UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF WISCONSIN

WILLIAM WHITFORD, ROGER ANCLAM, EMILY BUNTING, MARY LYNNE DONOHUE, HELEN HARRIS, WAYNE JENSEN, WENDY SUE JOHNSON, JANET MITCHELL, ALLISON SEATON, JAMES SEATON, JEROME WALLACE, and DONALD WINTER, Plaintiffs, v. GERALD C. NICHOL, THOMAS BARLAND, JOHN FRANKE, HAROLD V. FROEHLICH, KEVIN J. KENNEDY, ELSA LAMELAS, and TIMOTHY VOCKE, Defendants.	)	No. 15-cv-421-bbc

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MOTION FOR LEAVE TO PARTICIPATE AS *AMICUS CURIAE*

Dr. Jowei Chen respectfully moves for leave to participate in this matter as *amicus curiae* by filing the attached proposed brief and exhibit. In support of this motion, Dr. Chen states the following:

Dr. Chen is an associate professor in the Department of Political Science at the University of Michigan. Dr. Chen focuses his research and scholarship on spatial statistics, redistricting, gerrymandering, the Voting Rights Act, legislatures, elections, and political geography. In particular, he has expertise in the use of computer algorithms and geographic information systems (GIS) to study questions related to political and economic geography and redistricting. He was a principal author (with Jonathan Rodden) of *Unintentional*

Gerrymandering: Political Geography and Electoral Bias in Legislatures, published in the Quarterly Journal of Political Science, Vol. 8, No. 3: 239-269 (2013).

Plaintiffs in this case are challenging the current Wisconsin State Assembly redistricting plan as an unconstitutional partisan gerrymander. The issues in this lawsuit overlap significantly with Dr. Chen's academic research and area of expertise. In fact, experts for both sides in this case have discussed Dr. Chen's written work. *See, e.g.*, Expert Report of N. Goedert (Doc. No. 51) at 12-13, 18, 21; Decl. of S. Trende (Doc. No. 55) ¶¶ 89-90; Expert Report of S. Jackman (Rebuttal) (Doc. No. 63) at 20-21.

Of particular interest to Dr. Chen, Defendants have cited his research to argue that Wisconsin's geographic clustering of Democratic voters is part of a national trend whereby political geography creates a natural Republican bias in legislative maps. From that, Defendants argue that the current Wisconsin Assembly redistricting plan does not constitute an intentional partisan gerrymander. *See, e.g.*, Expert Report of N. Goedert (Doc. No. 51) at 18.

Plaintiffs contend that Dr. Chen's application of computer generated plans is inapplicable when evaluating a redistricting plan for partisan bias. *See* Expert Report of S. Jackman (Rebuttal) (Doc. No. 63) at 20-21. As explained in the accompanying brief, the distinctions Plaintiffs cite between this case and Dr. Chen's earlier publications are correct, but are irrelevant.

By moving to participate as *amicus curiae*, Dr. Chen seeks to provide the Court with a fuller explanation of his scholarship and offer additional insight, analysis, context, and other information relevant to these important issues currently before the Court. His proposed brief aims to clarify the correct application of his scholarship to this case. (Dr. Chen does not seek to participate in oral argument.)

This Court has the discretion to permit the filing of an *amicus curiae* brief. *E.g.*, *Nat'l Org. for Women, Inc. v. Scheidler*, 223 F.3d 615, 616 (7th Cir. 2000); *Laborers Local 236, AFL-CIO v. Walker,* No. 11-CV-462-WMC, 2013 WL 4875995, at *3 (W.D. Wis. Sept. 11, 2013), *aff'd*, 749 F.3d 628 (7th Cir. 2014). There is no rule governing district court *amicus curiae* briefs in the Federal Rules of Civil Procedure, but district courts in the Seventh Circuit look to the standards governing appellate briefs. The core criterion for deciding whether to permit the filing of an *amicus* brief is the same in every case: "whether the brief will assist the judges by presenting ideas, arguments, theories, insights, facts, or data that are not to be found in the parties' briefs." *Voices for Choices v. Ill. Bell Tel. Co*., 339 F.3d 542, 545 (7th Cir. 2003). That criterion is more likely to be satisfied when, among other things not relevant here, the *amicus* presents "a unique perspective or specific information that can assist the court beyond what the parties can provide." *Id.* Although a "small body of judicial opinions" disfavor motions for leave to file *amicus* briefs, federal courts generally allow leave. *Neonatology Assocs., P.A. v. C.I.R.*, 293 F.3d 128, 130 (3d Cir. 2002) (Alito, J.). That includes district courts considering gerrymandering claims. *E.g.*, *Henderson v. Perry*, 399 F. Supp. 2d 756 (E.D. Tex. 2005); *Vieth v. Pennsylvania*, 241 F. Supp. 2d 478, 480 (M.D. Pa. 2003); *Cano v. Davis*, 211 F. Supp. 2d 1208, 1213 n.4 (C.D. Cal. 2002).

Here, the fact that both sides discuss Dr. Chen's scholarship highlights the value that his brief can bring to the Court. The parties agree that Dr. Chen's scholarship is relevant but they argue about what Dr. Chen's work means for this case. Dr. Chen's brief will assist the Court because he is in the best position to explain how his scholarship applies to this case. Given his research and experience with the relevant issues, he has a unique perspective and specific information that will assist the Court in applying his work correctly. More precisely, Dr. Chen

will discuss the general extent to which political geography can influence the partisanship of a state's map. He will also provide an analysis of the current Wisconsin Assembly districting plan, using the same computer-simulation methodology from his cited research, which will demonstrate that a non-partisan districting process generally produces a minimally biased State Assembly plan.

There is no formal deadline for the filing of *amicus* materials in this case and this submission is well in advance of the oral arguments on Defendants' motion for summary judgment scheduled for March 23, 2016. The timing of this request alone should not prohibit the granting of leave. *Eby-Brown Co. LLC v. Wisconsin Dep't of Agric.*, No. 00-C-0718-C, 2001 WL 1913622, at *1 (W.D. Wis. Oct. 24, 2001) (Crabb, J.) (allowing an *amicus* submission but providing the opposition an opportunity to respond).

WHEREFORE, Dr. Chen respectfully requests that the Court grant Dr. Chen leave to participate in the case as *amicus curiae*, and allow him to file his proposed brief and exhibit.[1]

Date: March 17, 2016.

Respectfully submitted,

s/ Theodore R. Boehm
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Counsel for Amicus Curiae Jowei Chen

[1] Lawyers from the law firm of Faegre Baker Daniels participated in the drafting of these papers.

CERTIFICATE OF SERVICE

I hereby certify that on March 17, 2016, I electronically filed the foregoing Motion with the Clerk of the Court using the ECF system which will send notification of such filing by electronic Mail to all ECF participants.

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PROPOSED BRIEF OF JOWEI CHEN
AS *AMICUS CURIAE* IN SUPPORT OF PLAINTIFFS

The Defendants and the Defendants' experts in this litigation have cited Dr. Jowei Chen's published academic research for the proposition that Wisconsin's geographic clustering of Democratic voters, rather than partisan gerrymandering, caused the Republican-favoring efficiency gap observed in the Act 43 State Assembly districting plan. *See, e.g.*, Expert Report of N. Goedert (Doc. No. 51) at 12-13, 18, 21. Defendants' reliance on and interpretation of Dr. Chen's published research troubles Dr. Chen because it does not accurately represent his scholarship on the issue and it is misleading and incorrect both in general and as it relates to Wisconsin in particular. Plaintiffs' distinctions of Dr. Chen's methodology, though correct,

merely note differences in the issues addressed in prior publications and the issues in this case. They do not render Dr. Chen's analysis inapplicable to evaluate gerrymandering claims.

