

IN THE SUPREME COURT OF OHIO

LEAGUE OF WOMEN VOTERS OF OHIO, ET
AL.,

MERYL NEIMAN, ET AL.,

v.

SECRETARY OF STATE FRANK LAROSE, ET
AL.

Case No. 2022-0303

Case No. 2022-0298

Consolidated

**Original Action Filed Pursuant to
Ohio Constitution, Article XIX, Section
3(A)**

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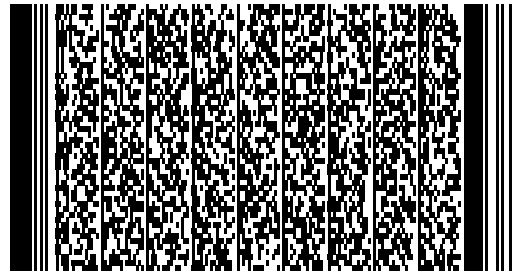
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E-Signature 1: Kosuke Imai (KI)

April 21, 2022 13:11:52 -8:00 [CF0DCF694EE5] [108.26.227.252]
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I, Theresa M Sabo, did witness the participants named above electronically sign this document.



IN THE SUPREME COURT OF OHIO

LEAGUE OF WOMEN VOTERS OF OHIO, et al.,

Petitioners,

v.

SECRETARY OF STATE FRANK LAROSE, et al.,

Respondents.

Case No. 2022-0303

Original Action Filed Pursuant to Ohio Const., Art. XIX, Sec. 1(C)(3)

AFFIDAVIT OF KOSUKE IMAI

Franklin County /ss State of Ohio

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

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

FURTHER AFFIANT SAYETH NAUGHT

04/21/2022

Executed on _____, 2022.

Kosuke Imai (Signature box)

Kosuke Imai

04/21/2022

Sworn and subscribed before me this ___ day of _____, 2022



(Signature box) Theresa M Sabo Notary Public

Notarial act performed by audio-visual communication



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EXHIBITS APPENDIX - IMAI AFFIDAVIT
Volume 1 of 1

Index of Documents

<u>ITEM</u>	<u>DESCRIPTION</u>	<u>BATES RANGE</u>
1	Expert Report of Kosuke Imai, Ph.D., dated April 20, 2022	IMAI_001-022

IN THE SUPREME COURT OF OHIO

League of Women Voters of Ohio, *et al.*

Petitioners,

v.

Ohio Redistricting Commission, *et al.*

Respondents.

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Const., Art. XIX, Sec. 3(A)

EXPERT REPORT

Kosuke Imai, Ph.D.

April 20, 2022

Table of Contents

I. Introduction and Scope of Work 3

II. Summary of Opinions 3

III. Methodology 4

IV. Outlier Analysis 5

V. Local Analysis 7

 A. Hamilton County 8

 B. Franklin County 11

VI. Compactness Analysis 13

 A. District 1 of the Revised Plan 13

 B. District 15 of the Revised Plan 13

VII. Example Plan 16

VIII. Appendix 19

 A. Compactness of the Revised, Simulated and Example Plans 19

 B. County Splits of the Revised, Simulated and Example Plans 20

 C. Additional Empirical Results for the Local Analyses 20

EXPERT REPORT

I. INTRODUCTION AND SCOPE OF WORK

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

2. I have been asked by counsel representing the petitioners in this case to analyze relevant data and provide my expert opinions related to whether Ohio's congressional districting plan enacted on March 2 (which I will refer to as the "revised plan" in this report) meets the criteria in Article XIX, Section 1(C)(3)(a) of Ohio's Constitution. More specifically, I have been asked to statistically analyze the revised plan's compliance with Article XIX, Section 1(C)(3)(a)'s requirement that "[t]he general assembly shall not pass a plan that unduly favors or disfavors a political party or its incumbents" by comparing it against the 5,000 alternative plans that were generated as the basis of simulation analysis in my initial report submitted on December 10, 2021 for Case No. 2021-1449.

II. SUMMARY OF OPINIONS

3. My analysis yields the following findings:
- The revised plan exhibits a significant partisan bias in favor of the Republican Party. Under the revised plan, the vote share margins for three nominally Democratic-leaning districts are unusually narrow when compared to my 5,000 simulated plans. In contrast, Republican-leaning districts are much safer under the revised plan than the corresponding districts in the simulated plans. These differences are substantial in magnitude and statistically significant.
 - This partisan bias of the revised plan originates from the Congressional districts in Hamilton and Franklin Counties. In Hamilton County, the revised plan cracks Democratic voters into Districts 1 and 8, reducing the Democratic advantage of District 1 and resulting in a toss-up district in place of a safe Democratic-leaning district. In Franklin County, the

EXPERT REPORT

revised plan packs a disproportionately large number of Democratic voters into District 3, increasing the Republican advantage of the surrounding districts and creating a safe Republican-leaning District 15 while preventing the emergence of a second Democratic-leaning district. These patterns of cracking and packing are clear statistical outliers in comparison to my simulated plans.

- The revised plan’s decision to favor the Republican party in Hamilton and Franklin Counties led to highly non-compact districts. District 1, which combines a part of Cincinnati and its environs with Warren County, is much less compact than the corresponding districts under the simulated plans. Similarly, District 15, which combines a part of Franklin County with five other counties in the western part of the state, splits a total of five counties and is much less compact than the corresponding districts under the simulated plans. Districts 1 and 15 are clear statistical outliers for their lack of compactness in comparison to my 5,000 simulated plans.
- I submitted an example plan to the Ohio Redistricting Commission on February 22, 2022 that is compliant with Article XIX of the Ohio Constitution. This example plan is less biased, has fewer county splits, and is more compact than the revised plan.

III. METHODOLOGY

4. In my initial expert report submitted on December 10, 2021, I conducted simulation analyses to evaluate the enacted plan (SB 258; hereafter “enacted plan”). As explained in that report, the redistricting simulation analysis has the ability to directly account for political geography and redistricting rules specific to the state. By comparing a proposed plan with simulated plans that are generated using a set of redistricting criteria, it is possible to assess the partisan bias of the plan relative to the set of alternative plans one could have drawn by following those specified criteria.

