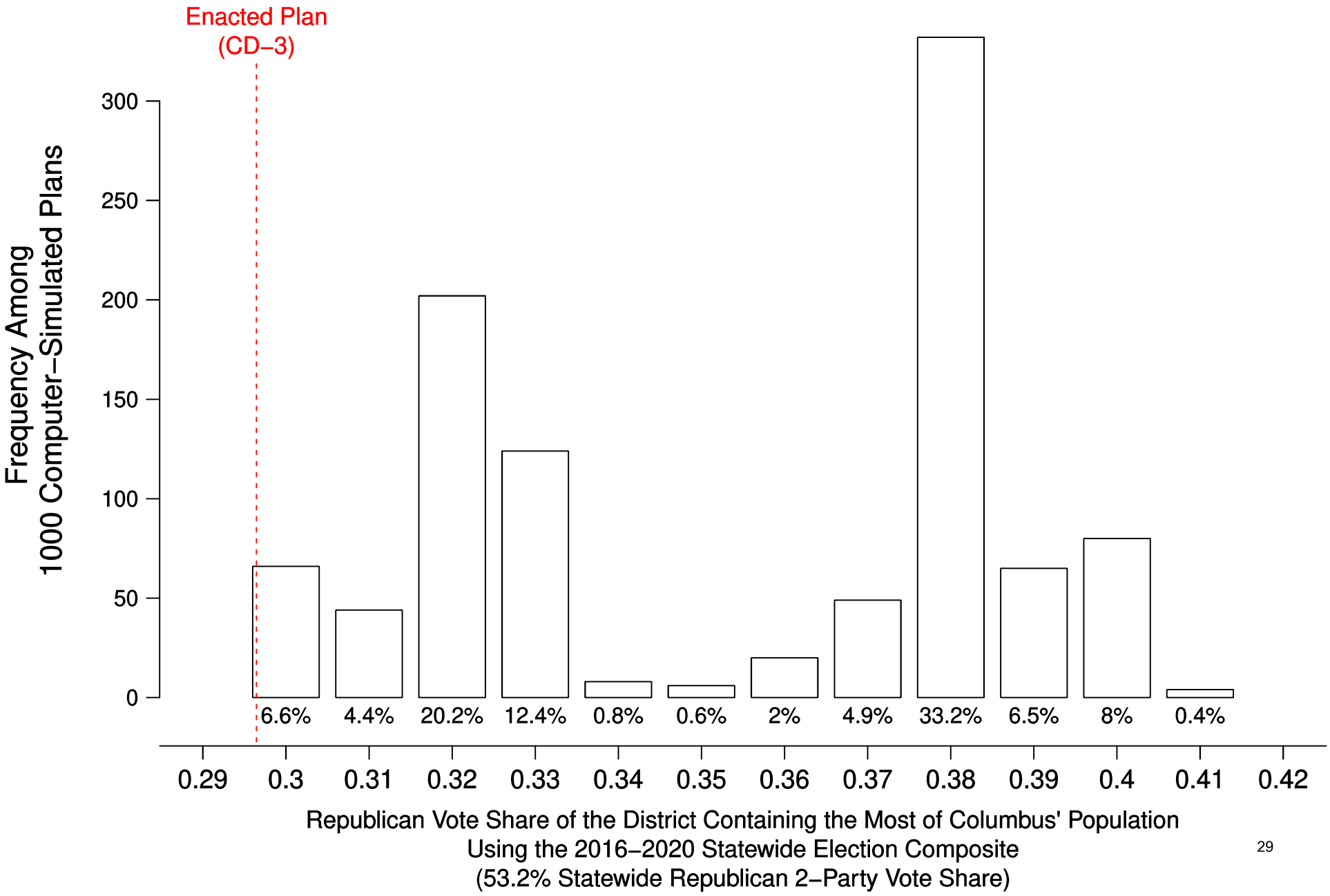

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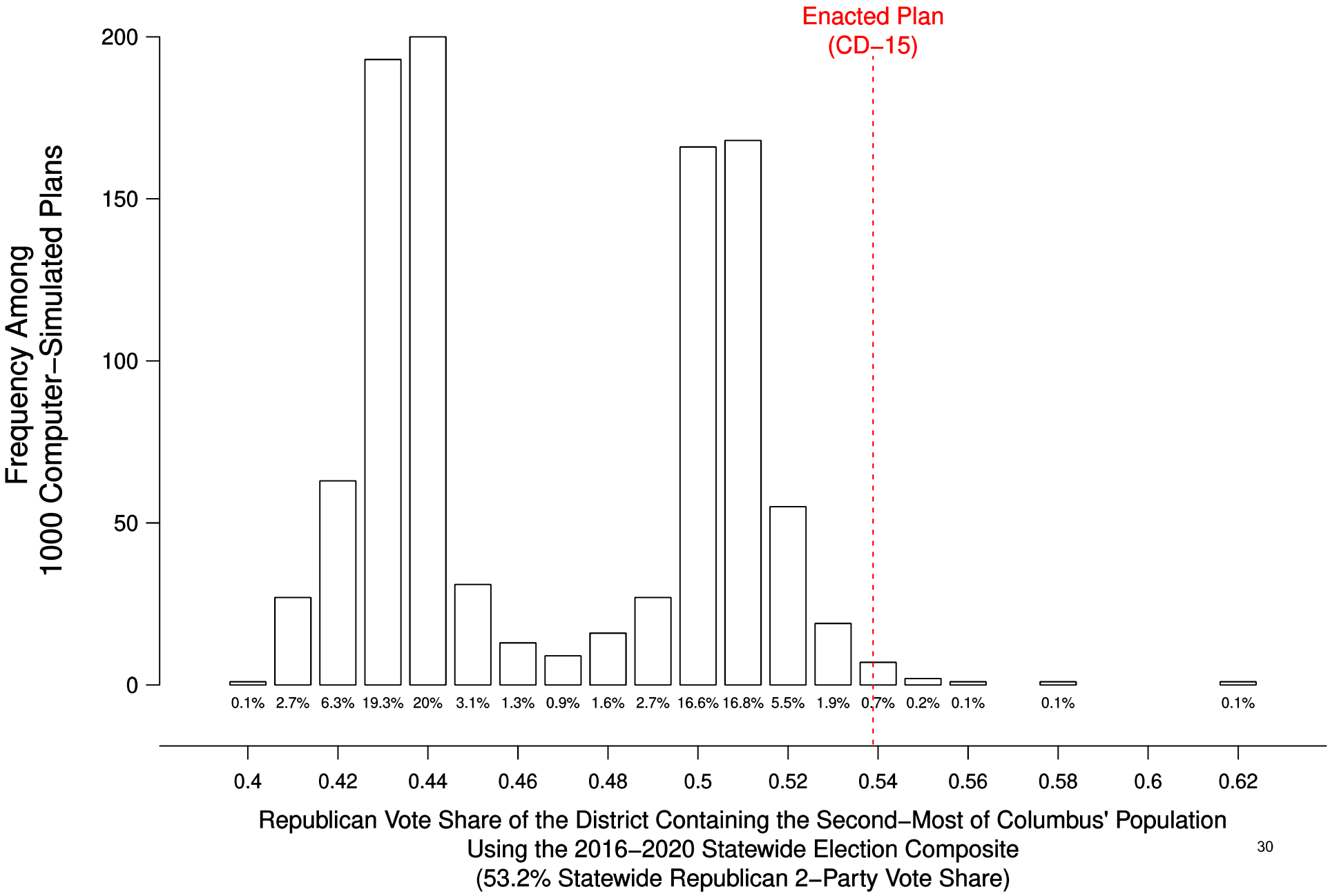
Figure 10: District Containing the Second−Most of Columbus' Population in the Enacted Plan and 1,000 Computer−Simulated Plans



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67. Finally, Figures 11 and 12 illustrate *how* the General Assembly was able to create such statistically anomalous outcomes with respect to the partisan characteristics of CD-3 and CD-15. In Figure 11, the vertical axis compares the Polsby-Popper compactness scores of the district containing the most of Columbus' population in the Enacted 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 Columbus districts. Figure 11 reveals that CD-3 is less geographically compact than nearly every computer-simulated district containing the most of Columbus' population. Hence, it is clear that the Enacted Plan was able to create an anomalously extreme Democratic district in CD-3 by sacrificing the geographic compactness of the district. It is also clear that CD-3 is much less compact than Columbus-area districts that would reasonably emerge from a map-drawing process following the Ohio Constitution's Article XIX requirements.

