

STRUCTURAL RESTRICTIONS TO GERRYMANDERING: AN EXAMINATION
OF THE EFFECT OF THE NUMBER OF DISTRICTS ON PARTISAN
REDISTRICTING

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By

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ABSTRACT

Gerrymandering, which is the practice of drawing representative districts to enable an unfair electoral advantage for one particular group, has afflicted the American political system for centuries. However, certain states that have been apportioned only one congressional district, cannot engage in gerrymandering because there are no lines to draw. Thus the structural requirement prevents gerrymandering from occurring at the congressional level in these states. Based on this observation, it might seem that reducing the number of districts might simultaneously decrease the potency of gerrymandering. This paper examines the relationship between the number of districts and gerrymandering along with the effect that the change in districts over time has on partisan redistricting. The results produce here suggests that more populous states with many districts are more susceptible to gerrymandering than their less populous counterparts. However, there does not appear to be any significant relationship between the change in the number of districts over time and the level of gerrymandering.

There are a number of people without whom this work never would have been written.

Firstly, to my advisor, Jeffrey Thompson, whose guidance and support turned my scattered ideas into a coherent approach. Also to my fellow classmates in my thesis group along with many other students at the McCourt School, whose support and suggestions enhanced this work significantly. Many of the staff members of the New York Civil Liberties Union, especially Perry Grossman, who first introduced me to the ideas of the efficiency gap and the mean-median gap and other approaches to measuring gerrymandering. I would also like to thank my friends and extended family for their encouragement. Finally, to my sister, Rachel, and my parents, Mike and Roz, for their love and their willingness to listen to me talk endlessly about gerrymandering.

Many thanks,
Daniel Greenberg

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Introduction

The problems created by gerrymandering have troubled the United States of America since its founding in the late eighteenth century. The Boston Gazette originally coined this term in 1812 to describe Massachusetts Governor Elbridge Gerry's redrawing of the state senate districts to benefit his Democratic-Republican Party in the upcoming elections.¹ Some critics remarked that one of the districts in the Boston area resembled a salamander in its shape. The word gerrymandering, arose from a combination of the surname Gerry and the word salamander.²

Majority parties both in the United States and throughout the world have utilized this practice to consolidate their own power and prevent the opposition party from winning elections. One major tactic involves splitting up the voting power of a political party or another group of interest by placing them into a number of different districts. As a collective, this group might exert substantial power in elections, but through this practice of "cracking", their votes are diluted amongst the other votes in each district.³ One such example of this can be seen in the case of the redistricting for Ohio, which saw portions of the city of Columbus split into the 4th, 12th, and 15th congressional districts.⁴ Despite the city's general preference for Democratic candidates, each of these three districts have consistently voted for Republican congressman since the redistricting in 2011.⁵ Another tactic, called "packing", would draw a district to include almost every

¹ Nicholas R. Seabrook, *Drawing the Lines: Constraints on Partisan Gerrymandering in U.S. Politics*, (Ithaca: Cornell University Press, 2017), 10.

² Ibid, 10.

³ Ibid, 15.

⁴ Daley, *Ratf**ked: Why Your Vote Doesn't Count*, (New York: W.W. Norton & Company, 2016), 86 – 88.

⁵ Jim Jordan of the 4th congressional district was first elected in the 2006 elections, Jim Tiberi of the 12th Congressional district was first elected in the 2000 election though he resigned in January 2018, and Steve Stivers of the 15th district was first elected in 2010.

member of a particular group within that one district.⁶ While this ensures that this specific district will favor the targeted group, that same collection of people will not have a substantial impact on any other district. In Pennsylvania, districts were drawn in such a way to pack as many Democratic votes in Philadelphia and Pittsburgh into as few districts as possible, which under Pennsylvania's map consistently saw Republicans winning 13 districts and Democrats winning 5 in a state that is generally considered evenly split.⁷ While these tools of packing and cracking can target any particular group, traditionally they have impacted minority parties, certain racial groups like people of color, religious groups, and people with similar socio-economic backgrounds. More recently, developments in mapping and spatial modeling technology have exacerbated this problem to a truly profound extent. Utilizing these tools, politicians, consultants, and other party officials can determine on a household by household basis exactly who they want in which district in an effort to maximize overall victories for their preferred party.⁸ These efforts have created circumstances where the elected officials in the House of Representatives does not reflect the choices of the electorate. For instance, during the 2012 elections, the Republican party won 234 congressional seats to the Democrat's 201, but Democratic candidates won 48.8% of the overall vote, which was about 1.2 percentage points more than all Republican candidates.⁹ Indeed 1,417,278 more people voted for Democratic candidates than Republicans, yet under the redistricting efforts of 2010, the Republicans won 31 more seats than the Democrats.¹⁰ Additionally, according

⁶ Anthony J. McGann, Charles Anthony Smith, Michael Laetner, and Alex Keena, *Gerrymandering in America: The House of Representatives, the Supreme Court, and the Future of Popular Sovereignty*, (New York: Cambridge University Press, 2016), 48.

⁷ Daley, *Ratf**ked*, 24 – 25.

⁸ *Ibid*, 51 – 55.

⁹ *Ibid*, XXII.

¹⁰ McGann, Smith, Laetner and Keena, *Gerrymandering in America*, 1 – 4.

to estimates from the Brennan Center for Justice, Democrats might need to win by 7% in the House popular vote in order to win a bare majority of congressional seats.¹¹ This prediction bases its findings on analyses of the redistricted states following the 2010 census. While it might appear that this paper solely focuses on cases of Republican gerrymandering, this is not the case as seen with the redistricting of Maryland in 2011. The Democratic party packed many Republicans into the 1st district, while cracking their base of support into the seven other districts. This gerrymander has allowed Democrats to consistently win seven of the eight congressional districts, despite winning only 60.4% of the overall House vote in 2016.¹² Evidently gerrymandering has become a major problem that tarnishes democracy.

Given the damage caused by partisan redistricting, finding a way to prevent its implementation has become quite important. With every almost state undergoing redistricting in 2021, following the release of the 2020 census, this issue has become incredibly pertinent to any understanding of policy. Most states, with only a few notable exceptions, allow their state legislatures to determine the drawing of the district lines with some input from the state's governor.¹³ But these state legislators also determine the format of their own districts at the state house or state senate level. This can create a cycle of gerrymandering, which allows one political party to become thoroughly entrenched as the majority party even if it does not reflect the will of the voters. Admittedly some states, like California, Hawaii, and Arizona, do require the use of a bipartisan redistricting committee, which generally appears to reduce the level of

¹¹ Ella Nilsen, "A new report says Democrats need to win the popular vote by 11 points to retake the House," *Vox*, March 17, 2018, <https://www.vox.com/policy-and-politics/2018/3/27/17144198/gerrymandering-brennan-center-report-midterms-democrats-house-2018>.

¹² McGann, Smith, Laetner and Keena, *Gerrymandering in America*, 117.

¹³ *Ibid*, 3 – 5.

gerrymandering in their particular state.¹⁴ Also judges have expressed some willingness to rule against partisan gerrymandering in states like North Carolina, Pennsylvania and Wisconsin.¹⁵ Certainly the Pennsylvania Supreme Court's decision in 2018 to redraw the state map with more competitive congressional districts suggests that institutional power might effectively mitigate the harm of gerrymandering.¹⁶ However, given that thus far independent redistricting commissions and judicial power have diminished the power of gerrymandering in only a few states, it might be premature to assume that they will address this problem by themselves.

Interestingly, seven states prohibit gerrymandering not because of any legal stipulation, but simply due to the apportionment of congressional seats. Currently Alaska, Delaware, Montana, North Dakota, South Dakota, Vermont, and Wyoming cannot gerrymander due to having only one congressional seat. The apportionment process only allotted one congressional seat to each of these state because they are the least populous in the nation. The mapping of each of these states' one congressional district is determined by their specific state borders rather than a cavalcade of state legislators, consultants, and mapping experts huddled into a small conference room. This format ensures that political parties or minority groups will not be packed or cracked into different districts on the whim of the Democratic or Republican majority. Clearly, gerrymandering cannot occur if there are no districts to be drawn.

¹⁴ McGann, Smith, Laetner and Keena, *Gerrymandering in America*, 148.

¹⁵ Jeffrey Toobin, "The Courts Take Aim at Partisan Gerrymandering," *The New Yorker*, January 23, 2018, <https://www.newyorker.com/news/daily-comment/the-courts-take-aim-at-partisan-gerrymandering>.

¹⁶ Christopher Ingraham, "Pennsylvania Supreme Court Draws a Much More Competitive District Map to Overturn Republican Gerrymander," *The Washington Post*, February 20, 2018, <https://www.washingtonpost.com/news/wonk/wp/2018/02/19/pennsylvania-supreme-court-draws-a-much-more-competitive-district-map-to-overturn-republican-gerrymander/>.

This observation also hints at the possibility that states with fewer congressional districts will gerrymander at a far less potent degree than states with more districts. While this observation does not necessitate that California with its 53 districts will be the most gerrymandered state in the country, it does suggest that absent California's other laws regarding redistricting, its large number of districts provides the state with the greatest ability to gerrymander. Certain states like Pennsylvania and North Carolina, which each contain a large number of districts, have used this opportunity to substantially gerrymander their states.¹⁷ According to this hypothesis, those same redistricting committees could not gerrymander at the same degree if they were forced to draw fewer districts. After all, even if the state legislatures of Rhode Island or Idaho, both of which contain only two congressional districts, gerrymandered their states at a truly egregious level it would only affect two seats in congress. However, when a state like Pennsylvania, North Carolina, New York, or Texas undergoes gerrymandering, it potentially could impact a much larger number of House seats.

This paper also seeks to ascertain the effect of changing the number of districts on the potency of gerrymandering. Following each decennial census, the apportionment of congressional seats, which has stayed fixed at 435 districts since 1910, changes based on the shifts in each state's population.¹⁸ As a result, Arizona's number of congressional seats has risen from four in the 1970s to nine in the 2010s, while Massachusetts's has declined from twelve to nine in that same time span.¹⁹ Changing the number of

¹⁷ Pennsylvania has 18 congressional districts, while North Carolina has 13.

¹⁸ Daniel Greenberg, "Why 435? How We Can Change the Size of the House of Representatives," *FairVote*, October 12, 2017, http://www.fairvote.org/how_we_can_change_the_size_of_the_house_of_representatives.

¹⁹ Nicholas Goedert, 2014, "Gerrymandering or Geography?: How Democrats Won the Popular Vote but Lost the Congress in 2012", <https://doi.org/10.7910/DVN/24354>, Harvard Dataverse, V1, UNF:5:+NyAuf86FhtePLctd2MFg==

congressional districts in a state between decades necessitates that the redistricting committee make serious changes to the map to reflect the gain or loss of a district. Certainly a highly partisan perspective might view the addition of a district as an opportunity to give their own party another seat, while looking at a loss in the number of districts as a chance to deprive their political opponents of a seat. Thus this paper attempts to determine whether gaining or losing a district more closely correlates with an increase in the level of gerrymandering or if a change in the number of districts is shown to have no tangible impact on the magnitude of gerrymandering.

This project seeks to determine to what extent the number of districts impacts the extent of gerrymandering. If the paper reaches a clear understanding of the issue, it could offer alternative tactics on how to reduce the level of gerrymandering in the future.

Literature Review

Given the political significance of gerrymandering and its importance in determining elections, many academics and policy analysts have written books and articles on the subject dating back to the nineteenth century. Because this project primarily focuses on gerrymandering over the past few decades, most of the referred sources are fairly recent. Indeed, sources that were written in the wake of the November 2012 elections were given prime of place as they could accurately discuss the consequences of the 2010 redistricting efforts.

