Received 3/14/2022 11:49:38 AM Supreme Court Middle District

Filed 3/14/2022 11:49:00 AM Supreme Court Middle District
11 MM 2022

IN THE SUPREME COURT OF PENNSYLVANIA

No. 11 MM 2022

IN RE: PETITION FOR REVIEW CHALLENGING THE FINAL 2021 LEGISLATIVE REAPPORTIONMENT PLAN

ANSWER OF JOANNA E. MCCLINTON TO APPLICATION FOR ORDER STRIKING UPDATED EXPERT REPORTS

Daniel T. Brier
Donna A. Walsh
Patrick J. Brier
Richard L. Armezzani
Myers, Brier & Kelly, LLP
425 Biden Street, Suite 200
Scranton, PA 18503

Michael A. Comber
Reisinger Comber & Miller LLC
300 Koppers Building
436 Seventh Avenue
Pittsburgh, PA 15219

Attorneys for Joanna E. McClinton,
Leader of the Democratic Caucus of the Pennsylvania House of Representatives
and Member of the Legislative Reapportionment Commission

I. INTRODUCTION

"[I]n the law, what is sauce for the goose is normally sauce for the gander." *Heffernan v. City of Patterson*, 578 U.S. 266, 272 (2016). Appellant Kerry Benninghoff, however, wants all the sauce for himself. In addition to offering three new affidavits,[1] Leader Benninghoff lodged with this Court additional written reports from his two experts, one of which raises entirely new arguments and offers new analyses in support of his challenge to the final plan, but he urges the Court to deny Joanna E. McClinton and the Legislative Reapportionment Commission ("Commission") an equal opportunity to provide updated expert support in favor of the final plan. His application is premised on an impermissible double standard and must therefore be denied.

II. ARGUMENT

A. Leader Benninghoff's New Submissions Went Beyond Merely Updating Prior Reports.

Leader Benninghoff would have the Court believe that the supplemental expert reports attached to his Petition for Review merely "update" his earlier submissions, Application To Strike ¶ 5, but this is not accurate. While the report

---

[1] Leader Benninghoff offered three affidavits (Bill Schaller, Ryan Mackenzie and Bob Nye) about events that purportedly occurred prior to the vote on the preliminary plan. No such testimony had been even referenced before the Commission and the affidavits faced no test of credibility or materiality.

from Jonathan Katz, Ph.D. is substantially the same as the original report delivered after the deadline set by the Commission for submitting expert reports,[2] the supplemental report from Michael Barber, Ph.D. is substantially different. As demonstrated by the blue underlining in the comparison of Dr. Barber's original and supplemental reports attached as Exhibit "A", his supplemental report includes entirely new sections on "Race" (Section 3.2), "Other Measures of Partisan Bias" (Section 7) and "Benninghoff Amendment" (Section 8)[3] and additional analysis and opinions in the sections titled "Methods" (Section 2), "Results" (Section 3), "Partisanship" (Section 3.3), "Political Geography of Pennsylvania" (Section 4), "Looking at Subsets of Pennsylvania" (Section 5, "Comparison to Other District

---

[2] Although Chairman Nordenberg set a deadline of January 7, 2022 for submission of expert reports and scheduled expert testimony for January 14, 2022, Leader Benninghoff submitted a written report from Dr. Katz on the day set for expert testimony. Over objection of Leader McClinton, the Commission voted to accept Dr. Katz's late report. He never provided oral testimony before the Commission and his opinions were never subjected to cross-examination. *See* Chairman Report at 40-41.

[3] The irony of the juxtaposition between the timing of the "Benninghoff Amendment" and this application warrants some attention. The "Benninghoff Amendment" was offered two *hours* before the Commission voted on the final plan. Despite months of exhaustive work by Chairman Nordenberg and other members and staff of the Commission, Leader Benninghoff failed to propose any comprehensive plan whatsoever until he did so at a press conference immediately prior to walking into the final vote. To now ask that the experts known to the Commissioners and subjected to vigorous questions by Leader Benninghoff himself cannot respond to the misstatements and contortions in Leader Benninghoff's appeal is, at best, hypocritical.

Scoring Programs" (Section 6) and "Political Geography of Pennsylvania" (Section 4). In total, Dr. Barber's new report adds 17 new pages of analysis and opinion which are wholly absent from his original report. *See* Suppl. Barber Report at pp. 8-9, 12-13, 54-66. His supplemental report is not a mere "updated analysis," but rather a materially new report.

Leader Benninghoff has not pointed to any authority or precedent for allowing one party but not another to supplement expert reports. There is no such authority. To consider the new Barber report without affording an opportunity to respond would be tying Respondents' hands behind their backs. Basic fairness demands that all parties be afforded an equal opportunity to supplement.

B. The Supplemental Expert Reports From Christopher Warshaw, Ph.D., Kosuke Imai, Ph.D. and Matthew Barreto, Ph.D. Update Their Earlier Reports To Address the Final Plan.

Leader Benninghoff claims that the supplemental reports by Christopher Warshaw, Ph.D., Kosuke Imai, Ph.D., and Matthew Barreto, Ph.D. "go well beyond responding to any updated analysis" in Dr. Barber's new report, Application p.1, but this too is inaccurate. As the chart attached as Exhibit "B" demonstrates, each of the supplements fairly updated the original reports with specific conclusions based on the final plan and responded to the new arguments advanced by Leader Benninghoff.

In his original report (LRC.R.–Tab 34d), Dr. Warshaw analyzed the Commission's preliminary plan using objective partisan fairness metrics.[4] Specifically, Dr. Warshaw determined that the preliminary plan was relatively neutral with a slight Republican bias according to the symmetry, mean-median difference, efficiency gap and declination measures. He summarized his findings on page 17 of his initial report as follows:

Metric	Value	2014-2020 Composite > Biased than this % Elections	2014-2020 Composite > Pro-Rep. than this % Elections
2014-2020 Plan			
Symmetry Bias	-7.7%	77%	85%
Mean-Median	-3.8%	70%	81%
Efficiency Gap	-5.8%	60%	83%
Declination	-.348	66%	82%
Average		68%	83%
Proposed Plan			
Symmetry Bias	-2.5%	29%	61%
Mean-Median	-1.4%	31%	63%
Efficiency Gap	-2.6%	27%	69%
Declination	-.175	38%	65%
Average		31%	65%

Table 2: Composite bias metrics for proposed plan based on statewide elections

Dr. Warshaw performed the very same analyses on the final plan and reached the same conclusions. He summarized his findings in the updated chart on page 8 of his supplemental report (attached to Leader McClinton's brief as Exhibit B):

[4] This Court acknowledged that "[p]artisan fairness metrics provide tools for objective evaluation of proposed . . . districting plans to determine their political fairness and avoid vote dilution based on political affiliation." *Carter v. Chapman*, --- A.3d ---, 2022 WL 702894, at *11 (Pa. Mar. 8, 2022).

Metric	Value	2014-2020 Composite > Biased than this % Elections	2014-2020 Composite > Pro-Rep. than this % Elections
2014-2020 Plan			
Symmetry Bias	-7.7%	77%	85%
Mean-Median	-3.8%	70%	81%
Efficiency Gap	-5.8%	60%	83%
Declination	-.348	66%	82%
Average		68%	83%
Preliminary Plan			
Symmetry Bias	-2.5%	29%	61%
Mean-Median	-1.4%	31%	63%
Efficiency Gap	-2.6%	27%	69%
Declination	-.175	38%	65%
Average		31%	65%
Enacted Plan			
Symmetry Bias	-2.7%	31%	62%
Mean-Median	-1.4%	31%	63%
Efficiency Gap	-2.5%	26%	68%
Declination	-.173	38%	65%
Average		31%	65%

Table 1: Composite bias metrics for enacted House plan based on statewide elections

Dr. Warshaw's supplemental report is just that: an update to his original report with updated partisan fairness calculations based on the final plan. Leader Benninghoff does not and cannot claim otherwise in his application.

The supplemental report by Dr. Barreto performs the same function. In his original report, Dr. Barreto detailed the basis for his expert opinion that the preliminary plan comported with the Voting Rights Act in that it included majority-minority districts where required by the *Gingles* test and ensured that districts with substantial minority populations did not unlawfully dilute minority voting strength. LRC.R.-Tab 34b. In his supplemental report, Dr. Barreto addressed the specific districts referenced in the Petition or Review and affirmed that his opinions remain the same under the final plan and that it remains his

professional opinion that the final plan comports with the Voting Rights Act and does not dilute minority voting strength or deprive minorities of equal voting opportunities. He wrote: "It remains my opinion that the Final Plan fully complies with the VRA and does not impair any minority group's ability to elect representatives of their choice." *See* Suppl. Barreto Report (attached to Leader McClinton's Brief as Exhibit E) at 6. Leader Benninghoff appears to concede that Dr. Barreto's supplemental report does not introduce any new analysis. Application ¶ 19.

Similarly, the supplemental report from Kosuke Imai, Ph.D., is an update to his original report addressing the final plan (LRC.R.-Tab 34e). As explained in his report (attached to Leader McClinton's Brief as Exhibit D), Dr. Imai generated an additional 5,000 simulated plans using traditional redistricting criteria in Article II, Section 16 and the number of municipal splits in the final plan and, based on this additional analysis, concluded that the final plan falls squarely within the range of

the simulated plans, as demonstrated in the charts below:

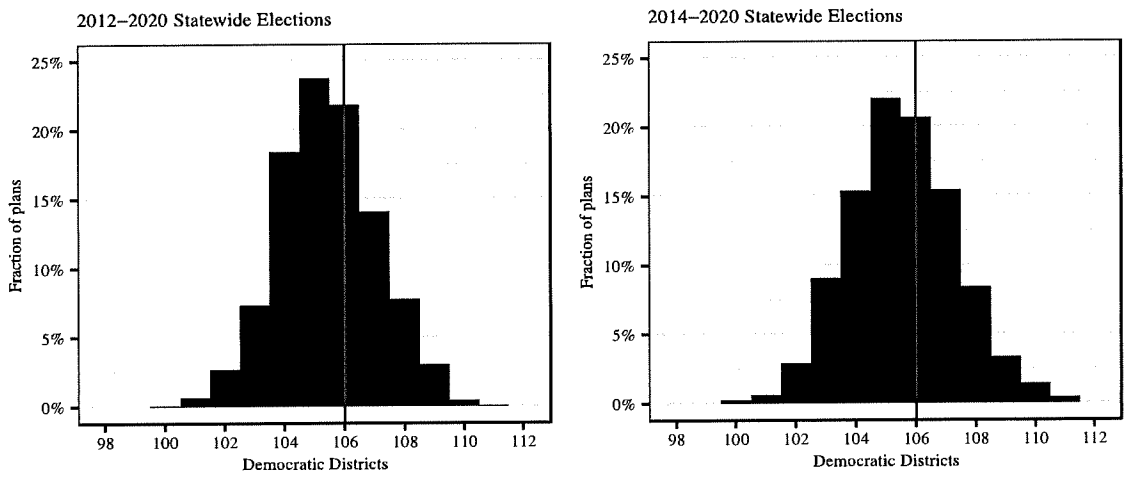


Figure 1: The likely number of Democratic districts across 5,000 *race-blind* simulated plans. Democratic districts are tallied based on an average of statewide elections for the 2012–2020 cycles (left) and the 2014–2020 cycles (right). The red vertical lines represent the results under the final House plan, which fall well within the simulation ranges.

See Suppl. Imai Report at 9.

Leader Benninghoff criticizes Dr. Imai's supplemental report as new, but the supplement is in direct response to Dr. Barber's report. In his supplemental report, Dr. Barber criticized Dr. Imai's initial race-blind simulation for containing "many more municipal splits" than the Commission's preliminary plan and Dr. Barber's own race-blind simulations. *See* Suppl. Barber Report attached to Leader Benninghoff's Petition for Review at 12 n.6. To respond to Dr. Barber's criticism, Dr. Imai performed a race-blind analysis of the final House plan using the same geographic clusters as in his initial simulations and the merge-split MCMC algorithm (which Dr. Imai and his collaborators implemented in open-source software). The merge-split MCMC algorithm allows for more precise controls for

municipal and county splits than the Sequential Monte Carlo algorithm used by Dr. Imai in his initial simulation and presumably used by Dr. Barber.[5] As Dr. Imai explained in his supplemental report, his race-blind simulations produced maps with comparable municipal and county splits to the final House plan. The same race blind simulations by Dr. Imai confirmed that the final House plan is not a partisan gerrymander. Leader Benninghoff wants the Court to consider Dr. Barber's supplemental report, but not Dr. Imai's refutation because it is so devastating to his appeal. But he cannot have it both ways.

The supplemental reports update the analyses in the original reports based on the final plan and respond to arguments advanced in the supplemental Barber report. They are properly considered in this appeal.

---

[5] Nowhere, in any of his reports, does Dr. Barber disclose which algorithm he used for any of his simulations. Nevertheless, Leader Benninghoff seeks to strike Dr. Imai's rebuttal report which transparently details his methodology and identifies the algorithms used for each simulation. It remains unclear why Dr. Barber declined to disclose his methodology or the algorithm he selected. Rather than ask the court to strike Dr. Imai's rebuttal expert, Leader Benninghoff should have asked Dr. Barber to verify Dr. Imai's work based on the transparent methodology. But that of course would likely have proven that the final House plan is not a partisan gerrymander, a finding that Leader Benninghoff wants to suppress.

D. Admission of the Report of Jonathan Rodden, Ph.D. Is Necessary To Respond to the Fundamental Misimpression Created by Dr. Barber's Reports.

In his new report, Dr. Barber includes an entirely new section on partisan fairness and his theory of political geography and, specifically, his view that "the geography of Pennsylvania leads to a naturally arising advantage for Republicans due to the dense clustering of Democratic voters in Philadelphia, Pittsburgh, and the other medium-sized cities throughout the state." Suppl. Barber Report at 58. He bases his theory of political geography primarily on the work of Jonathan Rodden, Ph.D. Dr. Barber's new report references Dr. Rodden at least 13 times in his supplemental report and he intertwines Dr. Rodden's written work throughout his opinions to make it appear as though Dr. Rodden likewise supports Leader Benninghoff's appeal. But Dr. Rodden's writings do not support Dr. Barber's opinions. Dr. Barber misrepresented the content and implication of Dr. Rodden's scholarly writings to suggest support for his theory that the only fair map in Pennsylvania is one that substantially favors Republicans. As Dr. Rodden detailed in his report, he does not subscribe to this theory and his book "*Why Cities Lose The Deep Roots of the Urban-Rural Political Divide*" was misquoted in Dr. Barber's submissions to this Court. Dr. Rodden's report is necessary to prevent Dr. Barber's misleading presentation from going unrebutted.

This Court should not be the first court to credit Dr. Barber for many reasons. A principal reason, however, is that Dr. Barber's foundational claims about Pennsylvania are based on material, knowing misrepresentations of Dr. Rodden's academic research. This alone disqualifies Dr. Barber even under the most lax competency and reliability standard.

If Leader Benninghoff were truly concerned about the integrity of these proceedings, he would withdraw Dr. Barber's new report, not move to strike Dr. Rodden's full-throated rebuttal of it.

D. The Unique Constitutional Procedure for Appeals From the Final Plan Allows for Supplemental Expert Reports.

Notwithstanding his unilateral decisions to lodge his own new expert report and new affidavits, Leader Benninghoff argues that the record on appeal should include only the materials available to the Commission. The rule on which he relies, Pa. R. App. 1951(a), applies to appeals in proceedings conducted pursuant to the Administrative Agency Law, 2 Pa. C.S.A. §§ 101-106, 501-508, 701-704. It has no application here.

The appellate rules are silent as to the content of the record in appeals from a final plan adopted by the Commission. *See* G. Ronald Darlington, et al., *Pennsylvania Appellate Practice* § 3321:5. Indeed, direct appeals to this Court from the final plan are *sui generis* and distinct from any other proceedings in this Commonwealth. The Pennsylvania Constitution directs a 30-day period within

which aggrieved persons may file exceptions to the preliminary plan and the Commission must prepare "a revised reapportionment plan." Pa. Const. art. II, § 17(c). The 30-day period to file appeals from the final plan begins immediately after approval of the final plan. Pa. Const. art. II, § 17(d). Because introduction and adoption of the final plan occurs in the same Commission meeting, and because the Commission does not reconvene following adoption of the final plan, there is no opportunity or procedure for proponents or critics of a final plan to submit expert evaluations of the final plan to the Commission. In this unique procedural context, rules relating to the record in ordinary appeals simply do not apply. *See, e.g., Pocono Manor Investors LP v. Pa. Gaming Control Bd.*, 927 A.2d 209, 218-19 (Pa. 2007) (declining to find waiver in direct appeal from Pennsylvania Gaming Control Board where there was no mechanism for appellant to raise challenge in proceeding below).

Importantly, unlike the appeals from administrative agency decisions in the cases cited by Leader Benninghoff,[6] the scope of review in appeals from a final

---

[6] *See*, e.g., *Anam v. Workman's Compensation Appeal Bd.*, 537 A.2d 932, 934 n.6 (Pa. Commw. 1988) ("[O]n review of a decision of [the Workmen's Compensation Appeal] Board, we are limited to a determination of whether there has been a violation of constitutional rights, an error of law has been committed, or whether necessary findings of fact are supported by substantial evidence."); *Miller v. Commonwealth, Dep't of Pub. Welfare*, 513 A.2d 569, 570 (Pa. Commw. 1986) (scope of review on appeal from Department of Public Welfare decision denying education benefit "is limited to the determination of whether the adjudication was in accordance with the law, whether the petitioner's rights were violated and

redistricting plan is plenary. *Holt v. 2011 Legislative Reapportionment Comm'n*, 38 A.3d 711, 733 (Pa. 2012). "This entails consideration of all relevant evidence, and legal authority . . . ." *Id.*

Because there was no procedural mechanism for Leader McClinton to submit supplemental expert reports to the Commission in support of the final plan after it was approved on February 4, 2022 and this Court's scope of review is plenary, the supplemental reports are properly considered by this Court in relation to the appeals from the final plan. That unassailable point is no doubt the reason that Leader Benninghoff lodged—without leave of court—the new reports that he did; the same reports that he now wants to go unchallenged.

---

whether the hearing officer's findings of fact can be upheld without a capricious disregard of competent evidence"). These cases do not apply to appeals from final redistricting plans under Article II, Section 17. Nor is this appeal governed by "federal administrative agency practice." Application ¶ 24.

III. CONCLUSION

There is no legal basis to disallow supplemental expert reports from Leader McClinton and the Commission and therefore Leader Benninghoff's application to strike should be denied.

Respectfully submitted:

/s/ Daniel T. Brier
Daniel T. Brier
Donna A. Walsh
Patrick J. Brier
Richard L. Armezzani

Myers, Brier & Kelly, LLP
425 Biden Street, Suite 200
Scranton, PA 18503

/s/ Michael A. Comber
Michael A. Comber

Reisinger Comber & Miller LLC
300 Koppers Building
436 Seventh Avenue
Pittsburgh, PA 15219

Date: March 14, 2022

CERTIFICATE OF COMPLIANCE

I certify that this filing complies with the provisions of the *Public Access Policy of the Unified Judicial System of Pennsylvania: Case Records of the Appellate and Trial Courts* that requires filing confidential information and documents differently than non-confidential information and documents.

/s/ Daniel T. Brier
Daniel T. Brier

Date: March 14, 2022

Exhibit A

Report on Redistricting Plan for the Pennsylvania House of Representatives of the Pennsylvania Legislative Reapportionment Commission

Dr. Michael Barber
Brigham Young University
724 Spencer W. Kimball Tower
Provo, UT 84604
barber@byu.edu

APPENDIX A

0002a

1 Introduction and Qualifications

I have been asked by counsel to review the Legislative Reapportionment Commission's proposed redistricting plan and compare it to a set of simulated redistricting plans across a number of factors commonly considered in the redistricting process and in redistricting litigation.

I am an associate professor of political science at Brigham Young University and faculty fellow at the Center for the Study of Elections and Democracy in Provo, Utah. I received my PhD in political science from Princeton University in 2014 with emphases in American politics and quantitative methods/statistical analyses. My dissertation was awarded the 2014 Carl Albert Award for best dissertation in the area of American Politics by the American Political Science Association.

I teach a number of undergraduate courses in American politics and quantitative research methods.[1] These include classes about political representation, Congressional elections, statistical methods, and research design.

I have worked as an expert witness in a number of cases in which I have been asked to analyze and evaluate various political and elections-related data and statistical methods. Cases in which I have testified at trial or by deposition are listed in my CV, which is attached to the end of this report. I have previously provided expert reports in a number of cases related to voting, redistricting, and election-related issues: *Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida); Common Cause, et al., Plaintiffs, vs. Lewis, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina); Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida); Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina); Richard Rose et al., Plaintiffs, v. Brad Raffensperger,*

[1]The political science department at Brigham Young University does not offer any graduate degrees.

Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern District of Georgia); Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia); Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE NO. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division); League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio); Harper, et al., Plaintiffs, v. Hall et al., Defendants. Case No. 21-CVS-015426 (Wake County North Carolina)

In my position as a professor of political science, I have conducted research on a variety of election- and voting-related topics in American politics and public opinion. Much of my research uses advanced statistical methods for the analysis of quantitative data. I have worked on a number of research projects that use "big data" that include millions of observations, including a number of state voter files, campaign contribution lists, and data from the US Census. I have also used geographic information systems and other mapping techniques in my work with political data.

Much of this research has been published in peer-reviewed journals. I have published nearly 20 peer-reviewed articles, including in our discipline's flagship journal, *The American Political Science Review* as well as the inter-disciplinary journal, *Science Advances*. My CV, which details my complete publication record, is attached to this report as Appendix A.