68. Figure 12 illustrates a similar comparison of the compactness scores of the district containing the second-most of Columbus' population in the Enacted Plan and in the simulated plans. Once again, the horizontal axis reports the Republican vote shares of these districts. Figure 12 reveals that CD-15 is less geographically compact than nearly every computer-simulated district containing the most of Columbus' population. Hence, it is clear that the Enacted Plan was able to create an anomalous 53.9% Republican district in CD-15 by sacrificing the geographic compactness of the district. It is also clear that CD-15 is much less compact than Columbus-area districts that would reasonably emerge from a map-drawing process following the Ohio Constitution's Article XIX requirements.

69. I therefore conclude that the Enacted Plan's Columbus-area districts, CD-3 and CD-15, were collectively drawn in a manner that clearly favors the Republican Party, and these two districts 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 11: Comparisons of the District Containing the Most of Columbus' Population in the Enacted Plan and 1,000 Computer–Simulated Plans

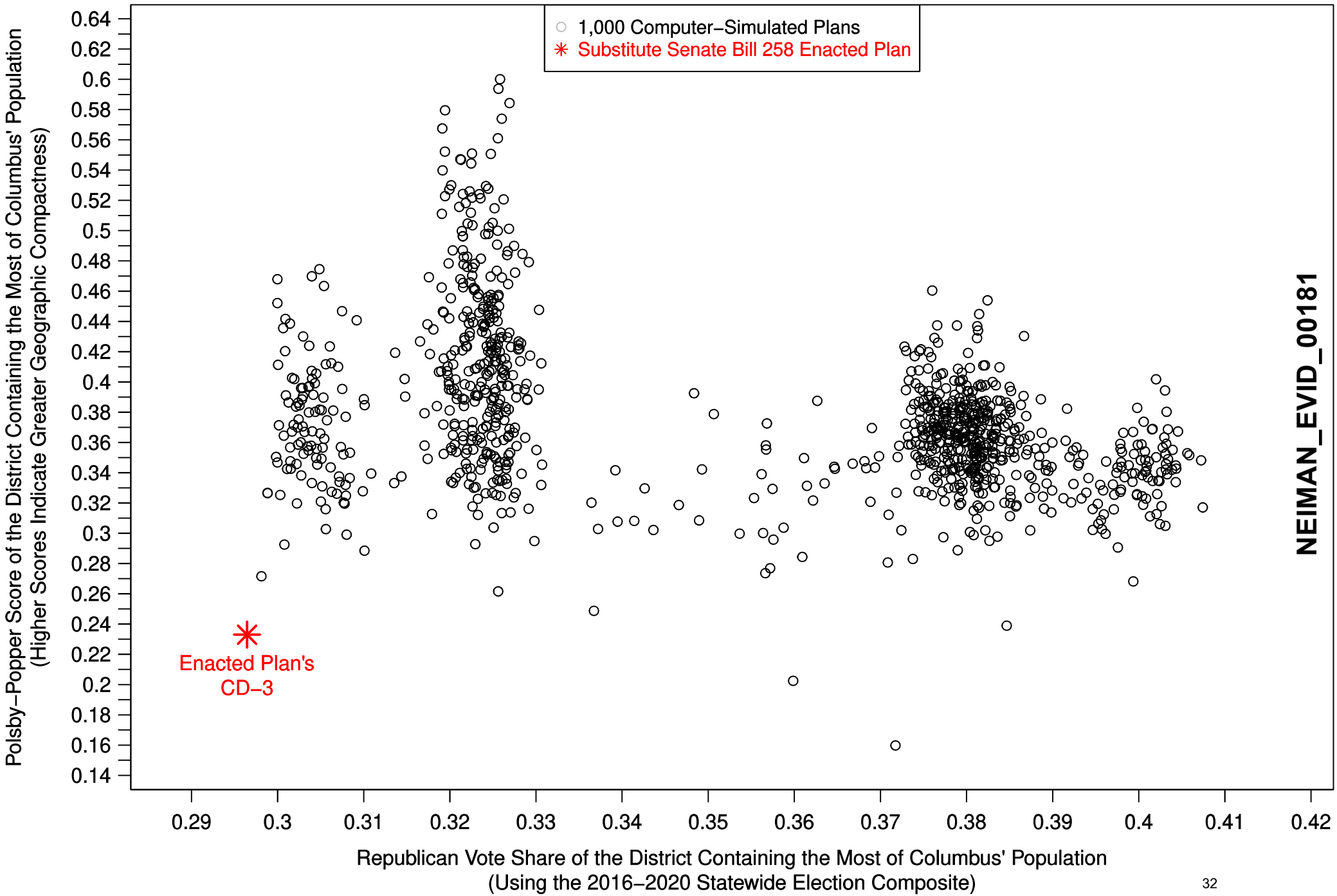

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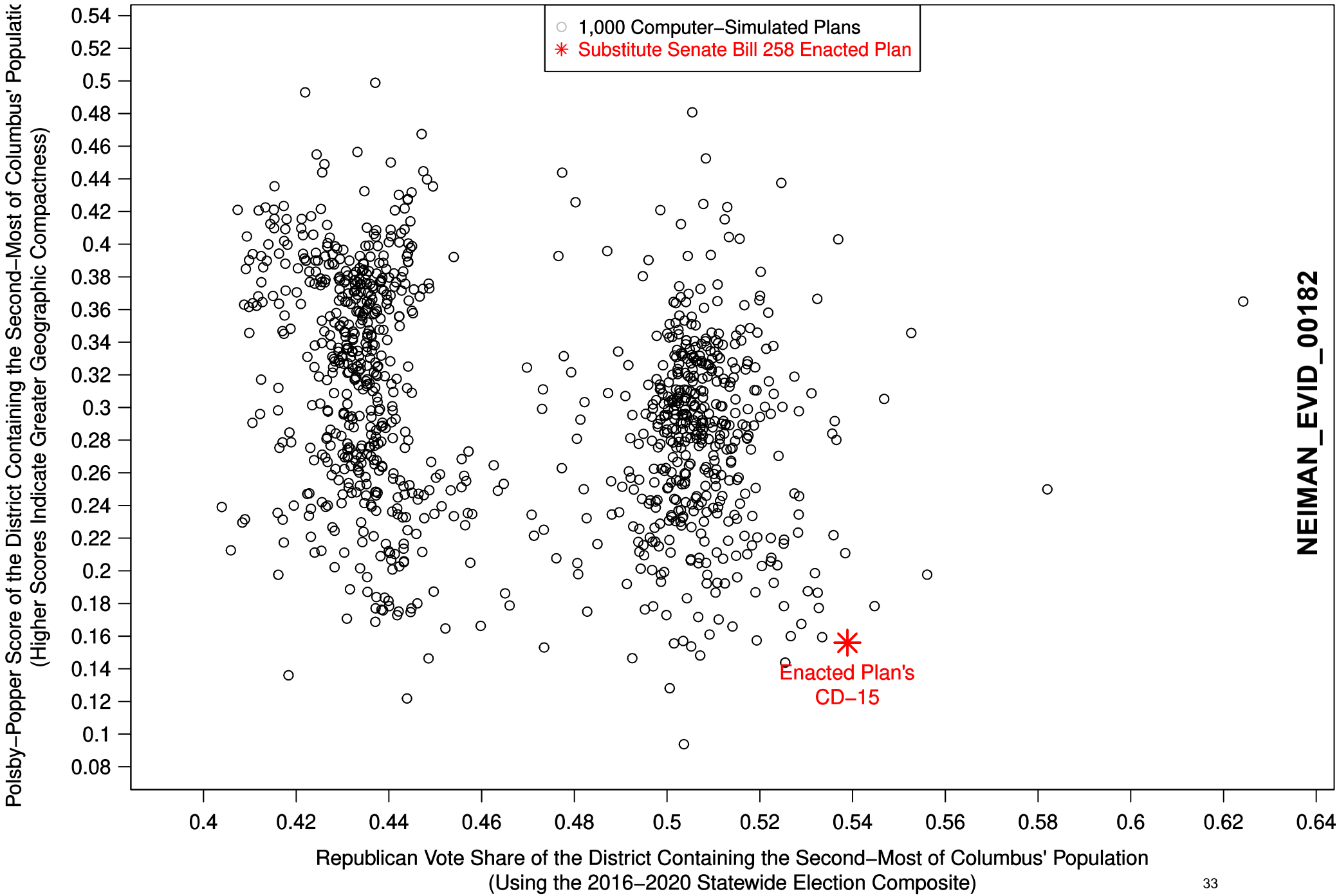
Figure 12:
Comparisons of the District Containing the Second–Most of Columbus' Population in the Enacted Plan and 1,000 Computer–Simulated Plans



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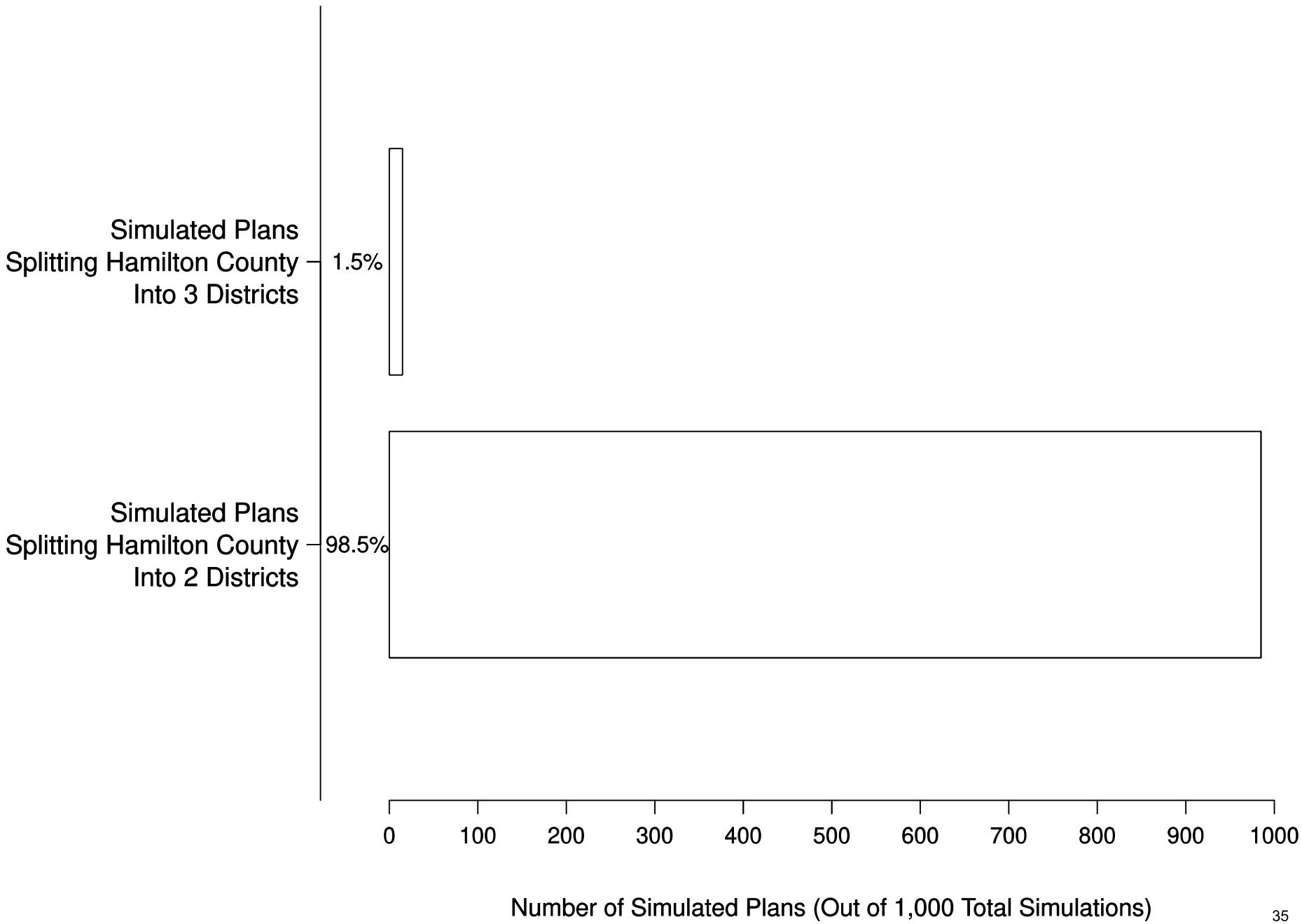
XI. THE ENACTED PLAN'S DISTRICTS IN HAMILTON COUNTY

70. Hamilton County's population exceeds the required population for a single congressional district, so splitting Hamilton County is clearly permissible under the Ohio Constitution. However, Section (1)(C)(3) requires that the congressional plan not "unduly split counties."