Many of the books provided narrative accounts of gerrymandering and redistricting efforts directed more towards a general audience rather than experts in the field. In his 2016 book, *Ratf**ked: Why Your Vote Doesn't Count*, David Daley describes

the experiences of the redistricting architects like Chris Jankowski. Several chapters take on a third person narrative depicting how Jankowski and others in light of the 2008 election endeavored to promote a conservative wave in the 2010 elections, which could be utilized to control the redistricting efforts.²⁰ Daley also describes meeting with several of these figures such as Andy Jorgensen, who played a pivotal role in the Wisconsin redistricting.²¹ While these narratives certainly prove interesting, in the context of this paper by themselves they offer little more than anecdotes about a much discussed process. Fortunately, as many of the chapters are divided by state, Daley offers insight regarding particularly interesting states or congressional districts. For instance, he makes specific reference to egregiously gerrymandered districts like the Michigan 14th, North Carolina 4th, Ohio 7th and 16th, and the Pennsylvania 7th.²² Utilizing this knowledge, these five districts can serve as the most extreme versions of partisan gerrymandering in contrast to the at-large districts of states like Wyoming, Montana, and Vermont.²³ Additionally, Daley's discussion about the consequences of additional or fewer congressional districts in the case of Florida and Pennsylvania respectively, provides greater insight for the overall hypothesis regarding changes in the number of districts over time.²⁴ Meanwhile, the chapters on Iowa and Arizona depict cases where gerrymandering was diminished due to several factors and thus warrants further analysis.

Other works focus on specific aspects of the gerrymandering field. For instance, *Gerrymandering in America: The House of Representatives, the Supreme Court, and the*

²⁰ Daley, *Ratf**ked*, 1 – 15.

²¹ Ibid, 136 – 139.

²² Ibid, 24, 41, 61, 84.

²³ At-large districts are another common term for a state's sole congressional district as the boundaries of that district is the same as the state's borders.

²⁴ Daley, *Ratf**ked*, 25, 121 – 123.

Future of Popular Sovereignty, which was written in 2016 by Anthony J. McGann, Charles Anthony Smith, Michael Latner, and Alex Keena, primarily fixates on the legal background of gerrymandering. While this makes much of the book less applicable to this paper, there are certain chapters dedicated to the quantification of gerrymandering. For instance, the authors provide a detailed account on the impact of partisan versus bipartisan redistricting commissions and the effect those have on drawing of maps.²⁵ Additionally, In one 2004 Supreme Court Case, *Vieth v. Jubelirer*, Justice Anthony Kennedy indicated that with proper measurements to calculate degrees of gerrymandering, he might be willing to side against it in a future court case.²⁶ In response to this, several scholars have written extensively on how to measure gerrymandering. The authors discussed different ways of measuring partisanship such as the seats/votes function, in which the number of votes needed to win each additional seat is graphed on an XY axis, which visualizes whether or not gerrymandering has taken place on a state level.²⁷ This function known as electoral responsiveness was first discussed by Andrew Gelman and Gary King in a 1994 *American Political Science Review* article, “Enhancing Democracy Through Legislative Redistricting.” In this article, Gelman and King tested to see how much redistricting affected the level of electoral responsiveness and partisan bias in each state for each year between 1968 and 1988.²⁸ The authors used indicator and ordinal variables as independent variables and measures of gerrymandering to examine this relationship. Their findings suggested the majority party on average will win about 6% of the seats the minority party would have won if they had controlled the drawing of

²⁵ McGann, Smith, Laetner and Keena, *Gerrymandering in America*, 108 – 109.

²⁶ Ibid, 2.

²⁷ Ibid, 59 – 61.

²⁸ Gelman and King, “Enhancing Democracy Through Legislative Redistricting,” *American Political Science Review* 88, no. 3 (September 1994): 543.

the districts.²⁹ However they posited that despite the partisan harms caused by allowing one party to control the redistricting, such an outcome was more democratic than not conducting any type of redistricting efforts.³⁰

In his 1973 article from *American Political Science Review* “The Relationship Between Seats and Votes in Two Party Systems,” Edward Tufte also examined the relationship between the number of votes and the number of congressional seats and tested different methods of examining their relationship such as the Linear Fit, the Cube Law, and the Logit Model, on United States House elections between 1868 and 1970, while also examining elections in the states of Michigan, New York, New Jersey as well as the United Kingdom, and Australia.³¹ In this study he found that in the late 1970s, the swing responsiveness of the number of votes to the number of seats had decreased, suggesting a rise in the utilization of partisan gerrymandering.³² Gary King and Robert Browning wrote a similar article in the *American Political Science Review* entitled “Democratic Representation and Political Bias in Congressional Election” in 1987. This piece also conducted data using the Cube Law to detect magnitude of partisan bias.³³

An additional way to measure gerrymandering is utilizing the efficiency gap, which Nicholas Stephanopoulos and Eric McGhee first discussed in a 2015 article from the University of Chicago Law Review called “Partisan Gerrymandering and the Efficiency Gap.” The efficiency gap calculates the number of wasted votes in each congressional district to determine to what extent the state has been gerrymandered and

²⁹ Gelman and King, “Enhancing Democracy Through Legislative Redistricting,” 553.

³⁰ Ibid, 553.

³¹ Edward Tufte, “The Relationship Between Seats and Votes in Two-Party Systems,” *American Political Science Review* 67, no. 2 (June 1973): 541 – 546.

³² Ibid, 553 – 556.

³³ Gary King and Robert X. Browning, “Democratic Representation and Partisan Bias in Congressional Elections,” *American Political Science Review* 81 (1987): 1253.

to what degree.³⁴ This method has received a great deal of attention and functions as a cornerstone of the argument against gerrymandering in the 2017 Supreme Court Case, *Gill v. Whitford*.³⁵ In addition to discussing these formulas, the authors offer key visualization of the different forms of these formulas and detail how they apply to specific states as well.³⁶ While such assessments are only one way of determining partisan bias and only work for the state as a whole rather than specific districts, these functions should prove useful in further analysis. The authors also offer an interesting viewpoint of compactness namely that creating compact districts does not necessarily eliminate partisan bias.³⁷ These accounts while utilized for the purpose of discussing it in a legal framework, nonetheless will prove quite useful in this research project.

Gerrymandering in America also offers a detailed account and counterargument about the premise laid forward by works such as Bill Bishop's 2008 book *The Big Sort*, which claim that gerrymandering occurs due in large part liberals concentrating themselves in urban areas.³⁸ Indeed, this theory received additional support from Nicholas Goedert's 2012 article in *Research and Politics*, "Gerrymandering or Geography: How Democrats Won the Popular Vote But Lost the Congress in 2012." Goedert posited that partisan gerrymandering alone cannot explain the retention of the Republican majority in the House of Representatives, but that the effects of geographical

³⁴ Nicholas O. Stephanopoulos and Eric M. McGhee, "Partisan Gerrymandering and the Efficiency Gap," *University of Chicago Law Review* 82, (2015): 834.

³⁵ Robin I. Mordfin, "Proving Partisan Gerrymandering with the Efficiency Gap," *The University of Chicago Law School*, 2017, <https://www.law.uchicago.edu/news/proving-partisan-gerrymandering-efficiency-gap>.

³⁶ Stephanopoulos and McGhee, "Partisan Gerrymandering and the Efficiency Gap," 858.

³⁷ *Ibid*, 892 – 893.

³⁸ Bill Bishop, *The Big Sort: Why the Clustering of Like-Minded Americans is Tearing Us Apart*, (Boston: Houghton Mifflin Company, 2008), 11 – 13.

sorting also played a substantial role.³⁹ Because this claim certainly holds some weight, any effective understanding of gerrymandering must recognize the importance of geography.

The 2017 book, *Drawing the Lines, Constraints on Partisan Gerrymandering in U.S. Politics* by Nicholas Seabrook, provides an additional insight into the actual specifics of how redistricting occurs. It discusses several factors that act as barriers to gerrymandering including control of the state government, incumbency, state constitutional requirements, and most importantly the number of districts each state has.⁴⁰

While Seabrook does not provide much information regarding number of districts as a limiting factor, he did refer to a 1999 paper by Thomas Gilligan and John Matsusaka on the topic.⁴¹ In a *Public Choice* article, “Structural constraints on partisan bias under the efficient gerrymander,” Gilligan and Matsusaka also attempted to determine the effect of the number of congressional districts on partisanship in election.⁴² Based on their findings, they concluded that increasing the number of congressional districts while holding the overall population constant will reduce partisan bias. Similarly, they determined that holding the number of districts constant and increasing the total population will increase partisan bias.⁴³ Certainly these findings differ from the hypothesis of this paper. However, the authors’ approach differed from this method used in this paper in several key ways. Firstly, Gilligan and Matsusaka attempted to determine the level of partisan bias by calculating the number of total votes cast for each candidate

³⁹ Nicholas Goedert, “Gerrymandering or Geography? How Democrats Won the Popular Vote but Lost the Congress in 2012,” *Research and Politics* 1, (2014): 2

⁴⁰ Seabrook, *Drawing the Lines*, 28 – 30.

⁴¹ *Ibid*, 29.

⁴² Thomas W. Gilligan and John G. Matsusaka, “Structural constraints on partisan bias under the efficient gerrymander,” *Public Choice* 100, (1999): 65

⁴³ Gilligan and Matsusaka, “Structural constraints on partisan bias under the efficient gerrymander,” 72.

rather than examining the amount of wasted votes as suggested by the efficiency gap analysis.⁴⁴ Next they utilized data from 1950 to 1994 rather than from 1972 to 2016.⁴⁵ Given the changes in technology and its effect on redistricting, the elections between 1994 and 2016 may change the results somewhat. Finally, Gilligan and Matsusaka attempted to determine the effect of adjusting population or number of districts without simultaneously adjusting the other.⁴⁶ Given that the population determines the number of districts, this analysis does not reflect the framing of the current system. For these reasons, this paper may determine notably different results from this Gilligan and Matsusaka’s paper. Nevertheless, given the similarities, it would make sense to compare their findings with those expressed in this paper.

Data Description

The primary dataset utilized in this project was previously used by Nicholas Goedert in his 2014 article “Gerrymandering or Geography?: How Democrats Won the Popular Vote but Lost Congress in 2012.”⁴⁷ The data was primarily used for his research in this article. Goedert’s dataset included information on both the primary and general elections along with vote totals for both major parties and third parties. However, this study only used the information related to the total votes of the two major parties in congressional elections from 1972 to 2010. Because neither primary elections nor third party votes can offer much information on the level of gerrymandering such findings were unnecessary for this study’s approach. It also includes data acquired from the

⁴⁴ Gilligan and Matsusaka, “Structural constraints on partisan bias under the efficient gerrymander,” 74.

⁴⁵ Ibid, 67.

⁴⁶ Ibid, 73 – 74.

⁴⁷ Nicholas Goedert, 2014, “Gerrymandering or Geography?: How Democrats Won the Popular Vote but Lost the Congress in 2012”, <https://doi.org/10.7910/DVN/24354>, Harvard Dataverse, V1, UNF:5:+NyAuf86FhtePLctd2MFg==

Federal Election Commission for the 2012 and 2014 congressional election results, and the vote returns from CNN for the 2016 election results.⁴⁸ While Goedert’s dataset expressed each unit as any candidate running for congress, this study’s modified data instead focuses on each of the fifty states in one particular election cycle as the unit of interest. By examining the state rather than the specific district or candidate, it allows usage of the efficiency gap and the mean-median gap tests, both of which are performed at the state level. Thus this paper can incorporate regressions using effective measurements of gerrymandering.

