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A Quantitative Assessment of the U.S. Electoral College, 1790-2020

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Political Science

by

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DEDICATION

To

my parents and friends

in recognition of their worth

Choose an advisor whom you respect both as an intellect and as a human being.

A Wuffle

I am grateful to have found many advisors I respect, including three who have names attached to this document.

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ABSTRACT OF THE DISSERTATION

A Quantitative Assessment of the U.S. Electoral College, 1790-2020

by

Jonathan Cervas

Doctor of Philosophy in Political Science

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Professor Bernard Grofman, Chair

The United States mode for election of the President consist of a two-stage process where states appoint Electors, and those Electors then vote for the President. This structure of election is often criticized because it leads to non-majoritarian outcomes. There are two mechanical features that can lead to an electoral inversion: the two-seat Senate bonus and the winner-take-all method of appointment adopted by all but two states. This dissertation evaluates these mechanical aspects of the Electoral College and finds that while indeed inversions are possible, even likely when the national vote is close, the mode of election provides for very little mechanical bias. The goal is to neither bury nor to praise the Electoral College, but to evaluate it historically on several premises that are often used by reformers seeking reform.

Introduction

The final edits of constitution were drafted with little by way of objection to the system for electing the president. Months of debate over precise wording of provisions outlining the U.S. House and Senate, the judiciary, and other important institutions of governance had created an exasperation over the process. Going through historical records will not yield letters from esteemed statesmen advocating for a system of Electors equal to the number of representatives plus the number of senators. The Electoral College may very well be regarded as an institution without support.

The central hypothesis of this dissertation is that the Electoral College is a fair system for electing the President. Fairness is based on the normative idea in a democracy that the voters be treated equally and unbiasedly. As a hypothesis, it is intended to allow for falsification. Indeed, the structural basis for the EC guarantees a certain level of dis-proportionality. To be clear, when talking about fairness and equality, we must keep in mind that different normative conceptions will dictate the extent to which we think these institutions provide for equal protection. For instance, are these institutions set to provide equal representation to voters, to citizens, or to persons? Assuming some level of in-equality, how can we adjudicate when a bright-line from equality to inequality has been crossed? Such normative questions are beyond the scope of a quantitative analysis. Rather, I take perfect equality of *persons* to be the baseline, and measure deviations from this idea.

The constitutional framers did not use terms like 'bias' to describe imbalances between voters or persons; however, they were acutely aware that the choices they made would have consequences. The ink had barely dried before problems began to arise. Ambiguities and flawed systems resulting from inattention to detail nearly lead to an early collapse of this young system of government. In the 1800 election, no candidate received the required majority of Electors to win the election outright, so instead the election moved to the House of Representatives. There, it took over 30 ballots for Thomas Jefferson to emerge victorious.

The lesson to be had from this crisis is that people respond to institutions, not vis versa. And it is the institutions that I study here. By most accounts, the constitutional convention did not take seriously the mechanics of the system of Electoral College. It is not even clear what objective the framers sought in creating the Electoral College or if they seriously entertained the ideas of bias and manipulation. To the extent that there was debate, it was mostly about how to limit the power of the president and to what group the president would be responsive to. Ultimately, they believed the president would be a consensus pick and created an institution that would reflect that. When instead political parties created anger, disagreement, and polarized into factions, the first system designed in the constitutional convention failed.

The potential flaws, such as risk of inversion, malapportionment, or other types of biases that result from an Electoral College that were not addressed at the constitutional convention also seem to escape the debate in the 8th Congress which ratified the XII amendment. Foley (2019) argues that the 1803 fix of the Electoral College provisions were a "product of extensive and erudite deliberations". Hawley (2014) contends that the twelfth amendment was

transformative for the presidency, not merely a mechanical fix. If the metric of success is stability, indeed it worked as intended since no changes have been made to the institutional arrangement of the EC (Foley does not agree that it has worked as intended, and rather argues that it has lost the majoritarian principles in which it was established.). Setting aside the thoughts of those who drafted the twelfth amendment, even their fix to the originally drafted provisions still allow for an institutional arrangement with potential flaws including non-majoritarian outcomes, inducing campaign incentives to focus on just a handful of battleground states, and weighing voters from different states differently. The twelfth amendment failed to address what many views as fundamental flaws.

This dissertation is not intended as a lesson on history as read from notes. Nor is it intended to revisit the founder's intentions. Rather, it is a comment on history as gleaned from the records of apportionment, votes, and institutions. This attempt is to classify the system for electing the president not on the merits which were debated in 1787, but by the standards of equality in which we recognize in the 21st century. But it is on this very question this dissertation will largely focus: is the Electoral College a system that provides for the fair election of the executive, giving voice to the people in an equal way? To this end, I have assembled three essays that contribute to answering this question. Collectively, they allow for a limited if not specialized evaluation.