71. To follow this constitutional requirement, my computer simulation algorithm split counties only for the purpose of equalizing district populations. As explained earlier in this report, the computer-simulated plans, as well as the Enacted Plan, always contain exactly 14 total county splits, with any county divided into three districts being counted as two total county splits. Hence, the Enacted Plan certainly does not create an excessively large number of total county splits *statewide*.

72. However, the Enacted Plan's splitting of Hamilton County into three districts is statistically anomalous when compared to the 1,000 simulated plans' districts in Hamilton County. As Figure 13 illustrates, only 1.3% of the simulated plans similarly split Hamilton County into three districts. The remaining 98.7% of the simulated plans only split Hamilton County into two districts. This finding, when combined with my findings below regarding the extreme partisanship and the low compactness score of the Enacted Plan's Cincinnati-based district, collectively indicate a districting process in the Hamilton County area that was inconsistent with the Article XIX, Section (1)(C)(3) requirements. Below, I detail my findings regarding the extreme partisanship and the low compactness score of the Enacted Plan's Cincinnati-based district.

Figure 13: Splits of Hamilton County in Computer–Simulated Plans



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73. In the Enacted 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 Enacted Plan with respect to their partisan characteristics and their compactness scores.

74. Figure 14a and Figure 14b contain two maps. The map in Figure 14a depicts the boundaries of the Enacted Plan's CD-1. The map in Figure 14b 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 14a and 14b also report the Polsby-Popper scores and Republican vote shares of these two districts in the Enacted Plan and in the computer-simulated plan.

