IN THE UNITED STATES DISTRICT COURT
FOR THE 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,	)	No.
Plaintiffs,	)	Three Judge Panel Requested 28 U.S.C. 2284(a)
v.	)	
GERALD C. NICHOL, THOMAS BARLAND, JOHN FRANKE, HAROLD V. FROEHLICH, KEVIN J. KENNEDY, ELSA LAMELAS, and TIMOTHY VOCKE,	)	
Defendants.	)	

NOW COME Plaintiffs 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, by their undersigned attorneys, and complain of Defendants Gerald C. Nichol, Thomas Barland, John Franke, Harold V. Froehlich, Elsa Lamelas, Kevin J. Kennedy, and Timothy Vocke, not personally, but solely in their official capacities as members of the Wisconsin Government Accountability Board, as follows:

INTRODUCTION

1. Plaintiffs seek both a declaratory judgment that the Wisconsin State Assembly district plan adopted in 2012 by Wisconsin Act 43 (the "Current Plan") violates the First and Fourteenth Amendments of the United States Constitution and an order permanently enjoining the implementation of the Current Plan in the 2016 election. As explained in greater detail below, the Current Plan is, by any measure, one of the worst partisan gerrymanders in modern

American history. In the first election in which it was in force in 2012, the Current Plan enabled Republican candidates to win sixty of the Assembly's ninety-nine seats even though Democratic candidates won a ***majority*** of the statewide Assembly vote. The evidence is overwhelming that the Current Plan was adopted to achieve precisely that result: indeed, before submitting the map for approval, the Republican leadership retained an expert (at State expense) who predicted the partisan performance of each proposed district—as it turned out, with remarkable accuracy.

2. This kind of partisan gerrymandering is both unconstitutional and profoundly undemocratic. It is unconstitutional because it treats voters unequally, diluting their voting power based on their political beliefs, in violation of the Fourteenth Amendment's guarantee of equal protection, and because it unreasonably burdens their First Amendment rights of association and free speech. Extreme partisan gerrymandering is also contrary to core democratic values because it enables a political party to win more legislative districts—and thus more legislative power—than is warranted by that party's popular support. By distorting the relationship between votes and assembly seats, it causes policies to be enacted that do not accurately reflect the public will. In the end, a political minority is able to rule the majority and to entrench itself in power by periodically manipulating election boundaries.

3. Partisan gerrymandering has increased throughout the United States in recent years as a result of both a rising tide of partisanship and greater technological sophistication, which enables maps to be drawn in ways that are likely to enable the party in power to remain in power even if it no longer represents the views of the majority of voters. This nationwide trend threatens a "'core principle of republican government,' namely, 'that the voters should choose their representatives, not the other way around.'" *Arizona State Legislature v. Arizona Independent Redistricting Comm'n*, No. 13-1314 (U.S. June 29, 2015), slip op. at 35.

4. The United States Supreme Court has recognized that partisan gerrymandering can be unconstitutional. Nevertheless, a constitutional challenge has yet to succeed on that ground because plaintiffs have been unable to offer a workable standard to distinguish between permissible political line-drawing and unconstitutional partisan gerrymandering. In this case, plaintiffs propose a new test that ***is*** workable, based on the concept of partisan symmetry—the idea that a district plan should treat the major parties symmetrically with respect to the conversion of votes to seats and that neither party should have a systematic advantage in how efficiently its popular support translates into legislative power.

5. One way to measure a district plan's performance in terms of partisan symmetry is to determine whether there is an "efficiency gap" between the performances of the two major parties and, if so, to compare the magnitude of that gap to comparable district plans in the modern era nationwide. The efficiency gap captures in a single number all of a district plan's ***cracking*** and ***packing***—the two fundamental ways in which partisan gerrymanders are constructed. Cracking means dividing a party's supporters among multiple districts so that they fall short of a majority in each one. Packing means concentrating one party's backers in a few districts that they win by overwhelming margins. Both cracking and packing result in "wasted" votes: votes cast either for a losing candidate (in the case of cracking) or for a winning candidate but in excess of what he or she needed to prevail (in the case of packing). The efficiency gap is the difference between the parties' respective wasted votes in an election, divided by the total number of votes cast.

6. When the efficiency gap is relatively small and roughly equivalent to the efficiency gaps that have traditionally existed, the map should not be deemed unconstitutional. In such cases, there may be no intent to treat voters unequally; in any event, the effects of any

gerrymandering are likely to be redressable through the political process. But where the efficiency gap is large and much greater than the historical norm, there should be a presumption of unconstitutionality. In such a case, an intent to systematically disadvantage voters based on their political beliefs can be inferred from the severity of the gerrymander alone. And because such severe gerrymanders are likely to be extremely durable as well, it is unlikely that the disadvantaged party's adherents will be able to protect themselves through the political process. Where partisan gerrymandering is extreme, the process itself is broken: current legislators have no incentive to alter it, and adherents of the disadvantaged party are unable to do so because their votes have been unfairly diluted.

7. Wisconsin's Current Plan is presumptively unconstitutional under this analysis. In the 2012 election, the Current Plan resulted in an efficiency gap of roughly 13% in favor of Republican candidates. Between 1972 and 2014, fewer than ***four percent*** of all state house plans in the country benefited a party to that extent. In the 2014 election, the efficiency gap remained extremely high at 10%. Between 1972 and 2010, not a ***single*** plan anywhere in the United States had an efficiency gap as high as the Current Plan in the first two elections after redistricting. A district plan this lopsided is also highly unlikely ever to become neutral over its ten-year lifespan. Indeed, we can predict with nearly 100% confidence that, absent this Court's intervention, Wisconsin's Current Plan will continue to unfairly favor Republican voters and candidates—and unfairly disadvantage Democratic voters and candidates—throughout the remainder of the decade.

8. There are three additional facts that reinforce the conclusion that the Current Plan is unconstitutional. First, the Current Plan was not the result of an ordinary political process, where a bill is formulated through a give-and-take between political adversaries and subject to

open debate. Instead, it was drawn up in secret by the Legislature's Republican leadership, without consultation with Democratic leaders or rank-and-file members of either party, with the purpose and intent of altering what was already a favorable map to maximize the Republican Party's partisan advantage. Then the proposal was rammed through the Assembly, without any opportunity for real debate.

9. Second, the Current Plan is also an outlier by another measure of partisan symmetry—partisan bias. Partisan bias is the difference in the share of seats that each party would win if they tied statewide, each receiving 50% of the vote. In 2012, there was a 13% bias in favor of Republicans; in a tied election, Republicans would have won 63% of the Assembly seats, with Democrats winning only 37%. In 2014, there was a 12% bias in favor of Republicans.

10. Third, the Current Plan's extreme partisan skew was entirely unnecessary. Plaintiffs have designed a Demonstration Plan that complies at least as well as the Current Plan with every legal requirement—equal population, the Voting Rights Act, compactness, and respect for political subdivisions—but that is almost perfectly balanced in its partisan consequences. Thus, defendants cannot salvage the Current Plan on the theory that adherence to redistricting criteria or the State's underlying political geography made an unfair plan unavoidable.

11. To be clear, plaintiffs do not seek to replace a pro-Republican gerrymander with a plan that is gerrymandered to be pro-Democratic. Rather, plaintiffs seek as a remedy the creation of a neutral plan that is not gerrymandered to give either side an unfair partisan advantage.

JURISDICTION AND VENUE

12. This Court has jurisdiction over this action pursuant to 28 U.S.C. §§ 1331, 1343(a)(3) and (4), and 2284. It also has jurisdiction under 28 U.S.C. §§ 2201 and 2202, the Declaratory Judgments Act, to grant the declaratory relief requested.

13. Pursuant to 28 U.S.C. § 2284(a), a three-judge panel should be convened to hear this case.

14. Venue is proper in this judicial district under 28 U.S.C. § 1391(b). At least one of the Defendants resides in the Western District of Wisconsin. In addition, at least six of the plaintiffs reside and vote in this judicial district.

PARTIES

15. Plaintiffs are qualified, registered voters in the State of Wisconsin, who reside in various counties and legislative districts. Plaintiffs are all supporters of the public policies espoused by the Democratic Party and of Democratic Party candidates. Together with other Democratic voters, plaintiffs have been harmed by the Current Plan's unlawful partisan gerrymandering because it treats Democrats unequally based on their political beliefs and impermissibly burdens their First Amendment right of association. Some of the plaintiffs have been packed into districts with other Democratic voters, while others live in districts that have been cracked by the Current Plan to disadvantage Democratic candidates in close races. Either way, the purpose and effect of the Current Plan is to dilute their voting strength because of their political affiliations.

16. Regardless of where they reside in Wisconsin and whether they themselves reside in a district that has been packed or cracked, all of the plaintiffs have been harmed by the manipulation of district boundaries in the Current Plan to dilute Democratic voting strength. As

a result of the statewide partisan gerrymandering, Democrats do not have the same opportunity provided to Republicans to elect representatives of their choice to the Assembly. As a result, the electoral influence of plaintiffs and other Democratic voters statewide has been unfairly, disproportionately, and undemocratically reduced.

17. Plaintiff William Whitford, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 76th Assembly District in Madison in Dane County, Wisconsin.

18. Plaintiff Roger Anclam, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 31st Assembly District in Beloit in Rock County, Wisconsin.

19. Plaintiff Emily Bunting, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 49th Assembly District in Richland County, Wisconsin.

20. Plaintiff Mary Lynne Donohue, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 26th Assembly District in Sheboygan in Sheboygan County, Wisconsin. In addition to the injury suffered by all Democrats in Wisconsin, Ms. Donohue was harmed when the City of Sheboygan was split into Districts 26 and 27 and District 26 was cracked and converted from a Democratic to a Republican district. *See infra* ¶¶ 63-65.

21. Plaintiff Helen Harris, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 22nd Assembly District in Milwaukee, in Milwaukee County, Wisconsin.

22. Plaintiff Wayne Jensen, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 63rd Assembly District in Rochester, in Racine County, Wisconsin.

23. Plaintiff Wendy Sue Johnson, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 91st Assembly District in Eau Claire, in Eau Claire County, Wisconsin. In addition to the injury suffered by all Democrats in Wisconsin, Ms. Johnson was harmed when Democratic voters were packed into District 91, wasting their votes and diluting the influence of Ms. Johnson's vote, as part of a gerrymander that reduced the number of Democratic seats in her region. *See infra* ¶¶ 69-71.

24. Plaintiff Janet Mitchell, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 66th Assembly District in Racine, in Racine County, Wisconsin. In addition to the injury suffered by all Democrats in Wisconsin, Ms. Mitchell was harmed when Democratic voters were packed into District 66, wasting their votes and diluting the influence of Ms. Mitchell's vote, as part of a gerrymander that reduced the number of Democratic seats in her region. *See infra* ¶¶ 66-68.

25. Plaintiffs James and Allison Seaton, citizens of the United States and of the State of Wisconsin, are residents and registered voters in the 42nd Assembly District in Lodi, in Columbia County, Wisconsin.

26. Plaintiff Jerome Wallace, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 23rd Assembly District, in Fox Point, in Milwaukee County, Wisconsin. In addition to the injury suffered by all Democrats in Wisconsin, Mr. Wallace was harmed when Democrats in District 22 were cracked so that his previously Democratic district is now a Republican district. *See infra* ¶¶ 60-62.

27. Plaintiff Don Winter, a citizen of the United States and of the State of Wisconsin, is a resident and registered voter in the 55th Assembly District in Neenah, in Winnebago County, Wisconsin.

28. Defendant Gerald C. Nichol is the Chair of the Wisconsin Government Accountability Board ("G.A.B.") and is named solely in his official capacity as such. The G.A.B. is a state agency under Wis. Stat. § 15.60, which has "general authority" over and "responsibility for the administration of . . . [the State's] laws relating to elections and election campaigns," Wis. Stat. § 5.05(1), including the election every two years of Wisconsin's representatives in the Assembly.

29. Defendants Thomas Barland, John Franke, Harold V. Froehlich, Elsa Lamelas, and Timothy Vocke are all members of the G.A.B. and are named solely in their official capacities as such.

30. Defendant Kevin J. Kennedy is the Director and General Counsel of the G.A.B. and is named solely in his official capacity as such.

BACKGROUND

The Current Plan Was Intended To Discriminate Against Democrats

31. The Current Plan was drafted and enacted with the specific intent to maximize the electoral advantage of Republicans and harm Democrats to the greatest possible extent, by packing and cracking Democratic voters and thus wasting as many Democratic votes as possible. Indeed, after a trial in prior litigation, a three-judge court characterized claims by the Current Plan's drafters that they had not been influenced by partisan factors as "almost laughable" and concluded that "partisan motivation. . .clearly lay behind Act 43." *Baldus v. Wisconsin Government Accountability Board*, 849 F.Supp.2d 840, 851 (E.D. Wis. 2012).

32. The Current Plan was drafted via a secret process run solely by Republicans in the State Assembly and their agents, entirely excluding from participation all Democratic members of the Assembly as well as the public, and preventing public knowledge of and deliberation about the parameters of the Plan.

33. In January 2011, Scott Fitzgerald, Republican member of the Wisconsin State Senate and Wisconsin Senate Majority Leader, and Jeff Fitzgerald, Republican member of the Wisconsin State Assembly and Speaker of the Assembly, hired attorney Eric McLeod ("McLeod") and the law firm of Michael, Best & Friedrich, LLP ("Michael Best"), ostensibly to represent the entire Wisconsin State Senate and Wisconsin State Assembly in connection with the reapportionment of the state legislative districts after the 2010 Census. In fact, McLeod and Michael Best were retained to assist the Republican leadership in the Legislature in designing a pro-Republican partisan gerrymander.

34. To accomplish this goal, McLeod and Michael Best supervised the work of the legislative aide to the Republican Speaker of the Assembly, Adam Foltz, and the legislative aide to the Republican Majority Leader of the Senate, Tad Ottman, in planning, drafting, negotiating, and gaining the favorable vote commitments of a majority of Republican legislators sufficient to obtain passage of the Current Plan through Wisconsin Act 43.

35. In creating the Current Plan, McLeod, Michael Best, Foltz, and Ottman used past election results to measure the partisanship of the electorate and to design districts, through packing and cracking, that would maximize the number of districts that would elect a Republican and minimize the number of districts that would elect a Democrat. Thus, they intentionally diluted the electoral influence of Democrats, including that of plaintiffs, and discriminated against Democrats, including plaintiffs, because of their political views.

36. McLeod, Michael Best, Foltz, and Ottman were assisted in their work by Dr. Ronald Keith Gaddie, a professor of political science at the University of Oklahoma. Dr. Gaddie created a model that analyzed the expected partisan performance of all of the districts established by Act 43. Dr. Gaddie's model forecast that the Assembly plan would have a pro-Republican efficiency gap of 12%. When a common methodology is used to ensure an apples-to-apples comparison, this is almost exactly the efficiency gap that the Assembly plan actually exhibited in the 2012 election.

37. Preparation of the Current Plan was done in complete secrecy, excluding Democrats and the public from any part of the process. Indeed, even Republican state legislators were prevented from receiving any information that would allow public discussion or deliberation about the plan. All redistricting work was done in Michael Best's office and the "map room" was located there. A formal written policy provided that only the Senate Majority Leader, the Speaker of the House and their aides Ottman and Foltz, and McLeod and legal staff designated by McLeod would have unlimited access to the map room.

38. The access policy provided for limited access by rank-and-file legislators: "Legislators will be allowed into the office for the sole purpose of looking at and discussing their district. They are only to be present when an All Access member is present. No statewide or regional printouts will be on display while they are present (with the exception of existing districts). They will be asked at each visit to sign an agreement that the meeting they are attending is confidential and they are not to discuss it." But only Republican legislators were allowed even this limited access. After signing the secrecy agreements contemplated by the policy, Republican legislators were allowed to see only small portions of the map: how their own

districts would be affected and details of the partisan performance of voters in their districts in the past, showing that they would be reliable Republican districts.

39. Under the direction and supervision of McLeod, Ottman met with 17 Republican members of the Wisconsin State Senate, identified in Ex. 4 hereto. Each of them signed a secrecy agreement entitled "Confidentiality and Nondisclosure Related to Reapportionment" before being allowed to review and discuss the plan that Michael Best had been hired to develop. The secrecy agreement said that McLeod had "instructed" Ottman to meet with certain members of the Senate to discuss the reapportionment process and characterized such conversations as privileged communications pursuant to the attorney-client and attorney work product privileges —even though the assertion of the privilege was a part of an elaborate "charade" designed "to cover up a process that should have been public from the outset." *Baldus v. Wisconsin Government Accountability Board*, 843 F.Supp.2d 955, 958-61 (E.D. Wis. 2012).

40. Under the direction and supervision of McLeod, Foltz met with 58 Republican members of the Wisconsin State Assembly, identified in Ex. 4 hereto. Each of them signed the same secrecy agreement entitled "Confidentiality and Nondisclosure Related to Reapportionment" before being allowed to review and discuss the plan that Michael Best had been hired to develop, which also improperly described their conversations as privileged.

41. On July 11, 2011, the plan was introduced by the Committee on Senate Organization without any Democratic members of the Legislature having previously seen their districts or the plan as a whole. As noted above, all Republican members of the Legislature had previously seen their individual districts along with visual aids demonstrating the partisan performance of these districts, but had not seen the overall map.

42. Act 43 was passed in extraordinarily rushed proceedings with little opportunity for input by the public. A public hearing was held on July 13, 2011. The bill was then passed by the Senate on July 19, 2011, and by the Assembly the next day on July 20, 2011. Act 43 was published on August 23, 2011.

43. McLeod and Michael Best were paid $431,000 in State taxpayer funds for their work on the plan, even though they worked solely for Republican leaders of the Legislature and for the benefit of Republicans, and even though they provided no services to Democrats, entirely excluded them from the process, and concealed their work from the public, preventing any public deliberation about the plan.

The Current Plan Has The Effect of Discriminating Against Democrats

The Efficiency Gap Reliably Measures Partisan Gerrymandering

44. The Supreme Court has unanimously agreed that partisan gerrymandering can rise to the level of a constitutional violation. See *Vieth v. Jubelirer*, 541 U.S. 267, 293 (2004) ("[A]n ***excessive*** injection of politics is ***un***lawful") (emphasis added). To date, though, partisan gerrymandering plaintiffs have failed to propose a judicially manageable standard for deciding what constitutes an "excessive" injection of politics into the redistricting process.

45. In the Court's most recent gerrymandering case, *LULAC v. Perry*, 548 U.S. 399 (2006), a majority of the Justices expressed support for a test based on the concept of partisan symmetry. Partisan symmetry is a "require[ment] that the electoral system treat similarly-situated parties equally." *Id.* at 466 (Stevens, J., concurring in part and dissenting in part). In other words, a map is symmetrical when it creates a level playing field, giving neither major party a systematic advantage over its opponent in the conversion of electoral votes into legislative seats.

46. In *LULAC*, the Court considered one particular measure of partisan symmetry, called partisan bias. As described above, partisan bias refers to the divergence in the share of seats that each party would win given the same share (typically 50%) of the statewide vote. *See id.* at 419-20 (opinion of Kennedy, J.); *id.* at 466 (Stevens, J., concurring in part and dissenting in part).

47. Partisan bias is not the only measure of partisan symmetry. In the last few years, political scientists and legal academics have developed a new symmetry metric, called the efficiency gap, which improves on partisan bias in several respects. *See* Eric M. McGhee, *Measuring Partisan Bias in Single-Member District Electoral Systems*, 39 Legis Stud. Q. 55 (2014); Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap*, 82 U. Chi. L. Rev. 101 (2015); Expert Report of Prof. Kenneth R. Mayer (July 3, 2015) ("Mayer Report"), attached hereto as Ex. 2; Expert Report of Prof. Simon D. Jackman (July 7, 2015) ("Jackman Report") attached hereto as Ex. 3.

48. The efficiency gap is rooted in the insight that, in a legal regime in which each district must have an approximately equal population, there are only two ways to implement a partisan gerrymander. First, a party's supporters can be cracked among a large number of districts so that they fall somewhat short of a majority in each one. These voters' preferred candidates then predictably lose each race. Second, a party's backers can be packed into a small number of districts in which they make up enormous majorities. These voters' preferred candidates then prevail by overwhelming margins. All partisan gerrymandering is accomplished through cracking and packing, which enables the party controlling the map to manipulate vote margins in its favor.

49. Both cracking and packing produce so-called "wasted" votes—that is, votes that do not directly contribute to a candidate's election. When voters are cracked, their votes are wasted because they are cast for losing candidates. Similarly, when voters are packed, their votes are wasted to the extent they exceed the 50%-plus-one threshold required for victory (in a two-candidate race). Partisan gerrymandering also can be understood as the manipulation of wasted votes in favor of the gerrymandering party, so that it wastes fewer votes than its adversary.

50. The efficiency gap is the difference between the parties' respective wasted votes in an election, divided by the total number of votes cast. Suppose, for example, that there are five districts in a plan with 100 voters each. Suppose also that Party A wins three of the districts by a margin of 60 votes to 40, and that Party B wins two of them by a margin of 80 votes to 20. Then Party A wastes 10 votes in each of the three districts it wins and 20 votes in each of the two districts it loses, adding up to 70 wasted votes. Likewise, Party B wastes 30 votes in each of the two districts it wins and 40 votes in each of the three districts it loses, adding up to 180 wasted votes. The difference between the parties' respective wasted votes is 110, which, when divided by 500 total votes, yields an efficiency gap of 22% in favor of Party A.

51. The efficiency gap is ***not*** based on the principle that parties have a right to proportional representation based on their share of the statewide vote, nor does it measure the deviation from seat-vote proportionality. Instead, by aggregating all of a plan's cracking and packing into a single number, the efficiency gap measures a party's ***undeserved*** seat share: the proportion of seats a party receives that it would ***not*** have received under a balanced plan in which both sides had approximately equal wasted votes. In the above example, for instance, the 22% efficiency gap in favor of Party A means that it won 22% more seats—in this example, 1 more seat out of 5—than it would have under a balanced plan.

52. Over the 1972-2014 period—since the end of the reapportionment revolution of the 1960s— the distribution of state house plans' efficiency gaps has been normal and has had a median of almost exactly zero. *See* Jackman Report at 61; Stephanopoulos & McGhee, *supra*, at 140-42. This indicates that neither party has enjoyed an overall advantage in state legislative redistricting during the modern era.

53. However, recently the average absolute efficiency gap (*i.e.*, the mean of the absolute values of all plans' efficiency gaps in a given year) has increased sharply. This metric stayed roughly constant from 1972 to 2010. But in the current cycle, fueled by rising partisanship and greater technological sophistication, it spiked to the highest level recorded in the modern era: over 6% for state house plans. *See* Jackman Report at 47; Stephanopoulos & McGhee, *supra*, at 142-45. This means that the severity of today's partisan gerrymandering is historically unprecedented—as is the need for judicial intervention.

Wisconsin's Current Plan Is an Outlier

54. Between 1972 and the present, the efficiency gaps of Wisconsin's Assembly plans became steadily larger and more pro-Republican. The Current Plan represents the culmination of this trend, exhibiting the largest and most pro-Republican efficiency gap ever recorded in modern Wisconsin history. In the 1970s, the Assembly plan had an average efficiency gap close to zero. In both the 1980s and the 1990s, it had an average pro-Republican gap of 2%. The Republican advantage deepened in the 2000s to an average gap of 8%. And it then surged, thanks to the Current Plan, to an average gap of ***11%*** in 2012 and 2014. *See* Jackman Report at 34; Stephanopoulos & McGhee, *supra*, at 154-56.

55. More specifically, using the same methodology as for all other states, the Current Plan produced a pro-Republican efficiency gap of 13% in 2012 and 10% in 2014. The 2012

figure represents the 28th-worst score in modern American history (out of nearly 800 total plans), placing the Current Plan in the worst 4% of this distribution, more than two standard deviations from the mean. Based on this historical data, there is close to a zero percent chance that the Current Plan's efficiency gap will ever switch signs and favor the Democrats during the remainder of the decade. Furthermore, prior to the current cycle, not a ***single*** plan in the country had efficiency gaps as high as the Current Plan's in the first two elections after redistricting. *See* Jackman Report at 63.

56. Using a more detailed methodology available only for Wisconsin, the Current Plan produced a pro-Republican efficiency gap of 12% in 2012. This is a figure nearly identical to the one calculated using the national data. Using the Wisconsin-specific methodology as well as data compiled prior to 2012 by Dr. Gaddie, the expert retained by the Legislature's Republican leadership to assist them in drafting the Current Plan, that Plan was ***forecast*** to produce an efficiency gap of 12%. This figure also is nearly identical, and shows that the Current Plan performed precisely as its authors hoped and expected. *See* Mayer Report at 46.

57. This extraordinary level of partisan unfairness was achieved through the rampant cracking and packing of Wisconsin's Democratic voters, which resulted in their votes being disproportionately wasted. The Mayer Report shows that Democratic voters were cracked so that Republican candidates were far more likely to prevail in close races (where the winner had 60% or less of the vote): Republicans were likely to win 42 such districts, while Democrats would win only 17.[1] Democrats were also packed into a number of districts where they would win overwhelmingly (by getting 80% or more of the vote): there were eight districts where

[1] In making this analysis, the Mayer Report used 2012 election results and further assumed that all districts had been contested and no incumbents had run. These are both standard assumptions made by political scientists to determine a plan's underlying partisanship.

Democrats would win by this margin, compared to ***zero*** districts where Republicans would win such a lopsided victory. Thus, through gerrymandering, Republican votes were used more efficiently than Democratic votes to elect representatives, producing an undemocratic result that does not accurately reflect the preferences of the Wisconsin electorate. *See* Mayer Report at 38-41.

58. The forecasts of Dr. Gaddie, the Republican consultant, prior to the 2012 election confirm that the Current Plan was expected and intended to crack and pack Wisconsin's Democratic voters to this extent. Dr. Gaddie predicted that Republicans would win 46 Assembly districts by a margin smaller than 60%-40%, compared to just 20 such victories for Democrats. He also predicted that Democrats would prevail in seven districts by a margin greater than 80%-20%, compared to zero such wins for Republicans. *See* Mayer Report at 38-41. These figures are nearly identical to plaintiffs' estimates, and further demonstrate that the Current Plan was intended to disadvantage Democrats and waste Democratic votes to the maximum extent possible.

Examples of Cracking and Packing in the Current Plan

59. These plan-level statistics are the product of innumerable local cracking and packing decisions. Across Wisconsin, the Current Plan systematically alters prior district configurations to waste larger numbers of Democratic votes and smaller numbers of Republican votes. The following regional examples (depicted in map form in Exhibit 1 hereto) show how the Current Plan deliberately allocates Democratic voters less efficiently and Republican voters more efficiently. These are only illustrative examples; they do not show ***all*** of the ways in which Wisconsin's current pro-Republican gerrymander was achieved. In addition, the examples focus on: (1) the 2012 election because it was the first one held after this cycle's redistricting; (2) the

2008 election because it was the most comparable prior election, featuring a similar share of the statewide Assembly vote for each party (53.9% Democratic in 2008, 51.4% Democratic in 2012) and also coinciding with a presidential election; and (3) Plaintiffs' Demonstration Plan, because it reveals the fair results that could have been, but were not, attained in 2012.

Milwaukee, Ozaukee, Washington, and Waukesha Counties:

60. Under the prior Assembly plan that was in force from 2002-2010 (the "Prior Plan"), District 22 included part of northeastern Milwaukee County; District 23 included part of northern Milwaukee County (home to Plaintiff Wallace) and part of southern Ozaukee County; and District 24 included part of Washington and Waukesha Counties. In the 2008 election, a Democratic candidate won District 22, and Republican candidates won Districts 23 and 24. Under the Demonstration Plan, a Democratic candidate would win District 22, and Republican candidates would win Districts 23 and 24.

61. As a result of the Current Plan, Democratic voters who were in the old District 22 were cracked into the new Districts 23 and 24. Due to these changes, Districts 22, 23, and 24 were won by Republican candidates in 2012.

62. The shift from one Democratic seat and two Republican seats in the Prior Plan and the Demonstration Plan in Milwaukee, Ozaukee, Washington, and Waukesha Counties, to zero Democratic seats and three Republican seats in the Current Plan, contributed to Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex. 1.

Calumet, Fond du Lac, Manitowoc and Sheboygan Counties:

63. Under the Prior Plan, District 26 centered on the City of Sheboygan in the central eastern part of Wisconsin (home to Plaintiff Donohue) and District 27 consisted of the northern

part of Sheboygan County as well as parts of Fond du Lac, Calumet, and Manitowoc Counties. In the 2008 election, a Democratic candidate won District 26 and a Republican candidate won District 27. Under the Demonstration Plan, a Democratic candidate would win District 26, and a Republican candidate would win District 27.

64. As a result of the Current Plan, Democratic voters who were in District 26 were cracked so that roughly half of that district was distributed to District 27 and additional voters from south of Sheboygan County were added to District 26. Due to these changes, Districts 26 and 27 were won by Republican candidates in 2012.

65. The shift from one Democratic seat and one Republican seat in the Prior Plan and the Demonstration Plan in Sheboygan County and southern Fond du Lac, Manitowoc and Calumet Counties, to zero Democratic seats and two Republican seats in the Current Plan, contributed to Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex. 1.

Racine and Kenosha Counties:

66. Under the Prior Plan, Districts 61, 62, 63, 64, 65, and 66 were almost entirely within Racine and Kenosha Counties in the southeastern edge of Wisconsin (the City of Racine is home to Plaintiff Mitchell). Districts 61 and 62 centered on the City of Racine, with District 63 covering the western side of Racine County. Districts 64 and 65 centered on the City of Kenosha, with District 66 covering the western edge of Kenosha County. In the 2008 election, Democratic candidates won Districts 61, 62, 64, and 65, while Republican candidates won Districts 63 and 66. Under the Demonstration Plan, Democratic candidates would win Districts 62, 63, 64, and 66, while Republican candidates would win Districts 61 and 65.

67. As a result of the Current Plan, Democratic voters who were in the old Districts 61 and 62 were packed into the new District 66, thus wasting more Democratic votes in the region. Due to these changes, Districts 64, 65, and 66 were won by Democratic candidates in 2012, while Districts 61, 62, and 63 were won by Republican candidates.

68. The shift from four Democratic seats and two Republican seats in the Prior Plan and the Demonstration Plan in Racine and Kenosha Counties, to three Democratic seats and three Republican seats in the Current Plan, contributed to Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex. 1.

Buffalo, Chippewa, Eau Claire, Jackson, La Crosse, Pepin, Pierce, St. Croix, and Trempealeau Counties:

69. Under the Prior Plan, most of seven Districts (67, 68, 91, 92, 93, 94, and 95) were spread across Buffalo, Chippewa, Eau Claire, Jackson, La Crosse, Pepin, Pierce, St. Croix, and Trempealeau Counties in northwestern Wisconsin (Eau Claire is home to Plaintiff Johnson). In the 2008 election, Democratic candidates won five of the seven Districts (68, 91, 92, 93, and 95), and Republicans won two of them (67 and 94). The district numbers in the Demonstration Plan are slightly different; instead of District 68, District 69 is in Eau Claire County. Under the Demonstration Plan, Democratic candidates would win six of seven Districts (67, 69, 91, 92, 94, and 95) and a Republican candidate would win one of them (93).

70. As a result of the Current Plan, Democratic voters who were in the old District 68 were packed into the new District 91, and Democrats in the rest of old District 68 as well as old Districts 91 and 93 were cracked into the new Districts 68, 92, and 93. Due to these changes, Democratic candidates won only four of the seven districts in 2012 (91, 92, 94, and 95), and Republican candidates won three of them (67, 68, and 93).

71. The shift from five or six Democratic seats, in the Prior Plan and Demonstration Plan respectively, and two or one Republican seats in the Prior Plan and Demonstration Plan respectively, to four Democratic seats and three Republican seats in the Current Plan, in Buffalo, Chippewa, Eau Claire, Jackson, La Crosse, Pepin, Pierce, St. Croix, and Trempealeau Counties, contributed to Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex. 1.

Adams, Columbia, Marathon, Marquette, Portage, and Wood Counties:

72. Under the Prior Plan, most of eight Districts (42, 47, 69, 70, 71, 72, 85, and 86) were spread across Adams, Columbia, Marathon, Marquette, Portage, and Wood counties in central Wisconsin (Columbia County is home to Plaintiffs Allison and James Seaton). In the 2008 election, Democratic candidates won five of the eight Districts (42, 70, 71, 72, and 85), and Republicans won three Districts (47, 69, and 86). In the Demonstration Plan the district numbers are different (5, 40, 41, 42, 71, 72, 86, and 87), but of these eight Districts, Democratic candidates would win five (71, 86, 40, 41, and 42), and Republican candidates would win three (5, 72, and 87).

73. As a result of the Current Plan, Democratic voters who were in the old Districts 42, 70, and 72 were cracked, and the new Districts 41, 42, 69, 70, 71, 72, 85, and 86 were created in areas of Adams, Columbia, Marathon, Marquette, Portage, and Wood Counties. Due to these changes, Democratic candidates won only three of the eight Districts (70, 71, and 85) in 2012, and Republican candidates won five of them (41, 42, 69, 72, and 86).

74. The shift from five Democratic seats and three Republican seats in the Prior Plan and the Demonstration Plan in Adams, Columbia, Marathon, Marquette, Portage, and Wood Counties, to three Democratic seats and five Republican seats in the Current Plan, contributed to

Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex. 1.

Brown and Manitowoc Counties:

75. Under the Prior Plan, Brown and Manitowoc Counties were split to include parts of Districts 1, 2, 4, 5, 25, 88, 89, and 90 in the Green Bay area of Wisconsin. In the 2008 election, Democratic candidates won Districts 2, 5, 25, and 88, and Republican candidates won Districts 1, 4, 89, and 90. Under the Demonstration Plan, Brown and Manitowoc Counties would include Districts 1, 2, 3, 25, 26, 88, 89, and 90. Under the Demonstration Plan, Democrats would win Districts 2 and 88, and Republicans would win the remaining six districts.

76. As a result of the Current Plan, Democratic voters who were in the old Districts 2, 5 and 25 were cracked into the new Districts 2, 5, 25, and 88. Due to these changes, seven of the eight districts in the Brown and Manitowoc County area (1, 2, 4, 5, 25, 88, and 89) were won by Republican candidates in 2012, and one District (90) was won by a Democratic candidate in 2012.

77. The shift from four or two Democratic seats in the Prior Plan and the Demonstration Plan, respectively, and four or six Republican seats in the Prior Plan and the Demonstration Plan, respectively, to one Democratic seat and seven Republican seats in the Current Plan, in Brown and Manitowoc Counties, contributed to Wisconsin's current pro-Republican efficiency gap. This gerrymandering and its results are shown in the maps attached hereto as Ex.1.

Wisconsin Does Not Need to Have a Gerrymandered Plan

78. Not only did the Current Plan exhibit extremely large efficiency gaps in 2012 and 2014, but this poor performance was entirely unnecessary and served no legitimate purpose. It

would have been possible for Wisconsin to enact an Assembly plan that treated both parties symmetrically and did not disproportionately waste Democratic votes. To prove this point, plaintiffs' expert has designed a Demonstration Plan that would have had an efficiency gap of just ***2%*** in 2012 (assuming all contested districts and no incumbents). *See* Mayer Report at 46. This far better score is attributable to plaintiffs' efforts ***not*** to crack and pack Democratic voters, and instead to enable both parties to convert their popular support into legislative seats with equal ease.

79. Plaintiffs' Demonstration Plan performs at least as well as the Current Plan on every other relevant metric. Both plans have total population deviations of less than 1%—far below the courts' 10% threshold for presumptive constitutionality. Both plans have six African American opportunity districts and one Hispanic opportunity district, and so are identical for Voting Rights Act purposes. The Demonstration Plan splits one fewer municipal boundary than the Current Plan (119 versus 120), and so is superior in that regard. And the Demonstration Plan's districts are substantially more compact than the Current Plan's (average compactness of 0.41 versus 0.28). *See* Mayer Report at 37.

80. The Demonstration Plan proves that the Current Plan's extreme pro-Republican tilt cannot be blamed on either an effort to comply with legitimate redistricting criteria or Wisconsin's underlying political geography. Both of those factors were perfectly compatible with a neutral map.

COUNT I – FOURTEENTH AMENDMENT VIOLATION

81. Plaintiffs incorporate and re-allege paragraphs 1-80 of this Complaint as paragraphs 1-80 of this Count I.

82. The Current Plan is a partisan gerrymander so extreme that it violates Plaintiffs' Fourteenth Amendment right to equal protection of the laws. The Current Plan intentionally and severely packs and cracks Democratic voters, thus disproportionately wasting their votes, even though a neutral map could have been drawn instead. Accordingly, Wisconsin's Act 43 deprives plaintiffs of their civil rights under color of state law in violation of 42 U.S.C. §§ 1983 and 1988.

83. The efficiency gap provides a workable test to identify unconstitutional partisan gerrymandering similar to the two-part approach applied to state legislative reapportionment claims. In a reapportionment challenge, the first issue is whether a district plan's total population deviation exceeds 10%. If so, the plan is presumptively unconstitutional, and if not, it is presumptively valid. The second issue, which is reached only if the total population deviation is greater than 10%, is whether the malapportionment is necessary to achieve a legitimate state goal. The state bears the burden at this stage of rebutting the presumption of unconstitutionality. *See Voinovich v. Quilter*, 507 U.S. 146, 161-62 (1993); *Brown v. Thomson*, 462 U.S. 835, 842-43 (1983); *Connor v. Finch*, 431 U.S. 407, 418 (1977).

84. The same two-part approach should be applied to partisan gerrymandering claims, only with the efficiency gap substituted for total population deviation. The first step in the analysis is whether a plan's efficiency gap exceeds a certain numerical threshold. If so, the plan is presumptively unconstitutional, and if not, it is presumptively valid. The second step, which is reached only if the efficiency gap is sufficiently large, is whether the plan's severe partisan unfairness is the necessary result of a legitimate state policy, or inevitable given the state's underlying political geography. The state would bear the burden at this stage of rebutting the presumption of unconstitutionality.

85. The Current Plan is plainly unlawful under this two-part test. First, it was ***forecast*** to produce, and then ***did*** produce, an efficiency gap of approximately 13% in the 2012 election. This is an extraordinarily high level of partisan unfairness, more than two standard deviations from the mean: as noted above, the 2012 figure represents the 28th-worst score in modern American history (out of nearly 800 total plans), placing the Current Plan in the worst 4% of this distribution. This is also not a temporary or transient gerrymander. The Current Plan's efficiency gap means that there is close to a zero percent chance that the Plan will ever favor Democrats during its lifespan. *See* Jackman Report at 60. Given its severity and predicted durability, the Current Plan's efficiency gap far exceeds any plausible threshold for presumptive unconstitutionality.

86. Indeed, even a 7% efficiency gap should be presumptively unconstitutional. A 7% efficiency gap is at the edges of the overall distribution of all state house plans in the modern era, making it indicative of uncommonly severe gerrymandering. See Jackman Report at 61. Historical analysis shows that with a 7% efficiency gap, the gerrymandering is also likely to be unusually durable—over its lifespan, a plan with an efficiency gap of that magnitude is unlikely ever to favor the opposing party. See Jackman Report at 61. However, this Court need not decide at what point an efficiency gap is large enough to trigger a presumption of unconstitutionality. In the state legislative reapportionment context, the applicable cutoff (10%) emerged over a series of cases, in which extreme population deviations (of 34%, then 26%, then 20%) were struck down and deviations of 8% and 10% were upheld before the 10% threshold was adopted. Here too the Current Plan's extreme efficiency gap should be deemed presumptively unconstitutional, without the need to decide what the cut-off should be.

87. Second, the State cannot rebut the presumption that the Current Plan is unlawful. Plaintiffs' Demonstration Plan would have had an efficiency gap of just 2% in 2012 while complying with all federal and state criteria at least as well as the Current Plan. *See* Mayer Report at 46. Accordingly, neither an attempt to achieve legitimate redistricting goals nor Wisconsin's underlying political geography could have necessitated the Current Plan's partisan imbalance.

88. In addition to its extreme efficiency gap, the Current Plan exhibits a severe partisan bias. The Current Plan produced a partisan bias of 13% in 2012 and 12% in 2014—scores that in and of themselves demonstrate the unconstitutional effects produced by the Current Plan.

89. Finally, there is no doubt that the Current Plan was specifically intended and indeed designed to benefit Republican candidates, and to disadvantage Democratic candidates, to the greatest possible extent. Thus, the Current Plan had both the purpose and effect of subordinating the adherents of one political party and entrenching a rival party in power, in violation of their right to equal protection under the law.

COUNT II—FIRST AMENDMENT VIOLATION

90. Plaintiffs incorporate and re-allege paragraphs 1-89 of this Complaint as paragraphs 1-89 of this Count II.

91. Plaintiffs and other Democratic voters in the state of Wisconsin have a First Amendment right to freely associate with each other without discrimination by the State based on that association; to participate in the political process and vote in favor of Democratic candidates without discrimination by the State because of the way they vote; and to express their political views without discrimination by the State because of the expression of those views or the content of their expression.

92. Wisconsin Act 43 violates the First and Fourteenth Amendments because it intentionally uses voters' partisan affiliation to affect the weight of their votes. By taking the actions described above, the drafters of the Current Plan deliberately discriminated against plaintiffs and other Democratic voters because they are Democrats and have voted for and will vote for Democratic candidates and because of the positions they have expressed and will take on public affairs — that is, because of their views and the content of their expression.

93. By excessively and unreasonably cracking and packing groups of Democratic voters to intentionally weaken their voting power, the State of Wisconsin discriminated against Democratic voters, including the plaintiffs, on the basis of their voting choices, their political views, and the content of their expression.

94. The unusual extent of the partisan gerrymandering in this case, as shown by the extremely high efficiency gap and the factors described above, indicates that the gerrymandering in this case is so high that the Current Plan denies to plaintiffs and other Democratic voters in Wisconsin their rights to free association and freedom of expression guaranteed by the First and Fourteenth Amendments.

95. For these reasons, and because Act 43 and the Current Plan have the purpose and effect of subjecting Democrats to disfavored treatment by reason of their views, Act 43 and the Current Plan are subject to strict scrutiny and cannot be upheld absent a compelling government interest, which is not present in this case.

96. Accordingly, Wisconsin's Act 43 deprives plaintiffs of their civil rights under color of state law in violation of 42 U.S.C. §§ 1983 and 1988.

RELIEF REQUESTED

WHEREFORE, Plaintiffs respectfully request that this Court:

97. Declare Wisconsin's 99 State Assembly Districts, established by Act 43, unconstitutional and invalid, and the maintenance of these districts for any primary, general, special, or recall election a violation of plaintiffs' constitutional rights;

98. Enjoin Defendants and the G.A.B.'s employees and agents, including the county clerks in each of Wisconsin's 72 counties, from administering, preparing for, and in any way permitting the nomination or election of members of the State Assembly from the unconstitutional districts that now exist;

99. In the absence of a state law establishing a constitutional district plan for the Assembly districts, adopted by the Legislature and signed by the Governor in a timely fashion, establish a redistricting plan that meets the requirements of the U.S. Constitution and federal statutes and the Wisconsin Constitution and state statutes;

100. Award plaintiffs their reasonable attorneys' fees, costs, and litigation expenses incurred in bringing this action; and

101. Grant such further relief as the Court deems just and proper.

By: */s/ Peter G. Earle*
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One of the attorneys for plaintiffs

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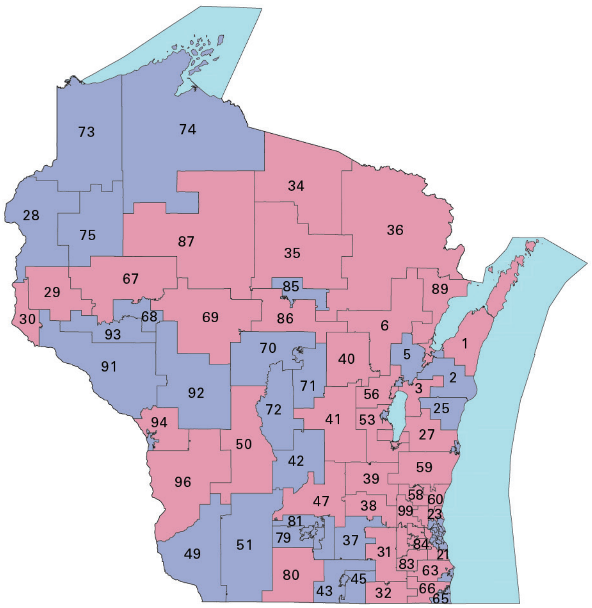
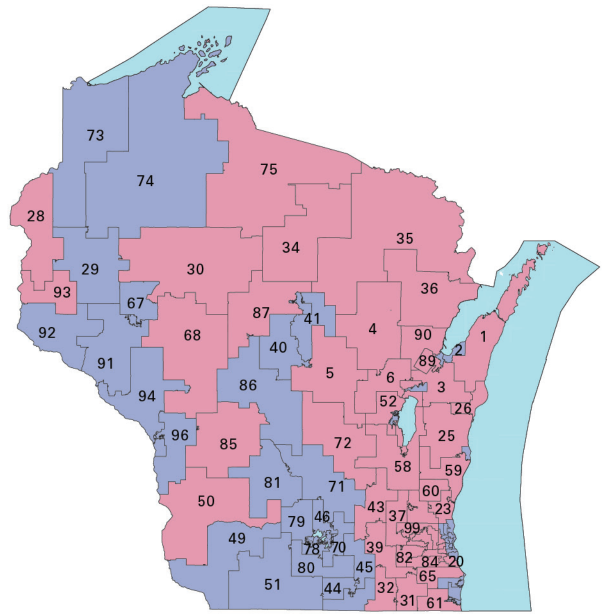
rgreenwood@clccrul.org
Applications for admission pro hac vice pending

FULL STATE PLANS

Prior Plan with 2008 General Election Results



Demonstration Plan with imputed 2012 General Election Results



Current Plan with 2012 General Election Results

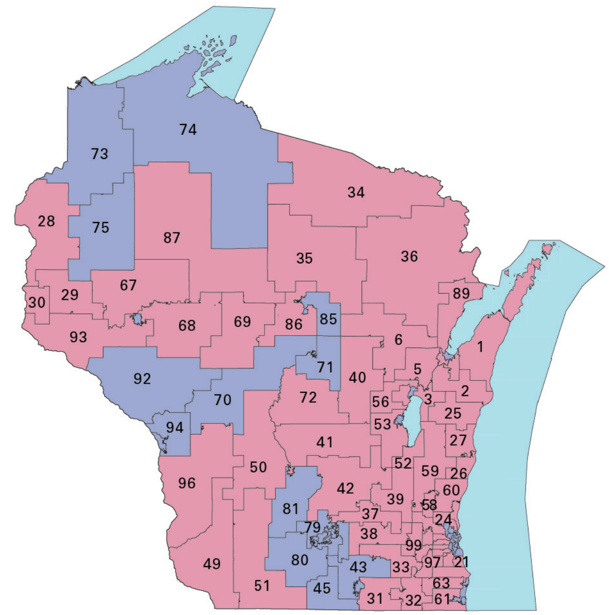
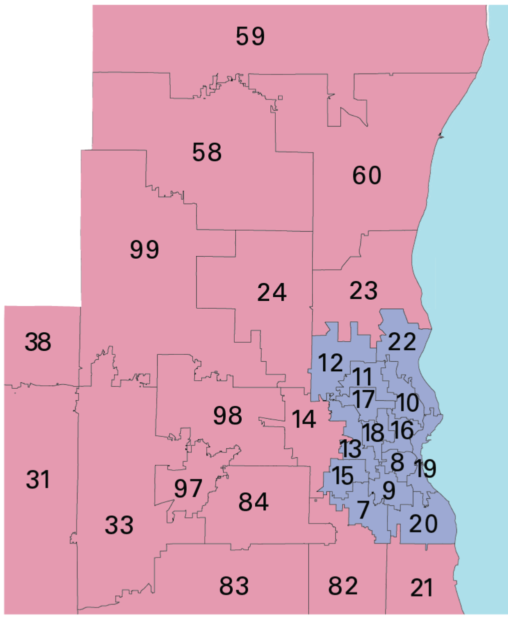


EXHIBIT 1

MILWAUKEE, OZAUKEE, WASHINGTON AND WAUKESHA COUNTIES

Prior Plan with 2008 General Election Results



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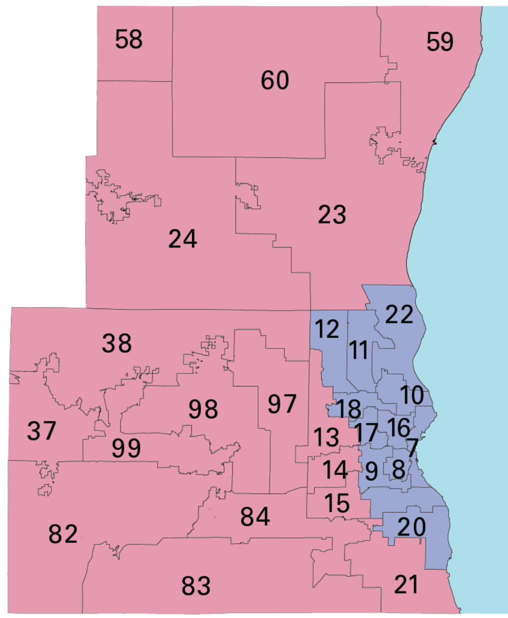

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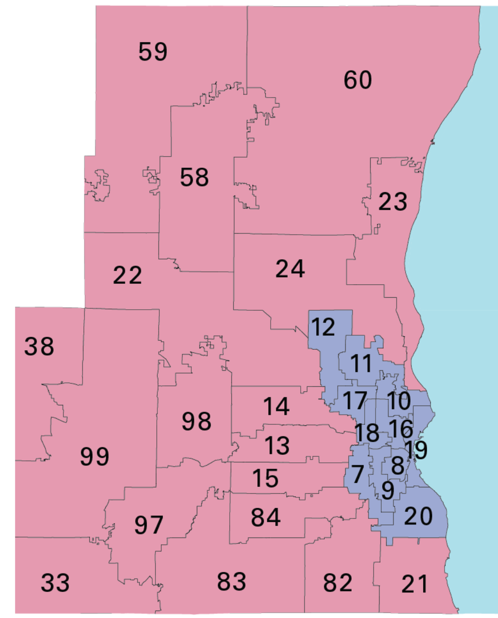
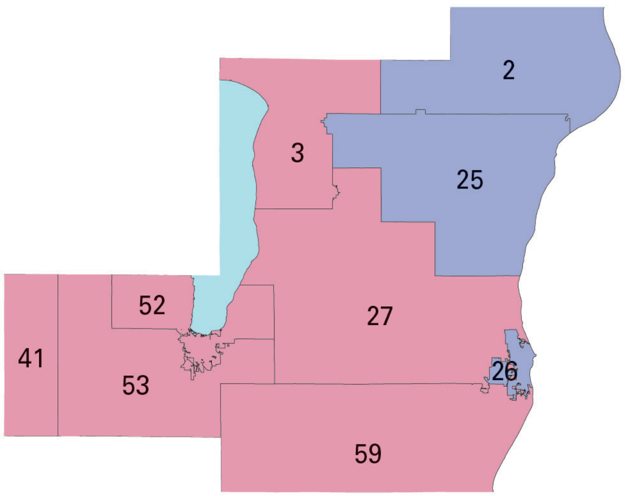