A. Dr. Chen's Background

Dr. Chen is an associate professor in the Department of Political Science at the University of Michigan, Ann Arbor. He is also a faculty associate at the Center for Political Studies of the Institute for Social Research at the University of Michigan and a research associate at the Spatial Social Science Laboratory at Stanford University. In 2007, he received a M.S. in Statistics from Stanford University, and in 2009, he received a Ph.D. in Political Science from Stanford University. He has published academic papers on political geography and districting in top political-science journals, including *The American Journal of Political Science, The American Political Science Review*, and *The Quarterly Journal of Political Science*.[1] Dr. Chen's academic areas of expertise include spatial statistics, redistricting, gerrymandering, the Voting Rights Act, legislatures, elections, and political geography. In particular, he has expertise in the use of computer algorithms and geographic information systems (GIS) to study questions related to political and economic geography and redistricting.[2]

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[1] *Voter Partisanship and the Effect of Distributive Spending on Political Participation,* American Journal of Political Science, Vol. 57, No. 1: 200-217 (2012); *The Law of k/n: The Effect of Chamber Size on Government Spending in Bicameral Legislatures,* American Political Science Review, Vol. 101, No. 4: 657-676 (2007); *Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures,* Quarterly Journal of Political Science, Vol. 8, No. 3: 239-269 (2013).

[2] Dr. Chen has also provided expert reports in the following redistricting court cases: *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District and St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Rene Romo et al. v. Ken Detzner et al*. (Fla. 2d Judicial Cir. Leon Cnty. 2013); *The League of Women Voters of Florida et al. v. Ken Detzner et al*. (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Wright et al. v. McCrory et al*. (E.D. N.C. 2013); *Raleigh Wake Citizens Association et al. v. Wake County Board of Elections* (E.D. N.C. 2015); *Corrine Brown et al. v. Ken Detzner et al*. (N.D. Fla. 2015).

B. Dr. Chen's Objection to Defendant's Interpretation of His Work

Defendants argue that Wisconsin Democrats are disadvantaged by geography, rather than by an intentional partisan gerrymander. *See, e.g.*, Defs.' Br. in Support of Summ. J. at 27 ("Both Goedert and Trende rely on recent work by political scientists Jowei Chen of the University of Michigan and Jonathan Rodden of Stanford University."); Expert Report of N. Goedert (Doc. No. 51) at 12-13, 18, 21. Dr. Chen disagrees. The Defendants' misapplication of Dr. Chen's published work to the facts of this case suffers from several fundamental flaws.

As Dr. Chen has made clear throughout his published research, some natural electoral bias due to political geography does not preclude a state legislature from gerrymandering its districting plans to produce greater, in this case far greater, electoral bias. Both natural geography and intentional partisan gerrymandering can contribute to a districting plan's electoral bias.[3] Furthermore, Dr. Chen's previously published research discusses in detail how computerized districting simulations quantify how much electoral bias is caused by natural political geography and other legally permissible factors.[4] Dr. Chen has applied his districting simulation methodology to analyze plans in several other states, but has never before analyzed Wisconsin's Act 43 or other Wisconsin maps. Dr. Chen is concerned that his work is being misinterpreted and misapplied by Defendants, and wishes to explain how that is so.

Although Dr. Chen had not previously analyzed Wisconsin's Act 43 in his published research, it was a straightforward matter for him to apply his computer simulation methodology and statistical tests developed in his published work to Wisconsin. Those results, attached hereto in Exhibit A, show that Dr. Chen's methods and work actually demonstrate that Act 43's

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[3] *See Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures,* Quarterly Journal of Political Science, Vol. 8, No. 3: 239-269 (2013).
[4] *See id.*

political bias does **not** arrive solely, or even significantly, from political geography. This is the opposite of Defendants' position on Dr. Chen's work.

C. Why Dr. Chen's Methodology Applies to Evaluate Partisan Bias in a Districting Plan

Plaintiffs' contentions that Dr. Chen's methodology is inapplicable to this case are correct, but irrelevant.

First, Plaintiffs are correct that the cited articles did not consider Voting Rights Act issues. But the problems addressed in Dr. Chen's earlier publications did not address the lawfulness of any state plan. And, as shown below, Voting Rights Act compliance can be factored in, and was in the following analyses of Act 43.

Second, presidential voting data is often more reliable than local race data to gauge the partisan bias of a district. Long-standing incumbency and other local factors may affect a district, but are not permanent measures of the district's partisan bias.

Third, it is no criticism of Dr. Chen's methodology as applied here to point out, as Plaintiffs do correctly, that his methodology generates a much smaller number of plans than one that is limited only by equal population requirements. His purpose is to identify plans that not only meet equal population requirements, but also consider compactness and community of interests as well. These additional requirements eliminate many possible equal population plans.

Fourth, the Plaintiffs' brief mischaracterizes the Fryer and Holden study, whose results actually support Dr. Chen's published research on gerrymandering and electoral bias.[5] The Fryer and Holden study finds that simulated, compact districts exhibit a smaller degree of electoral bias in many states when compared to the enacted, existing Congressional maps in those respective

[5] *See* Roland G. Fryer Jr. & Richard Holden, *Measuring the Compactness of Political Districting Plans,* Journal of Law and Economics, Vol. 54, No. 3, 493-535 (2011).

states. This is exactly what Dr. Chen argued in his research and in his expert work on gerrymandering, and this is precisely what he has found when analyzing Wisconsin's enacted Assembly plan in Act 43: a simulated plan with more compact districts exhibits less bias than the Legislature's enacted plan.

Furthermore, Fryer and Holden do not find electoral bias to be "pro-Democratic in all cases." Instead, Fryer and Holden find that as Democrats' vote share increases, the Democratic Party's seat share increases as well.[6]

D. Conclusion

Despite Plaintiffs' contentions, Dr. Chen's work is directly relevant to the central issue in this or any other gerrymandering case: is there a manageable standard to evaluate partisan bias in redistricting? Defendants' portrayal of Dr. Chen's scholarship to support their position is not accurate. Defendants' conclusions, to the extent based upon reliance on his work, should not be credited. Dr. Chen has demonstrated through the attached exhibit that, as applied to Wisconsin specifically, his analysis supports Plaintiffs rather than Defendants.

Date: March 17, 2016.

Respectfully submitted,

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[6] *See id.* at 514.

CERTIFICATE OF SERVICE

I hereby certify that on March 17, 2016, I electronically filed the foregoing Proposed Brief with the Clerk of the Court using the ECF system which will send notification of such filing by electronic mail to all ECF participants:

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EXHIBIT A

DR. JOWEI CHEN'S ANALYSIS OF WISCONSIN'S ACT 43

I was able to apply the same computer simulation methodology and statistical tests developed in my published article cited by the Defendants to Wisconsin's Act 43.[1] I employed substantially the same computer simulation methodology to produce and analyze a large number of state assembly plans drawn using traditional districting principles. I sought to answer the following three questions:

> 1) What level of electoral bias emerges from a non-partisan process that draws Wisconsin's assembly districts by following the traditional districting principles of equal apportionment, preserving communities of interest (county and municipal boundaries), respecting the Voting Rights Act, and maximizing compactness?
>
> 2) How likely is such a non-partisan process to produce a state assembly districting plan with minimal electoral bias, as measured by the plan's efficiency gap?
>
> 3) How likely is such a non-partisan process to produce a districting plan with an efficiency gap similar to that of the enacted Act 43?