Figure 14a:
CD–1 of the 2021 Enacted Plan:

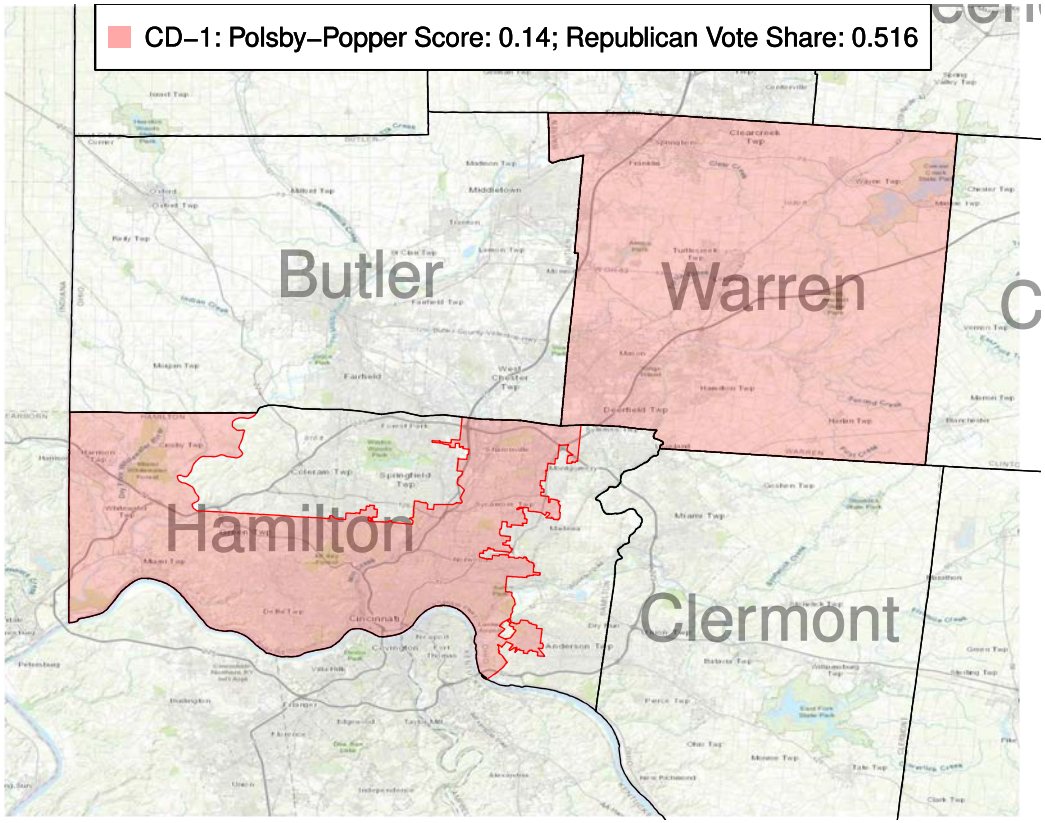
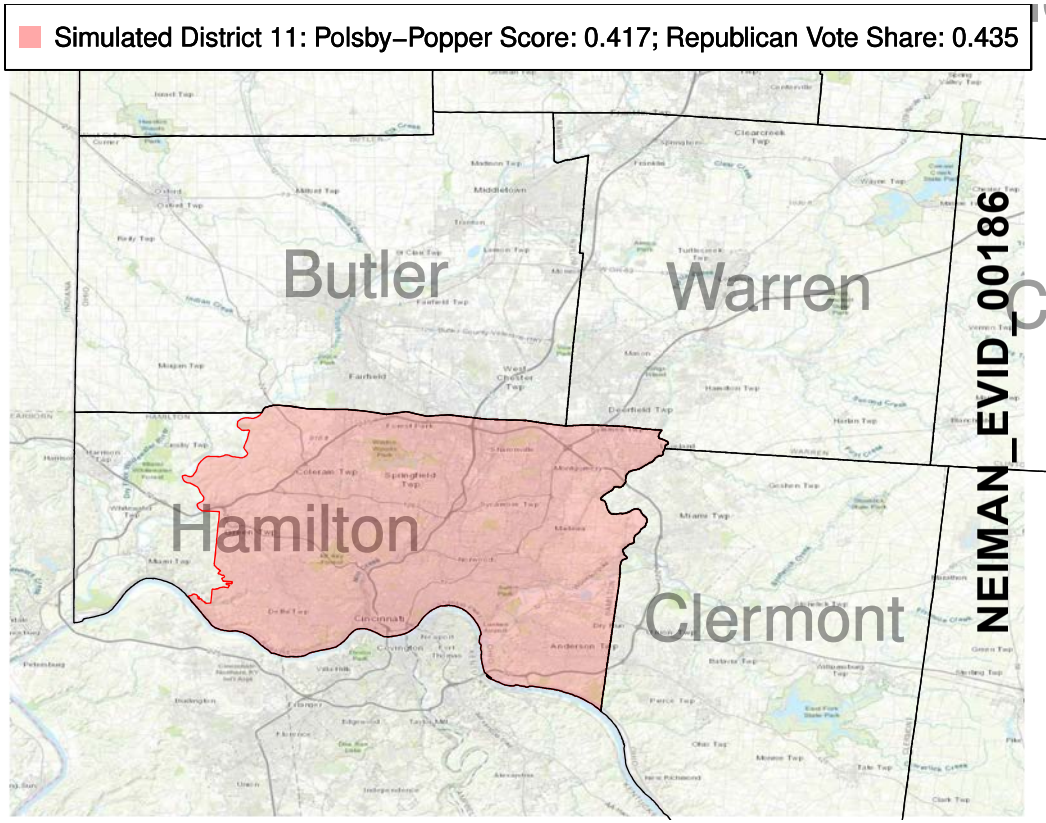


Figure 14b: Computer–Simulated Plan with the Most Compact Cincinnati District (Simulated Plan #639 of 1000):



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75. Figure 15 reports the Republican vote share of every computer-simulated district containing Cincinnati, as well as the 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.

76. But the Enacted Plan's CD-1 is a statistical outlier in terms of its partisanship when compared to these computer-simulated Cincinnati districts. The Enacted Plan's CD-1 has a Republican vote share of 51.6%, which is higher than over 98% of the simulated districts containing Cincinnati. The Enacted Plan's CD-1 achieves this unnaturally high Republican vote share by splitting Hamilton County into three districts and 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 51.6%.

77. By connecting Warren County with the fragmented portion of Hamilton County containing Cincinnati, CD-1 of the Enacted 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 16 compares the Polsby-Popper compactness score of the Enacted 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 a Polsby-Popper score of 0.34 to 0.42. Over 99% of the simulated districts containing Cincinnati have a higher Polsby-Popper score than CD-1. Hence, it is clear that the geographic shape of the Enacted Plan's CD-1 does not reflect a reasonable attempt to draw geographically compact districts in the Cincinnati area. Instead, I concluded that CD-1 was drawn to create a Republican-favorable district in Cincinnati, and this effort resulted in a district that was more favorable to the Republican Party than the Cincinnati district in over 97% of the computer-simulated plans.