5. I evaluate the revised plan’s compliance with Article XIX, Section 1(C)(3)(a) by comparing it with the same set of 5,000 simulated plans as those used in my initial report to

EXPERT REPORT

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

IV. OUTLIER ANALYSIS

6. I evaluate the partisan bias of the revised plan by comparing its district-level vote shares against those under my 5,000 simulated plans. In Figure 1, for any given plan (revised or simulated), I ordered the districts based on the magnitude of their expected Republican vote share. This means that under any given plan, district R1 yields the highest expected vote share while district R15 is expected to give the least support to the Republican candidate (to be clear, the R1 through R15 district identifiers do not correspond to the Congressional district numbers in the revised or enacted plan). If the expected Republican vote share of each ordered district under the revised plan (red square) diverges from the corresponding distribution of the simulated plans (boxplot), it constitutes evidence of possible partisan bias. Note that in a boxplot, the “box” contains 50% of the data points (those from 25 percentile to 75 percentile to be exact) with the horizontal line indicating the median value whereas the vertical lines coming out of the box, called “whiskers”, indicate the range, which contains most data. Any data points that are beyond these whiskers are considered as outliers according to the most common definition, which was also used in my initial report.¹

7. The figure shows clear evidence that the revised plan favors the Republican party. For all of my 5,000 simulated plans, districts R9 and R10 (the 9th and 10th most Republican-leaning districts, respectively) slightly lean toward the Republican party with narrow margins. The expected median Republican vote shares for these districts are equal to 51.1% and 50.6%,

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

EXPERT REPORT

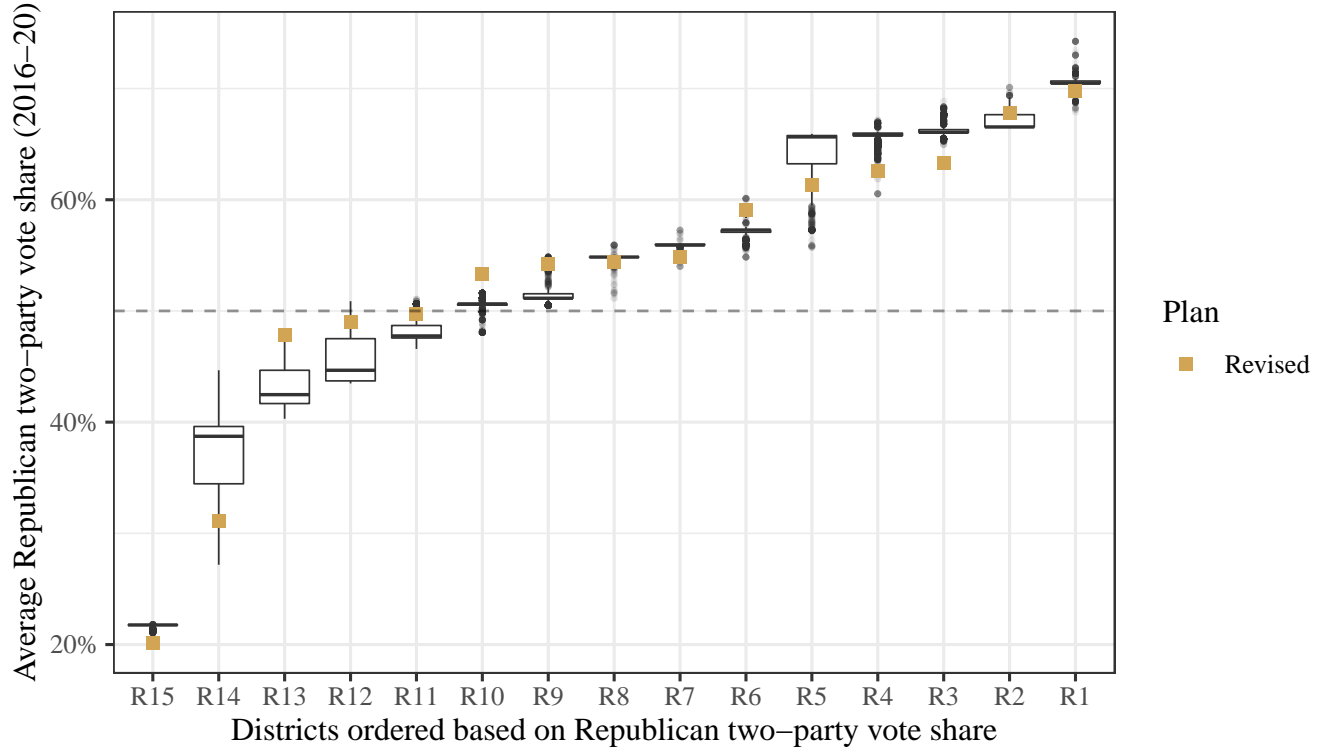


Figure 1: Expected Republican vote share for districts using the statewide elections from 2016 to 2020. For any given plan, the districts are ordered based on their expected Republican vote share. Boxplots represent the distribution of the expected Republican vote share across the simulated plans, whereas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

respectively. In other words, they are toss-up districts under the simulated plans. Yet under the revised plan, both of these districts are safely Republican with the expected Republican vote shares equal to 54.2% and 53.3%. According to the aforementioned definition, these two points associated with the revised plan are clear statistical outliers, with the vote shares of district R9 and R10 under the revised plan being 3.4 and 5.5 standard deviations away from the simulation median, respectively.

8. Furthermore, under the revised plan, districts R11, R12, and R13 lean much less strongly towards the Democratic party than under a vast majority of the simulated plans. For example, the expected median Republican vote share for R11 under the simulated plans is 47.8%. In other words, this district strongly leans towards the Democratic party under the simulated plans. Under the revised plan, however, it becomes a toss-up district. Its expected Republican vote share

EXPERT REPORT

is 49.7%, which is 1.9 percentage points (or 1.9 standard deviations) higher than the simulation median. Indeed, 86.6% of my 5,000 simulated plans have a lower expected Republican vote share for R11 than the revised plan.

9. Similarly, the expected median Republican vote shares for R12 and R13 are 44.7% and 42.5%, respectively, under my simulated plans, implying that these are safe Democratic districts. Under the revised plan, however, the expected vote shares for R12 and R13 are 49.0% and 47.8%, respectively, which are 4.3 and 5.3 percentage points (or 2.8 and 3.5 standard deviations) higher than the corresponding simulation median. That is, the Democratic advantages of these districts are substantially reduced under the revised plan. Indeed, for these two districts, less than 0.25% of my 5,000 simulated plans yield as high levels of expected Republican vote share as the revised plan.

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

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

V. LOCAL ANALYSIS

12. Next, as done in my initial report, I conduct a detailed analysis of the Congressional districts in Hamilton and Franklin Counties. I show that the partisan bias of the revised plan identified in my outlier analysis above originates in these districts. In Hamilton County, the revised plan

EXPERT REPORT

cracks Democratic voters into Districts 1 and 8, substantially reducing the Democratic advantage of District 1. In Franklin County, the revised plan packs Democratic voters into District 3, increasing the Republican advantage of the surrounding districts. Thus, my local analysis shows that Hamilton and Franklin Counties are primarily responsible for the Republican bias of the revised plan.

13. My analysis of each county proceeds as follows. For each precinct, I first compute the expected two-party vote share of the district to which the precinct is assigned under the revised plan. I then perform the same calculation under each simulated plan and average these expected vote shares across all of the simulated plans. Comparison of these two numbers reveals whether the revised plan assigns a precinct to a district whose political leaning is different from what would be expected under the simulated plans.