CALUMET, FOND DU LAC, MANITOWOC, AND SHEBOYGAN COUNTY

Prior Plan with 2008 General Election Results



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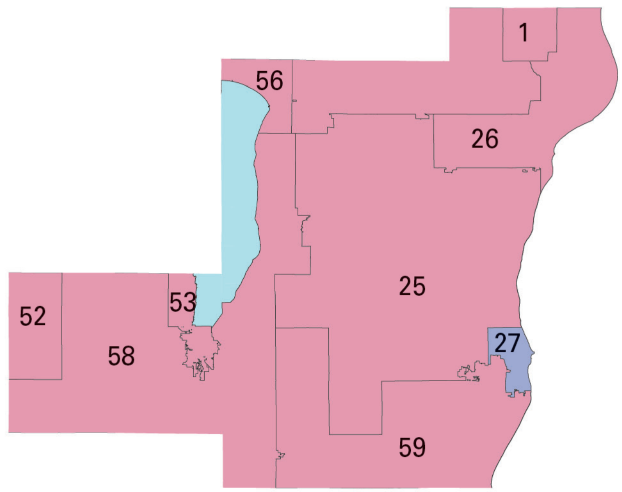

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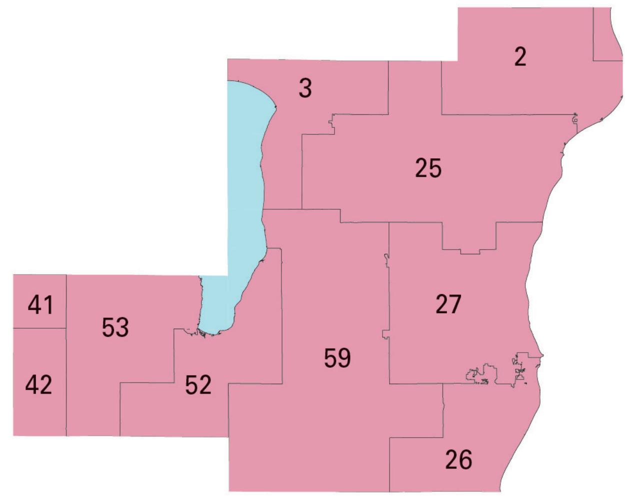
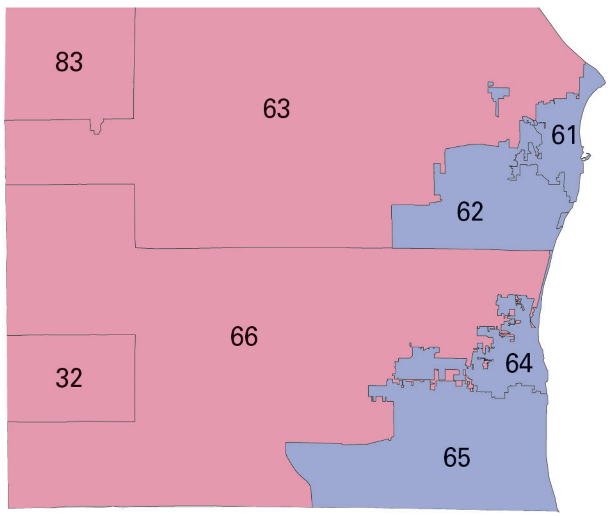


RACINE AND KENOSHA COUNTIES

Prior Plan with 2008 General Election Results



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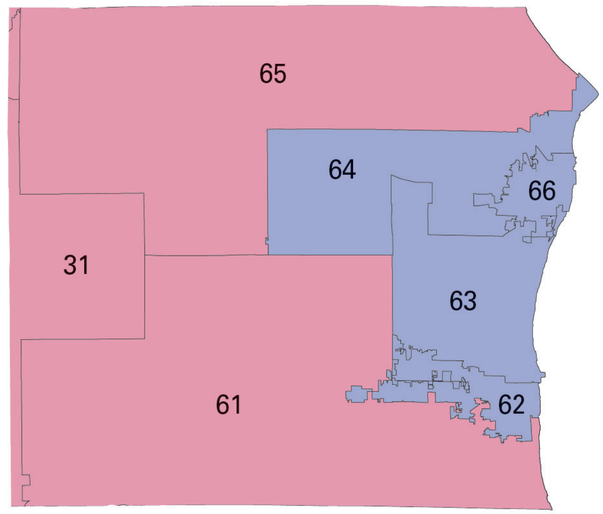

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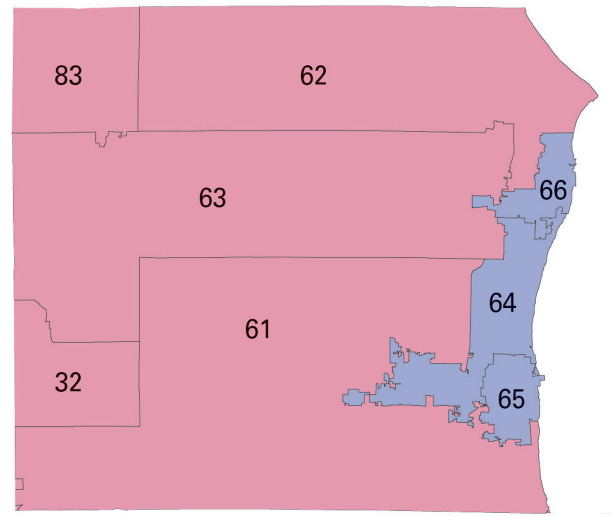
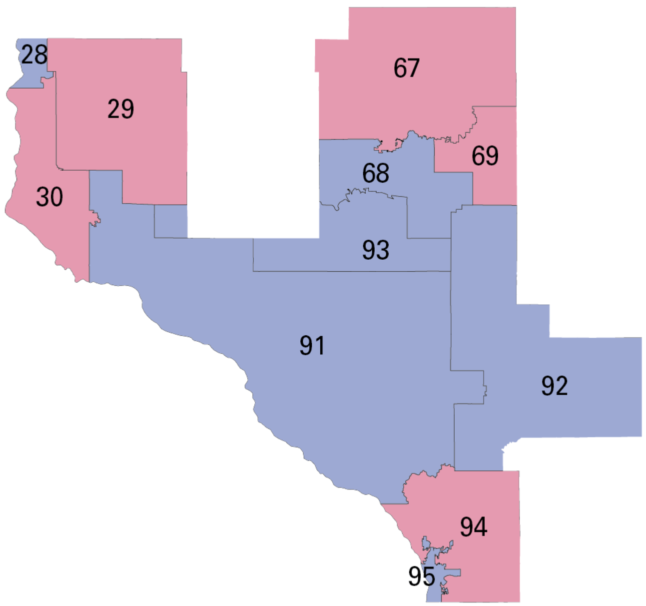


BUFFALO, CHIPPEWA, EAU CLAIRE, JACKSON, LA CROSSE, PEPIN, PIERCE, ST CROIX, TREMPEALEAU COUNTIES

Prior Plan with 2008 General Election Results



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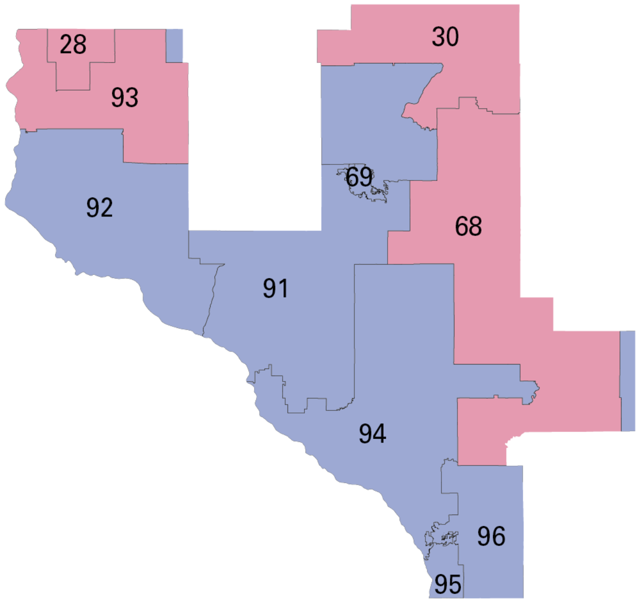

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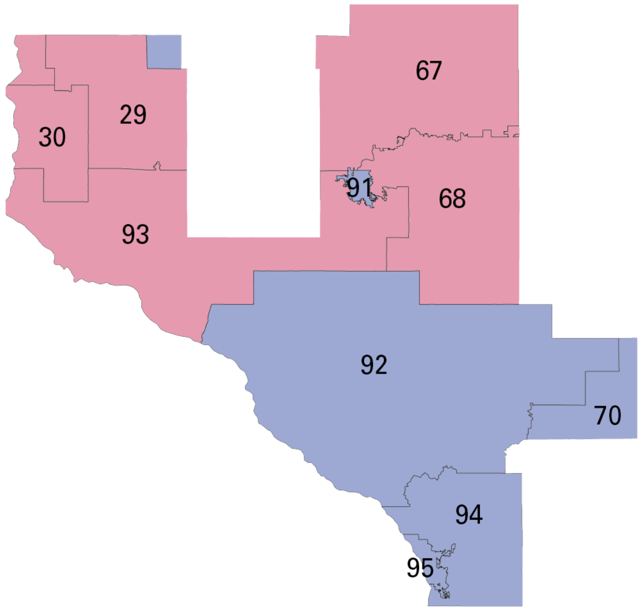
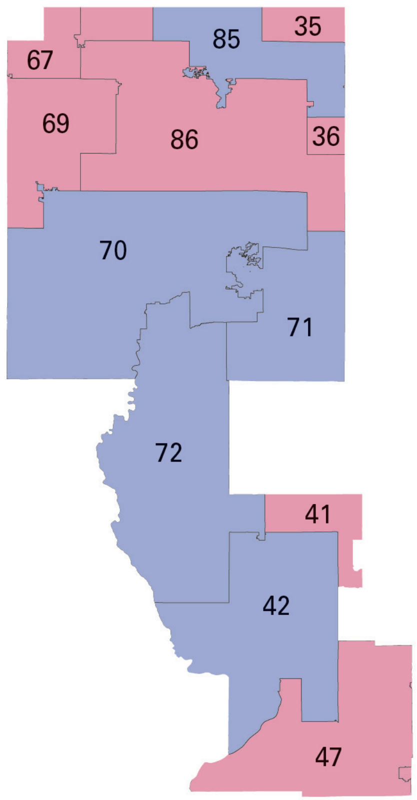
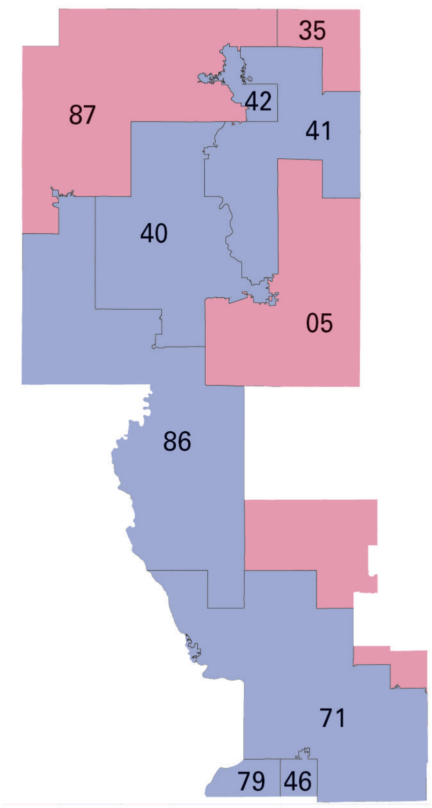


ADAMS, COLUMBIA, MARATHON, MARQUETTE, PORTAGE, AND WOOD COUNTIES

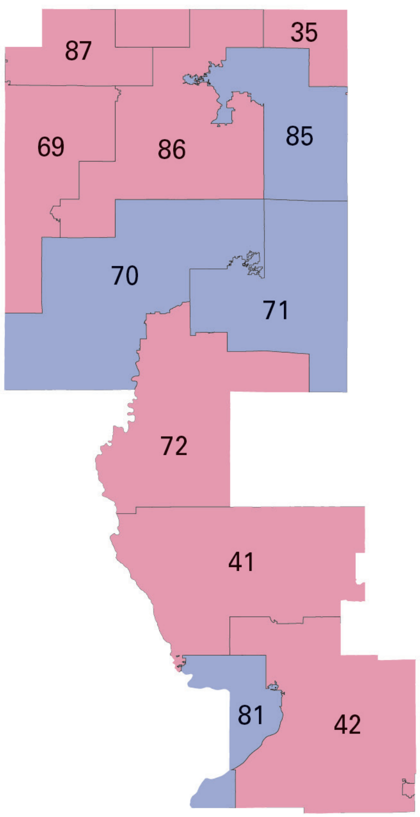
Prior Plan with 2008 General Election Results



Demonstration Plan with imputed 2012 General Election Results

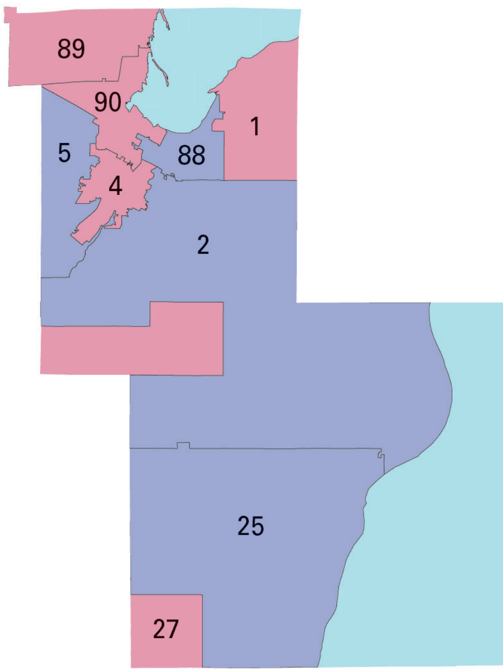


Current Plan with 2012 General Election Results



BROWN AND MANITOWOC COUNTIES

Prior Plan with 2008 General Election Results



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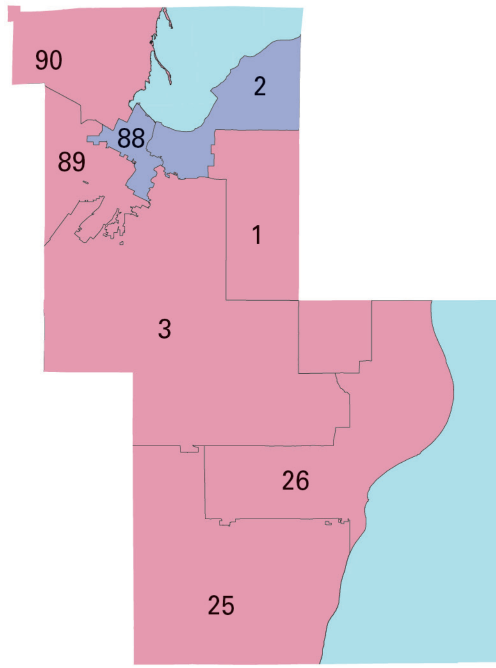

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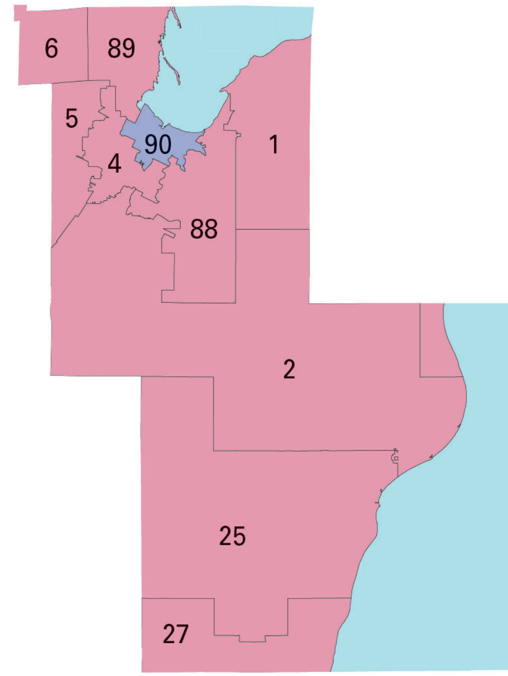

Analysis of the Efficiency Gaps of Wisconsin's Current Legislative District Plan and Plaintiffs' Demonstration Plan

Kenneth R. Mayer, Ph.D.
Department of Political Science
University of Wisconsin-Madison
July 3, 2015

EXHIBIT 2

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I. Introduction

My name is Kenneth Mayer and I currently am a Professor of Political Science at the University of Wisconsin-Madison, and a faculty affiliate at the Lafollette School of Public Affairs, at the University. I joined the faculty in 1989. I teach courses on American politics, the presidency, Congress, campaign finance, election law, and electoral systems.

I have been retained by counsel representing the plaintiffs in this lawsuit (the "Plaintiffs") to analyze and provide expert opinions. I have been asked to determine whether, in my opinion, it is possible to create a Wisconsin state legislative map that does not result in systemic partisan advantage, by drawing a legislative district plan that has an efficiency gap as close to zero as possible while complying with federal and state requirements at least as well as the plan enacted by the Wisconsin legislature in Act 43.[1]

I submit this report, which contains the opinions that I intend to give in this matter. I describe my methods for estimating the state Assembly vote in actual and hypothetical state legislative redistricting plans, and for calculating the efficiency gap for Act 43 and for the alternative demonstration plan I drew.

My opinions, which are based on the technical and specialized knowledge that I have gained from my education, training and experience, are premised on commonly used, widely accepted and reliable methods of analysis, the application of the legal requirements of redistricting, and are based on my review and analysis of the following information and materials:

- Redistricting materials available from the Wisconsin legislature at http://legis.wisconsin.gov/gis/data, including Geographic Information System (GIS)

[1] The federal requirements are equal population, compliance with Section 2 of the Voting Rights Act, and the ban on racially gerrymandered districts. The state requirements are contiguity, compactness, and respect for political subdivisions (counties, towns, cities, and villages).

files for Act 43 districts, and ward level election data for 2012

- Census Bureau data on population, citizenship, and location of institutionalized populations as explained below
- Election data from the 2013-2014 Wisconsin *Blue Book* for the 2012 State Assembly and presidential elections
- Election data from the Government Accountability Board, including ward level 2012 election results for State Assembly and presidential elections.
- GIS data, including Census population figures, block assignments, and shape files for Wisconsin, available in the GIS program Maptitude for Redistricting
- Files submitted by defendants in *Baldus et al. v. Brennan et al.*

I conducted my analysis using Stata, Excel, R, and Maptitude for Redistricting.

II. Qualifications, Publications, Testimony, and Compensation

I have a Ph.D. in political science from Yale University, where my graduate training included courses in econometrics and statistics. My undergraduate degree is from the University of California, San Diego, where I majored in political science and minored in applied mathematics. My curriculum vitae is attached to this report as Exhibit 1.

All publications that I have authored and published in the past ten years appear in my curriculum vitae, attached as Exhibit 1. Those publications include the following peer-reviewed journals: Journal of Politics, American Journal of Political Science, Election Law Journal, Legislative Studies Quarterly, Presidential Studies Quarterly, American Politics Research, Congress and the Presidency, Public Administration Review, and PS: Political Science and Politics. I have also published in law reviews, including the Richmond Law Review, the UCLA Pacific Basin Law Journal, and the University of Utah Law Review. My work on campaign finance has been published in Legislative Studies Quarterly, Regulation, PS: Political Science and Politics, Richmond Law Review, the Democratic Audit of Australia, and in an edited volume on electoral competitiveness published by the Brookings Institution Press. My research on campaign finance has been cited by the Government Accountability Office, and by legislative research offices in Connecticut and Wisconsin.

My work on election administration has been published in the Election Law Journal, American Journal of Political Science, Public Administration Review, and American Politics Research. I was part of a research group retained as a consultant by the Wisconsin Government Accountability Board to review their compliance with federal mandates and reporting systems, and to survey local election officials throughout the state. I serve on the Steering Committee of the Wisconsin Elections Research Center, a unit with the UW-Madison College of Letters and Science. In 2012 I was retained by the U.S. Department of Justice to analyze data and methods regarding Florida's efforts to identify and remove claimed ineligible noncitizens from the statewide file of registered voters.

In the past eight years, I have testified as an expert witness in trial or deposition in the following cases: *Baldus et al. v. Brennan et al.,* 849 F. Supp. 2d 840 (E.D. Wis. 2012); *Milwaukee Branch of the NAACP et al. v. Walker et al.,* 2014 WI 98, 357 Wis. 2d 469, 851 N.W. 2d 262; *McComish et al. v. Brewer et al.,* No.CV- 08-1550, 2010 WL 2292213 (D. Ariz. June 23, 2010); and *Kenosha County v. City of Kenosha,* No. 11-CV-1813 (Kenosha County Circuit Court, Kenosha, WI, 2011).

I am being compensated at a rate of $300 per hour.

III. Opinions

A. Summary

My opinions may be summarized as follows.

- Using a model that estimates baseline ward-level partisanship, I conclude that the redistricting plan enacted by Act 43 is significantly biased against Democrats, with an efficiency gap of 11.69%. The plan achieves this via the use of classic "packing and cracking" gerrymandering techniques: concentrating Democratic voters into districts where they have overwhelming majorities (packing), and drawing other districts so that Democrats constitute partisan minorities well below 50% and unlikely to win legislative seats (cracking). In doing so, Republicans guarantee a strong majority of legislative seats, even if they obtain well below 50% of the statewide legislative vote. In 2012, Republicans won 61% of State Assembly seats (60 of 99) while achieving only 46.5% of the statewide vote (as measured by the presidential vote, a common proxy for statewide partisanship).

- Using the same measure of partisan strength that the Wisconsin state legislature used in assessing partisan impact of proposed districts in Act 43, Act 43 has an efficiency gap of 12.36%.

- I created a demonstration redistricting plan (the "Demonstration Plan") that is equivalent to Act 43 on population deviation, has fewer political subdivision splits, and has better compactness scores, with a much lower efficiency gap score of 2.20%. This is less than one-fifth of the Act 43 efficiency gap.

- The Demonstration Plan shows that the partisan advantage secured in Act 43 was in no sense required in order to adhere to the constitutional and statutory requirements of legislative redistricting.

B. Measuring Partisanship in Actual and Hypothetical Districting Plans

The efficiency gap is a measure of "wasted votes" that fall into two categories: those votes cast for a losing candidate in a district (lost votes), and votes cast for the winning candidate above what is necessary to win (surplus votes). In an existing set of districts, the calculation is based on the actual vote in each district, with adjustments for uncontested races (Stephanopoulos and McGhee 2015). Larger imbalances in the number of wasted votes signify a degree of partisan unfairness against the political party with more wasted votes.

Calculating the efficiency gap in the Demonstration Plan requires estimating what the underlying partisan vote would be in each newly drawn (and hypothetical) district. The gap cannot be estimated by simply rearranging the votes cast in actual Assembly contests into a new district configuration, as the votes cast for specific Assembly candidates in each district are a function of the electoral environment in that district and whether a race is even contested by both parties. A large literature has developed around the problem of estimating the likely election results in redistricting plan alternatives and calculating summary statistics that characterize existing and hypothetical plans (Gelman and King 1994; Cain 1985).

In most applications, the partisan consequences of a redistricting plan are expressed in terms of the effect on *future* elections: using prior election results to predict outcomes in subsequent election cycles, or estimating the statewide vote swing required to significantly change the partisan composition of the legislature from one election to the next (Gelman and King 1990; Cain 1985). The results are typically expressed as the estimated two-party vote percentages in each new district (Gelman and King 1994), which are sufficient to forecast who will win an election and calculate swing ratios and seats-votes curves.[2]

My aim is different. Instead of estimating future election results for an existing or proposed hypothetical plan, my goal was to determine whether it was possible to draw a district plan following the 2010 Census that minimized the efficiency gap while maintaining strict fidelity to the federal and state constitutional requirements of population equality, contiguity, compactness, respect for political subdivisions, and compliance with the Voting Rights Act. The efficiency gap is a function of the *number* of wasted votes, and therefore requires a model that generates predictions of *how many votes* would have been cast for Democratic and Republican candidates in 2012 in a different district configuration, rather than simply vote

[2] Winners are determined by which candidate receives >50% of the vote in a two party race. Seats votes curves depend on the number of seats a party wins in an election (determined by the number of races in which that party received >50% of the vote) and the statewide vote totals in legislative races or some other set of statewide races

percentages. My methods provide a way of estimating what the 2012 Assembly election results would have been in such a Demonstration Plan.

Given appropriate data, it is possible to generate reliable and accurate vote count predictions that can be aggregated to any district boundaries. What is required is a set of independent variables that accurately predict the vote in state Assembly elections but which are to the greatest extent possible *exogenous* to that vote, meaning that the independent variables have underlying values that do not themselves depend on the district vote. If this condition is met, we can estimate what the district vote would have been in an alternative district configuration, since the independent variables do not depend on any particular district configuration. This is not an issue in models that predict future election results, since by definition variables measured today are exogenous to outcomes that occur several years in the future. Because I use one set of election results (the 2012 presidential vote) as part of a model that predicts another set of contemporaneous election results (the 2012 Assembly vote), it is an important but manageable methodological issue.

My method consists of two steps. The first is the construction of a regression model that predicts the 2012 Assembly vote as a function of partisanship, population, demographics, incumbency, and fixed geographic boundaries in Wisconsin's roughly 6,600 wards. In doing so, I establish the empirical relationships between a set of exogenous variables independent of any specific district configurations and the actual Assembly vote in existing wards. In the second step, I use this model to generate a forecast of Assembly vote preferences as a function of these independent variables, and disaggregate this forecast to the Census block level. Using these block level estimates of the Assembly vote, I draw a Demonstration Plan and estimate the Assembly vote and efficiency gap in the resulting districts.

1. Step One: A Model of Voting in Assembly Elections

Estimating the Assembly vote in alternative district configurations requires a model that can generate accurate estimates of the underlying partisanship of a district. As I noted above, the most common models regress the observed Assembly vote on measures of district partisan preferences and other variables known to affect the vote, and generate a predicted value of the vote based on the values of the independent variables. Changing district boundaries will change the values of the independent variables as new voters are moved into the district and others moved out, which in turn allows forecasts of what the vote would be in those new districts.

What I am interested in estimating is *how many* votes will be cast for Democratic and Republican candidates in each district in a demonstration district plan. This involves a different set of variables than is typical in models that evaluate the percentage of votes each party receives, since I require a measure that accounts for both differences in ward populations and variation in turnout.

I use ward level vote totals as the unit of analysis to increase the number of observations available and allow for more precise estimates. Wisconsin's 99 Assembly districts are composed of roughly 6,600 wards, with districts containing between 24 and 153 wards. While the ideal population of an Assembly district is 57,444, wards have an average population of approximately 869 people, and are far more demographically homogeneous.[3]

[3] Legislative Technology Services Bureau data show 6,592 wards in Wisconsin, of which 66 are unpopulated and another 50 have fewer than 10 people. The average populated ward contains 869 people. Wisconsin statutes 5.15 (2)(b) specifies a permissible population range for wards of 300-4,000, depending on a municipality's size, with exceptions allowed in certain circumstances (for example, when single blocks exceed a permitted ward size, or when a municipality is divided into multiple counties or school districts, contains islands, or has wards that must be altered to match district boundaries).

There are four reasons analysis at the ward level is preferable to analysis at the district level. The first is a matter of sheer numbers: the precision of coefficient estimates, forecasting accuracy, and overall statistical power are all strongly related to the number of observations (or sample size). An n of 6,600 is far preferable to an n of 99, all other things being equal.[4]

The second is the amount of information lost when smaller units are ignored. From a statistical standpoint, using district data when ward data are available imposes the assumption that the values of all of the ward-level variables are equal to the district level variables, when we know this to be untrue immediately upon inspection. Assembly district 1, for example, has 110 populated wards, ranging in population between one and 999 people. In 2012, 73.4% of the voting age population cast ballots in the Assembly contest, and the victorious Republican Assembly candidate received 51.3% of the vote. At the ward level, however, there was considerable variation, with the Republican vote percentage ranging from a low of 38.4% to a high of 75%, and turnout ranging from 50% to over 90%. Ignoring this information and variation will lead to less accurate estimates and forecasts.

Third, in the second step of the analysis I disaggregate ward level estimates to the block level. Minimizing the differences in size and maximizing the homogeneity across that disaggregation will lead to more accurate block level estimates.

And fourth, each Census block is assigned to a single ward,[5] with a unique numerical code that identifies the block's location.[6] These codes allow for disaggregating ward level data

[4] The larger n also means that OLS is an accurate method of estimating the underlying relationships, whereas more complicated techniques may be required with smaller sample sizes (Afshartous and de Leeuw 2005).
[5] The Census Bureau uses the term "Voting Tabulation District" (VTD). Most states call VTDs precincts. In Wisconsin these units are called "wards."
[6] These are known as FIPS (Federal Information Processing Standard) codes. http://www.census.gov/geo/reference/ansi.html.

into blocks and generating inputs for the redistricting software I use in the second step of my analysis.

I use two main sources of data. The first is redistricting data prepared by the Wisconsin Legislative Technology Services Bureau (LTSB), which consists of spreadsheets with ward level Census population data and election results, as well as ward and district shape files containing this data that can be imported into GIS software.[7] The second source is official election results published by the Government Accountability Board (GAB), both online and in the 2013 edition of the *Wisconsin Blue Book*.

In my experience working with large data sets, and especially when dealing with complex GIS data, I have found data errors to be a common problem. I assessed the reliability of the LTSB data by checking it against the GAB election data, and found numerous errors that required correction, as well some errors that could not be corrected.[8] I describe these errors and my corrections in greater detail in an annex to this report. All subsequent references to ward level vote or population counts uses these corrected vote totals.

The regression model used to predict Assembly vote totals takes the standard form of

$$Y_i = \alpha + \beta X_i + \varepsilon_i,$$

where Y_i is the dependent variable in ward i, X_i is a set of independent variables in ward i, and α, β, and ε_i are parameters estimated as a function of the variables. The full model is:

$$\begin{matrix} Assembly \\ Vote \end{matrix}_{\,i} = \alpha + \beta_1 Total\ VEP_i + \beta_2 Black\ VEP_i + \beta_3\ Hispanic\ VEP_i$$

[7] The files are available at http://legis.wisconsin.gov/gis/data. The 2012 election results are in the file Wards_111312_ED_110612.xlsx.

[8] As I note in the Annex, I was not able to allocate 0.21% of the vote in 2012 because of inconsistencies between electoral data reported by the GAB and the geographic redistricting data reported by the LTSB. This small number of votes will not change any of my analysis or conclusions, and such errors are inevitable when working with large data sets.

$$+\beta_4 \begin{matrix} Democratic \\ Presidential\ Vote_i \end{matrix} + \beta_5 \begin{matrix} Republican \\ Presidential\ Vote_i \end{matrix}$$

$$+\beta_6 \begin{matrix} Democratic \\ Incumbent_i \end{matrix} + \beta_7 \begin{matrix} Republican \\ Incumbent_i \end{matrix} + \sum_{j=1}^{71} \gamma_j County_j + \varepsilon_i$$

Where

Assembly Vote	Number of votes cast for the Republican or Democratic candidate in the 2012 Assembly election in ward *i*. I estimate separate equations for the Democratic and Republican candidates
Total VEP	Voting eligible population in ward *i*, as measured in the 2010 Census
Black VEP	Voting eligible Black population in ward *i*
Hispanic VEP	Voting eligible Hispanic population in ward *i*
Democratic Presidential Vote	Number of votes cast for Barack Obama in the 2012 presidential election in ward *i*
Republican Presidential Vote	Number of votes cast for Mitt Romney in the 2012 presidential election in ward *i*
Democratic Incumbent	1 if the Assembly election in ward *i* has a Democratic incumbent, 0 otherwise, multiplied by the VEP in ward *i*
Republican Incumbent	1 if the Assembly election in ward *i* has a Republican incumbent, 0 otherwise, multiplied by the VEP in ward *i*
County	Set of fixed effects dummy variables for each county. Dunn County is the excluded value.[9]

The model explains the Assembly vote as a function of four types of variables: district demographics, underlying partisanship, incumbency, and fixed geographic effects.

[9] When using dummy variables (which take binary values of either 0 or 1) to measure effects in units or conditions across the full population, one unit must be excluded, as otherwise perfect collinearity prevents estimation (Greene 1990, 240-241).

a. The Dependent Variable: Ward level Assembly Vote

The key quantity of interest in this analysis is the number of Assembly votes for each party, and it is the dependent variable in the model, using LTSB ward data that I corrected using the process outlined above. Since I am interested in estimating actual vote counts and not the percentage of the two party vote, I estimate separate equations for votes received by each party.[10] Estimating vote counts provides more accuracy than vote percentages, as it controls for variations in turnout across districts.[11]

b. Independent Variables: Demographic Data

The first three independent variables - Total Voting Age Population (VEP), Black VEP, and Hispanic VEP - are the 2010 Census voting age population counts by ward, adjusted to remove ineligible voters.[12] Total VEP constitutes a baseline of the size of the voting population, reflecting the fact that the number of votes will be a function of total population. Black and Hispanic VEP are additional controls that reflect the partisan tendencies of key subpopulations as

[10] The reliance on actual numbers of voters eliminates the Modified Areal Unit Problem, which results when group statistics such as vote percentages or demographic fractions are aggregated into different geographic units levels. All of my variables and measures are scale invariant (see King 1996).

[11] The number of votes cast in Assembly races varies considerably even in in contested races. In 2012, the number of major party votes cast in the highest turnout Assembly election in the 23rd Assembly district, 36,205, was almost twice the number cast in the 90th Assembly district, 18,735, and almost 5 times the number cast in the uncontested 8th district, 7,869 (numbers taken from GAB figures).

[12] The voting eligible population (VEP) adjusts the voting age population by removing adults who are not eligible to vote. In Wisconsin, the two largest categories of ineligible adults that can be identified geographically are noncitizens and adults in prison for felonies. Noncitizens were removed using the 2008-2012 5 year American Community Survey county level noncitizen estimates (available at http://www.census.gov/acs/www/data_documentation/2012_release/. Institutionalized prison populations were identified using Census Bureau "Advanced Group Quarters" files for Wisconsin, available at .http://www2.census.gov/census_2010/02-Advance_Group_Quarters/, and described in http://www.census.gov/newsroom/releases/archives/2010_census/cb11-tps13.html. There are individuals on probation or extended supervision who are also ineligible to vote. I was not able to systematically identify their locations, but they are dispersed enough that they will not have a material effect on my resulting estimates or conclusions. All regression results and district estimates are materially unchanged when the unadjusted data are used.

well as turnout likelihood. Traditionally, both African American and Hispanic populations vote at lower rates that whites, although in 2012 African American turnout was comparable to white turnout. Hispanic populations vote at lower rates than other demographic groups, in part because of a higher noncitizen population, but also because of socioeconomic factors known to reduce turnout.

I expect weak relationships for these measures because of the importance of the next set of variables, which reflect actual voting in the 2012 presidential election.

c. Independent Variables: Measures of Partisanship

The next two variables are the number of votes cast for the Democratic and Republican candidates for president in the 2012 election. The presidential vote is widely used as an exogenous measure of district level partisanship (Ansolabehere, Snyder and Stewart 2000, 2001; Gelman and King 1994; Glazier, Grofman, and Robbins 1987; McDonald 2014; Jacobson 2003, 2009), and it correlates very strongly with other more complex measures of partisan strength (Levendusky, Pope, and Jackman 2008).

The presidential vote is, not surprisingly, an extremely strong predictor of the legislative vote. If we know how many votes were cast for the Republican presidential candidate in a ward we will have a very good idea, subject to some conditions, of how many votes will be cast for the Republican candidate in the legislative election in that ward. While not everyone who votes for the Republican presidential candidate will vote for the Republican state legislative candidate, nearly all will, and we can precisely quantify the nature of that relationship.

The strength of the relationship between presidential and Assembly votes is clear in Figures 1 through 3, which plot the total Assembly vote, Republican Assembly vote, and Democratic Assembly vote in 2012 by the respective presidential vote in each contested ward (where voters have an opportunity to express a preference for either party in the legislative race).

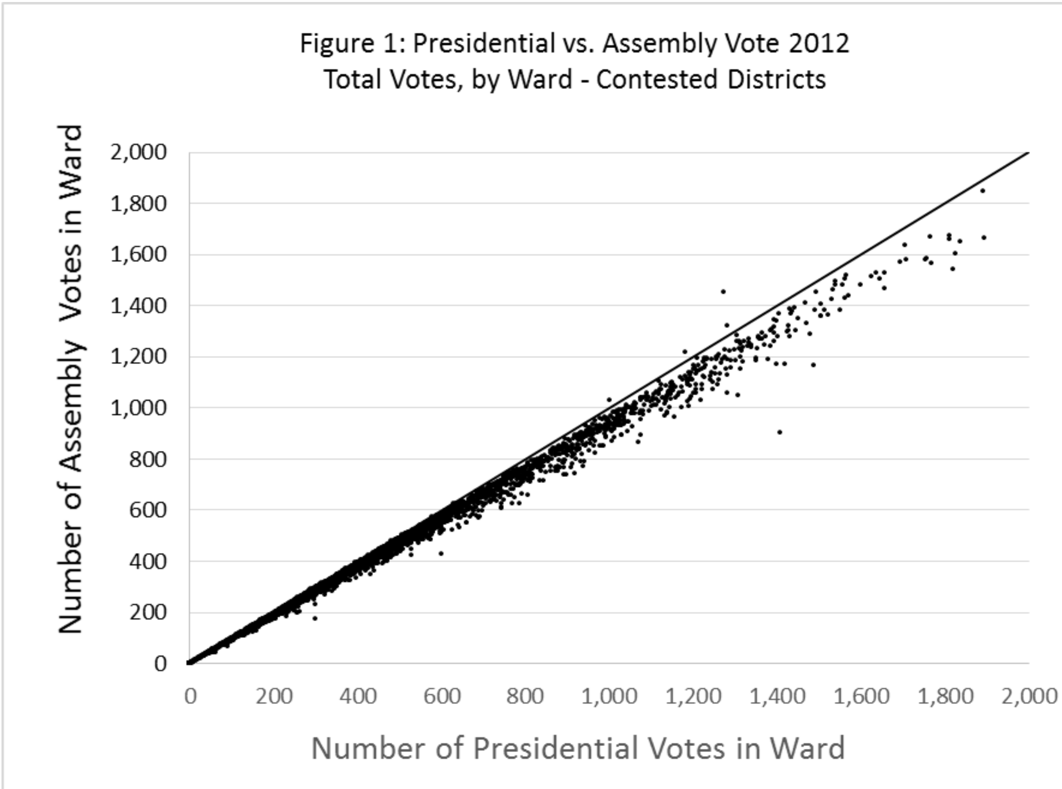
Figure 1: Presidential vs. Assembly Vote 2012
Total Votes, by Ward - Contested Districts
Number of Assembly Votes in Ward
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
Number of Presidential Votes in Ward

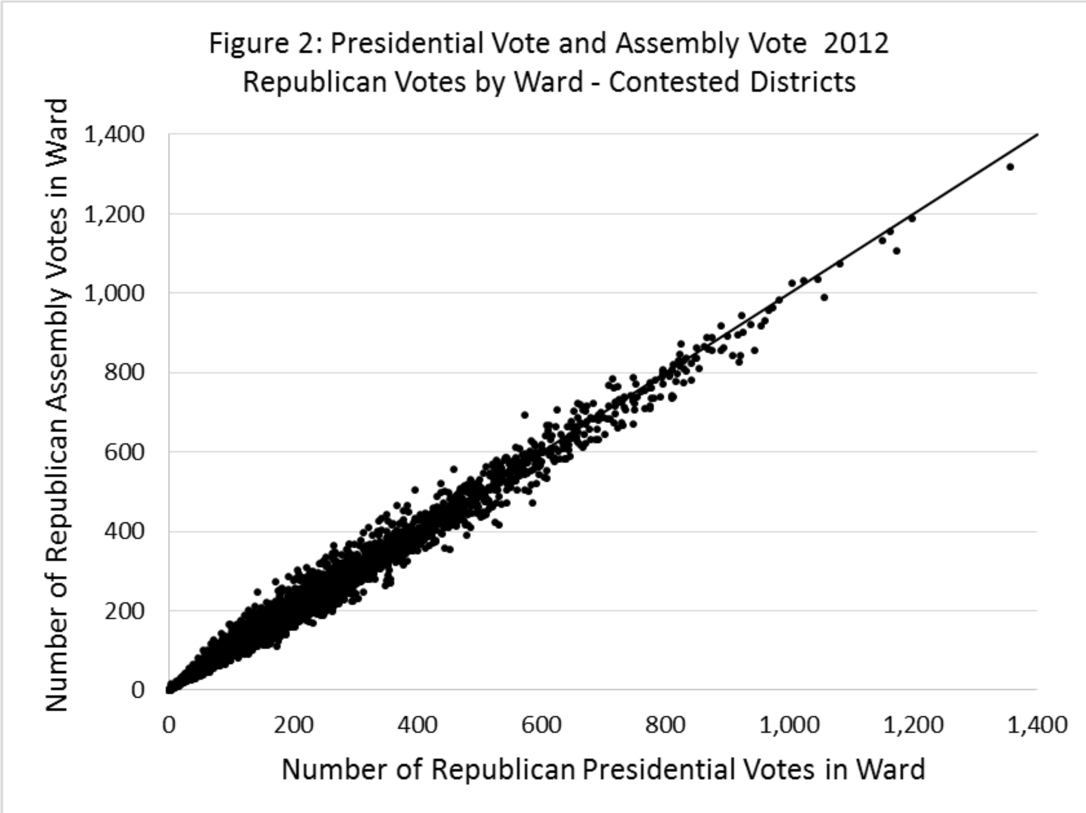
Figure 2: Presidential Vote and Assembly Vote 2012
Republican Votes by Ward - Contested Districts
Number of Republican Assembly Votes in Ward
1,400
1,200
1,000
800
600
400
200
0
0
200
400
600
800
1,000
1,200
1,400
Number of Republican Presidential Votes in Ward

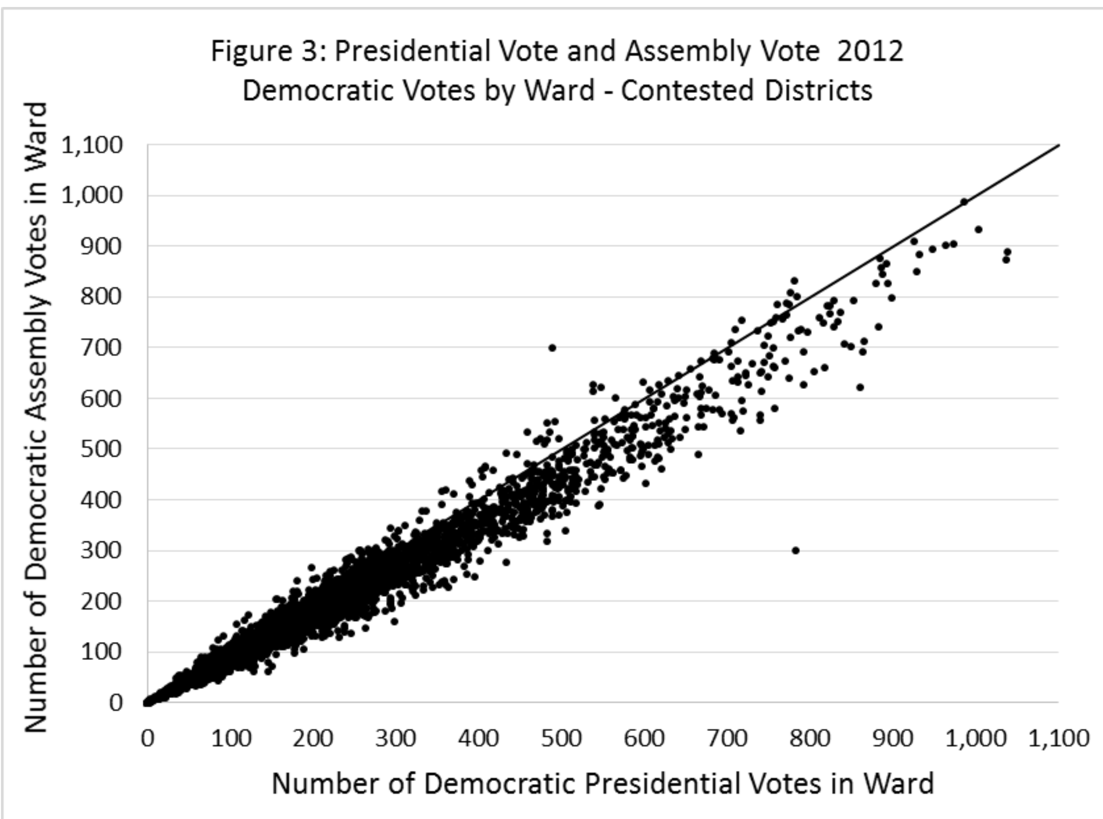
Figure 3: Presidential Vote and Assembly Vote 2012
Democratic Votes by Ward - Contested Districts
Number of Democratic Assembly Votes in Ward
1,100
1,000
900
800
700
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1,000
1,100
Number of Democratic Presidential Votes in Ward

Figure 1 shows that the number of presidential votes cast in a ward is very strongly related to the number of Assembly votes, although almost all wards show a "roll off" as some presidential voters opt not to mark the ballot in the assembly race (the reference line shows where the number of presidential and Assembly votes would be equal). Such drop-offs are ubiquitous in down-ticket races, because voters have less information about lower-level candidates and often have weaker or nonexistent preferences (Wattenberg, McAllister, and Salvanto 2000).

The graphs for the Republican (Figure 2) and Democratic (Figure 3) votes show more variance around this reference line, indicating that some voters are splitting their tickets by voting for a presidential candidate of one party and an Assembly candidate of the other. Nevertheless, the relationship between the number the Republican and Democratic presidential and Assembly votes is apparent. Taken together, these figures indicate that the presidential vote is a very strong predictor of the Assembly vote.

An important property of the presidential vote as an independent variable in this model is that it can be treated as exogenous to (i.e., not caused by) the legislative vote. Exogeneity can be described in two ways. The first is in causal terms. Most voters will vote for the same party for the president and state Assembly, as the above graphs show. These voters are consistent because they are Democrats or Republicans, and partisanship is the factor that explains both vote choices. Other voters will make their Assembly choice based on their presidential vote, because they use party labels as a cue when voting in a down-ticket race. "[P]arties are generally known by the presidential candidates they nominate, and candidates for state legislative races are a good deal less well known to voters than the congressional candidates who ride presidential coattails" (Campbell 1986, 46). Few voters, if any at all, will decide on an Assembly candidate first and then vote for president on the basis of their Assembly vote preference. The causal arrow runs from the presidential vote to the Assembly vote, not from the Assembly vote to the presidential vote. This is why we speak of presidential coattails affecting legislative races, and not the other way around (Campbell 1986; Jacobson 2009).

The second reason why the presidential vote is exogenous to the Assembly vote is that it is not affected by local district-level conditions such as incumbency, spending, or candidate quality (Abramowitz, Alexander, and Gunning 2006, 87). The broader factors that influence the presidential vote, and the presidential candidates themselves, are the same in every Assembly district. The presidential vote is affected by underlying partisanship, national conditions and the characteristics of the presidential candidates, factors that are constant whether that vote is aggregated at the state, district, or ward levels.

To put it another way, a change in the statewide presidential vote is virtually certain to affect state legislative election results. Adding or subtracting hundreds of thousands of Democrats or Republicans will alter voting patterns at the district level. However, nobody would expect that the statewide presidential result will be affected by the configuration of legislative districts. The statewide presidential vote would be the same, no matter how the district lines are drawn. Consequently, we can consider the presidential vote as exogenous to, but a causal factor of, the state legislative vote.

d. Independent Variables: Incumbency

The incumbency advantage is perhaps the most well-known feature of contemporary legislative elections (Jacobson 2009, 30-35). Legislative incumbents rarely lose, and usually win by large margins. All other things being equal, an incumbent will get more votes than a nonincumbent. The causes of this advantage are less important in this context than its magnitude.[13] The model takes into account the incumbency advantage by noting whether an incumbent is running in an Assembly district.

Incumbency effects are measured with a dummy variable equal to 1 when a candidate is an incumbent, and 0 otherwise,[14] multiplied by the ward voting eligible population to create an interactive variable that accounts for differences in size from one ward to the next. Since the dependent variable is an actual vote count, the value of incumbency – in terms of how many additional votes incumbents receive – will vary with the number of voters who reside in a ward.

e. Independent Variables: County Effects

The last set of variables estimate the effect that county geography has on the Assembly vote. Some counties in Wisconsin are heavily Republican (Ozaukee, Washington, Waukesha) and some heavily Democratic (Dane, Douglas, Milwaukee). It is possible that a voters' county of residence could have an effect on the vote choice, whether because of sorting, socialization or assimilation, or other unobserved effects. Including dummy variables for each county will capture these effects if they exist. There are 71 county variables (excluding Dunn County) set to 1 when a ward is located in that county, 0 otherwise.

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[13] In the political science literature, the incumbency advantage has been attributed to the political skills and campaign experience of officeholders, higher name recognition, fundraising advantages, constituency service, redistricting, and the ability to scare off quality challengers.

[14] Incumbents were identified using 2012 election data in the 2013 *Wisconsin Blue Book*. In the 43rd and 61st Assembly districts two incumbents were paired against each other; these districts were coded as having no incumbent, since the advantage cancels. In the 7th Assembly district, the Democratic incumbent lost in the primary election and ran a write in campaign in the general election. Because the incumbent was not on the ballot, this district is also coded as having no incumbent.

f. Estimation and Results

Using Stata IC 11.2 I performed ordinary least squares regression, using 2012 ward data from contested districts where both Republican and Democratic candidates were on the ballot.[15] Analyzing contested races solves the problem of trying to estimate partisan support in a district where voters have no opportunity to express their support for one side (Gelman and King 1994). The fact that Republicans registered 0 Assembly votes in the 78th district (Madison), and Democrats 0 votes in the 58th district (Washington County), does not mean there are no Republicans in the 78th or Democrats in the 58th districts, or that a Republican or Democratic candidate would receive zero votes if one were on the ballot. Using uncontested races in this initial analysis would produce inaccurate estimates of party strength in those districts.

The results for the Democratic and Republic regression models appear in Table 1.[16] Most variables show the expected effects, particularly the very strong impact of the presidential vote. The r^2 values are extremely high, and the standard errors of the regression models (Root MSE) are low. The model is also extremely accurate: when compared to actual ward vote, the model's predictions of the Republican ward totals are within 16 votes, and the Democratic predictions are within 18 votes.

Figure 4 shows the overall accuracy of the model by plotting the predicted ward level vote totals by the actual vote totals in each ward. Predictions for both Democrats and

[15] This major-party contested definition is standard. It counts as uncontested four districts where one major party candidate was not on the ballot but received votes as a write in (districts 7, 17, 48, and 57), and one district (district 95) where one major party candidate was on the ballot but did not campaign and received only 50 votes (or 0.24%). This is consistent with methods used in the literature, which often uses a 95% threshold for the winning candidate as a standard (Gelman and King 1990, 274).
[16] Standard errors were adjusted to reflect the aggregation (or clustering) of wards into districts. The full set of variables is included in an appendix to this report.