The analysis and opinions I provide in this report are consistent with my education, training in statistical analysis, and knowledge of the relevant academic literature. These skills are well-suited for this type of analysis in political science and quantitative analysis more generally. My conclusions stated herein are based upon my review of the information available to me at this time. I reserve the right to alter, amend, or supplement these conclusions based upon further study or based upon the availability of additional information. The opinions in this report are my own, and do not represent the view of Brigham Young

University.

2 Methods

To gauge the degree to which the Commission's proposed map is a partisan gerrymander, I conduct simulated districting analyses to allow me to produce a large number of districting plans that follow traditional redistricting criteria using small geographic units as building blocks for hypothetical legislative districts (election precincts). This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to create districting plans that follow traditional districting goals without paying attention to partisanship, race, or the location of incumbent legislators. Despite drawing districts without regard to race, the simulations nevertheless generates a similar number of majority-minority districts and minority opportunity districts as the Commission's proposal. This is due to the geographic clustering of minority populations in the state such that a race-blind simulation will nevertheless create many of these districts. I discuss this in more detail in a later section of the report. This set of simulated districts is helpful because it provides a set of maps to which we can compare the Commission's proposed map to see if it is biased in favor of either political party. This is because in comparing the Commission's map to the simulated districts, we are comping a map to a set alternative maps that we know to be unbiased. If the Commission's map produces a similar outcome as the alternative set of maps, we may reasonably conclude that the Commission's plan is also unbiased. Alternatively, if the Commission's proposed plan significantly diverges from the set of simulated maps, it may be the case that the proposed plan is biased in favor of one party.

The process of simulating districting plans has been recognized and used in a variety of redistricting cases, including in Pennsylvania.[2] While different people employ slightly

[2]See League of Women Voters of Ohio v. Ohio Redistricting Commission (2021); Harper v. Hall (2021); Common Cause v. Lewis (2019); Harper v. Lewis (2019); League of Women Voters of Pennsylvania v.

different methods, the overall process is much the same. For my simulations, I use a program developed by Fifield et al. (2020).[3] This algorithm has been validated and accepted or relied upon in a number of recent redistricting cases, including in Ohio, Alabama, North Carolina, and in Pennsylvania.

A significant advantage of the simulation-based approach is the ability to provide a representative sample of possible districting plans that accounts for the unique political geography of a state, such as the spatial distribution of voters or the location and number of administrative boundaries, such a counties. Simulation methods can also to a degree incorporate each state's unique redistricting rules. The simulation-based approach therefore permits us to compare a particular plan to a large number of representative districting plans in Pennsylvania. In the simulations I run, I instruct the model to generate plans that adhere to the redistricting criteria contained in the Pennsylvania Constitution.

Specifically, the model is constrained to conduct 50,000 simulations in which each simulation generates 203 districts that are of roughly equal population (<4.25% deviation above or below the target population of 64,053, which is the same range as in the commission's proposal). The algorithm does this by assembling small geographic units — electoral precincts — into larger groups of precincts until a group of precincts is large enough to constitute a new legislative district. The model does this 203 times to create a full redistricting plan containing 203 legislative districts. It then repeats this process 50,000 times, generating a different set of 203 districts with each run of the model. In each of the 50,000 iterations, the model is instructed to generate districts that cross county boundaries as few times as possible. Of course, county populations do not always add up to round units of districts,

Commonwealth of Pennsylvania (2018).

[3]Fifield, Benjamin, , Michael Higgins, Kosuke Imai, and Alexander Tarr. "Automated redistricting simulation using Markov chain Monte Carlo." Journal of Computational and Graphical Statistics 29, no. 4 (2020): 715-728.

Fifield, Benjamin, Kosuke Imai, Jun Kawahara, and Christopher T Kenny. 2020. "The essential role of empirical validation in legislative redistricting simulation." Statistics and Public Policy 7 (1): 52–68.

Kenny, Christopher T., Cory McCartan, Benjamin Fifield, and Kosuke Imai. 2020. redist: Computational Algorithms for Redistricting Simulation. https://CRAN.R-project.org/package= redist.

McCartan, Cory, and Kosuke Imai. 2020. "Sequential Monte Carlo for sampling balanced and compact redistricting plans." arXiv preprint arXiv:2008.06131.

and so of necessity some county boundaries will be split. The model is further instructed that when a county boundary needs to be crossed, it should avoid splitting the county more times than necessary. The model also includes instructions to generate districts that are geographically compact. The final constraint is an instruction to avoid splitting city, town, borough, and township boundaries (I refer to these collectively as municipalities in the rest of the report).

Once the simulated district plans are complete, only then do I compute the partisan composition of each district in each plan. For the partisan composition of each district I rely on the election results from statewide elections disaggregated to the level of the precinct. I then reassemble these election results for each of the simulated districts in each of the 50,000 simulations to compute the proportion of votes across all statewide elections conducted between 2012 and 2020 that were won by the Democratic and Republican candidates in those districts.[4] Creating a partisan index is common when measuring the general partisan tendency of a district and has frequently been used in other redistricting cases. In other words, the partisan index is the average vote share for Democratic candidates in each district for the statewide elections considered between 2012-2020. I choose 2012 as the starting date as this a full set of elections between the decennial census. Furthermore, averages of multiple elections have the benefit of "washing out" the impact of any particular election, since individual elections can vary due to particular candidate features and other idiosyncrasies, and particular years can vary due to national electoral waves (i.e. 2018 was an especially good year for Democrats while 2016 was an especially good year for Republicans nationwide).

[4]The particular races are 2020: President, Auditor, Attorney General, Treasurer; 2018: Governor, US Senate; 2016: President, US Senate, Auditor, Attorney General, Treasurer; 2014: Governor; 2012: President, US Senate, Auditor, Attorney General, Treasurer. I do not include statewide judicial elections in the index. It is uncommon in political science to use judicial elections to measure voters' partisan preferences as research suggests voters treat judicial elections very differently, even when judges run under party labels, than they do partisan elections to legislative and executive positions. Other commonly used measures indices such as Dave's Redistricting and PlanScore.com also omit judicial elections from their partisan indices.

3 Results

3.1 Population, Boundary Splits, and Compactness

Table 4 below compares the Commission proposal to the distribution of simulations for population deviation, boundary splits, and compactness. The Commission proposal and the simulations are within the same range of district population deviations from the target district size. The proposal splits 45 counties 186 times. This is in line with the simulations in terms of the number of counties split. The proposal divides 56 municipalities 92 times. This is lower than the range produced by the simulations. On the whole, the proposal appears to perform well at having few municipal splits. However, later in the report I will show how the choice of *which* municipalities to split is informative of why the Commission's proposal is such an extreme partisan outlier compared to the set of simulation results. With regards to district compactness, the Commission proposal is similarly compact and largely in line with the results of the simulations.

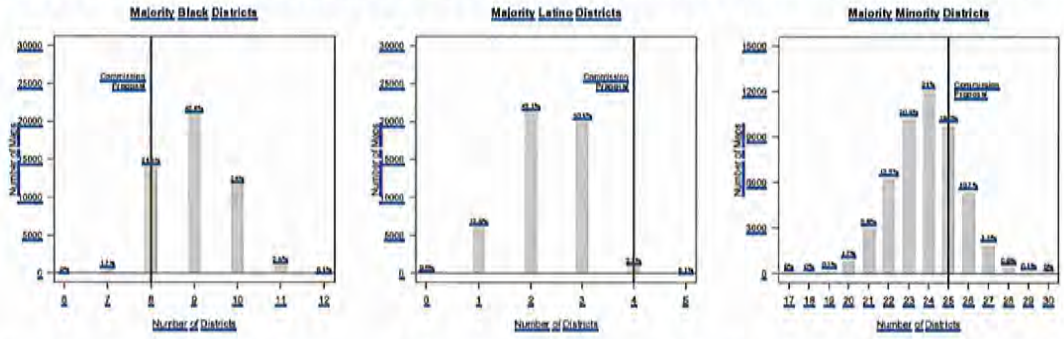
Table 1: Commission Proposal and 50,000 Simulations: Population, Splits, and Compactness

	Commission Final Proposal	Simulations Median	Simulations Range
Population Deviation			
Smallest District:	-4.24%	-4.22%	[-4.25., -3.91]
Largest District:	4.40%	4.23%	[3.93, 4.25]
Boundary Splits			
Counties Split:	45	46	[42, 52]
Total County Splits:	186	195	[184, 208]
Municipalities Split:	56	82	[61, 105]
Total Municipal Splits:	92	119	[98, 140]
Compactness			
Median Polsby-Popper:	0.35	0.32	[0.29, 0.34]

3.2 Race

Figure 1 displays the distribution of districts according to three different measures of the racial composition of districts commonly used in redistricting litigation - the number of majority Black districts, the number of majority Latino districts, and the number of majority-minority districts in the simulations as well as the Commission's proposal. The left panel shows the number of majority Black districts, the middle panel shows the number of majority Hispanic districts, and the right panel shows the number of majority-minority districts. The grey bars show the distribution of these districts in the simulations and the green vertical line shows the results for the Commission proposal according to each metric. The Commission proposal generates eight majority Black districts, four majority-Hispanic districts, and 25 majority-minority districts throughout the state. These are all within the range produced by the simulations even though the simulations do not explicitly consider race when drawing district lines.

Figure 1: **Racial Composition of Districts and Simulations - Majority Minority Districts**



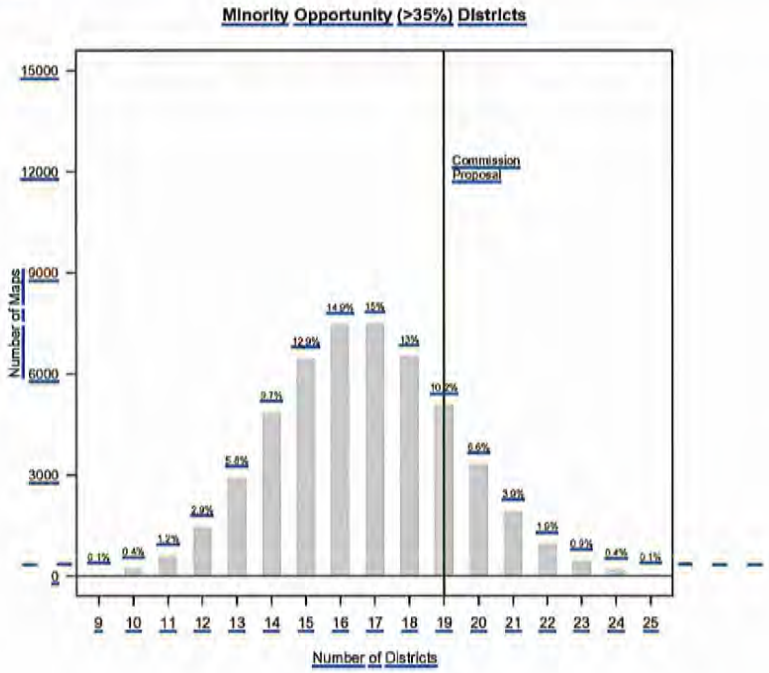
Note: The grey distributions are the number of majority Black (left panel), Hispanic (middle panel), and minority (right panel) districts generated from the 50,000 simulations. The vertical green line is the respective number in the Commission's final proposal.

An additional consideration is the creation of coalition majority "opportunity" districts where the proportion of minority voters is not over 50% but is large enough that they can exert substantial influence in the selection of candidates.[5] Figure 2 shows the results for

[5]The proportion of minority population necessary to constitute an effective "opportunity" district,

these coalition minority opportunity districts. The green line shows the results for the Commission proposal according to each metric. The Commission proposal generates 19 minority coalition opportunity districts, which is within the range of the simulation results as well.

Figure 2: **Racial Composition of Districts and Simulations - Coalition Minority Opportunity Districts**



Note: The grey distribution is the number of coalition minority opportunity districts generated from the 50,000 simulations. The vertical green line is the respective number in the Commission's final proposal.

whether or not a majority-minority district is necessary, and the number and location of these districts first requires an analysis of racially polarized voting in the different regions of the state, the degree of White crossover voting, as well as consideration of the other *Gingles* factors. I have not seen any such analysis of the LRC proposal.

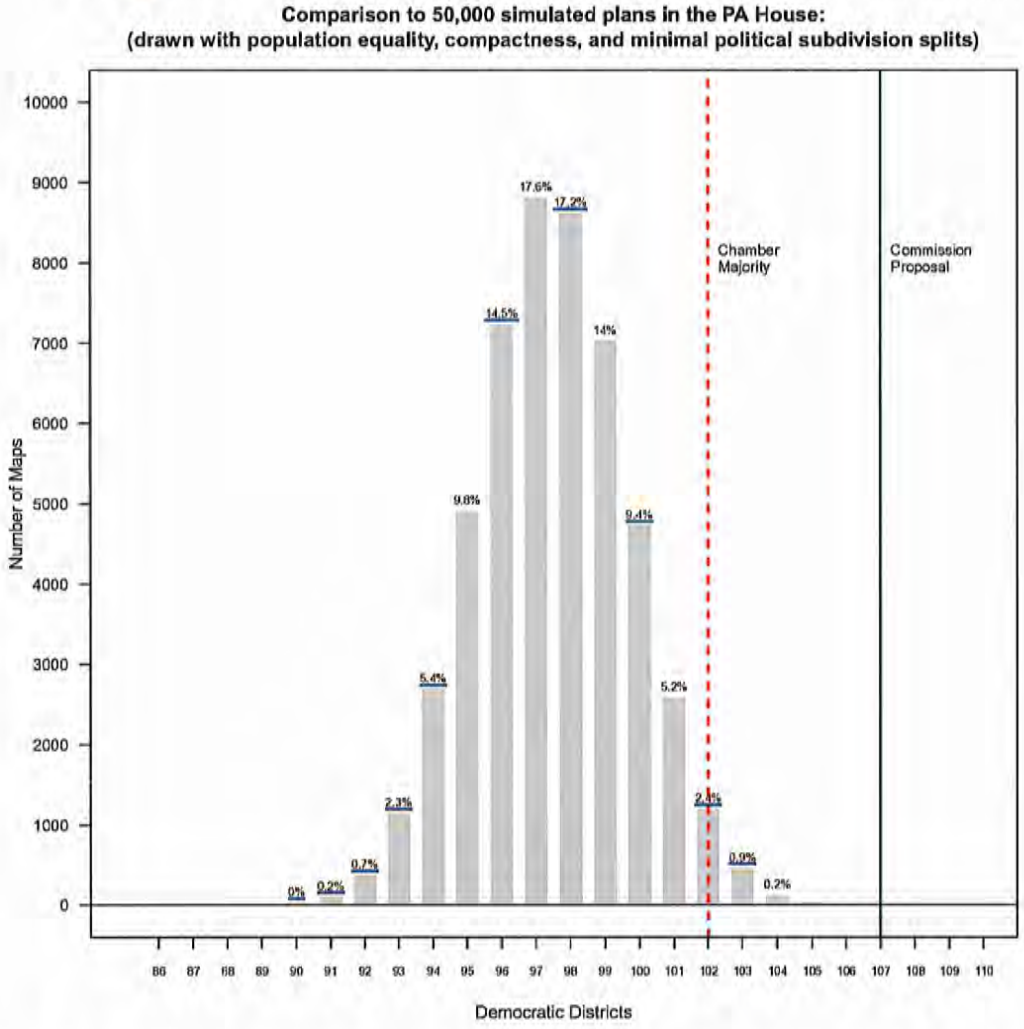
3.3 Partisanship

Figure 3 displays the distribution of Democratic leaning districts in both the simulations and the Commission's proposal using the partisan index discussed above. For reference the red dashed line in the plot is at 102, the number of seats needed for a majority in the Pennsylvania House of Representatives. The green line shows the results of calculating the partisan index for the Commission proposal. The Commission proposal generates 107 Democratic leaning districts (districts with a partisan index greater than 0.50), which is 10 seats larger than the most common outcome generated by the simulations, 97. The numbers above each bar in the histogram display the relative frequency of each outcome in the simulations. Beginning from the far left side of the figure and adding those numbers up as one moves to the right, we would find that the Commission's plan generates more Democratic leaning districts than 99.998% of the simulations.

Recall that in using the simulations we are comparing the Commission's proposed map to a set of maps drawn by the computer using only those criteria that I instructed the algorithm to follow - namely the pre-specified nonpartisan criteria of equal population, contiguity, geographic compactness and a preference for fewer county and municipal splits. And yet the degree to which the Commission's proposal diverges from the distribution of simulation results is extreme and represents a significant deviation from a fair outcome. Thus, the significant deviation observed here strongly suggests that the Commission's plan was drawn using some other, or additional criteria. This could, of course, include a motivation for Democratic partisan advantage given the incredibly large deviation between the number of Democratic districts generated by the proposal and the range of Democratic-leaning districts generated by the simulations.

One question raised in the LRC hearings was whether the Commission's proposed map is a partisan outlier compared to the simulations due to the presence (or absence) of a particular number of majority-minority districts. Dr. Imai testified that when we restrict the simulation algorithm to generate a certain number of majority minority districts that

Figure 3: **Partisan Composition of Commission Proposal and Simulations**



Note: The grey distribution is the number of Democratic districts generated from the 50,000 simulations. The vertical green line is the number of Democratic leaning districts in the Commission's proposal. The Commission's proposal generates more Democratic leaning districts than 99.998% of the simulations. The red dashed line is placed at 102, the number of seats needed for majority control in the Pennsylvania House of Representatives. The partisan lean of districts in the simulations and the Commission proposal are calculated as the two-party vote share of statewide partisan elections from 2012-2020.

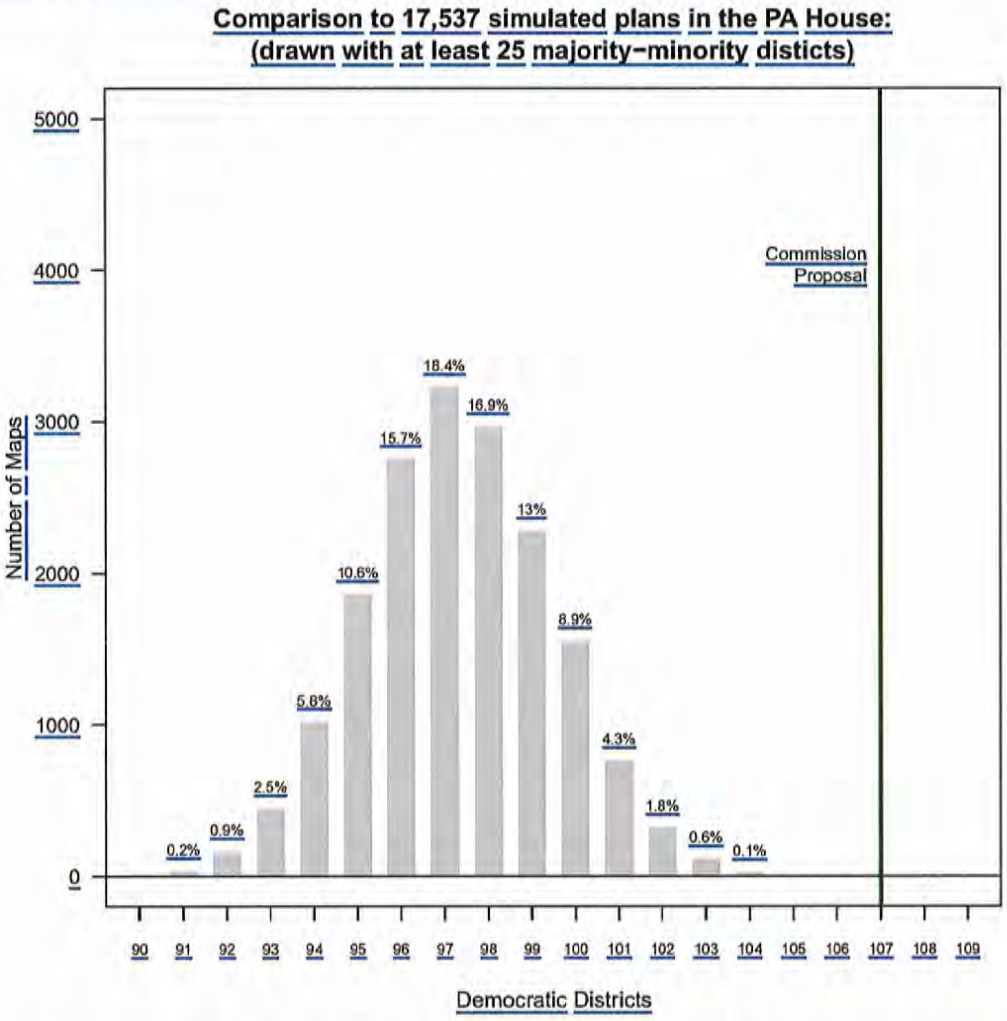
the simulations and the Commission's proposal become much more closely aligned. We can test this in my simulations by limiting the 50,000 simulations to only those that produce at least as many majority-minority districts as the Commission's proposal (25) and compare

this new distribution with the Commission's proposal in terms of the number of Democratic-leaning districts generated. Of the 50,000 simulations, there are 17,537 that contain at least 25 majority-minority districts, which is the same as the number created in the commission's proposal.

Figure 4 shows the partisan results of the simulations among this "race filtered" set of simulations. We see that the distribution of partisanship does not shift dramatically from the original set of 50,000 simulations, and the commission's proposal remains a partisan outlier. Thus, the results presented by Dr. Imai suggest that some other factor is causing the shift between the simulations and the commission's proposal aside from the constraint to contain a certain number of majority-minority districts.[6] These results also show that it is entirely possible to create a large number of majority-minority districts without also creating a plan that is systematically tilted towards benefiting the Democratic Party.