Executive Summary

The results of my simulation analysis, as outlined below, demonstrate that a non-partisan districting process following traditional districting principles generally produces a state assembly plan with minimal bias. In fact, 144 of the 200 random districting plans produced by the non-gerrymandered computer simulation process exhibit an efficiency gap of within 3% of zero, indicating no substantial favoring of either Democrats or Republicans.

The remaining fifty-six simulated plans exhibit an efficiency gap between -5.8% and -3.0%. Because a negative efficiency gap indicates electoral bias in favor of Republicans, these

[1] Those methodologies are described more fully in the article previously cited by Defendants and provided with their papers: Jowei Chen & Jonathan Rodden, *Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures,* Quarterly Journal of Political Science, Vol. 8, No. 3: 239-269 (2013).

results suggest that Wisconsin's natural political geography, combined with a non-partisan process following traditional districting principles, could plausibly produce a plan with a modest amount of Republican-favoring electoral bias.

These levels of natural electoral bias pale in comparison to the much more extreme electoral bias exhibited by the Act 43 plan. The Act 43 plan exhibits a Republican-favoring efficiency gap several times that of most simulated plans, and over twice as large as even the most biased of the 200 plans produced by the non-partisan computer simulation process. In sum, statistically speaking, it is extremely unlikely that a neutral districting process, using traditional factors, would have produced a plan exhibiting electoral bias as significant as that of Act 43.

Discussion

I begin with an explanation of the logic of the districting simulation approach, followed by an overview of the simulation technique. Then, I present the results of the simulations and illustrate how the Act 43 plan is a statistical outlier.

The Logic of Redistricting Simulations

When political representation is based on winner-take-all districts, asymmetries between votes and seats can emerge merely because one party's supporters are more clustered in space than those of the other party. When this happens, the party with a more concentrated support base achieves a smaller seat share because it racks up large numbers of "surplus" votes in the districts it wins, while falling just short of the winning threshold in many of the districts it loses. This can happen quite naturally in cities due to such factors as racial segregation, housing and labor markets, transportation infrastructure, and residential sorting by income and lifestyle.

By generating a large number of randomly drawn districting plans, optimizing traditional districting criteria, the computer simulation process demonstrates the range of districting plans

that would likely emerge from a neutral process. Courts and litigants can then draw inferences by comparing the partisanship of enacted plans against this range of simulated plans.

In my published academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed computer simulation programming techniques that allow me to randomly produce a large number of alternative districting plans in any given state or county using precincts as building blocks. Most importantly, these computer simulations can be programmed to optimize districts with respect to any specified traditional districting goal while ignoring partisan considerations.

I use this simulation approach to analyze Wisconsin's Act 43 plan. First, I analyze the Legislature's districting plans and identify areas in which these enacted plans deviate significantly from equally populated districts. To analyze the Legislature's motivations for these population deviations, I use computer simulations to randomly generate two-hundred districting plans that optimize four criteria: equal apportionment within 1% of ideal district population, preservation of municipal boundaries, preservation of county boundaries, and maximization of geographic compactness. Additionally, to comply with the Voting Rights Act, I preserve the one majority-Hispanic and six majority-Black districts that were drawn in the Act 43 plan.

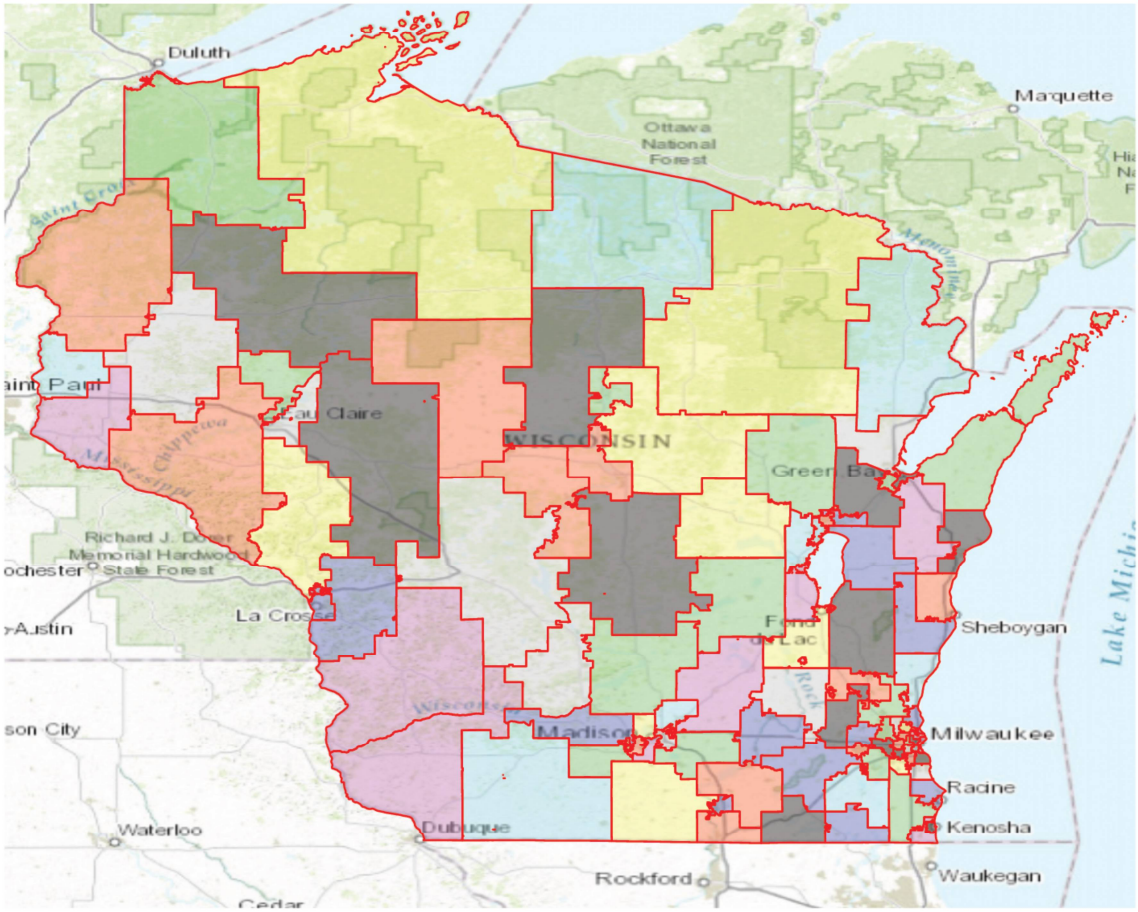
I then compare the computer-generated, non-partisan districting plans to the Act 43 plan using various measures of partisanship and electoral bias. The results show that computer-simulated districting plans produced by a non-partisan process preserve significantly more county and municipal boundaries than the Act 43 plan. More importantly, the simulated plans always produce significantly less electoral bias than Act 43, often resulting in a partisan efficiency gap of close to 0%. Thus, Wisconsin's Act 43 plan creates a level of electoral bias falling completely outside the range of likely outcomes under a non-partisan districting process

that creates equally populated districts while maximizing compactness and preserving county and municipal boundaries.