Figure 15:
Comparisons of Cincinnati's District in the Enacted Plan and 1,000 Computer–Simulated Plans

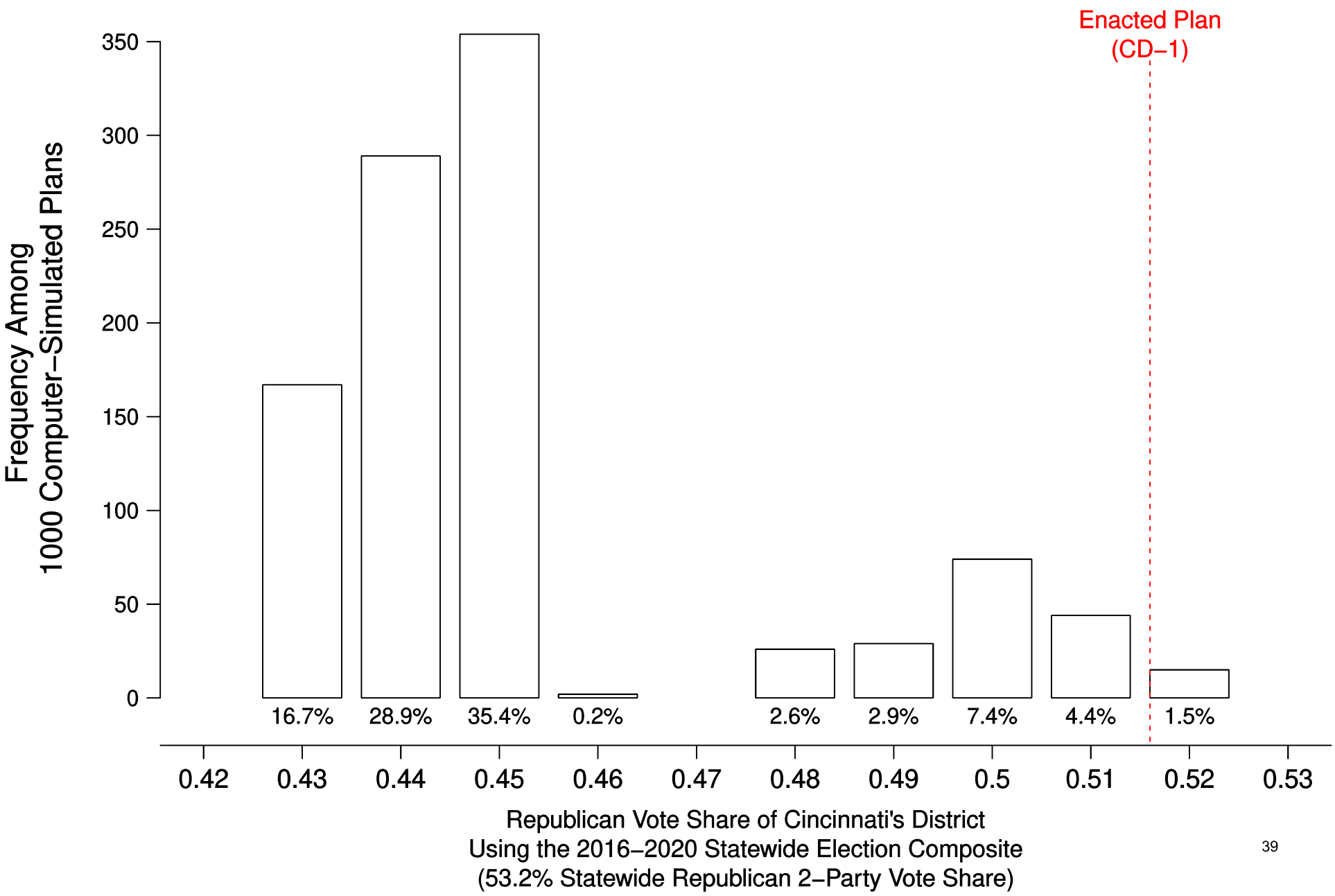

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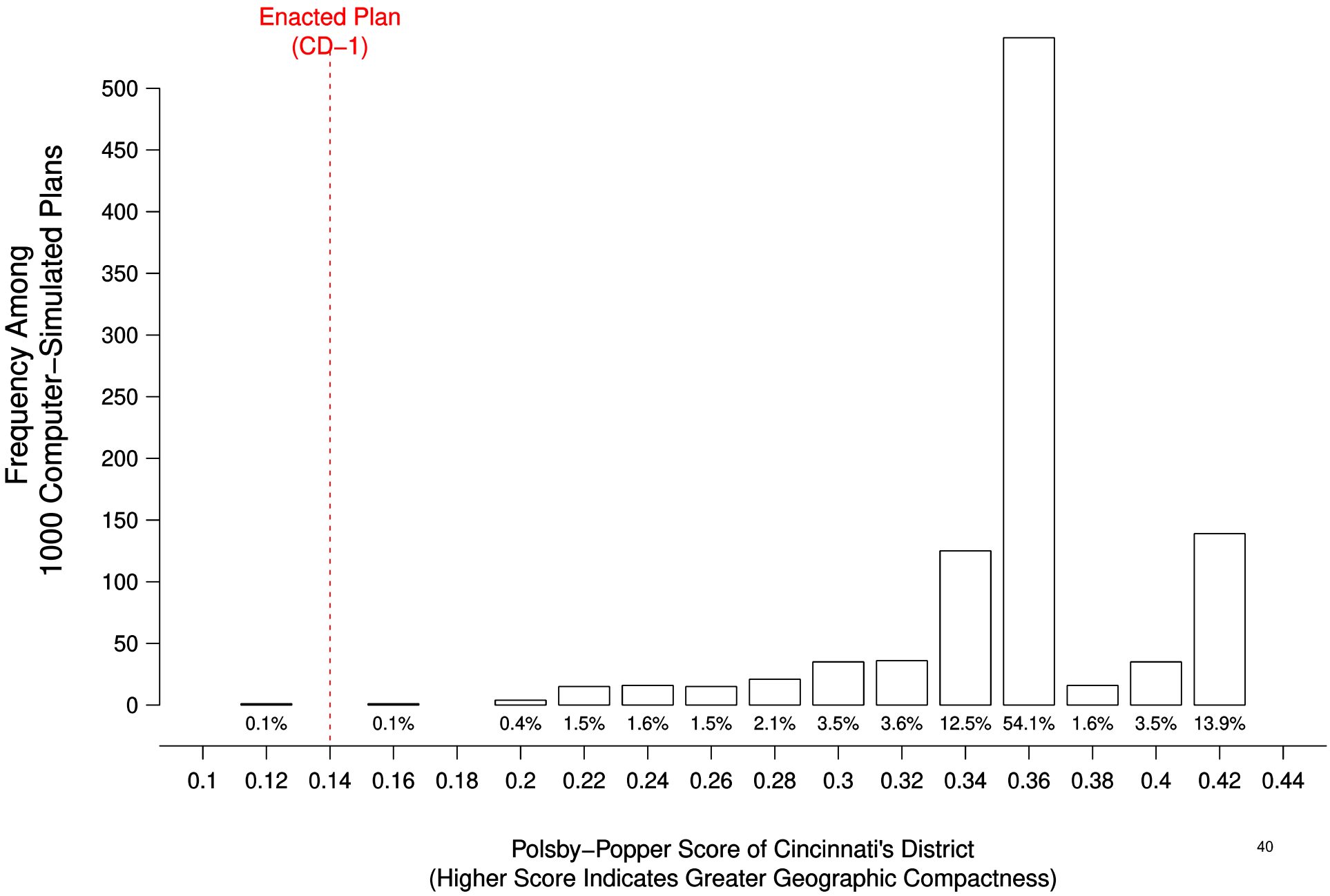
Figure 16:
Comparisons of Cincinnati's District in the Enacted Plan and 1,000 Computer–Simulated Plans



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XII. THE ENACTED PLAN'S DISTRICTS IN CUYAHOGA COUNTY

78. Cuyahoga County's population exceeds the required population for a single congressional district, so the county will generally be split into either two or three districts, with one of these districts containing all of Cleveland (Article XIX, Section 2(B)(4)(b)). Across the Enacted Plan and each of the 1,000 computer-simulated plans, I compare the one district in each plan containing all of Cleveland.