[6]Given the lack of detailed information about Professor Imai's simulation analysis in his report, I am unable to identify the precise reasons for this difference between my and Professor Imai's race-conscious simulation analyses. Additional factors could include the fact that Dr. Imai's simulations are much less geographically compact than my simulations (see Table 1 of this report and Figures A7-8 of Dr. Imai's written testimony at the LRC hearing). Dr. Imai's simulations also contain many more municipal splits than the Commission proposal or my simulations (see Table 1 of this report and Figures A9-11 of Dr. Imai's written testimony at the LRC hearing.)

Figure 4: **Partisan Composition of Simulations Containing at Least 25 Majority-Minority Districts**



Note: The grey distribution is the number of Democratic seats generated from the 17,537 simulations that contained at least 25 majority-minority districts. The vertical green line is the number of Democratic leaning seats in the Commission's proposal. Even after considering the racial composition of districts, the Commission's proposal remains a statistical outlier. The partisan lean of districts in the simulations and the Commission proposal are calculated as the two-party vote share of statewide partisan elections from 2012-2020.

4 Political Geography of Pennsylvania

Where are the discrepancies in partisanship arising? Given the geographic distribution of voters in Pennsylvania and the clustering of Democrats within the large and medium-sized cities of the state, there are only relatively few locations in which Democratic districts can be constructed.

Scholarship in political science has noted that the spatial distribution of voters throughout a state can have an impact on the partisan outcomes of elections when a state is, by necessity, divided into a number of legislative districts. This is largely the case because Democratic-leaning voters tend to cluster in dense, urban areas while Republican-leaning voters tend to be more equally distributed across the remainder of the state.[7] One prominent study of the topic (Chen and Rodden, 2013) finds that "Democrats are highly clustered in dense central city areas, while Republicans are scattered more evenly through the suburban, exurban, and rural periphery...Precincts in which Democrats typically form majorities tend to be more homogenous and extreme than Republican-leaning precincts. When these Democratic precincts are combined with neighboring precincts to form legislative districts, the nearest neighbors of extremely Democratic precincts are more likely to be similarly extreme than is true for Republican precincts. As a result, when districting plans are completed, Democrats tend to be inefficiently packed into homogenous districts."[8]

Rodden (2019) further discusses this with specific reference to Pennsylvania.[9] He

[7]See for example Stephanopoulos, N. O. and McGhee, E. M., Partisan Gerrymandering and the Efficiency Gap, *The University of Chicago Law Review* 82: 831-900, (2015); Chen, J. and Rodden, J., Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures, *Quarterly Journal of Political Science* 8: 239-269, (2013); Nall, C., The Political Consequences of Spatial Policies: How Interstate Highways Facilitated Geographic Polarization, *Journal of Politics*, 77(2): 394-406, (2015); Gimple, J. and Hui, I., . Seeking politically compatible neighbors? The role of neighborhood partisan composition in residential sorting, *Political Geography* 48: 130-142 (2015); Bishop, B., *The Big Sort: Why the Clustering of Like-Minded America is Tearing Us Apart*, Houghton Mifflin Press (2008); and Jacobson, G. C., and Carson, J. L., *The Politics of Congressional Elections*, 9th ed. Lanham, MD: Rowman and Littlefield (2016).

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

[9]Rodden, Jonathan A. Why cities lose: The deep roots of the urban-rural political divide. Hachette UK, 2019.. While Rodden is specifically discussing Pennsylvania in this quote, the statement is true of any location with Democrats clustered in urban areas.

states:

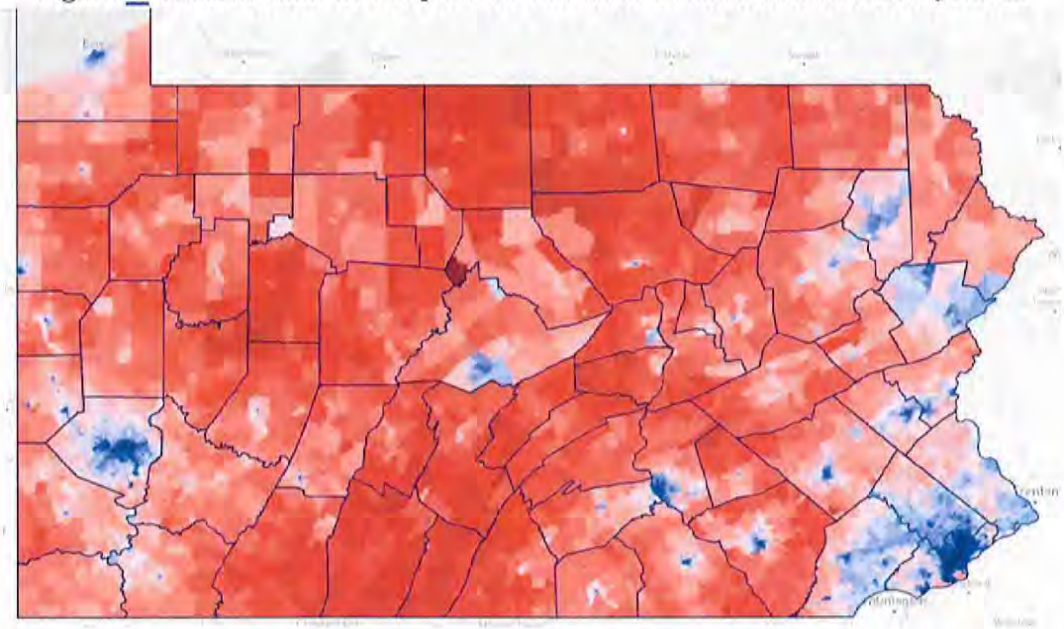
> Then and now, the Democrats have been plagued by a problem with geography. In the years following the New Deal, their supporters became concentrated in the core urban neighborhoods of Pennsylvania's nineteenth-century industrial cities and along the surrounding railroad tracks. They remain so today....Because of the scale and geographic arrangement of Pennsylvania's nineteenth-century cities, the Democrats' problem is severe when districts are very small—as in the state house of representatives—and even worse when they are medium-sized, as in the state senate.

The map below confirms that this is the case in Pennsylvania. We see large Democratic majorities shown in blue in and around Philadelphia and Pittsburgh as well as small pockets of densely populated Democratic voters in the other medium-sized industrial cities of the state. These areas are surrounded by large swaths of the state that are solidly Republican.

The upshot of this pattern is that political parties stand at a disadvantage when their voters are not "efficiently" distributed across the state. To understand what I mean by efficient, imagine two different scenarios. First, imagine a party with a slim majority of voters statewide in which every precinct's vote share perfectly reflected the overall state. In other words, the party has a slight majority in every precinct that adds up to a slight majority statewide. In this case, this party's voters are extremely efficiently distributed in such a way that the party will win every single district despite only a slim majority statewide. Now imagine a different arrangement, a party who still holds a slim majority statewide, but whose voters are heavily concentrated in a few areas and sparsely populated throughout the rest of the state. In this case, despite holding a majority of votes statewide, the party will only win a few seats where their voters are heavily concentrated. The political geography of Pennsylvania closely resembles the second scenario.

The geographic concentration of a party's voters tends to harm that party when single-member districts are drawn by creating districts that favor that party by very large

Figure 5: **Distribution of People and Partisan Preferences in Pennsylvania**



Note: Distribution of Partisan Preferences in Pennsylvania based on the average of statewide partisan elections. Blue = Democratic, Red = Republican

majorities, thus "wasting" many votes in running up large majorities far beyond 50%+1.[10] This occurs in Pennsylvania in the large and medium-sized cities of the state. These overwhelming margins for the party are what drives "wasted votes," which, in turn translate to fewer seats than the statewide proportion of the vote would suggest.[11]

Another way to consider this is to look at a lower level of geography, electoral precincts. Figure 6 shows the distribution of partisan preferences for recent statewide partisan elections for all precincts in Pennsylvania. The top panel notes precincts where there are strong majorities for either party and labels them as "inefficient" precincts (those precincts towards the outer edges of the figure). They are inefficient based on the discussion above

[10] McGhee, E. (2017). Measuring Efficiency in Redistricting. Election Law Journal: Rules, Politics, and Policy, 16(4), 417–442. doi:10.1089/elj.2017.0453

[11] The term "wasted votes" in political science is not to imply that a person's vote is not important or counted, but rather that the vote is less helpful in gaining an additional seat for their preferred party if it is an additional vote in favor of a candidate that has already won a substantial majority of the votes in their district. Technically, all votes beyond 50%+1 would be, as a result, "wasted". However, parties are interested in winning by majorities larger than 50%+1, but not by margins much beyond that point at which their candidate is all but assured to win.

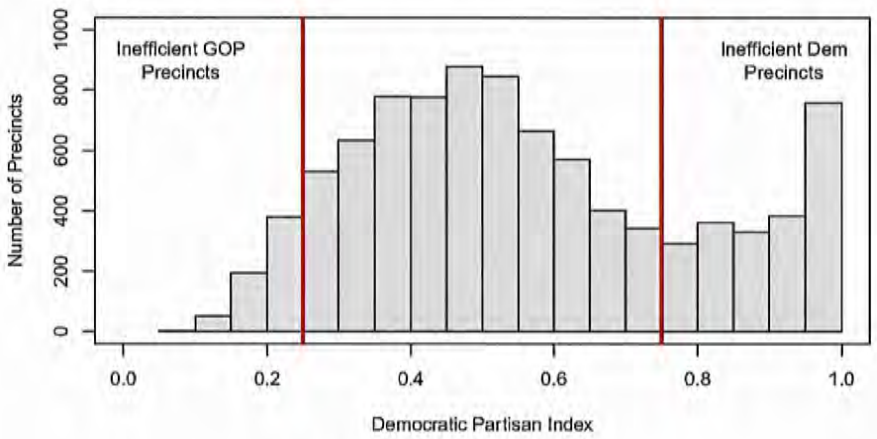
that a party wastes votes if it builds majorities far beyond the needed 50%+1. Note that the distribution is not symmetric and that there are many more precincts with very large Democratic majorities than there are precincts with equally large Republican majorities. The lower panel shows the same distribution but labels "efficient" precincts — those where a party has a majority, but not an overwhelming majority. Note here that there are many more precincts with efficient Republican majorities than there are precincts with efficient Democratic majorities.

This inefficient distribution of votes would not be a problem for Democrats if district boundaries were able to amble about the state and divide municipalities so as to create districts that had less overwhelming Democratic support. Rodden (2019) notes this by saying: "Democrats would need a redistricting process that intentionally carved up large cities like pizza slices or spokes of a wheel, so as to combine some very Democratic urban neighborhoods with some Republican exurbs in an effort to spread Democrats more efficiently across districts" (pg. 155).[12] However, the laws governing redistricting in Pennsylvania run counter to either of these strategies. Pennsylvania's redistricting rules that require districts to be geographically compact and to avoid county and municipal divisions prohibit the type of meandering districts that Rodden describes above. In the end, this means that Republicans begin the redistricting process with a natural geographic advantage due to the combination of laws requiring where and how districts are drawn combined with the particular spatial distribution of their voters.

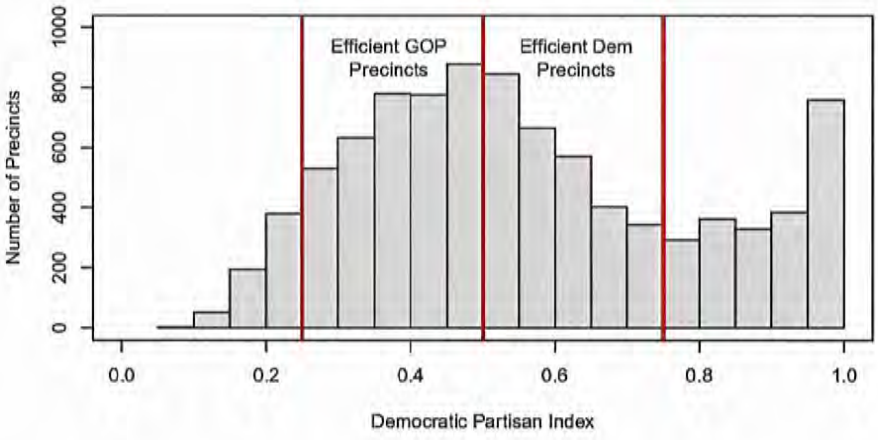
[12]Rodden, Jonathan A. Why cities lose: The deep roots of the urban-rural political divide. Hachette UK, 2019.

Figure 6: **Distribution of Votes Across Precincts in Pennsylvania**

(a) Inefficient precincts



(b) Efficient Precincts



Note: Partisan Index based on the average of statewide partisan races between 2012-2020.

5 Looking at Subsets of Pennsylvania

Given the discussion above, it is instructive to look at locations in the state that have urban clusters of Democratic voters. If the Commission's proposal is attempting to enact a Democratic gerrymander, we should see evidence of what Rodden (2019) discusses above, i.e. the intentional division of Democratic cities that are used to spread Democratic voters out more efficiently to overwhelm Republican votes in the adjacent suburbs and exurbs in order to create more Democratic districts than would otherwise be produced by keeping these municipalities whole.

To do this I focus on a number of counties (or groups of counties) in the state that contain large and medium-sized cities and compare the partisan outcomes in the Commission's proposed plan to the plans generated by the simulations. The table below summarizes these results. Looking at the table shows that the differences we observed between the simulations and the Commission's proposal are due to a systematic overrepresentation of Democrats in these counties with urban cores. Across the 7 groups of counties considered here, in 3 of the 7 cases the Commission's proposal generates one additional Democratic district than the most common outcome in the simulations, and in two regions the Commission's proposal generates 2 more Democratic seats than the most common outcome in the simulations. These deviations add up across the urban areas of the state to a collective deviation of seven seats, which accounts for a significant portion of the difference between the Commission's proposal and the most common outcome in the distribution of Democratic seats generated by the simulations statewide.

How does the Commission's proposed map generate an extra Democratic leaning seat in most of these counties considered in the table above? In the analysis below I show that the Commission's proposal follows exactly the strategy discussed by Rodden (2019) for how the Democratic party would have to work to overcome the disadvantage they face due to the geographic concentration of their voters. Recall the strategy he outlines, "Democrats would need a redistricting process that intentionally carved up large cities like pizza slices or

Table 2: County-by-County Analysis of Commission Proposal and 50,000 Simulations

	Number of Democratic Leaning Districts		
County:	Commission Proposal	Simulations Modal Outcome	% of Simulations Generating Fewer Democratic Seats Than Commission's Map
Philadelphia	25	25	0%
Allegheny	16	16	25.0%
Lehigh and Bucks	11	9	99.8%
Schuylkill, Berks, Lancaster, and Lebanon	5	4	80.8%
Dauphin, and Cumberland	3	2	76.4%
Susquehanna, Lackawanna, and Luzerne	12	10	97.7%
Centre and Clinton	2	1	71.7%

spokes of a wheel, so as to combine some very Democratic urban neighborhoods with some Republican exurbs in an effort to spread Democrats more efficiently across districts" (pg. 155).[13] This is exactly what the Commission's proposed plan does. In many of the largest cities in these counties the Commission unnecessary divides these cities when the population of these cities would not otherwise require them to be divided. The following section proceeds through each of these counties and shows the results of the simulations in the districts in these counties and compares them to the Commission's proposed districts in these counties. I then present maps of the Commission's map's district boundaries in these counties and show how in each case a heavily Democratic city is divided into more districts than its population would otherwise necessitate in order to more efficiently distribute Democratic voters across more districts and produce more districts with Democratic majorities. Furthermore, this is often accomplished by dividing cities that contain substantial minority populations. As a result, many of the districts created using this strategy crack minority populations and dilute their influence in the resulting districts.

[13]Rodden, Jonathan A. Why cities lose: The deep roots of the urban-rural political divide. Hachette UK, 2019.. While Rodden is specifically discussing Pennsylvania in this quote, the statement is true of any location with Democrats clustered in urban areas.

5.1 Lehigh and Bucks Counties

The combined population of Lehigh and Bucks counties is equal to approximately 16 legislative districts. In the 16 districts that cover this area, the Commission's proposal generates 11 Democratic leaning districts. The distribution of Democratic leaning districts based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 7. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the counties shown below each bar. The most common outcome in the simulations is 9 Democratic districts. The red vertical line at 11 represents the number of Democratic leaning seats in the Commission's map in the portion of the state. In 99.8% of the simulations there are fewer than 11 Democratic leaning districts in these counties. In less than 1% of the simulations are there 11 Democratic leaning districts in these counties, as is the case in the Commission's proposed map.

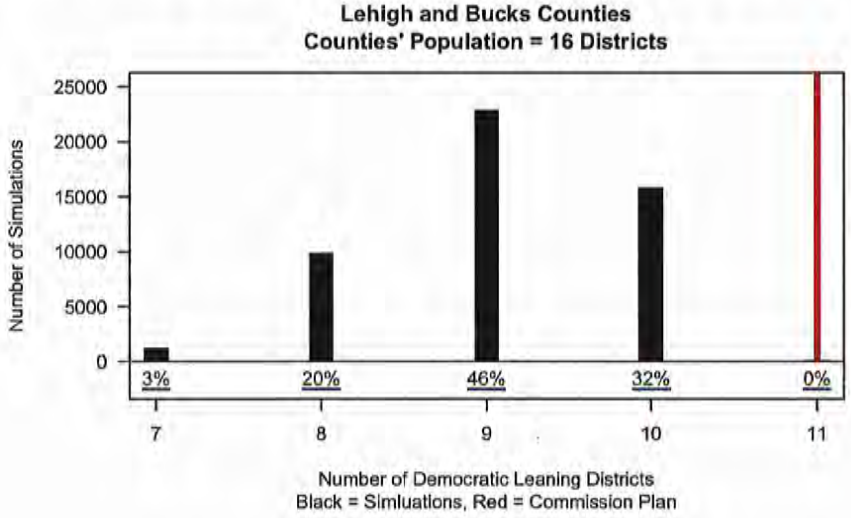
The Commission's plan achieves this by dividing the city of Allentown in Lehigh County more than is necessary so as to more evenly distribute the Democratic voters that live in the city across more districts. Allentown is heavily Democratic and has a population of 126,364, which when divided by the target district size of 64,053 comes to approximately 1.97 districts. Thus, Allentown is too large to be completely contained in one district and will need to be divided into two districts. However, the Commission's plan divides the city into three districts. Figure 8 below shows this using two maps. The top panel shows a map of the Commission's proposed district boundaries in Lehigh County where Allentown is located. The bottom panel focuses exclusively on the city of Allentown and shows how the city is split into three different districts.

The next set of maps shows how this division follows the gerrymandering strategy of dividing Democratic cities into "pinwheel" shapes where Democratic voters in the city can be combined with less Democratic areas outside of the city to make more Democratic districts with comfortable margins, but not the overwhelmingly Democratic margins that would occur

if fewer districts were drawn that were more geographically compact and split the city fewer times. In some cases this approach also has the effect of dividing minority communities that live in these cities and diluting their influence by distributing them across multiple legislative districts. Figure 9 shows a map of each of the three districts that intersect Allentown (HD-22, HD-134, HD-132). Each district is colored based on the partisan lean of the precincts in the district. The pattern we see, particularly in Districts 134 and 132, is exactly what I described earlier — the combination of heavily Democratic precincts in the center of the city with more Republican leaning precincts in the suburbs of the city. While Allentown itself is heavily Democratic (its partisan index based on the 2012-2020 statewide elections is 0.72), the inclusion of the more Republican leaning suburbs distributes Democrats more efficiently to create three Democratic leaning districts, two of which (HD-134 and HD-132) have less Democratic support, but are still comfortably Democratic.

The final map, Figure 10, shows that this approach also divides the Latino population in the city. As a whole, Allentown has a Hispanic voting age population of 48.9%. While District 22 is majority Latino, Districts 134 and 132 have substantially lower Latino populations (38.4% and 15.1%, respectively) as a result of the districts dividing the city and reaching into more suburban areas with a lower concentration of Latinos.

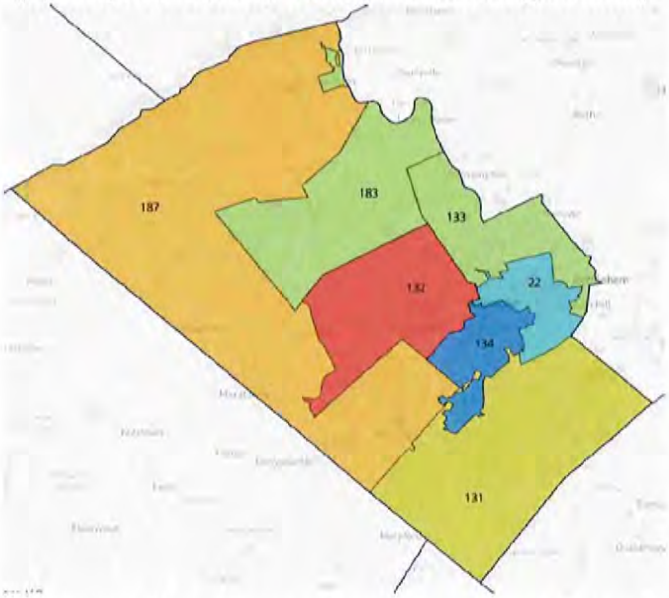
Figure 7: **Distribution of Partisan Districts from Simulations in Lehigh and Bucks Counties**



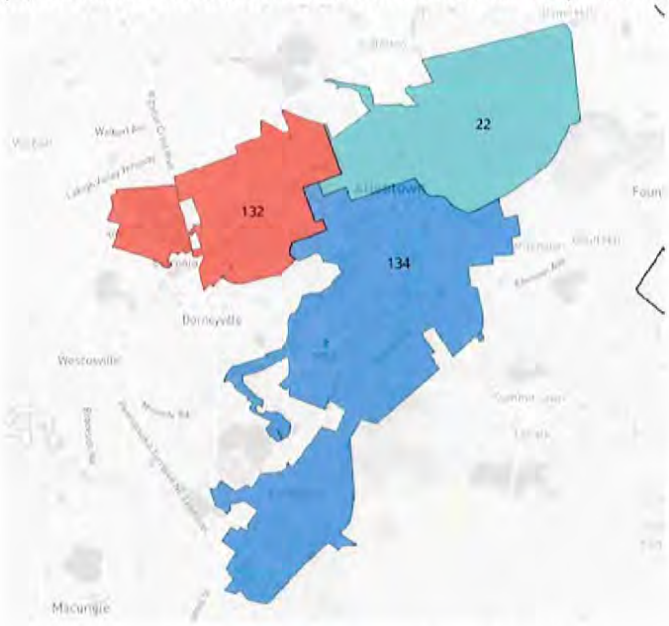
Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Commission's proposed map in the same county.

