

# **Exhibit A-1**

# An Evaluation of the Partisan Fairness of New Mexico's Enacted 2022 Congressional Districting Plan

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# 1 Introduction

My name is Christopher Warshaw. I am a Professor of Political Science at George Washington University. Previously, I was an Associate Professor at the Massachusetts Institute of Technology (MIT) from July 2016 - July 2017, and an Assistant Professor at MIT from July 2012 - July 2016. I have been asked by counsel representing the Proposed Intervenor in this case to analyze relevant data and provide my expert opinions about whether New Mexico’s enacted congressional districting plan has a bias in favor of a particular political party. This analysis speaks to the second prong of Justice Kagan’s test in her dissenting opinion in *Rucho v. Common Cause*, 139 S. Ct. 2484, 2516 (2019), which asks whether a plan leads to “substantial” partisan vote dilution, as well as the New Mexico Supreme Court’s “egregious effect” standard. I was also asked to evaluate whether the plan increases the number of competitive congressional elections in New Mexico.

My analysis indicates that the enacted plan does not have an extreme or egregious partisan effect. While it has a pro-Democratic bias on some metrics of partisan fairness, it is neutral on other metrics. Moreover, when I take the average of the metrics typically used by academics to assess the partisan fairness of a plan, the enacted map is more neutral than either the 2012 benchmark plan or any of the plans proposed by the Citizen Redistricting Committee. Outside studies from academics and data journalists also reach mixed conclusions about the fairness of the enacted plan, with no study finding it is uniformly biased in favor of one particular party on the relevant metrics. Based on the overall body of evidence, I conclude the enacted plan does not reflect substantial partisan vote dilution as described in the second prong of Justice Kagan’s test.

I also evaluated the competitiveness of congressional elections in New Mexico in the enacted plan and conclude that the enacted plan is likely to lead to more competitive elections than the 2012 benchmark plan and at least as many competitive elections as any of the plans proposed by the Citizen Redistricting Committee.

# 2 Qualifications, Publications and Compensation

My Ph.D. is in Political Science, from Stanford University, where my graduate training included courses in political science and statistics. I also have a J.D. from Stanford Law School. My academic research focuses on public opinion, representation, elections, and polarization in American Politics. I have written over 25 peer-reviewed papers on these topics. Moreover, I have written multiple papers that focus on elections and four articles that focus specifically on redistricting. I also have written a book that includes

an extensive analysis on the causes and consequences of partisan gerrymandering in state governments.

My curriculum vitae is attached to this report. All publications that I have authored and published appear in my curriculum vitae. My work is published or forthcoming in peer-reviewed journals such as: *Nature Communications*, *Science Advances*, the *American Political Science Review*, the *American Journal of Political Science*, the *Journal of Politics*, *Political Analysis*, *Political Science Research and Methods*, the *British Journal of Political Science*, the *Annual Review of Political Science*, *Political Behavior*, *Legislative Studies Quarterly*, *Science Advances*, the *Election Law Journal*, *Nature Energy*, *Public Choice*, and edited volumes from Cambridge University Press and Oxford University Press. My book entitled *Dynamic Democracy: Public Opinion, Elections, and Policy Making in the American States* was published by the University of Chicago Press in 2022. My non-academic writing has been published in the *New York Times* and the *Washington Post*. My work has also been discussed in the *Economist* and many other prominent media outlets.

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

- GIS Files of the 2012-20 plan, the enacted 2022-30 plan, and alternative plans proposed by the Citizen Redistricting Committee: I obtained the Citizen’s Committee plans from the Citizen Redistricting Committee website, <https://www.nmredistricting.org>.
- Precinct-level data on recent statewide New Mexico elections: I use shapefiles of precinct-level results from 2016-2020 from the Voting and Election Science Team (University of Florida, Wichita State University). I obtained files containing the 2014 data and 2022 data from New Mexico’s Secretary of State and merged them with precinct-level shapefiles.
- Estimates of the partisan bias in previous congressional elections: As part of my peer reviewed academic research, I have estimated the partisan bias of districting plans used in previous congressional elections around the country from 1972-2022 (Stephanopoulos and Warshaw 2020). For this report, I extended these estimates through 2022. I used data from:
  - A large data set on candidacies and results in Congressional elections: I obtained results from 1972-2020 collected by the Constituency-Level Elections

Archive (CLEA) (Kollman et al. 2017). The results from 1972-1990 are based on data collected and maintained by the Inter-university Consortium for Political and Social Research (ICPSR) and adjusted by CLEA. The data from 1992-2020 are based on data collected by CLEA from the Office of the Clerk at the House of the Representatives. I supplemented this dataset with 2020 election results collected by the MIT Election and Data Science Lab (MIT Election and Data Science Lab 2017) and 2022 results from the Cook Political report.

- Data on presidential election returns and incumbency status in Congressional elections. I used data on elections in congressional districts from 1972-2022 collected by Professor Gary Jacobson (University of California, San Diego). This dataset has been used in many political science studies and has canonical status in the political science profession (Jacobson 2015).

I have previously provided expert reports in ten redistricting-related cases. My expert testimony was found to be admissible and credible in each of these cases that reached a decision on the merits and was extensively cited by the judges in many of their decisions.

- Between 2017 and 2019, I provided reports for *League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania*, No. 159 MM 2017 (Pa. 2017-2018); *League of Women Voters of Michigan v. Johnson*, No. 2:17-cv-14148 (E.D. Mich 2018); and *APRI et al. v. Smith et al.*, No. 1:18-cv-357 (S.D. Ohio 2018).
- Between 2021 and 2023, I provided reports in *League of Women Voters v. Ohio Redistricting Commission*, No. 2021-1193 (Ohio 2022); *League of Women Voters v. Kent County Apportionment Commission*, No. 163952 (Mich. 2021); *League of Women Voters of Ohio v. Ohio Redistricting Commission*, No. 2021-144 (Ohio 2021-22); *League of Women Voters of Michigan v. Michigan Independent Citizens Redistricting Commission*, No. 164022 (Mich. 2022); *Rivera et al. v. Schwab*, No. 2022-CV-000089 (Kan. Dist. Ct. Wyandotte Cnty. 2022); *Benninghoff v. 2021 Legislative Reapportionment Commission*, No. 11 MM 2022 (Pa. 2022); and *BVM (Black Voters Matter) Capacity Building Institute, Inc., et al. v. Cord Byrd, in his official capacity as Florida Secretary of State, et. al.*, No. 2022-ca-000666 (Fla. 2d Cir. 2023).