Conceptual Model

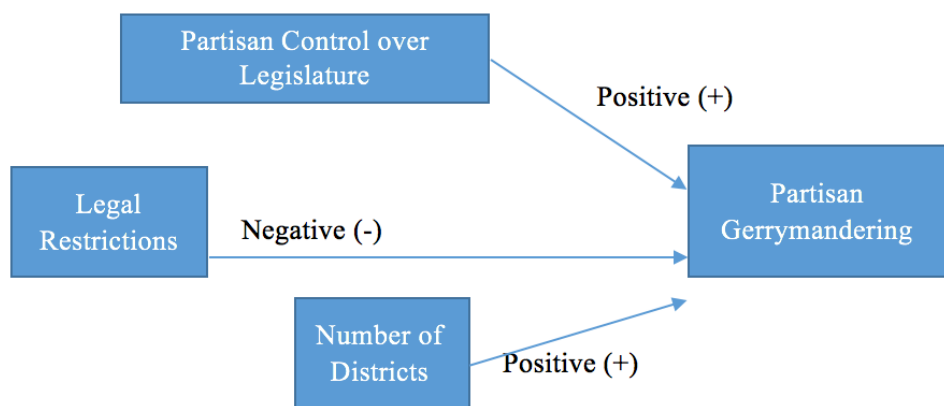


Figure 1: Conceptual Model of the Determining Factors of Gerrymandering

Partisan gerrymandering occurs due to a variety of factors. These include the partisan makeup of the state legislatures, the legal requirements of the redistricting process, and the number of congressional districts in a state. While none of these components instigate thorough and politically motivated redistricting by themselves,

⁴⁸ “Official Election Results for the United States Senate and the United States of House of Representatives,” *The Federal Election Commission*, 2012, <https://transition.fec.gov/pubrec/fe2012/2012congresults.pdf>. “Official Election Results for the United States House of Representatives,” 2014, <https://transition.fec.gov/pubrec/fe2014/2014house.pdf>. “House Results,” *CNN Politics*, 2016, <https://www.cnn.com/election/2016/results/house>.

removing any one of them from the equation makes the process that much harder. This paper predicts that excluding or limiting any one of these factors would act as a notable barrier to gerrymandering attempts. Particularly it focuses on the effect that the number of congressional districts has on partisan redistricting.

The central premise of this theory originated from observations of states with only one congressional district, which includes Alaska, Delaware, Montana, North Dakota, South Dakota, Vermont, and Wyoming. Following the 2010 census and the apportionment of only one congressional seat to each of these states, the redistricting process would not occur in any of these states. Thus even if in Wyoming, the Republicans held supermajorities in both houses, controlled the governor's office, could exert complete control over the redistricting process, and were favored by geographic sorting, they still could not engage in gerrymandering as they would only hold one congressional district. Though states with only one congressional seat cannot experience gerrymandering, it notably does not prevent partisan bias. Certainly if South Dakota's electorate consistently supported Republican candidates by a 51-49 margin, then Republicans would continuously get elected to congress despite having a large Democratic minority. However, in states with only one district to run in, no party can win more seats than is proportionally fair.

Based on these observations, this paper speculates that limiting the effect of the redistricting process will similarly limit the effectiveness of gerrymandering. States with only two congressional districts like Hawaii, Idaho, Maine, New Hampshire, and Rhode Island, must divide their area into two districts with relatively equal populations. As a result, implementing severe gerrymandering onto such a state would be more difficult as

a redistricting committee could only draw one dividing line between the two districts. Thus in an evenly split state, drawing the districts to provide one party with two favorable districts would become rather difficult. Admittedly, assuming one of these states met all the other criteria for partisan redistricting, gerrymandering might still occur. But the degree to which a political party can gerrymander a state with two or even three or four districts is hypothesized to be more limited than for a state with twelve, thirteen, or fourteen districts. Comparing the magnitude of gerrymandering in a state, as measured by the difference in wasted votes, with the number of districts in that same state certainly lends credence to this theory as seen in Figure 2.

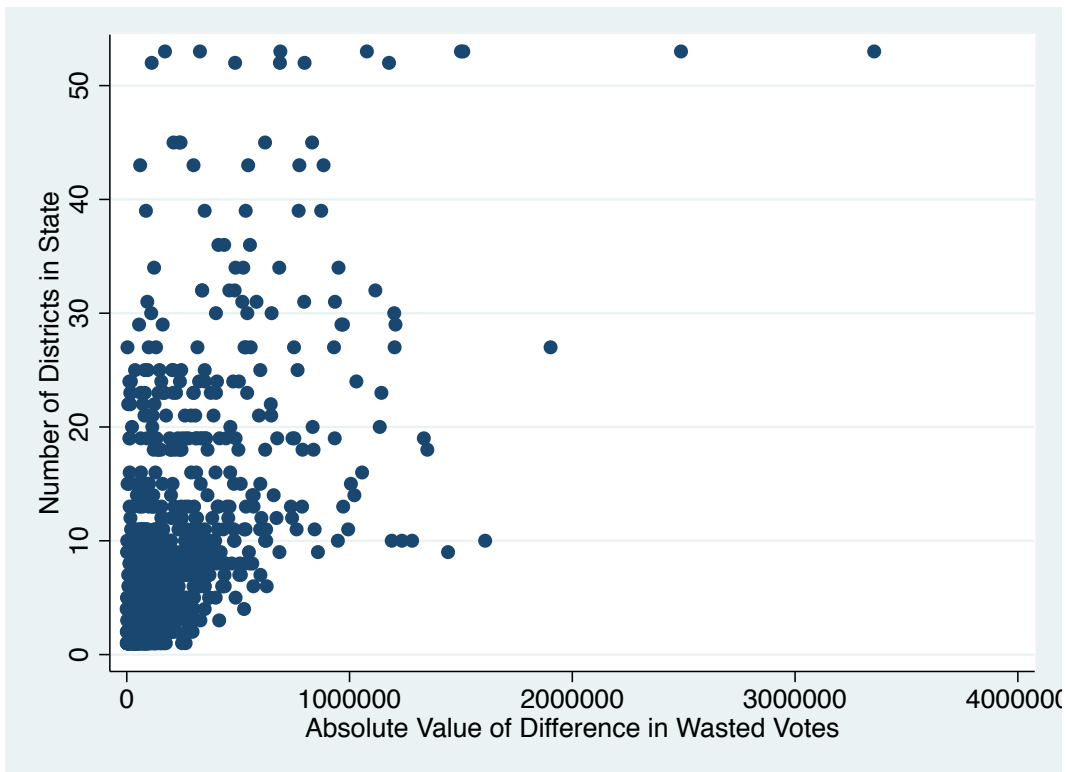


Figure 2: Scatter Plot of Number of Districts and Absolute Value of Difference in Wasted Votes

As seen in Figure 2, the states with more districts exhibit more cases in which the absolute value of difference in wasted votes in a state exceeds 1,000,000 votes. Assuming that gerrymandering affected smaller and larger states at the same level, it could be assumed that larger states would not show this potential for extremely large wasted vote differences. While in a non-gerrymandered state, the overall number of votes would increase as the population increases, there would be relatively minimal change to the difference in wasted votes. However, because the scatter plot shows a clear potential for large increases in wasted votes with an increase in the number of districts in a state, this figure supports this paper's theory that more populous states are more susceptible to gerrymandering.

By this same logic it is assumed that partisans will gerrymander in a more effective and pronounced way in states with more congressional districts. For instance, Pennsylvania's eighteen congressional districts provided the Pennsylvanian state legislature with significantly more opportunities to gerrymander than their counterparts in states like Idaho or Maine. Drawing eighteen districts during the redistricting process allows legislators with more instances to pack or crack minorities or the opposition party throughout the state. Certainly in the case of Pennsylvania, these efforts succeeded as the Republicans currently hold thirteen congressional seats despite winning only 53.9% of the overall vote during the 2016 elections.⁴⁹ Even in 2012, when the Democrats won 50.3% of the overall vote, the Republicans still won 13 seats.⁵⁰ If Pennsylvania contained only two or three congressional districts, this degree of partisan gerrymandering likely

⁴⁹ "2016 House Results," *CNN Politics*.

⁵⁰ Daley, *Ratf**ked*, 31.

would be that much harder to implement. While limiting the number of districts does not outright prevent gerrymandering, it does appear to limit its effectiveness.

It should be noted that even states with a large number of congressional districts can still diminish gerrymandering through other means. For instance, California holds 53 congressional districts, which is more than any other state in the country. Yet because it utilizes an independent commission consisting of 5 Democrats, 5 Republicans, and four non-partisan members, it avoids partaking in partisan gerrymandering to the extent that partisan state legislatures often do.⁵¹ As a result, Democrats winning 62.3% of the vote and 39 of the 53 seats in 2016 is not quite as severe an example of gerrymandering as what was seen in Pennsylvania despite California having significantly more districts.⁵² Certainly when other steps are taken to limit gerrymandering like the use of an independent redistricting commission, the number of districts will not play as major a role. Recognizing this fact, this paper does not propose that the number of districts acts as a sole contributor to the level of gerrymandering. Instead it asserts that, while simultaneously holding all other variables constant, decreasing the number of districts may limit gerrymandering to some extent.

Additionally, it should be noted that several of the contributing factors for gerrymandering have certain causal relationships between each other. For instance, whatever laws have been passed regarding redistricting efforts in any particular state were determined by votes from the state legislature and the approval of the governor. While such bills were not necessarily decided by the present legislature, any law

⁵¹ John Myers, "Political Road Map: California's election maps, drawn without party favoritism, hit the halfway mark," *The Los Angeles Times*, November 6, 2016, <http://www.latimes.com/politics/la-pol-ca-road-map-political-districts-parties-20161106-story.html>.

⁵² "2016 House Results," *CNN Politics*.

presumably was approved by the state legislature at some point in time. It is also possible that a legal challenge from a plaintiff or a judge's order might have mandated that certain laws regarding redistricting be changed. Finally, geographic impacts regarding demographics and self-sorting of partisanship also determines the makeup of the state legislatures just as it does for congress. These causal relationships should all be born in mind when attempting to understand the relationship between number of districts and gerrymandering.

In addition to examining the relationship between the number of districts in a state and the level of gerrymandering, this paper also seeks to determine the effect of the change in the number of districts. Following each census, the states receive a certain number of congressional seats based on their recently assessed state population. Thus during each redistricting process, states that have undergone a particularly large population growth will acquire additional congressional seats to reflect their larger population, while other states that have lagged behind the national population growth might lose a certain number of seats. This paper also attempts to understand what effect the change in the number of districts has on the potency of gerrymandering. Certainly it makes sense to hypothesis that either adding or subtracting a district from a state's map may profoundly affect its congressional elections.

Ultimately, these describe factors appear to be the primary causal forces behind gerrymandering. While, partisan redistricting can and has occurred without all of the factors taking place, the power of the gerrymandering appears to be limited as a consequence. This paper concerns itself with examining the relationship between number

of districts and effectiveness of gerrymandering and thus must also take into account all other factors in determining how gerrymandering comes to be.

Empirical Strategies

Each of the formulas used in this paper's regressions, includes a measurement of gerrymandering as the dependent variable and the number of districts as the variable of interest. This paper initially planned to use the efficiency gap to measure gerrymandering potency. The formula calculates the difference between the sum of wasted votes for the Democratic and Republican parties in all of a state's congressional districts and divides it by the total number of votes cast in that state.⁵³ The equation for the efficiency appears below:

$$\text{Efficiency Gap} = (\sum(\text{Democratic Wasted Votes}) - \sum(\text{Republican Wasted Votes})) / (\text{Total Votes})$$

However, dividing the difference in wasted votes by the total number of votes cast normalizes each of these gerrymandering measurements. The efficiency gap shows the difference between the proportion of votes a political party received and the proportion of seats they won. Thus an efficiency gap of 0.1 will have very different political consequences for North Carolina and Idaho respectively. Stephanopoulos and McGhee understood this problem, which was why they multiplied the gap by the number of seats in a state when comparing efficiency gaps among the 50 states.⁵⁴ However, to do this for this paper's regression would cause serious collinearity problems as it would involve

⁵³ McGhee and Stephanopoulos, "Partisan Gerrymandering and the Efficiency Gap," 849 – 851. Every vote cast for a losing candidate is considered a wasted vote, while every vote that the winning candidate did not need to have in order to win is also counted as a wasted vote. Thus if a Democrat defeated a Republican 500 votes to 400, the Republican will have wasted 400 votes while the Democrat wasted 99 votes = (500 – 400 – 1).