Figure 8: **Commission Proposed Districts in Lehigh County**

(a) Proposal District Boundaries in Lehigh County

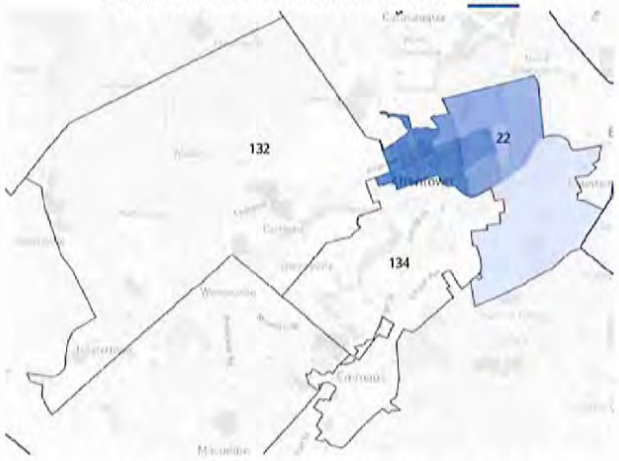


(b) District Boundaries within Allentown City Limits

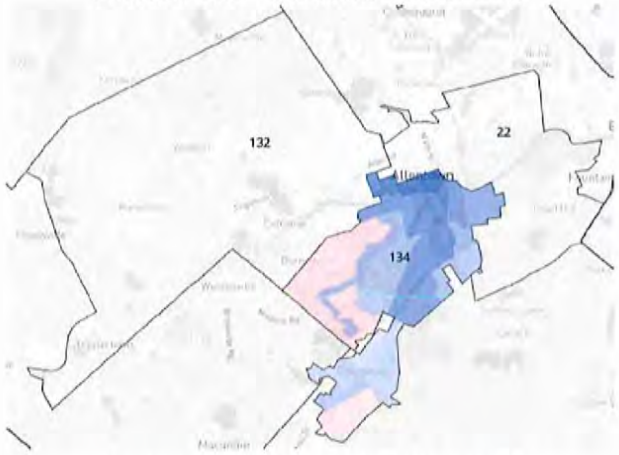


Note: The top figure shows the district boundaries within Lehigh County. The bottom figure shows how the city of Allentown is divided across three districts despite having a population that only requires it to be split into two districts. In each district we see a combination of heavily Democratic urban center with less Democratic suburban areas at the outer edges of the district.

District 22 - Partisan Index: 0.74



District 134 - Partisan Index: 0.63



District 132 - Partisan Index: 0.56

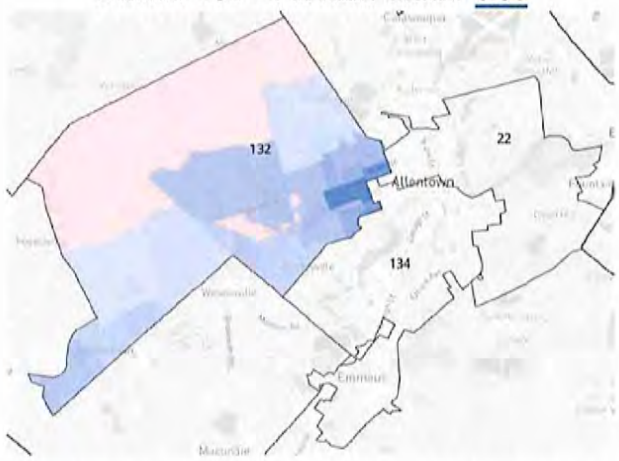
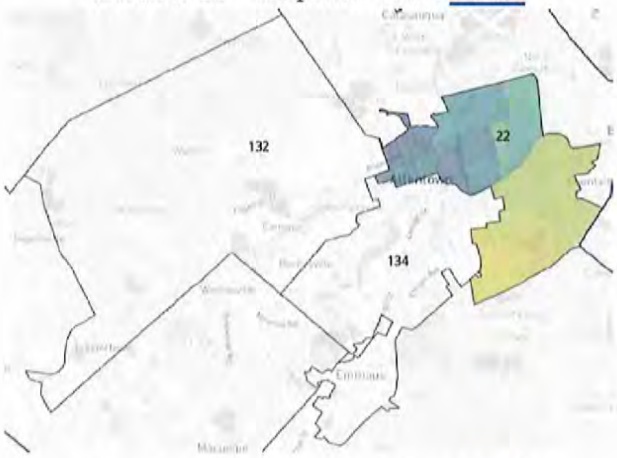
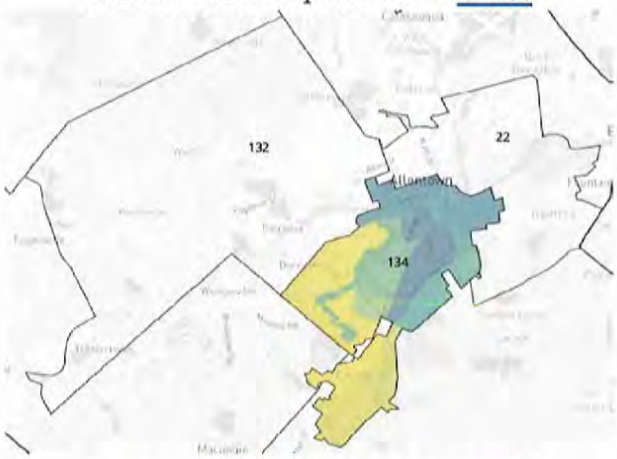


Figure 9: Note: Each panel shows one of the districts that intersect Allentown. The maps are colored according to the partisan composition of precincts in the district.

District 22 - Hispanic VAP: 53.3%



District 134 - Hispanic VAP: 38.4%



District 132 - Hispanic VAP: 15.1%

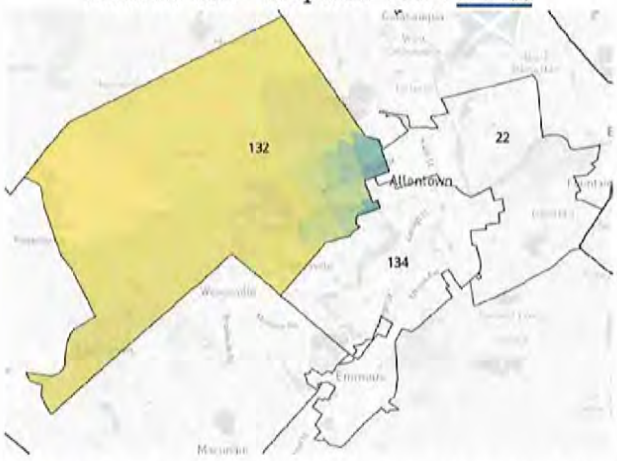


Figure 10: Each panel shows one of the districts that intersect Allentown. The maps are colored according to the Hispanic composition of precincts in the district. Darker shades indicate a greater proportion of Latinos. The city of Allentown has a 48.9% Hispanic voting age population.

5.2 Schuylkill, Berks, Lancaster, and Lebanon Counties

The combined population of Schuylkill, Berks, Lancaster, and Lebanon counties is equal to approximately 20 legislative districts. In the 20 districts that cover this area, the Commission's proposal generates 5 Democratic leaning districts. The distribution of Democratic leaning districts based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 11. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the counties shown below each bar. The most common outcome in the simulations is 4 Democratic districts. The red vertical line at 5 represents the number of Democratic leaning seats in the Commission's map in the portion of the state. In 80.8% of the simulations there are fewer than 5 Democratic leaning districts in these counties. In only 19% of the simulations are there 5 or more Democratic leaning districts in these counties, as is the case in the Commission's proposed map.

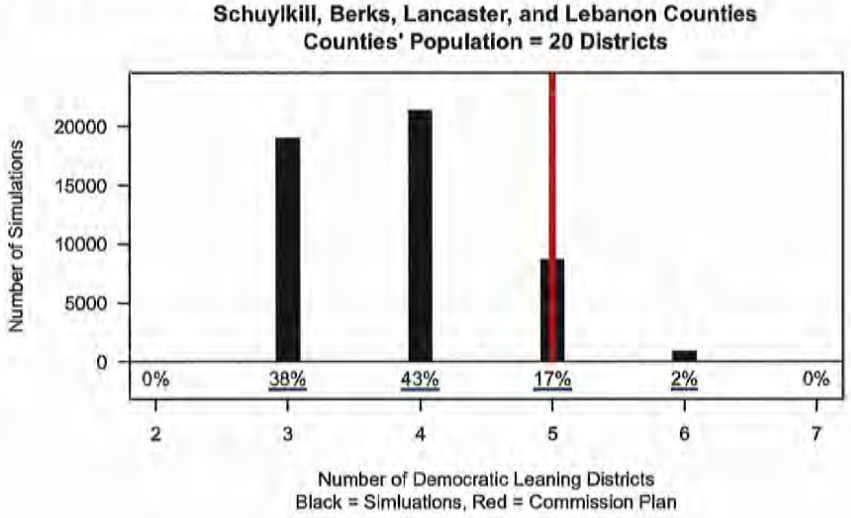
The Commission's plan achieves this by dividing the cities of Lancaster in Lancaster County and Reading in Berks County more than is necessary so as to more evenly distribute the Democratic voters that live in these cities across more districts. Lancaster is heavily Democratic and has a population of 58,431, which when divided by the target district size of 64,053 comes to approximately 0.91 districts. Thus, Lancaster is not larger than the target district population and could be kept whole. However, the Commission's plan divides the city nearly evenly into two districts. Figure 12 below shows this using two maps. The top panel shows a map of the Commission's proposed district boundaries in Lancaster County where the city of Lancaster is located. The bottom panel focuses exclusively on the city of Lancaster and shows how the city is split into two different districts.

The next set of maps shows how this division follows the gerrymandering strategy of dividing heavily Democratic cities and combining them with less Democratic areas outside of the city to make more Democratic districts with comfortable margins, but not the overwhelmingly Democratic margins that would occur if the city were kept whole. In Lancaster

this approach also has the effect of dividing and diluting the influence of the Latino community that lives in the city by distributing them across multiple legislative districts. Figure 13 shows a map of each of the two districts that intersect Lancaster (HD-50, HD-96). Each district is colored based on the partisan lean of the precincts in the district. The pattern we see is familiar — the combination of heavily Democratic precincts in the center of the city with more Republican leaning precincts in the suburbs of the city. While Lancaster itself is heavily Democratic (its partisan index based on the 2012-2020 statewide elections is 0.76), the inclusion of the more Republican leaning suburbs distributes Democrats more efficiently to create two Democratic leaning districts rather than one district that is overwhelmingly Democratic.

The final map, Figure 14, shows that this approach also divides the Latino population in the city. As a whole, Lancaster has a Latino voting age population of 35.9%. Both Districts 96 and 49 have a lower Latino population (12.8% and 34.3%, respectively) as a result of the districts dividing the city and reaching into more suburban areas with a lower concentration of Latinos.

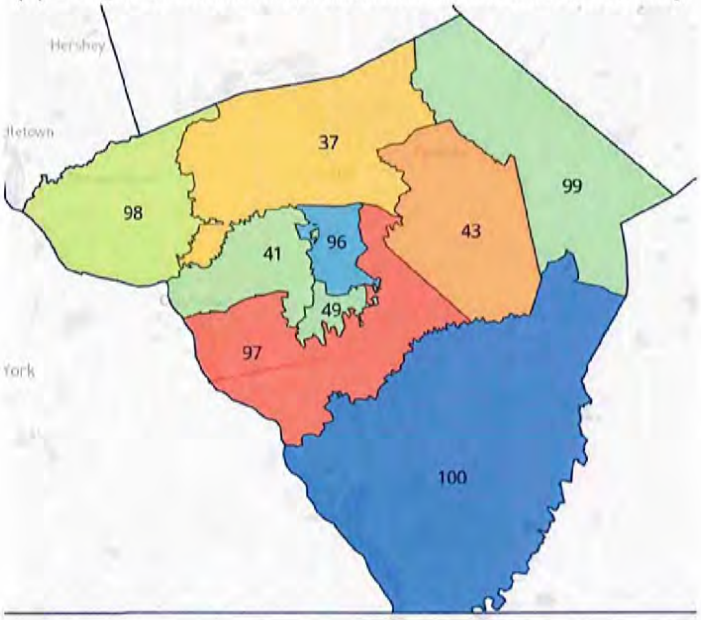
Figure 11: **Distribution of Partisan Districts from Simulations in Schuylkill, Berks, Lancaster, and Lebanon Counties**



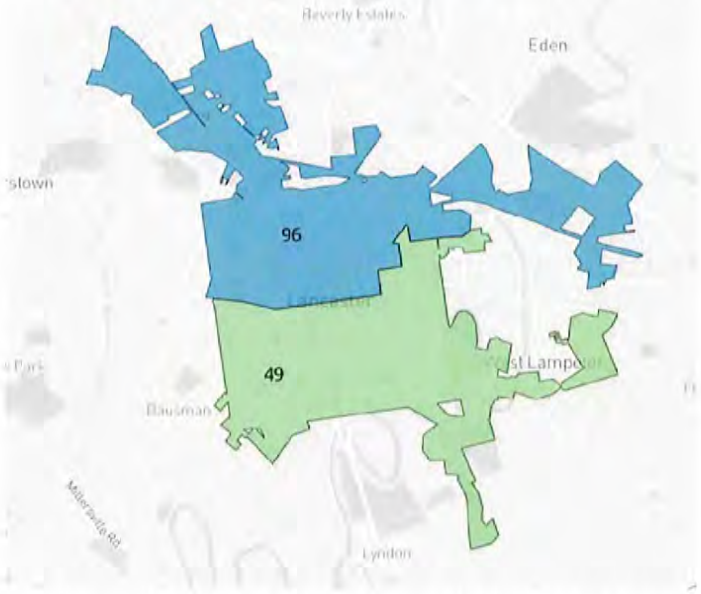
Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Commission's proposed map in the same county.

Figure 12: **Commission Proposed Districts in Lancaster County**

(a) Proposal District Boundaries in Lancaster County

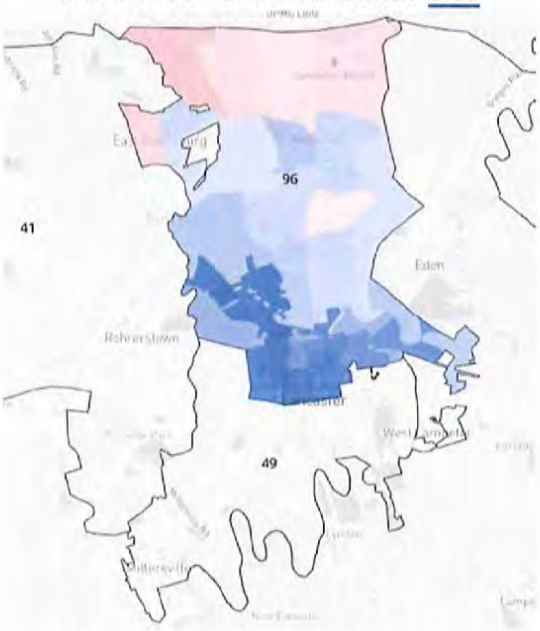


(b) District Boundaries within Lancaster City Limits



Note: The top figure shows the district boundaries within Lancaster County. The bottom figure shows how the city of Lancaster is divided nearly equally across two districts despite having a population that would allow the city to be entirely contained in one district.

District 96 - Partisan Index: 0.57



District 49 - Partisan Index: 0.69

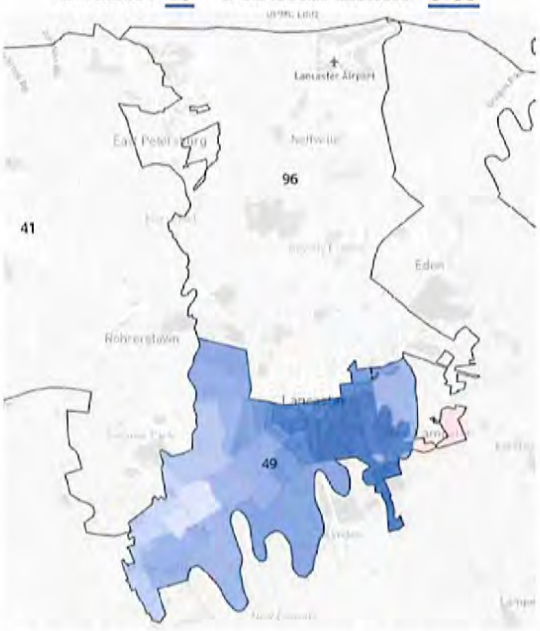
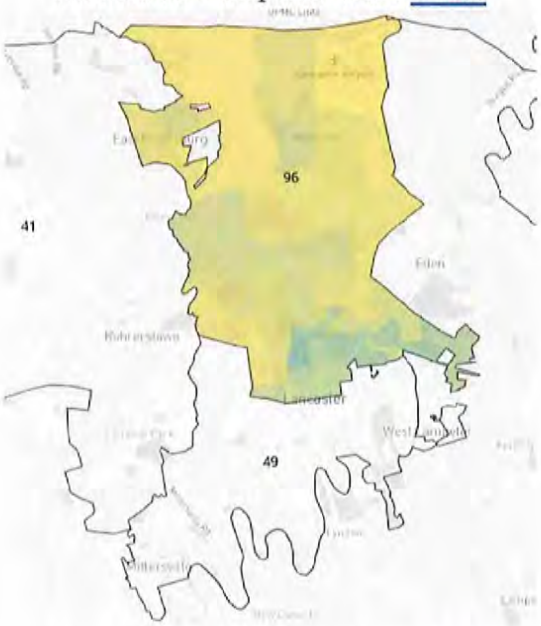


Figure 13: Each panel shows one of the districts that intersect Lancaster. The maps are colored according to the partisan composition of precincts in the district.

District 96 - Hispanic VAP: 12.8%



District 49 - Hispanic VAP: 34.3%

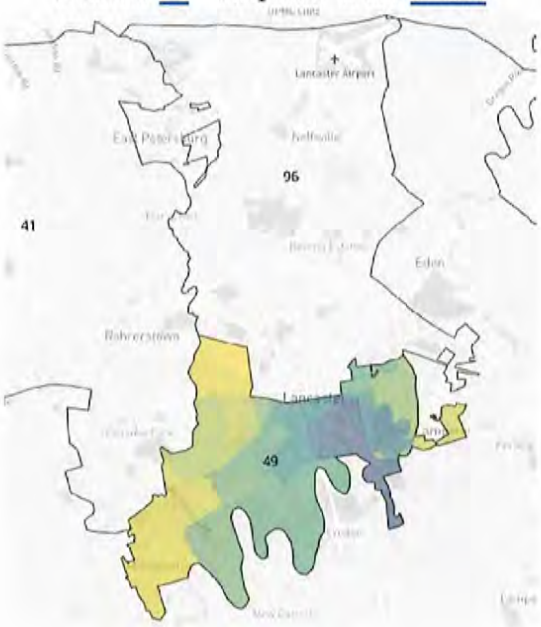


Figure 14: Each panel shows one of the districts that intersect Lancaster. The maps are colored according to the Hispanic composition of precincts in the district. Darker shades indicate a greater proportion of Latinos. The city of Lancaster has a 35.9% Hispanic voting age population.

In Berks County the Commission's plan creates an additional Democratic district by dividing the city of Reading more than is necessary. Reading is heavily Democratic and has a population of 95,719. which when divided by the target district size of 64,053 comes to approximately 1.49 districts. Thus, Reading is too large to be completely contained in one district and will need to be divided into two districts. However, the Commission's plan divides the city four different times into three different districts. Figure 15 below shows this using two maps. The top panel shows a map of the Commission's proposed district boundaries in Berks County where Reading is located. The bottom panel focuses exclusively on the city of Reading and shows how the city is split four times into three different districts.