Figure 1 illustrates an example of a computer simulated plan producing ninety-nine Assembly districts in Wisconsin. The plan displayed in Figure 1 is one of 200 complete districting plans produced by the simulation process and analyzed in this brief.

FIGURE 1

Example of a Simulated Districting Plan (Simulation #22)
20 Counties and 1,842 Municipalities Preserved Intact
Average Reock Compactness: 0.46
Efficiency Gap: +0.38% (702,384 wasted Rep. votes, 812,091 wasted Dem. votes)
41 Republican−Leaning Districts, 58 Democratic−Leaning Districts



In simulating Assembly districting plans for Wisconsin, the computer algorithm follows the following traditional districting criteria:

1) ***Equal Apportionment:*** Wisconsin's 2010 Census population was 5,686,986, so each of the 99 Assembly districts has an ideal population of 57,444.3. The computer simulation algorithm is designed to draw ninety-nine districts so that every district is within 1% of the ideal district population. As a result of this criterion, every computer simulated district produced for this analysis contains a population ranging from 56,871 to 58,017.

2) ***County Boundaries***: Wisconsin contains seventy-two counties, and Act 43 preserves fourteen of these counties intact while splitting each of the remaining fifty-eight counties into two or more Assembly districts. The left column of Table 1 lists the fourteen counties that Act 43 preserves intact.

All of the computer simulated plans preserve intact a significantly higher number of county boundaries. As Figure 2 illustrates, each of the simulated plans preserves from 18 to 25 counties intact. Though the precise set of intact counties differs from one simulated plan to the next, there are eighteen counties that are always preserved intact in 100% of the simulated plans. These counties are the first eighteen counties listed in the right column of Table 1. An additional twenty counties are preserved intact in some, but not all, of the simulated plans. These twenty additional counties are also listed in the right column of Table 1, along with the frequency with which each county is preserved intact in the simulated plans.

TABLE 1: Counties Preserved Intact in Enacted and Simulated Districting Plans

Counties Preserved Intact in Act 43 Assembly Plan	Counties Preserved Intact in Computer-Simulated Ninety-Nine -District Plans
Ashland	Ashland (100% of Simulated Plans)
Bayfield	Bayfield (100% of Simulated Plans)
Crawford	Buffalo (100% of Simulated Plans)
Door	Burnett (100% of Simulated Plans)
Florence	Crawford (100% of Simulated Plans)
Grant	Door (100% of Simulated Plans)
Iron	Florence (100% of Simulated Plans)
Kewaunee	Forest (100% of Simulated Plans)
Lincoln	Grant (100% of Simulated Plans)
Menominee	Iron (100% of Simulated Plans)
Pepin	Kewaunee (100% of Simulated Plans)
Price	Lincoln (100% of Simulated Plans)
Rusk	Marquette (100% of Simulated Plans)
Taylor	Menominee (100% of Simulated Plans)
	Pepin (100% of Simulated Plans)
	Price (100% of Simulated Plans)
	Rusk (100% of Simulated Plans)
	Taylor (100% of Simulated Plans)
	Marinette (58% of Simulated Plans)
	Douglas (51% of Simulated Plans)
	Vilas (38% of Simulated Plans)
	Lafayette (21% of Simulated Plans)
	Oneida (16% of Simulated Plans)
	Green Lake (15% of Simulated Plans)
	Langlade (12% of Simulated Plans)
	Richland (10% of Simulated Plans)
	Trempealeau (5% of Simulated Plans)
	Polk (4% of Simulated Plans)
	Vernon (3% of Simulated Plans)
	Sawyer (3% of Simulated Plans)
	Dunn (3% of Simulated Plans)
	Waushara (2% of Simulated Plans)
	Pierce (2% of Simulated Plans)
	Barron (2% of Simulated Plans)
	Iowa (1% of Simulated Plans)
	Green (1% of Simulated Plans)
	Clark (1% of Simulated Plans)
	Adams (1% of Simulated Plans)

3) ***Municipalities Boundaries***: Wisconsin contains a total of 1,896 municipalities, which include cities, towns, and villages. For purposes of counting municipal splits, I treated each Census Minor Civil Division (MCD) as a separate municipality, even if two MCD's have the same name.

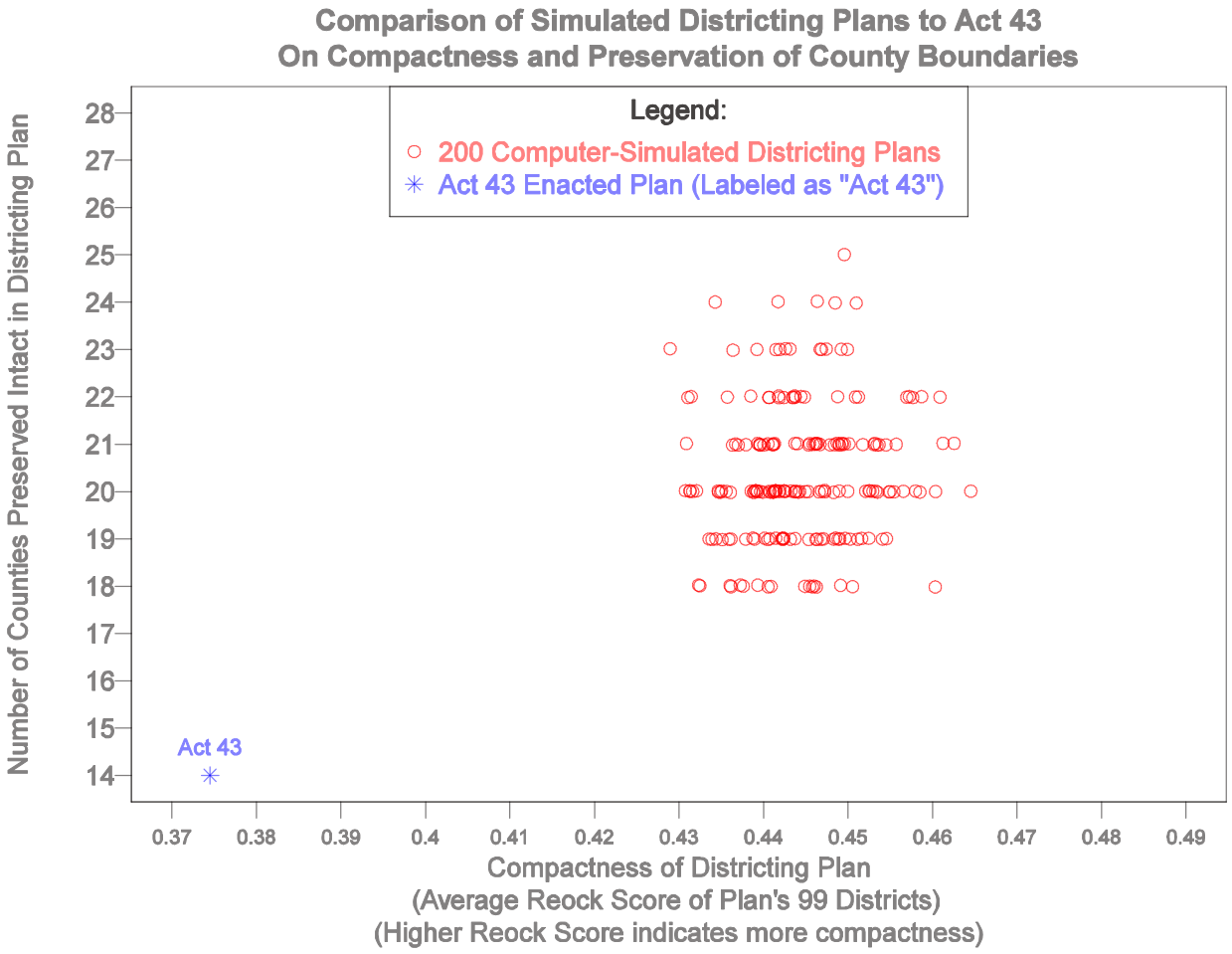
Act 43 preserves intact the boundaries of 1,825 municipalities. All of the computer simulated plans preserve intact a significantly higher number of municipalities. The number of municipalities preserved intact in the simulations ranges from 1,837 to 1,853.