⁵⁴ Laura Royden and Michael Li, "Extreme Maps," *The Brennan Center for Justice*, April 2017, <https://www.politico.com/f/?id=0000015c-11a2-d46a-a3ff-9da240e10002>, 6.

multiplying the dependent variable by the variable of interest. Meanwhile, due to problems with normalization the efficiency gap also cannot be utilized. Thus this paper instead uses the difference in wasted votes as both the dependent variable and the primary measurement of gerrymandering. While utilizing this difference in wasted votes does make interpreting the results in the regression and predicting the effect on congressional seats more difficult, it remains preferable to the other two options. Thus an OLS regression with no controls would look like the following:

$$ABwaste(s) = \beta_0 + \beta_1 \text{district} + e_i$$

In this regression, the absolute value of the difference in wasted votes (ABwaste) serves as the dependent variable, while the number of districts serves as the independent variable. Because this analysis focuses on magnitude of gerrymandering rather than the particular political preference, utilizing an absolute value for all measures of gerrymandering makes more sense. Meanwhile, the number of districts each state had at the time of the particular election serves as the variable of interest.

Obviously, other factors play a major role in causing gerrymandering, which were discussed in the conceptual model section. These other contributory factors are included in the next formula as covariates.

$$ABwaste(s) = \beta_0 + \beta_1 \text{district} + \beta_2 \text{phmaj} + \beta_3 \text{psmaj} + \beta_4 \text{irc} + \beta_5 \text{post94} + e_i$$

In this OLS regression, phmaj represents how much of a majority the dominant political party has over the state house. It is calculated by determining the difference between majority party's control over the state house and an even 50% split and multiplies that amount by two. Thus if the Democrats held 70% of the 150 seats in the New York State

Assembly, their phmaj amount would be 0.4.⁵⁵ The psmaj amount applies the same idea to the state senate. Admittedly, the variables for both the state senate and the state house likely will correlate, however incorporating both variables recognizes the rare occasion in which the two assemblies diverge in redistricting policy. The IRC variable is an indicator about whether or not a state has allowed an independent redistricting commission to oversee the redistricting process. By 2018, only seven of the states have enacted this policy. Finally, the post94 variable is another indicator about whether or not the election took place prior to the 1994 elections. Many political scientists have described these elections, in which Republicans took control of the House of Representatives as part of Newt Gingrich’s “Contract with America,” as the beginning of the current politically polarized era.⁵⁶ In recognition of this observation, this paper uses it as an indicator variable.

Because this paper also seeks to determine the impact of the change in districts over time, it also incorporates regressions to reflect this change. The first formula involves incorporating an additional covariate into the formula seen above.

$$ABwaste(s) = \beta_0 + \beta_1 \text{district} + \beta_2 \text{phmaj} + \beta_3 \text{psmaj} + \beta_4 \text{irc} + \beta_5 \text{post94} + \beta_6 \text{districtgain} e_i$$

The variable, district gain, denotes the change in the number of districts each state has undergone since the 1970s.⁵⁷ Specifically it denotes the change in the number of districts each state has undergone between each decade. However, this model by itself cannot

⁵⁵ In this hypothetical, Democrats hold 105 seats (70%). The difference between 0.7 and 0.5 is 0.2, which multiplied by 2 gets an amount of 0.4.

⁵⁶ Daley, *Ratf**ked*, 110.

⁵⁷ Every state in the 1970s has a district gain amount of 0. If a state gained an additional district in the 1980s, the amount for that state in every election in the 1980s is 1, while if it lost a district the amount would be -1. This variable also covers the change between the 1980s and the 1990s, the 1990s and the 2000s, and the 2000s and the 2010s.

fully account for changes over time. Still utilizing both a fixed effect model and a first differences model may accomplish this. Applying the fixed effect formula to these specifications would look like the following:

$$ABwaste_{st} - ABwaste_{s,mean} = \beta_1(district_{st} - district_{s,mean}) + \beta_2(phmaj_{st} - phmaj_{s,mean}) + \beta_3(psmaj_{st} - psmaj_{s,mean}) + \beta_4(irc_{st} - irc_{s,mean}) + e_{it} - e_{i,mean}$$

The fixed effect model takes the difference between each of the variables for each specific state during a certain election and the mean of that variable for each specific state. However, the post-1994 variable and the district gain variable are both excluded from this regression because they both include change over time, which the fixed effect model addresses.

The First Differences Model also incorporates change of each variable over time by specifically looking at the difference between the first and second periods. In this formula, each period is denoted by decades as redistricting changes on a decennial basis. The formula for this regression read as follows:

$$ABwaste_{st} - Abwaste_{st-1}$$

This formula demonstrates the difference in gerrymandering between each of the periods as reflected by the independent variables. However, it should be noted that this only serves as a robustness test.

Utilizing the number of wasted votes makes for an effective understanding of gerrymandering. However, the efficiency gap has received some criticism from other political scientists for adhering to a two-party view and ignoring political heterogeneity in political parties.⁵⁸ It also fails to account fully for uncontested races in that it cannot

⁵⁸ Christopher P. Chambers, Alan D. Miller, and Joel Sobel, "Flaws in the Efficiency Gap," *Journal Law and Politics* XXXIII, no. 1 (2017), 23 – 24.

count support for the minority party in that district if there is no candidate to vote for.⁵⁹ In recognition of these flaws, it would also make sense to utilize other methods of measuring gerrymandering as alternative dependent variables in order to account for some of these potential flaws in the formula. One such approach these include the Polsby-Popper Test, which calculates compactness of a district on a 0-1 scale, through the formula $PP(D) = 4\pi A(D)/p^2$, where $A(D)$ = District Area and p = District Perimeter.⁶⁰ This test can be applied either at the district level or at the state level by taking the average amount of the test. Unfortunately, this test merely measures geographic compactness and while it will account for the more egregiously drawn districts, it does not identify gerrymandered districts that are compactly drawn. Thus while it works as an alternative dependent variable, it certainly should be not utilized as the primary one. Another method would be to conduct a median-mean test, which would find the difference between the average vote share for one party across all congressional elections in a state and the median vote share for all the congressional elections in a particular state.⁶¹ Because the mean-median gap concentrates on the difference in vote shares for a specific political party, this paper conducts regressions with both the Democratic and the Republican mean-mean gaps as the dependent variables. Like with the difference in wasted votes, this analysis takes the absolute value of these gaps because it analyzes gerrymandering potency rather than bias for a specific political party. The OLS regression will read as follows:

$$ABDMM(s) = \beta_0 + \beta_1 \text{district} + \beta_2 \text{phmaj} + \beta_3 \text{psmaj} + \beta_4 \text{irc} + \beta_5 \text{post94} + e_i$$

⁵⁹ Benjamin Plener Cover, “Quantifying Partisan Gerrymandering: An Evaluation of the Efficiency Gap Proposal,” *Stanford Law Review* 70, (December 22, 2017), 18 – 19.

⁶⁰ McGann, Smith, Laetner and Keena, *Gerrymandering in America*, 83 – 84.

⁶¹ Royden and Li, “Extreme Maps,” 12 – 13.

$$ABRMM(s) = \beta_0 + \beta_1 \text{district} + \beta_2 \text{phmaj} + \beta_3 \text{psmaj} + \beta_4 \text{irc} + \beta_5 \text{post94} + e_i$$

In these regressions, ABDMM denotes the absolute value of the Democratic mean-median gap, while ABRMM denotes the absolute value of the Republican mean-median gap.

Results

This initial OLS regression includes only the dependent variable (the absolute value of the difference between the total Democratic and Republican wasted votes in a state) and the number of districts in that state. In recognition of the premise that states with only one congressional district cannot gerrymander, the paper has included a regression where all states are included (Wasted Votes Difference 1), a regression where all states which have only had 1 congressional district for the entire duration of the 1972 – 2016 time period are excluded (Wasted Votes Difference 2), and one where states with only 1 district are excluded (Wasted Votes Difference 3).⁶²

Table 1: OLS Regression Without Controls

	Wasted Votes Difference 1	Wasted Votes Difference 2	Wasted Votes Difference 3
Number of Districts	15,999*** (682.9)	15,788*** (747)	15,785*** (771.2)
Constant	56,377*** (8,703)	60,580*** (10,032)	60,639*** (10,541)
Observations	1,150	1,035	999
R-squared	0.323	0.302	0.296

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Vote Difference 1 includes all 50 states, Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972. Wasted Votes Difference 3 excludes Alaska, Delaware, Montana (from 1992 to the present), Nevada (from 1972 to 1980), North Dakota, South Dakota (from 1982 to the present), Vermont, and Wyoming.

⁶² In Wasted Votes Difference 2, Alaska, Delaware, North Dakota, Vermont, and Wyoming, are all excluded. Alaska, Delaware, Montana (from the 1990s onward), Nevada (in the 1970s), North Dakota, South Dakota (from the 1980s onward), Vermont, and Wyoming are all excluded in Wasted Votes Difference 3.

This regression predicts that if State A has one more additional district than State B, the difference in the number of wasted votes between the two political parties will increase by approximately 16,000 votes between State B and State A. Such a result is rather surprising as the conventional wisdom would hold that the difference of wasted votes between the parties, which is a key component in describing gerrymandering, would hold constant for both smaller and larger states. While the total number of wasted votes would increase alongside the number of districts in a state, the wasted votes for each of the parties should also increase at the same rate assuming that larger states do not suffer from a greater potency of gerrymandering. However, because the difference in wasted votes between the two parties increases steadily and the regression considers the coefficients in each of the three columns to be significant at the 0.01 level, this regression suggests that larger states display more signs of gerrymandering than smaller ones. Because of the dependent variable, this regression unfortunately cannot describe in depth how it would affect congressional elections as a whole. While the analysis predicts that the difference of wasted votes in a state will increase with each additional district, it cannot indicate how many more seats the majority party will win than they proportionally should have won. Nevertheless, it acts as a good demonstration of gerrymandering that avoids collinearity with the variable of interest. Additionally, the regression indicates that all three columns also have a highly significant constant of somewhere between 56,000 and 60,000. Following this amount, the regression predicts that any state with two districts would have a difference in wasted votes between the two parties of

approximately 90,000 votes.⁶³ In contrast, a state with 8 districts, which is one of McGhee and Stephanopoulos's chosen thresholds, would have a difference in wasted votes of approximately 185,000.⁶⁴ Thus based on this OLS regression, the paper's initial hypothesis that states with more districts allow for greater gerrymandering does seem supported. Interestingly, reducing the number of observations by excising states which have never had one at-large district throughout the time period of interest in Wasted Votes Difference 2 and excluding any state with only one district in Wasted Votes Difference 3 appears to create something of a trend. In Table 1, both the coefficient for number of districts and the r-squared amount steadily decreases as states with only one district are left out, while the constant steadily increases. Evidently excluding state with only one district places a greater importance on the other factors related to gerrymandering than just the number of districts. However, given the highly significant constant seen in Table 1, it would be a mistake to conclude that the number of districts in a state acts as the sole determining factor in regards to gerrymandering. This next regression takes this fact into account by including four different controls: having an independent redistricting committee, the degree of a political party's control over the state house and senate, and whether or not the election occurred in the post-1994 period.

⁶³ States with two districts were chosen for this formula, because states with only one district are excised in columns 2 and 3. For Wasted Votes 1, $56,377 + 2*15,999 = 88,375$, for Wasted Votes Difference 2, $60,580 + 2*15,788 = 92156$, and for Wasted Votes Difference 3, $60,639 + 2*15,785 = 92209$.

⁶⁴ McGhee and Stephanopoulos, "The Efficiency Gap and Gerrymandering," 831.

Table 2: OLS Regression With Controls

	Wasted Votes Difference 1	Wasted Votes Difference 2	Wasted Votes Difference 3
Number of Districts	16,452*** (679.2)	16,328*** (744.6)	16,311*** (769.2)
Independent Redistricting Commission	-8,759 (29,000)	-14,111 (30,592)	-15,957 (31,162)
Percentage of House Majority	125,350*** (48,158)	142,687*** (54,344)	147,392*** (56,633)
Percentage of Senate Majority	-21,519 (43,962)	-32,728 (50,314)	-34,877 (52,546)
Post-1994 Period	80,365*** (12,866)	88,685*** (14,308)	92,264*** (14,813)
Constant	-20,249 (14,914)	-23,112 (16,951)	-25,137 (17,584)
Observations	1,150	1,035	999
R-squared	0.352	0.333	0.329

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Vote Difference 1 includes all 50 states, Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972. Wasted Votes Difference 3 excludes Alaska, Delaware, Montana (from 1992 to the present), Nevada (from 1972 to 1980), North Dakota, South Dakota (from 1982 to the present), Vermont, and Wyoming.