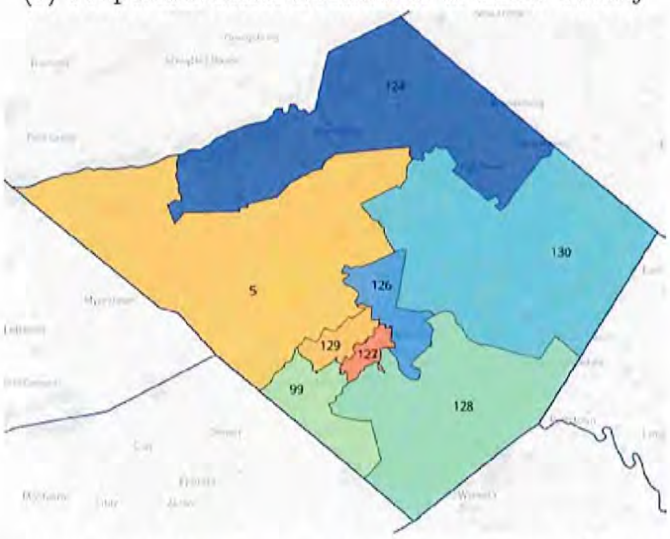
The next set of maps shows how this division follows the gerrymandering strategy of dividing Democratic cities into "pinwheel" shapes where Democratic voters in the city can be combined with less Democratic areas outside of the city to make more Democratic districts with comfortable margins, but not the overwhelmingly Democratic margins that would occur if fewer districts were drawn that were more geographically compact and split the city fewer times. In Reading this approach also has the effect of dividing and diluting the influence of the Latino community that lives in the city by distributing them across multiple legislative districts. Figure 16 shows a map of each of the three districts that intersect Reading (HD-126, HD-127, and HD-129). Each district is colored based on the partisan lean of the precincts in the district. The pattern we see is again repeated — the combination of heavily Democratic precincts in the center of the city with more Republican leaning precincts in the suburbs. While Reading itself is heavily Democratic (its partisan index based on the 2012-2020 statewide elections is 0.79), the inclusion of the more Republican leaning suburbs distributes Democrats more efficiently to create three Democratic leaning districts which all have less Democratic support than the city overall, but are still comfortably Democratic.

The final map, Figure 17, shows that this approach also divides the Latino population in the city. As a whole, Reading has a Latino voting age population of 64.0%. All three Districts that intersect Reading have a lower Latino population (33.2% in HD-126, 34.4%

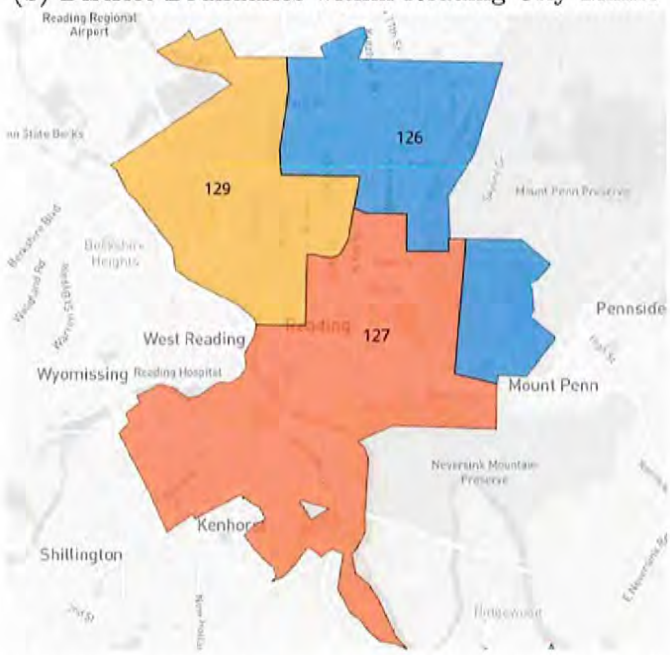
in HD-129, and 52.1% in HD-127) as a result of the districts dividing the city and reaching into more suburban areas with a lower concentration of Latinos.

Figure 15: **Commission Proposed Districts in Berks County**

(a) Proposal District Boundaries in Berks County

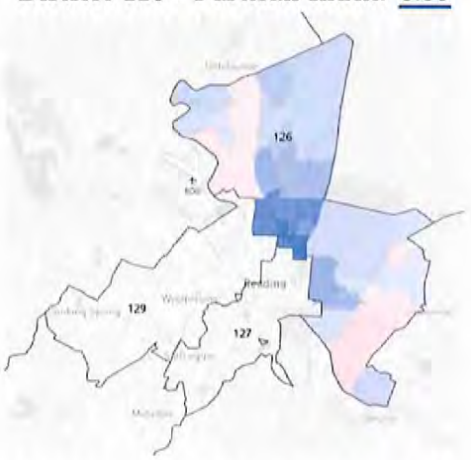


(b) District Boundaries within Reading City Limits

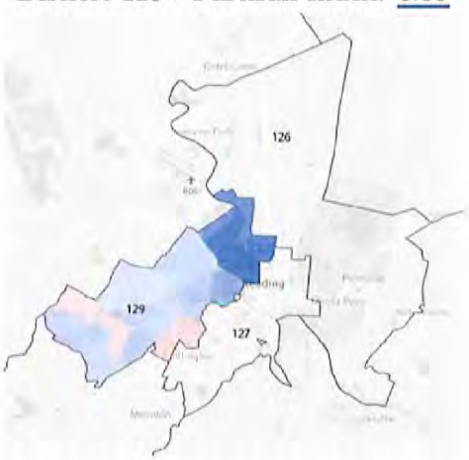


Note: The top figure shows the district boundaries within Berks County. The bottom figure shows how the city of Reading is divided four times into three districts despite having a population that would only require the city to be split into two districts.

District 126 - Partisan Index: 0.59



District 129 - Partisan Index: 0.59



District 127 - Partisan Index: 0.70

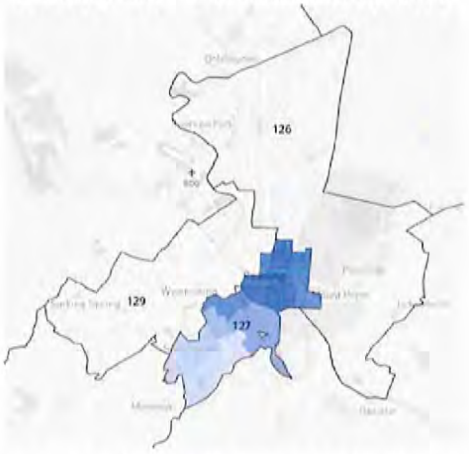
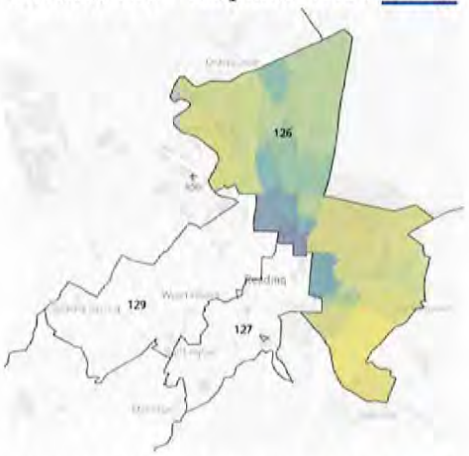


Figure 16: Each panel shows one of the districts that intersect Reading. The maps are colored according to the partisan composition of precincts in the district.

District 126 - Hispanic VAP: 33.2%



District 129 - Hispanic VAP: 34.4%

District 127 - Hispanic VAP: 52.1%

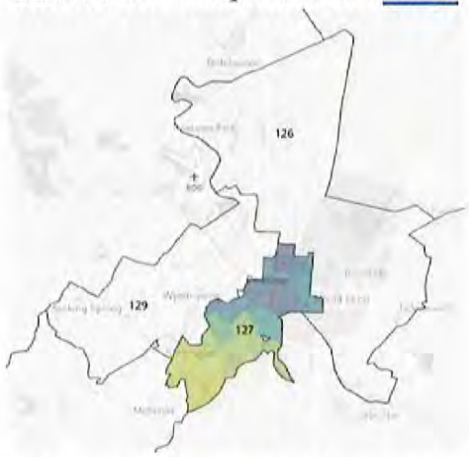


Figure 17: Each panel shows one of the districts that intersect Reading. The maps are colored according to the Hispanic composition of precincts in the district. Darker shades indicate a greater proportion of Latinos. The city of Reading has a 64.0% Hispanic voting age population.

5.3 Dauphin and Cumberland Counties

The combined population of Dauphin and Cumberland counties is equal to approximately 8.5 legislative districts. In the 8 complete districts that cover this area, the Commission's proposal generates 3 Democratic leaning districts. The distribution of Democratic leaning districts based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 18. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the counties shown below each bar. The most common outcome in the simulations is 2 Democratic districts. The red vertical line at 3 represents the number of Democratic leaning seats in the Commission's map in the portion of the state. In 76% of the simulations there are 2 Democratic leaning districts in these counties. There are 3 Democratic leaning districts in only 24% of the simulations in these counties, which is what the Commission's proposed map produces.

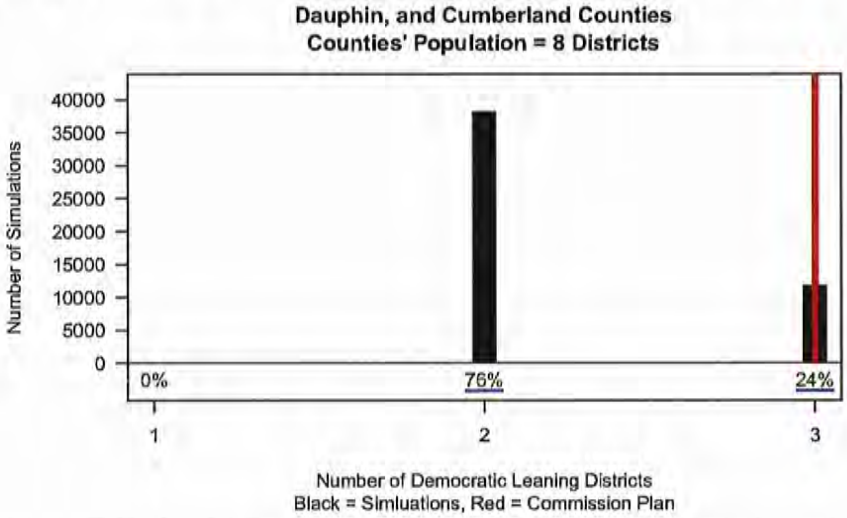
The Commission's plan achieves this by dividing the city of Harrisburg in Dauphin County more than is necessary so as to more evenly distribute the Democratic voters that live in Harrisburg across more districts. Harrisburg is heavily Democratic and has a population of 50,679, which when divided by the target district size of 64,053 comes to approximately 0.79 districts. Thus, Harrisburg is not larger than the target district population and could be kept whole. However, the Commission's plan divides the city into two districts. Figure 19 below shows this using two maps. The top panel shows a map of the Commission's proposed district boundaries in Dauphin County where the city of Harrisburg is located. The bottom panel focuses exclusively on the city of Harrisburg and shows how the city is split into two districts.

The next set of maps shows how this division follows the gerrymandering strategy of dividing Democratic cities into "pinwheel" shapes where Democratic voters in the city can be combined with less Democratic areas outside of the city to make more Democratic districts with comfortable margins, but not the overwhelmingly Democratic margins that

would occur if fewer districts were drawn that were more geographically compact and split the city fewer times. In Harrisburg this approach also has the effect of dividing the Black community that lives in the city and distributes them across multiple legislative districts. Figure 20 shows a map of each of the two districts that intersect Harrisburg (HD-103, HD-104). Each district is colored based on the partisan lean of the precincts in the district. The pattern we see is again repeated — the combination of heavily Democratic precincts in the center of the city with more Republican leaning precincts in the suburbs. While Harrisburg itself is heavily Democratic (its partisan index based on the 2012-2020 statewide elections is 0.86), the inclusion of the more Republican leaning suburbs distributes Democrats more efficiently to create two Democratic leaning districts that have less Democratic support, but are still comfortably Democratic-leaning.

Figure 21 shows that this approach also divides the Black population in the city. As a whole, Harrisburg has a Black voting age population of 41.7%. Both districts that intersect Harrisburg have a lower Black population (19.1% in HD-103, 27.4% in HD-104) as a result of the districts dividing the city and reaching into more suburban areas with a lower Black population.

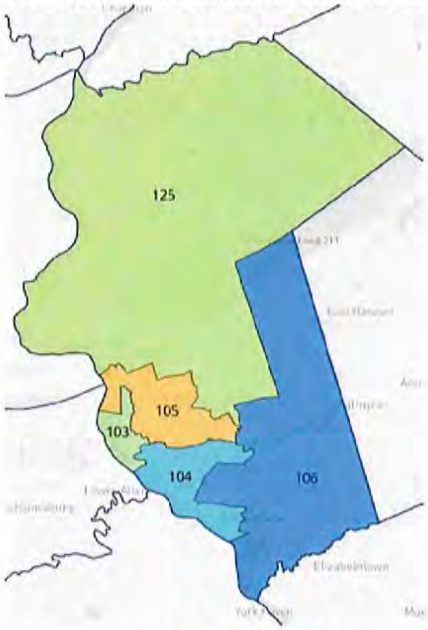
Figure 18: **Distribution of Partisan Districts from Simulations in Dauphin, and Cumberland Counties**



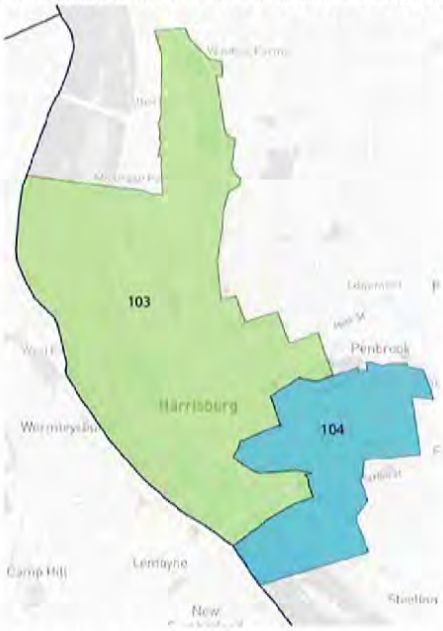
Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Commission's proposed map in the same county.

Figure 19: **Commission Proposed Districts in Dauphin County**

(a) Proposal District Boundaries in Dauphin County



(b) District Boundaries within Harrisburg City Limits



Note: The top figure shows the district boundaries within Dauphin County. The bottom figure shows how the city of Harrisburg is divided across two districts despite having a population that would allow the city to be entirely contained in one district.

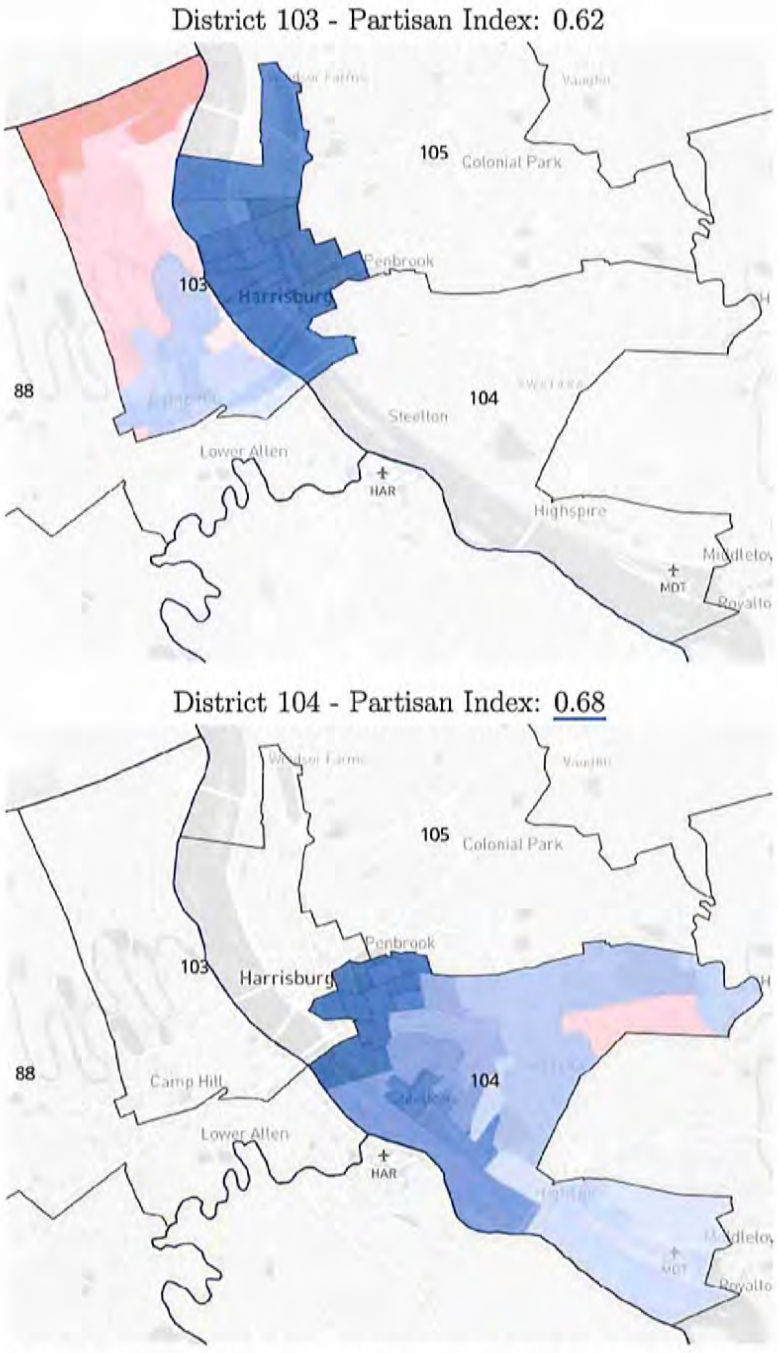
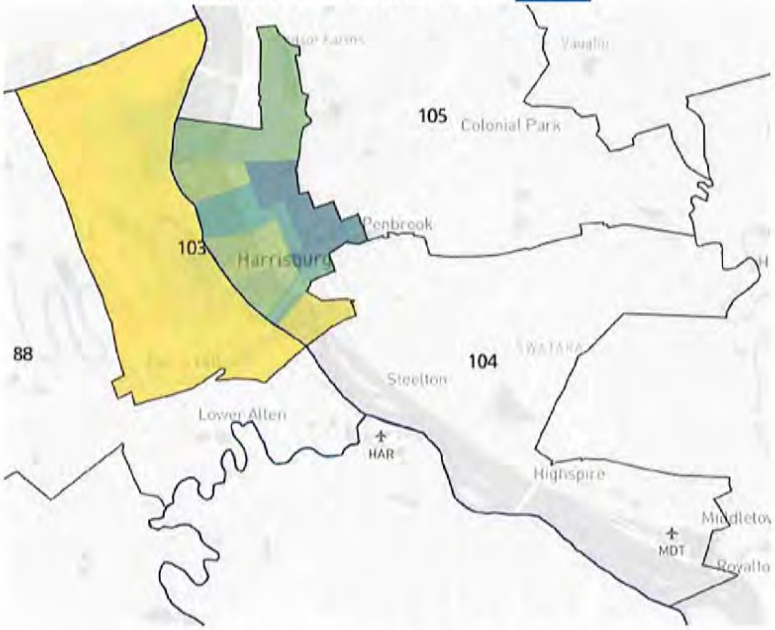


Figure 20: Each panel shows one of the districts that intersect Harrisburg. The maps are colored according to the partisan composition of precincts in the district.

District 103 - Black VAP: 19.1%



District 104 - Black VAP: 27.4%

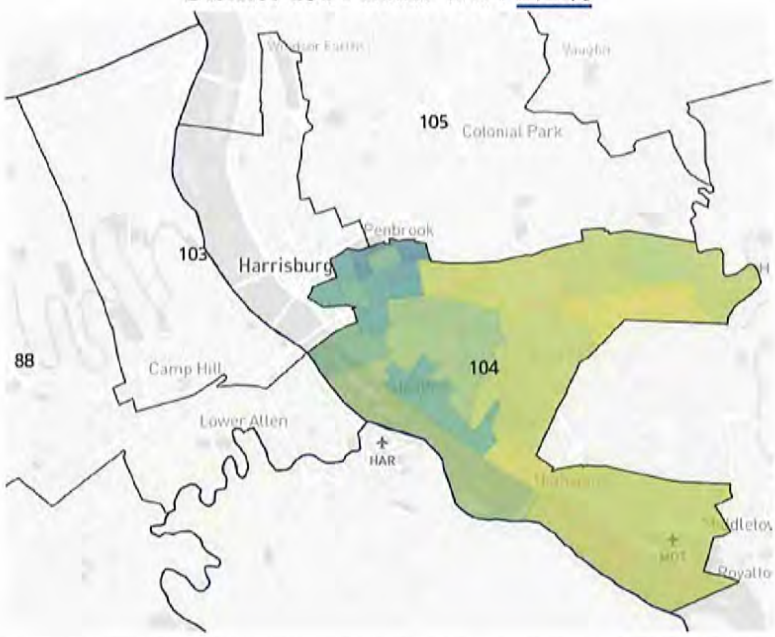


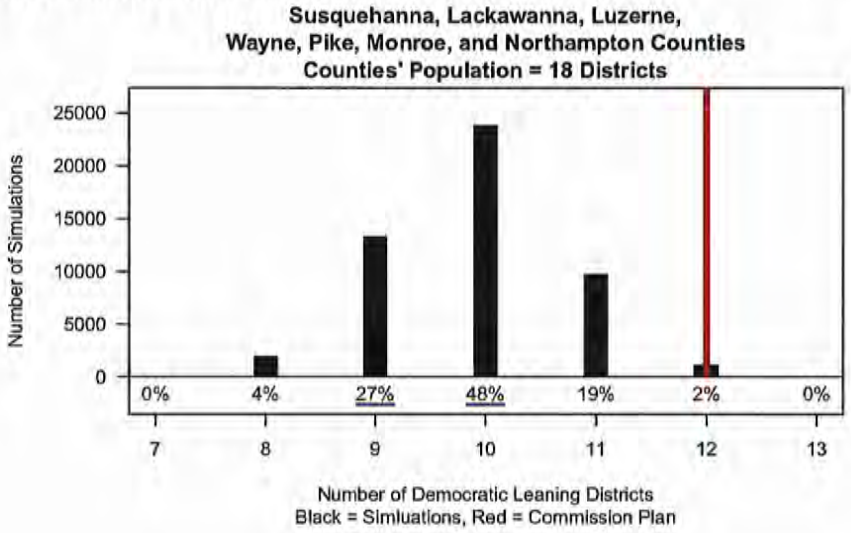
Figure 21: Each panel shows one of the districts that intersect Harrisburg. The maps are colored according to the Black composition of precincts in the district. Darker shades indicate a greater Black population. The city of Harrisburg has a 41.7% Black voting age population.