Republicans are grouped tightly around the 45-degree line where predicted and actual values would be equal.

Figure 5 shows the accuracy of the model at the district level, which is the more relevant quantity for real-world applicability. I calculated district level results by aggregating wards into the associated Assembly district, using LTSB assignments. The district-level estimates are very close to the actual vote totals, and the average absolute error is 356 votes for Democratic candidates and 344 votes for Republican candidates.

Table 1
Regression Results: 2012 Assembly Votes, Contested Districts
County fixed effect variables not shown,

	Independent Variable	
Dependent Variable	Assembly Republican Votes	Assembly Democratic Votes
Total Voting Eligible Population	0.009 (.0070)	-0.008 (.0122)
Black Voting Eligible Population	-0.026 (.0215)	-0.021 (.044)
Hispanic Voting eligible Population	-0.0083 (.0321)	-0.149** (.05)
Democratic Presidential Votes	0.0072 (.0173)	0.931*** (.028)
Republican Presidential Votes	0.946*** (.0086)	0.013 (.013)
Democratic Assembly Incumbent	-0.021*** (.006)	0.028*** (.007)
Republican Assembly Incumbent	0.011** (.0042)	-0.014** (.005)
Constant	-0.92 (7.52)	9.8 (5.4)
N	5,282	5,282
r^2	.9903	.9843
Root MS Error	15.8	17.7

Robust standard errors clustered by Assembly District in parentheses.
*p<.05, **p<0.01, ***p<0.001

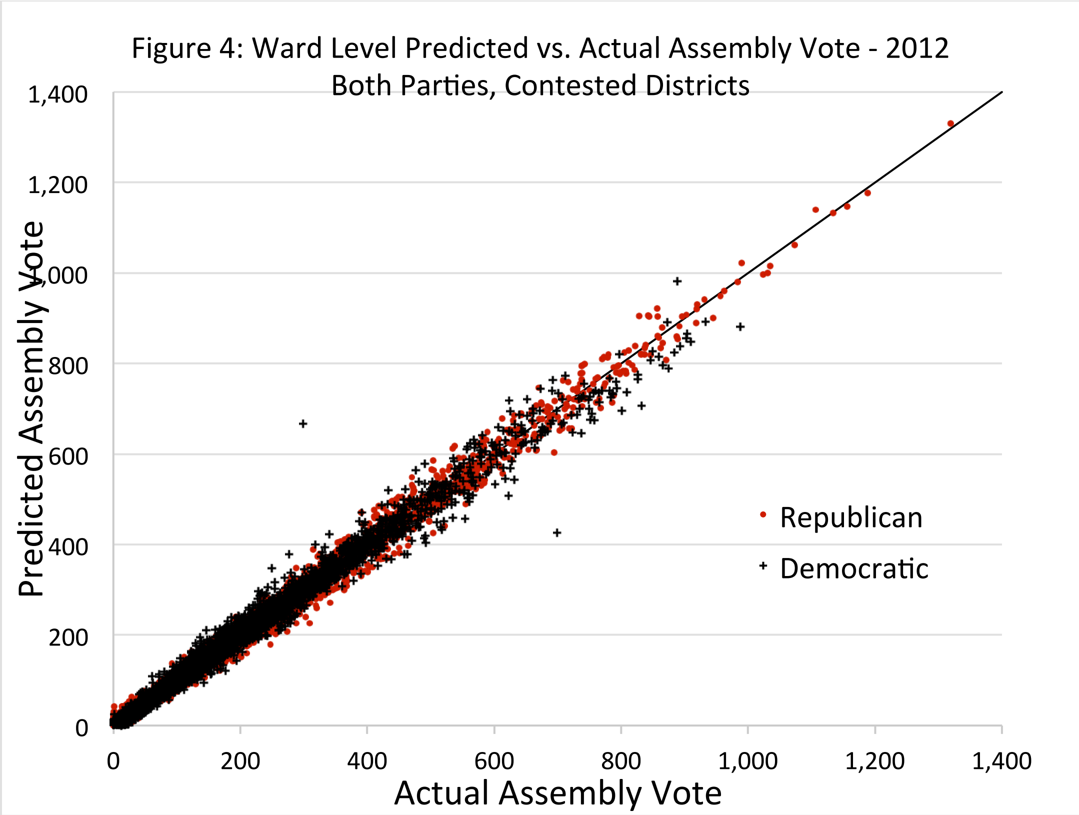
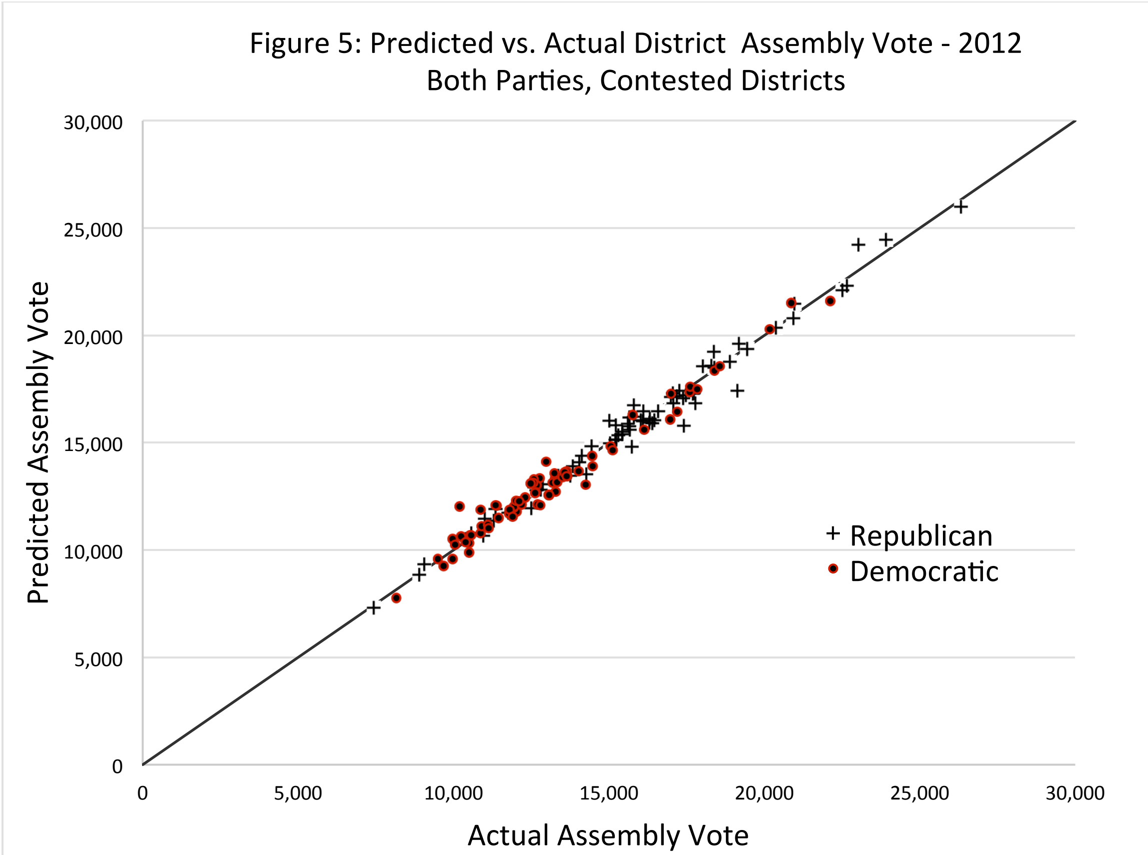


Figure 4: Ward Level Predicted vs. Actual Assembly Vote - 2012
Both Parties, Contested Districts
Predicted Assembly Vote
Actual Assembly Vote
Republican
Democratic
0
200
400
600
800
1,000
1,200
1,400



As important as the prediction of actual district vote totals is the model's ability to accurately identify the winner, as the efficiency gap calculation is sensitive to the party of the winners and losers.[17] The accuracy of the model is shown in Table 2, which gives the actual and predicted vote percentages of the two-party vote for Republican candidates in contested districts.[18]

[17] All of the votes for a losing candidate are defined as wasted, whereas only those votes in excess of the number required to win are wasted for the winner.
[18] The vote percentages were calculated using the actual and predicted vote totals.

Table 2 - Predicted vs. Actual Vote Percentages, Contested Districts

Assembly District	Actual GOP Vote %	Predicted GOP Vote %	Correct Winner?	Error
1	51.3%	52.3%	Y	1.0%
2	58.7%	58.8%	Y	0.1%
3	60.4%	58.6%	Y	-1.8%
4	55.7%	54.6%	Y	-1.0%
5	55.9%	57.6%	Y	1.7%
6	59.5%	59.9%	Y	0.4%
13	60.6%	60.4%	Y	-0.2%
14	59.1%	60.7%	Y	1.6%
15	58.3%	57.1%	Y	-1.2%
20	42.4%	40.9%	Y	-1.5%
21	59.3%	56.9%	Y	-2.5%
23	62.3%	61.8%	Y	-0.5%
24	62.4%	61.0%	Y	-1.4%
25	57.7%	57.0%	Y	-0.7%
26	51.3%	55.1%	Y	3.8%
27	57.8%	54.4%	Y	-3.5%
28	56.2%	56.5%	Y	0.3%
29	55.9%	55.2%	Y	-0.7%
30	55.8%	56.5%	Y	0.7%
31	56.5%	55.9%	Y	-0.7%
32	59.1%	59.7%	Y	0.6%
33	64.9%	63.8%	Y	-1.0%
34	61.3%	60.9%	Y	-0.4%
35	56.0%	55.9%	Y	-0.1%
36	59.0%	60.0%	Y	1.0%
37	54.3%	56.0%	Y	1.7%
38	60.0%	61.9%	Y	1.9%
39	60.4%	60.0%	Y	-0.4%
41	58.0%	57.4%	Y	-0.5%
42	56.6%	54.8%	Y	-1.8%
43	42.3%	42.9%	Y	0.7%
44	38.4%	40.1%	Y	1.7%
45	36.1%	35.2%	Y	-1.0%
46	35.2%	34.5%	Y	-0.7%
47	29.0%	30.2%	Y	1.1%
49	54.4%	54.6%	Y	0.3%
50	51.7%	51.8%	Y	0.1%
51	51.9%	49.9%	N	-2.0%
52	60.7%	60.1%	Y	-0.6%
53	60.1%	62.9%	Y	2.8%
54	39.8%	42.0%	Y	2.3%
55	65.2%	59.2%	Y	-6.1%
56	58.3%	59.7%	Y	1.3%
60	71.2%	72.6%	Y	1.4%
61	55.7%	55.6%	Y	-0.1%
62	53.1%	53.9%	Y	0.8%
63	58.4%	57.7%	Y	-0.6%

67	53.3%	53.5%	Y	0.2%
68	52.4%	50.7%	Y	-1.8%
69	61.2%	58.5%	Y	-2.7%
70	49.7%	50.1%	N	0.4%
71	39.0%	39.3%	Y	0.2%
72	50.2%	51.3%	Y	1.1%
74	41.0%	41.1%	Y	0.1%
75	48.9%	49.2%	Y	0.2%
80	36.1%	35.3%	Y	-0.8%
81	38.1%	39.6%	Y	1.4%
82	60.3%	61.6%	Y	1.4%
83	69.8%	71.6%	Y	1.9%
84	62.8%	61.8%	Y	-1.0%
85	48.2%	48.7%	Y	0.5%
86	55.7%	56.1%	Y	0.4%
87	58.6%	58.3%	Y	-0.3%
88	52.5%	54.1%	Y	1.7%
89	59.1%	59.2%	Y	0.1%
90	39.6%	37.7%	Y	-1.9%
93	50.8%	52.0%	Y	1.2%
94	39.4%	39.4%	Y	0.0%
96	59.6%	59.7%	Y	0.1%
97	64.7%	64.4%	Y	-0.3%
98	70.5%	70.0%	Y	-0.5%
99	76.3%	77.0%	Y	0.7%

The regression model identifies the correct winner in 70 of 72 districts (97.2%); that is, it accurately identifies the candidate who received the most votes. In the two misclassified races, the Republican candidates received 51.9% and 49.7% of the vote. The average absolute error in the vote margin is 1.49%.

g. Out of Sample Forecasting Accuracy

These results, which compare predicted election results to the actual election results, demonstrate that the model is very accurate. A harder test involves the accuracy of predictions using data not in the sample – that is, applying the model to data and election results that are different from the data used to estimate the model. To test the model's out of sample accuracy, I reran the model 72 times (once for every contested district) excluding every ward in one single contested district each time,[19] and then used the results of that estimation to predict the vote totals in wards in the excluded district using the independent variable values for those wards. For example, in the first run I excluded all wards in Assembly district 2 (see footnote 20), and estimated the model using data from the other seventy one contested districts. I then used the results to predict the vote totals in the 2nd district, and compared the prediction to the actual vote totals. Since we know the actual election results in excluded districts, this exercise is a "hard test" of the model's general predictive ability.

Figure 6 and Table 3 show the results for the 60 contested districts in which the full model could be estimated.[20] The average district forecast error of the Republican vote percentage increased slightly, to 2.1%, but the out of sample forecasts identified the correct winner in 59 out of 60 races (98.3%). In Figure 6, which plots the actual versus predicted vote totals, the points are not grouped as tightly around the 45-degree line as they are in the full model predictions (Figure 5), but still show a very high degree of accuracy.

Table 3 -Out of Sample Predicted vs. Actual Vote Percentages, Contested Districts

Assembly District	Actual GOP Vote %	Predicted GOP Vote %	Correct Winner?	Error
2	58.7%	59.0%	Y	0.3%
3	60.4%	57.5%	Y	-2.9%
4	55.7%	54.3%	Y	-1.3%
5	55.9%	58.9%	Y	2.9%
13	60.6%	60.4%	Y	-0.2%

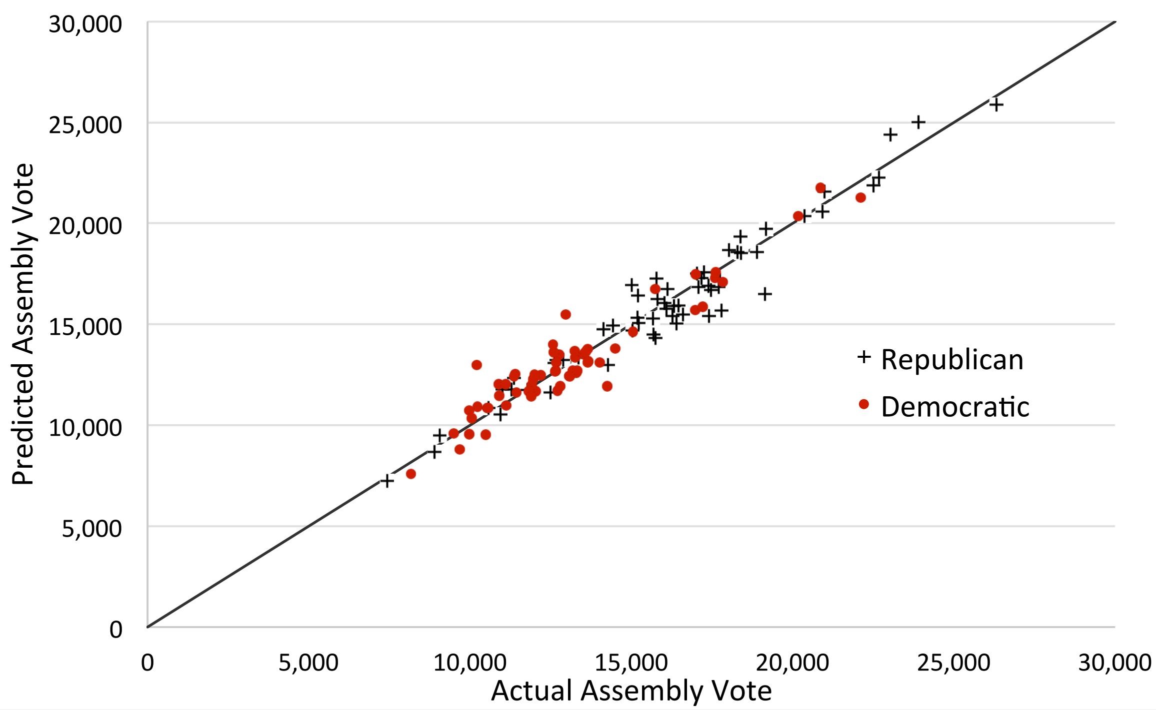
[19] Uncontested districts were not included in the analysis for reasons specified in section B(1)(f) above.

[20] In twelve districts (districts 1, 6, 34, 35, 36, 49, 68, 74, 75, 93, 94 and 96), at least one county was entirely contained in a single district, making it impossible to estimate the fixed effect coefficient value for that county. Consequently, when the out-of-sample predictions were calculated, a variable was missing. An accurate test involves districts for which it was possible to estimate the full model.

14	59.1%	61.0%	Y	1.8%
15	58.3%	56.7%	Y	-1.6%
20	42.4%	39.9%	Y	-2.5%
21	59.3%	56.3%	Y	-3.1%
23	62.3%	61.4%	Y	-0.9%
24	62.4%	60.2%	Y	-2.3%
25	57.7%	55.7%	Y	-2.0%
26	51.3%	58.6%	Y	7.3%
27	57.8%	50.3%	Y	-7.5%
28	56.2%	55.1%	Y	-1.2%
29	55.9%	54.6%	Y	-1.3%
30	55.8%	57.2%	Y	1.4%
31	56.5%	55.7%	Y	-0.9%
32	59.1%	60.2%	Y	1.1%
33	64.9%	63.0%	Y	-1.9%
37	54.3%	56.3%	Y	2.0%
38	60.0%	62.3%	Y	2.3%
39	60.4%	59.0%	Y	-1.5%
41	58.0%	56.2%	Y	-1.7%
42	56.6%	51.8%	Y	-4.8%
43	42.3%	43.3%	Y	1.1%
44	38.4%	40.8%	Y	2.5%
45	36.1%	34.1%	Y	-2.0%
46	35.2%	34.1%	Y	-1.0%
47	29.0%	30.9%	Y	1.8%
50	51.7%	53.1%	Y	1.4%
51	51.9%	48.7%	N	-3.2%
52	60.7%	59.4%	Y	-1.3%
53	60.1%	64.4%	Y	4.4%
54	39.8%	43.8%	Y	4.0%
55	65.2%	56.0%	Y	-9.3%
56	58.3%	59.9%	Y	1.6%
60	71.2%	73.9%	Y	2.8%
61	55.7%	54.9%	Y	-0.8%
62	53.1%	54.5%	Y	1.4%
63	58.4%	57.1%	Y	-1.3%
67	53.3%	54.7%	Y	1.4%
69	61.2%	57.2%	Y	-4.0%
70	49.7%	49.7%	Y	0.0%
71	39.0%	40.1%	Y	1.1%
72	50.2%	53.0%	Y	2.8%
80	36.1%	35.1%	Y	-1.0%
81	38.1%	40.8%	Y	2.6%

82	60.3%	62.0%	Y	1.8%
83	69.8%	71.8%	Y	2.0%
84	62.8%	61.7%	Y	-1.1%
85	48.2%	49.0%	Y	0.8%
86	55.7%	56.9%	Y	1.2%
87	58.6%	54.6%	Y	-3.9%
88	52.5%	54.6%	Y	2.1%
89	59.1%	59.0%	Y	-0.1%
90	39.6%	36.9%	Y	-2.7%
97	64.7%	64.2%	Y	-0.5%
98	70.5%	69.9%	Y	-0.5%
99	76.3%	77.3%	Y	1.0%

Figure 6: Out of Sample Results
Predicted vs. Actual District Assembly Vote Both Parties, Contested Districts



The model does an excellent job accurately forecasting vote totals and election results, and provides a solid foundation for estimating hypothetical vote totals in an alternative district plan.

h. Comparison to 2011 Republican Expert Baseline Partisanship Measure

The method I have outlined here is a standard technique in the analysis of redistricting plans: creating a baseline measure of partisanship that is independent of a particular district configuration, and applying those estimates to alternative hypothetical district plans.

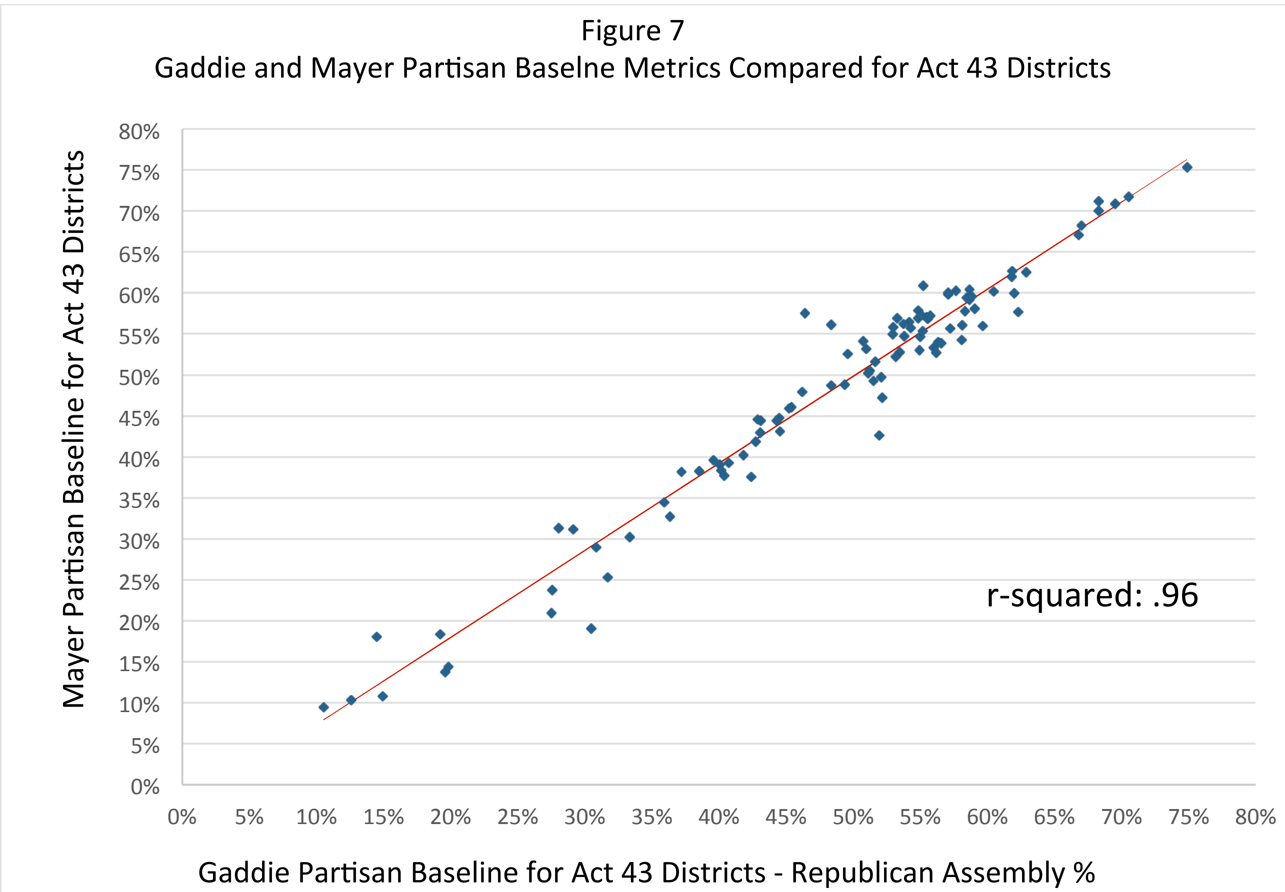
Indeed, in preparing the district plan that would become Act 43, the state legislature went through the same analytical exercise, generating partisanship measures to forecast what the election results would be in the districts enacted in that plan. The expert that the legislative Republicans relied on to conduct that analysis, Dr. Ronald Keith Gaddie, described the process and method as "an effort to create a partisan normal vote measure or a partisan baselining measure to use to apply to different districts to ascertain their political tendency."[21] The results of his regression analysis of the districts in Act 43 are in a spreadsheet used to evaluate the plan entitled "Final Map" which contains open seat baseline partisan estimates for existing and new Assembly districts.

Figure 7 compares Dr. Gaddie's open-seat baseline partisanship measure for the Act 43 districts with the equivalent results of my model, excluding the 8th and 9th Assembly districts which were redrawn by the Federal Court and are therefore not comparable. Gaddie's partisan baseline measure is plotted on the x-axis, and my measure on the y-axis. My measure is the expected partisan performance in actual Act 43 districts, with incumbency effects removed.[22] The two measures are strongly related, indicating that both are capturing stable features of partisanship in Wisconsin. The line is a bivariate regression line produced by using Dr. Gaddie's partisanship estimate as the independent variable and my measure as the dependent variable.

[21] Deposition, January 20, 2012, p. 196.
[22] I generated this data by calculating predicted values for my model in Act 43 districts, setting all incumbency variables to zero.

The r-squared for this regression is 0.96, indicating that the two measures are almost perfectly related, and are both capturing the same underlying partisanship.

The most important characteristics of Gaddie's measure is that it constitutes a true forecast of what was expected to occur in the 2012 elections, since the measure itself was generated in 2011 using data from the 2004-2010 elections. As I show below, this metric can be used to generate an efficiency gap measure of what was likely to happen (indeed, what *did* happen) in the 2012 election.



2. Step Two – Predicting Votes in a Demonstration District Plan

a. Creating a Demonstration District Plan

With the model parameters in hand, I can estimate baseline partisanship and vote totals in every ward, including those uncontested by both parties (because I have independent variables in all wards, even when only one party is on the Assembly ballot). For uncontested districts, the predicted ward vote totals are what would be expected if both parties ran a candidate, based on the values of the independent variables in the wards. I then use these predicted ward level vote totals to generate vote estimates at the Census block level, and build a demonstration district using Census blocks as my basic unit. Because the variables used in the model are exogenous to district configuration and the out of sample predictions are accurate, the results of the analysis in Step one represent a valid measure of what the Assembly vote would have been in a different district configuration.

I calculated estimated "open seat" vote totals, by subtracting the incumbency advantage in every district in which an incumbent ran. This is a more accurate method of determining the baseline partisanship of a district, as it removes the effect of incumbents, who may or may not be running in an alternative plan. This baseline process is standard in the discipline, and was used by the expert retained by the state legislature, Dr. Ronald Keith Gaddie, to analyze the partisan effects of Act 43 during the redistricting process.

To obtain block level vote estimates, I disaggregated the ward level predicted values for the Democratic and Republican vote totals to individual blocks in that ward, based on each block's share of the ward vote eligible population. This technique is widely used and accepted in the discipline (McDonald 2014; Pavia. and López-Quílez 2013). Census blocks have a voting eligible population range between 0 and 2,988, with an average of approximately 17 people. Wards contain an average of 40 blocks, although the range is substantial, with a minimum of 1 and a maximum of 740. At the end of this disaggregation process, I have a predicted Democratic and Republican Assembly vote total for each Census block in the state.

Table 4 shows an illustrative example, using Ward 23 in the city of Waukesha. This ward, located in the southeastern part of the city, had a 2010 Census population of 1,426, a voting age population of 1,089, and a voting eligible population of 1,071. The voting model generated estimates of 552 Republican and 318 Democratic votes in an open seat Assembly race in that ward. The ward contains twenty five Census blocks ranging in population from 0 to 127, with a voting eligible population range of 0 to 115.

The first column in Table 4 is the block's geographic identifier, a unique code.[23] The next column is the block's voting eligible population (VEP) calculated as described in the previous section by removing noncitizens and institutionalized persons (although there are no prisons in this ward). The third column is the block's share of the ward's total VEP of 1,071; for the first block in the table it is 38 ÷ 1,071= .0352, or 3.52%. The next column is block level Republican vote estimate, calculated as 3.52% the ward Republican vote of 552, or 19.438. While the table rounds these vote totals, I use fractional values in the actual calculations.

[23] The identifier is a combination of state, county, Census tract, and block FIPS codes.

Table 4 - Ward to Block Disaggregation
City of Waukesha Ward 23

Ward Voting Eligible Population	**1,071**
Ward Estimated Republican Assembly Vote	**552**
Ward Estimated Democratic Assembly Vote	**318**

Block Geographic Identifier	Block VEP	Block Share of Ward VEP (Block VEP ÷ 1,071)	Block Level Republican Vote Estimate (Block Share * 522)	Block Level Democratic Vote Estimate (Block Share * 318)
551332024001002	38	3.52%	19	11
551332024001003	56	5.24%	29	17
551332024001004	65	6.06%	33	19
551332024001005	30	2.77%	15	9
551332024001007	47	4.37%	24	14
551332024001008	81	7.57%	42	24
551332024001009	12	1.11%	6	4
551332024001010	50	4.70%	26	15
551332024001011	26	2.46%	14	8
551332024001012	25	2.32%	13	7
551332024001013	44	4.14%	23	13
551332024001014	60	5.57%	31	18
551332024001015	30	2.77%	15	9
551332024001016	53	4.99%	28	16
551332024001017	0	0.00%	0	0
551332024002009	10	0.93%	5	3
551332024002010	50	4.68%	26	15
551332024002011	65	6.06%	33	19
551332024002012	37	3.44%	19	11
551332024002013	39	3.61%	20	12
551332024003036	41	3.78%	21	12
551332024003039	15	1.39%	8	4
551332024003040	62	5.76%	32	18
551332024003042	22	2.01%	11	6
551332025005011	115	10.73%	59	34

Next, I input this block level data into a commercial GIS software package used for redistricting (Maptitude for Redistricting 2013, Build 2060) matching each block in the database of estimated votes with the same block in the Maptitude data using the block identification code.

Finally, I drew a redistricting plan with the goal of minimizing the efficiency gap while adhering to the Wisconsin and federal Constitutional requirements of equal population, contiguity, compactness, and respect for political subdivisions. Beyond these criteria. the primary decision rule was creating competitive districts where possible, and balancing the number of districts with large Democratic and Republican majorities.

Figures 8 and 9 show the statewide map and the districts in the Milwaukee area.

Figure 8 – Demonstration Plan Statewide Map

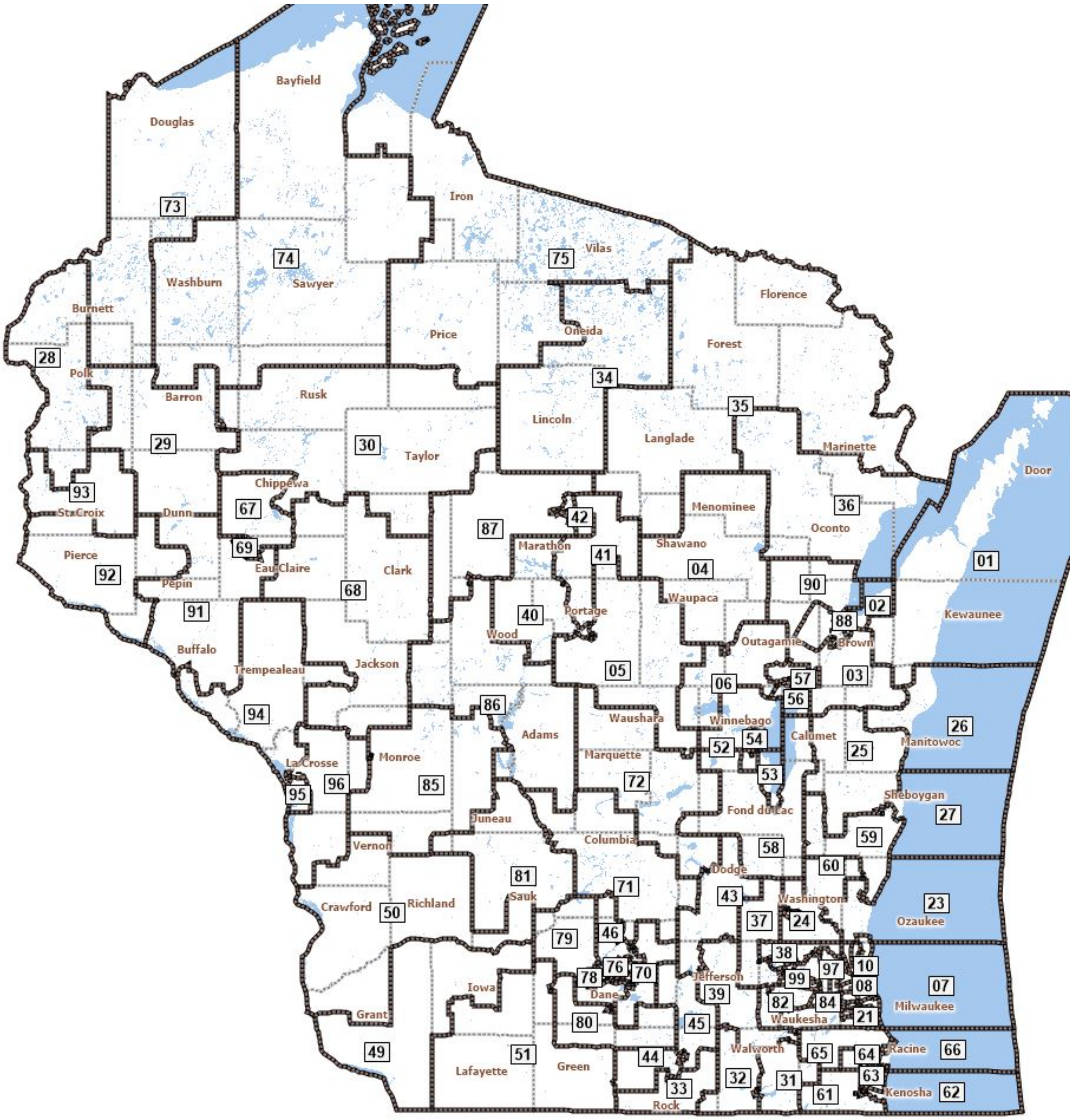
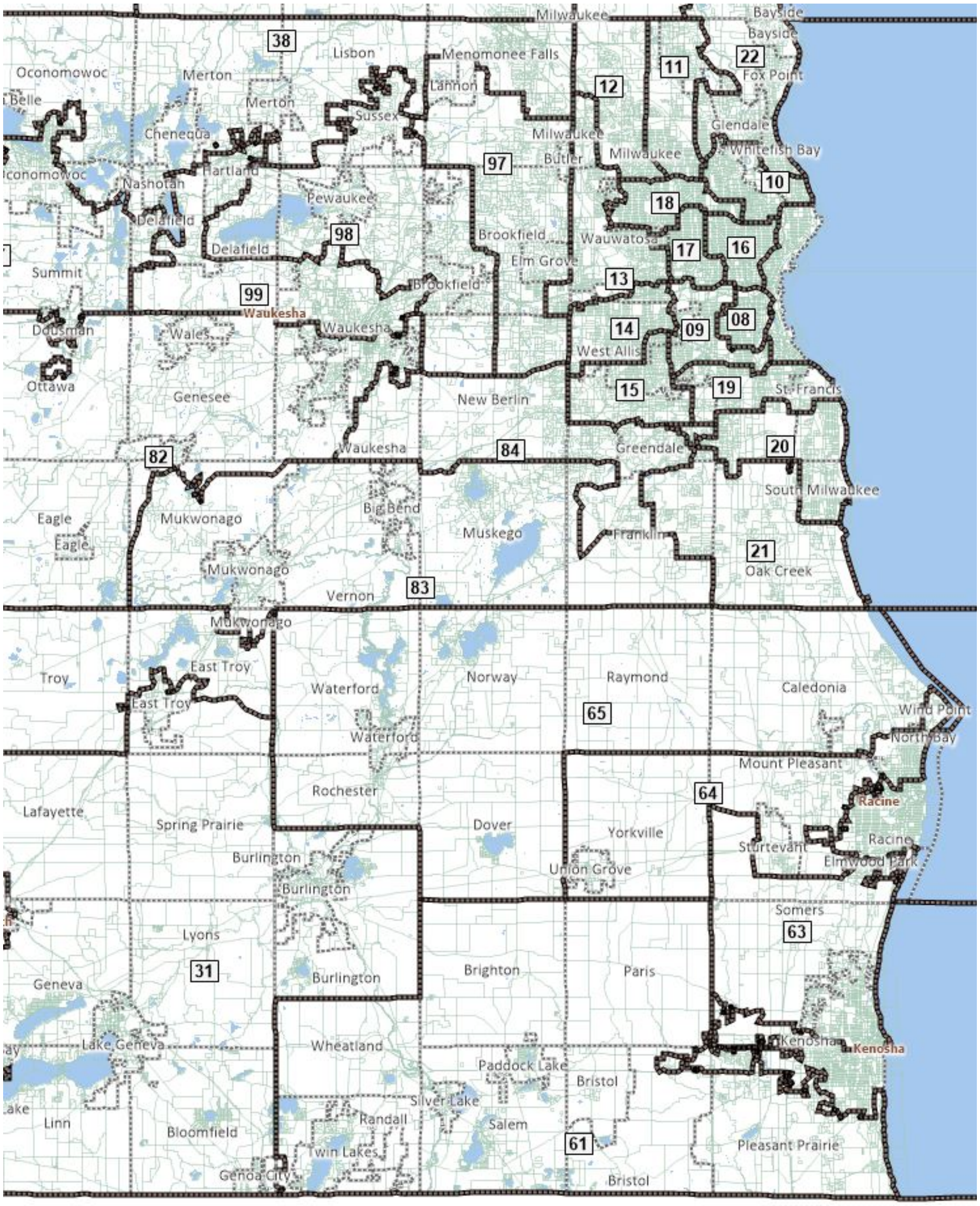


Figure 9 – Demonstration Plan - Milwaukee Area



b. Constitutional and Statutory Requirements

Table 5 shows the summary data for the Demonstration Plan (the full tables are in the annex to this report) and comparison data for the actual 2012 plan implemented in Act 43.[24] The Demonstration Plan has a marginally larger population deviation, but is well below even the strictest standards applied to state legislative districts (a difference of 0.1% translates into 57 people). The population range in the Demonstration Plan is 57,191 to 57,686, a difference of 495 people. Given the ideal Assembly district population of 57,444, this is a deviation of 0.86%. The Demonstration Plan is more compact on average than Act 43, and has fewer municipal splits (119 compared to 120 in Act 43). On all constitutional requirements, the Demonstration Plan is comparable to Act 43.

Table 5 - Plan Comparison to Act 43

		Demonstration Plan	Act 43
Population Deviation		0.86%	0.76%
Average Compactness (Reock)		0.41	0.28
Number of Municipal Splits	County	55	58
	City Town Village	64	62

Act 43 created six majority-minority Black population districts (numbers 10-12 and 16-18), ranging from 56.7% -67.6% Black population, and from 51.1%-61.8% Black voting age population. The Demonstration Plan retains six Majority Black Assembly districts, ranging from 60.0% to 63.4% Black population, and from 56.2% to 60.5% Black voting age population:

[24] Act 43 figures are taken from the Joint Final Pretrial Report filed in *Baldus et al. vs Brennan et al.*11-CV-562, filed February 24, 2012.

Table 6 - Black Majority Districts in Demonstration Plan						
Assembly District	**Population**	**Voting Age Population**	**Black Population**	**Black Percentage of Population**	**Black Voting Age Population**	**BVAP%**
10	57,195	41,528	36,593	64.0%	25,125	60.5%
11	57,455	40,510	34,822	60.6%	22,762	56.2%
12	57,420	38,774	34,923	60.8%	21,829	56.3%
16	57,282	42,469	36,321	63.4%	23,920	56.3%
17	57,437	39,639	34,450	60.0%	22,275	56.2%
18	57,241	40,840	35,316	61.7%	24,054	58.9%

In *Baldus et al. v. Brennan et al.*, a federal Court created a majority Latino district in Milwaukee (the 8th Assembly District). The Demonstration Plan retains the boundaries of this district thereby insuring compliance with Section 2 of the Voting Rights Act.

C. Efficiency Gap Calculations

With the model described in Step one above and the block-level partisanship baseline it generates, I can analyze any existing or hypothetical district configuration and generate predicted vote totals and efficiency gap measures for the Demonstration Plan.

1. Analysis of Act 43

Any discussion of Act 43 must begin with the basic fact that in 2012 Republicans achieved a 60-39 majority in the Assembly in an election in which the Democratic Party achieved 53.5% of the statewide two-party presidential vote. The imbalance between the Republican Party's statewide vote margin at the top of the ticket (46.5%) and its Assembly majority (60.6%) turns the very notion of partisan symmetry on its head. That standard, according to King and Grofman (2007,8) "requires that the number of seats one party would receive if it garnered a particular percentage of the vote be identical to the number of seats the other party would receive if it had received the same percentage of the vote" (2007,8). Here, it means that Democrats would have had to obtain 60 Assembly seats with 46.5% of the vote, an absurd proposition that requires a party's legislative seat share to go *up* as its share of the vote goes *down*.

This result was achieved via the classic gerrymandering strategies of packing and cracking. Figure 10, a histogram of Republican two party vote percentages in 2012, shows the pattern. Here, the bars to the right of 50% indicate a Republican victory. Twenty three Democratic candidates were uncontested, indicating a significant level of packing (the bar at the far left side of the figure); uncontested races occur largely when one party sees zero probability of winning because the majority party has such overwhelming majorities in the district. By contrast, only four Republicans were uncontested. Act 43 also successfully cracked Democratic majorities in other districts, creating Republican majorities that were either marginal (twelve in the 50-55% range) or relatively safe (thirty nine in the 55-65% range). The 2012 results are consistent with what was forecast in 2011, as shown by Figure 11, a histogram of Dr. Gaddie's baseline partisanship measure for Act 43 districts. This measure forecast fifty one Assembly districts with between 50% and 65% Republican vote share. This is the same number that actually occurred, fifty one.

Figure 12 shows the baseline partisanship district forecasts for Act 43, using the model outline in Step one, above. It is very similar to Dr. Gaddie's forecast and the actual results: it forecast fifty districts with between 50% and 65% Republican vote share.

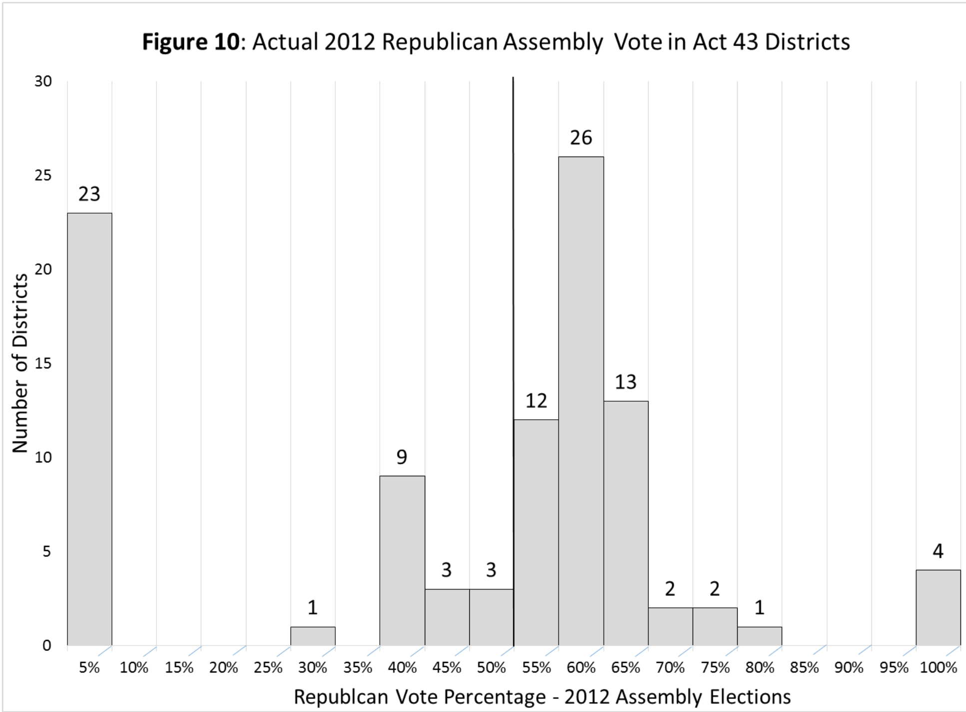


Figure 10: Actual 2012 Republican Assembly Vote in Act 43 Districts
Number of Districts
30
25
20
15
10
5
0
23
1
9
3
3
12
26
13
2
2
1
4
5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75% 80% 85% 90% 95% 100%
Republcan Vote Percentage - 2012 Assembly Elections

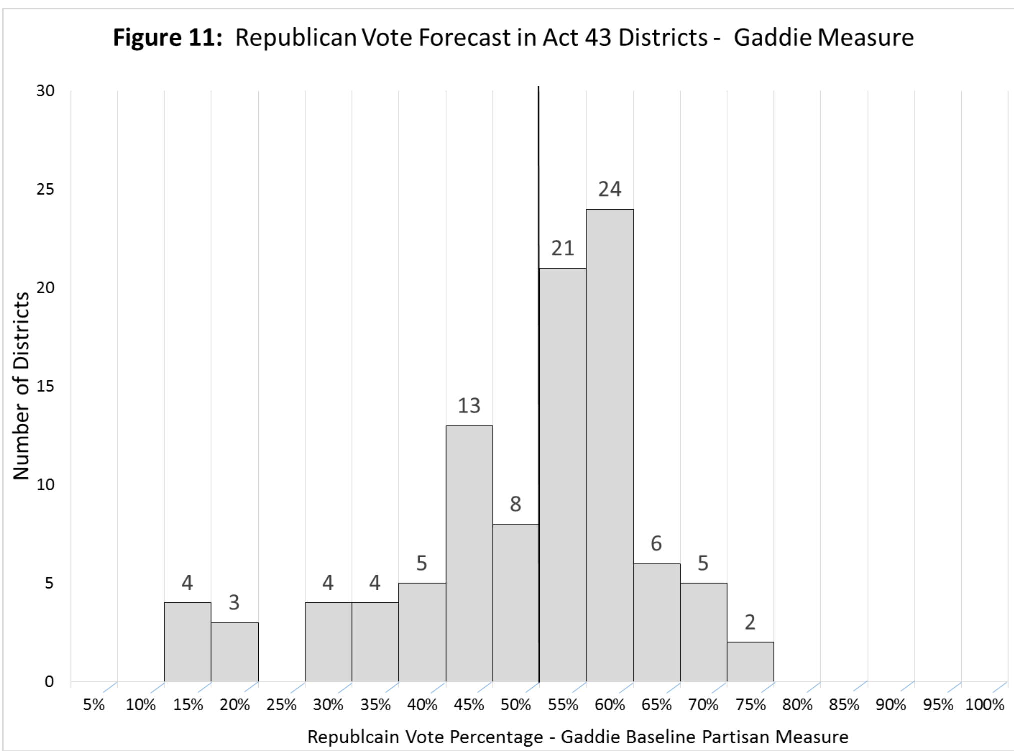
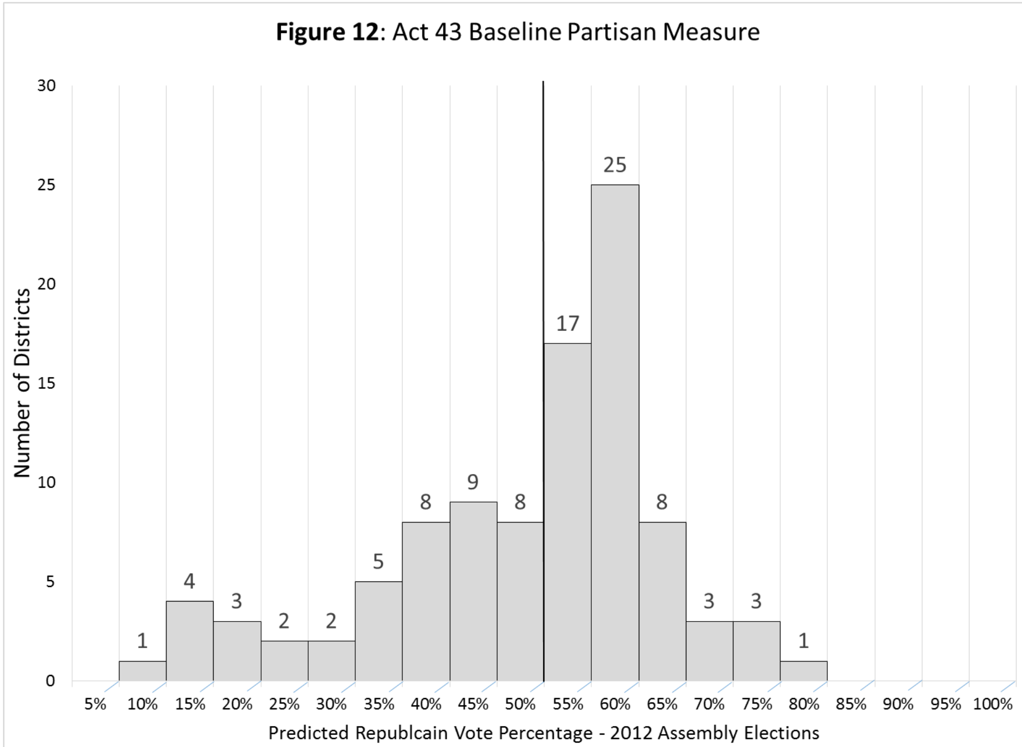


Figure 11: Republican Vote Forecast in Act 43 Districts - Gaddie Measure
Number of Districts
30
25
20
15
10
5
0
4
3
4
4
5
13
8
21
24
6
5
2
5% 10% 15% 20% 25% 30% 35% 40% 45% 50% 55% 60% 65% 70% 75% 80% 85% 90% 95% 100%
Republcain Vote Percentage - Gaddie Baseline Partisan Measure



The treatment of the city of Sheboygan shows how this cracking was achieved. Sheboygan is a city on the Lake Michigan shoreline with a population of 49,285. It is a strongly Democratic area, voting 58.7%-41.3% for Obama in 2012; my baseline partisanship estimate for the city is 58.2%. The city is small enough to be contained in a single Assembly district in which it would constitute 86% of the ideal population, and it was entirely within the 26th Assembly district in both the 1992 and 2001 redistricting rounds. The areas surrounding it – the Village of Kohler and the Towns of Sheboygan and Wilson are all strongly Republican (with vote percentages for Romney of 62.8 %, 56.3%, and 59.4%, respectively; together, these municipalities constitute an area that is 58.2% Republican, as measured by the presidential vote).

Keeping the city of Sheboygan together would have created a Democratic district, made up of the city itself (58.7% Democratic) with the remaining 14% of population drawn from one of the Republican areas around it. The result would have been a District that was roughly 54%-56% Democratic.

Act 43, however, split Sheboygan into separate Assembly districts, placing 32,640 residents of the city into the 26th District, and 16,645 into the 27th. With the city split, these areas were combined into the Republican areas surrounding the city, producing two Republican districts: the 26th (51.3% Republican in the 2012 Assembly race; baseline open seat partisanship measure of 53.3%) and the 27th (57.9% Republican in the 2012 Assembly race, baseline open seat partisanship measure of 52.3%).