A. Hamilton County

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

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

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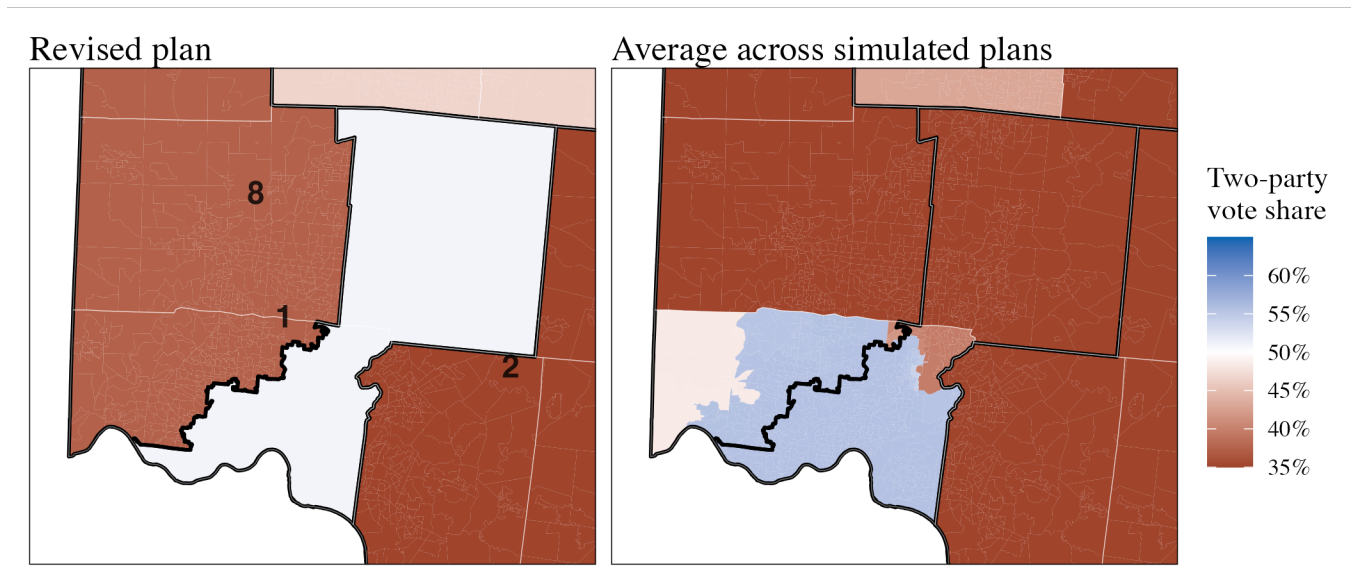


Figure 2: Congressional districts in Hamilton County. The left map presents the expected two-party vote shares of districts under the revised plan, while the right map shows, for each precinct, the average expected two-party vote share of districts to which the precinct is assigned across the simulated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

trict 8 under the revised plan, would normally be expected to belong to a safe Democratic district. Because the revised plan lumps it with District 8, this area instead belongs to safely Republican districts.

16. Similarly, voters in Cincinnati would normally be expected to belong to a strongly Democratic-leaning district under the simulated plans, as indicated by its darker blue color in the right map. The unusual pairing of Hamilton and Warren counties in the revised plan's District 1, however, makes these voters part of a much less Democratic-leaning district. The histogram in Figure 3 represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 1 lying in Hamilton County belongs. The simulated plan assigns this area to a Democratic-leaning district with the average Republican share of 45.6%, which is much lower than the corresponding vote share of 49.0% under the revised plan (vertical yellow line). This difference, which equals 3.0 standard deviations of the simulated

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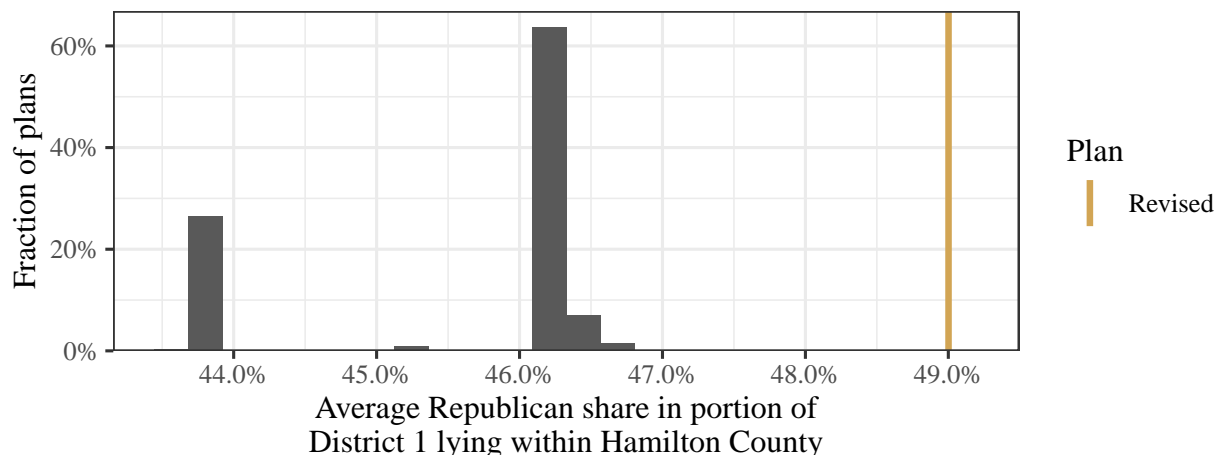


Figure 3: Average district-level Republican vote share across the simulated plans for the portion of Hamilton County that belongs to District 1 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 1 lying in Hamilton County belongs. The revised plan is indicated by the vertical yellow line. No simulated plan assigns this area to a district that has as high as the Republican vote share under the revised plan.

distribution, is statistically significant. In fact, no simulated plan assigns this area to a district whose Republican vote share is as high as the revised plan, showing that the revised plan is a clear outlier in this regard.

17. Figure 13 of Appendix C presents the corresponding histogram for the portion of Warren County that belongs to District 1 under the revised plan. The figure shows that no simulated plan assigns this area to a district whose Republican vote share is lower than the revised plan. In fact, this area belongs to a much more strongly Republican-leaning district under the simulated plans. Lastly, according to Figure 14 of the same appendix, no simulated plan assigns the portion of Hamilton County that belongs to District 8 under the revised plan to a district whose Republican vote share is higher than the revised plan. This area belongs to a Democratic-leaning district under the simulated plans. These findings reaffirm the conclusion that the revised plan cracks Democratic voters in Hamilton County and combine them with Republican voters in Warren County.

18. As a result of these manipulations and additional splits of Hamilton County, the revised plan has no safe Democratic seats under the average statewide contest, whereas the simulated plans are expected to yield a relatively safe Democratic seat. In sum, in Hamilton County,