5.4 Northeastern Counties

In this section I consider Susquehanna, Lackawanna, Luzerne, Wayne, Pike, Monroe, and Northampton counties. These counties are grouped together in the northeastern part of the state, and their combined population is equal to approximately 18 legislative districts. In the 18 complete districts that cover this area, the Commission's proposal generates 12 Democratic leaning districts. The distribution of Democratic leaning districts based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 22. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the counties shown below each bar. The most common outcome in the simulations is 10 Democratic districts. The red vertical line at 12 represents the number of Democratic leaning seats in the Commission's map in the portion of the state. In 98% of the simulations there are 11 or fewer Democratic leaning districts in these counties. In only 2% of the simulations are there 12 Democratic leaning districts in these counties, as is the case in the Commission's proposed map.

In a previous version of the Commission's proposal, the city of Scranton was divided five different times across four different districts. Figure 23 shows a map of each of the four districts that intersected Scranton (HD-112, HD-113, HD-114, HD-118). The bottom panel shows the final proposal. The final proposal shows improvement on this issue and only divides Scranton twice. Scranton is too large to be completely contained in one district and will need to be divided into two districts, so the final Commission proposal contains the minimum division of Scranton necessary. Even with this adjustment, which is an improvement over the previous proposal, the Commission's map generates more Democratic-leaning districts than the simulations in nearly all cases due to the particular way in which cities and townships are grouped together in these counties so as to maximize the distribution of Democratic voters.

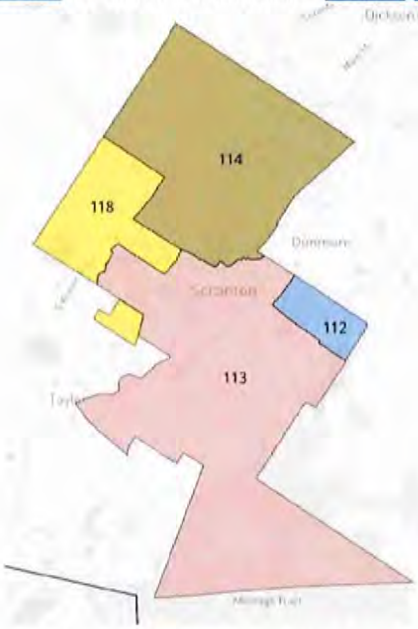
Figure 22: **Distribution of Partisan Districts from Simulations in Susquehanna, Lackawanna, and Luzerne Counties**



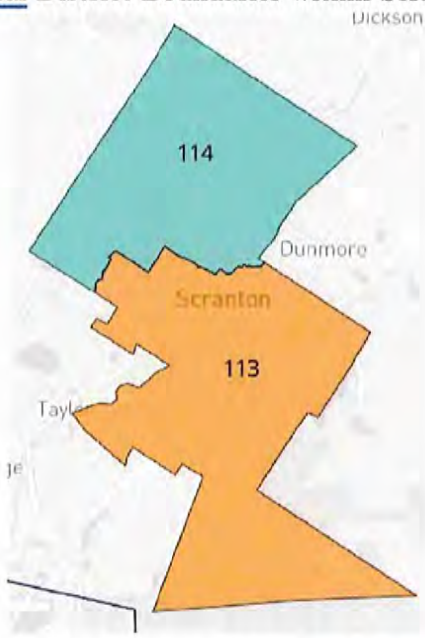
Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Commission's proposed map in the same county.

Figure 23: **Commission Proposed Districts in Scranton**

(a) Previous Proposed District Boundaries within Scranton City Limits



(b) Final Proposal District Boundaries within Scranton City Limits



Note: The top figure shows the district boundaries that intersect Scranton in the previous Commission proposal. The bottom figure shows how the city of Scranton is divided across two districts in the final proposal.

5.5 Centre and Clinton Counties

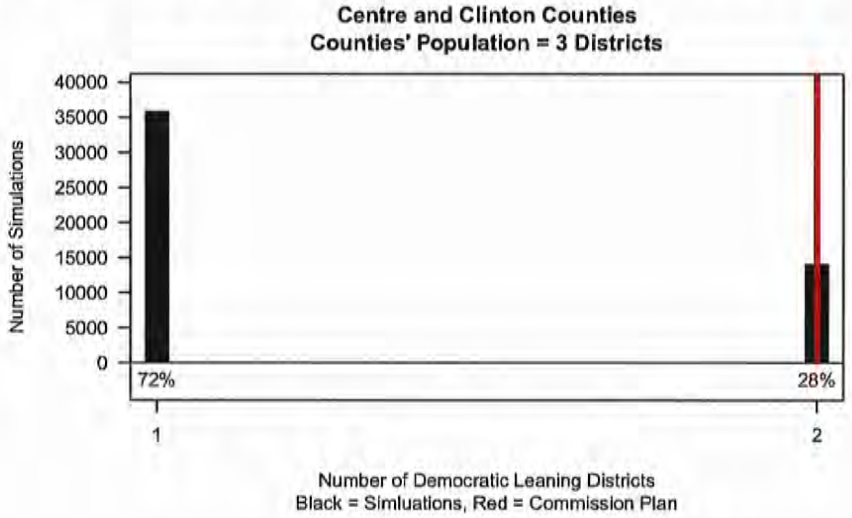
The final area I consider is the middle of the state in Centre and Clinton counties. The combined population of Centre and Clinton counties is equal to approximately 3 legislative districts. In the 2 complete districts that are included in these counties and the 2 additional districts that are partially in these counties, the Commission's proposal generates 2 Democratic leaning districts. The distribution of Democratic leaning districts based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 24. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the counties shown below each bar. The most common outcome in the simulations is 1 Democratic district. The red vertical line at 2 represents the number of Democratic leaning seats in the Commission's map in the portion of the state. The simulations generate 1 Democratic leaning district in these counties 72% of the time. There are 2 Democratic leaning districts in only 28% of the simulations, as is the case in the Commission's proposed map.

The Commission's plan achieves this by dividing the borough of State College in Centre County more than is necessary so as to more evenly distribute the Democratic voters that live in this city across more districts. State College is heavily Democratic and has a population of 40,508, which when divided by the target district size of 64,053 comes to approximately 0.63 districts. Thus, State College is not larger than the target district population and could be kept whole. However, the Commission's plan divides the city nearly equally into two districts. Figure 25 below shows two maps. The top panel shows a map of the Commission's proposed district boundaries in Centre County where the borough of State College is located. The bottom panel focuses exclusively on the city of State College and shows how the city is split into two different districts. The Commission's plan divides the Penn State University campus nearly in half. In fact, students in the southern portion of the Westgate Building, which houses the College of Information Sciences and Technology,

will be in District 77 but if a student were to walk down the hall to the northern portion of the building, they would cross over into District 82 without leaving the building.

The next set of maps shows how this division follows the gerrymandering strategy of dividing Democratic cities into "pinwheel" shapes where Democratic voters in the city can be combined with less Democratic areas outside of the city to make more Democratic districts with comfortable margins, but not the overwhelmingly Democratic margins that would occur if fewer districts were drawn that were more geographically compact and split the city fewer times. Figure 26 shows a map of each of the two districts that intersect State College (HD-77, HD-82). Each district is colored based on the partisan lean of the precincts in the district. The pattern we see is yet again repeated — the combination of heavily Democratic precincts in the center of the city with more Republican leaning precincts in the suburbs. While State College itself is heavily Democratic (its partisan index based on the 2012-2020 statewide elections is 0.70), the inclusion of the more Republican leaning suburbs distributes Democrats more efficiently to create two Democratic leaning districts that have less Democratic support, but are still comfortably Democratic-leaning. State College does not have a large or geographically concentrated minority population to warrant a specific analysis on how the districts in this county divide specific minority groups in the city (the city has a 77.6% White voting age population, 5.5% Hispanic VAP, 2.8% Black VAP, and 9.7% Asian VAP).

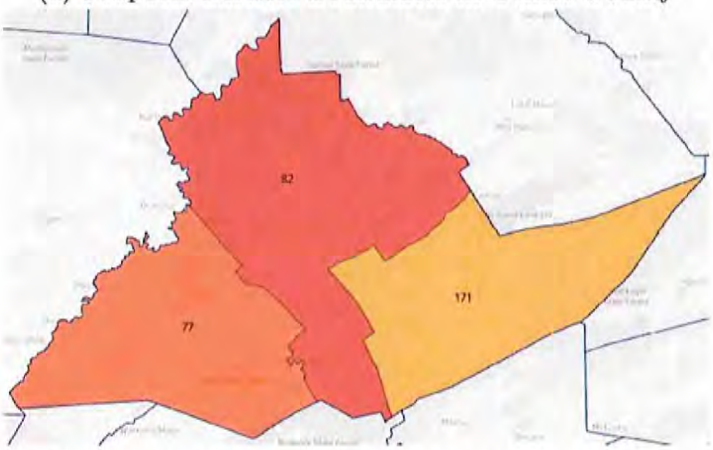
Figure 24: **Distribution of Partisan Districts from Simulations in Centre and Clinton Counties**



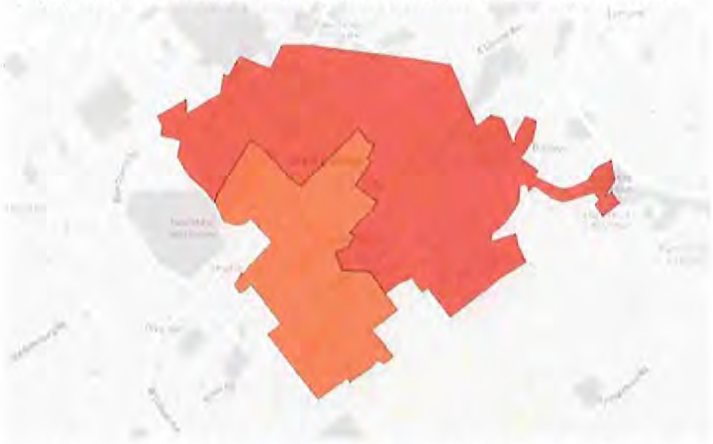
Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Commission's proposed map in the same county.

Figure 25: **Commission Proposed Districts in Centre County**

(a) Proposal District Boundaries in Centre County



(b) District Boundaries within State College Limits



Note: The top figure shows the district boundaries within Centre County. The bottom figure shows how the city of State College is divided across two districts despite having a population that would allow it to be kept entirely within one district.

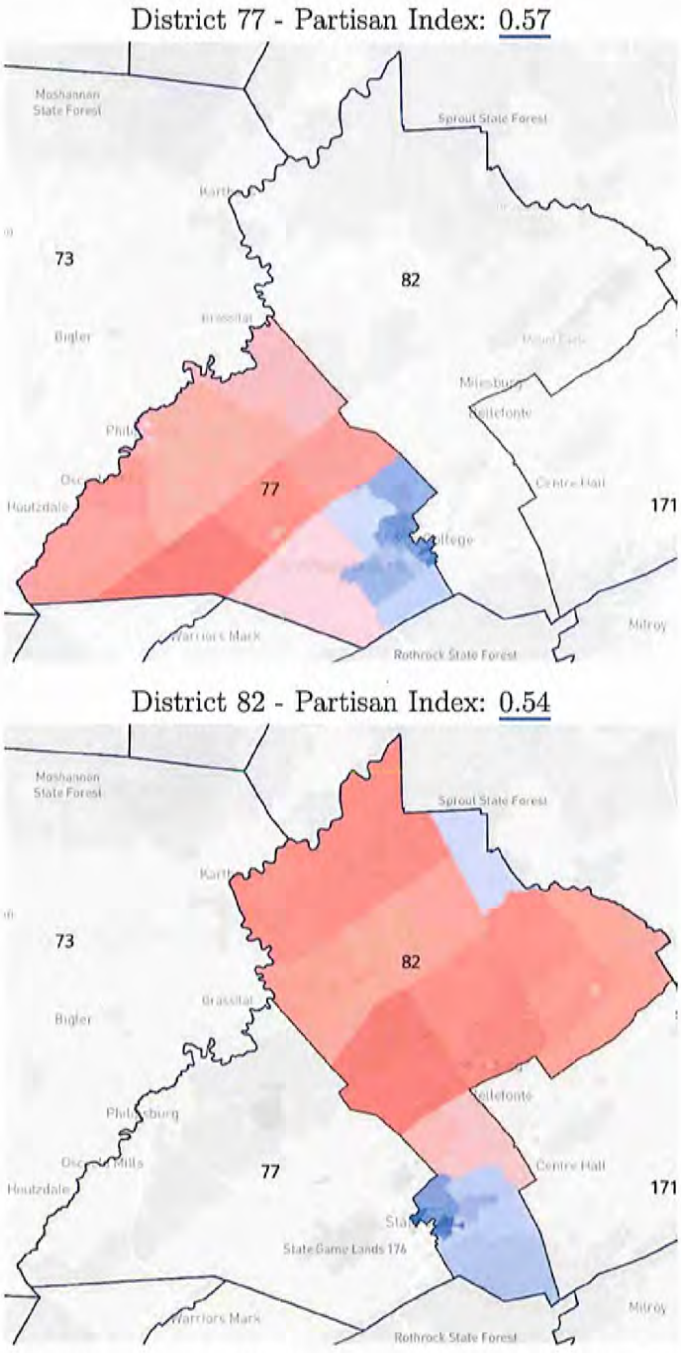


Figure 26: Each panel shows one of the districts that intersect State College. The maps are colored according to the partisan composition of precincts in the district.

6 Comparison to Other District Scoring Programs

To validate the predicted seat shares produced by my analysis, I upload the proposed plan into a commonly used redistricting program - Dave's Redistricting (DRA).[14] This program has been used extensively in redistricting and in redistricting litigation. After uploading the plans, I compare the number of seats the program predicts will lean Democratic to the predictions produced by my analysis. There is perfect agreement when the same elections are used. Table 3 shows the results. In each case I take the proportion of the total two-party vote cast in the elections being included for each district. I then classify each district as a Democratic-leaning district if the Democratic two-party vote share is larger than 0.50.

The DRA uses an index of elections to generate predictions, in a similar way to the indices I described using above. As I noted above, the benefit of an index is that it helps to "wash out" the idiosyncratic features of any particular election, the specific issues in that race, the candidate's qualities (for better or worse), and other factors of the electoral environment. However, the DRA program uses a different combination of elections. The DRA index uses a combination of the 2020 and 2016 presidential elections, the 2018 and 2016 US Senate elections, the 2020 attorney general election, and the 2018 gubernatorial election. When I compute partisan measures that match the DRA index, I get the same results as they do. The DRA index predicts 106 Democratic leaning seats.

Because the choice of elections can have an impact on the predicted seat share for a party, my preferred method is to include all available elections. As discussed above, the main results I present throughout this report use all statewide elections between 2012-2020.[15] I choose 2012 as a starting point because that range incorporates an entire decade, or one decennial census period in which population enumeration and reapportionment take place.

[14] https://davesredistricting.org

[15] I do not include statewide judicial elections in the index. It is uncommon in political science to use judicial elections to measure voters' partisan preferences as research suggests voters treat judicial elections very differently, even when judges run under party labels, than they do partisan elections to legislative and executive positions. Other commonly used measures indices such as Dave's Redistricting and PlanScore.com also omit judicial elections from their partisan indices.

For completeness, I also present the results of the Commission's plan and the distribution of simulations using two alternative indices of statewide elections. First, I recompute an average for all statewide races between 2014-2020 to start after the Holt case in which districts in Pennsylvania were altered as a result of litigation. Finally, I consider an index of statewide elections held in 2020. This measure gives weight to more recent elections and does not include elections from cycles prior to 2020. However, it has the drawback of being heavily influenced by the national political environment of a single election year. Using these indices the Commission's plan contains between 103-107 Democratic leaning districts.

I note that these predictions are independent of the simulations discussed earlier. The predicted seat shares shown below are only a function of different election results and the map put forward by the Legislative Reapportionment Commission. The simulations discussed above provide a comparison of alternative maps that are drawn without consideration of any criteria other than population equality, compactness, and minimizing splits of political subdivisions. They are helpful because they provide a benchmark by which to make an "apples-to-apples" comparison to other districts that are drawn using the same geographic distribution of voters in the state.

Table 3: Comparison of Seat Composition Under Different Elections/Indices

	Commission Plan		% of Simulations Generating Fewer Democratic Seats Than Commission's Map
Election Indices:	Number D Districts	Number R Districts	
DRA index	106	97	
Barber Replication of DRA Index	106	97	
Barber 2012-2020 index	107	96	99.998%
Barber 2014-2020 index	104	99	99.794%
Barber 2020 index	103	100	99.956%

7 Other Measures of Partisan Bias

The written expert testimony submitted by Dr. Warshaw to the LRC computes a number of measures of partisan bias for the Commission's proposed plan. However, the report does not compare these measures of partisan bias to any simulation results. Instead, the comparison is largely to historical plans in Pennsylvania as well as plans enacted throughout the country. This is problematic because if a proposed map contains apparent bias, we do not know if it is in fact biased until we compare it to a set of maps that we know were drawn using unbiased inputs. Furthermore, comparisons to historical plans do not accurately consider the unique contemporary political geography of Pennsylvania, nor do comparisons to other states that have very different political dynamics. Without this benchmark, we cannot disentangle any measures of partisan bias from impacts due to political geography or other unique factors in a particular state. As I noted at the beginning of this report, it is well established that the contemporary political geography of Pennsylvania is beneficial to Republicans. Thus, we need to know how much of bias is due, if at all, to geography, and how much is actually partisan bias from the map drawer.

With that in mind, Figure 27 shows the median-mean difference for the Commission's proposed plan compared to the median-mean difference for each of the 50,000 simulations.[16] The median-mean measure is calculated by taking the median value of the partisan index across all 203 districts in a plan (the value for which half of the observations are smaller and half the observations are larger) and subtracting from that the mean partisan index (the simple average) of all of the districts from the median. Consider a simple example in which there are three districts in a plan with partisan indices of 0.91, 0.46, and 0.40. To find the median we simply look for the district for which there is one district larger and one district

[16]See Best, Robin E., Shawn J. Donahue, Jonathan Krasno, Daniel B. Magleby, and Michael D. McDonald. "Considering the prospects for establishing a packing gerrymandering standard." Election Law Journal 17, no. 1 (2018): 1-20. Warrington, Gregory S. "A comparison of partisan-gerrymandering measures." Election Law Journal: Rules, Politics, and Policy 18, no. 3 (2019): 262-281. Wang, Samuel S-H. "Three tests for practical evaluation of partisan gerrymandering." Stan. L. Rev. 68 (2016): 1263. McDonald, Michael D., and Robin E. Best. "Unfair partisan gerrymanders in politics and law: A diagnostic applied to six cases." Election Law Journal 14, no. 4 (2015): 312-330.

smaller (0.46 in this case). To find the mean, we simply take the average by dividing the sum of the partisan indices by the number of districts. In this case, (0.91+0.46+0.40)/3 = 0.59. The median-mean value would then be 0.46-0.59 = -0.13.[17]

Negative numbers indicate plans where the median district is less Democratic than the mean district, indicating the presence of heavily-Democratic districts that are pulling the mean up and away from the median district.[18] This indicates that the party that is packed into the districts with overwhelming majorities will have a harder time translating their votes into seats.[19]

One drawback of the median-mean test is that it does not account for the natural clustering of voters that occurs in Pennsylvania and other states. This can be remedied by also computing the median-mean difference for the simulated districting plans that also consider for the geographic distribution of voters in the state. This allows us to make an apples-to-apples comparison that holds the political geography of the state constant. Figure 27 displays the results of the median-mean measure for the simulations (in grey) and the Commission plan (solid vertical line). The fact that the distribution of results from the simulations is mostly less than zero shows that the geography of Pennsylvania leads to a natural advantage for Republicans due to the dense clustering of Democratic voters in cities even when districts are drawn using strictly non-partisan criteria.