Figure 13, below, shows the split into Districts 26 and 27:

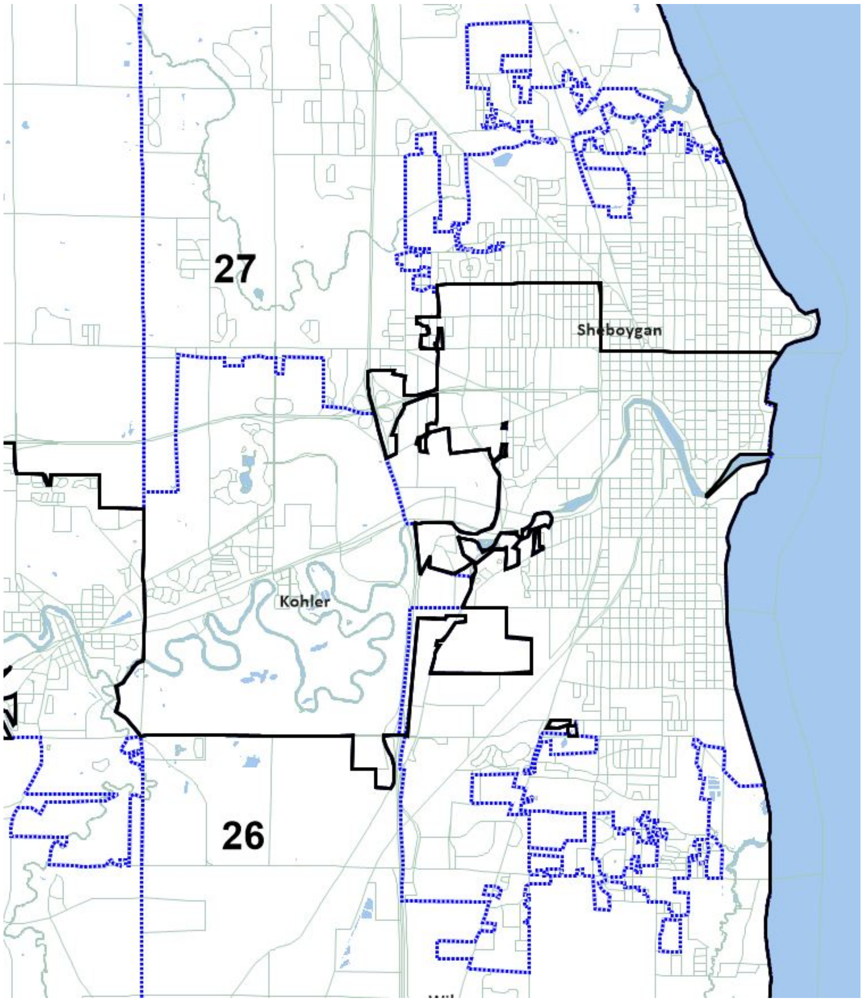


Figure 13– Act 43 Treatment of Sheboygan

2. Efficiency Gap Calculations for Act 43 and The Demonstration Plan

Recall that the efficiency gap is a measure of gerrymandering based on the difference in the number of "wasted votes." Votes cast for losing candidates are wasted, as are surplus votes for winning candidates above what is necessary to win. The gap is defined as the difference between the sum of wasted votes for the two parties, divided by the total number of votes cast in the election.

Comparing a hypothetical district plan (where vote totals are predicted) to an existing district plan (where vote totals are known) requires care, in large part because it can be difficult to know with certainty what districts will have incumbents (or how incumbents might rearrange themselves after a redistricting cycle), and because not every district will be contested in an actual election (Stephanopoulos and McGhee 2015).

Handling uncontested races is a straightforward problem; the key is applying a consistent rule to all plans being compared. In the efficiency gap calculation for my plan, I measure underlying partisan strength in each district by estimating the number of votes that would be cast for each party in an open seat election each district, *assuming that all races are contested*. In the actual 2012 Assembly elections, only 72 of 99 seats were contested by both major parties, leaving 27 uncontested races. Uncontested races by themselves will not necessarily have a dramatic effect on efficiency gap calculations as long as the number of races is small, or if uncontested districts are evenly split between the parties (as a rule, one uncontested race with only a Democrat will cancel out one uncontested race with only a Republican, conditioned on the number of votes cast in each race). But a significant imbalance in uncontested races will have a material effect on the results. Of the 27 uncontested races in 2012, 23 were in Democratic districts and only 4 in Republican districts.

In the academic redistricting literature, uncontested seats are typically handled by imputing what the vote totals would have been if a race had been contested (Gelman and King 1990), or assigning each uncontested race a 75%-25% vote split in favor of the party whose candidate ran unopposed (Gelman and King 1994; Stephanopoulos and McGhee 2015). Because I have direct measures of partisanship and vote predictions, I am able to generate accurate estimates of what the vote totals would have been in Act 43's uncontested districts had both parties fielded candidates. In applying this method to the uncontested districts in the 2012 State Assembly elections, I create two directly equivalent sets of data: one for the Demonstration Plan, with predicted values of open seat vote totals for all districts, and one for the districts created in Act 43, using open seat estimates for each district. Efficiency gap results for the two redistricting plans constructed this way can be compared directly.

Table 7 shows the full set of efficiency gap calculations for the Demonstration Plan, with incumbency effects removed. For each district I calculate an estimated Democratic and Republican vote total, and forecast a winner. The resulting columns show the number of "wasted votes," counting all votes cast for a losing candidates, and surplus votes for winning candidates (equal to ½ of the margin of victory). Totals for each party are summed, and the efficiency gap calculated as the Net Wasted Votes (here, Democratic Wasted Votes – Republican Wasted Votes) divided by the total number of votes cast in the election.

The data in Table 7 (on page 48) show that the Demonstration Plan results in 741,984 wasted Democratic votes (column E), obtained by adding the number of lost Democratic votes cast for losing candidates (566,634, column A) and the number of surplus Democratic votes cast for winners above what was necessary to win (175,350, column C). The same calculation for Republicans (using columns B and D) results in 689,570 wasted Republican votes. The difference between these two numbers, 781,984 - 689,570 = 62,414 net wasted Democratic votes. Dividing 62,414 by the predicted total number of votes 2,843,108, produces the baseline efficiency gap for my plan, .0220, or 2.20%.

Table 8 (on page 50) shows the same calculation for Act 43 districts, using estimated partisan vote totals with incumbent advantages removed. Act 43 resulted in a total of 332,552 net wasted Democratic votes. The efficiency gap of Act 43 is 11.69%, more than five times larger than the Demonstration Plan.

Table 9 (on page 52) shows the efficiency gap calculation for the partisan baseline prediction used by Dr. Gaddie during the drawing of the Act 43 districts, applying his partisanship division to the total number of votes predicted from my model in each district. As described above in section III(B)(1)(h) above, this is the predicted baseline partisanship measure of Act 43. It produces a forecast Efficiency Gap for Act 43 of 12.36%.

Table 10 summarizes these results:

	Table 10: Summary Statistics for Redistricting Plans		
	My Plan Baseline	**Act 43 Baseline**	**Act 43 - Gaddie Measure**
party split (R-D)	48-51	57-42	58-41
Wasted Republican Votes	679,570	544,893	535,057
Wasted Democratic Votes	741,984	877,445	886,403
Gap	62,414	332,552	351,346
Total Democratic Votes	1,454,117	1,454,717	1,394,018
Total Republican Votes	1,388,991	1,389,958	1,448,901
Total Votes	2,843,108	2,844,676	2,842,919
Efficiency Gap (gap/total votes)	**2.20%**	**11.69%**	**12.36%**

Three things are worth emphasizing. The first is that the predicted partisan effect of Act 43, represented by the Gaddie metric, produced an efficiency gap calculation (12.36%) that was very close to the actual partisan effect of Act 43, as measured by the efficiency gap calculation for the actual 2012 partisan baseline (11.69%). In brief, the architects of the Act 43 districts expected a partisan result that was almost identical to what actually occurred. The second is the large reduction in the efficiency gap that I am able to produce, which I have achieved without any departure from the core constitutional and statutory requirements of redistricting. The

Demonstration Plan is equivalent to Act 43 on all key criteria: population deviation, compactness, number of political subdivision splits, and compliance with the Voting Rights Act. At the same time, I have generated an efficiency gap score 82% smaller than the Act 43 gap. And third, I have reached this efficiency gap score with virtually identical numbers of Democratic and Republican voters as exist under Act 43. Given that my partisan estimates, once incumbency effects are removed, are *entirely exogenous to any particular district configuration*, these can be considered the same statewide set of voters. By placing the same voters as exist in Act 43 into a new set of districts designed to minimize the effects of gerrymandering while adhering to constitutional standards, I have generated a plan that is fair to both parties.

Figure 14 shows the distribution of baseline Republican vote predictions in the Demonstration Plan Assembly districts. The districts are far more balanced, with similar numbers of districts between 40% - 50% (twenty seven) and between 50% - 60% (twenty nine). There are also roughly equal numbers of districts above 65% (twelve) and below 35% (sixteen).

Figure 14: Predicted Vote - Demonstration Plan

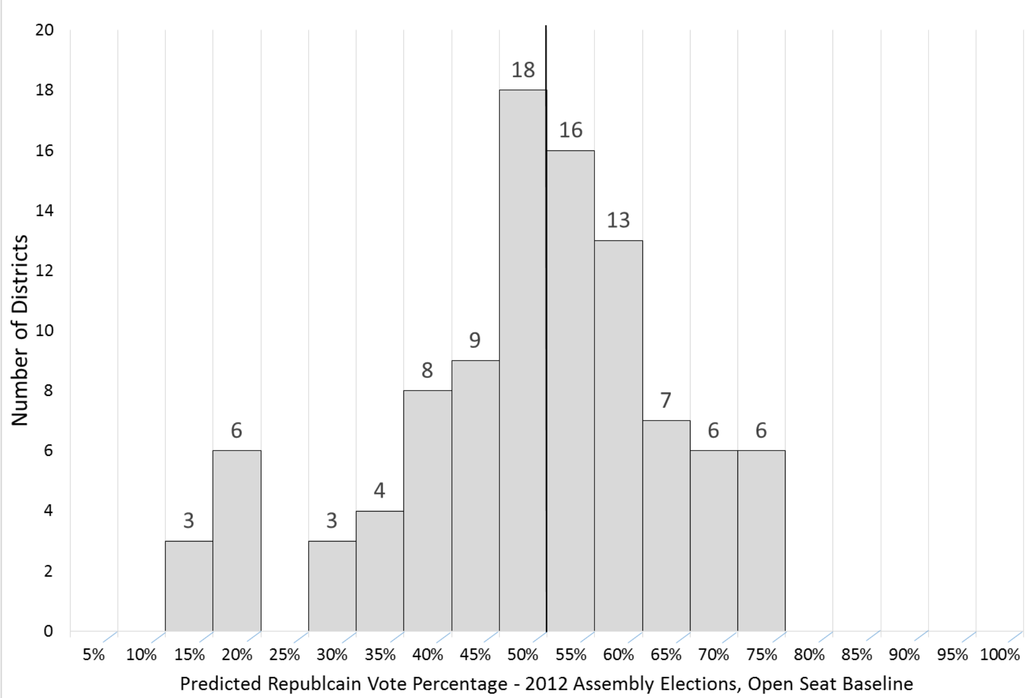


Table 7 - Efficiency Gap Calculation for Demonstration District Plan - No Incumbent Baseline

				A	B	C	D	E	F	
Assembly District	Predicted Democratic Votes	Predicted Republican Votes	Predicted Winning Party	Lost Democratic Votes	Lost Republican Votes	Surplus Democratic Votes	Surplus Republican Votes	Wasted Democratic Votes (A + C)	Wasted Republican Votes (B + D)	Net Wasted Votes (E - F)
1	16,259	16,414	Republican	16259	0	0	78	16259	78	16181
2	11,805	10,025	Democratic	0	10025	890	0	890	10025	-9136
3	11,243	17,807	Republican	11243	0	0	3282	11243	3282	7961
4	10,881	12,790	Republican	10881	0	0	955	10881	955	9926
5	13,497	13,845	Republican	13497	0	0	174	13497	174	13323
6	11,045	17,627	Republican	11045	0	0	3291	11045	3291	7753
7	22,822	10,214	Democratic	0	10214	6304	0	6304	10214	-3910
8	7,192	1,695	Democratic	0	1695	2749	0	2749	1695	1054
9	10,497	5,635	Democratic	0	5635	2431	0	2431	5635	-3205
10	25,348	3,270	Democratic	0	3270	11039	0	11039	3270	7769
11	22,374	4,855	Democratic	0	4855	8759	0	8759	4855	3904
12	20,041	4,039	Democratic	0	4039	8001	0	8001	4039	3962
13	15,950	16,510	Republican	15950	0	0	280	15950	280	15670
14	13,575	13,799	Republican	13575	0	0	112	13575	112	13464
15	13,412	14,901	Republican	13412	0	0	745	13412	745	12667
16	21,234	2,856	Democratic	0	2856	9189	0	9189	2856	6333
17	21,769	3,569	Democratic	0	3569	9100	0	9100	3569	5531
18	23,817	4,954	Democratic	0	4954	9431	0	9431	4954	4477
19	15,160	10,904	Democratic	0	10904	2128	0	2128	10904	-8776
20	14,118	12,901	Democratic	0	12901	609	0	609	12901	-12292
21	12,257	16,911	Republican	12257	0	0	2327	12257	2327	9930
22	18,335	14,831	Democratic	0	14831	1752	0	1752	14831	-13079
23	10,922	25,459	Republican	10922	0	0	7268	10922	7268	3654
24	8,667	25,868	Republican	8667	0	0	8601	8667	8601	66
25	12,179	18,248	Republican	12179	0	0	3034	12179	3034	9145
26	13,251	14,527	Republican	13251	0	0	638	13251	638	12613
27	14,935	11,755	Democratic	0	11755	1590	0	1590	11755	-10165
28	12,617	15,591	Republican	12617	0	0	1487	12617	1487	11131
29	14,180	12,954	Democratic	0	12954	613	0	613	12954	-12341
30	11,308	15,165	Republican	11308	0	0	1929	11308	1929	9379
31	11,304	16,117	Republican	11304	0	0	2406	11304	2406	8898
32	12,685	13,787	Republican	12685	0	0	551	12685	551	12135
33	14,609	10,151	Democratic	0	10151	2229	0	2229	10151	-7922
34	13,139	15,690	Republican	13139	0	0	1275	13139	1275	11864
35	11,288	16,503	Republican	11288	0	0	2607	11288	2607	8681
36	11,516	14,997	Republican	11516	0	0	1741	11516	1741	9775
37	9,222	22,240	Republican	9222	0	0	6509	9222	6509	2713
38	9,710	25,021	Republican	9710	0	0	7655	9710	7655	2055
39	10,747	17,526	Republican	10747	0	0	3390	10747	3390	7357
40	15,061	13,947	Democratic	0	13947	557	0	557	13947	-13391
41	16,784	13,120	Democratic	0	13120	1832	0	1832	13120	-11288
42	13,254	12,282	Democratic	0	12282	486	0	486	12282	-11796
43	12,658	13,606	Republican	12658	0	0	474	12658	474	12184
44	16,477	10,886	Democratic	0	10886	2795	0	2795	10886	-8091
45	16,352	13,589	Democratic	0	13589	1382	0	1382	13589	-12207
46	20,583	11,418	Democratic	0	11418	4582	0	4582	11418	-6835
47	20,208	9,888	Democratic	0	9888	5160	0	5160	9888	-4728

48	24,457	8,840	Democratic	0	8840	7808	0	7808	8840	-1032
49	13,625	13,477	Democratic	0	13477	74	0	74	13477	-13403
50	12,289	13,709	Republican	12289	0	0	710	12289	710	11579
51	14,760	13,323	Democratic	0	13323	718	0	718	13323	-12605
52	12,376	19,416	Republican	12376	0	0	3520	12376	3520	8857
53	12,388	13,362	Republican	12388	0	0	487	12388	487	11902
54	14,032	12,240	Democratic	0	12240	896	0	896	12240	-11344
55	13,565	15,300	Republican	13565	0	0	868	13565	868	12697
56	12,553	14,518	Republican	12553	0	0	983	12553	983	11570
57	14,897	13,016	Democratic	0	13016	941	0	941	13016	-12075
58	9,325	21,180	Republican	9325	0	0	5927	9325	5927	3398
59	11,565	21,984	Republican	11565	0	0	5209	11565	5209	6356
60	8,756	22,415	Republican	8756	0	0	6830	8756	6830	1926
61	12,933	16,576	Republican	12933	0	0	1822	12933	1822	11112
62	15,181	9,999	Democratic	0	9999	2591	0	2591	9999	-7408
63	15,640	9,902	Democratic	0	9902	2869	0	2869	9902	-7033
64	15,089	13,470	Democratic	0	13470	810	0	810	13470	-12660
65	12,721	19,816	Republican	12721	0	0	3547	12721	3547	9173
66	16,286	6,362	Democratic	0	6362	4962	0	4962	6362	-1401
67	15,321	14,226	Democratic	0	14226	547	0	547	14226	-13678
68	11,958	12,124	Republican	11958	0	0	83	11958	83	11875
69	17,902	12,022	Democratic	0	12022	2940	0	2940	12022	-9083
70	18,661	12,266	Democratic	0	12266	3197	0	3197	12266	-9069
71	15,081	13,884	Democratic	0	13884	599	0	599	13884	-13285
72	11,180	16,542	Republican	11180	0	0	2681	11180	2681	8500
73	17,137	10,785	Democratic	0	10785	3176	0	3176	10785	-7609
74	17,712	14,219	Democratic	0	14219	1747	0	1747	14219	-12472
75	13,902	17,700	Republican	13902	0	0	1899	13902	1899	12002
76	30,929	6,811	Democratic	0	6811	12059	0	12059	6811	5248
77	26,708	6,059	Democratic	0	6059	10325	0	10325	6059	4266
78	24,413	9,847	Democratic	0	9847	7283	0	7283	9847	-2564
79	20,439	13,294	Democratic	0	13294	3572	0	3572	13294	-9722
80	20,179	11,644	Democratic	0	11644	4267	0	4267	11644	-7377
81	13,703	12,741	Democratic	0	12741	481	0	481	12741	-12260
82	9,871	21,201	Republican	9871	0	0	5665	9871	5665	4206
83	9,241	23,075	Republican	9241	0	0	6917	9241	6917	2324
84	11,990	22,700	Republican	11990	0	0	5355	11990	5355	6634
85	10,028	13,190	Republican	10028	0	0	1581	10028	1581	8448
86	13,853	13,494	Democratic	0	13494	180	0	180	13494	-13314
87	11,358	17,003	Republican	11358	0	0	2823	11358	2823	8535
88	14,209	11,142	Democratic	0	11142	1533	0	1533	11142	-9609
89	13,374	15,771	Republican	13374	0	0	1199	13374	1199	12175
90	11,349	17,468	Republican	11349	0	0	3059	11349	3059	8290
91	14,807	13,845	Democratic	0	13845	481	0	481	13845	-13364
92	14,907	14,594	Democratic	0	14594	157	0	157	14594	-14437
93	12,441	18,057	Republican	12441	0	0	2808	12441	2808	9633
94	16,171	11,759	Democratic	0	11759	2206	0	2206	11759	-9553
95	19,769	9,949	Democratic	0	9949	4910	0	4910	9949	-5040
96	14,665	13,836	Democratic	0	13836	415	0	415	13836	-13421
97	11,492	24,222	Republican	11492	0	0	6365	11492	6365	5128
98	9,864	24,773	Republican	9864	0	0	7454	9864	7454	2410
99	10,783	19,160	Republican	10783	0	0	4188	10783	4188	6594
TOTALS	**1,454,117**	**1,388,991**		**566,634**	**536,783**	**175,350**	**142,787**	**741,984**	**679,570**	**62,414**

Table 8 - Efficiency Gap Calculation for Act 43 - No Incumbent Baseline

				A	B	C	D	E	F	
Assembly District	Predicted Democratic Votes	Predicted Republican Votes	Predicted Winning Party	Lost Democratic Votes	Lost Republican Votes	Surplus Democratic Votes	Surplus Republican Votes	Wasted Democratic Votes (A + C)	Wasted Republican Votes (B + D)	Net Wasted Votes (E - F)
1	16,235	16,628	Republican	16235	0	0	197	16235	197	16038
2	12,398	16,357	Republican	12398	0	0	1980	12398	1980	10419
3	12,623	16,636	Republican	12623	0	0	2006	12623	2006	10617
4	13,926	15,576	Republican	13926	0	0	825	13926	825	13101
5	12,710	16,017	Republican	12710	0	0	1654	12710	1654	11056
6	10,929	14,938	Republican	10929	0	0	2005	10929	2005	8924
7	13,793	11,778	Democratic	0	11778	1007	0	1007	11778	-10771
8	7,342	1,738	Democratic	0	1738	2802	0	2802	1738	1064
9	10,023	4,533	Democratic	0	4533	2745	0	2745	4533	-1787
10	25,306	2,897	Democratic	0	2897	11205	0	11205	2897	8308
11	21,698	3,368	Democratic	0	3368	9165	0	9165	3368	5797
12	19,700	5,222	Democratic	0	5222	7239	0	7239	5222	2018
13	13,345	20,358	Republican	13345	0	0	3506	13345	3506	9839
14	14,499	21,025	Republican	14499	0	0	3263	14499	3263	11235
15	13,006	17,310	Republican	13006	0	0	2152	13006	2152	10853
16	22,293	2,342	Democratic	0	2342	9975	0	9975	2342	7633
17	24,088	4,047	Democratic	0	4047	10020	0	10020	4047	5973
18	22,204	2,692	Democratic	0	2692	9756	0	9756	2692	7064
19	22,759	10,364	Democratic	0	10364	6198	0	6198	10364	-4166
20	16,066	12,856	Democratic	0	12856	1605	0	1605	12856	-11252
21	12,566	15,324	Republican	12566	0	0	1379	12566	1379	11187
22	11,290	22,958	Republican	11290	0	0	5834	11290	5834	5456
23	14,260	21,633	Republican	14260	0	0	3687	14260	3687	10573
24	13,885	20,335	Republican	13885	0	0	3225	13885	3225	10659
25	12,032	15,933	Republican	12032	0	0	1950	12032	1950	10082
26	13,639	15,559	Republican	13639	0	0	960	13639	960	12679
27	14,709	16,360	Republican	14709	0	0	826	14709	826	13883
28	12,719	15,302	Republican	12719	0	0	1291	12719	1291	11428
29	12,909	14,662	Republican	12909	0	0	876	12909	876	12033
30	14,019	16,951	Republican	14019	0	0	1466	14019	1466	12553
31	13,273	15,615	Republican	13273	0	0	1171	13273	1171	12102
32	11,255	15,359	Republican	11255	0	0	2052	11255	2052	9203
33	11,226	18,298	Republican	11226	0	0	3536	11226	3536	7690
34	12,445	19,355	Republican	12445	0	0	3455	12445	3455	8991
35	12,270	15,525	Republican	12270	0	0	1628	12270	1628	10643
36	11,403	15,672	Republican	11403	0	0	2134	11403	2134	9269
37	12,707	16,202	Republican	12707	0	0	1747	12707	1747	10960
38	12,668	19,129	Republican	12668	0	0	3231	12668	3231	9437
39	11,491	17,211	Republican	11491	0	0	2860	11491	2860	8630
40	11,485	13,597	Republican	11485	0	0	1056	11485	1056	10429
41	11,719	14,492	Republican	11719	0	0	1387	11719	1387	10332
42	13,705	15,462	Republican	13705	0	0	879	13705	879	12826
43	17,380	13,075	Democratic	0	13075	2153	0	2153	13075	-10923
44	16,680	10,304	Democratic	0	10304	3188	0	3188	10304	-7116
45	15,153	9,691	Democratic	0	9691	2731	0	2731	9691	-6959
46	19,173	11,534	Democratic	0	11534	3819	0	3819	11534	-7714
47	21,609	9,340	Democratic	0	9340	6135	0	6135	9340	-3205
48	24,517	7,635	Democratic	0	7635	8441	0	8441	7635	806
49	12,307	13,621	Republican	12307	0	0	657	12307	657	11650

50	12,467	12,326	Democratic	0	12326	71	0	71	12326	-12256
51	14,173	13,048	Democratic	0	13048	563	0	563	13048	-12485
52	11,294	15,656	Republican	11294	0	0	2181	11294	2181	9113
53	9,875	16,753	Republican	9875	0	0	3439	9875	3439	6437
54	15,180	12,882	Democratic	0	12882	1149	0	1149	12882	-11733
55	12,634	16,971	Republican	12634	0	0	2169	12634	2169	10465
56	12,564	18,576	Republican	12564	0	0	3006	12564	3006	9559
57	14,387	11,676	Democratic	0	11676	1355	0	1355	11676	-10321
58	8,843	22,417	Republican	8843	0	0	6787	8843	6787	2055
59	8,784	21,725	Republican	8784	0	0	6471	8784	6471	2313
60	9,848	23,989	Republican	9848	0	0	7071	9848	7071	2778
61	13,145	16,481	Republican	13145	0	0	1668	13145	1668	11477
62	14,828	17,309	Republican	14828	0	0	1240	14828	1240	13588
63	13,233	16,830	Republican	13233	0	0	1799	13233	1799	11434
64	15,702	11,307	Democratic	0	11307	2198	0	2198	11307	-9109
65	15,105	7,929	Democratic	0	7929	3588	0	3588	7929	-4341
66	16,162	5,472	Democratic	0	5472	5345	0	5345	5472	-127
67	13,769	14,674	Republican	13769	0	0	453	13769	453	13316
68	13,663	13,005	Democratic	0	13005	329	0	329	13005	-12676
69	11,083	14,347	Republican	11083	0	0	1632	11083	1632	9451
70	12,211	14,387	Republican	12211	0	0	1088	12211	1088	11123
71	17,614	11,383	Democratic	0	11383	3115	0	3115	11383	-8267
72	14,294	13,895	Democratic	0	13895	199	0	199	13895	-13696
73	17,353	10,784	Democratic	0	10784	3284	0	3284	10784	-7500
74	17,095	13,772	Democratic	0	13772	1662	0	1662	13772	-12110
75	15,000	13,418	Democratic	0	13418	791	0	791	13418	-12627
76	30,939	6,805	Democratic	0	6805	12067	0	12067	6805	5262
77	26,925	6,041	Democratic	0	6041	10442	0	10442	6041	4402
78	24,163	9,857	Democratic	0	9857	7153	0	7153	9857	-2704
79	20,753	13,975	Democratic	0	13975	3389	0	3389	13975	-10586
80	20,369	12,604	Democratic	0	12604	3882	0	3882	12604	-8722
81	16,310	12,356	Democratic	0	12356	1977	0	1977	12356	-10379
82	12,168	18,085	Republican	12168	0	0	2959	12168	2959	9210
83	10,186	23,755	Republican	10186	0	0	6784	10186	6784	3401
84	12,503	18,765	Republican	12503	0	0	3131	12503	3131	9373
85	13,613	12,925	Democratic	0	12925	344	0	344	12925	-12581
86	13,425	17,152	Republican	13425	0	0	1863	13425	1863	11561
87	11,780	15,118	Republican	11780	0	0	1669	11780	1669	10111
88	13,141	14,380	Republican	13141	0	0	620	13141	620	12521
89	11,610	15,516	Republican	11610	0	0	1953	11610	1953	9658
90	12,080	7,309	Democratic	0	7309	2385	0	2385	7309	-4924
91	17,942	11,769	Democratic	0	11769	3086	0	3086	11769	-8683
92	14,285	11,441	Democratic	0	11441	1422	0	1422	11441	-10019
93	15,268	15,393	Republican	15268	0	0	62	15268	62	15206
94	17,408	12,954	Democratic	0	12954	2227	0	2227	12954	-10727
95	19,804	9,627	Democratic	0	9627	5088	0	5088	9627	-4539
96	10,950	14,873	Republican	10950	0	0	1962	10950	1962	8989
97	10,826	18,042	Republican	10826	0	0	3608	10826	3608	7219
98	10,182	21,855	Republican	10182	0	0	5837	10182	5837	4346
99	8,346	25,535	Republican	8346	0	0	8594	8346	8594	-248
TOTALS	**1,454,717**	**1,389,958**		**702,148**	**401,975**	**175,297**	**142,918**	**877,445**	**544,893**	**332,552**

Table 9 - Efficiency Gap Calculation for Act 43 2011 Gaddie Metric - No Incumbent Baseline

				A	B	C	D	E	F	
Assembly District	Predicted Democratic Votes	Predicted Republican Votes	Predicted Winning Party	Lost Democratic Votes	Lost Republican Votes	Surplus Democratic Votes	Surplus Republican Votes	Wasted Democratic Votes (A + C)	Wasted Republican Votes (B + D)	Net Wasted Votes (E - F)
1	15,857	16,651	Republican	15857	0	0	397	15857	397	15461
2	12,983	15,766	Republican	12983	0	0	1391	12983	1391	11591
3	12,976	16,236	Republican	12976	0	0	1630	12976	1630	11346
4	13,742	15,791	Republican	13742	0	0	1025	13742	1025	12717
5	13,134	15,593	Republican	13134	0	0	1230	13134	1230	11904
6	10,779	15,088	Republican	10779	0	0	2155	10779	2155	8624
7	13,967	11,604	Democratic	0	11604	1181	0	1181	11604	-10423
8	6,178	2,709	Democratic	0	2709	1735	0	1735	2709	-974
9	10,173	4,184	Democratic	0	4184	2995	0	2995	4184	-1189
10	24,623	3,547	Democratic	0	3547	10538	0	10538	3547	6992
11	20,235	4,927	Democratic	0	4927	7654	0	7654	4927	2728
12	18,066	6,856	Democratic	0	6856	5605	0	5605	6856	-1251
13	13,929	19,774	Republican	13929	0	0	2922	13929	2922	11007
14	14,693	20,831	Republican	14693	0	0	3069	14693	3069	11624
15	13,497	16,819	Republican	13497	0	0	1661	13497	1661	11835
16	22,223	2,618	Democratic	0	2618	9803	0	9803	2618	7184
17	22,553	5,582	Democratic	0	5582	8486	0	8486	5582	2904
18	21,176	3,719	Democratic	0	3719	8728	0	8728	3719	5009
19	23,838	9,284	Democratic	0	9284	7277	0	7277	9284	-2007
20	16,451	12,471	Democratic	0	12471	1990	0	1990	12471	-10482
21	13,125	14,765	Republican	13125	0	0	820	13125	820	12305
22	11,364	22,885	Republican	11364	0	0	5761	11364	5761	5603
23	15,182	20,658	Republican	15182	0	0	2738	15182	2738	12444
24	14,205	20,015	Republican	14205	0	0	2905	14205	2905	11299
25	13,065	14,887	Republican	13065	0	0	911	13065	911	12154
26	12,853	16,338	Republican	12853	0	0	1743	12853	1743	11110
27	13,611	17,458	Republican	13611	0	0	1923	13611	1923	11688
28	12,609	15,412	Republican	12609	0	0	1401	12609	1401	11208
29	13,519	14,054	Republican	13519	0	0	267	13519	267	13251
30	14,267	16,601	Republican	14267	0	0	1167	14267	1167	13101
31	12,616	16,273	Republican	12616	0	0	1829	12616	1829	10787
32	10,038	16,566	Republican	10038	0	0	3264	10038	3264	6773
33	11,274	18,247	Republican	11274	0	0	3487	11274	3487	7788
34	14,239	17,558	Republican	14239	0	0	1660	14239	1660	12579
35	13,067	14,729	Republican	13067	0	0	831	13067	831	12236
36	12,227	14,848	Republican	12227	0	0	1310	12227	1310	10917
37	12,110	16,799	Republican	12110	0	0	2345	12110	2345	9766
38	12,574	19,218	Republican	12574	0	0	3322	12574	3322	9251
39	10,899	17,782	Republican	10899	0	0	3442	10899	3442	7457
40	10,514	14,561	Republican	10514	0	0	2024	10514	2024	8490
41	11,761	14,467	Republican	11761	0	0	1353	11761	1353	10407
42	13,152	16,036	Republican	13152	0	0	1442	13152	1442	11710
43	17,339	13,113	Democratic	0	13113	2113	0	2113	13113	-10999
44	16,941	10,043	Democratic	0	10043	3449	0	3449	10043	-6595
45	14,886	9,957	Democratic	0	9957	2464	0	2464	9957	-7493
46	17,681	13,010	Democratic	0	13010	2336	0	2336	13010	-10674

47	20,628	10,322	Democratic	0	10322	5153	0	5153	10322	-5169
48	23,290	8,861	Democratic	0	8861	7215	0	7215	8861	-1646
49	13,071	12,859	Democratic	0	12859	106	0	106	12859	-12752
50	11,887	12,908	Republican	11887	0	0	511	11887	511	11376
51	14,637	12,584	Democratic	0	12584	1026	0	1026	12584	-11558
52	11,034	15,918	Republican	11034	0	0	2442	11034	2442	8592
53	9,930	16,099	Republican	9930	0	0	3084	9930	3084	6846
54	15,372	12,690	Democratic	0	12690	1341	0	1341	12690	-11348
55	13,302	16,297	Republican	13302	0	0	1498	13302	1498	11804
56	12,809	18,326	Republican	12809	0	0	2759	12809	2759	10050
57	14,436	11,575	Democratic	0	11575	1431	0	1431	11575	-10145
58	9,211	22,056	Republican	9211	0	0	6422	9211	6422	2789
59	9,669	20,843	Republican	9669	0	0	5587	9669	5587	4083
60	10,307	23,508	Republican	10307	0	0	6601	10307	6601	3706
61	12,661	16,935	Republican	12661	0	0	2137	12661	2137	10524
62	13,959	18,175	Republican	13959	0	0	2108	13959	2108	11851
63	11,973	17,692	Republican	11973	0	0	2860	11973	2860	9113
64	15,452	11,524	Democratic	0	11524	1964	0	1964	11524	-9560
65	14,760	8,274	Democratic	0	8274	3243	0	3243	8274	-5031
66	14,776	6,861	Democratic	0	6861	3957	0	3957	6861	-2904
67	13,748	14,698	Republican	13748	0	0	475	13748	475	13273
68	13,508	13,177	Democratic	0	13177	165	0	165	13177	-13011
69	11,657	13,773	Republican	11657	0	0	1058	11657	1058	10599
70	13,105	13,493	Republican	13105	0	0	194	13105	194	12911
71	17,189	11,807	Democratic	0	11807	2691	0	2691	11807	-9116
72	13,674	14,514	Republican	13674	0	0	420	13674	420	13254
73	16,837	11,300	Democratic	0	11300	2769	0	2769	11300	-8531
74	17,628	13,239	Democratic	0	13239	2195	0	2195	13239	-11044
75	13,590	14,829	Republican	13590	0	0	620	13590	620	12970
76	32,275	5,469	Democratic	0	5469	13403	0	13403	5469	7934
77	26,627	6,339	Democratic	0	6339	10144	0	10144	6339	3804
78	23,528	10,492	Democratic	0	10492	6518	0	6518	10492	-3974
79	20,211	14,516	Democratic	0	14516	2848	0	2848	14516	-11668
80	20,251	12,704	Democratic	0	12704	3773	0	3773	12704	-8931
81	15,887	12,770	Democratic	0	12770	1559	0	1559	12770	-11211
82	12,985	17,269	Republican	12985	0	0	2142	12985	2142	10843
83	10,756	23,185	Republican	10756	0	0	6215	10756	6215	4541
84	13,414	17,854	Republican	13414	0	0	2220	13414	2220	11194
85	13,703	12,843	Democratic	0	12843	430	0	430	12843	-12413
86	15,780	14,789	Democratic	0	14789	495	0	495	14789	-14294
87	12,413	14,420	Republican	12413	0	0	1004	12413	1004	11409
88	12,882	14,638	Republican	12882	0	0	878	12882	878	12004
89	12,009	15,118	Republican	12009	0	0	1554	12009	1554	10455
90	11,556	7,833	Democratic	0	7833	1861	0	1861	7833	-5972
91	18,044	11,816	Democratic	0	11816	3114	0	3114	11816	-8701
92	14,313	11,383	Democratic	0	11383	1465	0	1465	11383	-9919
93	15,014	15,690	Republican	15014	0	0	338	15014	338	14676
94	14,601	15,761	Republican	14601	0	0	580	14601	580	14022
95	18,730	10,701	Democratic	0	10701	4014	0	4014	10701	-6687
96	13,841	11,982	Democratic	0	11982	930	0	930	11982	-11052
97	10,706	18,158	Republican	10706	0	0	3726	10706	3726	6979
98	10,566	21,472	Republican	10566	0	0	5453	10566	5453	5113
99	8,517	25,349	Republican	8517	0	0	8416	8517	8416	102
TOTALS	**1,448,901**	**1,394,018**		**726,238**	**402,334**	**160,165**	**132,723**	**886,403**	**535,057**	**351,346**

D. Conclusions

In this report, I have outlined a method that generates accurate estimates of underlying partisanship using the 2012 presidential election vote, demographics, incumbency, and geographic features to explain patterns of voting in Assembly elections. This method is accurate, as demonstrated by its ability to forecast vote totals at both the individual ward and district levels, and I demonstrate that it generates valid out of sample estimates. It produces results that are very similar to those derived by the expert witness retained by the state legislature during its development of the redistricting map implemented in Act 43.

The results demonstrate that Act 43 was an egregious gerrymander, packing Democratic voters into a small number of districts and distributing Republican voters efficiently in a large number of districts in which they constituted safe majorities. As I demonstrated with the treatment of the city of Sheboygan in Act 43, areas of Democratic strength large enough to constitute majorities in single districts were unnecessarily split and then combined with larger Republican populations to create additional Republican districts and eliminate Democratic districts. The city, which had been in a single Democratic Assembly district since 1992, was split into two Republican districts. This packing and cracking was so successful that Republicans won 61% of Assembly seats in 2012, while obtaining only 46.5% of the statewide presidential vote.

The scope of the gerrymander is demonstrated by the efficiency gap calculation for Act 43: 11.69%. Based on the baseline partisanship estimates produced by Dr. Ronald Keith Gaddie during the drawing of the Act 43 plan, this was the intended outcome: using Gaddie's baseline estimates, Act 43 had an expected efficiency gap of 12.36 %.

However, I drew a demonstration districting plan that was equivalent to Act 43 on population deviation, municipal splits, and compliance with the Voting Rights Act, and better on compactness, with a dramatically lower efficiency gap score of 2.20%. This proves that Act 43's extreme partisan effects were not required by these constitutional or statutory mandates.

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Assessing the Current Wisconsin State Legislative Districting Plan

Simon Jackman

July 7, 2015

EXHIBIT 3

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1 Introduction

My name is Simon Jackman. I am currently a Professor of Political Science at Stanford University, and, by courtesy, a Professor of Statistics. I joined the Stanford faculty in 1996. I teach classes on American politics and statistical methods in the social sciences.

I have been asked by counsel representing the plaintiffs in this lawsuit (the "Plaintiffs") to analyze relevant data and provide expert opinions in the case titled above. More specifically, I have been asked

- to determine if the current Wisconsin legislative districting plan constitutes a partisan gerrymander;
- to explain a summary measure of a districting plan known as "the efficiency gap" (Stephanopolous and McGhee, 2015), what it measures, how it is calculated, and to assess how well it measures partisan gerrymandering;
- to compare the efficiency gap to extant summary measures of districting plans such as partisan bias;
- to analyze data from state legislative elections in recent decades, so as to assess the properties of the efficiency gap and to identify plans with high values of the efficiency gap;
- to suggest a threshold or other measure that can be used to determine if a districting plan is an extreme partisan gerrymander;
- to describe how the efficiency gap for the Wisconsin districting plan compares to the values of the efficiency gap observed in recent decades elsewhere in the United States;
- to describe where the efficiency gap for the current Wisconsin districting plan lies in comparison with the threshold for determining if a districting plan constitutes an extreme partisan gerrymander.

My opinions are based on the knowledge I have amassed over my education, training and experience, and follow from statistical analysis of the following data:

- a large, canonical data set on candidacies and results in state legislative elections, 1967 to the present available from the Inter-University Consortium for Political and Social Research (ICPSR study number 34297); I use a release of the data updated through 2014, maintained by Karl Klarner (Indiana State University and Harvard University).
- presidential election returns, 2000-2012, aggregated to state legislative districts.

2 Qualifications, Publications and Compensation

My Ph.D. is in Political Science, from the University of Rochester, where my graduate training included courses in econometrics and statistics. My curriculum vitae is attached to this report.

All publications that I have authored and published in the past ten years appear in my curriculum vitae. Those publications include peer-reviewed journals such as: *The Journal of Politics*, *Electoral Studies*, *The American Journal of Political Science*, *Legislative Studies Quarterly*, *Election Law Journal*, *Public Opinion Quarterly*, *Journal of Elections, Public Opinion and Parties*, and *PS: Political Science and Politics*.

I have published on properties of electoral systems and election administration in *Legislative Studies Quarterly*, the *Australian Journal of Political Science*, the *British Journal of Political Science*, and the *Democratic Audit of Australia*. I am a Fellow of the Society for Political Methodology and a member of the American Academy of Arts and Sciences.

I am being compensated at a rate of $250 per hour.

3 Summary

1. **Partisan gerrymandering and wasted votes.** In two-party, single-member district electoral systems, a partisan gerrymander operates by effectively "wasting" more votes cast for one party than for the other. Wasted votes are votes for a party in excess of what the party needed to win a given district or votes cast for a party in districts that the party doesn't win. Differences

in wasted vote rates between political parties measure the extent of partisan gerrymandering.

2. **The efficiency gap** (*EG*) is a relative, wasted vote measure, the ratio of one party's wasted vote rate to the other party's wasted vote rate. *EG* can be computed directly from a given election's results, without recourse to extensive statistical modeling or assumptions about counter-factual or hypothetical election outcomes, unlike other extant measures of the fairness of an electoral system (e.g., partisan bias).

3. The efficiency gap is an "excess seats" measure, reflecting the nature of a partisan gerrymander. An efficiency gap in favor one party sees it wasting fewer votes than its opponent, thus translating its votes across the jurisdiction into seats more efficiently than its opponent. This results in the party winning more seats than we'd expect given its vote share (V) and if wasted vote rates were the same between the parties. $EG = 0$ corresponds to no efficiency gap between the parties, or no partisan difference in wasted vote rates. In this analysis (but without loss of generality) *EG* is normed such that negative *EG* values indicate higher wasted vote rates for Democrats relative to Republicans, and $EG > 0$ the converse.

4. A districting plan in which *EG* is consistently observed to be positive is evidence that the plan embodies a pro-Democratic gerrymander; the magnitudes of the *EG* measures speak to the severity of the gerrymander. Conversely, a districting plan with consistently negative values of the efficiency gap is consistent with the plan embodying a pro-Republican gerrymander.

5. **Performance of the efficiency gap in 786 state legislative elections.** My analysis of 786 state legislative elections (1972-2014) examines properties of the efficiency gap. *EG* is estimated with some uncertainty in the presence of uncontested districts (and uncontested districts are quite prevalent in state legislative elections), but this source of uncertainty is small relative to differences in the *EG* across states and across districting plans.

6. **Stability of the efficiency gap.** *EG* is stable in pairs of temporally adjacent elections held under the same districting plan. In 580 pairs of consecutive

EG measures, the probability that each *EG* measure has the same sign is 74%. In 141 districting plans with three or more elections, 35% have a better than 95% probability of *EG* being negative or positive for the entire duration of the plan; in about half of the districting plans the probability that *EG* doesn't change sign is above 75%.

7. **Recent decades show more pro-Republican gerrymandering, as measured by the efficiency gap.** Efficiency gap measures in recent decades show a pronounced shift in a negative direction, indicative of an increased prevalence of districting plans favoring Republicans. Among the 10 most pro-Democratic *EG* measures in my analysis, *none* were recorded after 2000.

8. **The current Wisconsin state legislative districting plan** (the "Current Wisconsin Plan"). In Wisconsin in 2012, the average Democratic share of district-level, two-party vote (V) is estimated to be 51.4% ($\pm$0.6, the uncertainty stemming from imputations for uncontested seats); recall that Obama won 53.5% of the two-party presidential vote in Wisconsin in 2012. Yet Democrats won only 39 seats in the 99 seat legislature (S = 39.4%), making Wisconsin one of 7 states in 2012 where we estimate $V > 50\%$ but $S < 50\%$. In Wisconsin in 2014, V is estimated to be 48.0% ($\pm$0.8) and Democrats won 36 of 99 seats (S = 36.4%).

9. Accordingly, Wisconsin's *EG* measures in 2012 and 2014 are large and negative: -.13 and -.10 (to two digits of precision). The 2012 estimate is the largest *EG* estimate in Wisconsin over the 42 year period spanned by this analysis (1972-2014).

10. Among 79 *EG* measures generated from state legislative elections after the 2010 round of redistricting, Wisconsin's *EG* scores rank 9th (2012, 95% CI 4 to 13) and 18th (2014, 95% CI 14 to 21). Among 786 *EG* measures in the 1972-2014 analysis, the magnitude of Wisconsin's 2012 *EG* measure is surpassed by only 27 (3.4%) other cases.

11. Analysis of efficiency gaps measures in the post-1990 era indicates that conditional on the magnitude of the Wisconsin 2012 efficiency gap (the first election under the Current Wisconsin Plan), there is a 100% probability

that *all subsequent elections* held under that plan will also have efficiency gaps disadvantageous to Democrats.

12. **The Current Wisconsin Plan presents overwhelming evidence of being a pro-Republican gerrymander**. In the entire set of 786 state legislative elections and their accompanying *EG* measures, there are *no precedents* prior to this cycle in which a districting plan generates an initial two-election sequence of *EG* scores that are each as large as those observed in *WI*.

13. The Current Wisconsin Plan is generating *EG* measures that make it *extremely likely* that it has a systematic, historically large and enduring, pro-Republican advantage in the translation of votes into seats in Wisconsin's state legislative elections.

14. **An actionable threshold based on the efficiency gap.** Historical analysis of the relationship between the first *EG* measure we observe under a new districting plan and the subsequent *EG* measures lets us assess the extent to which that first *EG* estimate is a *reliable* indicators of a *durable* and hence *systematic* feature of the plan. In turn, this let us assess the *confidence* associated with a range of possible *actionable EG thresholds*.

15. My analysis suggests that *EG* greater than .07 in absolute value be used as an actionable threshold. Relatively few plans produce a first election with an *EG* measure in excess of this threshold, and of those that do, the historical analysis suggests that most go on to produce a sequence of *EG* estimates indicative of systematic, partisan advantage consistent with the first election *EG* estimates, At the 0.07 threshold, 95% of plans would be either (a) undisturbed by the courts, or (b) struck down because we are sufficiently confident that the plan, if left undisturbed, would go on to produce a one-sided sequence of *EG* estimates, consistent with the plan being a partisan gerrymander. In short, our "confidence level" in the 0.07 threshold is 95%.

16. **The Current Wisconsin Plan is generating estimates of the efficiency gap far in excess of this proposed, actionable threshold**. In 2012 elections to the Wisconsin state legislature, the efficiency gap is estimated to be -.13; in

2014, the efficiency gap is estimated to be -.10. Both measures are separately well beyond the conservative .07 threshold suggested by the analysis of efficiency gap measures observed from 1972 to the present.

A vivid, graphical summary of my analysis appears in Figure 1, showing the average value of the efficiency gap in 206 districting plans, spanning 41 states and 786 state legislative elections from 1972 to 2014. The Current Wisconsin Plan has been in place for two elections (2012 and 2014), with an average efficiency gap of -.115. Details on the interpretation and calculation of the efficiency gap come later in my report, but for now note that negative values of the efficiency gap indicate a districting plan favoring Republicans, while positive values indicate a plan favoring Democrats. Note that *only four other districting plans have lower average efficiency gap scores than the Current Wisconsin Plan*, and these are also from the post-2010 round of redistricting. That is, Wisconsin's current plan is generating the 5th lowest average efficiency gap observed in over 200 other districting plans used in state legislative elections throughout the United States over the last 40 years. The analysis I report here documents why the efficiency gap is a valid and reliable measure of partian gerrymandering and why are confident that the current Wisconsin plan exceeds even a conservative definition of partisan gerrymandering.

4 Redistricting plans

A districting plan is an exercise in map drawing, partitioning a jurisdiction into districts, typically required to be contiguous, mutually exclusive and exhaustive regions, and — at least in the contemporary United States — of approximately the same population size. In a single-member, simple plurality (SMSP) electoral system, the highest vote getter in each district is declared the winner of the election. Partisan gerrymandering is the process of drawing districts that favor one party, typically by creating a set of districts that help the party win an excess of seats (districts) relative to its jurisdiction-wide level of support.

What might constitute evidence of partisan gerrymandering? One indication might be a series of elections conducted under the same districting plan in which a party's seat share (S) is unusually large (or small) relative to its vote share (V).

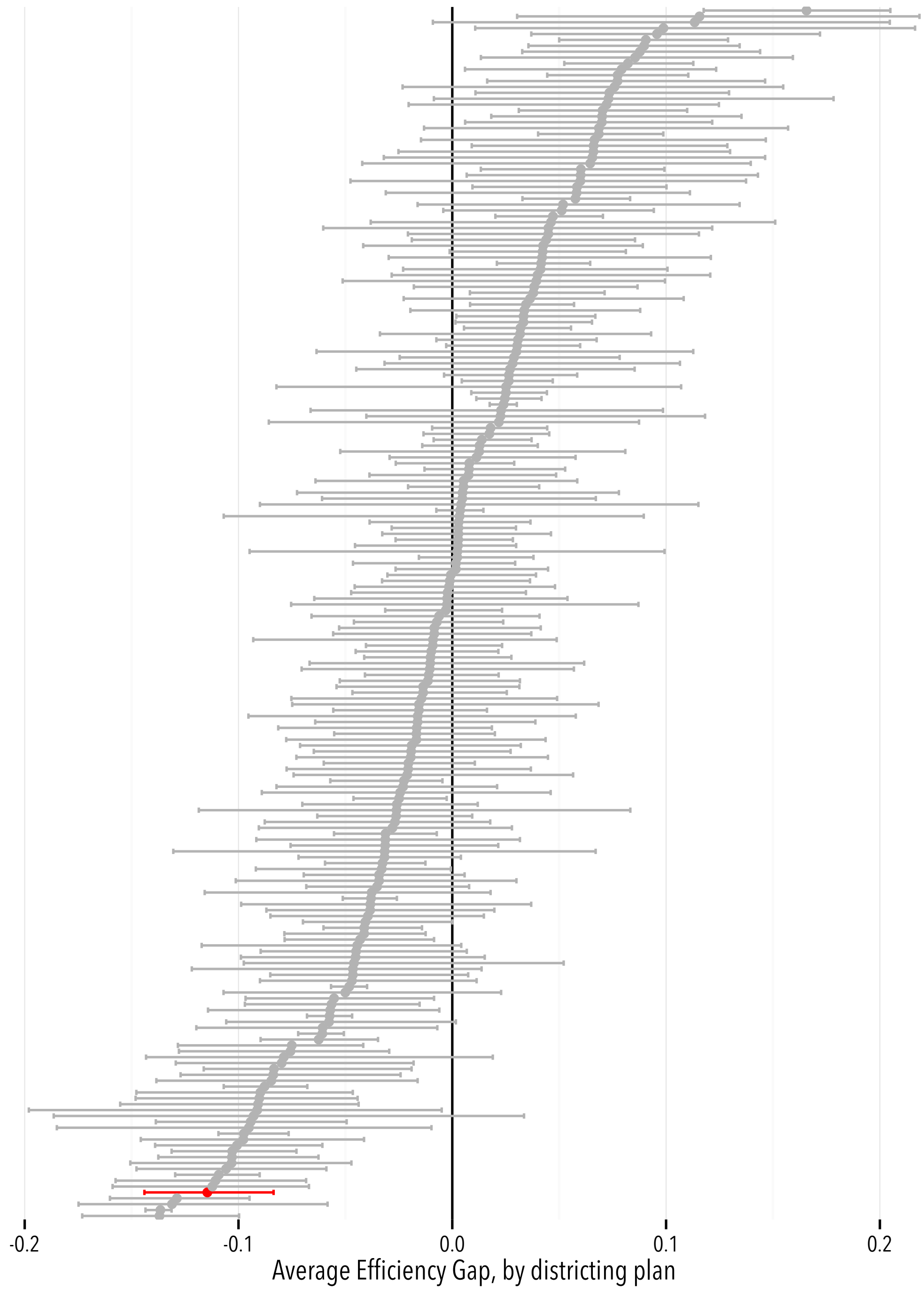

Figure 1: Average efficiency gap score, 206 districting plans, 1972-2014. Plans have been sorted from low average *EG* scores to high. Horizontal lines cover 95% confidence intervals. Negative efficiency gap scores are plans that disadvantage Democrats; positive efficiency gap scores favor Democrats. The Current Wisconsin Plan is shown in red. See also Figure 36.