EXPERT REPORT

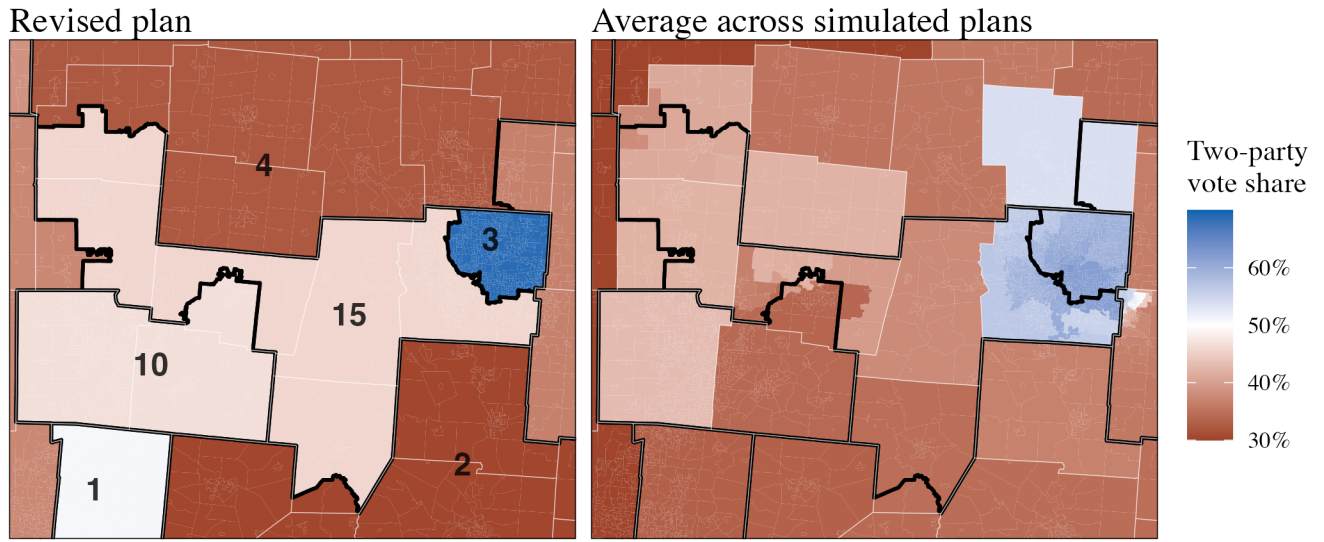


Figure 4: Congressional districts in Franklin County. The left map presents the expected two-party vote shares of districts under the revised plan, while the right map shows, for each precinct, the average expected two-party vote share of districts to which the precinct is assigned across the simulated plans. The revised plan's district boundaries are shown with thick black lines. While under the simulated plans, all of Franklin County are expected to belong to a Democratic district, the revised plan packs Democratic voters, leaving much of the city of Columbus and much of Franklin County in a Republican district stretching most of the way to Cincinnati.

the revised plan turns one safe Democratic district into a toss-up district by cracking Democratic voters.

B. Franklin County

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

20. The histogram in Figure 5 represents the simulated distribution of the average Re-

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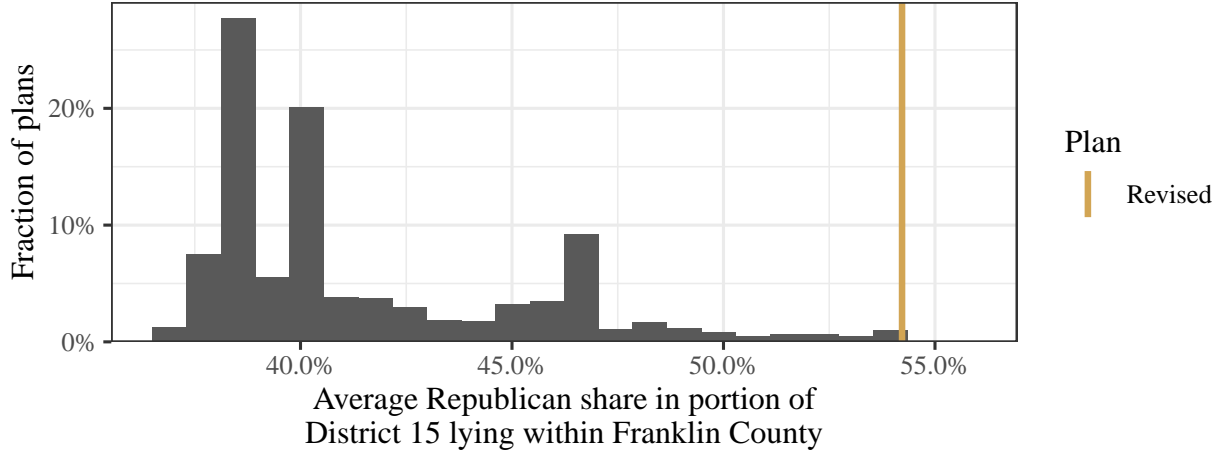


Figure 5: Average district-level Republican vote share across the simulated plans for the portion of Franklin County that belongs to District 15 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 15 lying in Franklin County belongs. The revised plan is indicated by the vertical yellow line. Only 0.18% of the simulated plan assign this area to a district that has a higher Republican vote share than the corresponding vote share under the revised plan.

publican vote share of a district to which the portion of District 15 lying in Franklin County belongs. The simulated plan assigns this area to a strongly Democratic-leaning district with a population-weighted average Republican share of 41.5%, which is much lower than the corresponding vote share of 54.2% under the revised plan (vertical yellow line). This difference, which equals 3.4 standard deviations of the simulated distribution, is statistically significant. In fact, only 0.18% of the simulated plan assign this area to a district whose Republican vote share is higher than the revised plan, showing that the revised plan is a clear outlier in this regard.

21. Figures 15 and 16 in Appendix C show the same histograms for the portions of Delaware County that belong to Districts 4 and 12, respectively. They show that the revised plan assigns these areas to districts whose Republican vote shares are unusually high. In contrast, under the simulated plans, Delaware County is always kept together in a single district and tends to be part of a Democratic-leaning district, with an average Republican vote share of 46.2%. In other words, most simulated plans do not split Delaware County and instead combine it with the northern part of Franklin County, yielding an additional Democratic-leaning district.

22. In sum, the revised plan packs Democratic voters into District 3 and submerges the

EXPERT REPORT

Democratic voters in the rest of Franklin County into District 15 that stretches out to the west rather than to the north as done under most of the simulated plans. By doing so, the revised plan creates a safe Republican district and deprives Democratic voters in the rest of the county of a reasonable opportunity to elect a Democratic candidate.

VI. COMPACTNESS ANALYSIS

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

A. District 1 of the Revised Plan

24. The left map of Figure 6 shows the compactness of District 1 under the revised plan. This district combines part of Cincinnati and its environs with Warren County, resulting in a highly non-compact shape with the Polsby-Popper compactness score of 0.241. In contrast, as shown in the right map of the figure, the simulated plans on average assign the precincts of District 1 to much more compact districts. In particular, because a majority of my simulated plans keep Cincinnati and its environs in the same district, these areas are expected to belong to a more compact district (indicated by a lighter color).

25. Figure 7 shows the histogram for the simulated distribution of the population-weighted average Polsby-Popper compactness score for a district to which the precincts of District 1 belong. The average district compactness score for these precincts under the simulated plans is 0.341, which is 42% higher than the compactness score of District 1 under the revised plan. In fact, all of the simulated plans assign these precincts to a district that is, on average, more compact than District 1.