When taking these four other controls into account, the coefficient for the number of districts stays at both the same level of significance and at roughly the same size with the coefficient for all three columns being just over 16,000 wasted votes as opposed to just under 16,000 in Table 1. This indicates that the variable of interest does not correlate much with the controls, as if it did this paper would expect the magnitude of the coefficients to decrease slightly. It also reflects the fact that none of the four controls included in these specifications depend on the number of districts in a state. Indeed, independent redistricting commissions (IRCs) draw the legislative maps for both Hawaii and California, while state size offers no indicator on whether a political party will hold a large or a minimal majority in either house of the state legislature. None of the signs or

magnitudes of the controls' coefficients appear particularly surprising. The presence of an IRC does decrease the difference in wasted votes by about 9,000 in Wasted Votes Difference 1, 14,000 in Wasted Votes Difference 2, and 16,000 in Wasted Votes Difference 3. However, these findings are not considered significant, possibly because only six states have established these commissions in the past few decades.⁶⁵ Due to these commissions only affecting 55 out of the 1,150 observations, they clearly do not play a significant role in the regression as a whole. Holding a sizable majority in State House also heavily affects the difference in wasted given the large coefficients of 125,350 in Wasted Votes Difference 1, 142,687 in Wasted Votes Difference 2, and 147,392 in Wasted Votes Difference 3. Thus if the Republicans controlled every seat of the Wisconsin State House while holding all other variables constant, this regression predicts that doing so would increase the difference in wasted votes by 125,350 votes in Wasted Votes Difference 1 when compared to an evenly split Wisconsin state legislature.⁶⁶ Interestingly, the coefficients on the percentage of senate majority one party holds is both negative and not significant for all three columns. This occurs due to the fact that there is a high correlation between one party controlling the State House and the State Senate. When performing the same regressions but excluding the percentage of House Majority as a control, the coefficients for Percentage of Senate Majority would be both positive

⁶⁵ Kim Soffen, "Independently Drawn Districts Have Proved to be More Competitive," *The New York Times*, July 1, 2015, <https://www.nytimes.com/2015/07/02/upshot/independently-drawn-districts-have-proved-to-be-more-competitive.html>. Hawaii established the first one in 1982 and Washington followed suit in 1992, Arizona, Idaho, and New Jersey only began theirs in 2002, while California's was established in 2012

⁶⁶ Complete Control of the State house (0.05)*House Majority Coefficient (250,700) = 125,350. For Column 2 the difference would be 147,391.5 votes, and for Column 3 the difference would be 142687.

and significant.⁶⁷ Finally, the coefficients on the post-1994 indicator variable suggests that beginning with Republican Congressman New Gingrich's surprise takeover of the House of Representatives in 1994, the the difference in wasted votes has increased by somewhere between 80,000 and 90,000 votes. As seen with Table 1, excluding states with only one district causes the coefficient to either increase in magnitude as seen in the case of the IRCs, the House Majority, the Senate Majority, and the post-1994 period, or decrease as seen in the case of the coefficient for number of districts. This paper will utilize the Wasted Votes Difference 2 as the primary dependent variable as it excises states which have never undergone gerrymandering but includes states, which have at one point had more than one district. Utilizing this as the dependent variable will allow for change in the number of districts to be included in each of the regressions.

⁶⁷ Running the regressions in Table 2 without the House Majority variable produces a coefficient of 73,697 in Wasted Votes Difference 1, 79,272 in Wasted Votes Difference 2, and 81,837 in Wasted Votes Difference 3. All of these coefficients are found to be significant at the $t=0.01$ level.

Table 3: OLS Regression Including Controls and District Gain⁶⁸

	Wasted Vote Difference
Number of Districts	16,411*** (738.5)
District Gain	-29,859*** (6,871)
Independent Redistricting Commission	-3,502 (30,427)
Percentage of House Majority	149,280*** (53,899)
Percentage of Senate Majority	-31,709 (49,883)
Post-1994 Period	87,064*** (14,190)
Constant	-26,508 (16,824)
Observations	1,035
R-squared	0.345

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

Adding the variable of district gain to this specification appears to have relatively little effect on any of the independent variables included in Table 2. However, the coefficient for district gain is found to be negative and significant at the 0.01 level. Indeed, it suggests that increasing the number of districts in a state by one will decrease the difference in wasted votes by 29,859 votes. This indicates that while more populous states are associated with a greater ability to gerrymander, granting any state an additional district during the apportionment process will reduce the difference in wasted votes between the two parties by approximately 30,000 votes. This makes sense as during

⁶⁸ This Table excludes the columns for the specification including all 50 states and the specification that excluded any state with only 1 district. Their coefficients for the number of districts are 16,515 and 16,371 respectively. This indicates that the excluding only states which have consistently had only 1 district is continuously placed in between these others two columns.

the redistricting process, gaining one additional district allows the mapmakers the possibility to keep most of the districts relatively intact while drawing out a new one. Though a partisan minded redistricting commission could utilize this opportunity to gerrymander, a general preference towards incumbency bias and these findings suggest otherwise. In contrast, reducing the number of districts by one inevitably will push one representative out of a job. When faced with such a prospect, most partisan redistricting committees will favor the incumbents of the majority party. This tendency likely contributes to the negative significant coefficient of about 30,000 votes. Thus while these OLS regressions suggest that larger states exhibit larger differences of wasted votes, this specification predicts that adding one additional district to such a state would decrease the difference of wasted votes.

Ultimately an OLS analysis cannot fully account for the number of changes each of the states go through in regards to both congressional apportionment and other factors. Given that this is panel data covering a 44-year period, it requires a fixed effect model. Such a regression will incorporate the changes over time that each of the 50 states experienced following each of the decennial reapportionment processes. Thus rather than just looking at the number of districts and the district gain, this regression will incorporate both of these aspects.

Table 4: Fixed Effects Regression With and Without Controls⁶⁹

	Wasted Vote Difference	Wasted Vote Difference
Number of Districts	-103.8 (4,372)	-2,495 (4,448)
Independent Redistricting Commission		127,905*** (40,881)
Percentage of House Majority		18,495 (66,982)
Percentage of Senate Majority		-57,236 (57,314)
Constant	212,438*** (42,296)	241,361*** (46,825)
Observations	1,035	1,035
R-squared	0	0.011
Number of States	45	45

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

These results tell a somewhat different story about the relationship between gerrymandering and the number of districts in a state. Table 4 puts out non-significant and negative coefficients for the number of districts both with and without covariates. While including the other determining factors for gerrymandering in the specification increases the magnitude of the coefficient from -103.8 votes to -2,495 votes, the coefficient remains insignificant. These findings suggest that when taking into account the changes in the number of district over this 44-year period, the regression cannot detect any notable relationship between the difference in wasted votes and the number of districts in a state. Meanwhile the IRC coefficient shows a positive sign and the highest

⁶⁹ The coefficients for number of districts without controls is -103.8 for all 50 states, and 30.29 for the specification without states with 1 district. The coefficients for number of districts with controls is -2,423 for all 50 states, and -2,415 for the specification without 1 district states. The coefficients for the controls also share the same significance level and place the shown specification in between the two omitted specifications.

level of significance, indicating that establishing such a commission is shown to increase the level of gerrymandering over time. This is somewhat surprising given that most experts assume these commissions actually reduce gerrymandering. However, because all seven of the IRCs were established during this period, it is possible that they detected the overall increase in gerrymandering potency in this 44-year period. Interestingly neither control over either of the state legislatures appears to have induced significant changes in gerrymandering over time. Again this makes some sense given that holding a majority in either of the state legislatures is likely to have the same effect of gerrymandering whether in the 1970s or the 2010s. Obviously these results stand in sharp contrast to the OLS results. Potentially this may have occurred because the OLS regression looked at the number of districts in a state and the gain or loss of additional districts separately and found that they had a significant positive and negative coefficient respectively. Because the fixed effects model incorporates both, these two findings may have counteracted each other and indicated that when examining the change in the number of districts for states over time there is not a significant relationship. Alternatively, perhaps the difference in wasted votes has undergone numerous changes over more than four decades. This dataset begins with the 1972 House of Representatives election that occurred during Richard Nixon's reelection campaign. Its final year examines the 2016 elections, during which Donald Trump won the electoral college. That period includes 23 different House Election years and the electoral system underwent a variety of changes. In recognition of these changes, this paper will include an interaction term between the number of districts and the post-1994 variable to take into this potential shift in the political dynamic.

Table 5: Fixed Effects Regression With Interaction Term⁷⁰

VARIABLES	Wasted Vote Difference	Wasted Vote Difference
Number of Districts	-8,698** (4,307)	-8,891** (4,353)
Number of Districts*Post-1994 Period	8,703*** (956.4)	8,595*** (992.5)
Independent Redistricting Commission		57,888 (40,249)
Percentage of House Majority		55,860 (64,746)
Percentage of Senate Majority		-17,604 (55,467)
Constant	251,171*** (40,871)	238,955*** (45,162)
Observations	1,035	1,035
R-squared	0.077	0.081
Number of States	45	45

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

The results seen in Table 5 may explain the results from Table 4. By including this interaction term between the post-1994 period and the number of districts into the specification, it creates a regression in which both the coefficients for the number of districts and the interaction terms are significant. The coefficient for the number of districts is found to be between -8,698 votes and -8,891 votes depending on whether additional covariates are included. This suggests during the pre-1994 period, an increase

⁷⁰ The coefficients for number of districts and the interaction term for the 50 state specification and the specification excluding all states with 1 district are found to be quite similar to the ones expressed in Table 5. When excluding the other controls, the 50 state specification gives a coefficient of -8,702 and is significant at the second level, while the other specification is at -8,610 and is significant at the lowest level. Meanwhile the interaction term is 8,707 and 8,693 respectively and both are significant at the highest level. When including the other controls, the number of districts coefficient for the 50-state specification is -8,914 and -8,832 for the more than 1 district specification, both of which are significant at the second level. The interaction terms are 8,593 and 8,583 respectively with both at the highest level of significance.

in a state's number of districts was associated with a decrease of just under 8,900 wasted votes. Thus in this period, this regression predicts that an increase in the number of districts was associated with a decrease in the potency of gerrymandering and that decreasing the number of districts would lead to an increase in the level of gerrymandering. However, the interaction term is shown to be significant at the highest level and has a positive sign ranging from 8,595 to 8,703, depending on whether the covariates are included. Interestingly, in the specification with the covariates, the coefficient for the interaction term is slightly smaller in magnitude at 8,595 than the coefficient for the number of districts at -8,891. This means that in the post-1994 period, the two coefficients counteract each other and cause an increase in the number of districts to be associated with only a slight decrease in the difference of wasted votes, which is similar to the results seen in Table 4. This suggests that during and after the 1994 election, a change in the number of districts was no longer suggestive of gerrymandering. Alternatively, it could also mean that during this time period, state legislatures viewed redistricting as an opportunity to gerrymander regardless of whether their state gained, lost, or retained its number of districts. Meanwhile, including this interaction term leaves the control over the legislatures relatively unaltered, though it notably causes the IRC coefficient to lose its significance. Presumably Table 4 showed that coefficient as significant because it was capturing some of the time-related aspects now shown by the interaction term.

To better understand these change over time, this paper also uses the first difference model to serve as a robustness check. Table 6 examines how the change in the number of districts has impacted gerrymandering by comparing the changes between

each election cycle. It also establishes the set of elections in this dataset, the elections of the 1970s, as the excluded period.

Table 6: First Differences Regression⁷¹

	Wasted Votes Difference	Wasted Votes Difference
First Difference in Number of Districts	7,798 (14,446)	8,069 (14,709)
First Difference in IRC		24,800 (48,550)
First Difference in House Majority		-2,724 (64,492)
First Difference in Senate Majority		58,544 (66,352)
Constant	30,660*** (8,839)	31,357*** (9,797)
Observations	810	810
R-squared	0.004	0.012

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972. Table 6 examines the first differences with the decade of 1970 being selected as the excluded period.