In comparison to the simulations, the Commission's proposed plan is more favorable to Democrats than all but 1 of the 50,000 simulations - it has a score of -0.015. This is in line with the partisan results presented above in which the Commission's proposed plan was more Democratic leaning than nearly all of the simulation results. The median-mean measures is sensitive to the value of the median district (and is less sensitive to the mean district value

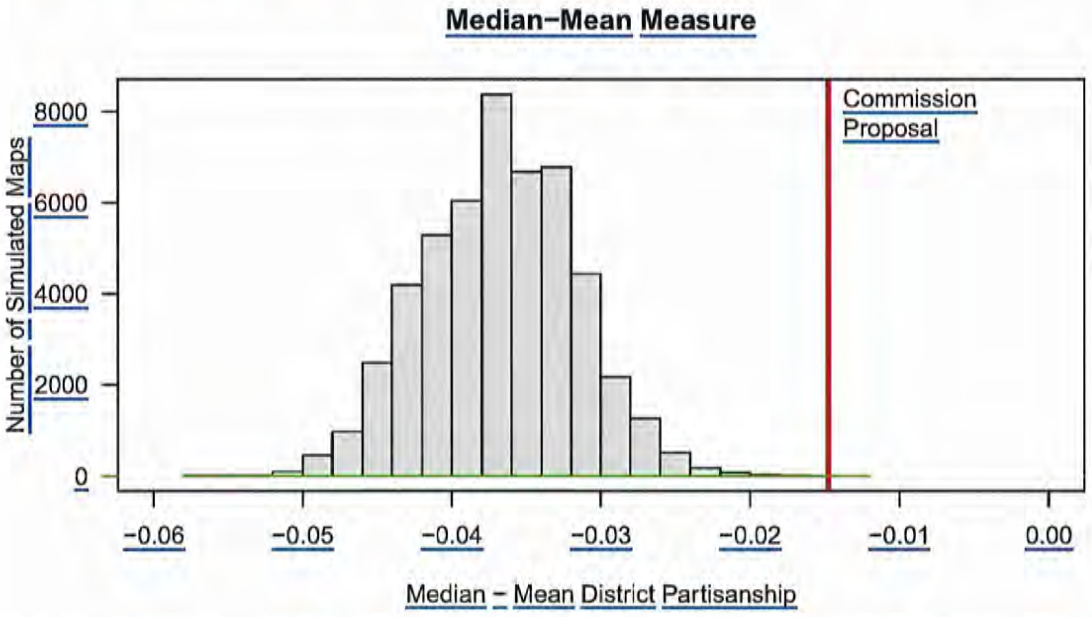
[17]A helpful analogy is to imagine a representative group of 100 Americans gathered at a restaurant. The median and mean incomes of the 100 customers are likely quite similar. If Bill Gates walks into the restaurant, the median income of the now 101 patrons will not shift by much at all, but the mean income will jump significantly, possibly by several million dollars.

[18]Professor Warshaw's written testimony in the LRC expert hearing provides an excellent summary of the median-mean measure.

[19]McDonald, Michael D., and Robin E. Best. "Unfair partisan gerrymanders in politics and law: A diagnostic applied to six cases." Election Law Journal 14, no. 4 (2015): 312-330.

because the mean is the average of 203 different data points whereas the median is a single value), and thus, small variations in the median-mean measure are to be expected as the median district's value changes across plans. However, the Commissions' proposed plan is systematically more Democratic than the entire distribution of plans in the simulations.

Figure 27: **Median-Mean Measures of Partisan Bias in Non-Partisan Simulations and Commission Proposal**



Note: The grey distribution shows the values of the median-mean measure for the 50,000 non-partisan simulations. The solid vertical line shows the value of the median-mean measure for the Commission's proposal. The Commission's proposal has a median-mean value of -0.015, which is more favorable to Democrats than all but 1 of the 50,000 non-partisan simulations.

The efficiency gap is another common redistricting metric and is similar to the median-mean measure in that it looks for the degree to which a party's votes statewide are translated into seats in each district.[20] A description of this measure provided by the Brennen Center

[20] McGhee, Eric. "Measuring efficiency in redistricting." Election Law Journal: Rules, Politics, and Policy 16, no. 4 (2017): 417-442. Veomett, Ellen. "Efficiency gap, voter turnout, and the efficiency principle." Election Law Journal: Rules, Politics, and Policy 17, no. 4 (2018): 249-263. Plener Cover, Benjamin. "Quantifying partisan gerrymandering: An evaluation of the efficiency gap proposal." Stan. L. Rev. 70 (2018): 1131.

for Justice summarizes it well: "[T]he efficiency gap counts the number of votes each party wastes in an election to determine whether either party enjoyed a systematic advantage in turning votes into seats. Any vote cast for a losing candidate is considered wasted, as are all the votes cast for a winning candidate in excess of the number needed to win."[21] In other words, the ideal strategy for a political party to maximize the impact of their voters is to distribute them as evenly as possible across districts so as to win by a narrow margin in the district they win and lose by very large margins in the districts where they lose. Put another way, "win by a little, lose by a lot" is the ideal strategy for a party to maximize their impact of their voters.[22]

The Brennen Center provides a simple example of how the efficiency gap is calculated:

> To understand how the efficiency gap works, consider a hypothetical state with 500 residents that is divided into five legislative districts, each with 100 voters. In the most recent election cycle, Democrats won Districts 1 and 2 by wide margins, while Republicans won Districts 3, 4, and 5 in closer races. Overall, Democratic candidates received 55 percent of the statewide vote but won just 40 percent of the legislative seats, while Republican candidates received 45 percent and won 60 percent of the seats. The table below shows the election results for each district.[23]

District	D votes	R Votes	Result
1	75	25	D wins
2	60	40	D wins
3	43	57	R wins
4	48	52	R wins
5	49	51	R wins
Total:	275	225	

Once we have the election results, the first step is to consider the number of "wasted votes" in each district. Because the Republican candidate in this example lost in District 1,

[21] https://www.brennancenter.org/sites/default/files/legal-work/How_the_Efficiency_Gap_Standard_Works.pdf

[22] Of course, parties have other priorities and winning by a single vote might not be their ideal scenario in reality.

[23] https://www.brennancenter.org/sites/default/files/legal-work/How_the_Efficiency_Gap_Standard_Works.pdf

all 25 of the votes cast for that candidates are wasted. The Democratic candidate in District 1 won, but by 24 more votes than would be necessary (since all that is needed is 51 votes to win). Thus, there are 24 wasted Democratic votes in this district. Taking the difference indicates that there was a net of 1 Republican wasted vote in this district.

The efficiency gap is then calculated as Efficiency Gap = (Total Democratic Wasted Votes - Total Republican Wasted Votes) / Total Votes. In order to account for uneven turnout across districts and elections, the efficiency gap formula can be re-expressed as the following equation: Efficiency Gap = (Seat Margin − 50%) − 2(Vote Margin − 50%) where the seat margin is the fraction of seats won by Democrats minus 0.50 and the vote margin is the fraction of votes won by Democratic candidates statewide minus 0.50.[24]

In this example and in Figure 28 I use the Democratic seat and vote margins which means that negative efficiency gap numbers indicate a districting plan that favors Republicans and positive numbers indicate a plan that favors Democrats. As with the median-mean test, the efficiency gap has the drawback of not accounting for the natural clustering of Democratic voters in Pennsylvania and other states. However, as before I remedy this by also computing the efficiency gap for the simulated districting plans that also must account for the geographic distribution of voters in the state. This allows us to make an apples-to-apples comparison that accounts for political geography. Figure 28 displays the results of the efficiency-gap measure for the simulations (in grey) and the Commission's proposed plan (solid black line). The distribution of results from the simulations show that the geography of Pennsylvania leads to a naturally arising advantage for Republicans due to the dense clustering of Democratic voters in Philadelphia, Pittsburgh, and the other medium-sized cities throughout the state.[25]

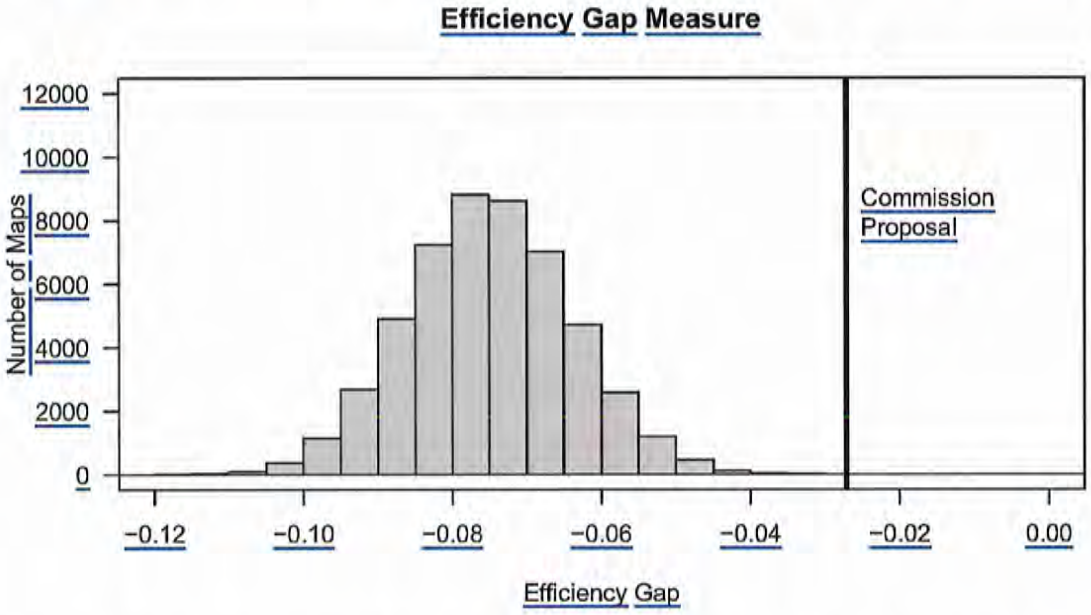
The solid black line shows the results of the Commission's proposed plan. There are

[24]See McGhee, Eric. "Measuring efficiency in redistricting." Election Law Journal: Rules, Politics, and Policy 16, no. 4 (2017): 417-442.

[25]Because the efficiency gap is a measure of seat shares, it will be a 'chunky' measure with values for each seat won or lost in a plan, unlike the median-mean measure which is a more continuous measure that changes based on small changes in the margin of victory in each district.

two major points to take away from the results. The efficiency gap for the Commission's proposed plan is -0.027. The simulations range from -0.12 to -0.027, with the median simulation producing a value of -0.076. These are all relatively small in magnitude.[26] However, when comparing the Commission's proposed plan to the simulations, the Commission's proposed plan is more favorable to Democrats than all 50,000 of the simulations.

Figure 28: **Efficiency Gap Measure of Non-Partisan Simulations and Commission Proposal**



Note: Distribution of efficiency gap among simulations shown in grey and the Commission's proposed plan shown as the solid vertical line. Negative values indicate plans that are have a Republican advantage and positive values indicate plans that have a Democratic advantage. The Commission's proposed plan has an efficiency gap of -0.027 and is more favorable to Democrats than all 50,000 of the non-partisan simulations, which have larger (more negative) efficiency gap values.

Both the efficiency gap and median-mean scores show that the Commission's proposed plan is more favorable to Democrats than nearly every simulated districting plan drawn using only the non-partisan criteria outlined in the Pennsylvania Constitution. This is largely an

[26]For reference, the congressional plan that was challenged in the *League of Women Voters of Pennsylvania* case in 2018 showed the congressional district plan had a pro-Republican efficiency gap of between -0.15 and -0.20.

active effort to overcome, or "correct for", the contemporary political geography of the state. However, an attempt to overcome the structural tilt to make "fairer" maps is unfair and misguided for two reasons. First, this strategy explicitly considers partisanship in the creation of districts. This is as close as one can come to the definition of gerrymandering - the drawing of maps to obtain a partisan advantage. Second, even if the effort is to undo a naturally occurring disadvantage to a party that is due to the contemporary geographic distribution of voters, there is no reason to believe that the particular arrangement of voters will persist into the future, even the near future. Previous decades show us that partisan preferences can be dynamic and will likely be so in the future as well. A better approach to redistricting would be to not consider partisanship when drawing the boundaries and let the chips fall where they may as the geography of politics shifts and changes over time.

8 Benninghoff Amendment

In this section I compare the map put forward to the LRC by Majority Leader Benninghoff on the metrics used above. I first consider population deviation and political subdivision splits. The Benninghoff amendment is equal to or superior to the Commission's plan across all of these measures. The Benninghoff amendment has smaller population deviation, splits counties by a nearly equal amount, and divides significantly fewer municipalities fewer total times. These numbers are reported in the table below. Furthermore, the Benninghoff amendment is slightly more compact, on average, than the Commission's proposal. Across each of these traditional non-partisan criteria the Benninghoff amendment is equivalent or superior to the Commission's proposal.

The significant reduction in municipal splits while maintaining majority-minority districts, which I discuss below, shows that the decision to divide particular cities was made not for minority representation but rather for partisan gain. This becomes especially apparent when we look at the particular cities that are divided by the Commission's plan and are

Table 4: Commission Proposal, Benninghoff Amendment, and 50,000 Simulations:

	Commission Final Proposal	Benninghoff Amendment	Simulations Range
Population Deviation			
Smallest District:	-4.24%	-4.02%	[-4.25., -3.91]
Largest District:	4.40%	3.97%	[3.93, 4.25]
Boundary Splits			
Counties Split:	45	46	[42, 52]
Total County Splits:	186	186	[184, 208]
Municipalities Split:	56	42	[61, 105]
Total Municipal Splits:	92	76	[98, 140]
Compactness			
Median Polsby-Popper:	0.35	0.36	[0.29, 0.34]

discussed above in this report. Figure 29 shows that the Benninghoff amendment does not split the cities of Harrisburg, Lancaster, or State College. These cities are small enough to be contained in a single district. However, as discussed above, the Commission's proposal unnecessarily divides these districts for partisan gain by generating more Democratic-leaning districts. Similarly, Figure 30 shows how the cities of Reading and Allentown are divided across only two districts (they are too large to be in a single district) in the Benninghoff amendment. As shown earlier in this report, the Commission's proposal divides each of them across three districts, again to create more Democratic-leaning districts.

One alternative justification for the additional municipal divisions in the Commission's proposal is that these particular municipal splits are necessary to create a sufficient number of majority-minority, or minority-opportunity districts. However, the Benninghoff amendment achieves a dramatic reduction in municipal splits without sacrificing minority representation. The Benninghoff proposal contains 26 majority-minority districts (the Commission's proposal contains 25), 5 majority-Latino districts (the Commission's proposal contains 4), 8 majority-Black districts (the Commission's proposal contains 8), and 17 coalition

(a) Harrisburg (b) Lancaster (c) State College

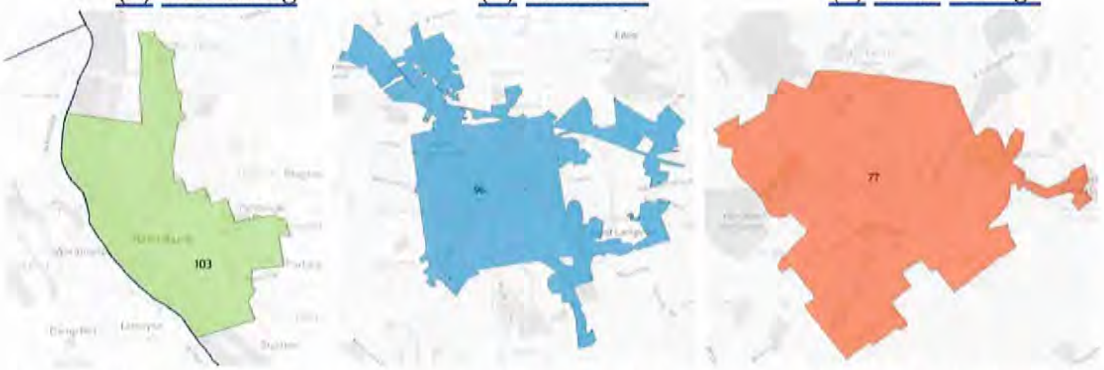


Figure 29: Each of these cities is small enough to be contained in a single district. The Benninghoff amendment does this. The Commission's plan, as discussed above, divides each of these cities unnecessarily.

(a) Reading (b) Allentown

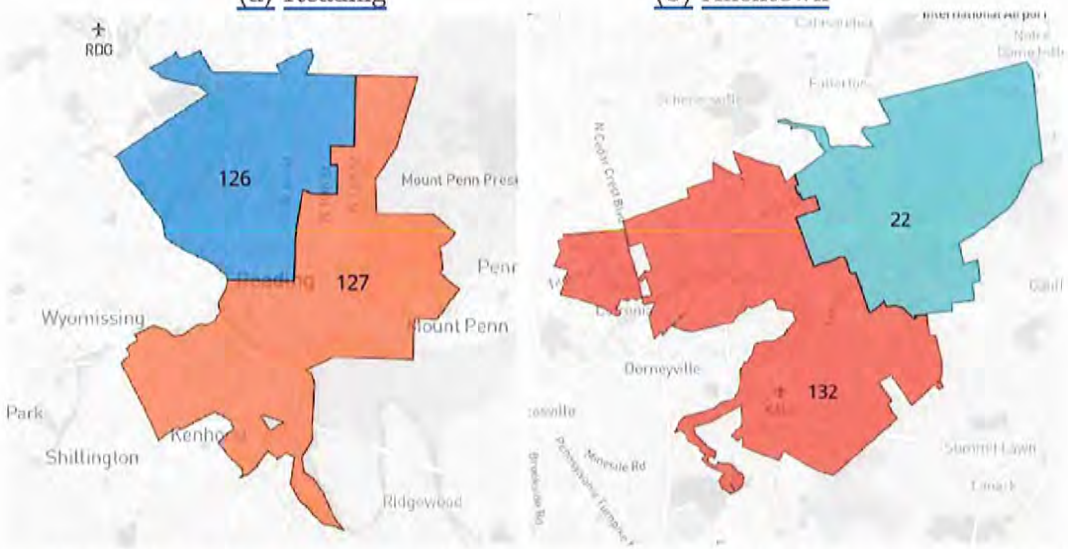


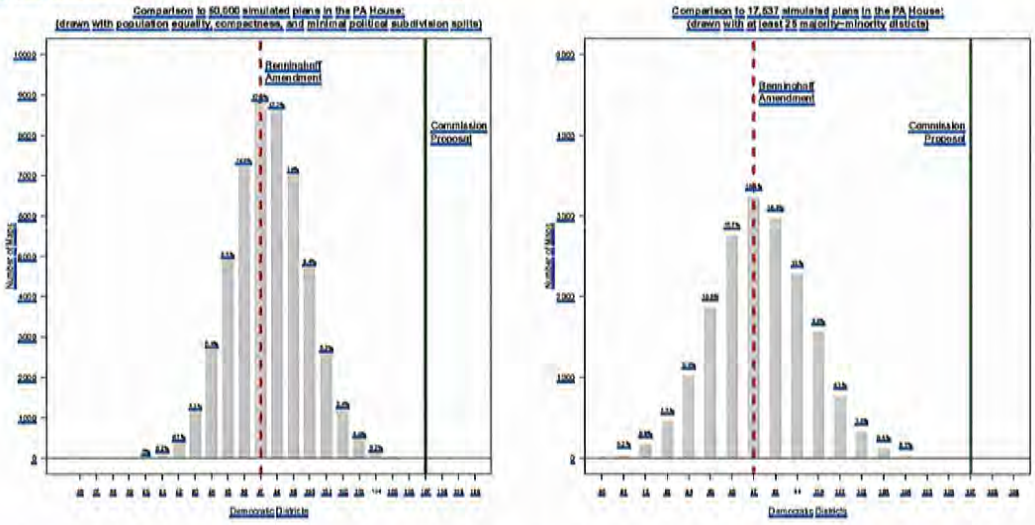
Figure 30: Each of these cities is small enough to be contained in two districts. The Benninghoff amendment does this. The Commission's plan, as discussed above, divides each of these cities unnecessarily across three districts.

minority opportunity districts (the Commission's proposal contains 19) where the minority voting age population is between 35% and 50% of the district population. Again, the Benninghoff amendment performs equally well on these measures compared to the Commission's proposal while dramatically outperforming it on the traditional non-partisan criteria of mu-

nicipal divisions. This shows that the decision to divide particular cities in the Commission's proposal is not driven by minority representation, but instead by partisan considerations.

On partisan metrics the Benninghoff amendment is less biased than the Commission's proposal. Figure 31 shows the distribution of Democratic-leaning districts from the simulations discussed above (race-blind on the left and race-filtered on the right). The vertical lines indicate the location of the Commission's proposal (solid green line) and the Benninghoff amendment (dashed red line). The Benninghoff amendment is in line with the modal outcome of the non-partisan simulations while the Commission's proposal is a Democratic partisan outlier.

Figure 31: Comparison of Partisanship of Commission Proposal and Benninghoff Amendment to Non-Partisan Simulation Results

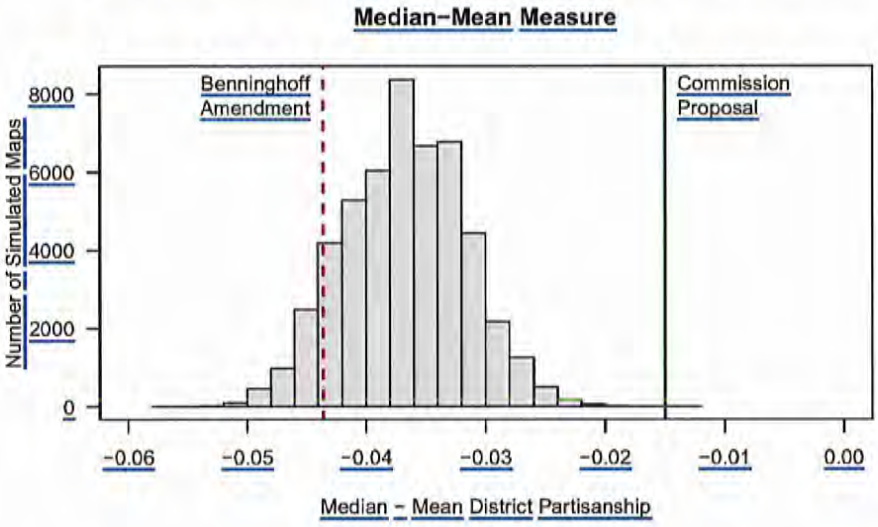


Note: Compared to the set of non-partisan simulations, the Benninghoff amendment is in line with the most common outcome in the simulations. This is true of when looking at all 50,000 simulations (left panel) and when focusing on only those simulations that contain at least 25 majority-minority districts (right panel). In both cases the Commission's proposal is a Democratic partisan outlier.