B. District 15 of the Revised Plan

26. The left map of Figure 8 shows the compactness of District 15 under the revised plan. This district combines part of Columbus and its environs with Madison County and extends

EXPERT REPORT

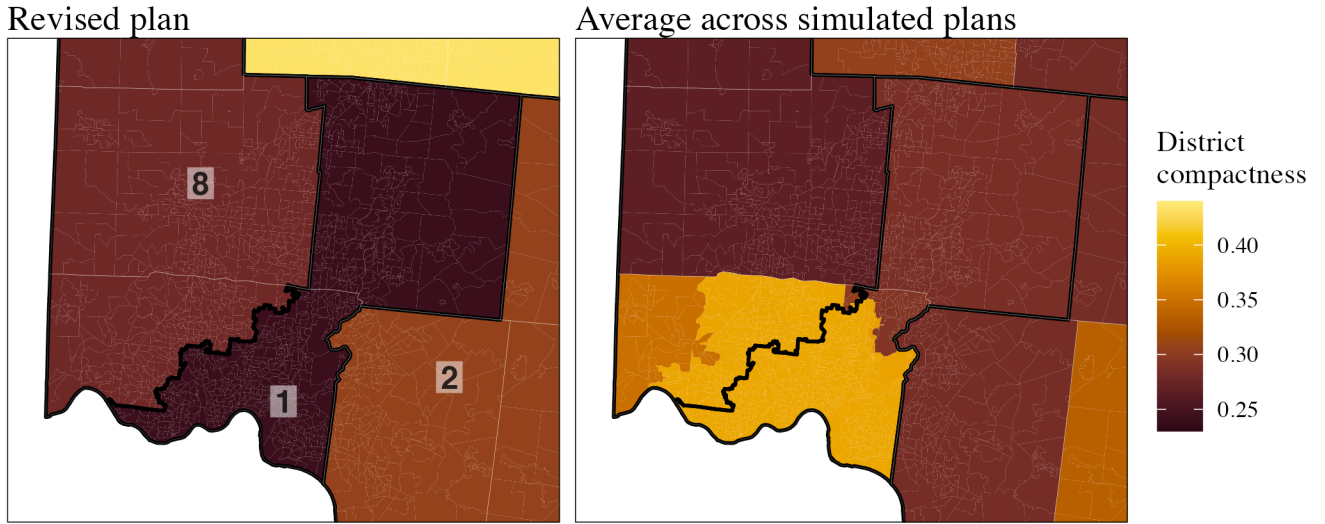


Figure 6: Compactness of District 1 under the Revised Plan. The left map presents the Polsby-Popper compactness score of each district under the revised plan, while the right map shows, for each precinct, the average compactness of districts to which the precinct is assigned across the simulated plans. The revised plan’s district boundaries are shown with thick black lines. District 1 is highly non-compact as indicated by a dark color while under the simulated plans the precincts of District 1 are expected to belong to much more compact districts as indicated by a much lighter color.

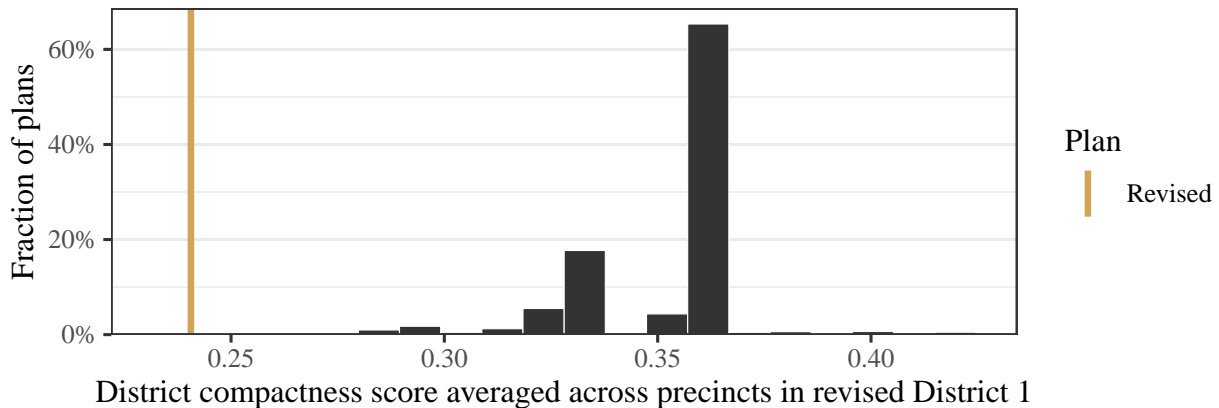


Figure 7: Average district-level Polsby-Popper compactness score across the simulated plans for the precincts that belong to District 1 under the revised plan. The histogram represents the simulated distribution of the population-weighted average compactness score of a district to which these precincts belong. The revised plan is indicated by the vertical yellow line. None of the simulated plans assigns this area to a district that is less compact than District 1 under the revised plan.

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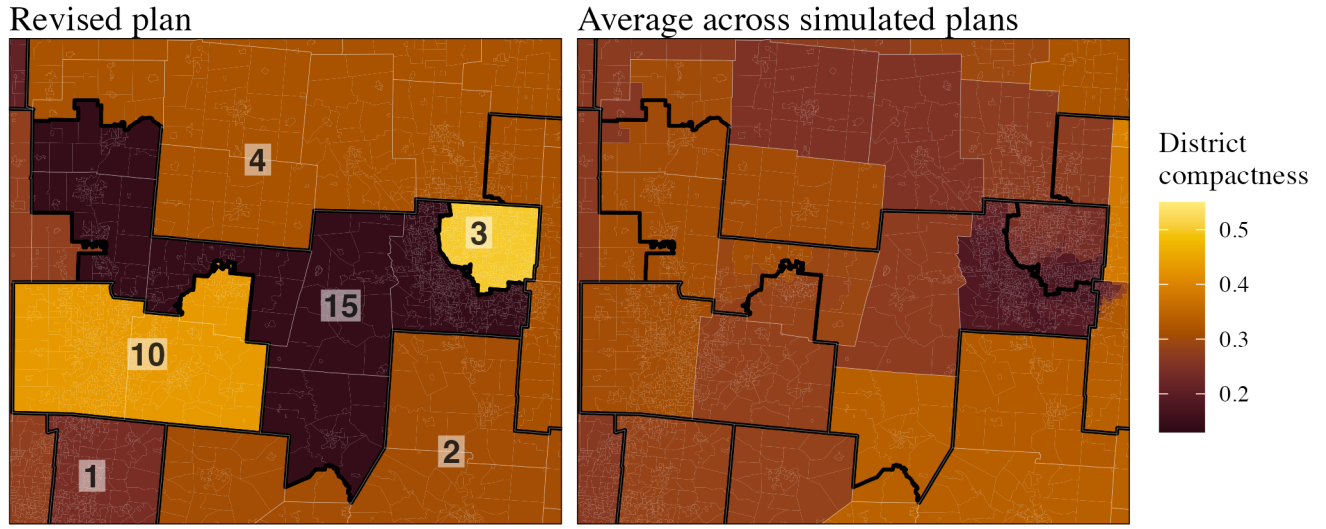


Figure 8: Compactness of District 15 under the Revised Plan. The left map presents the Polsby-Popper compactness score of each district under the revised plan, while the right map shows, for each precinct, the average compactness of districts to which the precinct is assigned across the simulated plans. The revised plan’s district boundaries are shown with thick black lines. District 15 is highly non-compact as indicated by a dark color while under the simulated plans the precincts of District 15 are expected to belong to much more compact districts as indicated by a much lighter color.