I also recently provided testimony to Pennsylvania’s Bipartisan Reapportionment Commission about the partisan fairness of its proposed State House plan. In addition, I have provided expert testimony and reports in several cases related to the U.S. Census:

*State of New York et al. v. United States Department of Commerce*, No. 18-cv-2921 (S.D.N.Y. 2019); *New York v. Trump*, No. 20-CV-5770 (S.D.N.Y. 2020); *Common Cause v. Trump*, No. 1:20-cv-02023 (D.D.C. 2020); and *La Union Del Pueblo Entero (LUPE) v. Ross*, No. GJH-19-2710 (D. Md. 2019).

I am being compensated at a rate of \$425 per hour. My compensation is in no way contingent on the conclusions I reach in this report. The opinions in this report are my own, and do not represent the views of George Washington University.

### 3 Background on Partisan Fairness in Districting

The relationship between the distribution of partisan support in the electorate and the partisan composition of the government—what Powell (2004) calls “vote–seat representation”—is a critical link in the longer representational chain between citizens’ preferences and governments’ policies. If the relationship between votes and seats (sometimes called the “vote-seat curve”) systematically advantages one party over another, then some citizens will enjoy more influence—more “voice”—over elections and political outcomes than others (Caughey, Tausanovitch, and Warshaw 2017).

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

There are a number of approaches that have been proposed to measure partisan advantage in a districting plan. Much of the recent literature has focused on a handful of related approaches that I describe below.

### 3.1 Efficiency Gap

The *efficiency gap* is a metric commonly used in the literature to measure partisan fairness in districting. It measures the efficiency with which parties are able to convert votes into seats. Both cracked and packed districts “waste” more votes of the disadvantaged party than of the advantaged one (McGhee 2014; Stephanopoulos and McGhee 2015). The efficiency gap is defined as “the difference between the parties’ respective wasted votes, divided by the total number of votes cast in the election” (Stephanopoulos and McGhee 2015, 831; see also McGhee 2014, 2017). All of the losing party’s votes are considered wasted if they lose the election. When a party wins an election, the “wasted” votes are those above the 50%+1 vote margin needed to win.<sup>1</sup>

New Mexico’s enacted congressional map yields a pro-Democratic efficiency gap of approximately 39% using the votes from the 2020 presidential election re-aggregated onto the enacted plan.<sup>2</sup> The inferences that can be drawn from this figure in isolation, however, are limited given that New Mexico has only three congressional seats. Past studies have found that states with small numbers of congressional seats can have high variance in their efficiency gap over the course of a decade due to close elections in one or two districts (Stephanopoulos and McGhee 2015). Indeed, I am unaware of the efficiency gap ever having been used in a study of a state with only three districts. As a result, the efficiency gap in New Mexico is likely to be substantially less reliable than in states with larger numbers of districts.

### 3.2 Mean-Median Difference

Another metric that some scholars have proposed to measure partisan bias in a districting plan is the *mean-median difference*: the difference between a party’s vote share in the median district and its average vote share across all districts. If the party wins

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1. In order to account for unequal population or turnout across districts, the efficiency gap formula can be written as:  $EG = S_D^{margin} - 2 * V_D^{margin}$  where  $S_D^{margin}$  is the Democratic Party’s seat margin (the seat share minus 0.5) and  $V_D^{margin}$  is the Democratic Party’s vote margin.  $V_D^{margin}$  is calculated by aggregating the raw votes for Democratic candidates across all districts, dividing by the total raw vote cast across all districts, and subtracting 0.5 (McGhee 2017, 11–12). As Campagna and Grofman (1990, 1247) note, “One key issue [for studies of redistricting] is how to handle uncontested seats. [One needs] to avoid using 100% as the vote share for a party in an uncontested seat (which, for Congress, tends to bloat ... vote share).” In my analysis, I estimate the two-party vote share in districts with uncontested races based on previous and future elections in that district as well as the results in similar districts elsewhere. For a more detailed discussion of the methodology, see Appendix A of Stephanopoulos and Warshaw (2020).

2. I use the 2020 presidential election throughout this section to illustrate the various metrics in the context of New Mexico. It is common in the academic literature to use the most recent presidential election as a benchmark for the partisan lean of congressional districts.



more votes in the median district than in the average district, it has an advantage in its translation of votes to seats (Krasno et al. 2018; Best et al. 2017; Wang 2016). In statistics, comparing a dataset’s mean and median is a common statistical analysis used to assess skews in the data and detect asymmetries (Brennan Center 2017).

| District | Democratic<br>Vote Share |
|----------|--------------------------|
| 2        | 0.53                     |
| 3        | 0.56                     |
| 1        | 0.57                     |
| Mean     | 55.3%                    |
| Median   | 55.5%                    |

Table 1: Results in 2020 New Mexico presidential elections on Enacted Map

Table 1 illustrates the mean-median approach using the results in the 2020 New Mexico presidential election re-aggregated to the districts in the enacted map. Across all districts, Democrats won an average of 55.3% of the vote. And they won 55.5% in the median district. This translated into a mean-median difference close to zero (0.2 percentage points), which implies that the New Mexico congressional plan has no skew or asymmetry in how it treats Democrats and Republicans. In other words, it implies that the New Mexico plan is fair.

The mean-median difference is very easy to apply (Wang 2016), but it is not without its own limitations. For instance, it is possible that this metric won’t always detect packing and cracking (Buzas and Warrington 2021) because it does not necessarily detect seats changing hands due to a gerrymander (McGhee 2017). Finally, the assumptions of the mean-median difference are less tenable in less electorally competitive states. This last point does not apply in New Mexico, however, since New Mexico is relatively competitive.

### 3.3 Symmetry in the Vote-Seat Curve Across Parties

The *symmetry* metric is based on the idea that basic fairness indicates that each party should receive the same share of seats for identical shares of votes (Niemi and Deegan 1978; Gelman and King 1994; McGhee 2014; Katz, King, and Rosenblatt 2020). For example, if a party receives a vote share of 54% and a seat share of 64%, the opposing party should also expect to receive a seat share of 64% if it were to receive a vote share of 54%.