4) ***Geographic Compactness***: Beyond preserving county and municipal boundaries, the simulation algorithm prioritizes the drawing of geographically compact districts. Compactness is quantifiably measured by a Reock score for each district in any given plan. The Reock score of a district is calculated by first drawing the smallest possible bounding circle that completely encloses the district's borders; hence, the bounding circle will always be at least as large as the district itself. The Reock score is then calculated as the ratio of the district's area to the area of the bounding circle. Therefore, the Reock score will always be a fraction less than or equal to one, with a higher Reock score indicating a more compact district. The Reock score for an entire plan is then calculated as the average score for the ninety-nine Assembly districts within the plan.

To compare the compactness of the computer simulated plans and the Act 43 Assembly plan, the horizontal axis of Figure 2 measures the Reock score for the Act 43 Assembly plan as well as the 200 computer simulated plans. Figure 2 illustrates that plans produced by the partisan-neutral computer simulation process are always significantly more compact than the Act 43 Assembly plan. While the Act 43 plan has a Reock score of 0.37, the 200 computer simulated

plans exhibit Reock scores ranging from 0.43 to 0.46, indicating that 100% of the simulated plans are substantially more compact than the plan enacted by the Wisconsin Legislature.

FIGURE 2



5) ***The Voting Rights Act:*** Act 43 produces one majority-Hispanic district (Assembly District 8) and six majority-African-American districts (Assembly Districts 10, 11, 12, 16, 17, and 18). To comply with the Voting Rights Act, the computer simulated plans preserve each of these seven majority-minority districts exactly as they were drawn in the Act 43 plan. In other words, these seven districts from Act 43 appear in each of my computer-simulated plans exactly as they were drawn by the Wisconsin Legislature with no modifications.

Simulation Results

The following describes the simulation results and inferences about Act 43.

Efficiency Gap: To calculate the efficiency gap of Act 43 and of each simulated plan, I first calculate the partisanship of each simulated district and each Act 43 Assembly district by calculating Republican Mitt Romney's share of the two-party presidential vote in November 2012 within each district. Using Mitt Romney and Barack Obama votes as a simple measure of district partisanship, I then calculate the districting plan's efficiency gap using the method outlined in *Partisan Gerrymandering and the Efficiency Gap*.[2] Districts are classified as Republican victories if Romney votes exceeded Obama votes in November 2012 and as Democratic victories if Obama garnered more votes than Romney. For each party, I then calculate the total sum of surplus votes in districts the party won and lost votes in districts where the party lost. The efficiency gap is then calculated as total wasted Republican votes minus total wasted Democratic votes, divided by the total number of two-party votes cast statewide.

Figure 3 illustrates the efficiency gap of the two-hundred simulated Assembly districting plans produced using the traditional districting criteria described in the previous section, and of Act 43. Each red circle in Figure 3 represents a complete simulated districting plan, with its efficiency gap measured along the horizontal axis. The vertical axis measures the total number of counties preserved intact by the plan, a number that, as noted above, ranges from eighteen to twenty-five counties for each simulation.

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

FIGURE 3

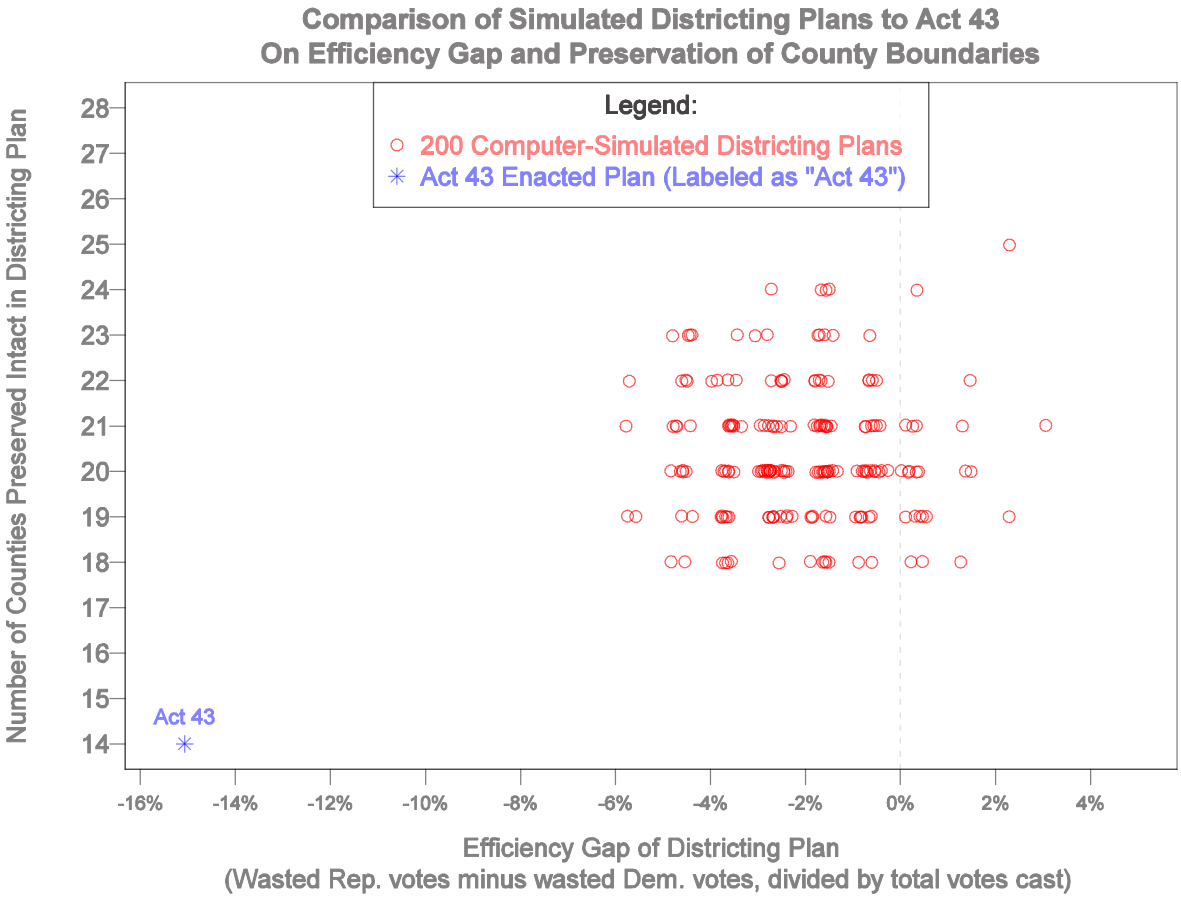


Figure 3 reveals that the simulated districting plans are reasonably neutral with respect to electoral bias. About 72% of the simulated plans exhibit an efficiency gap within 3% of zero, indicating de minimis electoral bias in favor of either party. In fact, 23% of the simulations produce an efficiency gap between -1.0% and +1.0%. These patterns illustrate that a non-partisan districting process following traditional criteria very commonly produces a neutral Assembly plan in Wisconsin with minimal electoral bias.