The alternative measures of partisan bias discussed above — the median-mean and efficiency gap — also show that the Benninghoff amendment is in line with the non-partisan simulations while the Commission's proposal, as discussed above, is an outlier. Figure 32 presents the median-mean measures for the simulations and the Commission's proposal,

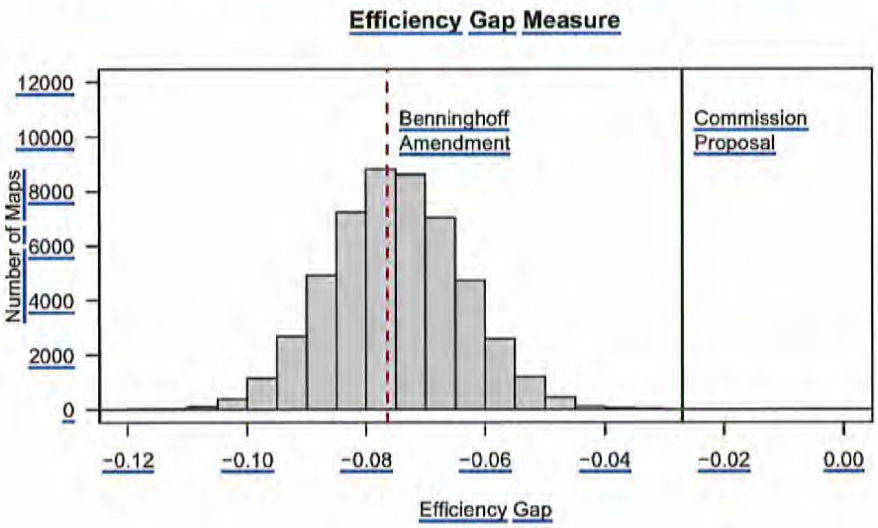
but now adds the Benninghoff amendment's median-mean score as well. The Benninghoff amendment is within the distribution of simulations. The same is not true of the Commission's proposal. Figure 33 presents the efficiency gap measures for the simulations and the Commission's proposal, but now adds the Benninghoff amendment's efficiency gap score. Again, the Benninghoff amendment is well within the distribution of simulations while the Commission's proposal is an outlier.

Figure 32: **Median-Mean Measures of Partisan Bias**



Note: The grey distribution shows the values of the median-mean measure for the 50,000 non-partisan simulations. The solid vertical line shows the value of the median-mean measure for the Commission's proposal. The dashed vertical line shows the median-mean measure for the Benninghoff amendment. The Commission's proposal has a median-mean value of -0.015, which is more favorable to Democrats than all but 1 of the 50,000 non-partisan simulations. The Benninghoff amendment has a median-mean value of -0.044, which is more favorable to Democrats than 9.15% of the simulations.

Figure 33: **Efficiency Gap Measures of Partisan Bias**



Note: The grey distribution shows the values of the efficiency gap measure for the 50,000 non-partisan simulations. The solid vertical line shows the value of the efficiency gap measure for the Commission's proposal. The dashed vertical line shows the efficiency gap measure for the Benninghoff amendment. The Commission's proposal has an efficiency gap value of -0.027, which is more favorable to Democrats than all 50,000 non-partisan simulations. The Benninghoff amendment has an efficiency gap value of -0.076, which is exactly in the middle of the non-partisan simulations.

Overall, the Benninghoff amendment improves on population deviation, maintains compact districts with a low number of county divisions, and dramatically improves on municipal splits compared to the Commission's proposal. Furthermore, the Benninghoff amendment is in line with the set of non-partisan districting simulations while the Commission's proposal is a Democratic partisan outlier. The Benninghoff amendment is not a partisan outlier while maintaining minority representation equivalent to that of the Commission's proposal.

Michael Jay Barber

Appendix A: Curriculum Vitae

Michael Jay Barber

CONTACT INFORMATION

Brigham Young University
Department of Political Science
724 KMBL
Provo, UT 84602

barber@byu.edu
http://michaeljaybarber.com
Ph: (801) 422-7492

ACADEMIC APPOINTMENTS

Brigham Young University, Provo, UT

August 2020 - present Associate Professor, Department of Political Science
2014 - July 2020 Assistant Professor, Department of Political Science
2014 - present Faculty Scholar, Center for the Study of Elections and Democracy

EDUCATION

Princeton University Department of Politics, Princeton, NJ

Ph.D., Politics, July 2014

- Advisors: Brandice Canes-Wrone, Nolan McCarty, and Kosuke Imai
- Dissertation: "Buying Representation: the Incentives, Ideology, and Influence of Campaign Contributions on American Politics"
- 2015 Carl Albert Award for Best Dissertation, Legislative Studies Section, American Political Science Association (APSA)

M.A., Politics, December 2011

Brigham Young University, Provo, UT

B.A., International Relations - Political Economy Focus, April, 2008

- *Cum Laude*

RESEARCH INTERESTS

American politics, congressional polarization, political ideology, campaign finance, survey research

PUBLICATIONS

19. **"Ideological Disagreement and Pre-emption in Municipal Policymaking"** with Adam Dynes
Forthcoming at *American Journal of Political Science*
18. **"Comparing Campaign Finance and Vote Based Measures of Ideology"**
Forthcoming at *Journal of Politics*
17. **"The Participatory and Partisan Impacts of Mandatory Vote-by-Mail"**, with John Holbein
Science Advances, 2020. Vol. 6, no. 35, DOI: 10.1126/sciadv.abc7685
16. **"Issue Politicization and Interest Group Campaign Contribution Strategies"**, with Mandi Eatough
Journal of Politics, 2020. Vol. 82: No. 3, pp. 1008-1025

15. **"Campaign Contributions and Donors' Policy Agreement with Presidential Candidates"**, with Brandice Canes-Wrone and Sharece Thrower
Presidential Studies Quarterly, 2019, 49 (4) 770–797
14. **"Conservatism in the Era of Trump"**, with Jeremy Pope
Perspectives on Politics, 2019, 17 (3) 719–736
13. **"Legislative Constraints on Executive Unilateralism in Separation of Powers Systems"**, with Alex Bolton and Sharece Thrower
Legislative Studies Quarterly, 2019, 44 (3) 515–548
Awarded the Jewell-Loewenberg Award for best article in the area of subnational politics published in *Legislative Studies Quarterly* in 2019
12. **"Electoral Competitiveness and Legislative Productivity"**, with Soren Schmidt
American Politics Research, 2019, 47 (4) 683–708
11. **"Does Party Trump Ideology? Disentangling Party and Ideology in America"**, with Jeremy Pope
American Political Science Review, 2019, 113 (1) 38–54
10. **"The Evolution of National Constitutions"**, with Scott Abramson
Quarterly Journal of Political Science, 2019, 14 (1) 89–114
9. **"Who is Ideological? Measuring Ideological Responses to Policy Questions in the American Public"**, with Jeremy Pope
The Forum: A Journal of Applied Research in Contemporary Politics, 2018, 16 (1) 97–122
8. **"Status Quo Bias in Ballot Wording"**, with David Gordon, Ryan Hill, and Joe Price
The Journal of Experimental Political Science, 2017, 4 (2) 151–160.
7. **"Ideologically Sophisticated Donors: Which Candidates Do Individual Contributors Finance?"**, with Brandice Canes-Wrone and Sharece Thrower
American Journal of Political Science, 2017, 61 (2) 271–288.
6. **"Gender Inequalities in Campaign Finance: A Regression Discontinuity Design"**, with Daniel Butler and Jessica Preece
Quarterly Journal of Political Science, 2016, Vol. 11, No. 2: 219–248.
5. **"Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate"**
Public Opinion Quarterly, 2016, 80: 225–249.
4. **"Donation Motivations: Testing Theories of Access and Ideology"**
Political Research Quarterly, 2016, 69 (1) 148–160.
3. **"Ideological Donors, Contribution Limits, and the Polarization of State Legislatures"**
Journal of Politics, 2016, 78 (1) 296–310.
2. **"Online Polls and Registration Based Sampling: A New Method for Pre-Election Polling"** with Quin Monson, Kelly Patterson and Chris Mann.
Political Analysis 2014, 22 (3) 321–335.
1. **"Causes and Consequences of Political Polarization"** In *Negotiating Agreement in Politics.* Jane Mansbridge and Cathie Jo Martin, eds., Washington, DC: American Political Science Association: 19–53. with Nolan McCarty. 2013.

    - Reprinted in *Solutions to Political Polarization in America*, Cambridge University Press. Nate Persily, eds. 2015
    - Reprinted in *Political Negotiation: A Handbook*, Brookings Institution Press. Jane Mansbridge and Cathie Jo Martin, eds. 2015

AVAILABLE WORKING PAPERS

"Misclassification and Bias in Predictions of Individual Ethnicity from Administrative Records" (Revise and Resubmit at *American Political Science Review*)

"Taking Cues When You Don't Care: Issue Importance and Partisan Cue Taking"
with Jeremy Pope (Revise and Resubmit)

"A Revolution of Rights in American Founding Documents"
with Scott Abramson and Jeremy Pope (Conditionally Accepted)

"410 Million Voting Records Show the Distribution of Turnout in America Today"
with John Holbein (Revise and Resubmit)

"Partisanship and Trolleyology"
with Ryan Davis (Under Review)

"Who's the Partisan: Are Issues or Groups More Important to Partisanship?"
with Jeremy Pope (Revise and Resubmit)

"Race and Realignment in American Politics"
with Jeremy Pope (Revise and Resubmit)

"The Policy Preferences of Donors and Voters"

"Estimating Neighborhood Effects on Turnout from Geocoded Voter Registration Records."
with Kosuke Imai

"Super PAC Contributions in Congressional Elections"

WORKS IN PROGRESS

"Collaborative Study of Democracy and Politics"
with Brandice Canes-Wrone, Gregory Huber, and Joshua Clinton

"Preferences for Representational Styles in the American Public"
with Ryan Davis and Adam Dynes

"Representation and Issue Congruence in Congress"
with Taylor Petersen

"Education, Income, and the Vote for Trump"
with Edie Ellison

INVITED PRESENTATIONS

"Are Mormons Breaking Up with Republicanism? The Unique Political Behavior of Mormons in the 2016 Presidential Election"

- Ivy League LDS Student Association Conference - Princeton University, November 2018, Princeton, NJ

"Issue Politicization and Access-Oriented Giving: A Theory of PAC Contribution Behavior"

- Vanderbilt University, May 2017, Nashville, TN

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- Yale University, April 2016, New Haven, CT

"The Incentives, Ideology, and Influence of Campaign Donors in American Politics"

- University of Oklahoma, April 2016, Norman, OK

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- University of Wisconsin - Madison, February 2016, Madison, WI

"Polarization and Campaign Contributors: Motivations, Ideology, and Policy"

- Hewlett Foundation Conference on Lobbying and Campaign Finance, October 2014, Palo Alto, CA

"Ideological Donors, Contribution Limits, and the Polarization of State Legislatures"

- Bipartisan Policy Center Meeting on Party Polarization and Campaign Finance, September 2014, Washington, DC

"Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate"

- Yale Center for the Study of American Politics Conference, May 2014, New Haven, CT

Conference Presentations

Washington D.C. Political Economy Conference (PECO):

- 2017 discussant

American Political Science Association (APSA) Annual Meeting:

- 2014 participant and discussant, 2015 participant, 2016 participant, 2017 participant, 2018 participant

Midwest Political Science Association (MPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2018 participant

Southern Political Science Association (SPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2017 participant

Teaching Experience

Poli 315: Congress and the Legislative Process

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

Poli 328: Quantitative Analysis

- Winter 2017, Fall 2017, Fall 2019, Winter 2020, Fall 2020, Winter 2021

Poli 410: Undergraduate Research Seminar in American Politics

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

AWARDS AND GRANTS

2019 BYU Mentored Environment Grant (MEG), American Ideology Project, $30,000

2017 BYU Political Science Teacher of the Year Award

2017 BYU Mentored Environment Grant (MEG), Funding American Democracy Project, $20,000

2016 BYU Political Science Department, Political Ideology and President Trump (with Jeremy Pope), $7,500

2016 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Hayden Galloway, Jennica Peterson, Rebecca Shuel

2015 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Michael-Sean Covey, Hayden Galloway, Sean Stephenson

2015 BYU Student Experiential Learning Grant, American Founding Comparative Constitutions Project (with Jeremy Pope), $9,000

2015 BYU Social Science College Research Grant, $5,000

2014 BYU Political Science Department, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Social Science College Award, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Center for the Study of Elections and Democracy, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $2,000

2012 Princeton Center for the Study of Democratic Politics Dissertation Improvement Grant, $5,000

2011 Princeton Mamdouha S. Bobst Center for Peace and Justice Dissertation Research Grant, $5,000

2011 Princeton Political Economy Research Grant, $1,500

OTHER SCHOLARLY ACTIVITIES

Expert Witness in Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida)

Expert Witness in Common Cause, et al., Plaintiffs, vs. LEWIS, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina)

Expert Witness in Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida)

Expert Witness in Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina)

Expert Witness in Richard Rose et al., Plaintiffs, v. Brad Raffensperger, Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern District of Georgia)

Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia)

Expert Witness in Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE No. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division)

Expert Witness in League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio)

Expert Witness in Regina Adams, et al., Relators, v. Governor Mike DeWine, et al., Respondents. Case No. 2021-1428 (Supreme Court of Ohio)

Expert Witness in Rebecca Harper, et al., Plaintiffs, v. Representative Destin Hall, et al., Defendants (Consolidated Case). Case No. 21 CVS 500085 (Wake County, North Carolina)

ADDITIONAL TRAINING — EITM 2012 at Princeton University - Participant and Graduate Student Coordinator

COMPUTER SKILLS — Statistical Programs: R, Stata, SPSS, parallel computing

Updated January 7, 2022

Exhibit B

SUMMARY CHART[1]

DR. JONATHAN A. RODDEN	
Rebuttal of February 17, 2021 Report by Dr. Michael Barber:	• Dr. Barber's claim that a "fair" or "unbiased" plan is one that resembles the most frequent outcomes from a large ensemble is "different" than any view encountered in the academic literature. (Rodden, pp. 4-7) • Dr. Barber's claim that traditional redistricting principles would necessarily lead to a redistricting plan in which Democrats are inefficiently concentrated in urban districts "draws heavily on my work, often in a misleading way." (Rodden, p. 7) • Dr. Rodden rejects Dr. Barber's claim that it is "universally impossible, or even difficult" to draw fair redistricting plans in Pennsylvania. (Rodden, p. 7) • There is no evidence that Final Plan undermines traditional redistricting criteria: o There is no evidence "of pinwheels, pie-slices, or non-compact, ambling districts that contradict traditional redistricting principals to favor Democrats." The Final House Plan is "more compact, and splits fewer municipalities, than any of the simulated plans." (Rodden, pp. 9-10) o Barber case studies (Scranton and Wilkes-Barre, Lancaster, Reading, Lehigh Valley, and Harrisburg) reveal that one cannot infer that redistricting principles were subverted for partisan gain through "simply visualizing maps of selected metro-area districts and considering the number of splits relative to city population counts." (Rodden, pp. 9-21)

[1] This Chart serves only to highlight points of rebuttal and analysis of the Final Plan within the Supplemental Reports of Drs. Rodden, Imai, Warshaw, and Barreto. It is not an exhaustive citation of such references. Indeed, the Rodden, Imai, Warshaw, and Barreto Supplemental Reports cite Dr. Barber 45, 8, 9, and 7 times, respectively.

DR. KOSUKE IMAI	
Rebuttal of February 17, 2021 Report by Dr. Michael Barber:	• Dr. Barber's simulated plans split many more municipalities than the final House plan. (Imai, p. 4, ¶ 5) This failure to minimize the number of municipality splits "likely contributed to his conclusion that is opposite of mine." (*Id.*, p. 10, ¶ 18) • Dr. Barber's February 17, 2022 Report "does not provide sufficiently detailed information about his algorithmic choices." (Imai, p. 7, ¶ 10)
Conclusions Regarding the 2021 Final Plan:	• "[A]ll of my simulation analyses, regardless of whether and how they consider race in addition to constitutional criteria, lead to the same conclusion that the final House plan is not a partisan gerrymander. This implies that the additional consideration of race in the final House plan does not favor any political party." (Imai, p. 13, ¶ 25)

DR. CHRISTOPHER WARSHAW	
Rebuttal of February 17, 2021 Report by Dr. Michael Barber:	• Dr. Barber's Report concludes that the final plan is a partisan gerrymander, but his "analysis does not actually indicate, however, that the enacted House plan is a partisan gerrymander." (Warhsaw, p. 16) • Dr. Barber's Report "reaches almost identical conclusions as my analysis as-to the modest pro-Republican bias of the enacted House plan based on the efficiency gap and the mean-median difference." (Warshaw, p. 16)
Conclusions Regarding the 2021 Final Plan:	• "Overall, there is no evidence that this plan is a partisan gerrymander." (Warshaw, p. 8) • <u>Partisan Fairness of 2021 Final Plan:</u> o Composite of 2014-2020 statewide election results: ▪ Symmetry Bias: -2.7% ▪ Mean-Median: -1.4% ▪ Efficiency Gap: -2.5% ▪ Declination: -.173 o 2020 State House election results: ▪ Symmetry Bias: -0.2% ▪ Mean-Median Difference: -1.6% ▪ Efficiency Gap: 0.2% ▪ Declination: -.076

	○ PlanScore: ▪ Symmetry Bias: -2.3% ▪ Mean-Median Difference: -1.1% ▪ Efficiency Gap: 2.5% ▪ Declination: -.14 ○ Responsiveness:"Both the 2014-2020 House plan and the enacted House plan are relatively responsive to shifts in voters' preferences. But the 2014-20 plan had a large pro-Republican bias, which is much smaller in the enacted House plan." (Warshaw, p. 11) ○ Number of Competitive Districts: "[T]he previous plan and the enacted House plan are fairly similar in terms of the number of competitive seats. The enacted House plan also has roughly the same percentage of seats that are competitive as other states' elections for their lower chambers in 2020." (Warshaw, p. 14)
DR. MATT BARRETO	
Rebuttal of February 4, 2021 Report by Dr. Jonathan Katz:	• Dr. Katz did not obtain Pennsylvania data to perform his analysis, but rather attempted to draw inferences about Hispanic voting patterns in Pennsylvania based on Hispanic voter registration data in Bakersfield, California. (Barreto, pp. 1-2, ¶ 3)
Rebuttal of February 17, 2021 Report by Dr. Michael Barber:	• Dr. Barber's simulation analysis "does not consider compliance with the VRA." (Barreto, p. 2, ¶ 4) • Dr. Barber does not "offer any performance analysis of the adopted Final LRC House Plan in support of their insinuation that certain districts will not perform for minority candidates of choice." (Barreto, p. 2, ¶ 5)
Response to Leader Benninghoff's Criticisms of Prior Reports:	• Criticism: Leader Benninghoff alleges cracking of the Hispanic and Black population in districts 126, 127, 129, 103, 104, and 22 (Barreto, p. 4, ¶ 11) • Response: Analysis confirms that (1) final plan "does not impair or prevent minorities from electing candidates of their choice" in districts 126, 127, and 129, (2) Black voters in districts 103 and 104 "will have a fair opportunity to elect candidates of their choice," and (3) "district 22 will very likely perform to elect minority candidates of choice." (Barreto, p. 4, ¶ 11)

	• Criticism: "In Paragraph 75 of the Petition, [Leader Benninghoff] claims that I conceded that my analysis failed to show racially polarized voting." (Barreto, p. 3, ¶ 6) • Response: A summary of his analysis in paragraph 11 of his January 7 report states "In regions in Pennsylvania that have sizable populations of both White and minority voters, data across more than a dozen elections points to a clear pattern of racially polarized voting." (Barreto, p. 3, ¶ 6) • Criticism: Leader Benninghoff claims that racially polarized voting analysis "lump[s] together minorities and otherwise failed to show white-bloc oppositional voting." (Barreto, p. 3, ¶ 7) • Response: Slide 6 of January 14, 2022 Presentation to LRC included "a data table . . . with separate racially polarized voting estimates of White, Black and Latino voting patterns, as well as for minority voters overall." (Barreto, p. 3, ¶ 7) • Criticism: Leader Benninghoff claims that analysis did not prove racially polarized voting and the *Gingles* standards. (Barreto, p. 4, ¶ 9) • Response: Paragraph 11 of January 7 Report states, "In contrast, White voters tend to block vote against minority candidates of choice" and "in most instances outside of these two large cities, White voters demonstrate considerable block voting against minority candidates of choice, often voting in the exact opposite pattern of Blacks, Latinos, and Asian Americans." Further, Paragraph 13 notes that "[t]his provides evidence of the second component of racially polarized voting under the *Gingles* test of White block voting against minority candidates of choice." (Barreto, p. 4, ¶ 9)
Conclusions Regarding the 2021 Final Plan:	• "[T]he Final Plan fully complies with the VRA and does not impair any minority group's ability to elect representatives of their choice." (Barreto, p. 6, ¶ 15) • Districts cited within the Benninghoff petition for review "are likely to perform to elect minority candidates of choice." (Barreto, p. 5, ¶ 14; p. 6, chart)

CERTIFICATE OF SERVICE

I hereby certify that I served the foregoing Answer upon counsel via the Court's PACFile System which service satisfies the requirements of Pa. R. App. P. 121.

/s/ Daniel T. Brier
Daniel T. Brier

Date: March 14, 2022