The *symmetry* idea also implies that a party that receives half the vote ought to receive half the seats. And if a party wins more than half the votes, they should receive a majority

of the seats. A plan that violates this principle undermines the foundational premise that legislatures “should be bodies which are collectively responsive to the popular will” for which “a majority of the people of a State” should reasonably be able to “elect a majority” in “a society ostensibly grounded on representative government” (*Reynolds v. Sims*, 377 U.S. 533, 565 (1964)).

The symmetry metric is typically a reliable indicator of gerrymandering in states such as New Mexico with competitive statewide elections.<sup>3</sup> Indeed, an important strength of the symmetry approach is that it is based on the overall vote-seat curve and not any particular point on it. As a result, it is relatively immune to shifts in party performance (McGhee 2014). Moreover, the symmetry approach has been very widely used in previous studies of gerrymandering and redistricting (Gelman and King 1994; McGhee 2014; Katz, King, and Rosenblatt 2020).<sup>4</sup>

Gelman and King (1994, 536) propose two ways to measure partisan bias using symmetry. First, symmetry can be measured using hypothetical election results where each party receives between 45% and 55% of the two-party vote. Across this range of vote shares, each party should receive the same number of seats for the same share of votes. Symmetry captures any departures from this standard. For example, if partisan bias is -0.05, Democrats receive 5% fewer seats in the legislature than they should under the symmetry standard (and Republicans receive 5% more seats than they should).

To illustrate the symmetry metric, Table 2 calculates what each party’s share of the seats would have been in New Mexico’s 2020 presidential election (re-aggregated onto the enacted map) across a range of statewide vote shares from 45%-55%. Both parties typically win a majority of the seats when they win a majority of the votes. Overall, Democrats receive an average of 47% of the seats, while Republicans win 53%. This implies a pro-Republican bias of just 3% using the symmetry metric. This is a relatively small amount of partisan bias and implies that the plan is fair.

Second, symmetry can be measured based on the seat share that each party receives when they split the statewide vote 50-50. In an unbiased system, each party should receive

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3. See also Mr. Trende’s expert report on p. 14, where he notes that New Mexico “is a relatively competitive state.”

4. A weakness of the symmetry approach, however, is that it requires the analyst to calculate counter-factual elections. This approach has both conceptual and empirical limitations. At a conceptual level, it is not clear that it aligns perfectly with the usual definition of a gerrymander. Indeed, “when observers assert that a district plan is a gerrymander, they usually mean that it systematically benefits a party (and harms its opponent) in actual elections. They do not mean that a plan would advantage a party in the hypothetical event of a tied election, or if the parties’ vote shares flipped” (Stephanopoulos and McGhee 2015, 857). At an empirical level, in order to generate symmetry metrics, we need to simulate counter-factual elections by shifting the actual vote share in each district a uniform amount (McGhee 2014). In general, this uniform swing assumption seems reasonable based on past election results.

| Dem. Vote<br>Share    | Dem. Seat<br>Share | Rep. Vote<br>Share | Rep. Seat<br>Share |
|-----------------------|--------------------|--------------------|--------------------|
| 45%                   | 0%                 | 45%                | 0%                 |
| 46%                   | 0%                 | 46%                | 0%                 |
| 47%                   | 0%                 | 47%                | 0%                 |
| 48%                   | 0%                 | 48%                | 33%                |
| 49%                   | 33%                | 49%                | 33%                |
| 50%                   | 67%                | 50%                | 33%                |
| 51%                   | 67%                | 51%                | 66%                |
| 52%                   | 67%                | 52%                | 100%               |
| 53%                   | 100%               | 53%                | 100%               |
| 54%                   | 100%               | 54%                | 100%               |
| 55%                   | 100%               | 55%                | 100%               |
| Mean Seat Share       | 47%                |                    | 53%                |
| Average symmetry bias | -3%                |                    | 3%                 |
| Bias in tied election | 17%                |                    | -17%               |

Table 2: Symmetry Calculations for 2020’s Presidential Election on Enacted Map

50% of the seats in a tied statewide election.

In the 2020 presidential election, Democrats would have won 67% of the seats in an exactly tied election statewide. This implies a pro- Democratic partisan bias of 17%. But the small number of seats in New Mexico makes this difficult to interpret. Since there are only three seats, it is impossible for New Mexico to have zero bias in a tied statewide election, and even the fairest map will have a partisan bias of 17% in favor of one party or another.

### 3.4 Comparison of Partisan Bias Measures

All of the measures of partisan advantage discussed in the previous sections are closely related both theoretically and empirically (McGhee 2017; Stephanopoulos and McGhee 2018), particularly in states with competitive elections. Figure 1 shows that the various measures generally have high correlations with one another (Stephanopoulos and McGhee 2018; Stephanopoulos and Warshaw 2020). As a result, where none of the metrics is an outlier and they all point in the same direction, we can draw a particularly robust conclusion.

If the metrics disagree with one another, however, the totality of the evidence is less likely to indicate there is substantial vote dilution in those states. Indeed, disagreement across metrics often suggests that our conclusions about a plan are sensitive to particular assumptions in the individual metrics. As we will see, in the case of New Mexico, three of



Figure 1: Correlation between measures of partisan bias in states with competitive statewide elections.

the metrics show the plan is relatively neutral and one is an outlier. That indicates that the totality of the data does not indicate that the map reflects substantial vote dilution.

## 4 Partisan Fairness of New Mexico’s Enacted Congressional Map

In this section, I will provide a comprehensive evaluation of the partisan fairness of New Mexico’s enacted congressional districting plan (see Figure 2 for a map of the enacted plan). To evaluate the enacted plan, we need to predict future election results on this map. Here, I use two complementary methodologies to predict future congressional elections in New Mexico and generate the various metrics I discussed earlier. First, I use a composite of the statewide elections over the past decade. Next, I use the actual 2022 congressional elections in New Mexico.