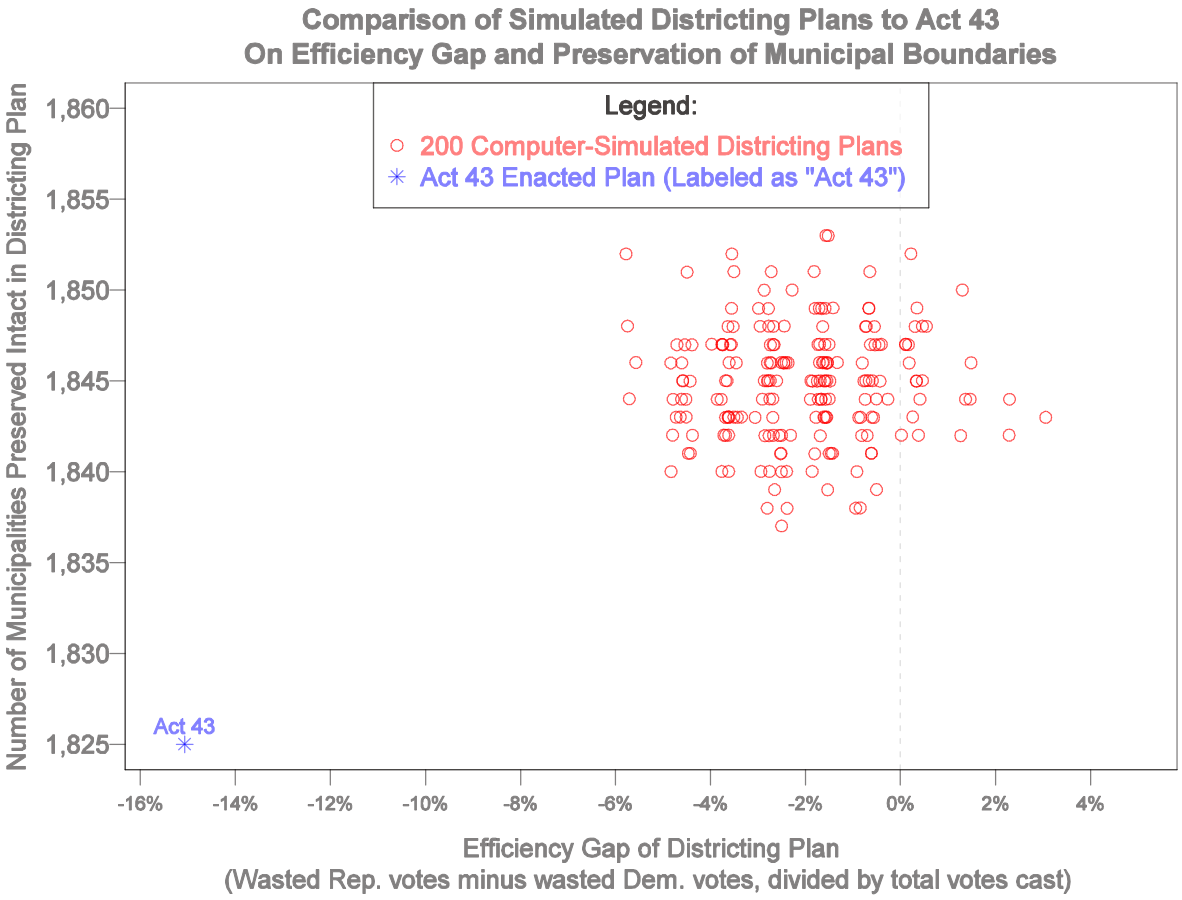
It is important to note that the simulations produce plans with both positive and negative efficiency gaps. Although the efficiency gap of every simulated plan is relatively small in magnitude, 90% of plans exhibit a negative efficiency gap, indicating slightly more wasted Democratic votes than wasted Republican votes. But 10% of the plans exhibit a positive efficiency gap, reflecting more wasted Republican votes. Hence, it is not extraordinary for Wisconsin's political geography, combined with traditional redistricting criteria, to naturally produce a districting plan that somewhat favors Republicans.

The blue star in the lower left corner of Figure 3 represents the Assembly plan enacted by Act 43. This blue star depicts the enacted plan's efficiency gap of -15.1%, reflecting significantly more wasted Democratic votes than wasted Republican votes. Thus, the level of electoral bias in the Act 43 Assembly plan is not only entirely outside of the range produced by the simulated plans, the enacted plan's efficiency gap is well over twice as biased as the most biased of the two-hundred simulated plans. The improbable nature of the Act 43 efficiency gap allows us to conclude with high statistical certainty that neutral, non-partisan districting criteria, combined with Wisconsin's natural political geography, would not have produced a districting plan as electorally skewed as the Act 43 Assembly plan.

Figure 3 additionally illustrates that the Act 43 plan preserves intact far fewer counties than would have been reasonably possible under a neutral process prioritizing traditional districting criteria. The Act 43 plan keeps intact only fourteen of Wisconsin's seventy-two counties. Meanwhile, each of the simulated plans preserves eighteen to twenty-five counties fully intact. Figure 3 suggests a possible connection between Act 43 plan's creation of an extreme efficiency gap and the plan's splitting up of far more counties than what could have been reasonably expected under a partisan-neutral districting process.

Figure 4 illustrates the same patterns regarding the splitting of municipal boundaries. As before, the horizontal axis of Figure 4 measures the efficiency gap of the simulated plans and the Act 43 Assembly plan. The vertical axis in Figure 4 measures the number of municipalities kept intact within each plan. Figure 4 illustrates that Act 43 is a statistical outlier not only in terms of its large, Republican-favoring efficiency gap, but also in its splitting of far more municipalities than any of the simulated plans.

FIGURE 4



As an additional measure of the partisanship of each plan, Figure 5 reports the number of Republican-leaning districts—defined as districts in which Romney voters outnumbered Obama voters in November 2012—in each plan. The horizontal axis in Figure 5 measures the number of

Republican districts (out of the ninety-nine Assembly districts) created by each simulated plan and by the Act 43 Assembly plan. The vertical axis measures the number of counties preserved intact by each plan. As before, red circles denote the two-hundred computer simulated plans, while the blue star represents the Act 43 plan.