To better understand the effect that the change in the number of districts has on the potency of gerrymandering, this paper has utilized this first difference model to ascertain the biyearly expected change in the differences of wasted votes. Based on the

⁷¹ The coefficient for the first difference in the number of districts for the 50 state specification is 7,798 while the other omitted specification is 7,818, both of which are found to be not significant. When including other covariates, the magnitudes increase slightly to 7,860 and 8,062 respectively, but remains non-significant. Interestingly, the coefficient for wasted votes with covariates shown in Table 6 is slightly larger than either of the excluded specifications. The control variables for the IRC and the senate majority coefficient appears in the middle between the two omitted specification's coefficients. However interestingly, the coefficients of House majority for both the 50 state regression and the exclusion of 1 district states regressions produce coefficients of -4,395 and -9,067, respectively. Both of these are notably larger in magnitude than the coefficient for the specification included in Table 6, which is -2,724. A similar case arises with senate majority, only the included coefficient of 94,790 is larger than either the coefficient for 50 states (76,945) or for the specification without one district states (86,337). Presumably, accounting for the change in districts that were at one point 1 district states had a large enough significance in the house majority to produce these results.

coefficient of approximately 8,000 in both columns, it suggests that over time increasing the number of districts correlates with a slight increase in the potency of gerrymandering. While this does appear to counter the results seen in the fixed effects regressions in Tables 4 and 5, it likely occurs because this regression takes into account the differences between each decades rather than the adjustments over time. Thus while an increase in districts over a forty-year period more closely associates with a slight decline in the level of gerrymandering, the acquisition of an additional district between two decades correlates with a slight increase in the difference of wasted votes. Additionally, this first difference model may put greater stock into the high levels of gerrymandering associated with the post-1994 period. Certainly it may be the case that the differences between the 1980s and the 1990s, along with changes in gerrymandering sparked by the other decennial transitions may account for these changes. For the most part the other covariates display similarly to their counterparts in Tables 4 and 5, with IRC having a positive but non-significant coefficient. Interestingly, the Senate majority coefficient is shown to be positive while the House coefficient is negative, which is the opposite of the results seen in Table 5. Potentially, when examining the time difference between the 1970s and the 1980s, control over the state senate changed in a more notable manner.

Whatever the reason for these results, the first difference analysis does offer some credence to the observations raised by the OLS regression. Based on these tables, it does appear that states with more districts will increase the difference in wasted votes and adding additional districts to any state in the pre-1994 period will reduce the difference, none of these changes will radically affect the level of gerrymandering in these states. Ultimately it would appear that the observed increase in partisan based redistricting

cannot fully be explained by other the number of districts or any of the other control variables. Some potential omitted variables would include incumbency bias, fundraising, and voter suppression efforts. Additionally, the mechanism to measure gerrymander suffers from numerous flaws, specifically the fact that there are not nearly enough observations to develop a greater sense of particular bias of certain maps. As a result, with a small number of observations and rather large standard errors, each of these regressions struggle to articulate the relationship between the number of districts and gerrymandering in a way that would be preferred.

Despite these challenges, this paper has utilized other approaches in an attempt to better understand this dynamic. By taking the natural log of the dependent variable, this method may mitigate some of the effects exhibited by outlier states like California. A natural log will diminish the effect that and other outliers may have on the data.

Table 7: OLS Regression With the Natural Log of the Wasted Vote Difference⁷²

	Natural Log of Wasted Vote Difference	Natural Log of Wasted Vote Difference	Natural Log of Wasted Vote Difference
Number of Districts	0.0584*** (0.00381)	0.0595*** (0.00384)	0.0598*** (0.00383)
Independent Redistricting Commission		-0.399** (0.158)	-0.362** (0.158)
Percentage of House Majority		0.507* (0.28)	0.530* (0.279)
Percentage of Senate Majority		-0.241 (0.259)	-0.237 (0.258)
Post-1994 Period		0.345*** (0.0738)	0.339*** (0.0735)
District Gain			-0.104*** (0.0356)
Constant	11.06*** (0.0512)	10.81*** (0.0874)	10.80*** (0.0872)
Observations	1,035	1,035	1,035
R-squared	0.185	0.206	0.213

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

Based on the similar results between Table 7 and those seen in Tables 1, 2 and 3, it does not appear that using the natural log of the dependent variable notably changes the results. The variable of interest continues to show a positive and significant coefficient in each of the three columns. Additionally, the larger states will increase the difference in wasted votes by about 6% for each additional district it has. The coefficients for the Independent Redistricting Committee all show signs of statistical significance, whereas in

⁷² The coefficients for the 50 state specification are 0.0644 without any covariates, 0.0659 with the covariates except for district gain, and 0.0661 with all of the covariates including district gain. The coefficients for the specification without any states with one district are 0.0571 without any covariates, 0.0580 with all the covariates except for district gain, and 0.0582 with all of the covariates including district gain. All of these coefficients are found to be significant at the highest level.

Table 2 they were negative but lacked significance. Evidently mitigating the effects of both very large and small states has led to these commissions displaying greater influence on the difference in wasted votes than before. This occurrence makes sense given that both most of the largest and smallest states, with the exception of Hawaii since the 1980s and California beginning in the 2010s, do not use such a commission. In contrast the effect of having control of the state house loses some of its significance by utilizing the natural log as these results are found to be the lowest level of significance. Though the sign remains the same, this factor appears to have lost some of its effect. Based on these and the results seen with the other OLS regressions, it would seem that the relationship between number of districts and gerrymandering only displays significance when disregarding time dependent variables. While larger states have shown a greater tendency for gerrymandering across time, its effect has not notably changed much in the decades since 1972.

Table 8: Fixed Effects Regressions With Natural Log of Dependent Variable⁷³

	Natural Log of Wasted Vote Difference	Natural Log of Wasted Vote Difference	Natural Log of Wasted Vote Difference
Number of Districts	-0.00635 (0.0223)	-0.0138 (0.0227)	-0.0292 (0.0229)
Independent Redistricting Commission		0.161 (0.209)	-0.00804 (0.211)
Percentage of House Majority		0.317 (0.342)	0.408 (0.34)
Percentage of Senate Majority		-0.624** (0.293)	-0.529* (0.291)
Number of District-Post 1994 Period Interaction Term			0.0208*** (0.00521)
Constant	11.68*** (0.215)	11.85*** (0.239)	11.84*** (0.237)
Observations	1,035	1,035	1,035
R-squared	0	0.006	0.022
Number of States	45	45	45

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Wasted Votes Difference 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

Utilizing the fixed effects model produces similar results to Tables 4 and 5 with the variable of interest showing a negative sign and being insignificant in all columns. Thus in the pre-1994 period, a district gain was associated with an insignificant decline in the level of gerrymandering. The interaction term indicates that the difference in the effect of the number of districts before and after the 1994 period are notable enough for this

⁷³ The coefficients for number of districts under the 50 state specification are -0.00635 without any covariates, -0.0131 with the covariates but without the interaction term, and -0.029 with the covariates and the interaction term. The coefficients for terms excluding all states with one district are -0.00339 without any covariates, -0.0108 with the covariates, and -0.0262 with the covariates and the interaction term. None of these coefficients are significant. The coefficient for the interaction term for the 50 state specification is 0.0211 and for the regression without one district states it is 0.0207. Both of these coefficients are significant at the highest level. Additionally none of the excluded covariates are found to be significant with the exception of the Senate Majority coefficient for the 50 state specification without the interaction term, which has a coefficient of -0.470 and is significant at the lowest level.

regression to pick up. Specifically, it means that following the 1994 election, a change in the number of districts is predicted to not have any significant impact on the magnitude of gerrymandering in a state. This follows as the coefficient in the interaction term mostly cancels out the coefficient of the variable of interest as both are 0.0208 and -0.0292 respectively. The results predict that states, which undergo an increase in the number of districts are not any more or less likely to be gerrymandered than states that decrease or stay at the same number of districts following the reapportionment process. In regards to the covariates, the percentage of senate majority is the only control variable shown to be significant and is predicted to reduce the difference in wasted voters over time. Typically, one would assume that greater control over the state legislature would correlate with large levels of gerrymandering. The fixed effects model may have detected a decrease in one party's control over the state senate correlating with an increase in gerrymandering as increased political polarization made political battles over state legislatures much more contentious. However, the fact that the model picks up the highest level of significance from the constant in all three columns with a coefficient ranging from 11.68 to 11.85 suggests that this model has ascertained the importance of omitted variables in this model. Though both the variable of interest and the control variables may play a role in the development of gerrymandering over time, certain omitted variables hold greater significance.

This paper also utilizes another mechanism for testing gerrymandering, the mean-median gap, and ran that as the dependent variable in a series of similar regressions to the ones seen in Tables 1 – 8, to ascertain whether the findings were evocative of gerrymandering in general or were the result of flaws with the efficiency gap. Because

this approach deals with total vote shares rather than the gap between the actual number of votes, the results will look differently from those seen in the calculation of the total number of wasted votes. Thus this paper focuses on similarities and differences in sign and significance rather than magnitude given that the coefficients will be measured in different manners.

Table 9: OLS Regression for Mean Median Gap With No Controls⁷⁴

	Democratic Mean-Median Gap	Republican Mean-Median Gap
Number of Districts	0.000588*** (0.000125)	0.000638*** (0.000139)
Constant	0.0305*** (0.00168)	0.0314*** (0.00187)
Observations	1,035	1,035
R-squared	0.021	0.02

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Democratic Mean-Median Gap indicates the difference between the mean and median vote shares in each state for the Democrats, while Republican mean-median gap denotes the same for the Republicans. Mean-Median Gap 2 excludes Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

The results in Table 9 certainly resemble those seen in Table 1 with the number of districts having a significant and positive coefficient of 0.000588 for the Democratic gap and 0.000638 for the Republican gap. This coefficient suggests that for each additional district that a state has will increase the mean median gap by about 0.06 percentage points. Interestingly, the coefficients for the Republican mean-median gap are slightly larger which suggests that altering the number of districts in a state will affect the mean-median gap somewhat more. However, given the large and significant amounts for the

⁷⁴ The dependent variable for each of the 6 columns is the difference between the mean and median vote shares for one part in a particular state. Columns 1 – 3 denotes the Democratic mean-median gap, and Columns 4 – 6 show the Republican mean median gap. Columns 1 and 4 include all states, Columns 2 and 5 exclude all states with only 1 district, and Columns 3 and 6 exclude all states which have only had 1 district during the time period

constant in all six columns, there clearly exist other factors in determining gerrymandering, which this paper will incorporate in the next specification.

Table 10: OLS Regression for Mean Median Gap With Controls and District Gain⁷⁵

	Democratic Mean-Median Gap	Republican Mean-Median Gap	Democratic Mean-Median Gap	Republican Mean-Median Gap
Number of Districts	0.000700*** (0.000123)	0.000782*** (0.000137)	0.000696*** (0.000123)	0.000780** * (0.000137)
Independent Redistricting Commission	-0.0239*** (0.00507)	-0.0295*** (0.00563)	-0.0244*** (0.00508)	-0.0298*** (0.00565)
Percentage of House Majority	-0.0025 (0.009)	0.00484 (0.01)	-0.00283 (0.009)	0.00467 (0.01)
Percentage of Senate Majority	0.0314*** (0.00833)	0.0311*** (0.00926)	0.0313*** (0.00833)	0.0311*** (0.00926)
Post 1994 Period	0.00967*** (0.00237)	0.00903*** (0.00263)	0.00975*** (0.00237)	0.00908*** (0.00263)
District Gain			0.00147 (0.00115)	0.000779 (0.00128)
Constant	0.0161*** -0.00281	0.0152*** (0.00312)	0.0163*** (0.00281)	0.0153*** (0.00312)
Observations	1,035	1,035	1,035	1,035
R-squared	0.081	0.086	0.082	0.087

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Democratic Mean-Median Gap indicates the difference between the mean and median vote shares in each state for the Democrats, while Republican mean-median gap denotes the same for the Republicans. These specifications exclude Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

Adding in these covariates does not seem to impact the coefficient for the number of districts in any notable way. Surprisingly, the addition of the district gain variable does not seem to notably impact the number of districts variable. Indeed, in contrast to the

⁷⁵ The corresponding coefficients for the 50 state specification and the specification which excludes all states with only one district all produced results that were quite similar to those seen in Table 10. Each of the coefficients that appear in Table 10 are in between the coefficients produced by the 50 state and the 1 district excluded regressions as has been witnessed in earlier tables.

negative and highly significant coefficient for this variable produced in Table 3, the inclusion of this variable in the above specification provides a positive and non-significant coefficient for both the Democratic and Republican gaps. This might suggest a potential issue with this variable's ability to explain the change in district over time. Interestingly, the percentage of Senate Majority is shown to be positive and significant while the percentage of House majority is negative and insignificant. While this certainly occurs due to correlation between the two independent variables, it is interesting that Senate Majority has more of an effect on the mean-median gap, as the results for the OLS regression with the wasted votes difference produced the opposite. Regardless these results appear quite reminiscent of the results seen in Table 2.