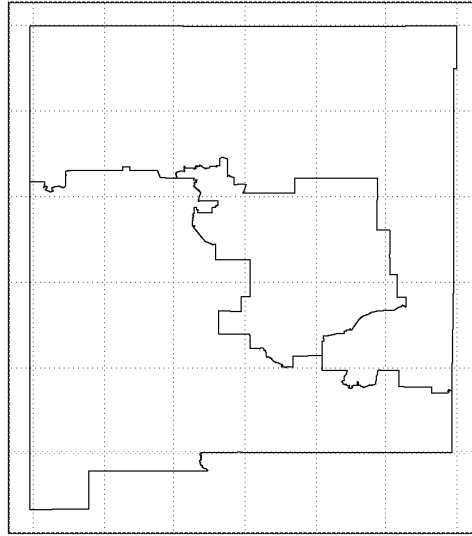


Figure 2: Map of Enacted Plan.

#### 4.1 Fairness of Plans based on Composite Index

First, I use a composite of 29 statewide election contests over the past five election cycles (2014-2022) re-aggregated to the enacted map.<sup>5</sup> The goal of this composite index is to help predict how a map will perform over a full decade. For each year, I estimate each party’s vote share, seat share, and the average of the partisan bias metrics across races. I then average them together to produce an overall composite result.

This composite index has a number of advantages over focusing on a single election to evaluate the new map. The composite index averages across 5 election cycles, which incorporates uncertainty across election cycles. That is, it includes both good years for Democrats and good years for Republicans. It also averages across 29 individual races, which reduces idiosyncratic variation due to incumbency (Jacobson 2015), variation in the local economy (Benedictis-Kessner and Warshaw 2020), campaign effects (Sides, Vavreck, and Warshaw 2022), and the presence of third party candidates such as former New Mexico

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5. These include all presidential, Senate, gubernatorial, treasurer, auditor, secretary of state, attorney general, commissioner of public lands, and state supreme court elections during this period. I focus on election results rather than voter registration data because registration data are less indicative of voter’s political preferences than actual elections. Moreover, the academic literature on partisan fairness in districting focuses on election results rather than voter registration. On these points, Mr. Trende’s expert report for the plaintiffs agrees with me, stating that “registration does not necessarily correspond to voting in New Mexico (a registered Democrat in southwest New Mexico can be very different than a registered Democrat in Santa Fe; the same is true for Republicans); (2) the political science literature with which I am familiar has almost entirely utilized vote outcomes [rather than registration]” (p. 61). Similarly, the Proposed Amici Brief at 6 states that “Election data, not voter registration data, is the relevant source of analysis.”

Governor Gary Johnson in 2016.<sup>6</sup> Due to the growing nationalization of elections, these statewide races are an excellent predictor of congressional races. The average correlation between my composite of statewide race and the actual congressional results is 0.98.<sup>7</sup> Moreover, the mean absolute error is 3.5%. This composite index is better than the approaches used in either Mr. Trende’s report or the Proposed Amici Brief to measure the partisan lean of New Mexico’s plan (see more discussion on this below).

In Table 3, I calculate partisan fairness metrics for the plans enacted in 2012 and 2022. Table 4 shows the partisan fairness metrics for the plans proposed by the Citizen Redistricting Committee. For each of these plans, I compare their partisan fairness to other plans around the country over the past 50 years in states with 3-7 seats that are directly comparable to New Mexico (right panel).

| Metric                        | Value | Compared to small states   |                              |
|-------------------------------|-------|----------------------------|------------------------------|
|                               |       | > Biased than this % Plans | > Pro-Dem. than this % Plans |
| <b>Enacted Plans:</b>         |       |                            |                              |
| <b>2012 Plan</b>              |       |                            |                              |
| Republican Seat Share         | 35%   |                            |                              |
| Efficiency Gap                | 5.4%  | 32%                        | 73%                          |
| Mean-Median Diff              | 3.8%  | 74%                        | 91%                          |
| Symmetry Bias (45-55)         | 10.4% | 67%                        | 87%                          |
| Symmetry Bias (tied election) | 14.4% | 72%                        | 89%                          |
| Average                       |       | 61%                        | 85%                          |
| <b>2022 Plan</b>              |       |                            |                              |
| Republican Seat Share         | 17%   |                            |                              |
| Efficiency Gap                | 23.7% | 94%                        | 95%                          |
| Mean-Median Diff              | 0.4%  | 10%                        | 59%                          |
| Symmetry Bias (45-55)         | 0.9%  | 13%                        | 59%                          |
| Symmetry Bias (tied election) | 7.5%  | 50%                        | 78%                          |
| Average                       |       | 42%                        | 73%                          |

Table 3: Composite bias metrics for enacted Congressional plans based on statewide elections compared to other congressional plans from 1972-2022. I refer to these plans as “previous plans” throughout the report.

On the 2012 benchmark plan, Republican won 35% of the seats based on the composite index. The efficiency gap of this plan is 5.4%, which is relatively neutral. When I average

6. As Mr. Trende’s report notes on p. 10-11, “the presence of former New Mexico Governor Gary Johnson, a Republican, on the Libertarian ticket in 2016 makes that election difficult to use in New Mexico. Assuming that he drew disproportionately from Republicans, his performance may make a district seem more Democratic than it actually was, biasing the evidence against the state.”

7. To calculate this statistic, I first take the correlation between the composite and congressional results in each individual year. I then calculate the average of these correlations across years.

| Metric  | Value | Compared to small states   |                              |
|---|-------|----------------------------|------------------------------|
|   |       | > Biased than this % Plans | > Pro-Dem. than this % Plans |
| <b>Citizen Redistricting Committee A Plan</b> |       |                            |                              |
| Republican Seat Share                         | 35%   |                            |                              |
| Efficiency Gap                                | 5.4%  | 32%                        | 73%                          |
| Mean-Median Diff                              | 3.9%  | 74%                        | 91%                          |
| Symmetry Bias (45-55)                         | 10.2% | 67%                        | 87%                          |
| Symmetry Bias (tied election)                 | 14.4% | 72%                        | 89%                          |
| Average                                       |       | 61%                        | 85%                          |
| <b>Citizen Redistricting Committee E Plan</b> |       |                            |                              |
| Republican Seat Share                         | 34%   |                            |                              |
| Efficiency Gap                                | 7.1%  | 40%                        | 77%                          |
| Mean-Median Diff                              | 3.4%  | 70%                        | 90%                          |
| Symmetry Bias (45-55)                         | 7.9%  | 50%                        | 78%                          |
| Symmetry Bias (tied election)                 | 14.4% | 72%                        | 89%                          |
| Average                                       |       | 58%                        | 84%                          |
| <b>Citizen Redistricting Committee H Plan</b> |       |                            |                              |
| Republican Seat Share                         | 21%   |                            |                              |
| Efficiency Gap                                | 19.6% | 88%                        | 94%                          |
| Mean-Median Diff                              | 0.7%  | 21%                        | 63%                          |
| Symmetry Bias (45-55)                         | -0.6% | 13%                        | 45%                          |
| Symmetry Bias (tied election)                 | 9.7%  | 50%                        | 78%                          |
| Average                                       |       | 43%                        | 70%                          |

Table 4: Composite bias metrics for plans proposed by Citizen Redistricting Committee plans based on statewide elections compared to other congressional plans from 1972-2022. I refer to these plans as “previous plans” throughout the report.

across metrics of partisan fairness, the benchmark plan is in the 61st percentile of the absolute bias levels of previous plans.