FIGURE 5

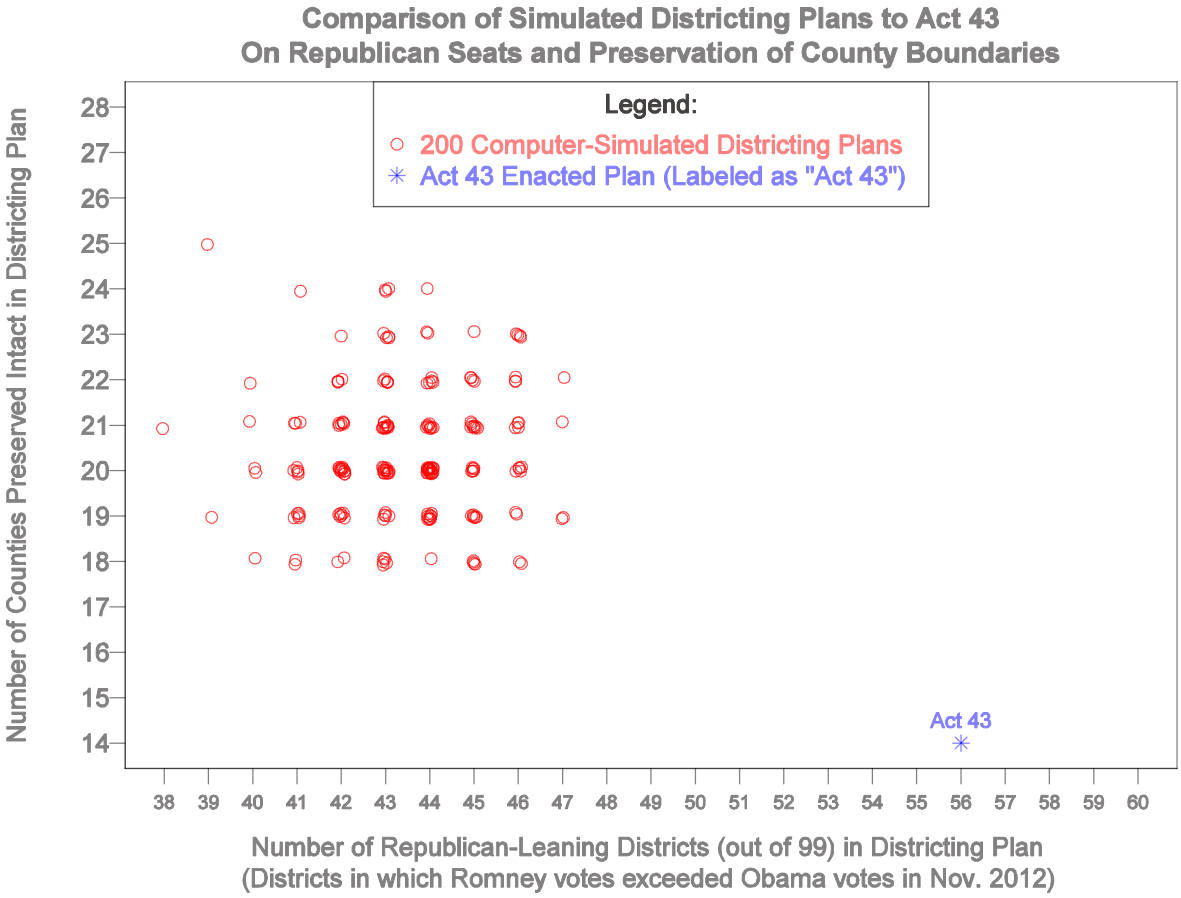


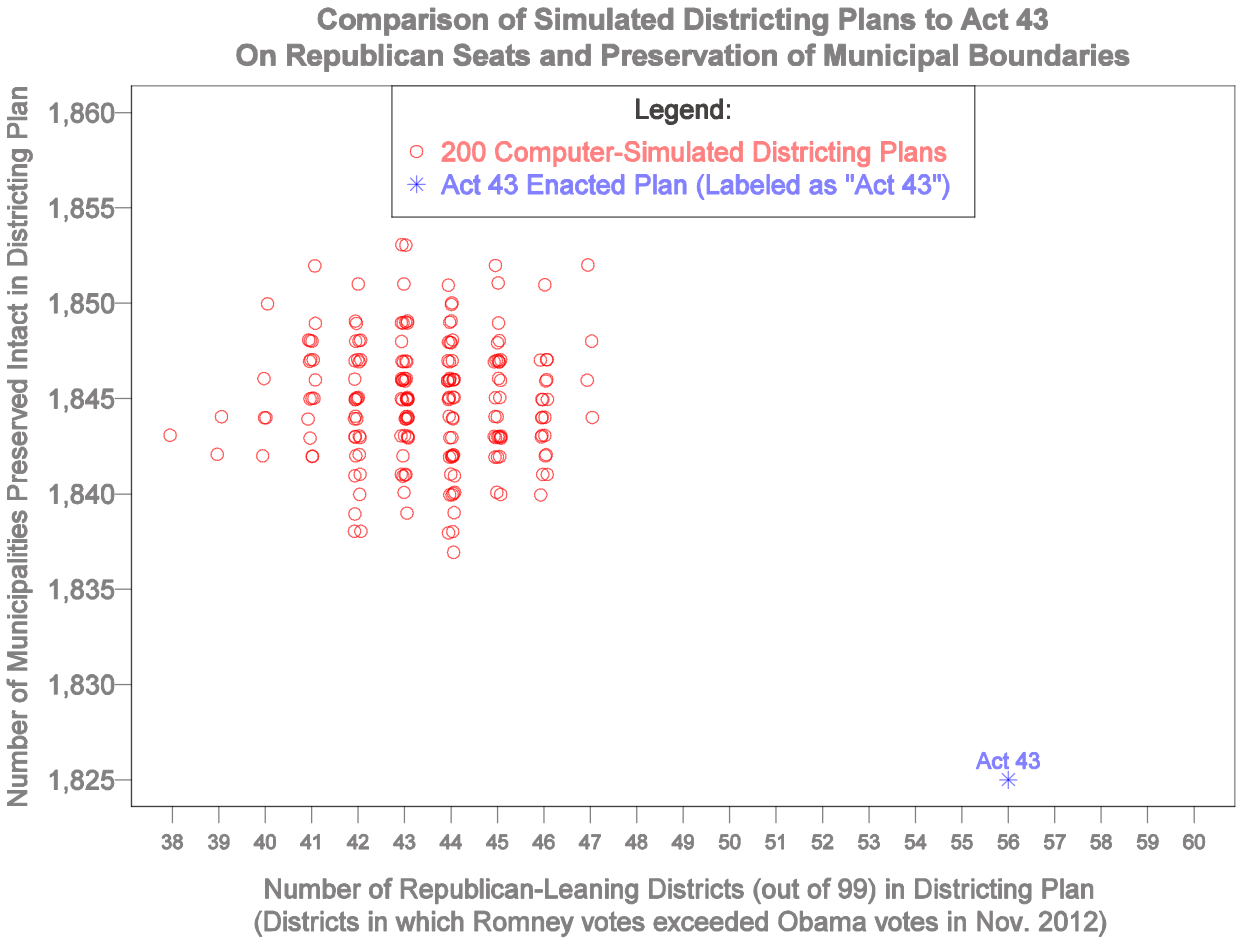
Figure 5 illustrates the contrast between the simulated plans and the Act 43 plan in terms of their partisan division of Assembly seats. In the simulated plans (drawn in a non-partisan manner respecting traditional districting criteria), between thirty-eight and forty-seven districts contain more Republican than Democratic voters. This range translates to a 38.4% to 47.4%

Republican share of the ninety-nine total Assembly districts, a range consistent with and reflective of the Republicans' statewide 46.5% share of the November 2012 presidential vote.