There may be elections where a party wins a majority of seats (and control of the jurisdiction's legislature) despite not winning a majority of votes: $S > .5$ while $V < .5$ and vice-versa. In fact, there are numerous instances of mismatches between the party winning the statewide vote and the party controlling the state legislature in recent decades. I estimate that since 1972 there have been 63 cases of Democrats winning a majority of the vote in state legislative elections, while not winning a majority of the seats, and 23 cases of the reverse phenomenon, where Democrats won a majority of the seats with less than 50% of the statewide, two-party vote.

Geographic clustering of partisans is typically a prerequisite for partisan gerrymandering. This is nothing other than partisan "packing": a gerrymandered districting plan creates a relatively small number of districts that have unusually large proportions of partisans from party *B*. The geographic concentration of party *B* partisans might make creating these districts a straightforward task. In other districts in the jurisdiction, party *B* supporters never (or seldom) constitute a majority (or a plurality), making those districts "safe" for party *A*. This districting plan helps ensure party *A* wins a majority of seats even though party *B* has a majority of support across the jurisdiction, or at the very least, the districting plan helps ensures that party *A*'s seat share exceeds its vote share in any given election.

It is conventional in political science to say that such a plan allows party *A* to "more efficiently" translate its votes into seats, relative to the way the plan translates party *B*'s votes into seats. This nomenclature is telling, as we will see when we consider the *efficiency gap* measure, below.

Assessing the partisan fairness of a districting plan is fundamentally about measuring a party's excess (or deficit) in its seat share relative to its vote share. The efficiency gap is such a summary measure. To assess the properties of the efficiency gap, I first review some core concepts in the analysis of districting plans: vote shares, seat shares, and the relationship between the two quantities in single-member districts.

4.1 Seats-Votes Curves

Electoral systems translate parties' vote shares (V) into seat shares (S). Both V and S are proportions. Plotting the two quantities V and S against one another yields the "seats-votes" curve, a staple in the analysis of electoral systems and districting plans. Two seats-votes curves are shown in Figure 2, one showing a non-linear relationship between seats and votes typical of single-member district systems,[1] the other showing a linear relationship between seats and votes observed under proportional representation systems.

In pure proportional representation (PR) voting systems, seats-votes curves are 45 degree lines by design, crossing the $(V, S) = (.5, .5)$ point: i.e., under PR, $S = V$ and a party that wins 50% of the vote will be allocated 50% of the seats. Absent a deterministic allocation rule like pure PR, seats-votes curves are most usefully thought of in probabilistic terms, due to the fact that there are many possible configurations of district-specific outcomes corresponding to a given jurisdiction-wide V, and hence uncertainty — represented by a probability *distribution* — over possible values of S given V.

In single-member, simple plurality (SMSP) systems, we often see non-linear, "S"-shaped seats-votes curves. With an approximately symmetric mix of districts (in terms of partisan leanings), large changes in seat shares (S) can result from relatively small changes in votes shares (V) at the middle of the distribution of district types. This presumes a districting plan such that both parties have a small number of "strongholds," with extremely large changes in vote shares needed to threaten these districts, and so the seats-votes curve tends to "flatten out" as jurisdiction-wide vote share (V) takes on relatively large or small values. Other shapes are possible too: e.g., bipartisan, incumbent-protection plans generate seats-votes curves that are largely flat for most values of V, save for the constraint that the curve run through the points $(V, S) = (0, 0)$ and $(1, 1)$; i.e., relatively large movements in V generates relatively little change in seats shares.

[1] The curve labeled "Cube Law" in Figure 2 is generated assuming that $S/(1-S) = [V/(1-V)]^3$, an approximation for the lack of proportionality we observe in single-member district systems, though hardly a "law."

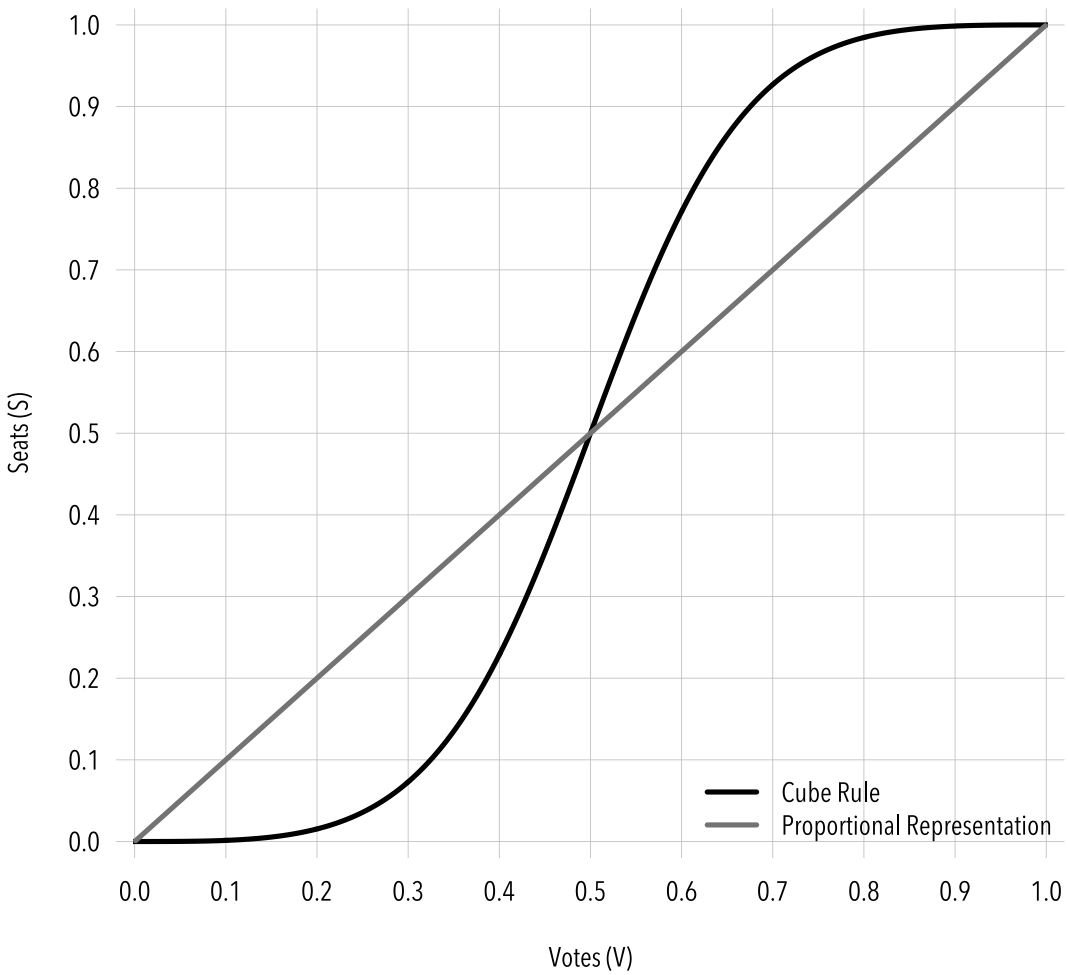

Figure 2: Two Theoretical Seats-Votes Curves

5 Partisan bias

Both of the hypothetical seats-votes curves in Figure 2 run through the "50-50" point, where $V = .5$ and $S = .5$. An interesting empirical question is whether *actual* seats-votes curves run through this point, or more generally, whether the seats-votes curve is symmetric about $V = .5$. Formally, symmetry of the seats-vote curve is the condition that $E(S|V) = 1 - E(S|1 - V)$, where E is the expectation operator, averaging over the uncertainty with respect to S given V. The vertical offset from the $(.5, .5)$ point for a seats-votes curve is known as *partisan bias*: the extent to which a party's expected seat share lies above or below 50%, conditional on that party winning 50% of the jurisdiction-wide vote.

Figure 3 shows three seats-votes curves, with the graph clipped to the region $V \in [.4, 6.]$ and $S \in [.4, .6]$ so as to emphasize the nature of partisan bias. The blue, positive bias curve "lifts" the seats-votes curve; it crosses $S = .5$ with $V < .5$ and passes through the upper-left quadrant of the graph. That is, with positive bias, a party can win a majority of the seats with *less* then a majority of the jurisdiction-wide or average vote; equivalently, if the party wins $V = .5$, it can expect to win *more* than 50% of the seats. Conversely, with negative bias, the opposite phenomenon occurs: the party can't expect to win a majority of the seats until it wins more than a majority of the jurisdiction-wide or average vote.

5.1 Multi-year method

With data from multiple elections under the same district plan, partisan bias can be estimated by fitting a seats-votes curve to the observed seat and vote shares, typically via a simple statistical technique such as linear regression; this approach has a long and distinguished lineage in both political science and statistics (e.g., Edgeworth, 1898; Kendall and Stuart, 1950; Tufte, 1973). Niemi and Fett (1986) referred to this method of estimating the partisan bias of an electoral system as the "multi-year" method, reflecting the fact that the underlying data comes from a sequence of elections.

This approach is of limited utility when assessing a new or proposed districting plan. More generally, it is of no great help to insist that a sequence of elections must be conducted under a redistricting plan before the plan can be properly assessed. Indeed, few plans stay intact long enough to permit reliable analysis in

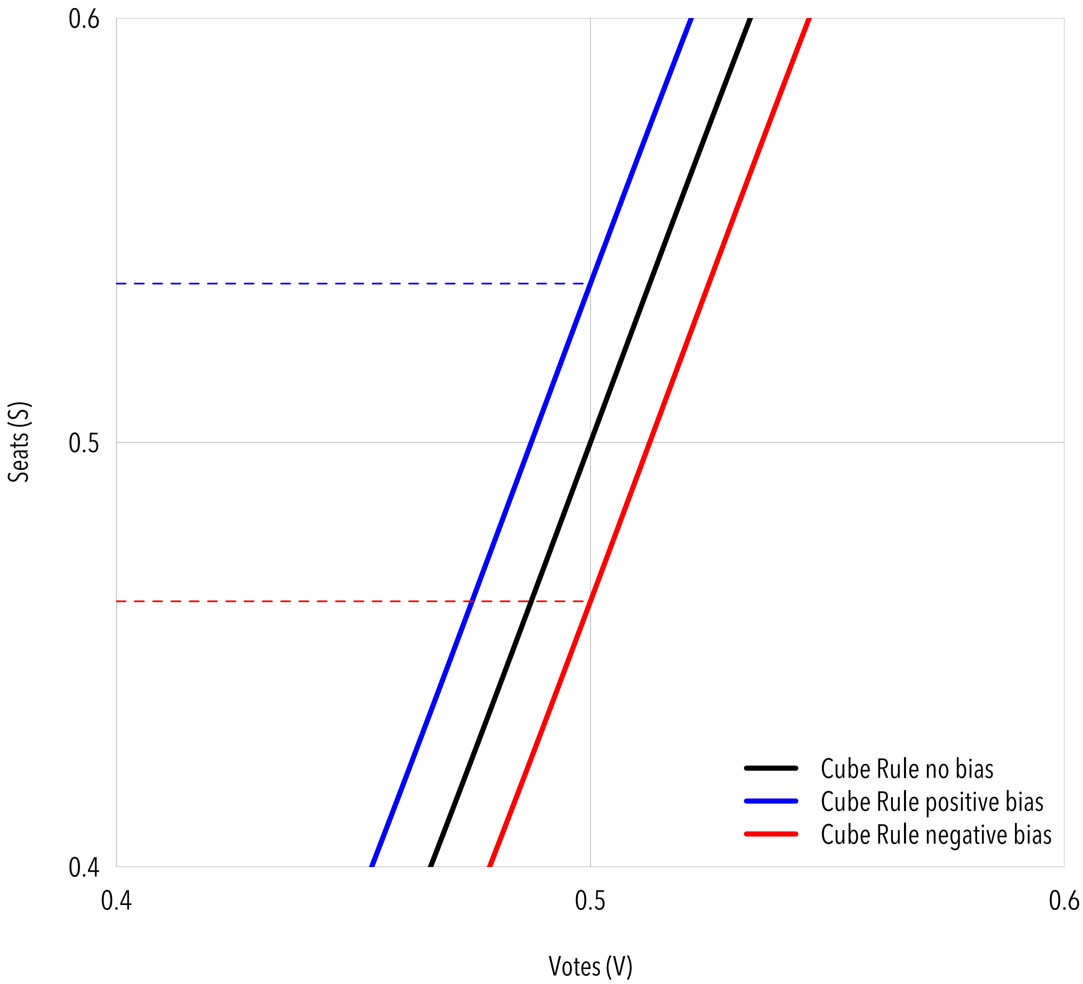

Figure 3: Theoretical seats-votes curves, with different levels of partisan bias. This graph is "zoomed in" on the region $V \in [.4, .6]$ and $S \in [.4, .6]$; the seats-votes "curves" are approximately linear in this region.

this way. State-level plans in the United States might generate as many five elections between decennial censuses. Accordingly, many uses of the "multi-year" method pool multiple plans and/or across jurisdictions, so as to estimate average partisan bias. For instance, Niemi and Jackman (1991) estimated average levels of partisan bias in state legislative districting plans, collecting data spanning multiple decades and multiple states, and grouping districting plans by the partisanship of the plan's authors (e.g., plans drawn under Republican control, Democratic control, mixed, or independent).

Assessing the properties of a districting plan after a tiny number of elections — or *no* elections — requires some assumptions and/or modeling. A single election yields just a single (V, S) data point, through which no unique seats-vote curve can be fitted and so partisan bias can't be estimated without further assumptions. Absent *any* actual elections under the plan, we might examine votes from a previous election, say, with precinct level results re-aggregated to the new districts.

5.2 Uniform swing

One approach—dating back to Sir David Butler's (1974) pioneering work on British elections—is the uniform partisan swing approach. Let $\mathbf{v} = (v_1, \dots, v_n)'$ be the set of vote shares for party A observed in an election with n districts. Party A wins seat i if $v_i > .5$, assuming just two parties (or defining v as the share of two-party vote); i.e., $s_i = 1$ if $v_i > .5$) and otherwise $s_i = 0$. Party A's seat share is $S = \frac{1}{n}\sum_{i=1}^{n} s_i$. V is the jurisdiction-wide vote share for party A, and if each district had the same number of voters $V = \bar{v} = \frac{1}{n}\sum_{i=1}^{n} v_i$, the average of the district-level v_i. Districts are never *exactly* equal sized, in which case we can define V as follows: let t_i be the number of voters in district i, and $V = \sum_{i=1}^{n} t_i v_i / \sum_{i=1}^{n} t_i$.

The uniform swing approach perturbs the observed district-level results $\mathbf{v}$ by a constant factor δ, corresponding to a hypothetical amount of *uniform swing* across all districts. For a given δ, let $v_i^* = v_i + \delta$ which in turn generates $V^* = V + \delta$ and an implied seat share S^*. Now let δ vary over a grid of values ranging from $-V$ to $1 - V$; then V^* varies from 0 to 1 and a corresponding value of S^* can also be computed at every grid point. The resulting set of (V^*, S^*) points are then plotted to form a seats-vote curve (actually, a step function). Partisan bias is simply "read off" this set of results, computed as $S^*|(V^* = .5) - .5$.

There is an elegant simplicity to this approach, taking an observed set of district-level vote shares $\mathbf{v}$ and shifting them by the constant δ. The observed distribution of district level vote shares observed in a given election is presumed to hold under *any* election we might observe under the redistricting plan, save for the shift given by the uniform swing term δ.

5.3 Critiques of partisan bias

Among political scientists, the uniform swing approach was criticized for its determinism. Swings are never exactly uniform across districts. There are many permutations of observed vote shares that generate a statewide vote share of 50% other than simply shifting observed district-level results by a constant factor. A less deterministic approach to assessing partisan bias was developed over a series of papers by Gary King and Andrew Gelman in the early 1990s (e.g., Gelman and King, 1990). This approach fits a statistical model to district-level vote shares — and, optionally, utilizing available predictors of district-level vote shares — to model the way particular districts might exhibit bigger or smaller swings than a given level of state-wide swing. Perhaps one way to think about the approach is that it is "approximate" uniform swing, with statistical models fit to historical election results to predict and bound variation around a state-wide average swing. The result is a seats-vote curve and an estimate of partisan bias that comes equipped with uncertainty measures, reflecting uncertainty in the way that individual districts might plausibly deviate from the state-wide average swing yet still produce a state-wide average vote of 50%.

The King and Gelman model-based simulation approaches remain the most sophisticated methods of generating seats-votes curves, extrapolating from as little as one election to estimate a seats-votes curve and hence an estimate of partisan bias. Despite the technical sophistication with which we can estimate partisan bias, legal debate has centered on a more fundamental issue, the *hypothetical* character of partisan bias itself. Recall that partisan bias is defined as "seats in excess of 50% *had the jurisdiction-wide vote split 50-50*." The premise that $V = .5$ is the problem, since this will almost always be a counter-factual or hypothetical scenario. The further V is away from .5 in a given election, the counter-factual we must contemplate (when assessing the partisan bias of a districting plan) becomes all the more speculative.

In no small measure this is a marketing failure, of sorts. Partisan bias (at least under the uniform swing assumption) is essentially a measure of skew or asymmetry in *actual* vote shares. Partisan bias garners great rhetorical and normative appeal by directing attention to what happens at $V = .5$; it seems only "fair" that if a party wins 50% or more of the vote it should expect to win a majority of the districts.

Yet this distracts us from the fact that *asymmetry* in the distribution of vote shares across districts is the key, operative feature of a districting plan, and the extent to which it advantages one party or the other. Critically, we need not make appeals to counter-factual, hypothetical elections in order to assess this asymmetry.

6 The Efficiency Gap

The efficiency gap (*EG*) is also an asymmetry measure, as we see below. But unlike partisan bias, the interpretation of the efficiency gap is *not* explicitly tied to any counter-factual election outcome. In this way, the efficiency gap provides a way to assess districting plans that is free of the criticisms that have stymied the partisan bias measure.

Stephanopoulos and McGhee (2015) derive the *EG* measure with the concept of wasted votes. A party only needs v_i = 50% + 1 of the votes to win district i. Anything more are votes that could have been deployed in other districts. Conversely, votes in districts where the party doesn't win are "wasted," from the perspective of generating seats: any districts with $v_i < .5$ generate no seats.

Wasted votes get at the core of what partisan gerrymandering is, and how it operates. A gerrymander against party A creates a relatively small number of districts that "lock up" a lot of its votes ("packing" with $v_i > .5$) and a larger number of districts that disperse votes through districts won by party B ("cracking" with $v_i < .5$). To be sure, both parties are wasting votes. But partisan advantage ensues when one party is wasting fewer votes than the other, or, equivalently, more efficiently translating votes into seats. Note also how the efficiency gap measure is also closely tied to asymmetry in the distribution of v_i.

Some notation will help make the point more clearly. If $v_i > .5$ then party A wins the district and $s_i = 1$; otherwise $s_i = 0$. The efficiency gap is defined by McGhee (2014, 68) as "relative wasted votes" or

$$EG = \frac{W_B}{n} - \frac{W_A}{n}$$

where

$$W_A = \sum_{i=1}^{n} s_i(v_i - .5) + (1 - s_i)v_i$$

is the sum of wasted vote proportions for party A and

$$W_B = \sum_{i=1}^{n} (1 - s_i)(.5 - v_i) + s_i(1 - v_i)$$

is the sum of wasted vote proportions for party B and n is the number of districts in the jurisdiction. If $EG > 0$ then party B is wasting more votes than A, or A is translating votes into seats more efficiently than B; if $EG < 0$ then the converse, party A is wasting more votes than B and B is translating votes into seats more efficiently than A.

6.1 The efficiency gap when districts are of equal size

Under the assumption of equally sized districts McGhee (2014, 80) re-expresses the efficiency gap as:

$$EG = S - .5 - 2(V - .5) \tag{1}$$

recalling that $S = n^{-1} \sum_{i=1}^{n} s_i$ is the proportion of seats won by party A and $V = n^{-1} \sum_{i=1}^{n} v_i$ is the proportion of votes won by party A.

The assumption of equally-sized districts is especially helpful for the analysis reported below, since the calculation of EG in a given election then reduces to using the jurisdiction-level quantities S and V as in equation 1. For the analysis of historical election results reported below, it isn't possible to obtain measures of district populations, meaning that we really have no option other than to rely on the jurisdiction-level quantities S and V when estimating the EG.

I operationalize V as the average (over districts) of the Democratic share of the two-party vote, in seats won by either a Democratic or Republican candidate;

this set of seats includes uncontested seats, where I will use imputation procedures to estimate two-party vote share. If districts are of equal size (and ignoring seats won by independents and minor party candidates) then this average over districts will correspond to the Democratic share of the state-wide, two-party vote.

6.2 The seats-vote curve when the efficiency gap is zero

This simple expression for the efficiency gap implies that *if the efficiency gap is zero*, we obtain a particular type of seats-votes curve, shown in Figure 4:

1. the seats-votes curve runs through the 50-50 point. If the jurisdiction wide vote is split 50-50 between party A and party B then with an efficiency gap of zero, $S = .5$.

2. conditional on $V = .5$ (an even split of the vote), the efficiency gap is the same as partisan bias: $V = .5 \iff EG = S - .5$, the seat share for party A in excess of 50%. That is, the efficiency gap reduces to partisan bias *under the counter-factual scenario* $V = .5$ that the partisan bias measure requires us to contemplate. On the other hand, the efficiency gap is not premised on that counter-factual holding, or any other counter-factual for that matter; the efficiency gap summarizes the distribution of observed district-level vote shares v_i.

3. the seats-votes curve is linear through the 50-50 point with a slope of 2. That is, with $EG = 0$, $S = 2V - .5$. Or, with a zero efficiency gap, each additional percentage point of vote share for party A generates *two* additional percentage points of seat share. A zero efficiency gap does not imply proportional representation (a seats-votes that is simply a 45 degree line).

4. a party winning 25% or less of the jurisdiction-wide vote should win zero seats under a plan with a zero efficiency gap; a party winning 75% or more of the jurisdiction-wide vote should win all of the seats under a plan with a zero efficiency gap. This is a consequence of the "2-to-1" seats/vote ratio and the symmetry implied by a zero efficiency gap. A party that wins an extremely low share of the vote ($V < .25$) can only be winning any seats if it enjoys an efficiency advantage over its opponent.

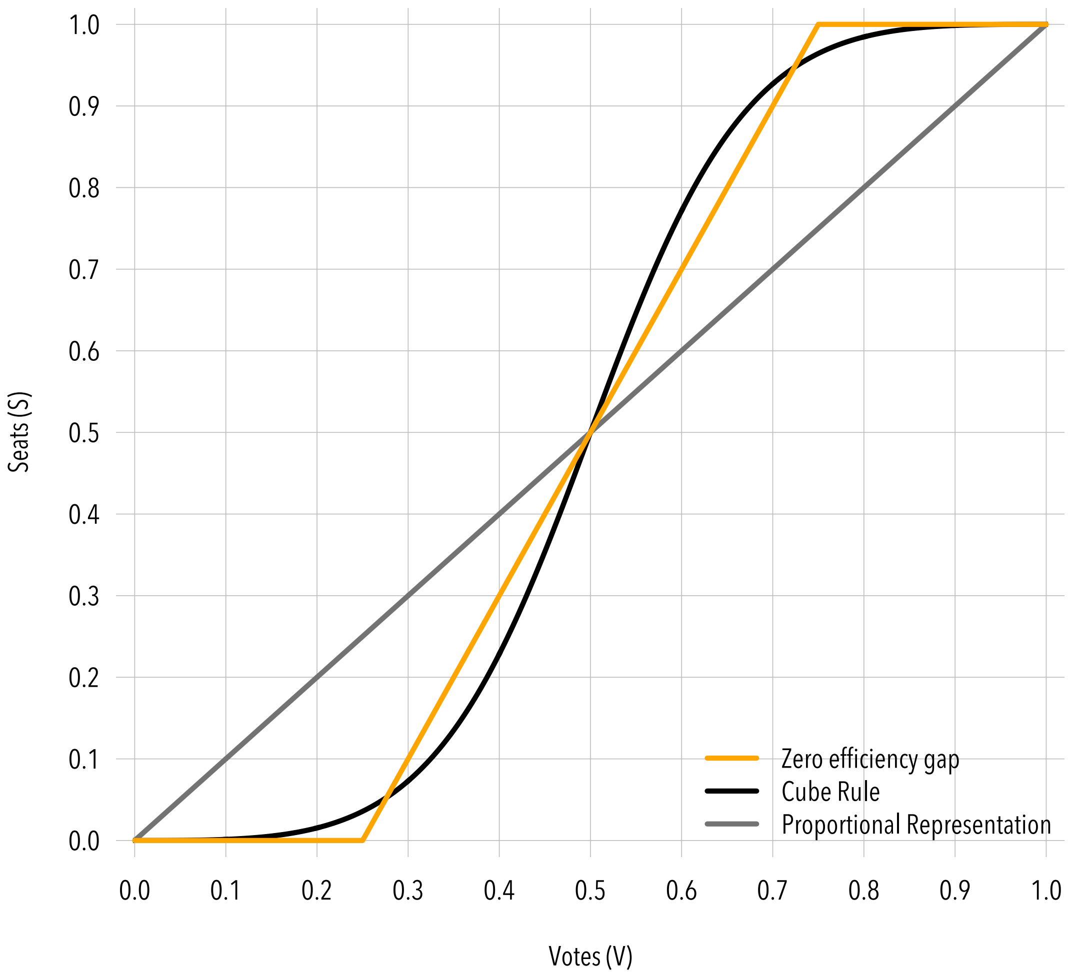

Figure 4: Theoretical seats-votes curves. The $EG = 0$ curve implies that (a) a party winning less than $V = .25$ jurisdiction-wide should not win any seats; (b) symmetrically, a party winning more than $V = .75$ jurisdistion-wide should win all the seats; and (c) the relationship between seat shares S and vote shares V over the interval $V \in [.25, .75]$ is a linear function with slope two (i.e., for every one percentage point gain in vote share, seat share should go up by two percentage points).

Moreover, the efficiency gap is trivial to compute once we have V and S for a given election. We don't need a sequence of elections under a plan in order to compute EG, nor do we need to anchor ourselves to a counter-factual scenario such as $V = .5$ as we do when computing partisan bias. For any given observed V, the hypothesis of zero efficiency gap tells us what level of S to expect.

6.3 The efficiency gap as an excess seats measure

In this sense the efficiency gap can be interpreted even more simply as an "excess seats" measure. Recall that $EG = 0 \iff S = 2V - .5$. In a given election we observe $EG = S - .5 - 2(V - .5)$. The efficiency gap can be computed by noting how far the observed S lies above or below the orange line in Figure 4.

A positive EG means "excess" seats for party A relative to a zero efficiency gap standard given the observed V in that election; conversely, a negative EG mean a deficit in seats for party A relative to a zero efficiency gap standard given the observed V.

7 State legislative elections, 1972-2014

We estimate the efficiency gap in state legislative elections over a large set of states and districting plans, covering the period 1972 to 2014. We begin the analysis in 1972 for two primary reasons: (a) state legislative election returns are harder to acquire prior to the mid-1960s, and not part of the large, canonical data collection we rely on (see below); and (b) districting plans and sequences of elections from 1972 onwards can be reasonably considered to be from the post-malapportionment era.

For each election we recover an estimate of the efficiency gap based on the election results actually observed in that election. To do this, I compute two quantities for each election:

1. V, the statewide share of the two-party vote for Democratic candidates, formed by averaging the district-level election results v_i (the Democratic share of the two-party vote in district i) in seats won by major party candidates, including uncontested seats, and

2. S, the Democratic share of seats won by major parties.

Recall that these quantities are the inputs required when computing the efficiency gap (equation 1).

The analysis that follows relies on a data set widely used in political science and freely available from the Inter-University Consortium for Political and Social Research (ICPSR study number 34297). The release of the data I utilize covers state legislative election results from 1967 to 2014, updated by Karl Klarner (Indiana State University and Harvard University). I subset the original data set to general election results since 1972 in states whose lower houses are elected via single-member districts, or where single-member districts are the norm. Multi-member districts "with positions" are treated as if they are single-member districts.

Figure 5 provides a graphical depiction of the elections that satisfy the selection criteria described above.

- Arizona, Idaho, Louisiana, Maryland, Nebraska, New Hampshire, New Jersey, North Dakota and South Dakota all drop out of the analysis entirely, because of exceedingly high rates of uncontested races, using multi-member districts, non-partisan elections, or the use of a run-off system (Louisiana).

- Alaska, Hawaii, Illinois, Indiana, Kentucky, Maine, Minnesota, Montana, North Carolina, Vermont, Virginia, West Virginia and Wyoming do not supply data over the entire 1972-2014 span; this is sometimes due to earlier elections being subject to exceedingly high rates of uncontestedness, the use of multi-member districts or non-partisan elections.

- Alabama and Mississippi have four-year terms in their lower houses, contributing data at only half the rate of the vast bulk of states with two-year legislative terms.

- Twenty-three states supply data every two years from 1972 to 2014, including Michigan and Wisconsin.

- Data is more abundant in recent decades. For the period 2000 to 2014, 41 states contribute data to the analysis at two or four year intervals.

In summary, the data available for analysis span 83,269 district-level state legislative contests, from 786 elections across 41 states.

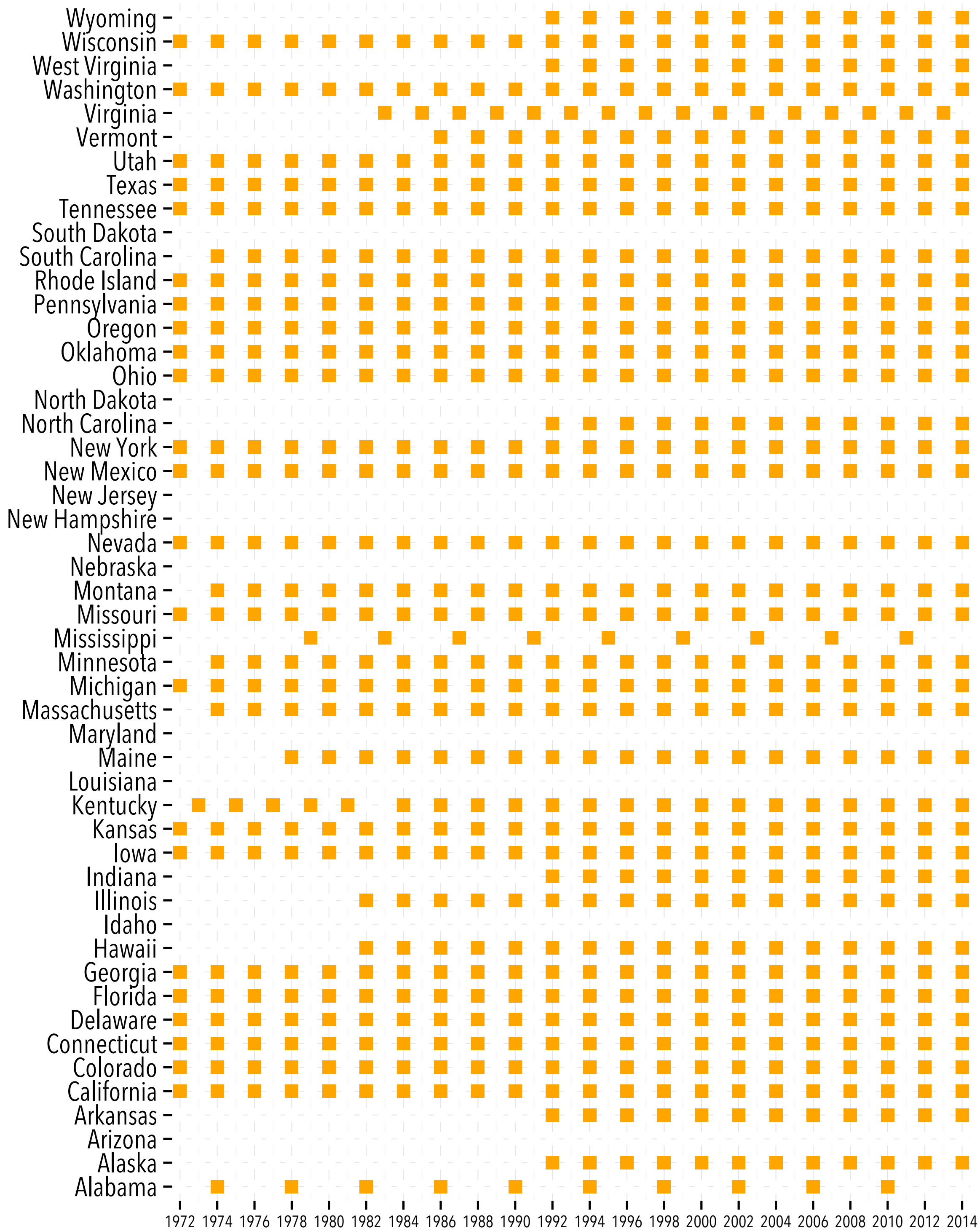

Figure 5: 786 state legislative elections available for analysis, 1972-2014, by state.

7.1 Grouping elections into redistricting plans

Districting plans remain in place for sequences of elections. An important component of my analysis involves tracking the efficiency gap across a series of elections held under the same districting plan. A key question is how much variation in the *EG* do we observe *within* districting plans, versus variation in the *EG between* districting plans.

To the extent that the *EG* is a feature of a districting plan per se, we should observe a small amount of within-plan variation relative to between plan variation. To perform this analysis we must group sequences of elections within states by the districting plan in place at the time.

Stephanopolous and McGhee (2015) provide a unique identifier for the districting plan in place for each state legislative election, for which I adopt here.

Figure 6 displays how the elections available for analysis group by districting plan. Districts are typically redrawn after each decennial census; the first election conducted under new district boundaries is often the "2" election (1982, 1992, etc). Occasionally we see just one election under a plan: examples include Alabama 1982, California, Hawaii 1982, Tennessee 1982, Ohio 1992, South Carolina 1992, North Carolina 2002, and South Carolina 2002.

Alaska, Kentucky, Pennsylvania and Texas held just one election under their respective districting plans adopted after the 2010 Census. In each of those states a different plan was in place for 2014 state legislative elections. Alabama's state legislature has a four year term and we observe only the 2014 election under its post-2010 plan. The last election from Mississippi was in 2011 and was held under the plan in place for its 2003 and 2007 elections.

7.2 Uncontested races

Uncontested races are common in state legislative elections, and are even the norm in some states. For 38.7% of the district-level results in this analysis, it isn't possible to directly compute a two-party vote share (v_i), either because the seat was uncontested or not contested by both a Democratic and Republican candidate, or (in a tiny handful of cases) the data are missing.

In some states, for some elections, the proportion of uncontested races is so high that we drop the election from the analysis. As noted earlier, examples

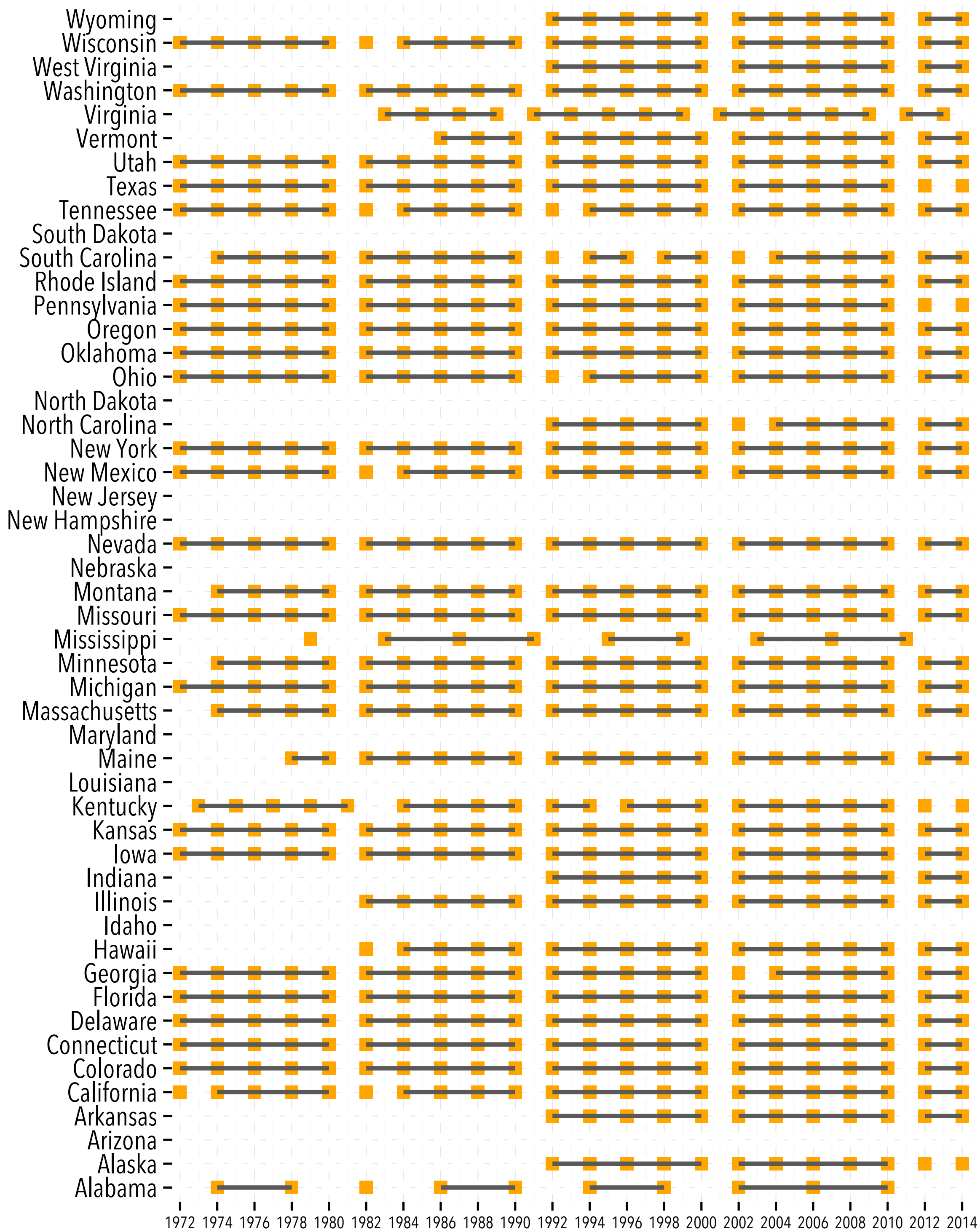

Figure 6: 786 state legislative elections available for analysis, 1972-2014, by state, grouped by districting plan (horizontal line).

include Arkansas elections prior to 1992 and South Carolina in 1972.

Even with these elections dropped from the analysis, the extent of uncontestedness in the remaining set of state legislative election results is too large to be ignored. Of the remaining elections, 31% have missing two-party results in at least half of the districts.

A graphical summary of the prevalence of uncontested districts appears in Figure 7, showing the percentage of districts without Democratic and Republican vote counts, by election and by state. Uncontested races are the norm in a number of Southern states: e.g., Georgia, South Carolina, Mississippi, Arkansas, Texas, Alabama, Virginia, Kentucky and Tennessee record rates of uncontestedness that seldom, if ever, drop below 50% for the period covered by this analysis. Wyoming also records a high proportion of districts that do not have Democratic versus Republican contests. States that lean Democratic also have high levels of uncontestedness too: see Rhode Island, Massachusetts, Illinois and, in recent decades, Pennsylvania.

Michigan and Minnesota are among the states with the lowest levels of uncontested districts in their state legislative elections. Over the set of 786 state legislative elections we examine, there are just *three* instances of elections with Democrats and Republicans running candidates in every district: Michigan supplies two of these cases (2014 and 1996) and Minnesota the other (2008).

8 Imputations for Uncontested Races

Stephanopolous and McGhee (2015) note the prevalence of uncontested races and report using a statistical model to impute vote shares to uncontested districts. They write:

> We strongly discourage analysts from either dropping uncontested races from the computation or treating them as if they produced unanimous support for a party. The former approach eliminates important information about a plan, while the latter assumes that coerced votes accurately reflect political support.

I concur with this advice, utilizing an imputation strategy for uncontested districts with *two* distinct statistical models, predicting Democratic, two-party

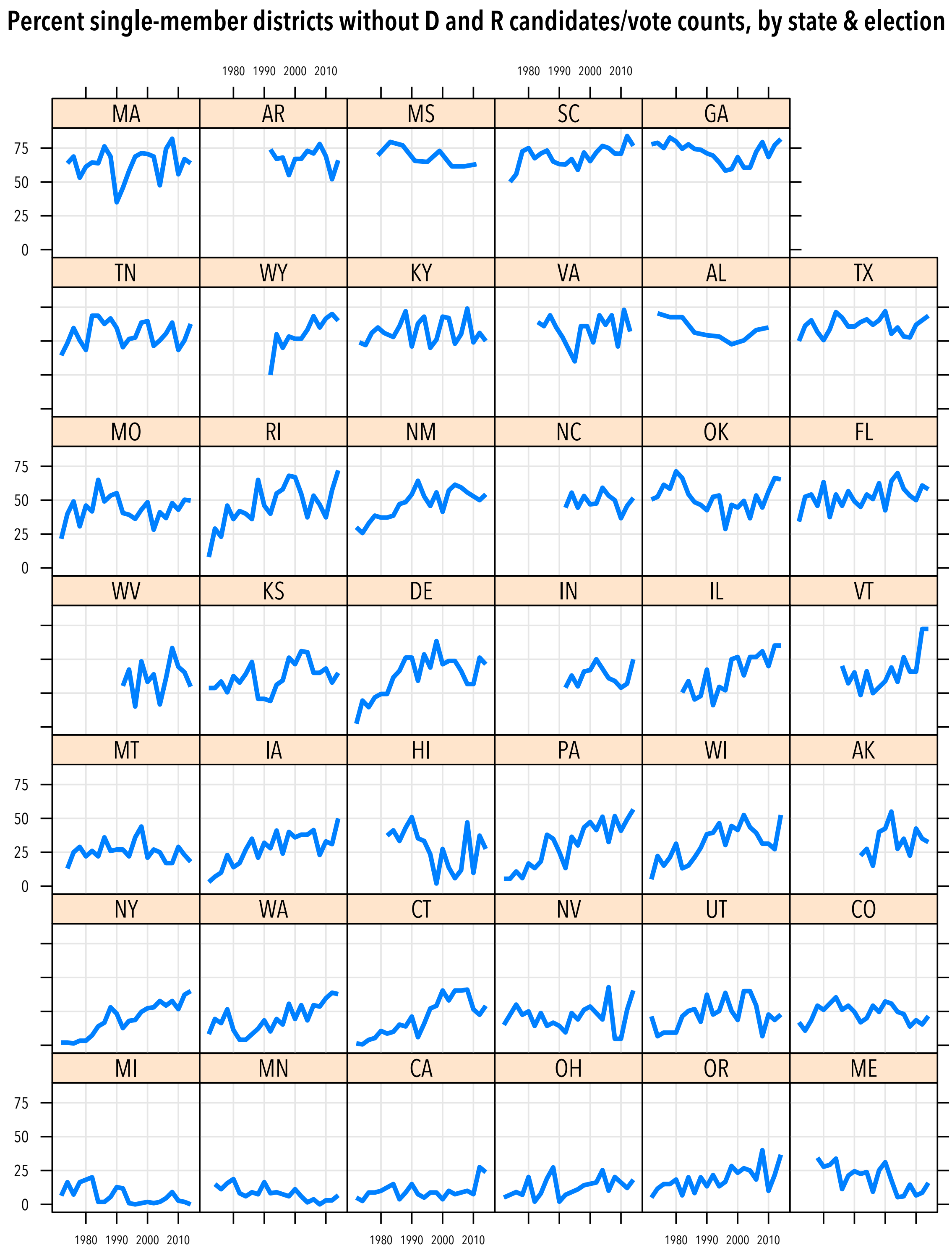

Figure 7: Percentage of districts missing two-party vote shares, by election, in 786 state legislative elections, 1972-2014. Missing data is almost always due to districts being uncontested by both major parties.

vote share in state legislative districts (v_i).

8.1 Imputation model 1: presidential vote shares

The first imputation model relies on presidential election returns reported at the level of state legislative districts. Presidential election returns are excellent predictors of state legislative election outcomes and observed even when state legislative elections are uncontested. I fit a series of linear regressions of v_i on the Democratic share of the two-party vote for president in district i, as recorded in the most temporally-proximate presidential election for which data is available and for which the current election's districting plan was in place; separate slopes and intercepts are estimated depending on the incumbency status of district i (Democratic, Open/Other, Republican).

The model also embodies the following assumptions in generating imputations for unobserved vote shares in uncontested districts. In districts where a Republican incumbent ran unopposed, we assume that the Democratic share of the two-party vote would have been less than 50%; conversely, where Democratic incumbents ran unopposed, we assume that the Democratic share of the vote would have been greater than 50%.

In most states the analysis predicts 2014 and 2012 state legislative election results v_i using 2012 presidential vote shares; 2006, 2008 and 2010 v_i is regressed on 2008 presidential vote shares, and so on. Some care is needed matching state and presidential election results in states that hold their state legislative elections in odd-numbered years, or where redistricting intervenes. In a small number of cases, presidential election returns are not available, or are recorded with district identifiers that can't be matched in the state legislative elections data. We lack data on presidential election results by state legislative district prior to 2000, so 1992 is the earliest election with which we can match state legislative election results to presidential election results at the district level.

The imputation model generally fits well. Across the 447 elections, the median r^2 statistic is 0.82. The cases fitting less well include Vermont in 2012 ($r^2 = 0.29$), with relatively few contested seats and multi-member districts with positions.

We examine the performance of the imputation model in a series of graphs, below, for six sets of elections: Wisconsin in 2012 and 2014, Michigan in 2014

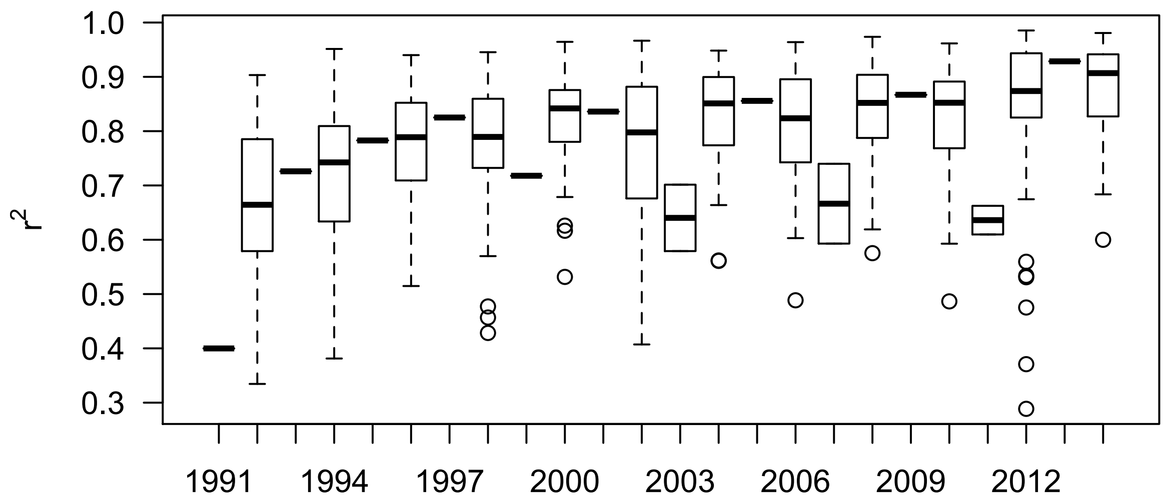

Figure 8: Distribution of r^2 statistics, regressions of Democratic share of two-party vote in state legislative election outcomes on Democratic share of the two-party for president.

(with no uncontested districts), South Carolina in 2012 (with the highest proportion of uncontested seats in the 2012 data), Virginia in 2013 and Wyoming in 2012 (the latter two generating extremely large, negative values of the efficiency gap). Vertical lines indicate 95% confidence intervals around imputed values for the Democratic share of the two-party vote in state legislative elections (vertical axis). Separate slopes and intercepts are fit for each incumbency type. Note also that the imputed data almost always lie on the regression lines.

Imputations for uncontested districts are accompanied by uncertainty. Although the imputation models generally fit well, like any realistic model they provides less than a perfect fit to the data. Note too that in any given election, there is only a finite amount of data and hence a limit to the precision with which we can make inferences about unobserved vote shares based on the relationship between observed vote shares and presidential vote shares.

Uncertainty in the imputations for v in uncontested districts generates uncertainty in "downstream" quantities of interest such as statewide Democratic vote share V and the efficiency gap measure EG. This is key, given the fact that uncontestedness is so pervasive in these data. We want any conclusions about the efficiency gap's properties or inferences about particular levels of the efficiency gap to reflect the uncertainty resulting from imputing vote shares in uncontested districts.