79. Figure 17a and Figure 17b contain two maps. The map in Figure 17a depicts the boundaries of the Enacted Plan's Cleveland-based district, CD-11. The map in Figure 17b depicts the boundaries of the Cleveland-based district that had the highest Polsby-Popper compactness score among all 1,000 computer-simulated plans. Figures 17a and 17b also report the Polsby-Popper scores and Republican vote shares of these districts from the Enacted Plan and the computer-simulated plan.

Figure 17a: CD–11 of the 2021 Enacted Plan:

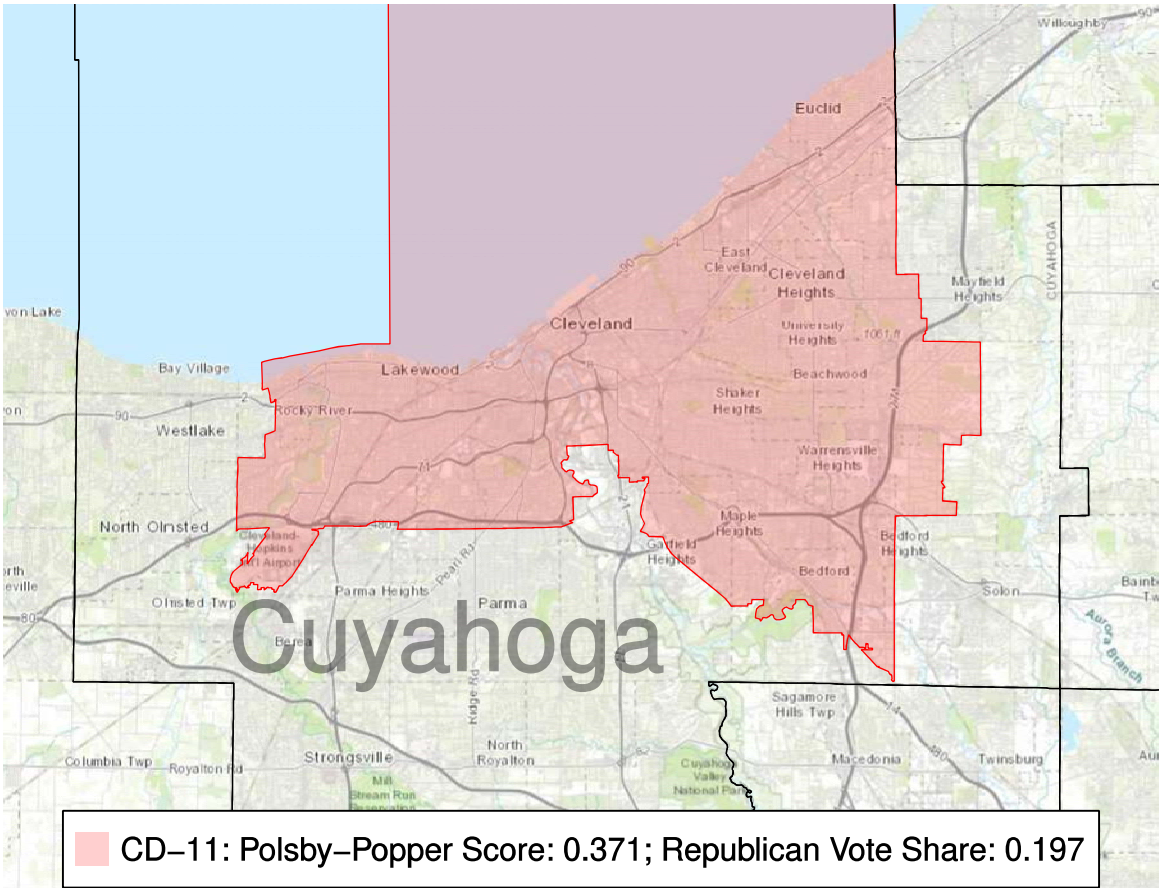
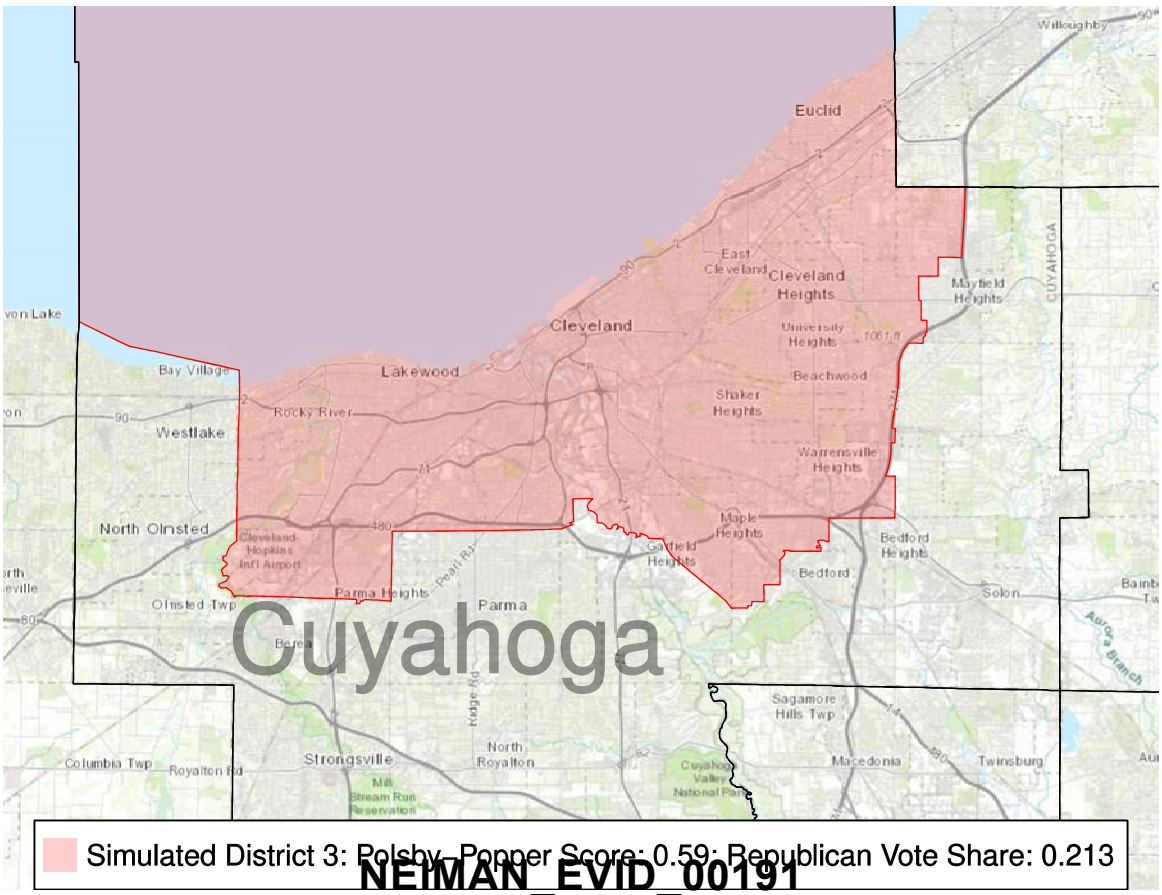


Figure 17b: Computer–Simulated Plan with the Most Compact Cleveland District (Simulated Plan #440 of 1000):



80. For the Enacted Plan and the 1,000 simulated plans, Figure 18 compares the Enacted Plan's CD-11 to the 1,000 simulated plans' Cleveland-based districts with respect to their partisanship and their Polsby-Popper compactness scores. Figure 18 contains 1,000 black circles, indicating the 1,000 simulated plans, and a red star representing the Enacted Plan. Each plan is plotted in this Figure along the horizontal axis according to the district's Republican vote share. The vertical axis then reports the district's Polsby-Popper compactness score, with higher scores indicating greater district compactness.