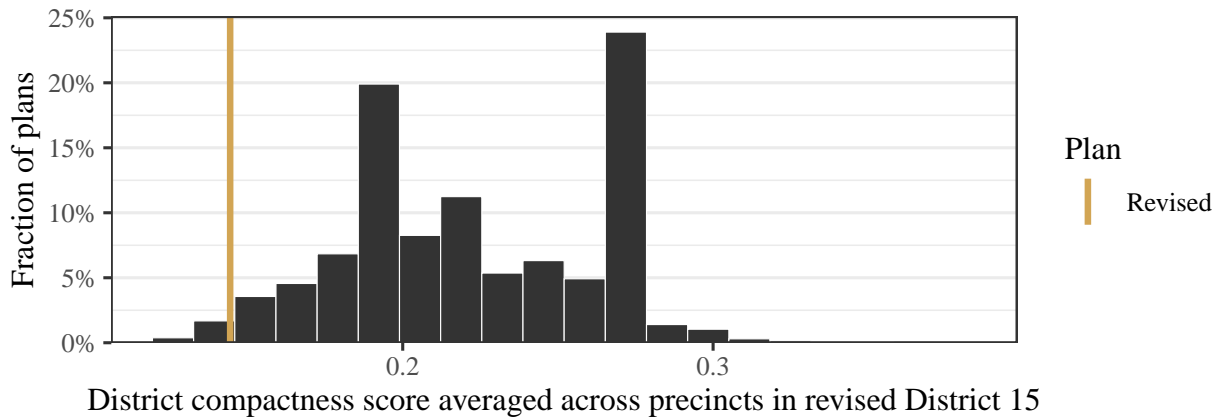


Figure 9: Average district-level Polsby-Popper compactness score across the simulated plans for the precincts that belong to District 15 under the revised plan. The histogram represents the simulated distribution of the population-weighted average compactness score of a district to which these precincts belong. The revised plan is indicated by the vertical yellow line. Only 1.1% of the simulated plans assigns this area to a district that is less compact than District 15 under the revised plan.

EXPERT REPORT

into five other counties in the west. As a result, the district splits a total of five counties and has a highly non-compact shape with the Polsby-Popper compactness score of 0.144, the lowest of all fifteen districts under the revised plan (though District 3 that packs Democratic voters of Columbus is highly compact). In contrast, as shown in the right map of the figure, the simulated plans on average assign the precincts of District 15 to much more compact districts (indicated by a lighter color).

27. Figure 9 shows the histogram for the simulated distribution of the population-weighted average Polsby-Popper compactness score for a district to which the precincts of District 15 belong. The average district compactness score for these precincts under the simulated plans is 0.224, which is 55% higher than the compactness score of District 15 under the revised plan. In fact, more than 98.9% of the simulated plans assign these precincts to a district that is, on average, more compact than District 15.

VII. EXAMPLE PLAN

28. On February 22, 2022, more than a week before the revised plan was enacted, I submitted an example plan (hereafter “example plan”) that is more compliant with Article XIX of the Ohio constitution than the revised plan. This example plan, shown in Figure 10, demonstrates that it is possible to generate a redistricting plan, which is free of the partisan bias and compactness problems while complying with the other redistricting requirements of the Ohio Constitution.

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

EXPERT REPORT

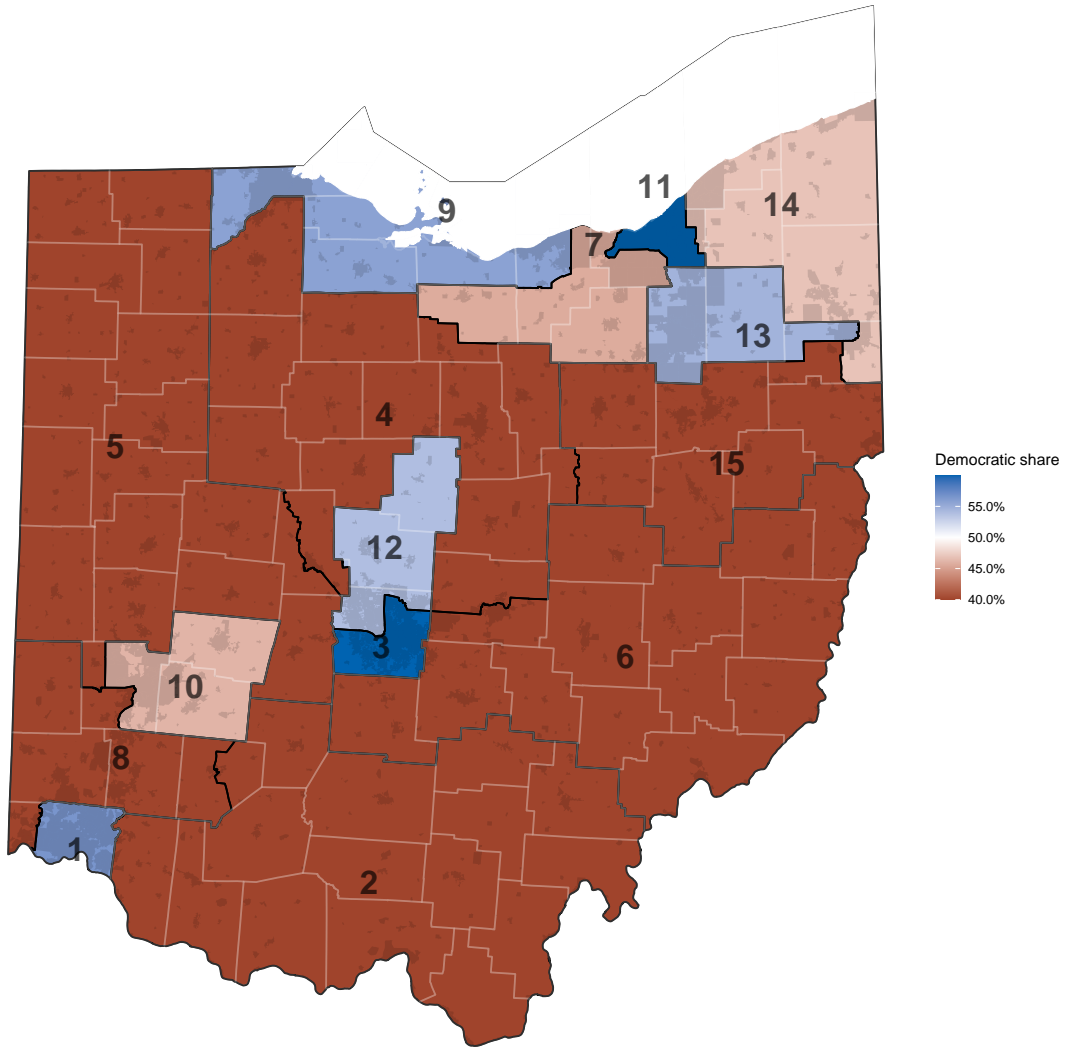


Figure 10: Example Congressional Plan Submitted to the Ohio Redistricting Commission on February 22, 2022.