On the enacted 2022 plan, Republican won 17% of the seats in the composite index (ie., about half a seat fewer per year than on the 2012 plan). The efficiency gap of the 2022 plan is 23.7%. This is farther from zero than 94% of previous plans in small states. But as discussed above, the efficiency gap is less reliable in states, such as New Mexico, with just 3 districts. Moreover, the other metrics of partisan fairness, including both symmetry metrics and the mean-median difference, are all relatively neutral. When we take the average of the four bias metrics, the 2022 plan is near the middle of the distribution of previous plans in small states (in just the 42nd percentile of previous plans). It is also more neutral than the 2012 plan across the average of the four metrics. Overall, these metrics do not indicate egregious partisan bias in favor of either political party on the 2022 plan.

Of the three Citizens Committee plans, Plan H looks most similar to the enacted plan.

In fact, the Democrats' seat share is very similar in Plan H and the enacted plan. Just like in the enacted plan, Plan H has a large pro-Democratic efficiency gap, but looks neutral on other metrics.

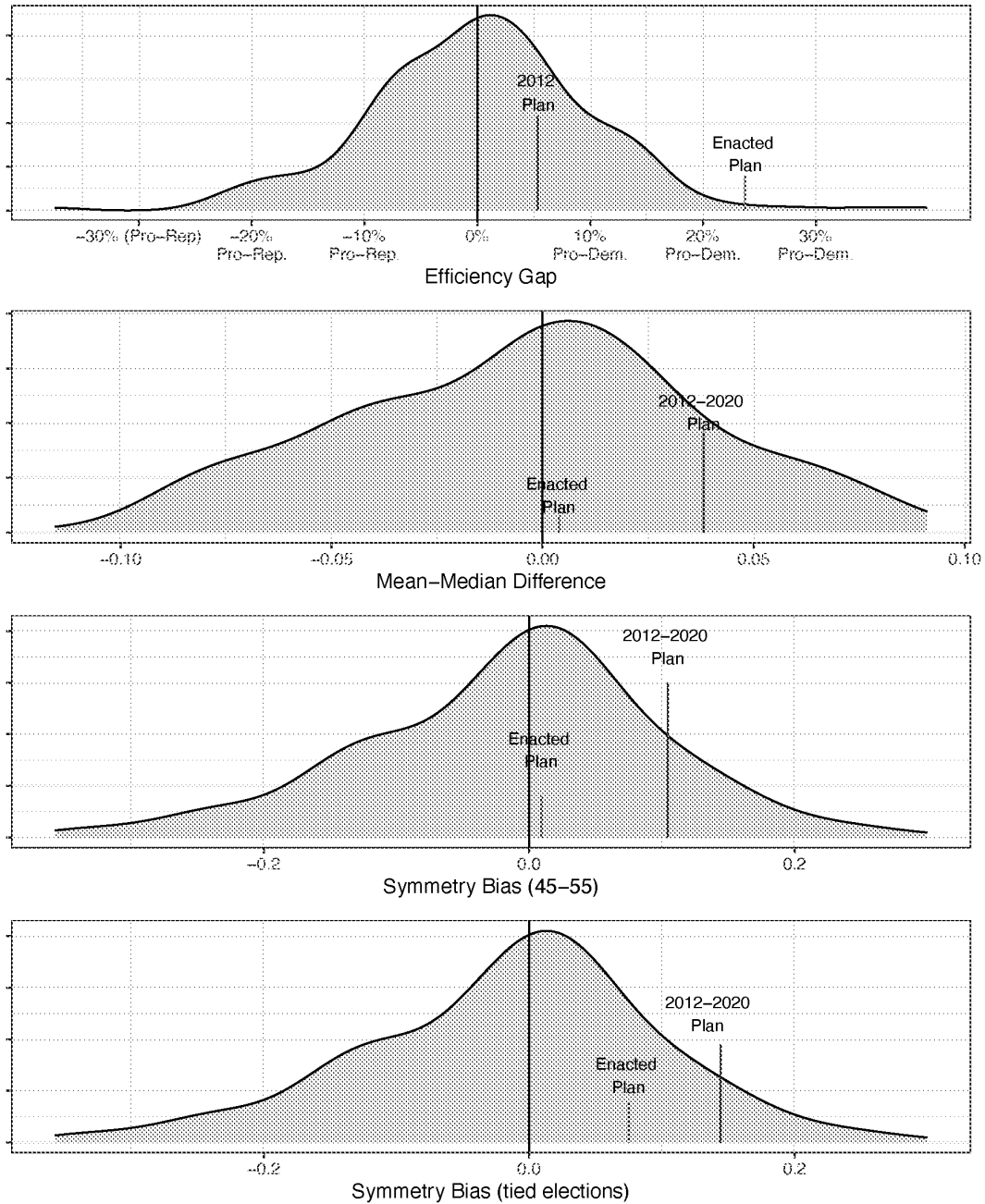


Figure 3: Partisan fairness metrics for 2022 Enacted Plan and the 2012 Benchmark Plan compared to other plans around the country from 1972-2022.



Lastly, Figure 3 graphically compares the bias in the 2022 enacted plan, the 2012 benchmark plan, and other plans in small states around the country over the past 50 years. It indicates that the enacted plan has a large pro-Democratic bias compared to other plans around the country on the efficiency gap, but not on symmetry and the mean-median difference. In fact, the enacted plan looks more neutral than both the 2012 plan and most other plans around the country on these metrics.