Table 11: Fixed Effect Regression for Mean Median Gap⁷⁶

	Democratic Mean-Median Gap	Republican Mean-Median Gap	Democratic Mean-Median Gap	Republican Mean-Median Gap
Number of Districts	0.000267 (0.000674)	0.000752 (0.000732)	0.000505 (0.000687)	0.00113 (0.000746)
Independent Redistricting Commission			-0.00469 (0.00632)	-0.0125* (0.00685)
Percentage of House Majority			-0.00942 (0.0104)	-0.00429 (0.0112)
Percentage of Senate Majority			0.0197** (0.00886)	0.0172* (0.00961)
Constant	0.0336*** (0.00652)	0.0303*** (0.00708)	0.0280*** (0.00724)	0.0230*** (0.00785)
Observations	1,035	1,035	1,035	1,035
R-squared	0	0.001	0.007	0.009
Number of States	45	45	45	45

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Democratic Mean-Median Gap indicates the difference between the mean and median vote shares in each state for the Democrats, while Republican mean-median gap denotes the same for the Republicans. These specifications exclude Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

Utilizing a fixed effect model for the mean median gap produces quite small coefficients for the number of districts that is not considered significant. While unlike the results in Table 3, all of the coefficients in the columns are positive, their small magnitudes indicate that changes in the number of district have not notably affected the level of gerrymandering, whether measured by the mean-median gap or the difference in wasted votes, across time. Certainly the highly significant constants suggest that other factors

⁷⁶ The corresponding coefficients for the 50 state specification and the specification which excludes all states with only one district all produced results that were quite similar to those seen in Table 11. Each of the coefficients that appear in Table 11 are in between the coefficients produced by the 50 state and the 1 district excluded regressions as has been witnessed in earlier tables. The constants showed significance at the highest level for all of the regressions. The senate majority coefficients also were significant at the second level for the Democratic mean-median specifications, and significant at the lowest level for the Republican mean-median gap. Finally, the IRC coefficient in the Republican mean-median gap regressions showed a negative coefficient and significance at the lowest level in both regressions.

have played a more notable role throughout these elections. Again the mean-median gap again more closely aligns with control over the state senate rather than the state house, though its predicted increase of the mean-median gap is expected. Additionally, it appears that control over the state senate more significantly increase the Democratic mean-median gap rather than the Republican one. This acts in contrast to the IRC coefficient, which significantly decreases the Republican mean-median gap but only slightly decreases the Democratic gap. Presumably the state senate variable more closely correlated with the Democratic gap, while the IRC coefficient more closely correlated with the Republican gap. Because both measurements examine gerrymandering potency rather than a specific bias, it most likely arose due to a quirk with the measurement itself. However, to get a clearer idea of how the change in districts affects gerrymandering, this paper utilizes the interaction term between the number of districts and the post-1994 period as it did with the wasted vote difference in Table 5.

Table 12: Fixed Effect Regression for Mean Median Gap With Interaction Term⁷⁷

	Democratic Mean-Median Gap	Republican Mean-Median Gap	Democratic Mean-Median Gap	Republican Mean-Median Gap
Number of Districts	-0.000113 (0.000689)	0.000382 (0.000749)	0.000135 (0.000694)	0.000736 (0.000754)
Number of District-Post 1994 Interaction	0.000385** (0.000153)	0.000375** (0.000166)	0.000497*** (0.000158)	0.000529*** (0.000172)
Independent Redistricting Commission			-0.00873 (0.00642)	-0.0168** (0.00697)
Percentage of House Majority			-0.00726 (0.0103)	-0.00199 (0.0112)
Percentage of Senate Majority			0.0220** (0.00885)	0.0196** (0.0096)
Constant	0.0353*** (0.00654)	0.0320*** (0.00711)	0.0278*** (0.0072)	0.0229*** (0.00782)
Observations	1,035	1,035	1,035	1,035
R-squared	0.007	0.006	0.017	0.018
Number of States	45	45	45	45

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Democratic Mean-Median Gap indicates the difference between the mean and median vote shares in each state for the Democrats, while Republican mean-median gap denotes the same for the Republicans. These specifications exclude Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

The results seen in Table 12 appear contrary to those seen in Table 5 in that the coefficient for the number of districts appears, with the exception of the Democratic mean-median gap without covariates, to be slightly positive and not significant.

Presumably this difference arises because of some issue with the two different

⁷⁷ The corresponding coefficients for the 50 state specification and the specification which excludes all states with only one district all produced results that were quite similar to the coefficients which were included in Table 12. The constants showed significance at the highest level for all of the regressions. The interaction term was found to be highly significant in every regression. The senate majority coefficients also were positive and significant at the second level for all of the regressions in which the variable was included. Finally, the IRC coefficient in the Republican mean-median gap regressions showed a negative coefficient and significance at the second level.

measurements of gerrymandering. However, they both produce similar results of a positive and highly significant coefficient with the interaction term, which suggests that following the 1994 election the effect of the number of districts played a significantly greater role in increasing the potency of gerrymandering than it did before. While it does not appear that changing the number of districts impacts the level of gerrymandering over time in the broad sense, there nevertheless appears to be a notable difference in the impact of the number of districts on gerrymandering when comparing the pre-1994 and post-1994 periods.

To further account for the changes over time, this paper also put the mean-median gap approach through the first differences regression to see if it produced similar results to those seen in Table 6 with the wasted vote difference. Such an analysis will help to indicate how the changes in district affects the level of gerrymandering as measured by the mean-median gap.

Table 13: First Differences Regression for Mean Median Gap⁷⁸

VARIABLES	Democratic Mean-Median Gap	Republican Mean-Median Gap	Democratic Mean-Median Gap	Republican Mean-Median Gap
First Difference in District	0.000448 (0.00153)	0.000643 (0.00138)	0.000647 (0.00154)	0.000932 (0.00136)
First Difference in IRC			-0.0145* (0.00813)	-0.0204** (0.00798)
First Difference in House Majority			-0.0187 (0.0155)	-0.00985 (0.0141)
First Difference in Senate Majority			0.0224 (0.0138)	0.015 (0.0138)
Constant	0.000933 (0.00104)	0.000622 (0.0011)	0.00161 (0.00118)	0.00151 (0.00112)
Observations	810	810	810	810
R-squared	0	0	0.009	0.008

Standard errors are included in parentheses below the coefficients. If a coefficient is considered significant at the $t = 0.01$ level it is denoted by ***, if it is significant at the $t = 0.05$ level it is marked **, and if it is significant at the $t=0.1$ level, it receives *. Any coefficient without any asterisk is considered not significant. Democratic Mean-Median Gap indicates the difference between the mean and median vote shares in each state for the Democrats, while Republican mean-median gap denotes the same for the Republicans. These specifications exclude Alaska, Delaware, North Dakota, Vermont, and Wyoming, all of which have had only 1 district in their state since 1972.

This regression lends further credence to the perspective that the change in number of districts over time has had a negligible overall effect on the magnitude of gerrymandering. The first difference between the 1970s and the 1980s allows for a slightly positive but non-significant change in the mean-median gap for both Democratic and Republican vote shares. With the small number of observations and an incredibly small r-squared amount, it is possible that this regression will have difficulty speaking for the entirety of these events or predicting future magnitudes of gerrymandering. The

⁷⁸ The coefficients for the 50 state specification and the specification which excludes all states with only one district all produced results that were quite similar to the corresponding coefficients which are included in Table 13. All of the other covariates show similar coefficients to the ones included in Table 13. However, the only terms that are considered significant are the coefficients for the difference in IRC which are significant at the second level.

presence of an IRC appears to have a notable influence on decreasing the potency of gerrymandering at least when addressing the first difference. However, the rest of the covariates are considered not significant.

Analysis

The various results produced by this series of regressions indicates that when disregarding time related variables, a somewhat significant relationship between gerrymandering and the number of districts emerges. Specifically, it suggests that while states with a larger number of districts are more likely to show signs of gerrymandering, adding an additional district is unlikely to have notable effect on the level of gerrymandering. The observation that larger states allow for a greater potential of gerrymandering is hardly surprising given the circumstances. A partisan state redistricting committee could draw one of the most gerrymandered and geographically offensive maps imaginable, which cracks the base of their political opponent by making them a sizable minority in all of the districts. Yet when a committee does that to a state like Maine with two districts or West Virginia with three, the map only impacts two to three congressional seats at the most. Though this should not diminish the harm such an endeavor brings to democracy, its impact is inarguably smaller than attempting to do the same thing to a state with more than twenty districts like California, Florida, New York, or Texas. In any of these four states, attempts at gerrymandering potentially could compromise numerous congressional seats through the strategies of packing and cracking. The results produced by the OLS regressions reflects this tendency. There exists a greater ability to gerrymander given the number of congressional seats up for grabs. Though these results may appear contrary to the findings presented by Gilligan and

Matsusaka, their results were based on increasing the number of districts but keeping the population constant. These findings were based on increasing the population and number of districts simultaneously. Consequently these different findings certainly makes sense.

When taking into account certain time related variable as this paper did with both the fixed effects model and the first differences regression, it became clear that changes in the number of districts overall had a minimal effect on the potency of gerrymandering. This is not altogether unsurprising given that the number of overall districts has stayed steadfast at 435 since the beginning of the 20th century. Thus given this lack of net change, the overall changes in gerrymandering between 1972 and 2016 would not directly respond to changes in the number of districts. Still based on results from using the interaction terms in the fixed effect model in Tables 5, 8, and 12, it seems that the effect of the change in districts over time is notably different between the pre-1994 and post-1994 periods. Though the difference in results for the pre-1994 period between these three tables makes interpretation more difficult, it would seem that during this period increasing the number of districts corresponded with a slight decrease in the level of gerrymandering. Though only the regression with the wasted vote difference suggests that this decline is significant, it nevertheless appears that during this period reducing the number of districts was likely to slightly increase the magnitude of gerrymandering. Presumably the potency caused by the decrease in districts outweighs whatever gerrymandering occurs when a state increases its district size.

Both the OLS and the pre-1994 results in the fixed effects model hint that taking a district away from a state following reapportionment will slightly increase the likelihood of gerrymandering. While this paper cannot analyze the specific intentions behind these

observations, clearly reducing the number of districts correlates with an increase in the number of districts. Such an occurrence inevitably involves placing two representatives into the same district, which often follows a partisan motivation. A Republican-led redistricting effort would prefer to force two Democrats to run against one another for a congressional seat and so too would a Democratic majority. Though adding a district to a state certainly allows a partisan redistricting committee to carve out another seat for their preferred party, the degree to which this happens presumably is dwarfed by the gerrymandering from reducing the district number given the results seen in both the variable district gain and in the fixed effects and first models regressions. Regardless it would seem that during the redistricting process, anti-gerrymandering experts should pay special attention to states which either gain or lose a district. The same practice should also be applied to the state legislatures on the rare occasion in which they change the number of seats in their specific chambers. Though gerrymandering can and does occur on the congressional level in the absence of a change in the number of districts, based on the results it would seem that such an occurrence often prompts some degree of gerrymandering.