EXPERT REPORT

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

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

EXPERT REPORT

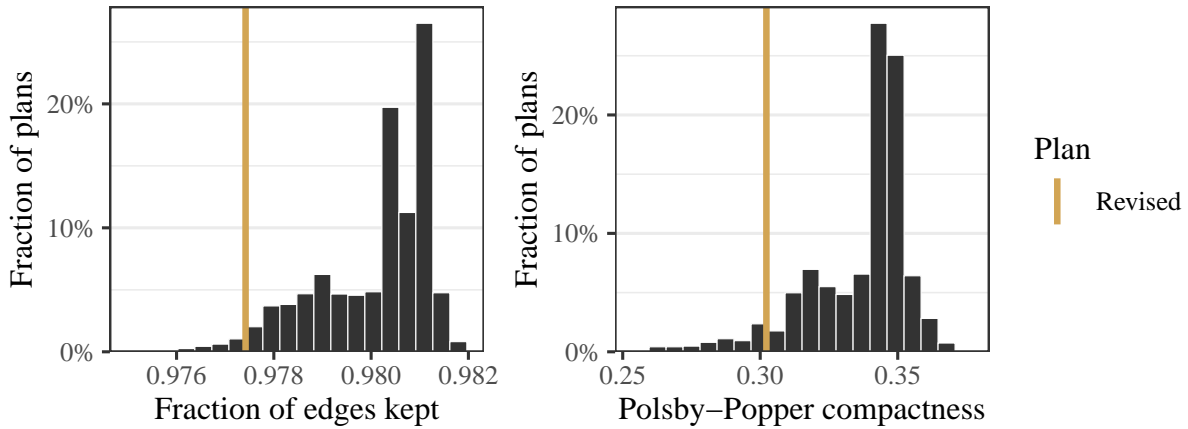


Figure 11: Fraction of edges kept and Polsby–Popper compactness scores for the simulated redistricting plans. Overlaid are scores for the revised plan (orange) and example plan (red). For both measures, greater values indicate more compact districts. The fraction of edges kept measure is not computed for the example plan because this plan is based on the census-block data while the simulated plans are based on the precinct-level data, making the direct comparison impossible.

VIII. APPENDIX

A. Compactness of the Revised, Simulated and Example Plans

1. In this appendix, I show that the simulated plans are more compact than the revised plan. I also show that the example plan is more compact than either the revised plan or simulated plans. I use the fraction of edges kept and the Polsby–Popper score, two commonly-used quantitative measures of district compactness. Note that I do not compute the fraction of edges kept for the example plan because the latter is built on the census-block level data rather than the precinct level data, making the comparison impossible. Figure 11 shows that a vast majority (roughly 93%) of the simulated plans are more compact than the revised plan according to the Polsby–Popper score. A similar conclusion holds even when one uses the fraction of edges kept measure. Moreover, the example plan is more compact than any of the simulated plans. The result clearly implies that it is possible to be compliant with Section 1(C)(3)(a) without sacrificing compliance with the requirement of an “attempt to draw districts that are compact.”

EXPERT REPORT

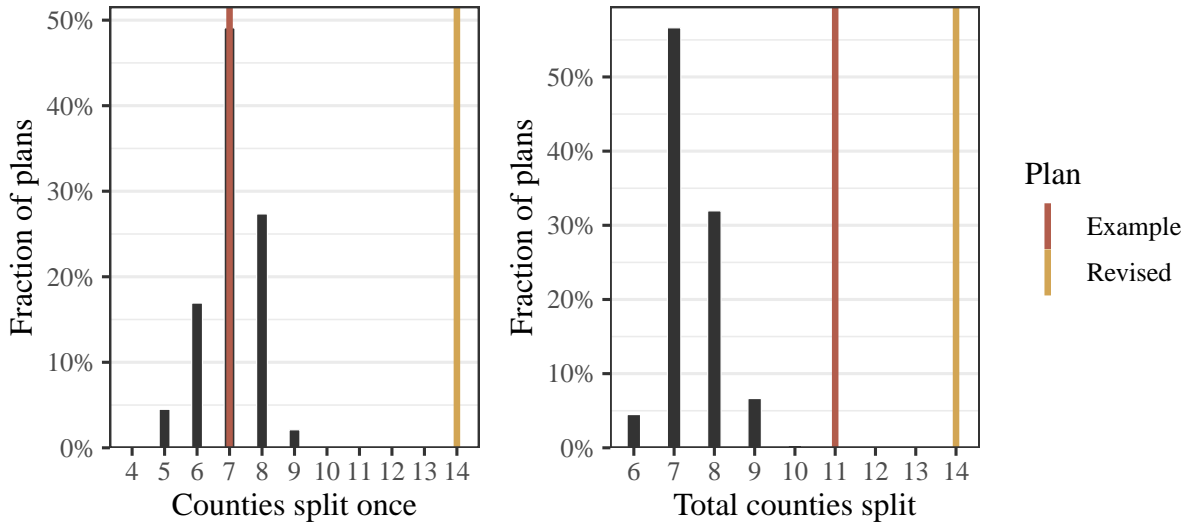


Figure 12: The number of county splits for the simulated redistricting plans. Overlaid are the scores for the revised plan (orange) and example plan (red). The left plot shows the number of counties that are split once under each plan, whereas the right plot shows the number of counties that are split either once or twice. No county is split more than twice under the revised plan, the example plan, or any of the simulated plans.

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

2. Similar to compactness, it is possible to be compliant with Section 1(C)(3)(a) without splitting counties more than the revised plan. The left plot of Figure 12 shows that the number of counties split once is much less under any of the simulated plans than under the revised plan. The bulk of the simulated plans, as well as the revised plan, do not split any counties twice. As a result, the total number of counties split under the revised plan is much greater than that under any of the simulated plans, and is also greater than the total number of counties split under my example plan (see the right plot of the figure).

C. Additional Empirical Results for the Local Analyses

Figures 13, 14, 15, and 16 present additional empirical results for the local analyses presented in Section V where the discussions of these figures are given.

EXPERT REPORT

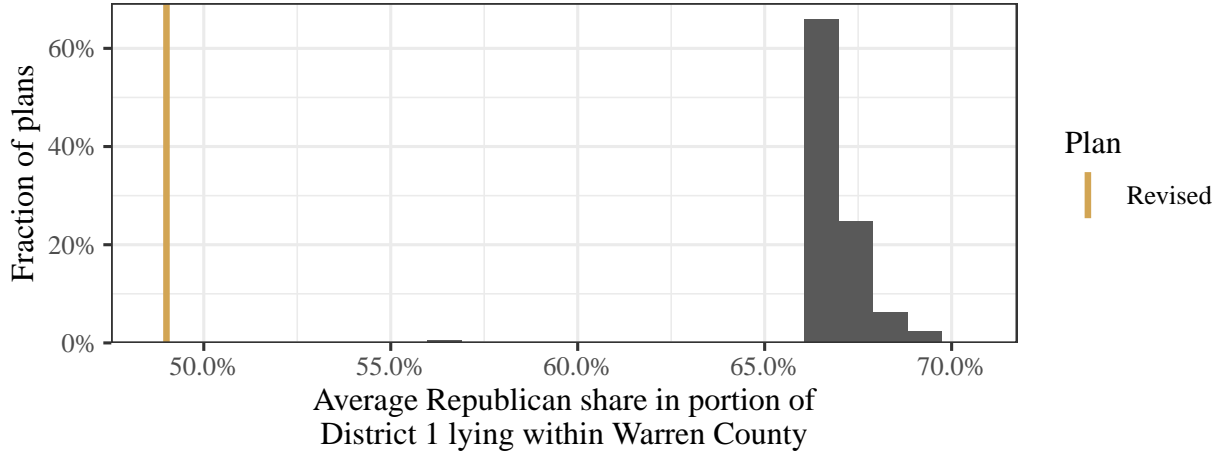


Figure 13: Average district-level Republican vote share across the simulated plans for the portion of Warren County that belongs to District 1 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 1 lying in Warren County belongs. The revised plan is indicated by the vertical yellow line. None of the simulated plans assign this area to a district that has a lower Republican vote share than the corresponding vote share under the revised plan.