#### **4.1.1 Comparison with Trende Expert Report and Amici Curiae Brief (Aug. 14, 2023)**

Here, I briefly compare my composite index with the approaches in two other submissions to the Court.

##### **Mr. Sean Trende Report:**

The expert report of Sean Trende for the plaintiffs takes two approaches to predict election results on the enacted map. First, he uses presidential results from 2016 and 2020 (p. 10-11). In general, recent analysis indicates that presidential election results are nearly perfectly correlated with congressional results in recent years (see, for instance, Table 3 in Jacobson 2021). But this is less true in New Mexico, where the average correlation between two-party presidential results and congressional results is 0.93 between 2014 and 2022. Moreover, the mean absolute error is 3.8%. Thus, presidential vote is less closely connected with congressional elections than my composite index.

Next, similarly to my report, Mr. Trende uses a composite partisan index (p. 11). But his composite only includes elections from the 2016 presidential election, which Mr. Trende acknowledges was a good year for Democrats in New Mexico due in part to Gov. Johnson's third party candidacy, and 2018-2020, which were both very good years for Democrats. Crucially, it does not include the 2014 and 2022 elections, where were both stronger years for Republicans. The selective choice of years in Mr. Trende's report makes the map appear to be better performing for Democrats than it is likely to be over the course of a full decade, which will inevitably include good years for Republicans (e.g., during the midterm of a Democratic president). Indeed, Republicans do not win any seats on the enacted plan using Trende's index, while they win 17% of the seats across the course of a decade using my index. Mr. Trende's composite also systemically excludes state supreme court races. Finally, it excludes the 2016 state secretary of state race.

##### **Proposed Amici Brief**

The Proposed Amici Brief at 6 and 15 also recommends the usage of a composite

partisan index. But like Mr. Trende’s report, the composite in the Proposed Amici Brief does not include the 2014 and 2022 elections, where were both stronger years for Republicans. It also does not include a number of statewide elections for downballot offices such as Treasurer or Auditor. Just like Mr. Trende’s composite, this makes the map appear to be better performing for Democrats than it is likely to be over the course of a full decade, which will inevitably include good years for Republicans (e.g., during the midterm of a Democratic president). Indeed, Republicans do not win any seats on the enacted plan using the Proposed Amici Brief index, while they win 17% of the seats across the course of a decade using my index.

## 4.2 Fairness of Plans based on 2022 Congressional election results

Next, I use the 2022 congressional results to estimate the various partisan fairness metrics of the enacted plan. In this election, Democrats did relatively well in the statewide vote – winning 55% of the vote. They then won 100% of the seats (3 out of 3) on the enacted plan.

| Metric                        | Compared to small states |                               |                                 |
|-------------------------------|--------------------------|-------------------------------|---------------------------------|
|                               | Value                    | > Biased than<br>this % Plans | > Pro-Dem. than<br>this % Plans |
| <b>Enacted Plan</b>           |                          |                               |                                 |
| Republican Vote Share         | 45%                      |                               |                                 |
| Republican Seat Share         | 0%                       |                               |                                 |
| Efficiency Gap                | 39.9%                    | 99%                           | 100%                            |
| Mean-Median Diff              | 1%                       | 30%                           | 68%                             |
| Symmetry Bias (45-55)         | -1.5%                    | 15%                           | 49%                             |
| Symmetry Bias (tied election) | 16.7%                    | 77%                           | 94%                             |
| Average                       |                          | 55%                           | 78%                             |

Table 5: Partisan bias metrics for 2022 Congressional election results compared to other congressional plans around the country from 1972-2022.

The efficiency gap of the enacted plan is 39.9% (see Table 5), which indicates a pro-Democratic bias. The other metrics, however, show that New Mexico’s enacted plan is relatively neutral. The mean-median difference is almost exactly zero and one of the symmetry metrics actually shows a small pro-Republican advantage. When we average across the absolute bias shown in all four metrics, the plan is near the middle of the distribution of previous plans around the country (in the 55th percentile of previous plans in small states). It is more pro-Democratic than about three quarters of previous plans. This does not indicate egregious partisan bias in favor of either political party in the 2022

election.

### 4.3 Academic Studies on Fairness of New Mexico’s Plan

There have been a number of studies by other academics and data journalists on the partisan fairness of congressional plans around the country that were enacted in 2021 and 2022. In regard to the New Mexico plan, these studies reached mixed conclusions. Some of these studies find evidence, usually based on the efficiency gap, that the 2022 enacted plan is biased in favor of Democrats. But according to other metrics, these studies find little or no evidence of pro-Democratic bias. Some even find evidence of pro-Republican bias.

- A team of political scientists at Harvard University compared the enacted New Mexico plan to an ensemble of nonpartisan simulations (McCartan et al. 2022; Kenny et al. 2023). Their simulation methodology closely mirrors the general approach that Mr. Trende takes in his report.<sup>8</sup> Their approach is also closely related to the simulation approach endorsed by Justin Kagan in her dissent in *Rucho*. Their analysis compares “the enacted plan to those under a set of alternative simulated plans that serve as a nonpartisan baseline.” Their approach incorporates both geography and state-specific redistricting rules into the nonpartisan baseline. The Harvard team concluded that the enacted plan gave Democrats an average of about .35 additional seats compared to a nonpartisan plan (Kenny et al. 2023). This led to a pro-Democratic bias using the efficiency gap metric.<sup>9</sup> In a supplemental analysis, however, they found that the plan had a pro-Republican bias in terms of its deviation from partisan symmetry.<sup>10</sup> In other words, if Democrats and Republicans evenly split the statewide vote, Republicans would do better under the enacted map than in a nonpartisan plan. Thus, similarly to my analysis, Kenny et al. (2023)’s analysis indicates that conclusions about the fairness of New Mexico’s plan are sensitive to our choice of partisan fairness metrics.<sup>11</sup>

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8. In fact, Mr. Trende uses the *redist* R package developed by the Harvard team in his report (see p. 17).

9. See Figures S4 and S5 in Christopher T. Kenny, “Widespread Partisan Gerrymandering Mostly Cancels Nationally, but Reduces Electoral Competition”, PNAS.org (June 13, 2023), <https://www.pnas.org/doi/10.1073/pnas.2217322120#supplementary-materials>.