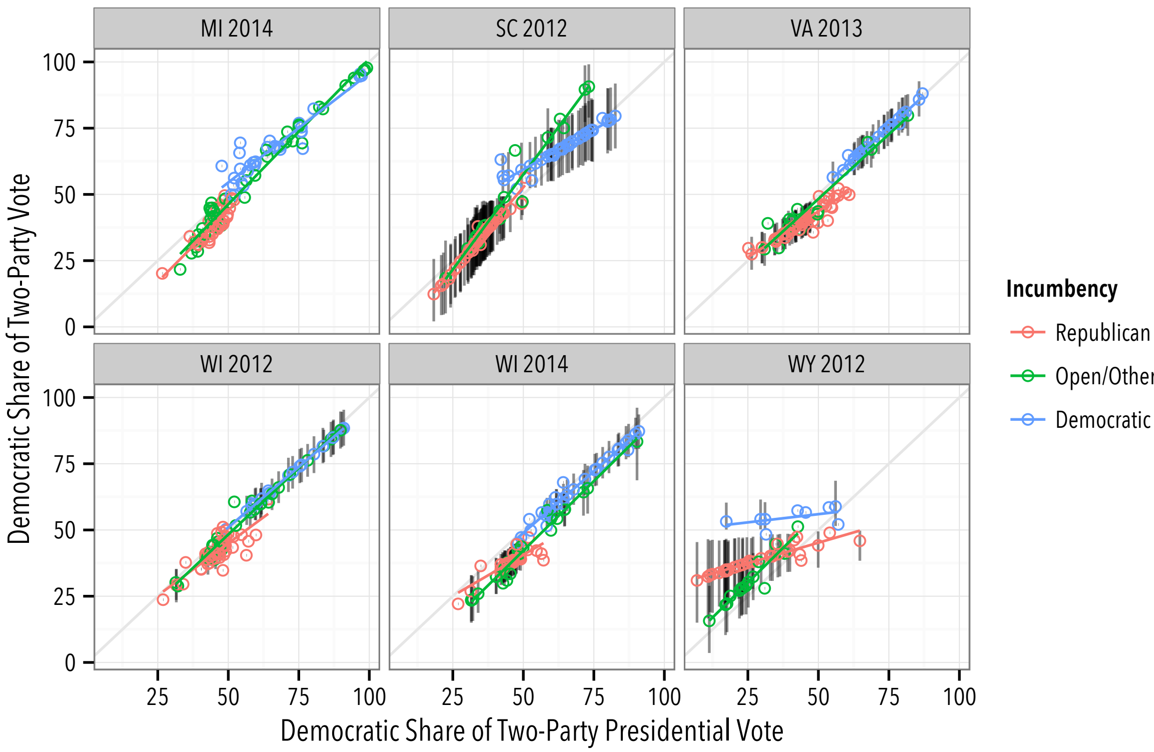

Figure 9: Regression model for imputing unobserved vote shares in 6 selected elections. Vertical lines indicate 95% confidence intervals around imputed values for the Democratic share of the two-party vote in state legislative elections (vertical axis). Separate slopes and intercepts are fit for each incumbency type. Note also that the imputed data almost always lie on the regression lines.

8.2 Imputation model 2

We rely on imputations based on presidential election returns when they are available. But presidential vote isn't always available at the level of state legislative districts (not before 1992, in this analysis). To handle these cases, we rely on a second imputation procedure, one that models sequences of election results observed under a redistricting plan, interpolating unobserved Democratic vote shares given (1) previous and future results for a given district; (2) statewide swing in a given state election; and (3) change in the incumbency status of a given district. This model also embodies the assumption that unobserved vote shares would nonetheless be consistent with what we *did* observe in a given seat: where a Democrat wins in an uncontested district, any imputation for v in that district must lie above 50%, and where a Republican wins an uncontested district, any imputation for v must lie below 50%.

8.3 Combining the two sets of imputations

We now have two sets of imputations for uncontested districts: (1) using presidential vote as a basis for imputation, where available (447 state legislative elections from 1992 to 2014); and (2) the imputation model that relies on the trajectory of district results over the history of a districting plan, including incumbency and estimates of swing, which supplies imputations for uncontested districts in all years.

When there are no uncontested districts, obviously the two imputations must agree, for the trivial reason that are no imputations to perform. As the number of uncontested districts rises, the imputations from the two models have room to diverge. Where the two sets of imputations are available for a given election (elections where presidential vote shares by state legislative districts are available) we generally see a high level of agreement between the two methods.

The two sets of imputations for V correlate at .99. With only a few exceptions (see Figure 10), the discrepancies are generally small relative to the uncertainty in the imputations themselves. As the proportion of districts with missing data increases, clearly the scope for divergence between the two models increases.

To re-iterate, we prefer the imputations from "Model 1" based on the regressions utilizing presidential vote shares in state legislative districts, and use them whenever available (i.e., for most states in the analysis, the period 1992-2014). We only rely on "Model 2" when presidential vote shares are not available. We model the difference between the two sets of imputations, adjusting the "Model 2" imputations of *V* to better match what we have obtained from "Model 1", had the necessary presidential vote shares by state legislative district been available.

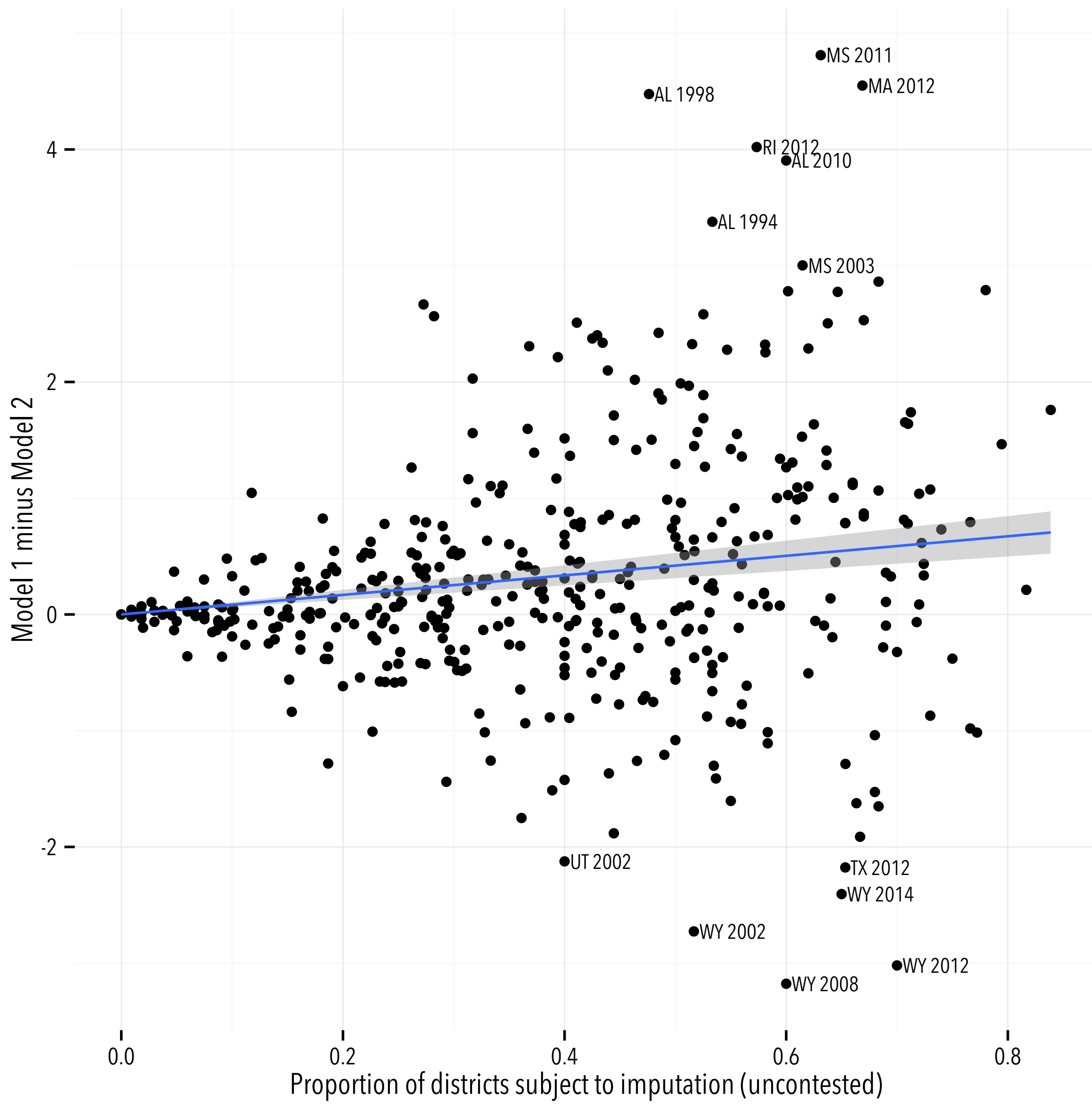

Figure 10: Difference between imputations for V by proportion of uncontested seats. The fitted regression line is constrained to respect the constraint that the imputations must coincide when there are no uncontested seats.

8.4 Seat and vote shares in 786 state legislative elections

After imputations for missing data, each election generates a seats-votes (V, S) pair. In Figure 11 we plot *all* of the V and S combinations over the 786 state elections in the analysis. We also overlay the seats-vote curve corresponding to an efficiency gap of zero. This provides us with a crude, visual sense of how often we see large departures from the zero EG benchmark.

The horizontal lines around each plotted point show the uncertainty associated with each estimate of V (statewide, Democratic, two-party vote share), given the imputations made for uncontested and missing district-level vote shares. Uncontested seats do not generate uncertainty with respect to the party winning the seat, and so the resulting uncertainty is with respect to vote shares, on the horizontal axis in Figure 11.

The efficiency gap in each election is the vertical displacement of each plotted (V, S) point from the orange, zero-efficiency gap line in Figure 11. Uncertainty as to the horizontal co-ordinate V (due to imputations for uncontested races) generates uncertainty in determining how far each point lies above or below the orange, zero efficiency gap benchmark.

9 The efficiency gap, by state and election

We now turn to the centerpiece of the analysis: assessing variation in the efficiency gap across districting plans.

We have 786 efficiency gap measures in 41 states, spanning 43 election years. These are computed by substituting each state election's estimate of V and the corresponding, observed seat share S into equation 1.

Figure 12 shows the efficiency gap estimates for each state election, grouped by state and ordered by year; vertical lines indicate 95% credible intervals arising from the fact that the imputation model for uncontested seats induces uncertainty in V and any quantity depending on V such as EG (recall equation 1). In many cases the uncertainty in EG stemming from imputation for uncontested seats is small relative to variation in EG both between and within districting plans.

We observe considerable variation in the EG estimates across states and elections. Some highlights:

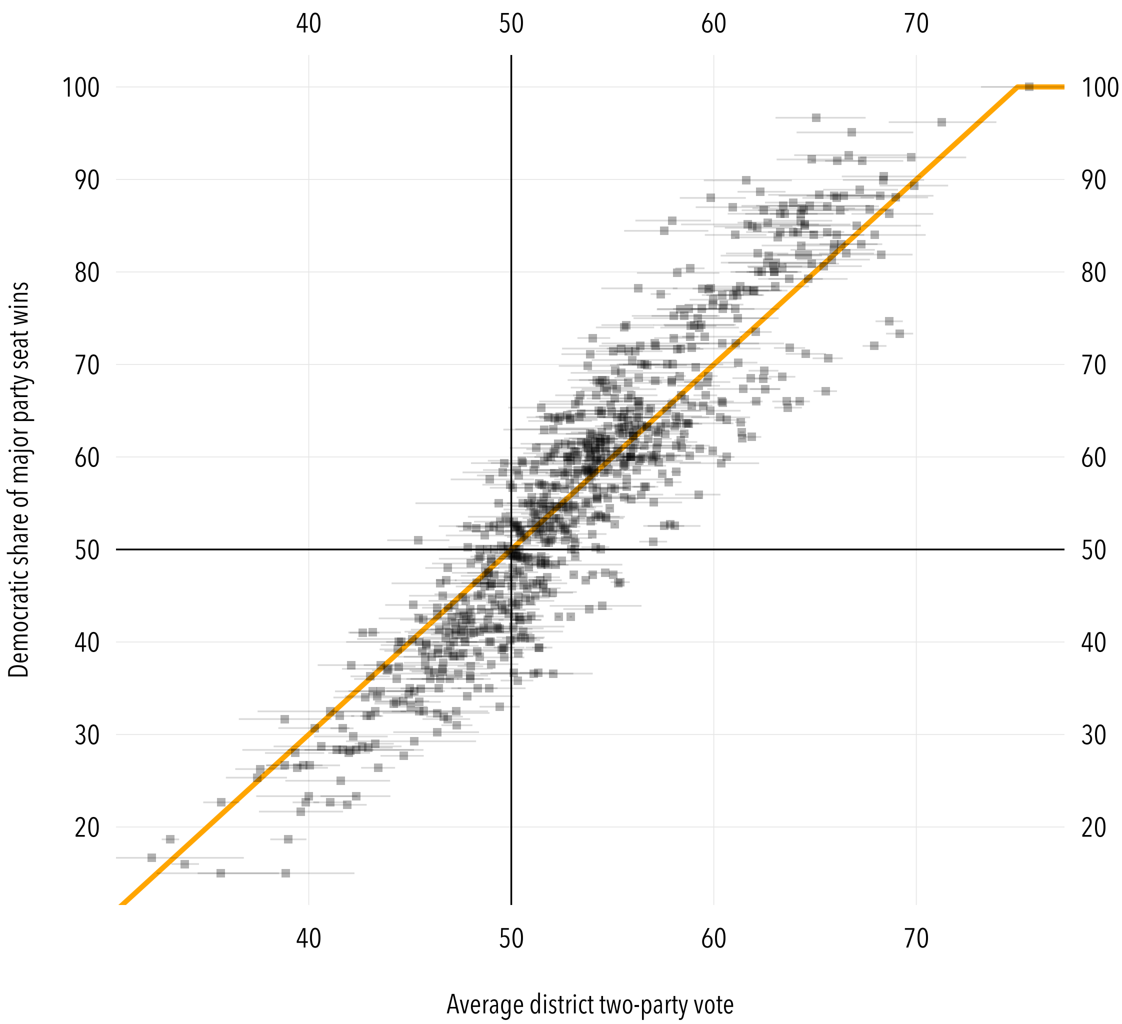

Figure 11: Democratic seat shares (S) and vote shares (V) in 786 state legislative elections, 1972-2014, in 41 states. Seat shares are defined with respect to single-member districts won by either a Republican or a Democratic candidate, including uncontested districts. Vote shares are defined as the average of district-level, Democratic share of the two-party vote, in the same set of districts used in defining seat shares. Horizontal lines indicate 95% credible intervals with respect to V, due to uncertainty arising from imputations for district-level vote shares in uncontested seats. The orange line shows the seats-votes relationship we expect if the efficiency gap were zero. Elections below the orange line have $EG < 0$ (Democratic disadvantage); points above the orange line have $EG > 0$ (Democratic advantage).

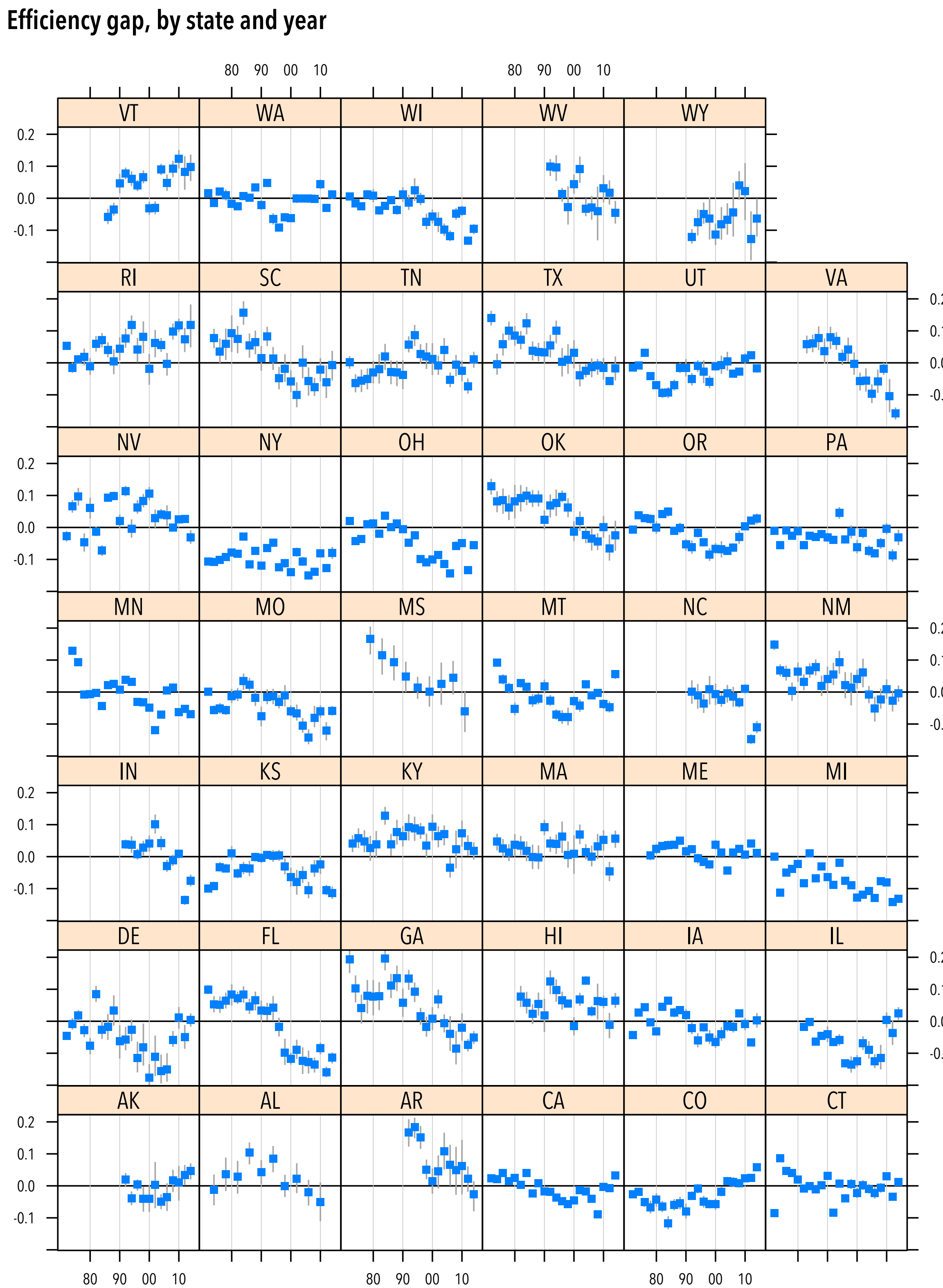

Figure 12: Efficiency gap estimates in 786 state legislative elections, 1972-2014. Vertical lines cover 95% credible intervals.

1. estimates of *EG* range from −0.18 to 0.20 with an average value of −0.005.

2. The lowest value, −0.18 is from Delaware in 2000. There were 19 uncontested seats in the election to the 41 seat state legislature. Democrats won 15 seats ($S = 15/41 = 36.6\%$). I estimate V to be 52.1%. Via equation 1, this generates $EG = -0.18$. Considerable uncertainty accompanies this estimate, given the large number of uncontested seats. The 95% credible interval for V is $\pm$ 2.03 percentage points, and the 95% credible interval for the accompanying *EG* estimate is $\pm$ 0.04.

3. The highest value of *EG* is 0.20 is from Georgia in 1984. There were 140 uncontested seats in the election to the 180 seat state legislature. Democrats won 154 seats ($S = 154/180 = 85.6\%$). I estimate V to be 57.9%. Again, using equation 1, this generates $EG = 0.2$. Considerable uncertainty also accompanies this estimate, given the large number of uncontested seats. The 95% credible interval for V is $\pm$ 1.89 percentage points, and the 95% credible interval for the accompanying *EG* estimate is $\pm$ 0.04. Figure 13 contrasts the seats and votes recorded in Georgia against those for the entire data set, putting Georgia's large *EG* estimates in context.

4. New York has the lowest median *EG* estimates, ranging from -.15 (2006) to -.028 (1984). Statewide V ranges from 53.7% to 69.2%, but Democrats only win 70 (1972) to 112 (2012) seats in the 150 seat state legislature, so S ranges from .47 to .75, considerably below that we'd expect to see given the vote shares recorded by Democrats if the efficiency gap were zero. See Figure 15.

5. Arkansas has the highest median *EG* score by state, .10; see Figure 14.

6. Connecticut has the median, within-state median *EG* score of approximately zero; Figure 16 shows Connecticut's seats and votes have generally stayed close to the $EG = 0$ benchmark.

7. Michigan has the third lowest median *EG* scores by state, surpassed only by New York and Wyoming. Michigan's *EG* scores range from -.14 (2012) to .01 (1984). V ranges from 50.3% to 60.6%, a figure we estimate confidently given low and occasionally even zero levels of uncontested districts

in Michigan state legislative elections. Yet *S* ranges from 42.7% (Democrats won 47 out of 110 seats in 2002, 2010 and 2014) to 63.6% (Democrats won 70 out of 110 seats in 1978). See Figure 17.

8. Wisconsin's *EG* estimates range from -.14 (2012) to .02 (1994). Although the *EG* estimates for WI are not very large relative to other states in other years, Wisconsin has recorded an unbroken run of negative *EG* estimates from 1998 to 2014 and records two very large estimates of the efficiency gap in elections held under its current plan: -.13 (2012) and -.10 (2014). In short, Democrats are underperforming in state legislative elections in Wisconsin, winning fewer seats than a zero efficiency gap benchmark would imply, given, their statewide level of support. See Figure 18.

9.1 Are efficiency gap estimates statistically significant?

Recall that $EG < 0$ means that Democrats are disadvantaged, with relatively more wasted votes than Republicans; conversely $EG > 0$ means that Democrats are the beneficiaries of an efficiency gap, in that Democrats have fewer wasted votes than Republicans. But *EG* does vary from election to election, even with the same districting plan in place and *EG* is almost always not measured perfectly, but is estimated with imputations for uncontested seats.

In Figure 19 we plot the imprecision of each efficiency gap estimate (the half-width of its 95% credible interval) against the estimated *EG* value itself. Points lying inside the cones have *EG* estimates that are small relative to their credible intervals, such that we would not distinguish them from zero at conventional levels of statistical significance. Not all *EG* estimates can be distinguished from zero at conventional levels of statistical significance, nor should they. But many estimates of the *EG are* unambiguously non-zero. Critically, the two most recent Wisconsin *EG* estimates (-.13 in 2012, -.10 in 2014) are clearly non-negative, lying far away from the "cone of ambiguity" shown in Figure 19; the 95% credible interval for the 2012 estimates runs from -.146 to -.121 and from -.113 to -.081 for the 2014 estimate.

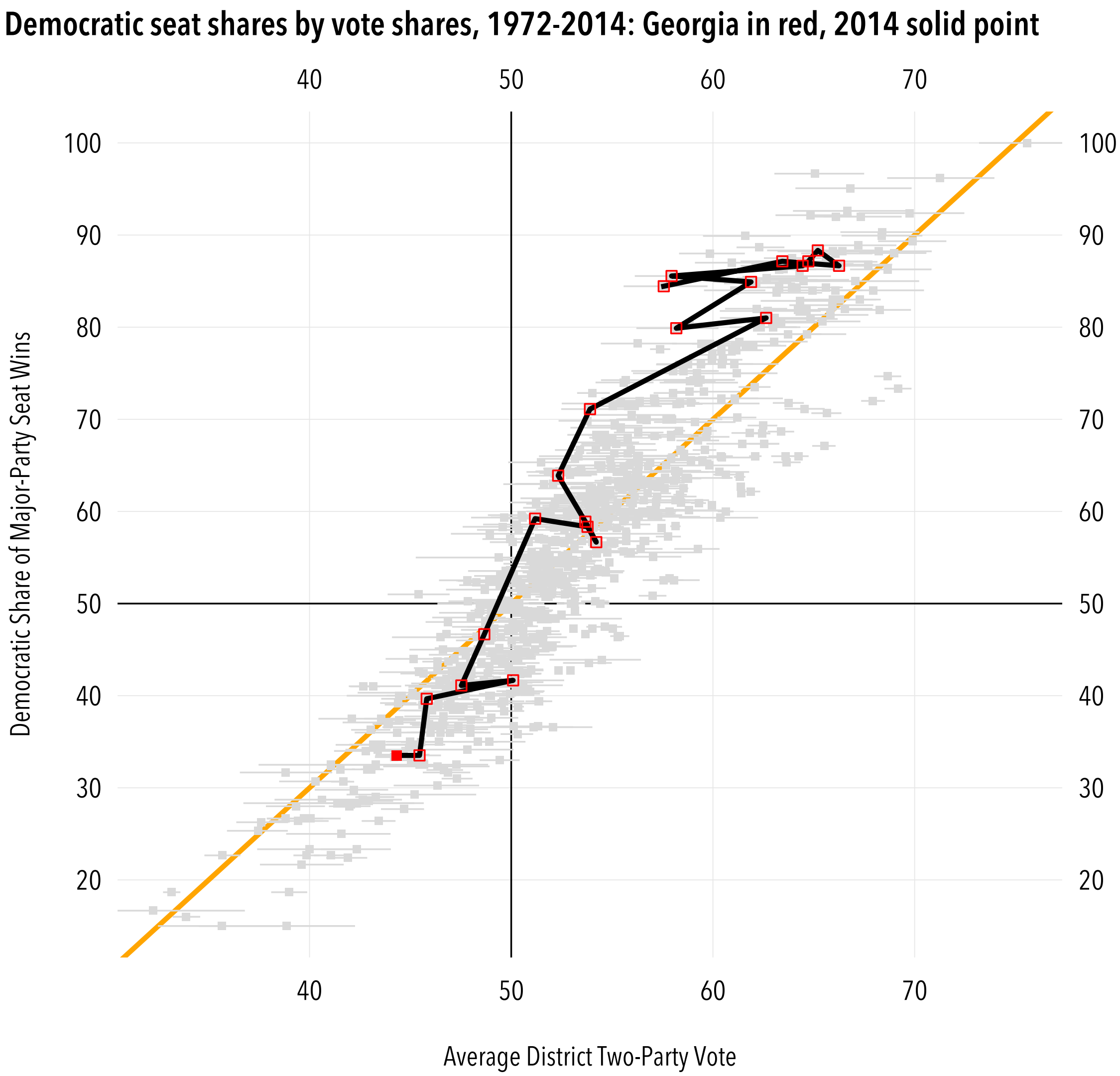

Figure 13: Georgia, Democratic seat share and average district two-party vote share, 1972-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

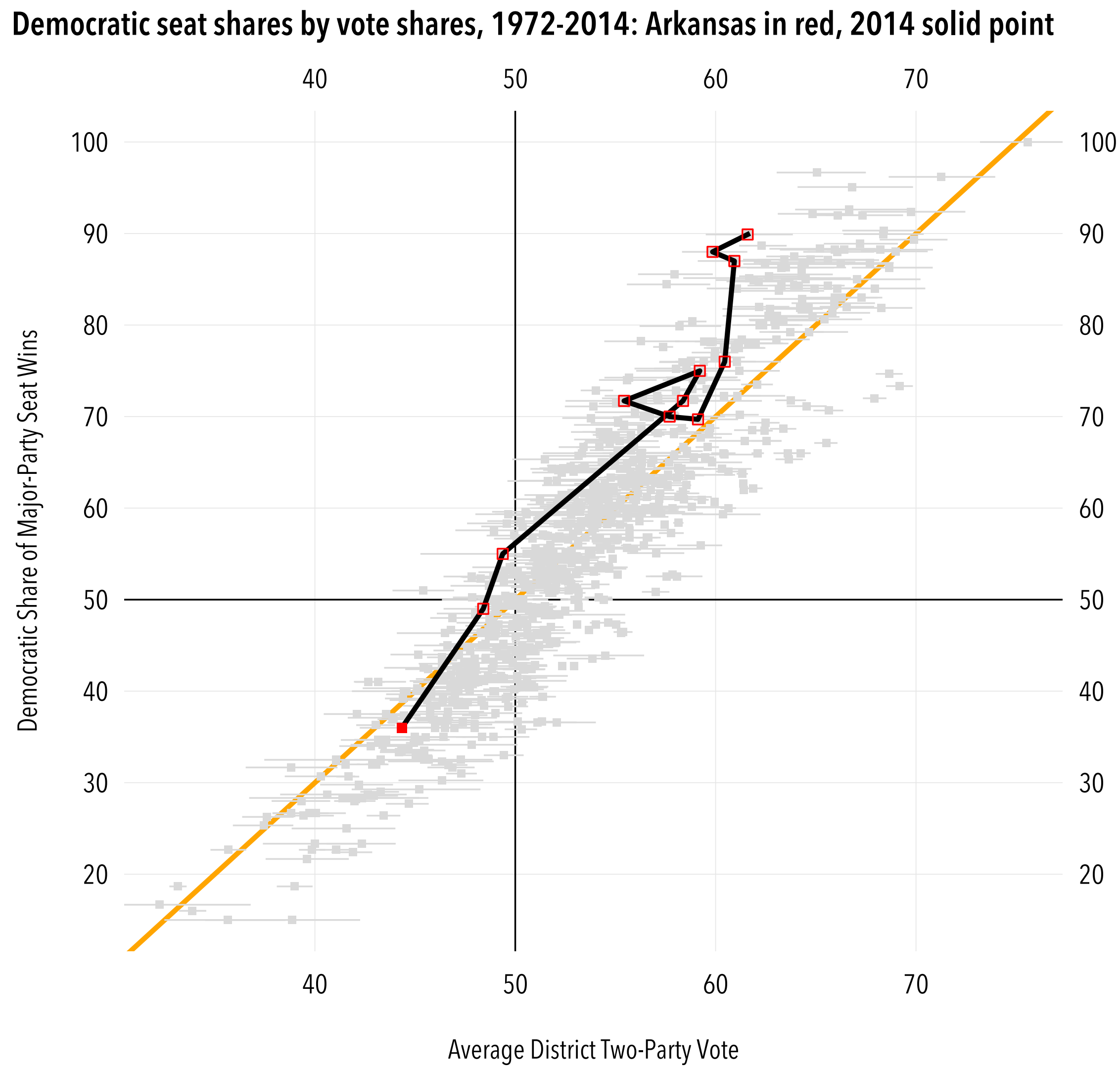

Figure 14: Arkansas, Democratic seat share and average district two-party vote share, 1992-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

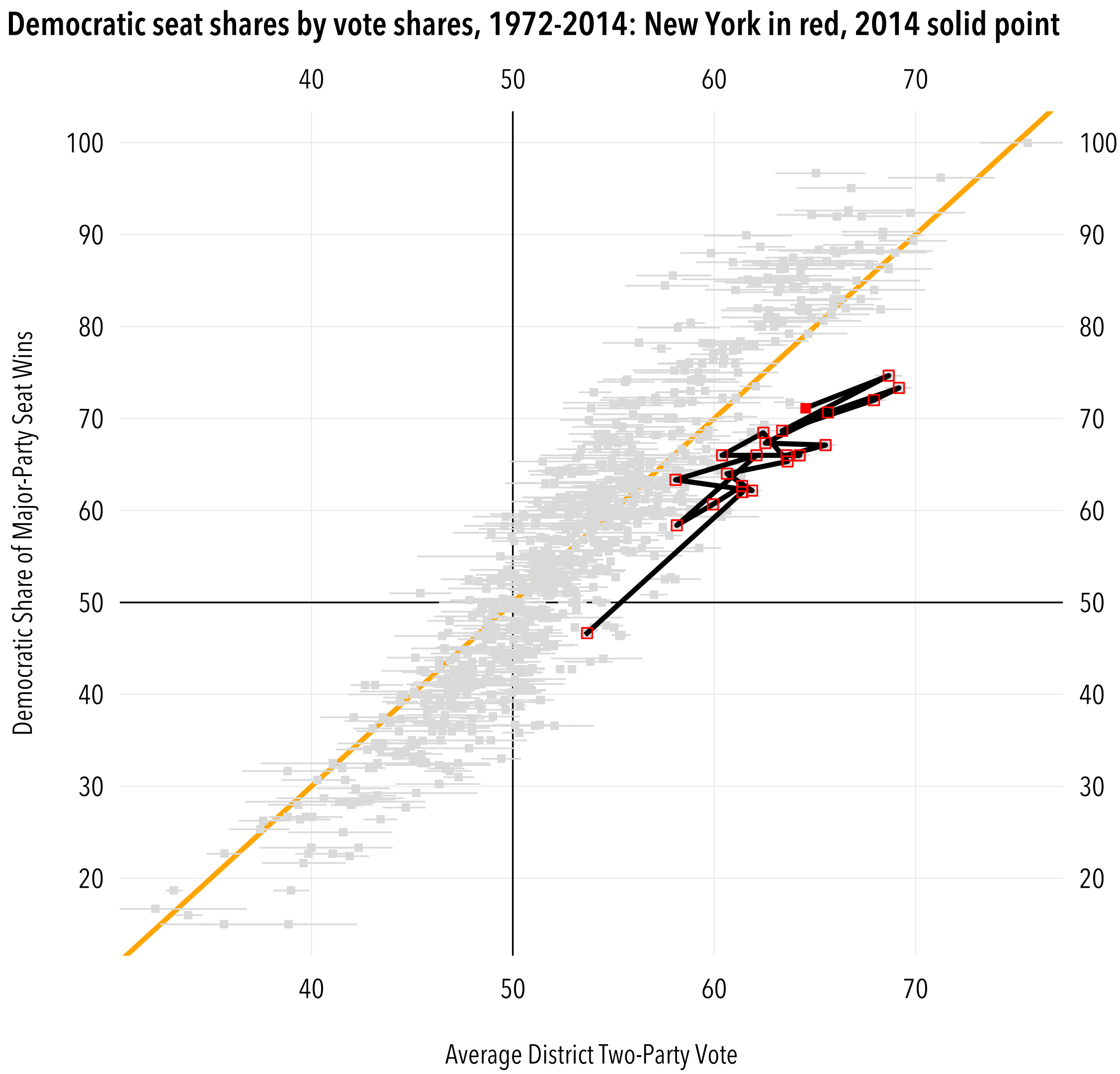

Figure 15: New York, Democratic seat share and average district two-party vote share, 1972-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

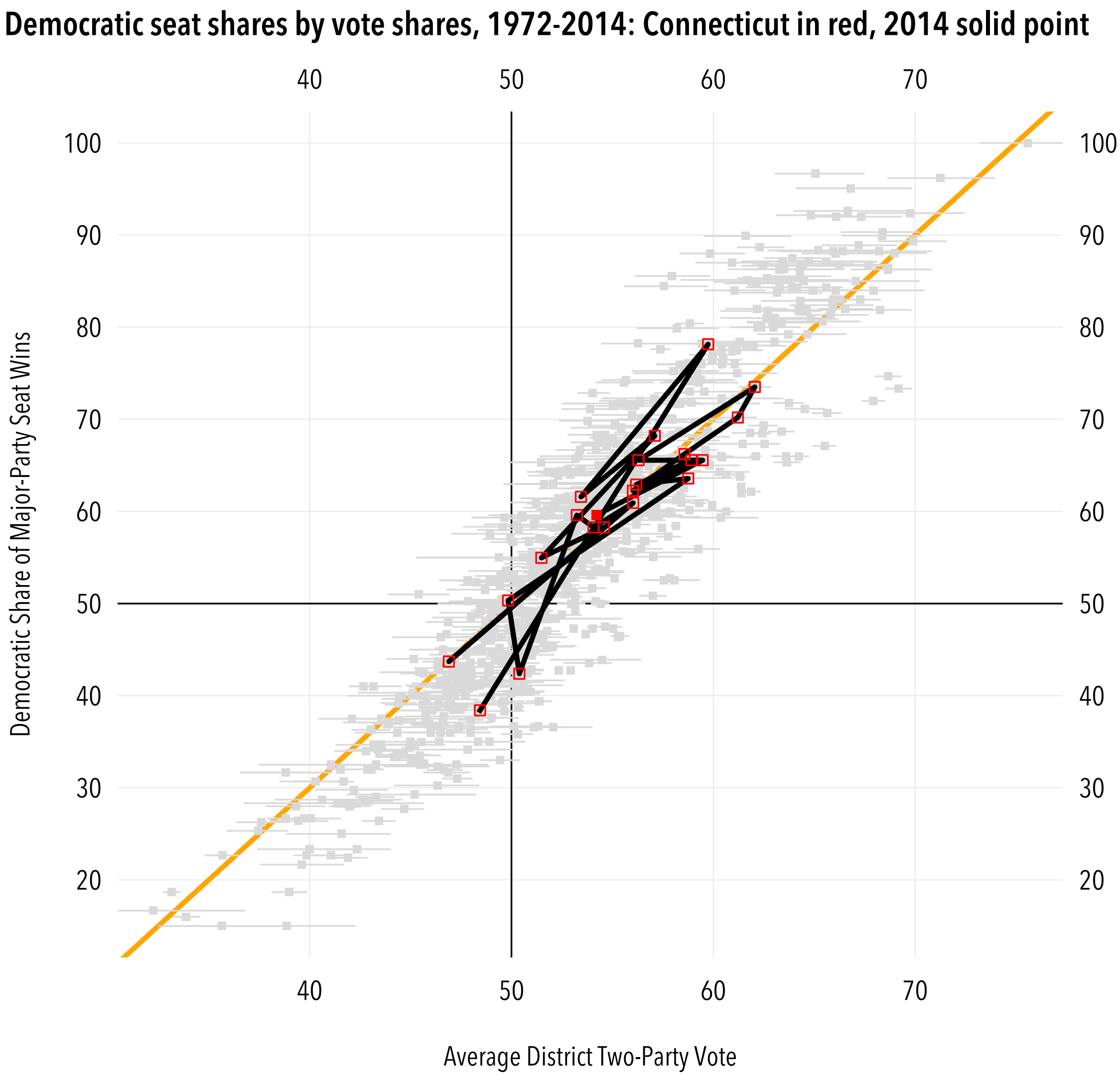

Figure 16: Connecticut, Democratic seat share and average district two-party vote share, 1972-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

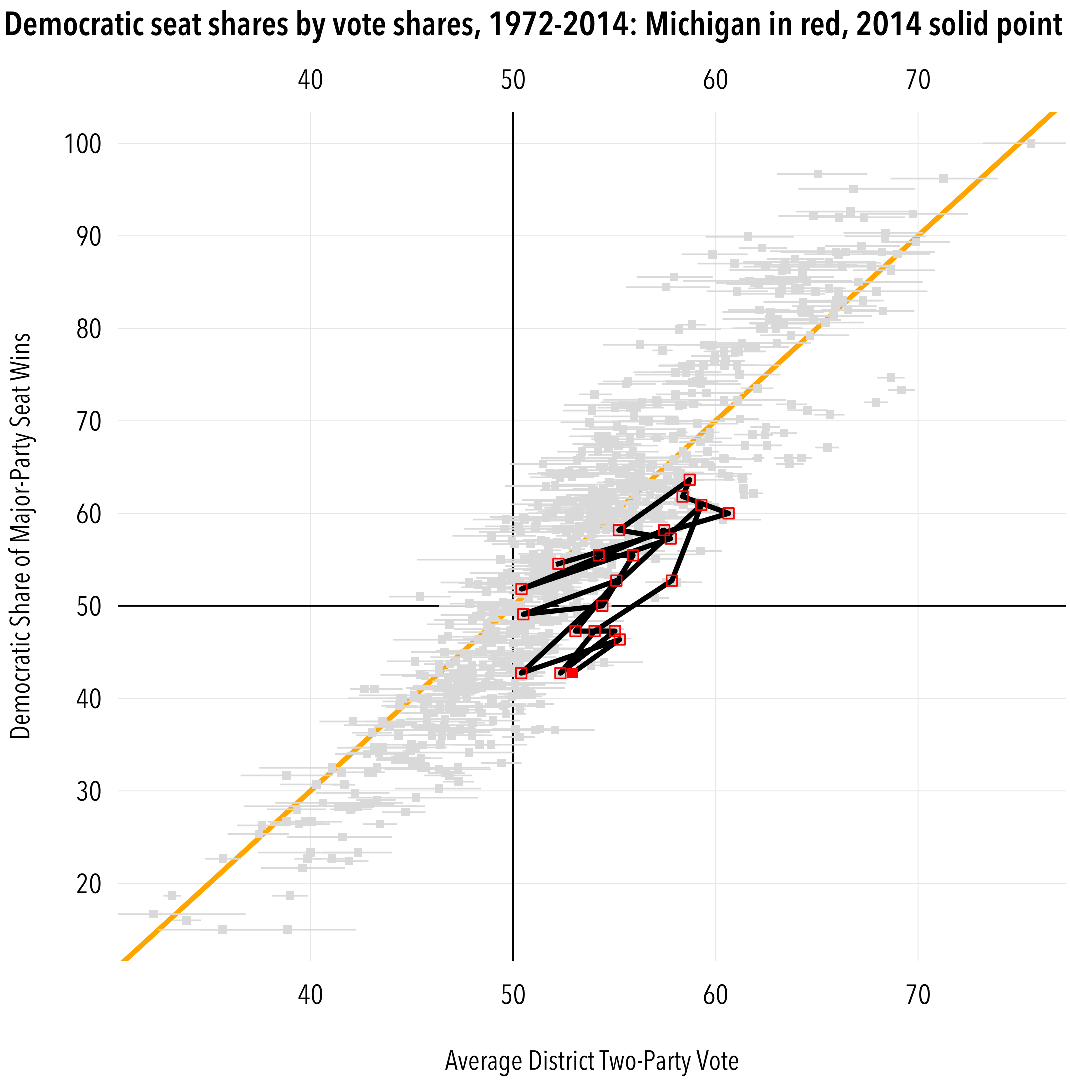

Figure 17: Michigan, Democratic seat share and average district two-party vote share, 1972-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

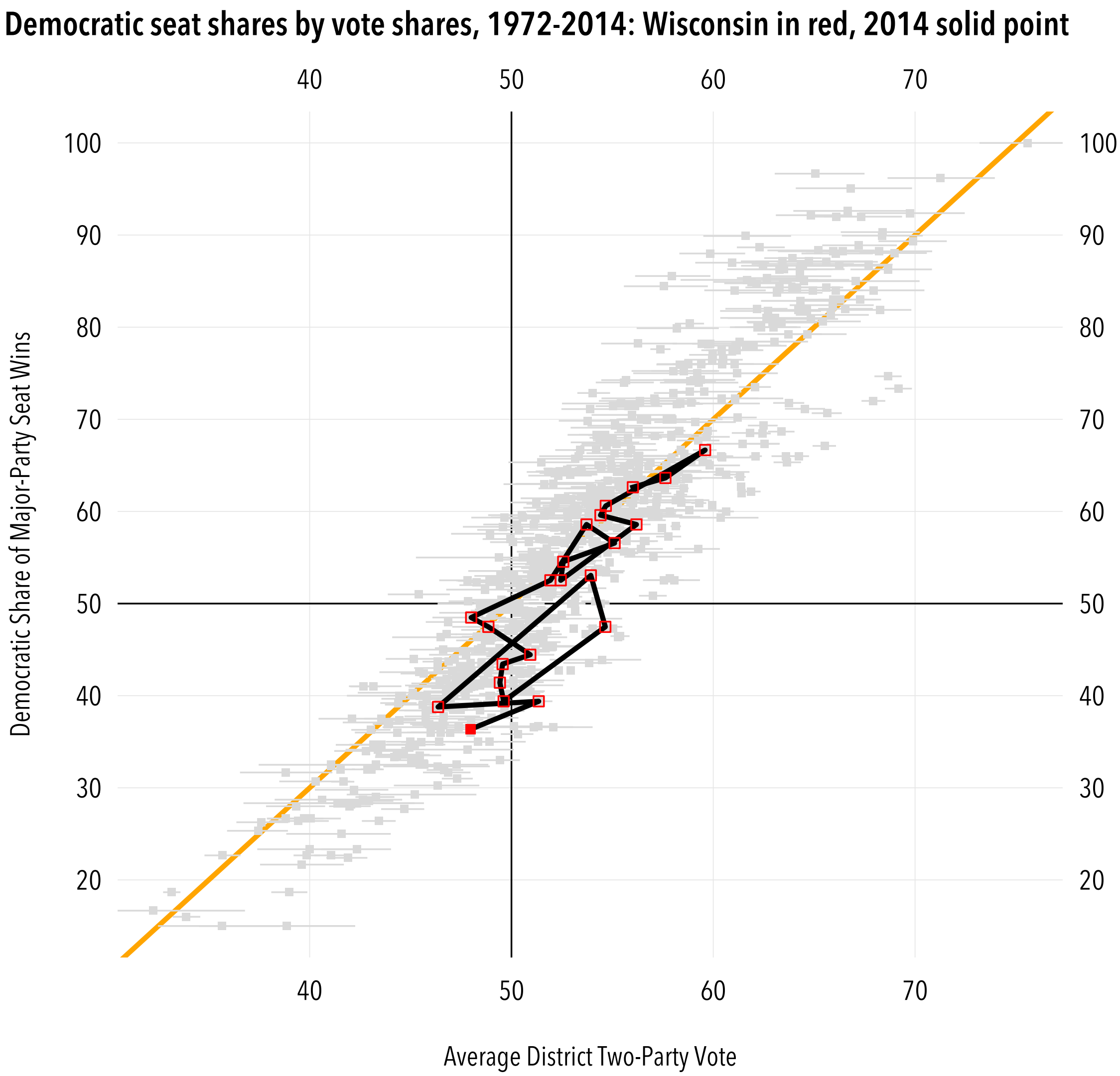

Figure 18: Wisconsin, Democratic seat share and average district two-party vote share, 1972-2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts.

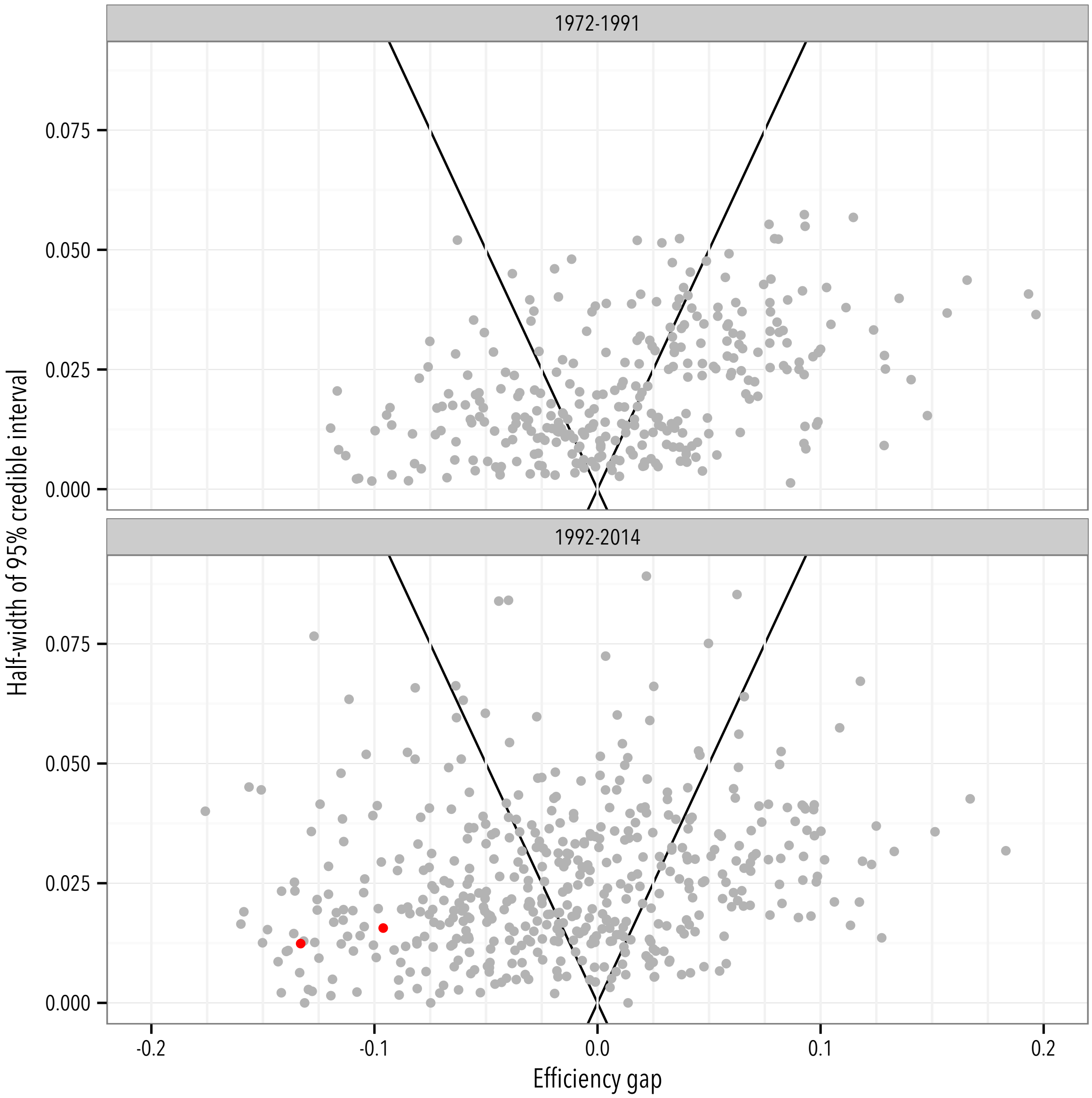

Figure 19: Uncertainty in the efficiency gap, against the *EG* estimate itself. The vertical axis is the half-width of the 95% credible interval for each *EG* estimate (plotted against the horizontal axis); points lying inside the cones have *EG* estimates that are small relative to their credible intervals, such that we would not distinguish them from zero at conventional levels of statistical significance. *EG* estimates from Wisconsin in 2012 and 2014 are shown as red points in the lower panel. Note the greater prevalence of large, negative and precisely estimated *EG* measures in recent decades.

9.2 Over-time change in the efficiency gap

Are large values of the efficiency gap less likely to be observed in recent decades? This is relevant to any discussion of a standard by which to assess redistricting plans. If recent decades have generally seen smaller values of the efficiency gap relative to past decades, then this might be informative as to how we should assess contemporary districting plans and their corresponding values of the *EG*.

Figure 20 plots *EG* estimates over time, overlaying estimates of the smoothed, weighted quantiles (25th, 50th and 75th) of the *EG* measures (the weights capture the uncertainty accompanying each estimate of the *EG*). The distribution of *EG* measures in the 1970s and 1980s appeared to slightly favor Democrats; about two-thirds of all *EG* measures in this period were positive. The distribution of *EG* measures trends in a pro-Republican direction through the 1990s, such that by the 2000s, *EG* measures were more likely to be negative (Republican efficiency advantage over Democrats); see Figure 21.

There is some evidence that the 2010 round of redistricting has generated an increase in the magnitude of the efficiency gap in state legislative elections. For most of the period under study, there seems to be no distinct trend in the magnitudes of the efficiency gap over time; see Figure 22. The median, absolute value of the efficiency gap has stayed around 0.04 over much of the period spanned by this analysis; elections since 2010 are producing higher levels of *EG* in magnitude.

It is also interesting to note that the estimate of the 75th percentile of the distribution of *EG* magnitudes jumps markedly after 2010, suggesting that districting plans enacted after the 2010 census are systematically more gerrymandered than in previous decades. Of the almost 800 *EG* estimates in the analysis, spanning 42 years of elections, the largest, negative estimates (an efficiency gap disadvantaging Democrats) are more likely to be recorded in the short series of elections after 2010. These include Alabama in 2014 (-.18), Florida in 2012 (-.16), Virginia in 2013 (-.16), North Carolina in 2012 (-.15) and Michigan in 2012 (-.14); these five elections are among the 10 least favorable to Democrats we observe in the entire set of elections. Among the 10 most pro-Democratic *EG* scores, *none* were recorded after 2000. The most favorable election to Democrats in terms of *EG* since 2010 is the 2014 election in Rhode Island (*EG* = .12), which is only the 20th largest (pro-Democratic) *EG* in the entire analysis.