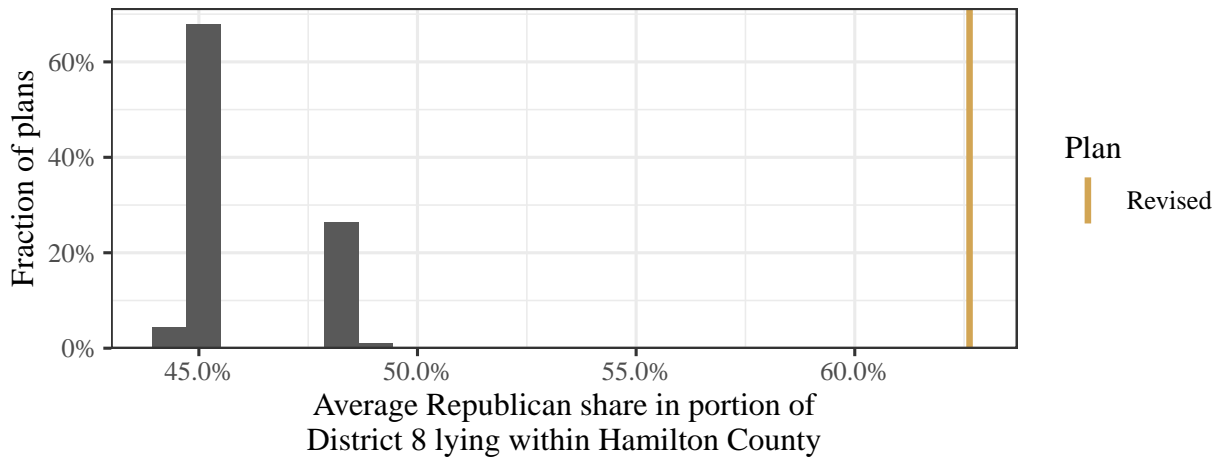


Figure 14: Average district-level Republican vote share across the simulated plans for the portion of Hamilton County that belongs to District 8 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 8 lying in Hamilton County belongs. The revised plan is indicated by the vertical yellow line. None of the simulated plans assign this area to a district that has a lower Republican vote share than the corresponding vote share under the revised plan.

EXPERT REPORT

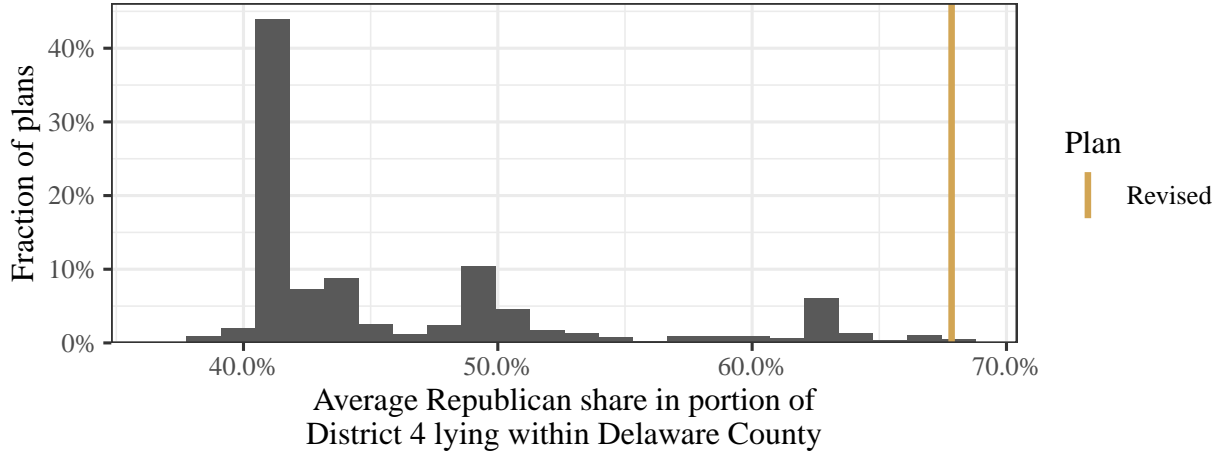


Figure 15: Average district-level Republican vote share across the simulated plans for the portion of Delaware County that belongs to District 4 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 4 lying in Delaware County belongs. The revised plan is indicated by the vertical yellow line. Only 0.4% of the simulated plans assign this area to a district that has a higher Republican vote share than the corresponding vote share under the revised plan.

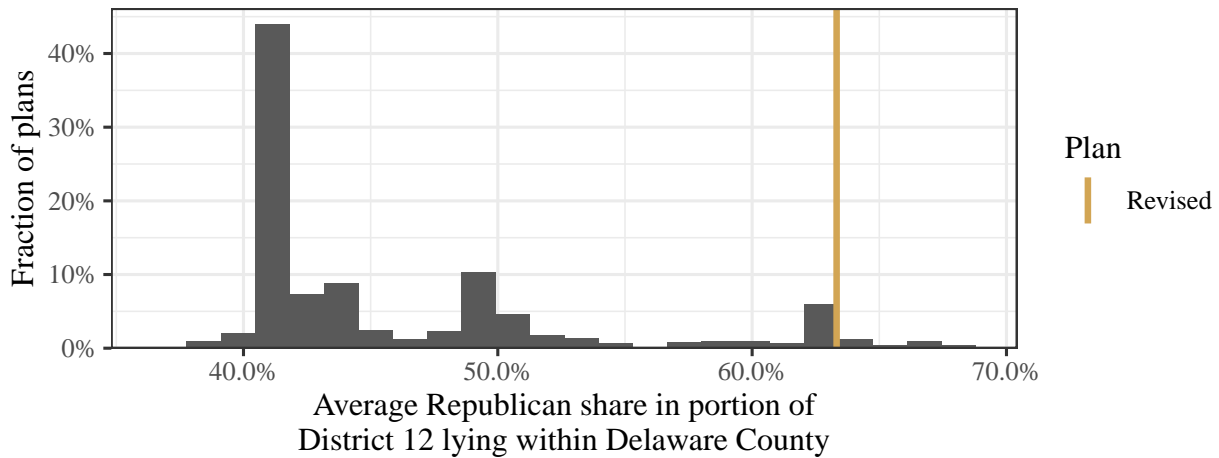


Figure 16: Average district-level Republican vote share across the simulated plans for the portion of Delaware County that belongs to District 12 under the revised plan. The histogram represents the simulated distribution of the population-weighted average Republican vote share of a district to which the portion of District 12 lying in Delaware County belongs. The revised plan is indicated by the vertical yellow line. Only 3.0% of the simulated plans assign this area to a district that has a higher Republican vote share than the corresponding vote share under the revised plan.

CERTIFICATE OF SERVICE

I, Freda J. Levenson, hereby certify that on this 25th day of April 2022, I caused a true and correct copy of the foregoing to be served by email upon the counsel below:

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