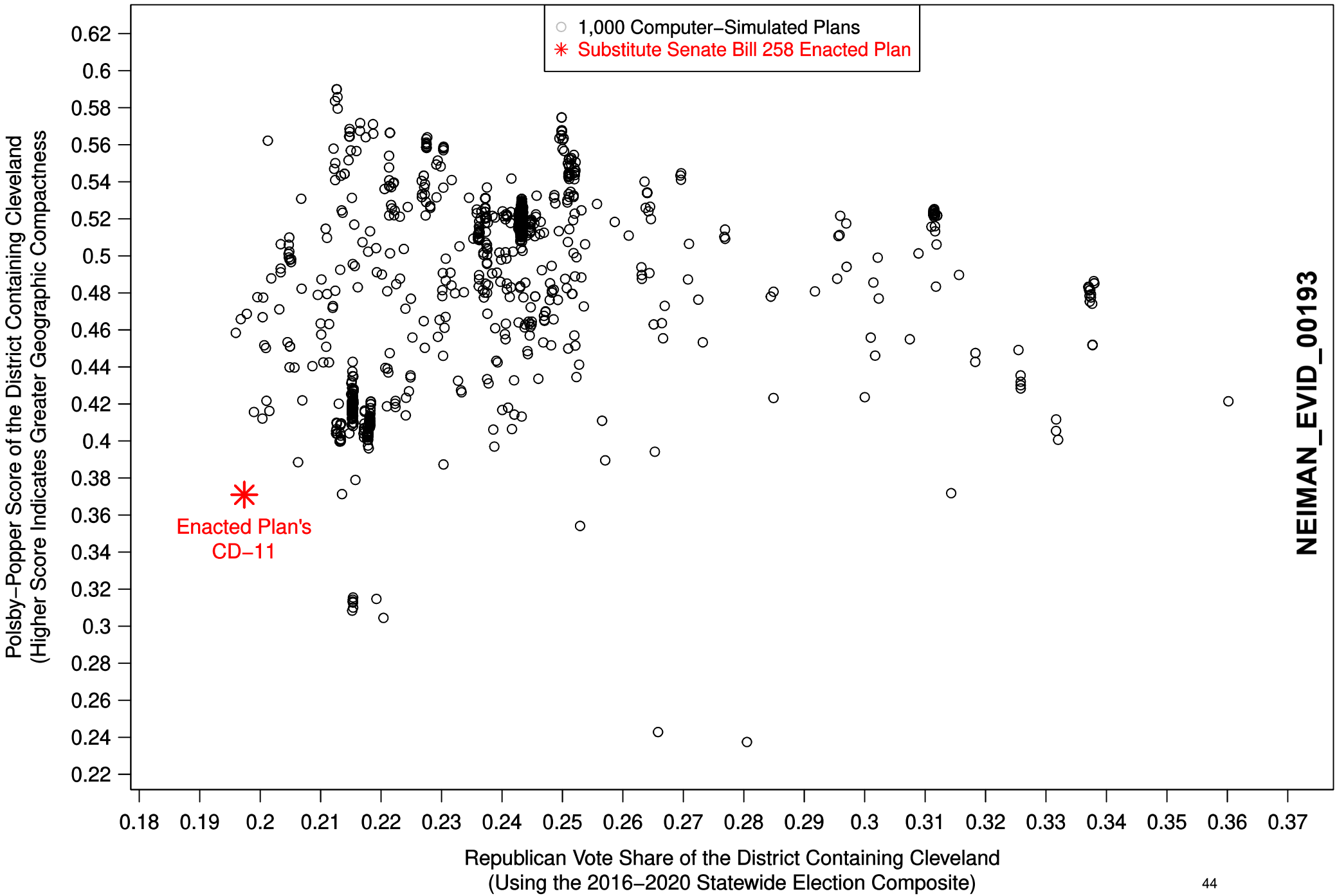
81. Cleveland voters are heavily Democratic, so any Cleveland-based district will always have a significant Democratic majority. As the 1,000 simulated districts in Figure 18 illustrate, there is no reasonable possibility that the Cleveland-based district could be drawn to have a Republican majority.

82. Instead, the Enacted Plan's CD-11 creates an extreme partisan outlier in the opposite direction. CD-11 has a Republican vote share of only 19.7%, which is lower than the Cleveland-based district in 99.8% of the computer-simulated plans. Figure 18 makes clear that Democratic voters are packed together in CD-11 to a more extreme extent than naturally occurs in virtually all of the simulated plans, which were produced by following the districting criteria mandated in Ohio's Constitution.

83. The vertical axis of Figure 18 reveals that CD-11's Polsby-Popper compactness score of 0.371 is lower than the Polsby-Popper score of 98.8% of the simulated Cleveland-based districts. The vast majority of the Cleveland-based simulated districts have Polsby-Popper scores generally ranging from 0.4 to 0.55. I therefore concluded that the Enacted Plan's CD-11 was not drawn by a districting process following Section (1)(C)(3)'s requirement regarding district compactness. CD-11 is clearly less geographically compact than is reasonable for a Cleveland-based district, and the district appears instead to have been drawn in order to create an extreme packing of Democratic voters that would not have naturally emerged from drawing a more compact Cleveland-based district.

84. I therefore conclude that the Enacted Plan's Cleveland-based districts, CD-11, was not drawn in a manner that is consistent with the Ohio Constitution's Article XIX, Section (1)(C)(3) requirements. This district was drawn in a manner that clearly favors the Republican Party by unnaturally packing together Democratic voters to an extent that is not explained by Cuyahoga County's political geography. This unnatural packing of Democrats was accomplished by drawing districting lines in CD-11 that exhibit a lower Polsby-Popper compactness score than is reasonably possible for the Cleveland-based district in the 1,000 computer-simulated plans.

Figure 18:
Comparisons of Cleveland's District in the Enacted Plan and 1,000 Computer–Simulated Plans



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XIII. THE RELATIONSHIP BETWEEN COMPETITIVENESS AND PARTISANSHIP IN THE ENACTED PLAN

85. Relators' counsel also asked me to analyze how the Enacted Plan's competitive districts affect the partisan characteristics of the plan. 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 Enacted Plan did: that is, a "competitive district" is one with a two-party Republican vote share between 46% and 54%.[14]