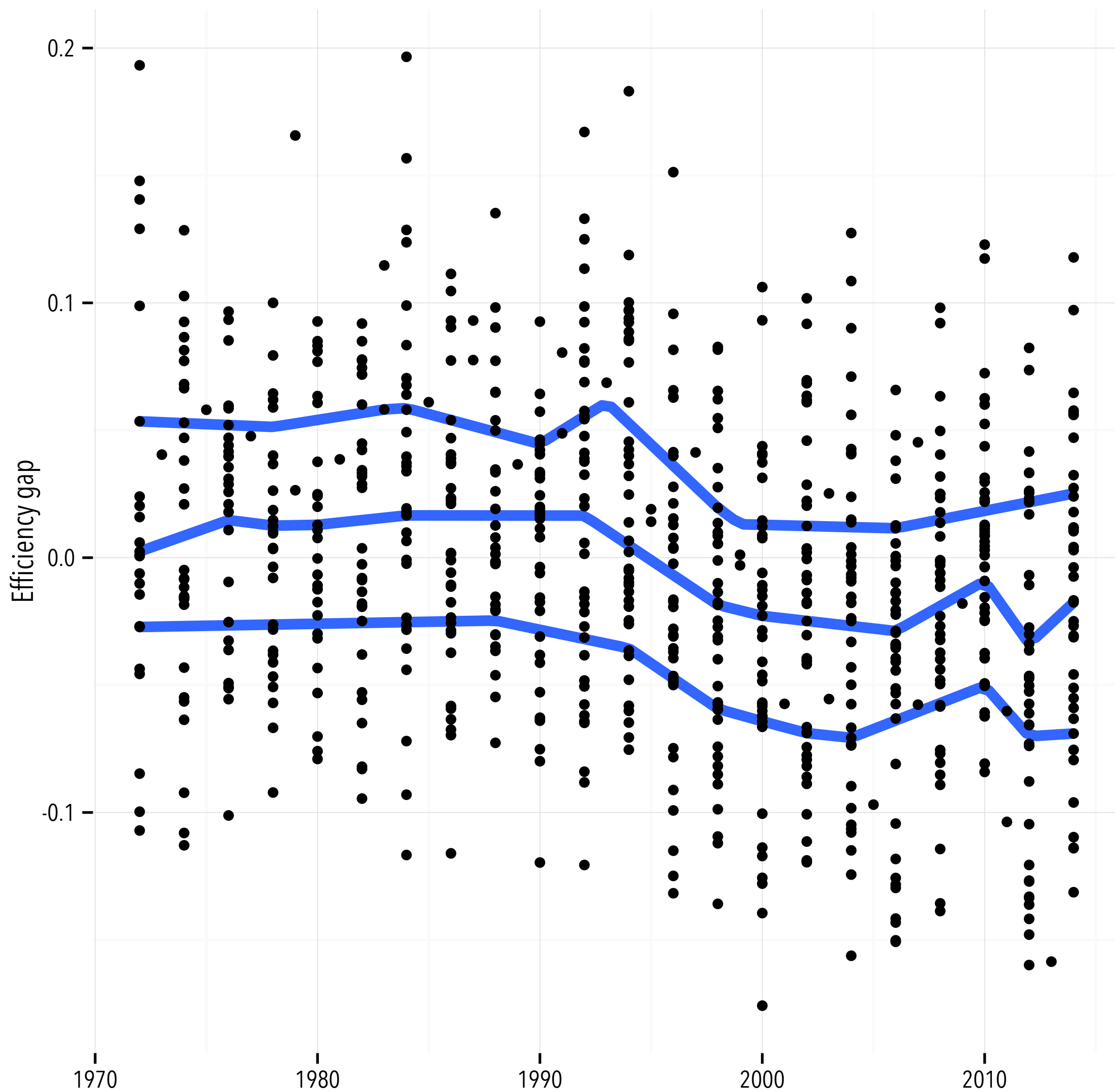

Figure 20: Efficiency gap estimates, over time. The lines are smoothed estimates of the 25th, 50th and 75th quantiles of the efficiency gap measures, weighted by the precision of each *EG* measure.

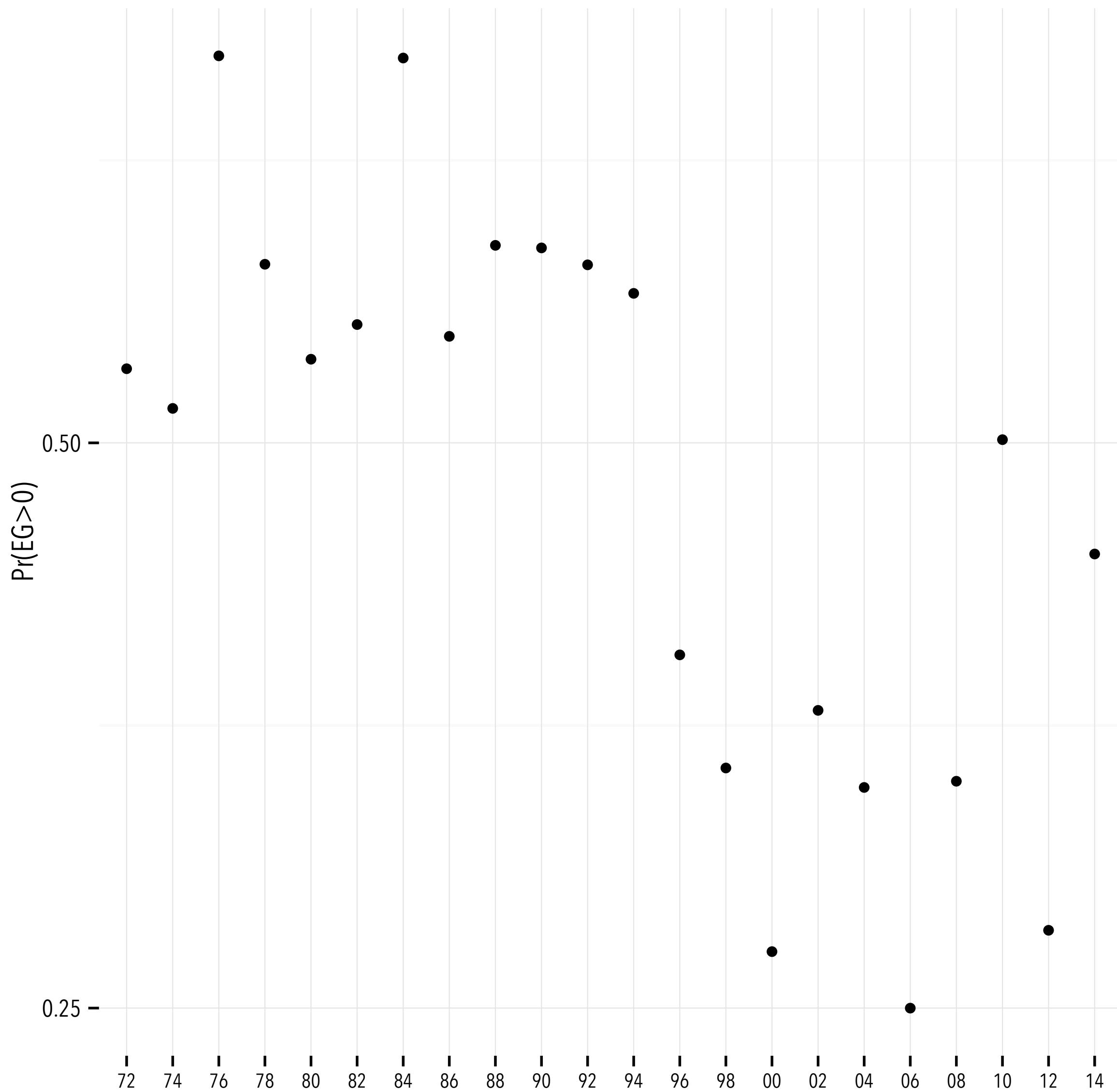

Figure 21: Proportion of efficiency gap measures that are positive, by two year intervals.

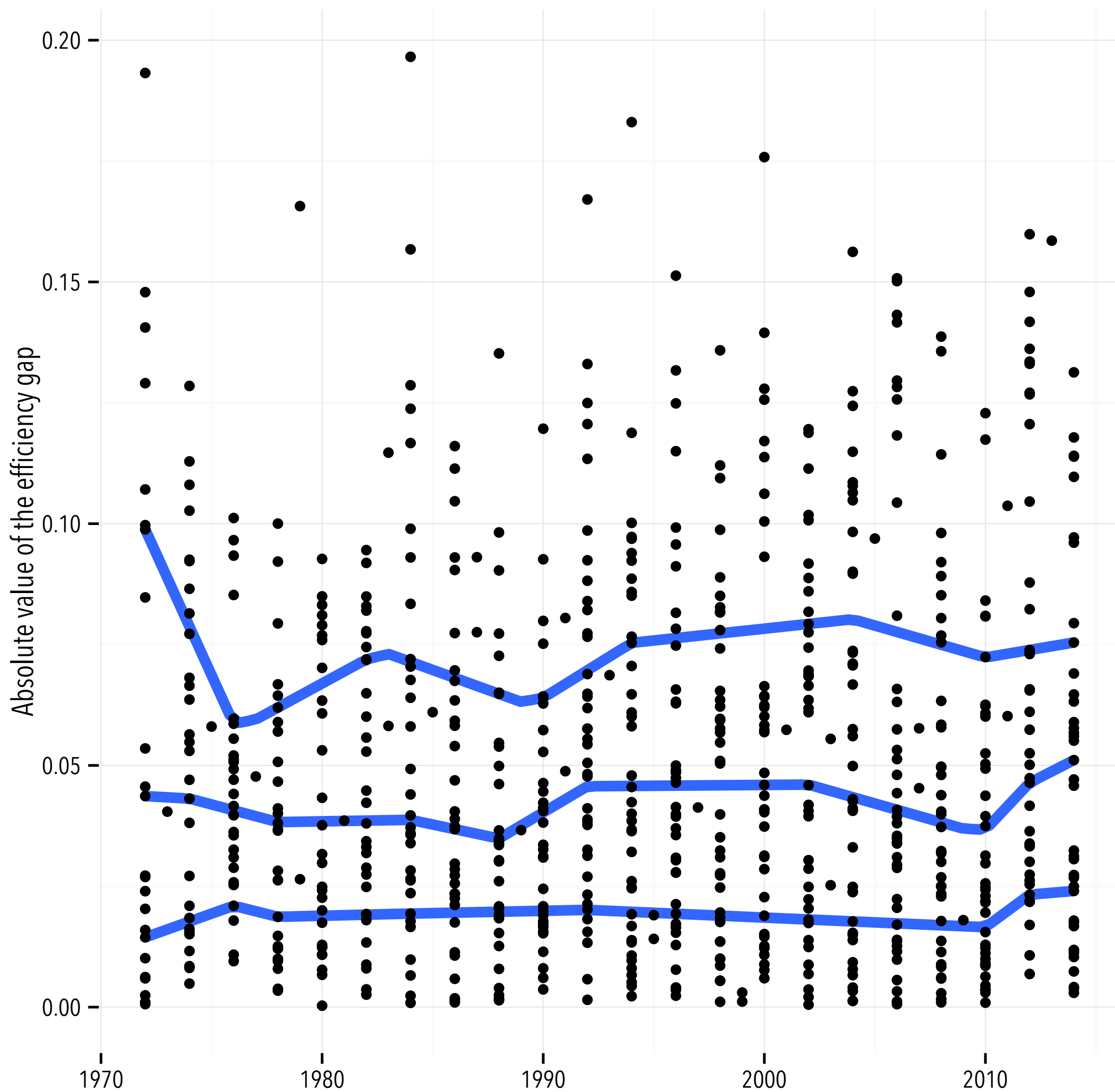

Figure 22: Absolute value of efficiency gap measures, over time. The lines are smoothed estimates of the 25th, 50th and 75th quantiles of the absolute value of the efficiency gap measure, weighted by the precision of each *EG* measure.

9.3 Within-plan variation in the efficiency gap

The efficiency gap is measured at each election, with a given districting plan typically generating up to five elections and hence five efficiency gap measures. Efficiency gap measures will change from election to election as the distribution of district-level vote shares varies over elections. Some of this variation is to be expected. Even with the same districting plan in place, districts will display "demographic drift," gradually changing the political complexion of those districts. Incumbents lose, retire or die in office; sometimes incumbents face major opposition, sometimes they don't. Variation in turnout — most prominently, from on-year to off-year — will also cause the distribution of vote shares to vary from election to election, even with the districting plan unchanged. All these election-specific factors will contribute to election-to-election variation in the efficiency gap.

Precisely because we expect a reasonable degree of election-to-election variation in the efficiency gap, we assess the magnitude of this "within-plan" variability in the measure. If a plan is a partisan gerrymander — with a systematic advantage for one party over the other — then the "between-plan" variation in *EG* should be relatively large relative to the "within-plan" variation in *EG*.

About 76% of the variation in the *EG* estimates is between-plan variation. The *EG* measure does vary election-to-election, but there is a moderate to strong "plan-specific" component to variation in the *EG* scores. We conclude that the efficiency gap *is* measuring an enduring feature of a districting plan.

We examine some particular districting plans. The 786 elections in this analysis span 150 districting plans. For plans with more than one election, we compute the standard deviation of the sequence of election-specific *EG* measures observed under the plan. These standard deviations range from .011 (Kentucky's plan in place for just two elections in 1992 and 1994, or Indiana's plan 1992-2000) to .079 (Delaware's plan between 2002 and 2010).

A highly variable plan: Deleware 2002-2010. Figure 23 shows the seats, votes and *EG* estimates produced under the Delaware 2002-2010 plan. This is among the most variable plans we observe with respect to the *EG* measure. An efficiency gap running against the Democrats for 2002, 2004 and 2006 (the latter election saw Democrats win only 18 seats out of 41 with 54.5% of the state wide vote) falls to a small gap in 2008 ($V = 0.584, S = 25/41 = .61, EG = -0.058$) and

Delaware ends the decade with a positive efficiency gap in 2010. The Democratic district-average two-party vote share fell to $V = 0.561$ in 2010, but translated into $S = 26/41 = .63, EG = 0.012$.

A plan with moderate variability in the EG. The median, within-plan standard deviation of the EG is about .03. This roughly corresponds to the within-plan standard deviation of the EG observed under the plan in place for five Wisconsin state legislative elections 1992-2000, presented in Figure 24. This was a plan that generated relatively small values of EG that alternated sign over the life of the plan: negative in 1992, positive in 1994 and 1996, and negative in 1998 and 2000.

A low variance plan, Indiana 1992-2000. See Figure 25. The EG measures recorded under this plan are all relatively small and positive, ranging from 0.008 to 0.041 and correspond to an interesting period in Indiana state politics. Democrats won 55 of the 100 seats in the Indiana state house in the 1992 election with what I estimate to be just over 50% of the district-average vote (29 of 100 seats were uncontested). Democratic vote share fell to about 45% in the 1994 election (38 uncontested seats), and Democrats lost control of the legislature. The 1996 election resulted in a 50-50 split in the legislature. Democrats won legislative majorities in the 1998 and 2000 elections, while the last election might have been won by Democrats with just less than 50% of the district-vote; I estimate $V = 0.495 \pm .012$ and $EG = 0.041$.

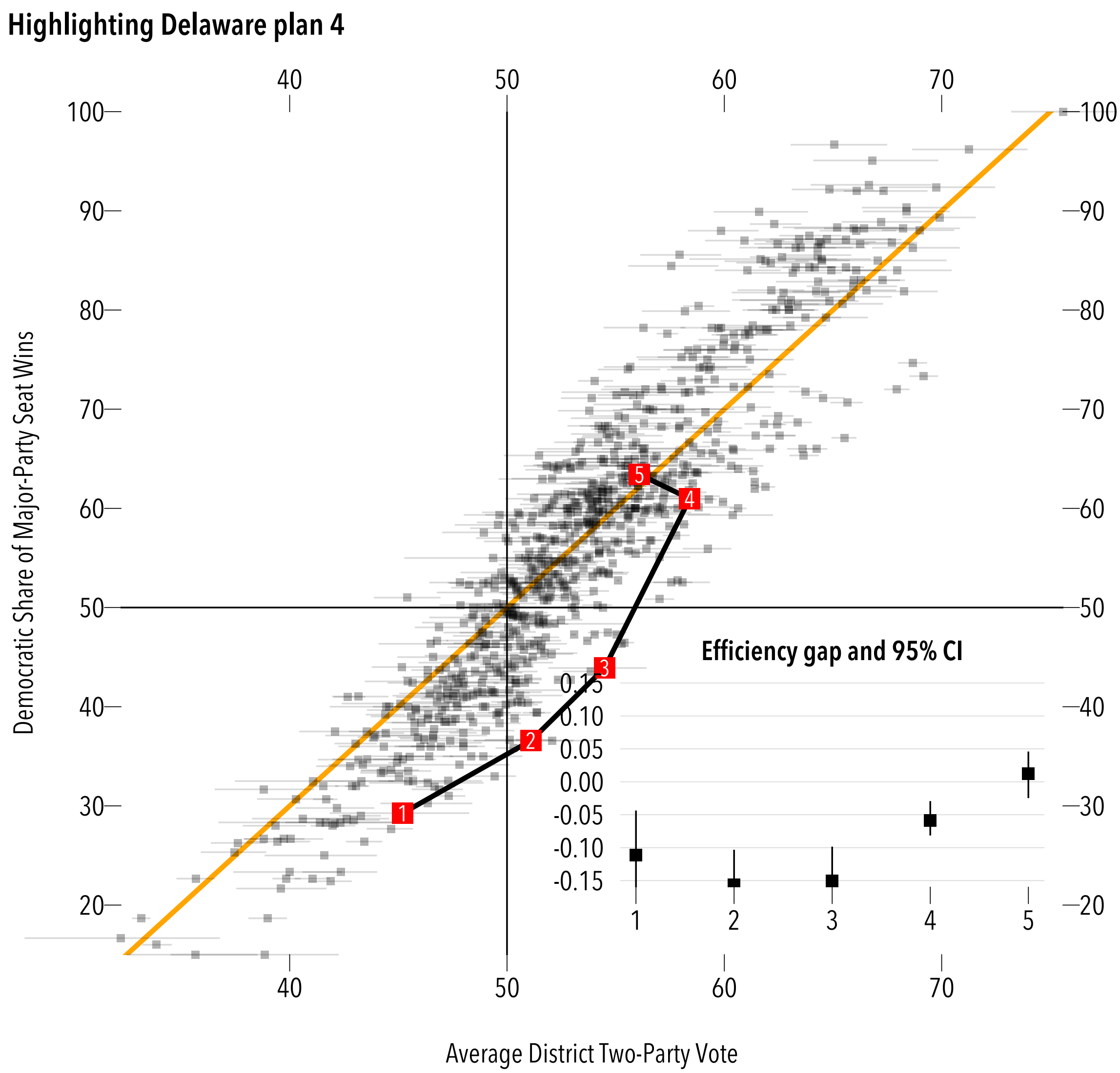

Figure 23: Seats, votes and the efficiency gap recorded under the Delaware plan, 2002-2010. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts. The inset in the lower right shows the sequence of efficiency gap measures recorded under the plan; vertical lines are 95% credible intervals.

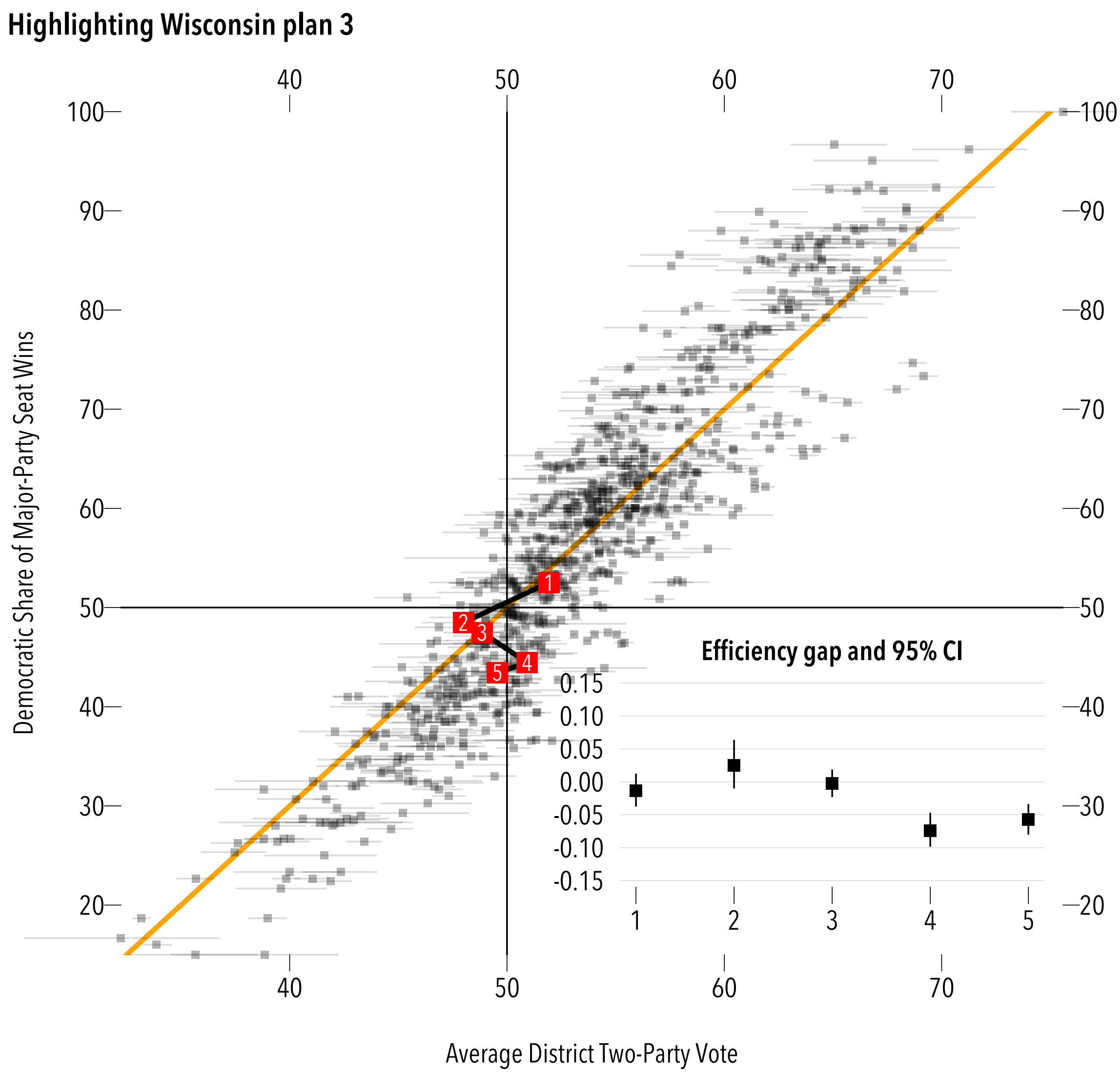

Figure 24: Seats, votes and the efficiency gap recorded under the Wisconsin plan, 1992-2000. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts. The inset in the lower right shows the sequence of efficiency gap measures recorded under the plan; vertical lines are 95% credible intervals.

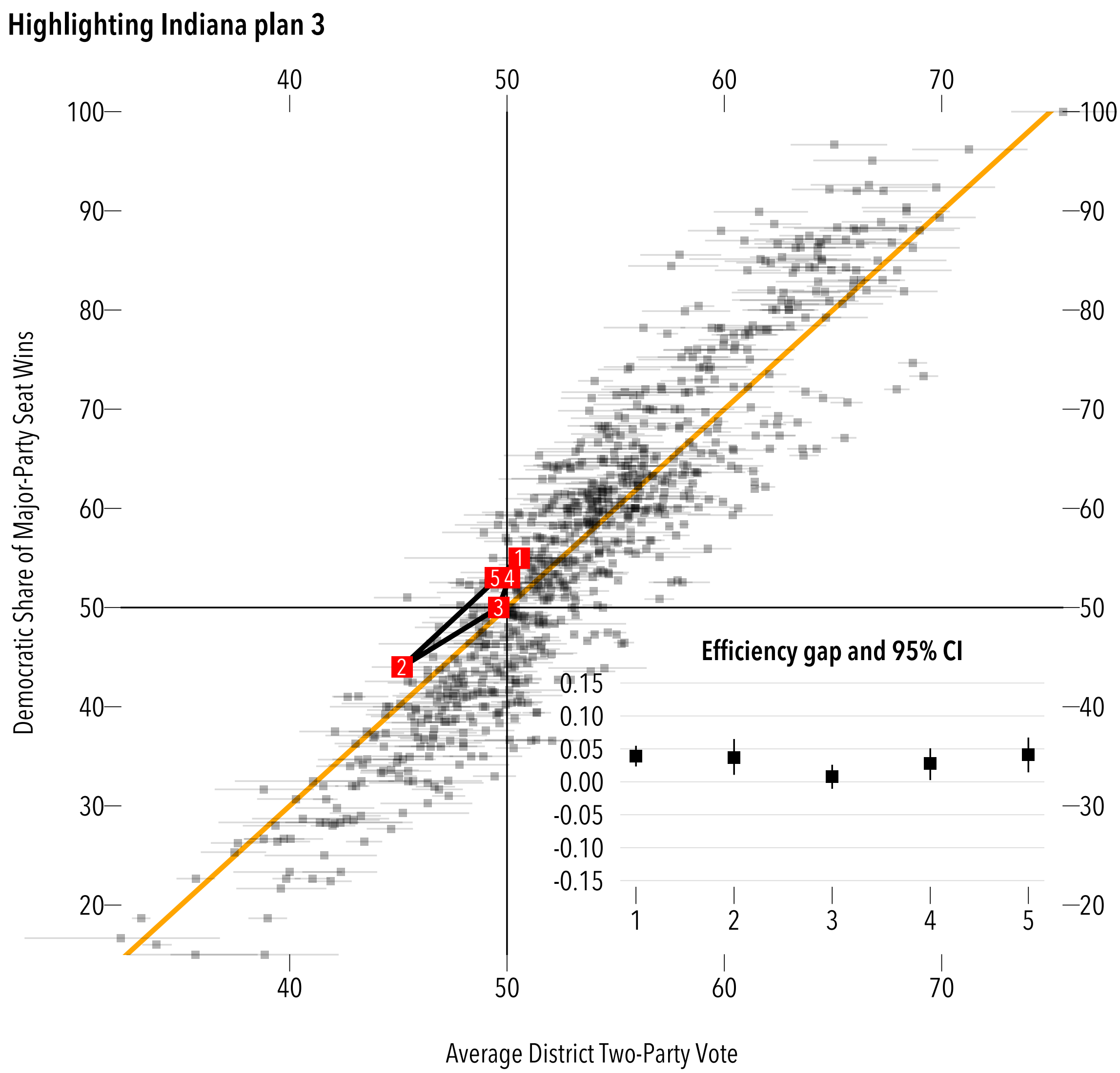

Figure 25: Seats, votes and the efficiency gap recorded under the Indiana plan, 1992-2000. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts. The inset in the lower right shows the sequence of efficiency gap measures recorded under the plan; vertical lines are 95% credible intervals.

9.4 How often does the efficiency gap change sign?

Having observed a particular value of *EG*, how confident are we that:

- the *EG* measure is distinguishable from zero at conventional levels of statistical significance? That is, how sure are we as to the sign of any particular *EG* estimate? We addressed this question in section 9.1.
- it will be followed by one or more estimates of *EG* that are of the same sign?
- over the life of a districting plan, *EG* remains on one side of zero or the other?

The latter two questions are key. It is especially important that we assess the *durability* of the sign of the *EG* measure under a districting plan, if we seek to assert that a districting plan is a partisan gerrymander. We will see that *magnitude* and *durability* of the efficiency gap go together: *large* values of the efficiency gap don't seem to be capricious, but likely to be repeated over the life of a districting plan, consistent with partisan disadvantage being a systematic feature of the plan.

We begin this part of the analysis by considering temporally adjacent *pairs* of *EG* estimates. Can we be confident that these have the same sign? In general, yes. Of the full set of 786 elections for which we compute an efficiency gap estimate, 580 are temporally adjacent, within state and districting plan. Figure 26 shows that we usually see efficiency gap measures with the same sign; this probability exceeds 90% for almost half of the temporally adjacent pairs of efficiency gap measures. Averaged over all pairs, this "same sign" probability is 74%. While the efficiency gap does vary election to election, these fluctuations are not so large that the *sign* of the efficiency gap is likely to change election to election.

What about over the life of an entire redistricting plan? How likely is it that the efficiency gap retains the same sign over, say, three to five elections in a given state, taking into account election-to-election variation *and* uncertainty arising from the imputation procedures used for uncontested districts?

We have 141 plans that supply three or more elections with estimate of the efficiency gap. Of these, 17 plans are *utterly unambiguous* with respect to the sign of the efficiency gap estimates recorded over the life of the plan: for each of these plans we estimate the probability that the *EG* has the same sign over the life of the plan to be 100%. These plans are listed below in Table 1.

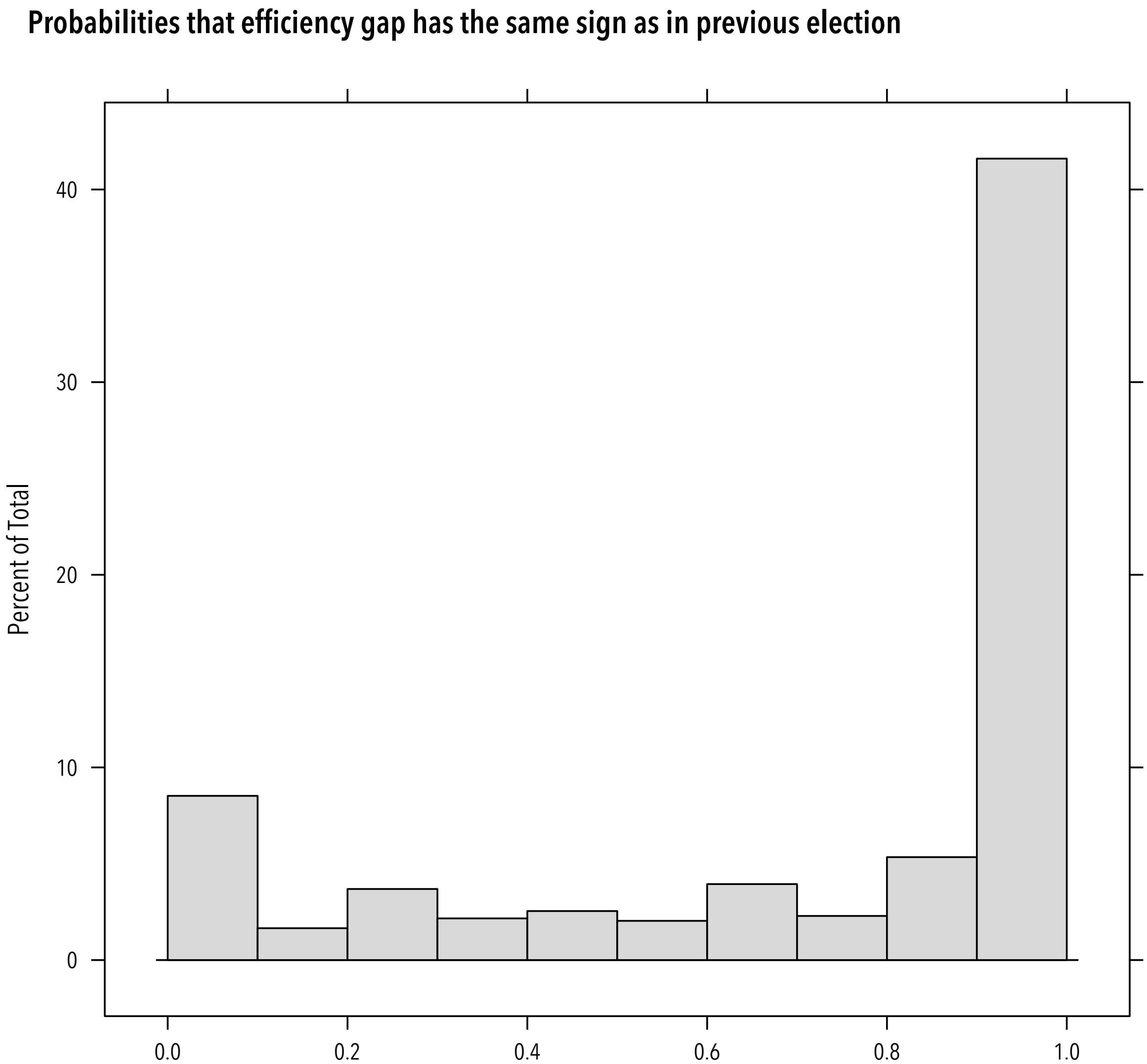

Figure 26: Stability in 580 successive pairs of efficiency gap measures

State	Plan	Start	End	EG avg	EG min	EG max
Florida	4	2002	2010	-0.112	-0.136	-0.084
New York	4	2002	2010	-0.111	-0.150	-0.078
Illinois	3	1992	2000	-0.103	-0.136	-0.058
Michigan	4	2002	2010	-0.103	-0.130	-0.077
New York	3	1992	2000	-0.098	-0.139	-0.048
New York	1	1972	1980	-0.097	-0.108	-0.079
Missouri	4	2002	2010	-0.091	-0.142	-0.061
Ohio	4	2002	2010	-0.090	-0.143	-0.049
New York	2	1982	1990	-0.084	-0.120	-0.028
Ohio	3	1994	2000	-0.083	-0.109	-0.025
Michigan	3	1992	2000	-0.080	-0.128	-0.019
Wisconsin	4	2002	2010	-0.076	-0.118	-0.039
Colorado	2	1982	1990	-0.075	-0.117	-0.055
Colorado	1	1972	1980	-0.041	-0.067	-0.018
California	3	1992	2000	-0.041	-0.057	-0.018
Pennsylvania	2	1982	1990	-0.033	-0.056	-0.020
Florida	1	1972	1980	0.070	0.052	0.099

Table 1: Plans with no doubt as to the sign of the efficiency gap over the life of the plan (3+ elections).

Interestingly, these plans with an utterly unambiguous history of one-sided *EG* measures are almost all plans with efficiency gaps that are disadvantagous to Democrats. Michigan's 2002-2010 plan is on this list, as is the plan in place in Wisconsin 2002-2010 (average *EG* of -.076).

We examine this probability of "3+ consecutive *EG* measures with the same sign" for all of the plans with 3 or more elections in this analysis. 35% of 141 plans with 3 or more elections have at least a 95% probability of recording plans with *EG* measures with the same sign. If we relax this threshold to 75%, then 46% of plans with 3 or more elections exhibit *EG* measures with the same sign. Again, there is a reasonable amount of within-plan movement in *EG*, but in a large proportion of plans the efficiency gap appears to be a stable attribute of the plan.

10 A threshold for the efficiency gap

We now turn to the question of what might determine a threshold for determining if the *EG* is a *large and enduring* characteristic of a plan. We pose the problem as follows:

> for a given threshold $EG^* > 0$, what is the probability that having observed a value of $EG \geq EG^*$ we then see $EG < 0$ in the remainder of the plan?

To answer this we compute

- if (and optionally, when) a plan has $EG \geq EG^*$;
- conditional on seeing $EG \geq EG^*$, do we also observe $EG < 0$ (a sign flip) in the same districting plan?

For $EG < 0$, the computations are reversed: conditional on seeing $EG < EG^*$, do we also see $EG > 0$ under the same plan?

Figure 27 displays two proportions, plotted against a series of potential thresholds on the horizontal axis. The two plotted proportions are:

- the proportion of plans in which we observe an *EG* more extreme than the specified threshold EG^* (on the horizontal axis);
- among the plans that trip the specified threshold, the proportion in which we see a *EG* in the same plan with a different sign to EG^*.

Plans with at least one election with $|EG| > .07$ are reasonably common: over the entire set of plans analyzed here — and again, with the uncertainty in *EG* estimates taken into account — there is about a 20% chance that a plan will have at least one election with $|EG| < .07$.

Observing $EG > .07$ is not a particularly informative signal with respect to the other elections in the plan. Conditional on observing an election with $EG > .07$ (an efficency gap favoring Democrats), there is an a 45% chance that *under the same plan* we will observe $EG < 0$. That is, making an inference about a plan on the basis of one election with $EG > .07$ would be quite risky. Estimates

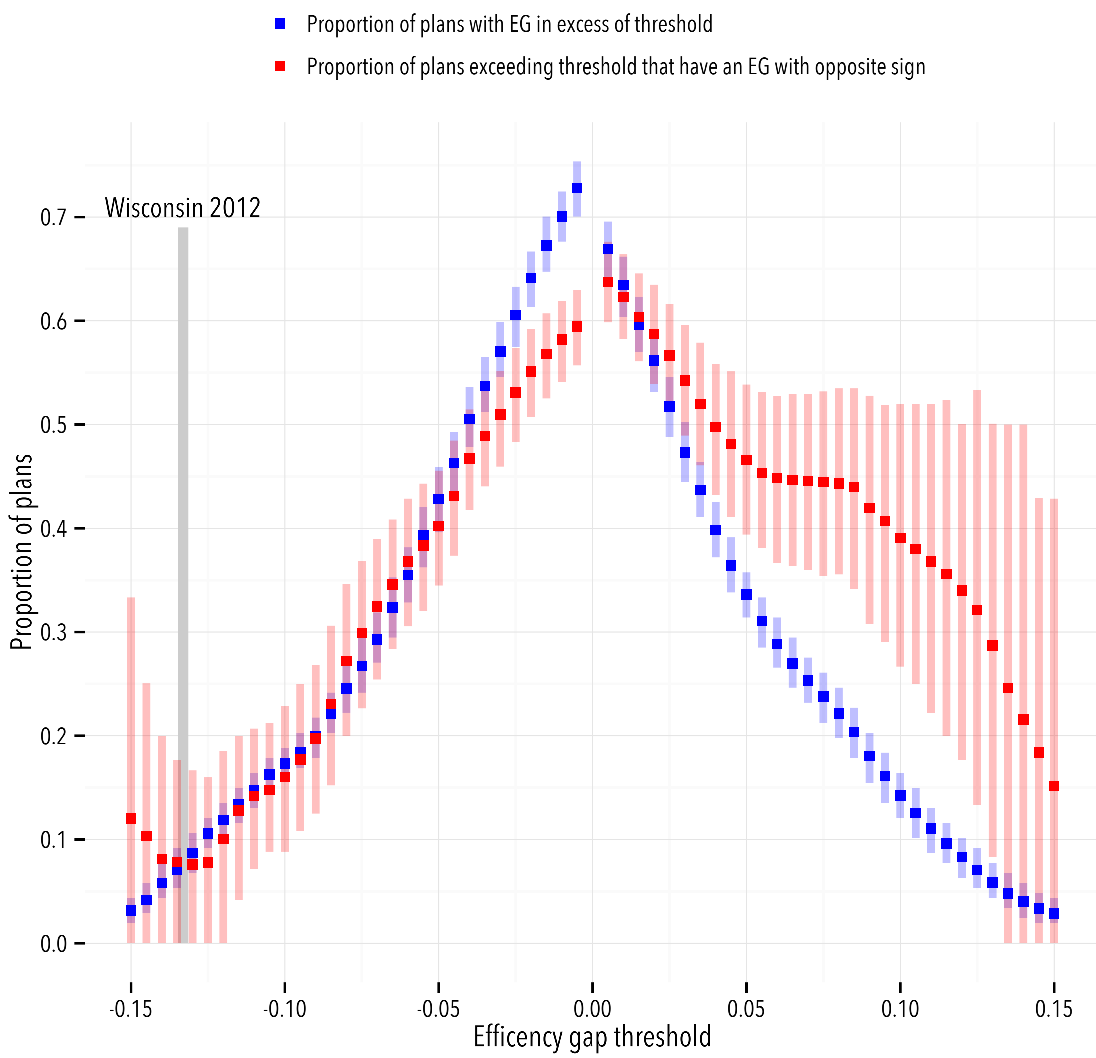

Figure 27: Proportion of plans that (a) record an efficiency gap measure at least as extreme as the value on the horizontal axis; and (b) conditional on at least one election with *EG* in excess of this threshold (not necessarily the first election), the proportion of plans where there is another election in the plan with an *EG* of the opposite sign.

of the "sign flip" rate conditional on a plan generating a relatively large, pro-Democratic *EG* estimates are quite unreliable because there are so few plans generating large, pro-Democratic *EG* estimates to begin with; note the confidence intervals on the "sign flip" rate get very wide as the data become more scarce on the right hand side of the graph.

This finding is not symmetric. The "signal" $EG < -.07$ (an efficiency gap disadvantageous to Democrats) is much more informative about other elections in the plan than the opposite signal $EG > .10$ (a pro-Democratic efficiency gap). If any single election in the plan has $EG < -.07$ then the probability that *all* elections in the plan have $EG < 0$ is about .80. That is, there is a smaller degree of within-plan volatility in plans that disadvantage Democrats. Observing a relatively low value of the *EG* such as $EG < -.07$ is much more presumptive of a systematic and enduring feature of a redistricting plan than the opposite signal $EG > .07$. Efficiency gap measures that appear to indicate a disadvantage for Democrats are thus more reliable signals about the respective districting plan than efficiency gap measures indicating an advantage for Democrats.

We repeat this previous exercise, but restricting attention to more recent elections and plans, with the results displayed in Figure 28. Again we see that plans with pro-Democratic *EG* measures are quite likely to also generate an election with $EG < 0$; and again, note that estimates of the "sign flip" rate are quite unreliable because there are so few plans generating large, pro-Democratic *EG* estimates to begin with.

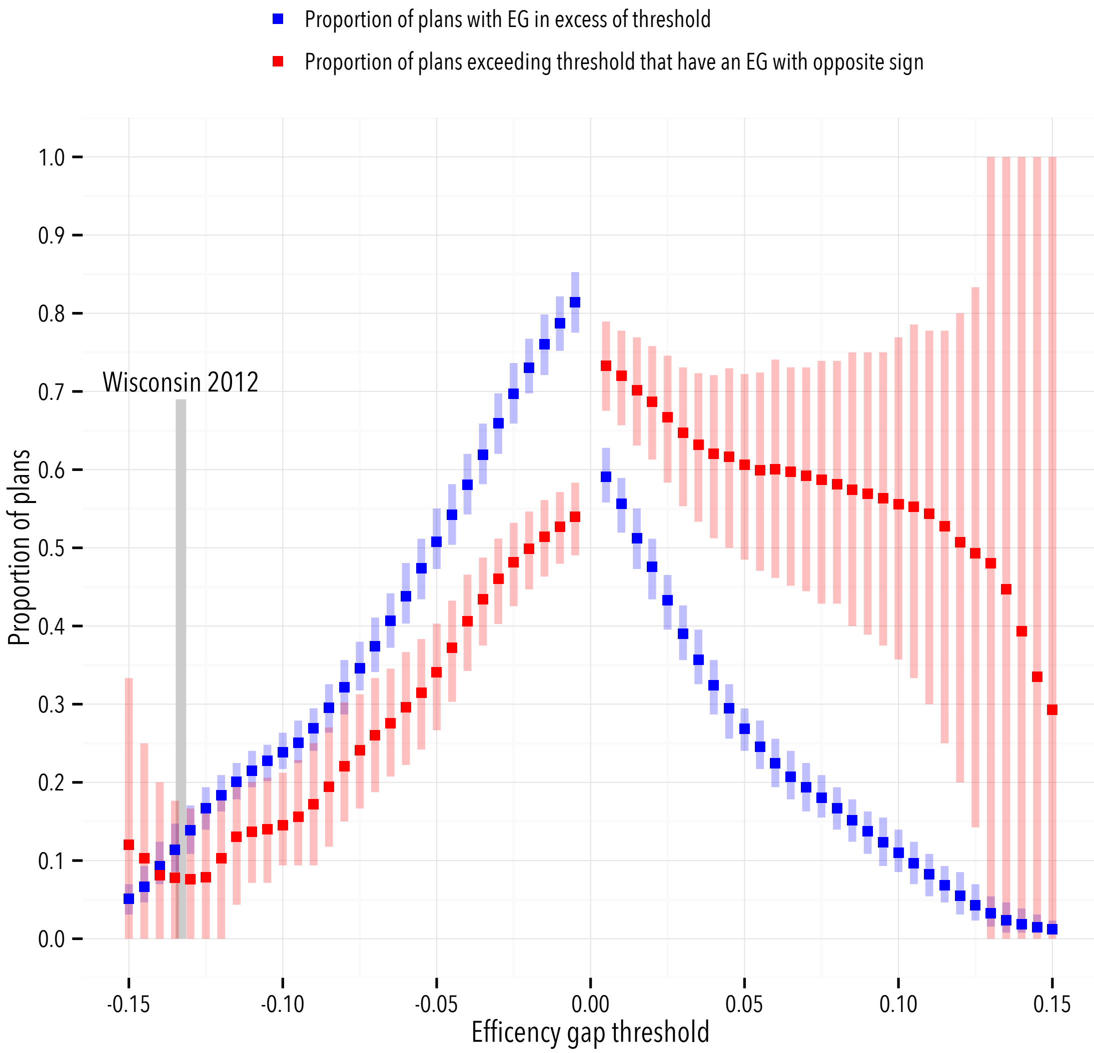

Figure 28: Proportion of plans in which (a) the efficiency gap measure is at least as extreme as the value on the horizontal axis; and (b) of these plans with at least one election with *EG* in excess of this threshold (not necessarily the first election), the proportion of plans in which there is another election in the plan with an *EG* of the *opposite* sign. Analysis of state legislative elections in 129 plans, 1991-present.

10.1 Conditioning on the first election in a districting plan

We also compute this probability of a sign flip in EG conditional on the magnitude of the EG observed with the *first* election under a districting plan. We perform this analysis twice: (1) for all elections in the data set and (2) for elections held under plans adopted in 1991 or later.

Figures 29 and 30 display the results of these analyses. First, over the full set of data (Figure 29) we observe a roughly symmetric set of EG scores in the first election under a plan. But we seldom see plans in the 1990s or later that commence with a large, pro-Democratic efficiency gap; the probability of a first election having $EG > .10$ is zero and the probability of a first election having $EG > .05$ (historically, not a large EG) is only about 11%. Negative efficiency gaps (not favoring Democrats) are much more likely under the first election in the post-1990 plans: almost 40% of plans open with $EG < -.05$ and about 20% of plans open with $EG < -.10$.

As noted earlier, pro-Democratic efficiency gaps seem much more fleeting than pro-Republican efficiency gaps. Conditional on a pro-Republican estimate of $EG > 0$ in the first election under a plan, the probability of seeing EG change sign over the life of the plan is almost always around 40% (1972-2014, Figure 29) or 50% (1991-present, Figure 30).

A very different conclusion holds if the first election observed under a plan indicates a sizeable efficiency gap working to disadvantage Democrats. In fact, the more negative the initial EG observed under a plan, the more confident we can be that we will continue to observe $EG < 0$ over the sequence of elections to follow under the plan. Conditional on a first election with $EG < -.10$, the probability of *all subsequent* efficiency gaps being negative is about 85%. Indeed, it is more likely than not that if the first election has $EG < 0$ (no matter how small), then so too will all subsequent elections (a 60% chance of this event).

Note that the Current Wisconsin Plan opens with $EG = -.13$ in the 2012 election. Analysis of efficiency gap measures in the post-1990 era (Figure 30) indicates that conditional on an EG measure of this size and sign, there is a 100% probability that *all subsequent elections* held under that plan will also have efficiency gaps disadvantageous to Democrats. That is, in the post-1990 era, if a plan's first election yields $EG \leq -.13$, we *never* see a subsequent election under that plan yielding a pro-Democratic efficiency gap. In short, a signal such as

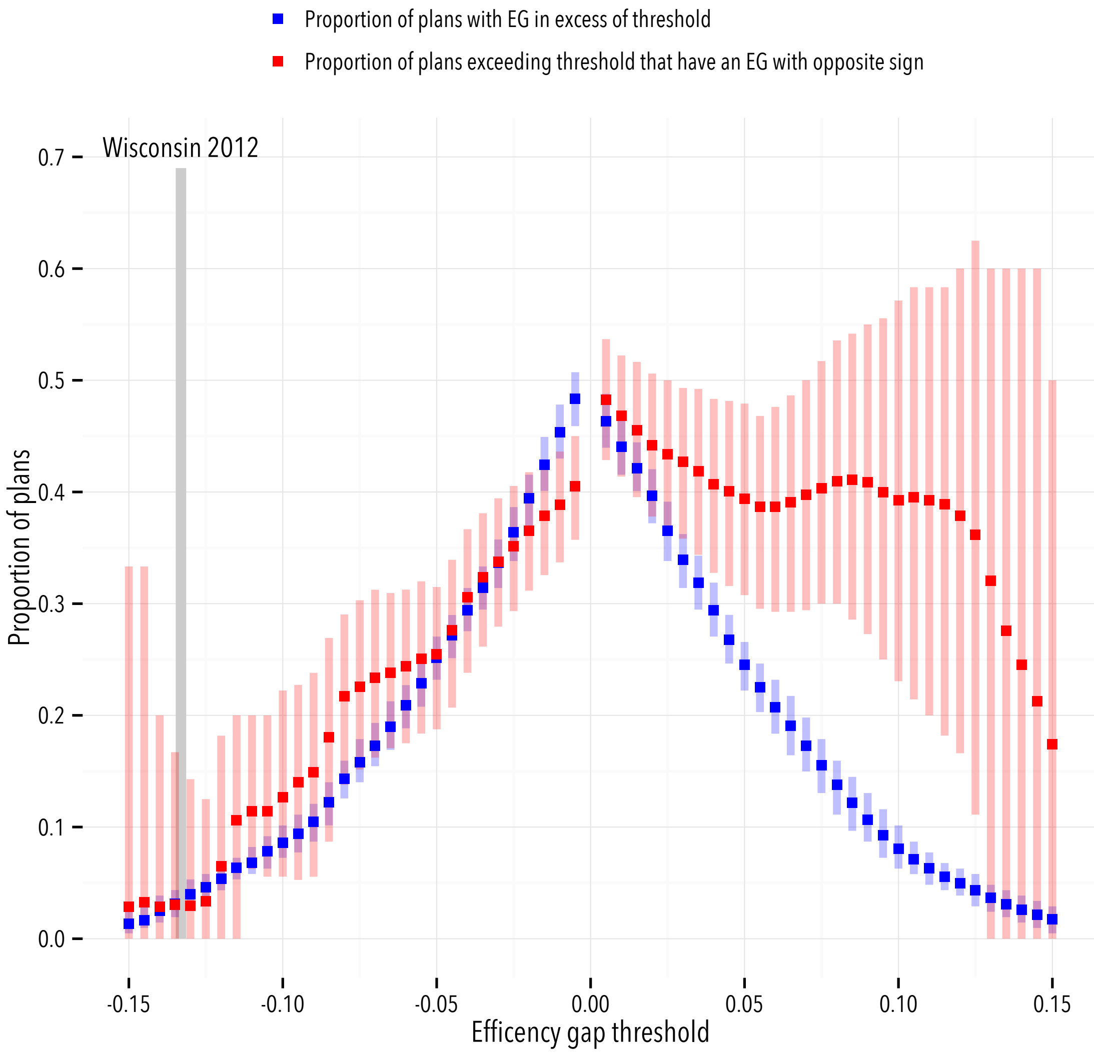

Figure 29: Proportion of plans in which the *first election* (a) has an efficiency gap measure at least as extreme as the value on the horizontal axis; and (b) conditional on the first election having an *EG* in excess of this threshold, the proportion of those plans in which a *subsequent election* has an *EG* of the *opposite* sign. Analysis of all state legislative elections in all plans with more than one election, 1972-present.