10. See New Mexico Congressional Districts, ALARM (June 17, 2023), [https://alarm-redist.org/fifty-states/NM\\_cd\\_2020/](https://alarm-redist.org/fifty-states/NM_cd_2020/). Note that the seat shares in the PNAS paper and the ALARM website do not exactly match because the ALARM website uses a much simpler, deterministic approach to predict elections (based on a relatively small set of elections between 2016-2020) than the more nuanced probabilistic approach in the authors’ PNAS paper.

11. Mr. Trende’s report does not present any generally accepted metrics of partisan fairness. So it is difficult to know whether his findings would also vary across fairness metrics.

- A team of mathematicians used a different technique to evaluate the fairness of plans around the country (Campisi et al. 2022). They concluded that the enacted plan has no measurable bias using the Geography and Election Outcomes (GEO) metric.<sup>12</sup> Their analysis indicates that neither party could improve its seat share using vote share swaps from neighboring districts. This contradicts the analysis in Mr. Trende’s report starting on p. 31, where he argues that small changes in New Mexico’s map would lead it to become much less favorable for Democrats, and conversely, more favorable for Republicans.
- The FiveThirtyEight website founded by Nate Silver also evaluated the fairness of redistricting plans around the country. It concluded that New Mexico’s plan had a pro-Democratic bias based on the efficiency gap but a pro-Republican bias based on the mean-median difference. Thus, similarly to my analysis and Kenny et al. (2023), the FiveThirtyEight analysis indicates that conclusions about the fairness of New Mexico’s plan are sensitive to which fairness metrics are used.<sup>13</sup> The FiveThirtyEight analysis also indicates that the new map yields much more competitive elections than the old 2012-2020 map.
- A group of academic redistricting experts filed a Proposed Amici Brief. Just like the other academic studies as well as my report, they find that the enacted plan yields a disproportionate seat share for Democrats in the average election. But they find that it is neutral in terms of its partisan symmetry. “Under hypothetical ‘tied’ conditions, Democrats and Republicans are equally likely to win congressional seats under the Enacted Plan.” Thus, this analysis also indicates that conclusions about the fairness of New Mexico’s plan differ across fairness metrics.
- The New Mexico Citizens Redistricting Committee commissioned Professor David Cottrell to evaluate the three plans proposed by the Committee. His report found that all the plans proposed by the Committee “were within all the expected ranges for the six partisan fairness metrics.”<sup>14</sup> Just like my report, he found that, based on efficiency gap, “Map H produces more Democratic districts than the others but its partisan symmetry favors Republicans.” This is relevant for understanding the fairness of the enacted plan, as well, since my analysis indicates that it is generally

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12. See <https://www.the-geometric.com/congressional-plans-table>.

13. See “What Redistricting Looks Like in Every State: New Mexico,” FiveThirtyEight (July 19, 2023, 3:50 PM), <https://projects.fivethirtyeight.com/redistricting-2022-maps/new-mexico/>.

14. See Citizen Redistricting Committee, “CRC District Plans & Evaluations,” 41 (November 2, 2021), <https://www.nmredistricting.org/wp-content/uploads/2021/11/2021-11-2-CRC-Map-Evaluations-Report-Reissued-1.pdf>.

quite similar to the Committee’s Plan H in terms of both its partisan fairness and competitiveness.

## 5 Responsiveness and Competitive Elections

Another benchmark for measuring the partisan bias in a districting plan is the percentage of districts likely to have competitive elections under that plan and the responsiveness of the plan to changes in voters’ preferences (Cox and Katz 1999). There are a number of normative reasons to care about the number of competitive districts in a plan. First, competitiveness affects the responsiveness of a map as the two parties’ statewide vote shares rise and fall. A plan with more competitive elections is likely to be more responsive to changes in voters’ preferences than a plan with fewer competitive elections (McGhee 2014). An unresponsive map ensures that the bias in a districting plan toward the advantaged party is insulated against changes in voters’ preferences, and thus is durable across multiple election cycles. Second, uncompetitive districts tend to protect incumbents from electoral consequences (Tufté 1973; Gelman and King 1994). This could harm political representation by making legislators less responsive and accountable to their constituents’ preferences.

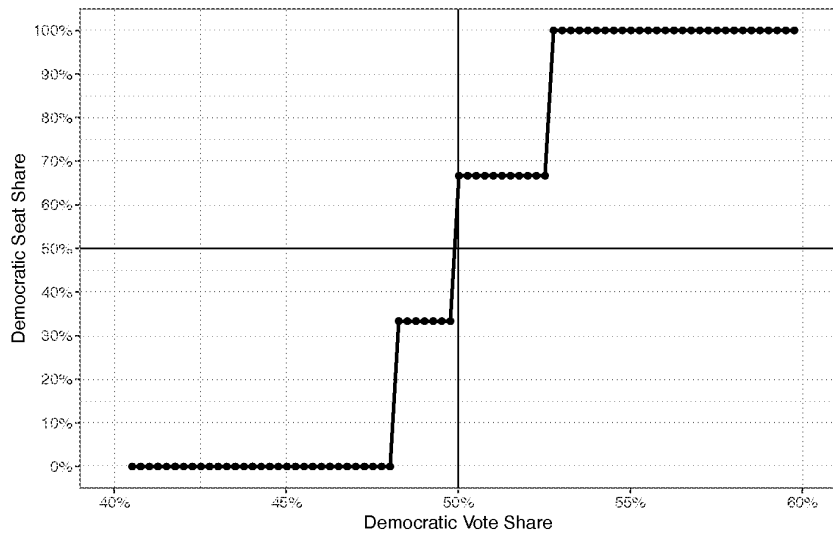


Figure 4: Vote-seat curve in New Mexico using uniform swings in 2020 election results re-aggregated using enacted plan.

To illustrate the concept of responsiveness, Figure 4 shows the vote-seat curve in New

Mexico generated by hypothetical modifications to the 2020 election results.<sup>15</sup> Specifically, I apply a uniform swing in the actual election results until I achieve an average Democratic vote share of 40%. Then I steadily increase the average Democratic vote share until it reaches 60%. This chart shows that New Mexico’s congressional map is highly responsive to changes in voter preferences. The two parties’ seat shares change as their vote shares change. This suggests that it is probably not an extreme gerrymander.