However, in the post-1994 period it was consistently found in all three tables that there was a significant increase in gerrymandering between the two periods. This does indicate that the magnitude of gerrymandering as related to the number of districts increased notably between the pre and post-1994 periods. This does not necessarily predict that in the post-1994 period increasing the number of districts will lead to greater gerrymandering, but merely that the difference between the two periods is notable. Additionally, both the first differences and the fixed effects model found the effect of the

change in the number of districts over time on gerrymandering to be non-significant. Thus it would appear that any state regardless of its change or lack thereof is capable of undergoing severe or minimal gerrymandering due to a host of other factors.

However, it is ill-advised to extrapolate too much from these results given the overall size of the observations. Though the results garnered from the OLS regressions originate from 23 years of House elections and 435 different elections in each of these years, each reapportioned map was only utilized for five different election cycles. During each of these elections, Americans often voted or chose not to vote based on the political climate, the nature of the candidates, their own personal interests, potential barriers to voting, and other numerous factors. Both of the mechanisms used in this analysis for testing gerrymandering depend on how people voted. This means that wave elections, foreign interference, or any other number of events could skew the results in some manner. Given the dearth of modern House elections, it can be difficult to surmise any broader understanding about gerrymandering from these results.

Despite this caveat, political scientists can still make certain observations from these results. Specifically, it seems that while states with more districts typically will have a greater potency for gerrymandering than smaller states, in the past taking away a district from any state would generally speaking increase the level of gerrymandering to a greater degree than adding an additional district. Though since 1994, a change in the number of districts has stopped working as an effective predictor about levels of gerrymandering. Additionally, despite these observations, it would seem that changes in the number of districts have not significantly contributed to either a rise or fall in gerrymandering over the past few decades.

Policy Recommendations

In light of these findings, it would make sense to carefully monitor the redistricting process in larger states. While the most populous states can take certain steps on their own to limit gerrymandering, an extremely partisan drawing of the maps could unfairly impact a number of house elections. Recognizing this possibility, Congress might consider establishing a group to observe redistricting while paying special attention to states like Pennsylvania, North Carolina, Texas, New York, Florida, and California. Such a group could operate independently or alternatively it could collaborate with an existing institution like the Federal Election Commission (FEC). Admittedly, the prospect of this current Congress approving such a watchdog organization does seem unlikely. However non-profit organizations like the American Civil Liberties Union, the Brennan Center for Justice, the National Association for the Advancement of Colored People, and the Southern Poverty Law Center might consider forming a non-government sponsored coalition that would perform a similar function. Following this paper's results, such organizations would pay special consideration to the larger states. While neither of these monitoring organizations would hold the authority to block certain state legislatures from gerrymandering, they could shine a light on the conduct and essentially shame the legislatures into conducting a fair redistricting process. However, this method would rely entirely on the legislatures feeling embarrassment from this public exposure.

A far more drastic measure would be for states to readjust how they engage in the entirety of the districting process. Certainly if the largest states adopted a multi-member district model, in which each district elected several people to congress based on

proportional voting, this would presumably limit the states' ability to gerrymander numerous congressional districts. A state like Pennsylvania might have six congressional districts with three members each instead of eighteen districts. Such an endeavor would rely on proportional votes to elect candidates to congress rather than continuing with the current winner take all system. Thus a partisan state legislature could no longer create several districts in which their preferred party consistently won 55% - 60% of the total vote as the minority party would still win a seat if this occurred in a multi-member district. Thus legislatures would not have the same ability to crack or pack the districts in pursuit of a partisan agenda. Admittedly, such a policy would represent a seismic shift to congressional politics. Congressmen would need to represent larger constituencies, which they would share with their fellow district members. While this would not be an unprecedented shift, given that each state has two senators who represent even larger constituencies in some cases, nonetheless it likely would create some turmoil during the transition process. Additionally, implementing such a reform would prove difficult as most state governments likely would not wish to adopt such laws first. Any state that established a multi-member district system would inevitably give more of a voice to the minority political party in that state with the full knowledge that no other state would necessarily take the same steps. Thus heavily the Democratic state of New York would know that forming multi-member districts would lead to more Republicans winning congressional without the guarantee that the Republican state of Texas would do the same. Meanwhile Republican states would share that same fear. Though Democratic Representative Don Beyer of the Virginia 8th has supported these reforms in the Fair Representation Act, it seems unlikely that this proposal will gain much traction in the

foreseeable future.⁷⁹ While multi-member districts may address the problem of larger states allowing for more gerrymandering, such a policy does not seem feasible at this point in time.

Politicians and proponents of good governance might also consider reducing the number of large states. After all, if California, Florida, Texas, and New York continuously run the risk of suffering severe gerrymandering, the state governments should consider splitting these states into several smaller states. Unquestionably, such a drastic step would create significant economic and political turmoil both within the hypothetical newly formed small states and throughout the rest of the country. However, splitting California into five different states, each with ten or eleven districts, potentially could make gerrymandering somewhat more difficult. Given the large set of chaos such a policy shift would instigate it is unlikely that such an event will occur. Nevertheless, it certainly would address the concerns about more populous states being more likely to undergo severe gerrymandering.

Given that the change in the number of districts over time does not appear to significantly impact the level of gerrymandering, it would seem unreasonable to scrutinize states that are either increasing or decreasing its number of districts. State legislatures have shown a willingness to gerrymander regardless of changes in the number of districts. Thus imposing certain structural restrictions about gerrymandering makes little sense, as it would appear that states, which have kept the same number of districts following the decennial reapportionment, are just as likely to gerrymander as state that have undergone some net change. Instead proponents of governance should

⁷⁹ Lee Drutman, “This voting reform solves 2 of America’s biggest political problems,” *Vox*, July 26, 2017, <https://www.vox.com/the-big-idea/2017/4/26/15425492/proportional-voting-polarization-urban-rural-third-parties>.

pursue other paths to prevent gerrymandering. These results have also shown that independent redistricting commissions can reduce gerrymandering, while highly partisan state legislatures often create the most egregiously gerrymandered states. Advocating for additional IRCs and closely policing highly partisan legislatures likely will prove a more effective barrier to gerrymandering than imposing stipulations about certain structural requirements.

Conclusion

Gerrymandering has tarnished the integrity of elections since its first utilization in the early nineteenth century. Since that time it has become a favored political tool to keep a particular group out of power regardless of the will of the voters. Given that this practice has become only more refined with the development of technology, it seems incredibly likely that state legislatures and other redistricting committees on both sides of the political spectrum will seek to consolidate power by gerrymandering these districts. With the 2020 census and the ensuing redistricting process in 2021, governmental institutions and supporters of good governance must take necessary to prevent rampant gerrymandering from occurring. This paper attempted to discern whether the number of districts significantly impacted the magnitude of gerrymandering. However, while results certainly suggested that more populous states were more susceptible to gerrymandering, changing the number of districts does not appear to significantly impact gerrymandering one way or another. As a result, imposing certain restricting on states that experience an adjustment in its district number following reapportionment would be unnecessary. Gerrymandering remains a critical threat to democracy in the United States and must be addressed in light of the forthcoming redistricting. However, rather than imposing certain

structural requirements regarding district size, this paper finds that it would be far more important to police the actual redistricting process. Going back to the eighteenth century, politicians have shown a willingness to draw maps for their own political purposes. Thus regulating those efforts will prove the most effective method to ending gerrymandering.

Bibliography

- Bishop, Bill. *The Big Sort: Why the Clustering of Like-Minded Americans is Tearing Us Apart*. Boston: Houghton Mifflin Company, 2008.
- Chambers, Christopher P., Alan D. Miller, and Joel Sobel. "Flaws in the Efficiency Gap," *Journal Law and Politics* XXXIII, no. 1 (2017).
- Cover, Benjamin Plener. "Quantifying Partisan Gerrymandering: An Evaluation of the Efficiency Gap Proposal." *Stanford Law Review* 70, (December 22, 2017).
- CNN Politics. "2016 House Results." Accessed April 11, 2018. <https://www.cnn.com/election/2016/results/house>.
- Daley, David. *Ratf**ked: Why Your Vote Doesn't Count*. New York: W.W. Norton & Company, 2016.
- Drutman, Lee. "This voting reform solves 2 of America's biggest political problems." *Vox*, July 26, 2017. <https://www.vox.com/the-big-idea/2017/4/26/15425492/proportional-voting-polarization-urban-rural-third-parties>.
- The Federal Election Commission. "Official Election Results for the United States Senate and the United States of House of Representatives." Accessed April 11, 2018. <https://transition.fec.gov/pubrec/fe2012/2012congresults.pdf>.
- The Federal Election Commission. "Official Election Results for the United States of House of Representatives." Accessed April 11, 2018. <https://transition.fec.gov/pubrec/fe2014/2014house.pdf>.
- Gelman, Andrew and Gary King. "Enhancing Democracy Through Legislative Redistricting." *American Political Science Review* 88, no. 3 (September 1994), 541 – 559.
- Gilligan, Thomas W. and John G. Matsusaka. "Structural constraints on partisan bias under the efficient gerrymander." *Public Choice* 100, (1999): 65 – 84.
- Goedert, Nicholas. "Gerrymandering or Geography? How Democrats Won the Popular Vote but Lost the Congress in 2012." *Research and Politics* 1, (2014): 1 - 8
- Goedert, Nicholas, 2014. "Gerrymandering or Geography?: How Democrats Won the Popular Vote but Lost the Congress in 2012." <https://doi.org/10.7910/DVN/24354>, Harvard Dataverse, V1, UNF:5:+NyAuf86FhtePLctd2MFg==.
- Greenberg, Daniel. "Why 435? How We Can Change the Size of the House of Representatives." *FairVote*, October 12, 2017. http://www.fairvote.org/how_we_can_change_the_size_of_the_house_of_representatives
- King, Gary and Robert X. Browning. "Democratic Representation and Partisan Bias in Congressional Elections." *American Political Science Review* 81, 1987, 1252 – 1273.
- Ingraham, Christopher. "Pennsylvania Supreme Court Draws a Much More Competitive District Map to Overturn Republican Gerrymander." *The Washington Post*, February 20, 2018. <https://www.washingtonpost.com/news/wonk/wp/2018/02/19/pennsylvania-supreme-court-draws-a-much-more-competitive-district-map-to-overturn-republican-gerrymander/>.
- McGann, Anthony J., Charles Anthony Smith, Michael Laetner, and Alex Keena. *Gerrymandering in America: The House of Representatives, the Supreme Court, and the Future of Popular Sovereignty*. New York: Cambridge University Press, 2016.

Mordfin, Robin I. "Proving Partisan Gerrymandering with the Efficiency Gap." *The University of Chicago Law School*, 2017. <https://www.law.uchicago.edu/news/proving-partisan-gerrymandering-efficiency-gap>.

Myers, John. "Political Road Map: California's election maps, drawn without party favoritism, hit the halfway mark." *The Los Angeles Times*, November 6, 2016. <http://www.latimes.com/politics/la-pol-ca-road-map-political-districts-parties-20161106-story.html>.

Nilsen, Elise. "A new report says Democrats need to win the popular vote by 11 points to retake the House." *Vox*, March 17, 2018. <https://www.vox.com/policy-and-politics/2018/3/27/17144198/gerrymandering-brennan-center-report-midterms-democrats-house-2018>.

Royden, Laura and Michael Li. "Extreme Maps." *The Brennan Center for Justice*, April 2017. <https://www.politico.com/f/?id=0000015c-11a2-d46a-a3ff-9da240e10002>.

Seabrook, Nicholas R. *Drawing the Lines: Constraints on Partisan Gerrymandering in U.S. Politics*. Ithaca: Cornell University Press, 2017.

Soffen, Kim. "Independently Drawn Districts Have Proved to be More Competitive." *The New York Times*, July 1, 2015. <https://www.nytimes.com/2015/07/02/upshot/independently-drawn-districts-have-proved-to-be-more-competitive.html>.

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

Toobin, Jeffrey. "The Courts Take Aim at Partisan Gerrymandering." *The New Yorker*, January 23, 2018. <https://www.newyorker.com/news/daily-comment/the-courts-take-aim-at-partisan-gerrymandering>.

Tufte, Edward. "The Relationship Between Seats and Votes in Two-Party Systems." *American Political Science Review* 67, no. 2 (June 1973), 540 – 554.