Yet the Act 43 plan creates a total of fifty-six Republican-leaning Assembly districts, as measured by 2012 presidential vote share. This total is far outside of the range of partisan outcomes observed in the simulations, indicating that the Act 43 plan was the product of an intentional effort to craft more Republican-leaning districts than was possible under a partisan-neutral map-drawing process following traditional districting criteria. As before, the fact that Act 43 preserved intact far fewer counties than any of the simulated plans suggests that the Act 43 Assembly plan had to violate the traditional districting principle of respecting county boundaries in order to achieve fifty-six Republican-leaning districts, an extremely improbable outcome.

Figure 6 illustrates the same pattern regarding the splitting of municipal boundaries. As in Figure 5, the horizontal axis of Figure 6 measures the number of Republican districts (out of ninety-nine) created by each simulated plan and by the Act 43 Assembly plan. But the vertical axis in Figure 6 measures the number of municipalities kept intact within each plan. This Figure illustrates that the Act 43 plan's statistically extreme creation of fifty-six Republican districts came at the expense of preserving far fewer municipalities intact than were reasonably possible under the partisan-neutral process followed by the computer simulations.

FIGURE 6



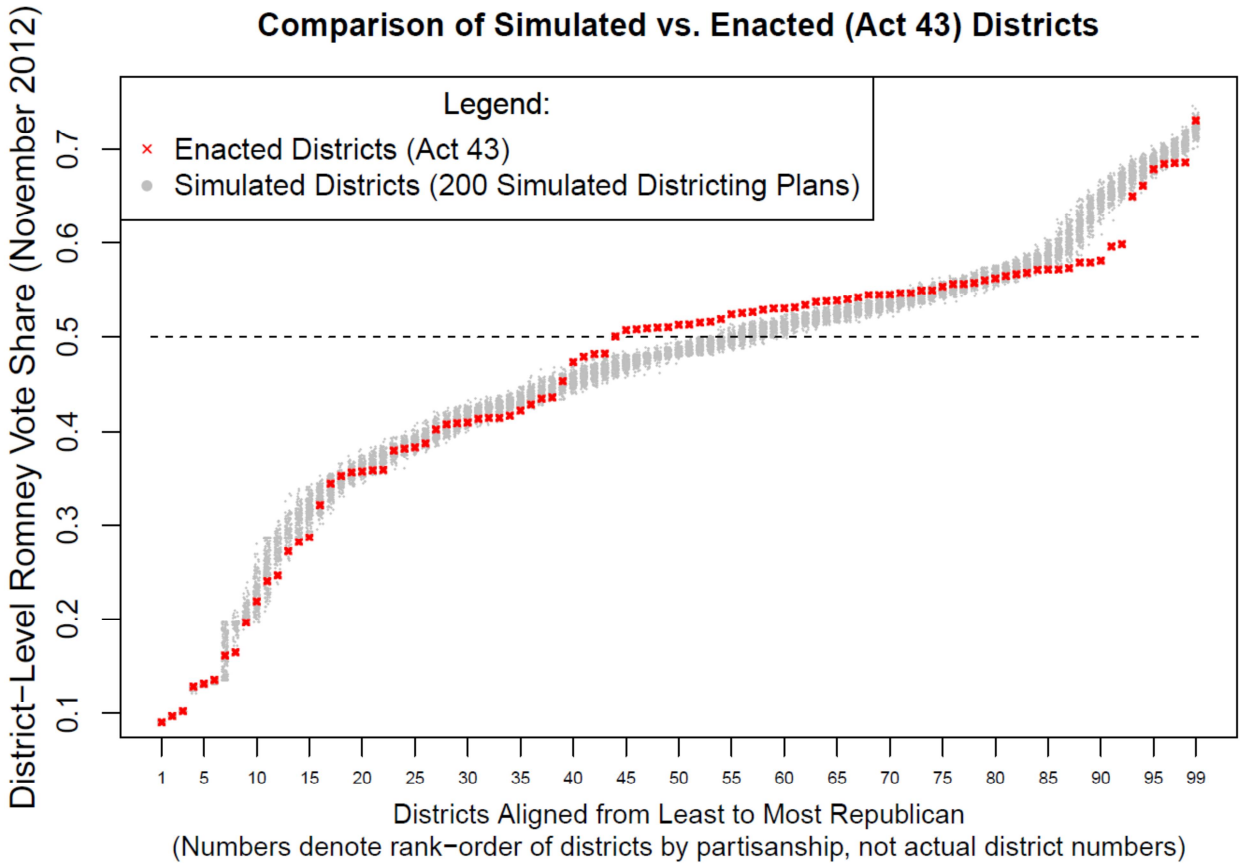
How did Act 43 create such a statistically improbable Assembly plan in terms of its partisan division of seats? Figure 7 provides suggestive evidence. Figure 7 displays the partisanship, measured by the Romney share of the November 2012 vote, of every single district in all simulated districting plans and the enacted Act 43 plan. The vertical axis measures each district's partisanship, with gray dots representing simulated districts and red stars representing the ninety-nine Assembly districts created under Act 43.

Figure 7 contains a total of ninety-nine columns. For each simulated plan and for the Act 43 plan, the ninety-nine districts are aligned from left to right by partisanship. In other words, the left-most red star represents the most Democratic-leaning Act 43 district (Assembly District 16,

in which Romney won 9.0% of the presidential vote), while the right-most red star represents the most Republican-leaning Act 43 district (Assembly District 99, in which Romney won 73.1% of the presidential vote). The gray dots representing districts for each simulated plan are similarly aligned by partisanship across the ninety-nine columns in Figure 7.

Overall, Figure 7 allows comparison of the enacted and the simulated districting plans with respect to their distribution of partisanship across districts. Most strikingly, Figure 7 illustrates how Act 43 created its unusually large sum of fifty-six Republican-leaning districts. As illustrated in the middle portion of Figure 7, Act 43 created eleven Republican-leaning districts that would instead have been Democratic-leaning districts when drawn by the partisan-neutral simulation process. This creation is evidenced by the noticeable divergence of the red stars away from the entire range of gray circles in the middle portion of Figure 7. In order to convert these Democratic-leaning districts into Republican-leaning districts, the Act 43 plan appears to have pulled Republican voters away from what would otherwise have been more heavily Republican districts, as illustrated in the far right portion of Figure 7. In the right-most fifteen columns in Figure 7, the red stars often fall under the entire range of gray circles, showing that Act 43 unpacked some Republican voters from these safe Republican districts and placed more Republican votes into what would otherwise have been slightly Democratic districts, tipping them into Republican-leaning districts.

FIGURE 7



Conclusion

Using computer simulations to generate a large baseline sample of legally valid districting plans under a partisan-neutral map-drawing process following traditional districting criteria, we find that drawing a minimally biased Assembly map is reasonably possible. The results show that the non-partisan simulation process successfully produces valid districting plans with a neutral efficiency gap with striking frequency.

Furthermore, we are able to discover not merely the ways in which the enacted Act 43 plan deviates from traditional districting criteria, but also the partisan consequences of such deviations. Act 43 not only created an extremely biased Assembly plan with an efficiency gap far outside of any gap observed in 200 simulations, the enacted plan achieved this partisan outcome

at the expense of traditional districting principles, splitting apart far more counties and municipalities than were necessary.

Respectfully submitted,

Jowei Chen

March 17, 2016