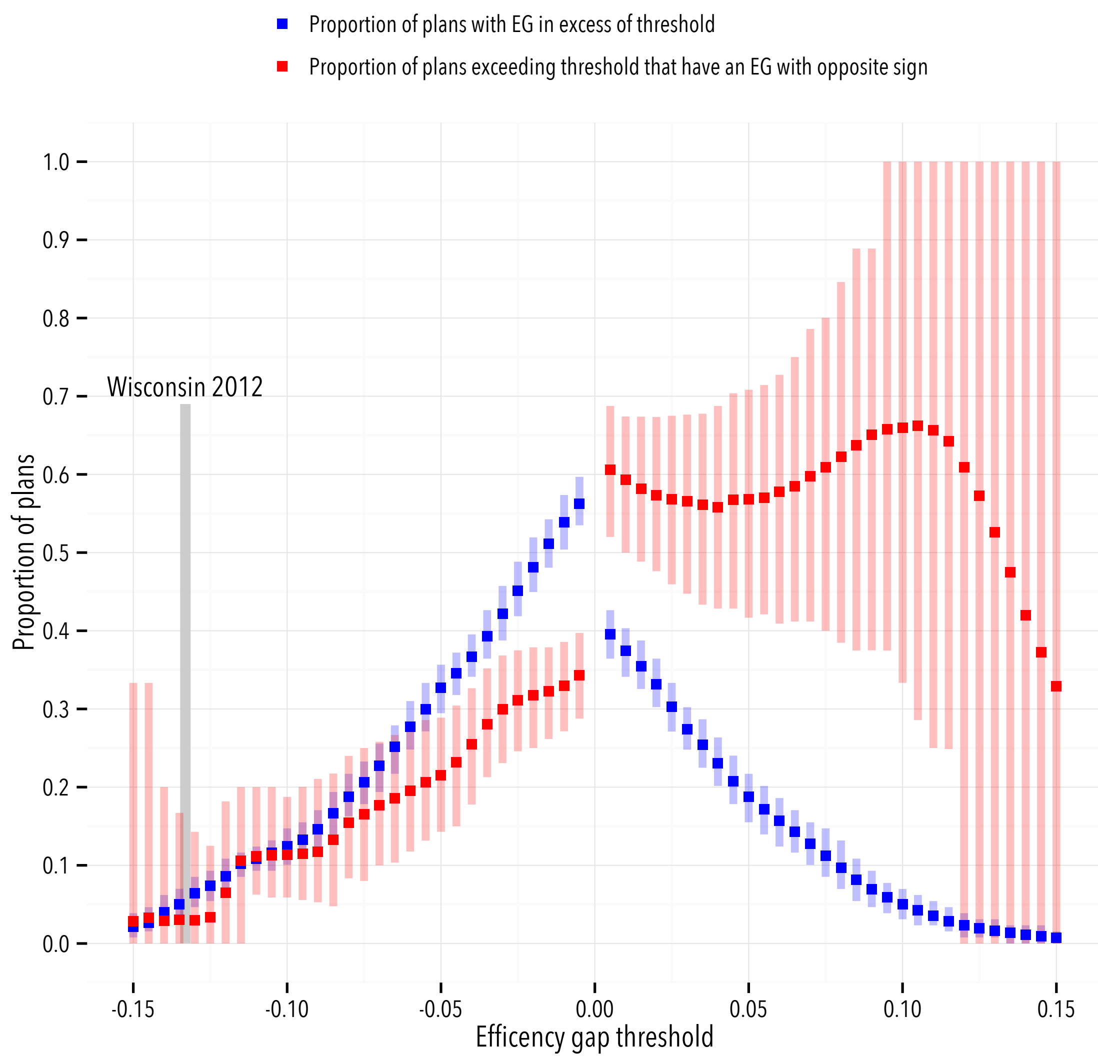

Figure 30: Proportion of plans in which the *first election* (a) has an efficiency gap measure at least as extreme as the value on the horizontal axis; (b) conditional on the first election having an *EG* in excess of this threshold, the proportion of those plans in which a *subsequent election* has an *EG* of the *opposite* sign. Analysis of state legislative elections in 129 plans, 1991-present.

$EG \leq -.13$ is extremely reliable with respect to the districting plan that generated it, at least given the post-1990 record.

10.2 Conditioning on the first two elections in a districting plan

The difficulty with conditioning on the first two elections of a districting plan is that the data start to thin out. In the entire data set there simply aren't many districting plans that equal or surpass the two, relatively large values of *EG* observed in Wisconsin in the first two elections of the current plan. Indeed, the only cases with a similar history of *EG* measures like Wisconsin's in 2012 and 2014 are contemporaneous cases: Florida, Michigan, and North Carolina in 2012 and 2014.

We relax the threshold of what counts as a similar case to encompass plans whose first two efficiency gap measures are within 75% of the magnitude of Wisconsin's 2012 and 2014 *EG* measures; we now pick up 11 roughly comparable cases, 4 of which date from earlier decades. Again, this is testament to how recent decades have seen an increase in the prevalence of larger, negative values of the efficiency gap.

For the four prior cases we plot the sequence of *EG* estimates in Figure 31. With the exception of the last election in the highly unusual Delaware sequence (among the most volatile observed in the data set; see section 9.3), the other proximate cases all go on to record efficiency gap measures that are below zero over the balance of the plan. We stress that four cases doesn't provide much basis for comparison, but this only speaks to the fact that the sequence of two large, negative values of the efficiency gap in Wisconsin in 2012 and 2014 are virtually without historical precedent. We have little guidence from the historical record as to what to expect given an opening sequence of *EG* measures like the ones observed in Wisconsin. But the little evidence we do have suggests that a stream of similarly sized, negative values of the efficiency gap are quite likely over the balance of the districting plan.

10.3 An actionable EG threshold?

We now consider a more general question: what is an actionable threshold for the efficiency gap?

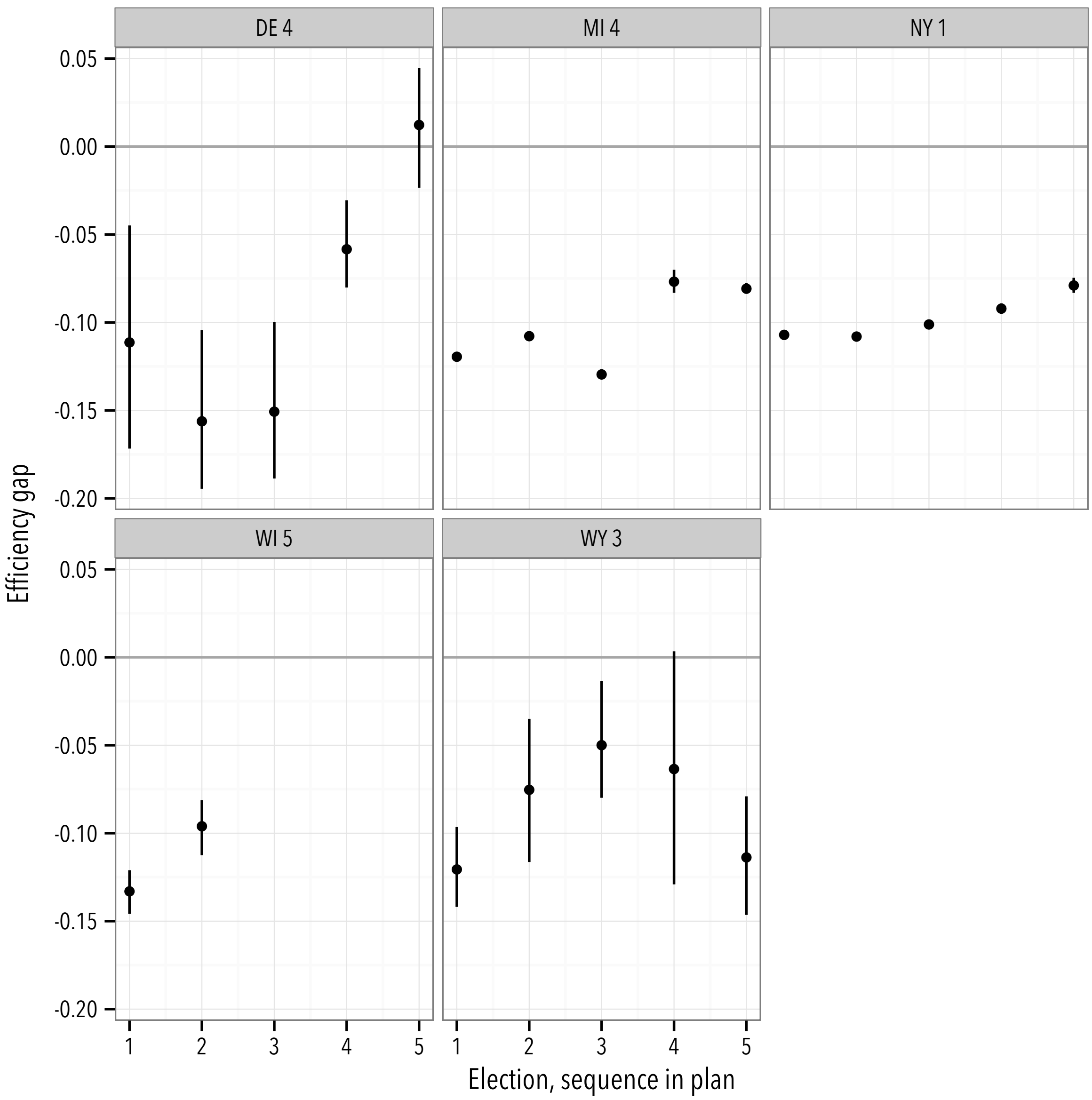

Figure 31: Sequence of *EG* estimates observed over the life of districting plans, for pre-2010 plans with first two *EG* scores within 75% of the magnitude of the *EG* scores observed in Wisconsin in 2012 and 2014.

First, recall that relatively small *EG* estimates are likely to be swamped by their estimation uncertainty, depending on the proportion of uncontested districts in the given election and the statistical procedures. In every instance though, this is an empirical question; at least in the approach I present here, each *EG* estimate I generate is accompanied with uncertainty bounds, letting us assess the *probability* that a given estimate is positive or negative. Figure 19 provides a summary of the relationship between the size of the *EG* estimate and the "statistical significance" of the estimate (in the sense that the 95% credible interval for each estimate does not overlap zero).

Second, the distribution of *EG* statistics in the 1972-2014 period is roughly symmetric around zero. Reference to this empirical distribution might also be helpful in setting actionable thresholds, and answering the question "is the *EG* measure at issues large relative to those observed in the previous 40 years of state legislative elections?" Double digit *EG* measures (-.10 or below; .10 or above) are pushing out into the extremes of the observed distribution of *EG* estimates: *EG* estimates of this magnitude are comfortably past the question of "statistical significance." Just 15% of the 786 *EG* measures generated in this analysis are below -.07; fewer than 12% are greater than .07.

We do need to be careful when making these kinds of *relative* assessments about the magnitude of the efficiency gap. If pro-Republican gerrymandering is widespread, then it will be less unusual to see a large, negative *EG* estimate, at least contemporaneously; in fact this appears to the case in the post-2010 set of elections, where the longer-term distinctiveness of the Wisconsin numbers is matched and in some cases exceeded by other states also recording unusually large, negative *EG* estimates (e.g., Florida, Michigan, Virginia and North Carolina). This speaks to the utility of the longer-term, historical analysis in both Stephanopolous and McGhee (2015) and in this report. It it is important to remember that $EG = 0$ corresponds to a partisan symmetry in wasted vote rates; we should be wary of arguments that would lead us to tolerate small to moderate levels of the efficiency gap because they appear to be the norm in some period of time, or in some set of jurisdictions.

In any litigation, much will turn on the question of *durability* in the efficiency gap, and this concern motivates much of the preceeding analysis. We cannot wait until three, four, or more elections have transpired under a plan in order to assess its properties. Courts will be asked to assess a plan based on only one *EG* estimate, or two. Analysis of the sort I provide here will be informative in these cases, assessing whether the estimate is so large that the historical record suggests that the first election's *EG* estimate is a reliable indicator as an enduring feature of the plan, and not an election-specific aberration.

10.4 Confidence in a given threshold

Figures 32 and 33 present my estimate of a "confidence rate" associated with a range of possible "actionabale thresholds" for the efficiency gap. These figures essentially re-package the information shown in Figures 29 and 30. Suppose a court rejects or amends every plan with a first election *EG* more extreme (further away from zero) than the proposed threshold shown on the horizontal axis of these graphs. A certain number of plans fail to trip this threshold, and so are upheld by the courts if they are challenged. Of those that do trip the threshold and are rejected by a court, what is our confidence that the plan, if left undisturbed, would go on to produce a sequence of *EG* measures that lie on the same side of zero as the threshold? Combining these two proportions gives us an overall confidence measure associated with a particular threshold.

This analysis points to a benchmark of about -.06 or -.07 as the actionable threshold given a first election with $EG < 0$ (Democratic disadvantage) or .08 or .09 when we observe $EG > 0$ in the first election under a redistricting plan (Democratic advantage); the asymmetry here reflects the fact that districting plans evincing apparent Democratic advantages are not as durable or as common (in recent decades) as plans presenting evidence of pro-Republican gerrymanders. At these proposed benchmarks the overall confidence rates are estimated to be 95%, with this confidence rate corresponding to a benchmark used widely in statistical decision-making in many fields of science.

Figures 32 and 33 also highlight that $EG < -.07$ or $EG > .07$ would be an extremely conservative threshold. On the pro-Democratic side, $EG > .07$ is a rare event. Districting plans unfavorable to Democrats, with $EG < -.07$ are not unusual; about 10% of post-1990 plans generate *EG* measures below -.07; the proportion of these plans that then record a sign flip is only about 10%; see Figure 30. If the presumption was that any plan with a first election showing

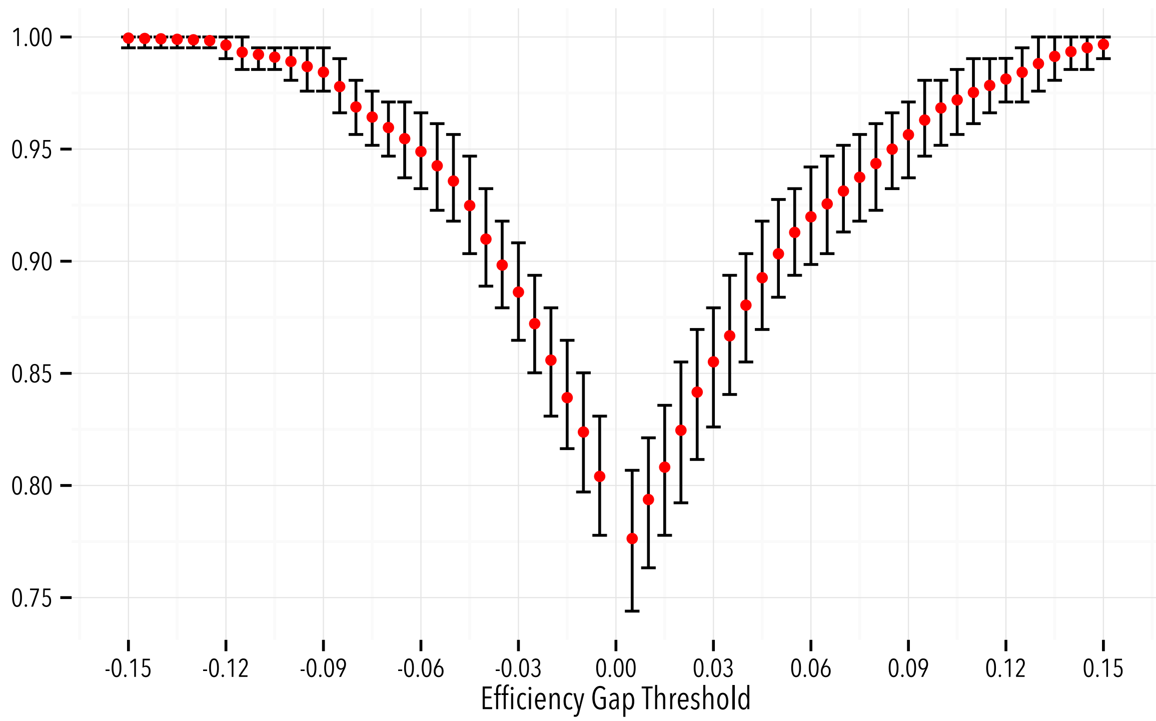

Figure 32: Proportion of plans being either (a) undisturbed or (b) if left undisturbed, would continue to produce one-sided partisan advantage (no sign change in subsequent *EG* measures), as a function of the proposed "first election," efficiency gap threshold (horizontal axis), based on analysis of all multi-election districting plans, 1972-2014. The proportion on the vertical axis is thus interpretable as the "confidence level" associated with intervention at a given first election, *EG* threshold. Vertical lines indicate 95% credible intervals.

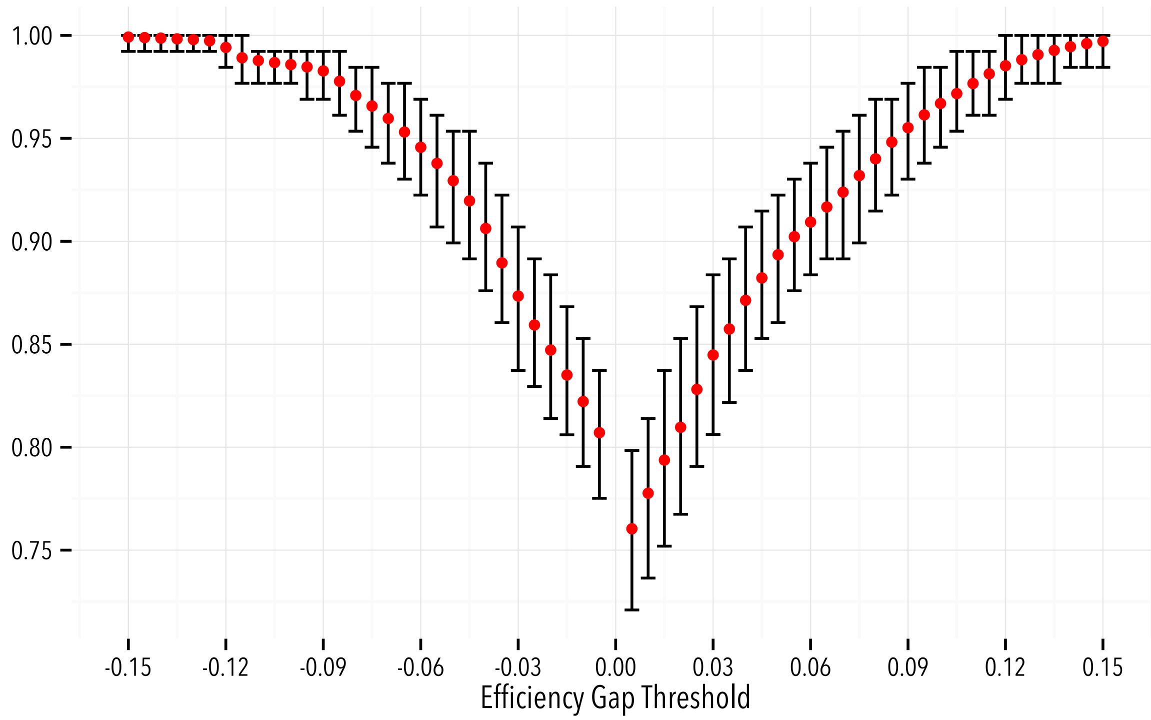

Figure 33: Proportion of plans being either (a) undisturbed or (b) if left undisturbed, would continue to produce one-sided partisan advantage (no sign change in subsequent *EG* measures), as a function of the efficiency gap threshold (horizontal axis), based on analysis of post-1990 plans and elections. The proportion on the vertical axis is thus interpretable as the "confidence level" associated with intervention at a given first election, *EG* threshold. Vertical lines indicate 95% credible intervals.

$EG < -.07$ would be rejected, then we'd be "wrong" to do so in about 10% of those cases (in the sense that if left in place, the plan would go on to produce at least one election with $EG > 0$). The total error rate in this case would be *1% of all plans*. Equivalently, 99% of all plans would be either left undisturbed or appropriately struck down or amended by a court, given the historical relationship between "first election" *EG* measures and the sequence of *EG* measures that follow.

11 Conclusion: the Wisconsin plan

Wisconsin has had two elections for its legislature under the plan currently in place, in 2012 and 2014. Both elections were subject to considerable rates of uncontestedness (27 of 99 seats in 2012 and 52 of 99 seats in 2014), but these rates are hardly unusual; Wisconsin's rates of uncontested districts in these two elections are low to moderate compared to other states. We use the relationship between state legislative election results and presidential election results in state legislative districts (and incumbency) to impute two-party vote shares in uncontested seats (see section 7.2). With a complete set of vote shares, we then compute average district-level Democratic two-party vote share (V) and note the share of seats (contested and uncontested) won by Democratic candidates (S).

In Wisconsin in 2012, and after imputations for uncontested seats, V is estimated to be 51.4% (±0.6); recall that Obama won 53.5% of the two-party presidential vote in Wisconsin in 2012. Yet Democrats won only 39 seats in the 99 seat legislature (S = 39.4%), making Wisconsin one of 7 states in 2012 where we estimate $V > 50\%$ but $S < 50\%$ and where Democrats failed to win a majority of legislative seats despite $V > 50$ (the other states are Florida, Iowa, Michigan, North Carolina and Pennsylvania). In 2014, V is estimated to be 48.0% (±0.8) and Democrats won 36 of 99 seats (S = 36.4%).

This provides the raw ingredients for computing the efficiency gap (*EG*) for these two elections (recalling equation 1). Repeating these calculations across a large set of state elections provides a basis for assessing whether the efficiency gap estimates for Wisconsin in 2012 and 2014 are noteworthy.

Wisconsin's efficiency gap measures in 2012 and 2014 are -.13 and -.10 (to two digits of precision). These negative estimates indicate the disparity between

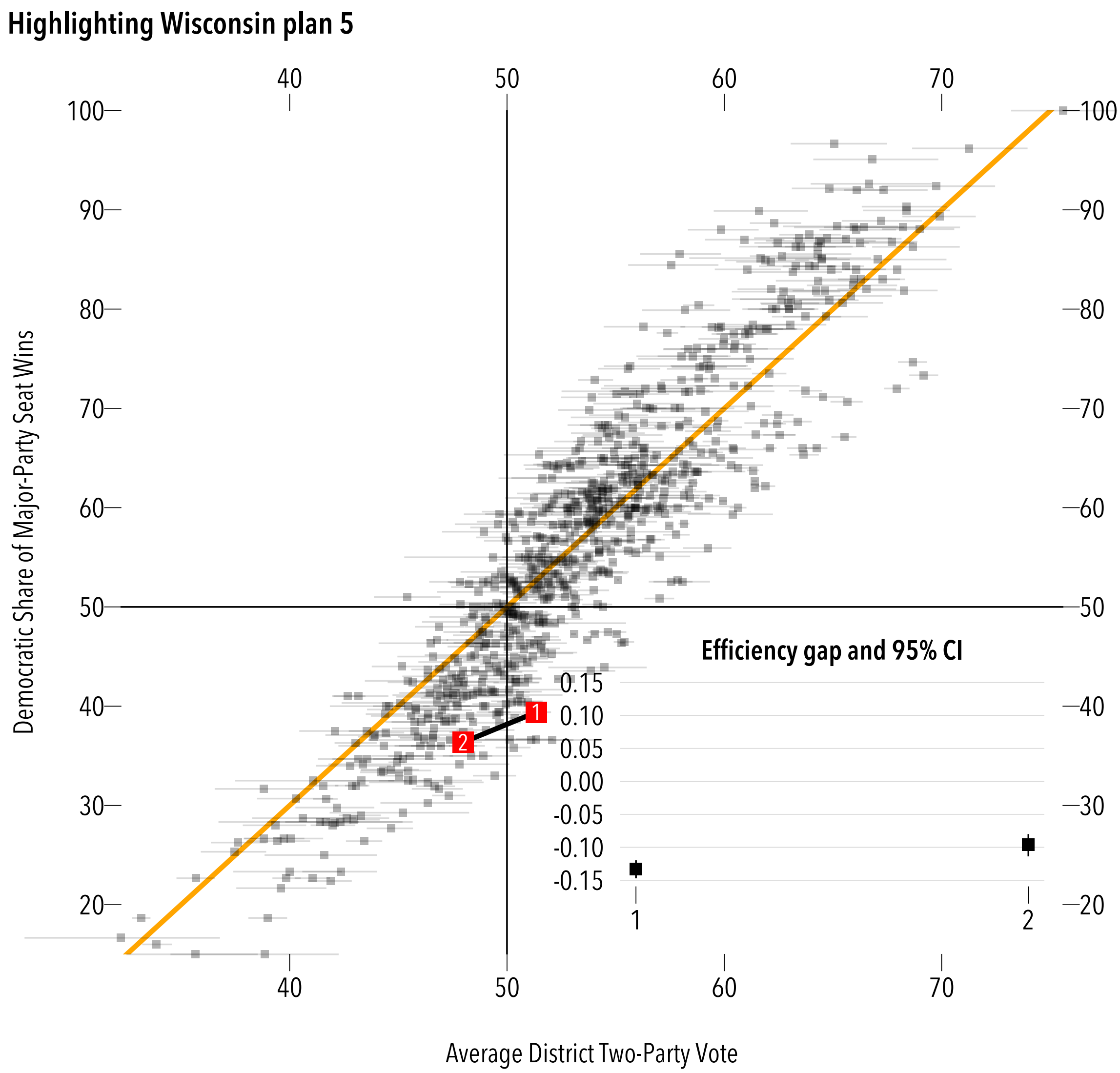

Figure 34: Seats, votes and the efficiency gap recorded under the Wisconsin plan, 2012 and 2014. Orange line shows the seats-votes curve if the efficiency gap were zero; the efficiency gap in any election is the vertical distance from the corresponding data point to the orange line. Gray points indicate elections from other states and elections (1972-2014). Horizontal lines cover a 95% credible interval for Democratic average district two-party vote share, given imputations in uncontested districts. The inset in the lower right shows the sequence of efficiency gap measures recorded under the plan; vertical lines are 95% credible intervals.

vote shares and seat shares in these elections, which in turn, is consistent with partisan gerrymandering. The negative *EG* estimates generated in 2012 and 2014 are unusual relative to Wisconsin's political history (see Figure 35). The 2012 estimate is the largest *EG* estimate in Wisconsin over the 42 year period spanned by this analysis (1972-2014); the 2014 estimate is the fourth largest (behind 2012, 2006 and 2004, although it is essentially indistinguishable from the 2004 estimate). The jump from the *EG* values being recorded towards the end of the previous districting plan in Wisconsin (2002-2010) to the 2012 and 2014 values strongly suggests that the districting plan adopted in 2011 is a driver of the change, systematically degrading the efficiency with which Democratic votes translate into Democratic seats in the Wisconsin state legislature.

Wisconsin's 2012 and 2014 *EG* estimates are also large relative to the *EG* scores being generated contemporaneously in other state legislative elections. Figure 36 shows *EG* estimates recorded under plans in place since the post-2010 census round of redistricting; the *EG* estimates are grouped by state and ordered, with Wisconsin highlighted. We have 78 *EG* scores from elections held since the last round of redistricting. Among these 79 scores, Wisconsin's *EG* scores rank eigth (2012, 95% CI 3 to 12) and seventeenth (2014, 95% CI 13 to 20).

The historical analysis reported above supports the proposition that Wisconsin's *EG* scores are likely to endure over the course of the plan. Few states ever record *EG* scores as large as those observed in Wisconsin; indeed, there is virtually no precedent for the lop-sided, two election sequence of *EG* scores generated in Wisconsin in 2012 and 2014 in the data I analyze here (1972-2014). The closest historical analogs suggest that a districting plan that generates an opening, two-election sequence of *EG* scores like those from Wisconsin will continue to do so, generating seat shares for Democrats that are well below those we would expect from a neutral plan.

The Current Wisconsin Plan is generating estimates of the efficiency gap far in excess of the proposed, actionable threshold (see section 10). In 2012 elections to the Wisconsin state legislature, the efficiency gap is estimated to be -.13; in 2014, the efficiency gap is estimated to be -.10. Both measures are separately well beyond the conservative .07 threshold suggested by the analysis of efficiency gap measures observed from 1972 to the present.

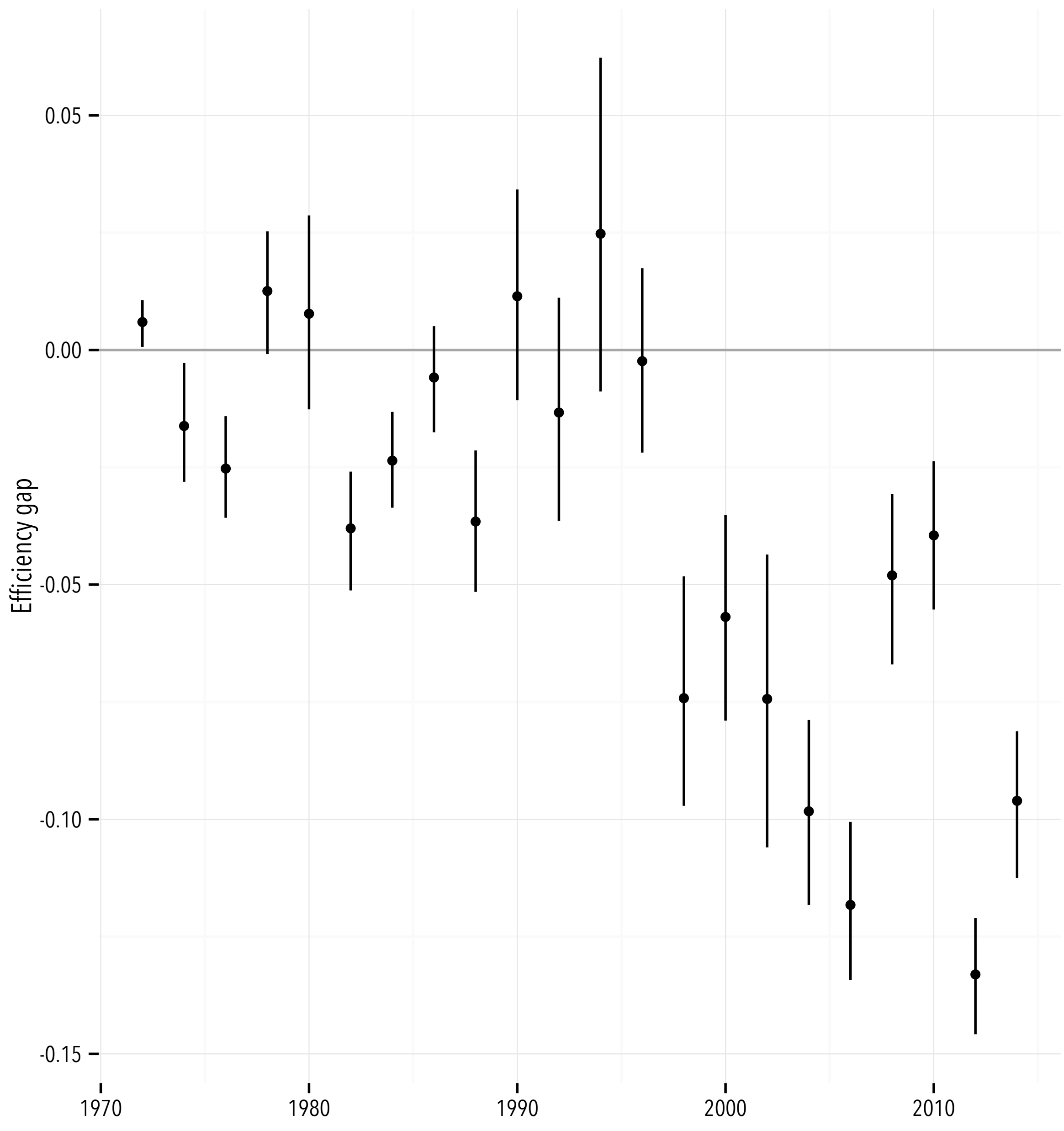

Figure 35: History of efficiency gap estimates in Wisconsin, 1972-2014. Vertical lines indicate 95% credible intervals.

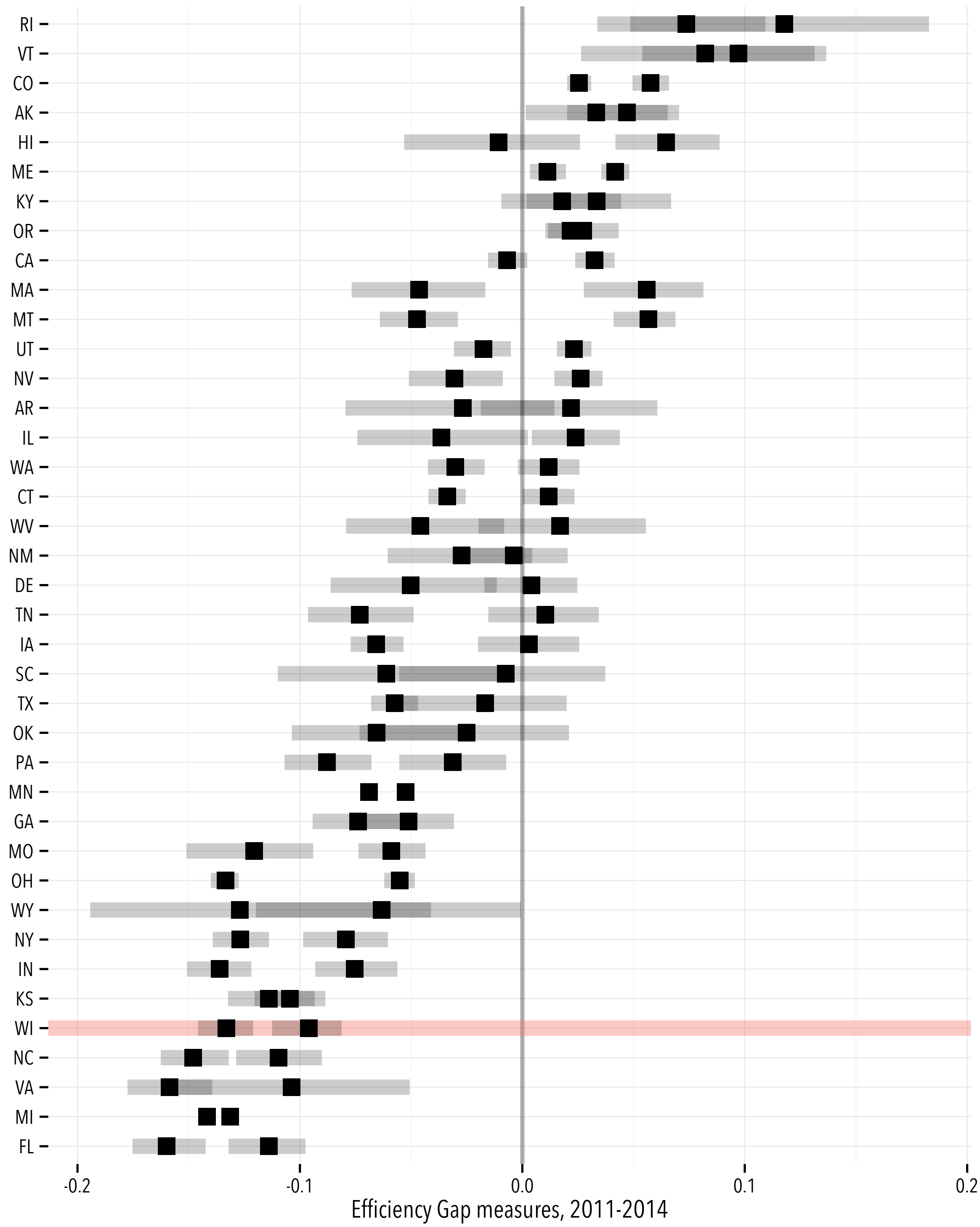

Figure 36: *EG* estimates in 2012 and 2014, grouped by state and ordered. Horizontal bars indicate 95% credible intervals.

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1. Each of the 17 Republican senators signed the secrecy agreements as follows:

   a) Robert Cowles, the elected Republican Senator from the 2nd Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

   b) Alberta Darling, the elected Republican Senator from the 8th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

   c) Michael Ellis, the elected Republican Senator from the 19th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

   d) Glenn Grothman, the elected Republican Senator from the 4^{th} Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 21, 2011.

   e) Sheila Harsdorf, the elected Republican Senator from the 10th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

   f) Neal Kedzie, the elected Republican Senator from the 11th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

   g) Frank Lasee, the elected Republican Senator from the 1st Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 21, 2011.

EXHIBIT 4

h) Mary Lazich, the elected Republican Senator from the 28th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

i) Joseph Leibham, the elected Republican Senator from the 9th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 21, 2011.

j) Terry Moulton, the elected Republican Senator from the 23rd Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 10, 2011.

k) Luther S. Olson, the elected Republican Senator from the 14th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 10, 2011.

l) Leah Vukmir, the elected Republican Senator from the 5th Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 4, 2011.

m) Van H. Wanggaard, the elected Republican Senator from the 21st Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 28, 2011.

n) Rich Zipperer, the elected Republican Senator from the 33rd Senate District, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

2. Under the direction and supervision of Mr. McLeod, Adam Foltz met with 58 Republican members of the Wisconsin State Assembly and asked that each representative sign a secrecy

agreement captioned "Confidentiality and Nondisclosure Related to Reapportionment" before being allowed to review and discuss the development of the legislative reapportionment plan for which Michael, Best & Friedrich had been hired to supervise. The secrecy agreement indicated that McLeod had "instructed" Mr. Foltz to meet with certain members of the Assembly to discuss the reapportionment process and that said conversations were to be considered subject to the attorney client and attorney work product privileges. Each of the 58 representatives signed the secrecy agreements between March 31, 2011 and June 2, 2011, and each thereby agreed not to disclose the fact and/or contents of the discussions or any draft documents within their possession related to reapportionment. The individual meetings occurred at Mr. Foltz's office at Michael, Best and Friedrich. Each of the 58 Republican representatives signed the secrecy agreements as follows:

a) Tyler August, the elected Republican Representative from Assembly District 32, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

b) Joan Ballweg, the elected Republican Representative from Assembly District 41, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

c) Kathleen M. Bernier, the elected Republican Representative from Assembly District 68, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 4, 2011.

d) Garey Bies the elected Republican Representative from Assembly District 1, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 12, 2011.

e) Ed Brooks, the elected Republican Representative from Assembly District 50, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

f) David Craig, the elected Republican Representative from Assembly District 83, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on June 1, 2011.

g) Michael Endsley, the elected Republican Representative from Assembly District 26, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 4, 2011.

h) Paul Farrow, the elected Republican Representative from Assembly District 98, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

i) Mark Honadel, the elected Republican Representative from Assembly District 21, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

j) Andre Jacque, the elected Republican Representative from Assembly District 2, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

k) Chris Kapenga, the elected Republican Representative from Assembly District 33, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 27, 2011.

l) Dean R. Kaufert, the elected Republican Representative from Assembly District 55, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

m) Samantha Kerkman, the elected Republican Representative from Assembly District 66, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 19, 2011.

n) Steve Kestell, the elected Republican Representative from Assembly District 27, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 12, 2011.

o) Joel Kleefisch, the elected Republican Representative from Assembly District 38, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 5, 2011.

p) John L. Klenke, the elected Republican Representative from Assembly District 88, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

q) Joseph K. Knilans, the elected Republican Representative from Assembly District 44, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

r) Dan Knodl, the elected Republican Representative from Assembly District 24, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

s) Dean Knudson, the elected Republican Representative from Assembly District 30, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

t) Dale Kooyenga, the elected Republican Representative from Assembly District 14, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 4, 2011.

u) William F. Kramer, the elected Republican Representative from Assembly District 97, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

v) Scott Krug, the elected Republican Representative from Assembly District 72, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 11, 2011.

w) Michael Kuglitsch, the elected Republican Representative from Assembly District 84, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 5, 2011.

x) Tom Larson, the elected Republican Representative from Assembly District 67, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

y) Daniel R. LeMahieu, the elected Republican Representative from Assembly District 59, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 4, 2011.

z) Michelle Litgens, in her individual and official capacity as the elected Republican Representative from Assembly District 56, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

aa) Amy Loudenbeck, in her individual and official capacity as the elected Republican Representative from Assembly District 45, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

bb) Howard Marklein, the elected Republican Representative from Assembly District 51, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

cc) Dan Meyer, the elected Republican Representative from Assembly District 34, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 20, 2011.

dd) Jeffrey Mursau, the elected Republican Representative from Assembly District 36, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 27, 2011.

ee) John Murtha, the elected Republican Representative from Assembly District 29, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

ff) Steven L. Nass, the elected Republican Representative from Assembly District 31, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 26, 2011.

gg) Lee Nerison, the elected Republican Representative from Assembly District 96, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 4, 2011.

hh) John Nygren, the elected Republican Representative from Assembly District 89, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 12, 2011.

ii) Alvin R. Ott, the elected Republican Representative from Assembly District 3, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 27, 2011.

jj) Jim Ott, the elected Republican Representative from Assembly District 23, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on June 2, 2011.

kk) Kevin David Peterson, the elected Republican Representative from Assembly District 40, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 5, 2011.

ll) Jerry Petrowski, the elected Republican Representative from Assembly District 86, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 27, 2011.

mm) Warren Petryck, the elected Republican Representative from Assembly District 93, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

nn) Don Pridemore, the elected Republican Representative from Assembly District 99, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on March 31, 2011.

oo) Keith Ripp, the elected Republican Representative from Assembly District 47, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

pp) Roger Rivard, the elected Republican Representative from Assembly District 75, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 4, 2011.

qq) Eric Severson, the elected Republican Representative from Assembly District 28, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

rr) Richard Spanbauer, the elected Republican Representative from Assembly District 53, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 12, 2011.

ss) Jim Steineke, the elected Republican Representative from Assembly District 5, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 14, 2011.

tt) Jeff Stone, the elected Republican Representative from Assembly District 82, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on June 2, 2011.

uu) Pat Strachota, the elected Republican Representative from Assembly District 58, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 4, 2011.

vv) Dewey Stroebel, the elected Republican Representative from Assembly District 60, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on June 1, 2011.

ww) Scott Suder, the elected Republican Representative from Assembly District 69, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 6, 2011.

xx) Gary Tauchen, the elected Republican Representative from Assembly District 6, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

yy) Jeremy Theisfeldt, the elected Republican Representative from Assembly District 52, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 12, 2011.

zz) Thomas P. Tiffany, the elected Republican Representative from Assembly District 35, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

aaa) Travis Tramel, the elected Republican Representative from Assembly District 49, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 9, 2011.

bbb) Karl Van Roy, the elected Republican Representative from Assembly District 90, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 13, 2011.

ccc) Chad Weininger, the elected Republican Representative from Assembly District 4, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 21, 2011.

ddd) Mary L. Williams, in her individual and official capacity as the elected Republican Representative from Assembly District 87, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on April 7, 2011.

eee) Evan Wynn, the elected Republican Representative from Assembly District 43, signed a secrecy agreement with Michael Best and Friedrich by Eric M. McLeod on May 3, 2011.

CIVIL COVER SHEET

The JS 44 civil cover sheet and the information contained herein neither replace nor supplement the filing and service of pleadings or other papers as required by law, except as provided by local rules of court. This form, approved by the Judicial Conference of the United States in September 1974, is required for the use of the Clerk of Court for the purpose of initiating the civil docket sheet. *(SEE INSTRUCTIONS ON NEXT PAGE OF THIS FORM.)*

I. (a) PLAINTIFFS
See attached

DEFENDANTS
See attached

(b) County of Residence of First Listed Plaintiff: DANE
(EXCEPT IN U.S. PLAINTIFF CASES)

County of Residence of First Listed Defendant: DANE
(IN U.S. PLAINTIFF CASES ONLY)
NOTE: IN LAND CONDEMNATION CASES, USE THE LOCATION OF THE TRACT OF LAND INVOLVED.

(c) Attorneys *(Firm Name, Address, and Telephone Number)*
See attached

Attorneys *(If Known)*

II. BASIS OF JURISDICTION *(Place an "X" in One Box Only)*

- ❒ 1 U.S. Government Plaintiff
- ☒ 3 Federal Question *(U.S. Government Not a Party)*
- ❒ 2 U.S. Government Defendant
- ❒ 4 Diversity *(Indicate Citizenship of Parties in Item III)*

III. CITIZENSHIP OF PRINCIPAL PARTIES *(Place an "X" in One Box for Plaintiff and One Box for Defendant)*

(For Diversity Cases Only)

	PTF	DEF		PTF	DEF
Citizen of This State	❒ 1	❒ 1	Incorporated *or* Principal Place of Business In This State	❒ 4	❒ 4
Citizen of Another State	❒ 2	❒ 2	Incorporated *and* Principal Place of Business In Another State	❒ 5	❒ 5
Citizen or Subject of a Foreign Country	❒ 3	❒ 3	Foreign Nation	❒ 6	❒ 6

IV. NATURE OF SUIT *(Place an "X" in One Box Only)*

CONTRACT
- ❒ 110 Insurance
- ❒ 120 Marine
- ❒ 130 Miller Act
- ❒ 140 Negotiable Instrument
- ❒ 150 Recovery of Overpayment & Enforcement of Judgment
- ❒ 151 Medicare Act
- ❒ 152 Recovery of Defaulted Student Loans (Excl. Veterans)
- ❒ 153 Recovery of Overpayment of Veteran's Benefits
- ❒ 160 Stockholders' Suits
- ❒ 190 Other Contract
- ❒ 195 Contract Product Liability
- ❒ 196 Franchise

REAL PROPERTY
- ❒ 210 Land Condemnation
- ❒ 220 Foreclosure
- ❒ 230 Rent Lease & Ejectment
- ❒ 240 Torts to Land
- ❒ 245 Tort Product Liability
- ❒ 290 All Other Real Property

TORTS

PERSONAL INJURY
- ❒ 310 Airplane
- ❒ 315 Airplane Product Liability
- ❒ 320 Assault, Libel & Slander
- ❒ 330 Federal Employers' Liability
- ❒ 340 Marine
- ❒ 345 Marine Product Liability
- ❒ 350 Motor Vehicle
- ❒ 355 Motor Vehicle Product Liability
- ❒ 360 Other Personal Injury
- ❒ 362 Personal Injury - Med. Malpractice

PERSONAL INJURY
- ❒ 365 Personal Injury - Product Liability
- ❒ 367 Health Care/ Pharmaceutical Personal Injury Product Liability
- ❒ 368 Asbestos Personal Injury Product Liability

PERSONAL PROPERTY
- ❒ 370 Other Fraud
- ❒ 371 Truth in Lending
- ❒ 380 Other Personal Property Damage
- ❒ 385 Property Damage Product Liability

CIVIL RIGHTS
- ❒ 440 Other Civil Rights
- ❒ 441 Voting
- ❒ 442 Employment
- ❒ 443 Housing/ Accommodations
- ❒ 445 Amer. w/Disabilities - Employment
- ❒ 446 Amer. w/Disabilities - Other
- ❒ 448 Education

PRISONER PETITIONS
- ❒ 510 Motions to Vacate Sentence

Habeas Corpus:
- ❒ 530 General
- ❒ 535 Death Penalty
- ❒ 540 Mandamus & Other
- ❒ 550 Civil Rights
- ❒ 555 Prison Condition
- ❒ 560 Civil Detainee - Conditions of Confinement

FORFEITURE/PENALTY
- ❒ 625 Drug Related Seizure of Property 21 USC 881
- ❒ 690 Other

LABOR
- ❒ 710 Fair Labor Standards Act
- ❒ 720 Labor/Mgmt. Relations
- ❒ 740 Railway Labor Act
- ❒ 751 Family and Medical Leave Act
- ❒ 790 Other Labor Litigation
- ❒ 791 Empl. Ret. Inc. Security Act

IMMIGRATION
- ❒ 462 Naturalization Application
- ❒ 463 Habeas Corpus - Alien Detainee (Prisoner Petition)
- ❒ 465 Other Immigration Actions

BANKRUPTCY
- ❒ 422 Appeal 28 USC 158
- ❒ 423 Withdrawal 28 USC 157

PROPERTY RIGHTS
- ❒ 820 Copyrights
- ❒ 830 Patent
- ❒ 840 Trademark

SOCIAL SECURITY
- ❒ 861 HIA (1395ff)
- ❒ 862 Black Lung (923)
- ❒ 863 DIWC/DIWW (405(g))
- ❒ 864 SSID Title XVI
- ❒ 865 RSI (405(g))

FEDERAL TAX SUITS
- ❒ 870 Taxes (U.S. Plaintiff or Defendant)
- ❒ 871 IRS—Third Party 26 USC 7609

OTHER STATUTES
- ❒ 375 False Claims Act
- ☒ 400 State Reapportionment
- ❒ 410 Antitrust
- ❒ 430 Banks and Banking
- ❒ 450 Commerce
- ❒ 460 Deportation
- ❒ 470 Racketeer Influenced and Corrupt Organizations
- ❒ 480 Consumer Credit
- ❒ 490 Cable/Sat TV
- ❒ 850 Securities/Commodities/ Exchange
- ❒ 890 Other Statutory Actions
- ❒ 891 Agricultural Acts
- ❒ 893 Environmental Matters
- ❒ 895 Freedom of Information Act
- ❒ 896 Arbitration
- ❒ 899 Administrative Procedure Act/Review or Appeal of Agency Decision
- ❒ 950 Constitutionality of State Statutes

V. ORIGIN *(Place an "X" in One Box Only)*

- ☒ 1 Original Proceeding
- ❒ 2 Removed from State Court
- ❒ 3 Remanded from Appellate Court
- ❒ 4 Reinstated or Reopened
- ❒ 5 Transferred from another district *(specify)*
- ❒ 6 Multidistrict Litigation

VI. CAUSE OF ACTION

Cite the U.S. Civil Statute under which you are filing ***(Do not cite jurisdictional statutes unless diversity)***:
42 USC 1983

Brief description of cause:
Unconstitutional partisan gerrymandering

VII. REQUESTED IN COMPLAINT:

❒ CHECK IF THIS IS A **CLASS ACTION** UNDER F.R.C.P. 23

DEMAND $

CHECK YES only if demanded in complaint:
JURY DEMAND: ❒ Yes ☒ No

VIII. RELATED CASE(S) IF ANY

(See instructions): JUDGE ________ DOCKET NUMBER ________

DATE: 07/07/2015

SIGNATURE OF ATTORNEY OF RECORD: /s/ Peter G. Earle

FOR OFFICE USE ONLY

RECEIPT # ________ AMOUNT ________ APPLYING IFP ________ JUDGE ________ MAG. JUDGE ________

Attachment to Civil Cover Sheet

Plaintiffs

Whitford, William; Anclam, Roger; Bunting, Emily; Donohue, Mary Lynne; Harris, Helen; Jensen, Wayne; Johnson, Wendy Sue; Mitchell, Janet; Seaton, Allison; Seaton, James; Wallace, Jerome; Winter, Donald

Defendants

Wisconsin Government Accountability Board, Nichol, Gerald C., Chair; Barland, Thomas, Secretary; Franke, John, Member; Harold, Froehlich, Member; Kennedy, Kevin J., Executive Director; Lamelas, Elsa, Vice Chair; Vocke, Timothy, Member

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