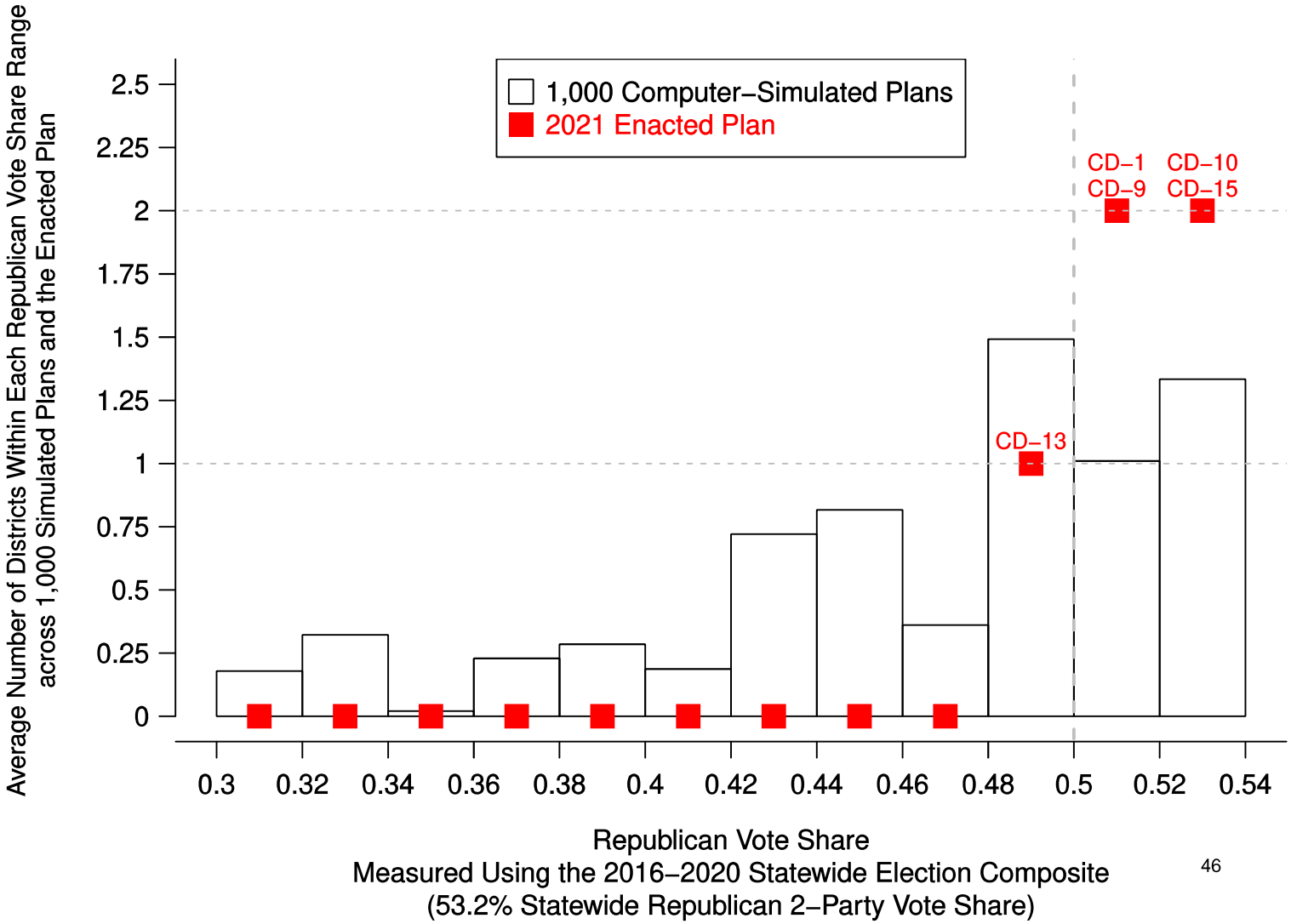
86. The Enacted Plan contains five competitive districts using this definition: CD-1 (51.6% Republican vote share), CD-9 (50.3%), CD-10 (53.3%), CD-13 (49.2%), and CD-15 (53.9%). Among these five competitive districts, four are Republican-favoring, while one is Democratic-favoring.

87. How does the number of Republican-favoring and Democratic-favoring competitive districts in the Enacted Plan compare to the number of such districts in the 1,000 computer-simulated plans? To analyze this question, I counted the average number of districts in each computer-simulated plan containing a Republican vote share within the range of 52-54%, then 50-52%, then 48-50%, and so on. I also counted the number of Enacted Plan districts within each of these two-percent ranges of partisanship.

88. Figure 19 summarizes this analysis. As an example, the last column in Figure 19 reports the number of districts in the Enacted and the simulated plans with a Republican vote share in the range of 52-54%. The red square reports the number of Enacted Plan districts in this partisanship range, while the black bar reports the average number of districts in the 1,000 simulated plans within this partisanship range. Similarly, the next-to-last column in this Figure compares the number of Enacted Plan districts and average number of simulated plan districts in the range of 50-52% Republican vote share.

[14] *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).

Figure 19:
Comparisons of 2021 Enacted Plan to 1,000 Computer–Simulated Plans
On Number of Districts Within Each Partisanship Range



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89. These final two columns reveal that the Enacted Plan contains more Republican-favoring competitive districts than in the average computer-simulated plan. The Enacted Plan contains two districts within the 50-52% Republican vote share range, while the average simulated plan contains only 1.0. Similarly, the Enacted Plan contains two districts within the 52-54% Republican vote share range, while the simulated plan contains only 1.3.

90. But Figure 19 reveals the opposite finding with respect to Democratic-favoring competitive districts. For every single two-percent interval analyzed in this Figure, the Enacted Plan contains fewer Democratic-favoring competitive districts than the average simulated plan. For example, the average simulated plan contains 1.5 districts within the 48-50% Republican vote share range, but the Enacted Plan contains only 1. Similarly, the average simulated plan contains 0.4 districts within the 46-50% Republican vote share range, but the Enacted Plan contains none.

91. In fact, the same finding holds for every two-percent partisanship range from 30 to 46% Republican vote share. The Enacted Plan contains zero Democratic-favoring districts within this range of partisanship, while the average simulated plan contains some districts within this range.

92. Overall, Figure 19 reveals a clear partisan asymmetry in the Enacted Plan's competitive districts when compared to the competitive districts in the computer-simulated plans. The Enacted Plan certainly contains more Republican-favoring competitive districts than the average simulated plan does. But the Enacted Plan created these Republican-favoring competitive districts at the expense of Democratic-favoring competitive districts, as well as safe Democratic-favoring districts (with a Republican vote share under 46%). In other words, the Enacted Plan created far more Republican-favoring competitive districts with Republican vote shares of 50-54%, compared to the average simulated plan. And this relative abundance of Republican-favoring competitive districts came at the expense of having relatively fewer Democratic-favoring districts than appear in the average computer-simulated plan.

XIV. OHIO'S POLITICAL GEOGRAPHY DID NOT CAUSE THE ENACTED PLAN'S EXTREME PARTISAN BIAS

93. How does Ohio's political geography affect the partisan characteristics of the 2021 Enacted 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,[15] 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.

[15] 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.

94. 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.

95. This districting simulation analysis allowed me to identify how much of the electoral bias in Ohio's 2021 Enacted Congressional 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 12 Republican-favoring districts out of 15 total districts.

96. The 2021 Enacted Plan's creation of 12 Republican-favoring 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 Enacted Plan is a statistical outlier in terms of its partisan characteristics when compared to the 1,000 computer-simulated plans. The Enacted Plan creates more Republican-favoring districts than 98.7% of the simulated plans. This extreme, additional level of partisan bias in the 2021 Enacted 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.

Jowei Chen

Dr. Jowei Chen

JURAT

STATE OF FLORIDA
COUNTY OF SAINT LUCIE

Sworn to before me this 10th day of December 2021.

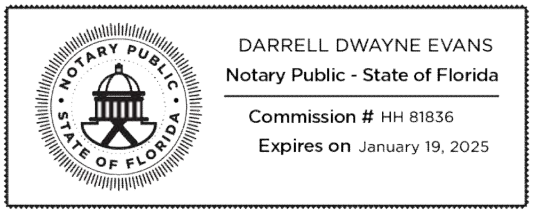
By Jowei Chen

Form of ID Produced: Driver's License

Darrell Dwayne Evans

Notary Public Darrell Dwayne Evans

My commission expires 01/19/2025



Notarized online using audio-video communication