Next, I evaluate whether the new map increases the competitiveness of New Mexico’s congressional elections compared to the 2012 benchmark plan. I use a variety of approaches to estimate the number of competitive districts in both the 2012 benchmark plan and the enacted plan (see Table 6). Overall, my analysis indicates that the enacted plan has more competitive districts than the 2012 plan.

| <b>Data:</b>   | Actual House Results |                  | Composite (2012-20) | PlanScore |                               |                         | <b>Mean</b> |
|----------------|----------------------|------------------|---------------------|-----------|-------------------------------|-------------------------|-------------|
| <b>Metric:</b> | 45-55                | Historical Swing | 45-55               | 45-55     | 20%+ Prob. of Each Party Win. | 50%+ Prob. Flip in Dec. |             |
| <b>Plan</b>    | (1)                  | (2)              | (3)                 | (4)       | (5)                           | (6)                     | (7)         |
| 2022 Plan      | 33%                  | 33%              | 49%                 | 33%       | 33%                           | 33%                     | 36.2%       |
| 2012 Plan      | 33%                  | 33%              | 21%                 | 0%        | 0%                            | 0%                      | 17%         |
| Citizen A Plan | NA                   | NA               | 17%                 | 0%        | 0%                            | 0%                      | 4%          |
| Citizen E Plan | NA                   | NA               | 24%                 | 0%        | 0%                            | 0%                      | 6%          |
| Citizen H Plan | NA                   | NA               | 47%                 | 33%       | 33%                           | 33%                     | 36.5%       |

Table 6: Number of competitive districts using various data sources and metrics.

First, I use the actual 2020 and 2022 House results to examine the number of competitive districts. In column 1 of Table 6, I begin by tallying the number of districts where each party’s two-party vote share was between 45 and 55%. This approach indicates there was 1 competitive district on the enacted plan (using 2022 House results) and 1 competitive district (33% of 3 districts) on the 2012 plan (using 2020 House results). As I discussed earlier, however, it is not clear that a sharp threshold at 55% is the best measure of competitiveness.

Based on the approach in Henderson, Hamel, and Goldzimer (2018, Appendix, p. 2), we can also define competitiveness based on whether a district is likely to switch parties at least once per decade based on the maximal swing in the two-party vote. In column 2 of Table 6, I use this approach to tally the number of districts that each party would win at least once over the course of the decade based on the historical range of statewide election results between 2012-2020. Specifically, I conduct a uniform swing to simulate what would happen if the most recent congressional election were held in the best year for

15. The layout of this chart is adapted from charts in Royden, Li, and Rudensky (2018).

Republicans (2014) and the best year for Democrats (2018). I then examine the number of districts that would have been won at least once by each party. This approach indicates there was 1 competitive district on the enacted plan and 1 competitive district on the 2012 plan.

Next, I use a composite of the 2012-2020 statewide election results to estimate the number of competitive districts. Once again, in column 3 of Table 6, I tally the number of districts where each party's two-party vote share was between 45 and 55%. This approach indicates that about 49% of congressional elections would have been competitive on the enacted plan compared to 21% of the elections on the 2012 plan.

Then, I use the PlanScore website to estimate the potential competitiveness of individual districts on the enacted plan using a probabilistic model based on the 2020 presidential election.<sup>16</sup> In column 4 of Table 6, I show the number of districts where PlanScore estimates that each party's two-party vote share is expected to be between 45 and 55%. This approach indicates there is 1 competitive district on the enacted plan compared with 0 competitive districts on the 2012 plan.

It is also possible to use PlanScore to evaluate whether a district is likely to switch parties at least once per decade (Henderson, Hamel, and Goldzimer 2018). PlanScore conducts 1,000 simulations of possible electoral scenarios based on the results of the 2012-2020 congressional elections in every state. Using these simulations, PlanScore provides an estimate of the probability that each party will win each seat as well as whether they are likely to have at least a 50% chance of winning each seat once over the course of the decade. In column 5 of Table 6, I estimate the percentage of districts where each party has at least a 20% chance of winning according to PlanScore. This approach indicates there was 0 competitive districts on the 2012-20 plan and 1 competitive district on the enacted plan. In column 6 of Table 6, I conduct a similar analysis where I tally the number of districts that each party would have at least a 50% chance of winning at least once over the course of the decade. This approach also indicates there is 1 competitive district on the enacted plan compared with 0 competitive districts on the 2012-20 plan.

Finally, column 7 of Table 6 averages across all of these approaches. It indicates that about 26% of the congressional elections would be competitive on the 2022 enacted plan compared to 17% on the 2012 plan. Thus, there is strong support for the notion that the enacted 2022 plan increases the likely number of competitive congressional elections compared to the 2012 plan. The table indicates that it also increases the number of competitive elections compared to two of the Citizen Redistricting Committee plans

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16. See PlanScore (Aug. 9, 2023), <https://planscore.org/plan.html?20230809T172220.950810347Z> and PlanScore (Aug. 9, 2023), <https://planscore.org/plan.html?20230809T173209.962383428Z>.

(Concepts A and E), and achieves roughly the same level of competitiveness as the third (Concept H).

## 6 Conclusion

This report has evaluated the partisan fairness and competitiveness of the enacted congressional districting plan in New Mexico. My analysis indicates that the enacted plan has a pro-Democratic bias on some metrics of partisan fairness, but is neutral on other metrics. Crucially, the plan does not violate the “majoritarian principle” that when a party receives the most votes it should usually win the majority of seats. When Democrats win a majority of the votes, they will usually win a majority of the seats on this plan. So too, when Republicans win a majority of the votes, they will usually win a majority of the seats on this plan.

When I take the average of the metrics typically used by academics to assess the partisan fairness of a plan, the enacted map is more fair than either the 2012 benchmark plan or any of the plans proposed by the Citizen Redistricting Committee. Outside studies from academics and data journalists also reach mixed conclusions regarding the fairness of the enacted plan. As a result, a comprehensive analysis of the relevant metrics indicates that the enacted plan does not lead to substantial vote dilution or create an egregious partisan effect.

I also evaluated whether the plan increases the competitiveness of congressional elections in New Mexico. I conclude that it does. It would lead to more competitive elections than the 2012 benchmark plan. It would also lead to at least as many competitive elections as any of the plans proposed by the Citizen Redistricting Committee.

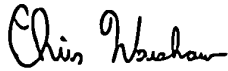


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