In the first chapter, I look at the period beginning with the first apportionment after the ratification of the Constitution and end with the most recent apportionment after the 23rd Census. The chapter considers several measures of equality from law, political science, and

economics to measure deviations of proportionality between voters and representation. This was of central concern, as stated above, for ratification. The Electoral College is compared to the U.S. House and the U.S. Senate (the two components which combine to make the EC). I find that the EC, regardless of the measure used, is far closer to the equality found in the House than that found in the Senate. This finding is consistent across measure and over time. I will also speak to the best measures for comparing disproportionality. Among the seven different measures used, each has several properties that make them more or less useful at measuring the relative equalities of institutions. I additionally construct a dataset of apportionment for the U.S. House in the antebellum period assuming slaves counted as five-fifths to compare to the actual apportionment where they were counted as three-fifths to show how some measures, including those most typically used by courts, prove unreliable as summaries of equality.

The second chapter addresses questions about how different states influence the EC results. Specifically, it is often said that battleground states, where the vote share between the two main competing parties is closely contested, are the only votes that decide the election outcome. In this section, I show that battleground states, while clearly having an importance in the selection of the president, do not hold the exclusive providence of importance. Non-competitive states create the conditions under which states become pivotal. Battlegrounds only exists because of the importance of "safe" states. Thus, a candidate cannot count solely on the battleground states for his or her election. Indeed, knowing the difference in proportion of the EC seats in which each party holds as Non-Competitive, what I call the *Non-Competitive*

Advantage, allows for the prediction of the eventual winner with great accuracy. From that view, the non-competitive states that have equal influence on the election.

In the final chapter, using election results from 1868 to 2016, I consider the claim that the EC facilitates non-majoritarian outcomes. These "inversions" are a central claim made about the lack of equality in a democracy. By inversion, I mean that the winner of the most two-party votes fails to win the Presidency. To do this, I fluctuate the institutional arrangements of the Electoral College and evaluate how slight changes to the rules affects the outcomes. Measuring the election outcomes under several sets of institutional arrangements, I find that under all arrangements an inversion can occur, though the elections in which they happen fluctuates. Even the most proportional of systems that uses an elector-based voting mechanism occasionally leads to inversions.

Why do we have an Electoral College?

The racist history of the founding of the United States is well traversed. Indeed, if perfect equality is the standard set for political institutions, the Constitution failed, explicitly, from the beginning. American political institutions initially linked the perceived worth of an individual — landed white males being of highest value, enslaved blacks being the lowest — to their power derived from the institutions. The implication of a system designed with such discrimination in mind was that equality was not the goal of the founding. Indeed, equality or other words indicating such an idea is not found in the U.S. Constitution until Amendment XIV, which was not added until 1868.

No doubt, however, that the Constitution does provide for some forms of equality. The U.S. Senate was established to give a voice to the states, and Article V says that "no State, without its Consent, shall be deprived its *equal* Suffrage in the Senate" (Emphasis added). Indeed, regardless of its population size, each state received two senators. During the Continental Congress, which we have a good record of thanks to Thomas Jefferson (VA) through his personal notes, the treatments of states received a great deal of debate. ''Mr. [Samuel] Chase observed that this article was the most likely to divide us... that the larger colonies had threatened they would not confederate at all if their weight in congress should not be equal to the numbers of people they added to the confederacy'' (Jefferson 1776). Delegates of large states preferred voting in proportion to numbers. John Adams (Massachusetts) explained that if the contribution of state A is £5, state B £50, and state C £500, what sense does it make to for each to have equal representation.[1] Stephen Hopkins (Rhode Island) made the observation that there were four large states, four small states, and four middle sized states. The four largest stated contained the inhabitants of more than half of all twelve states. James Wilson of Pennsylvania thought it strange that simply affixing the term ''State'' to a colony entitled it to equal representation.

But population itself, or its relevance to apportionment, posed its own set of disagreements among the founders. The lower house of the legislature would be made to represent the people proportionally in legislative districts. The American Revolution was

[1] These monetary values are taken from Adam's example.

essentially a war for representation, rooted in the belief that there can be no taxation without representation. Apportionment, the process by which fractional proportions of the population are translated into whole numbers of legislative districts, involves at least three important questions related to equality of representation.

First, how many districts will be created. This is answered originally in the U.S. Constitution (Art. I, Sec. 2) by the mathematical formula $total\ population/30{,}000$, and each state will have a minimum of one representative.[2] The closer the ratio of legislators per person is to 1:1, the less malapportionment that will exist. This is the problem that will be taken up in chapter one of this dissertation.

Second, by what method do proportional fractions get translated into whole numbers.[3] This problem has been extensively investigated in the academic literature, including the well-known Alabama Paradox, and will not be rehashed here (Balinski and Young 1974; Grofman and Scarrow 1981; Balinski and Young 2001; Caulfield 2010; Edelman 2015). I will briefly explore a paradox of malapportionment measures in chapter one. When an institution provides for more equality in representation a measure of malapportionment should likewise show more equality.

Third, and perhaps most important regarding the Constitutional Convention and eventual adoption of the Constitution, was who to count for the purpose of apportionment. Even today,

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[2] In an 11th change, this ratio went from 40,000:1 to 30,000:1. It was subsequently amended over time as the total U.S. population (and number of states) increased, eventually frozen at 435 members in 1929.

[3] This too has changed over time between five different methods. The methods each propose a different formula, which in turn affected whether large or small states benefited.

debate still lingers about whether all residents, regardless of their legal status, should be counted. In the late 1700s, the debate turned on how to count slaves. Southern states benefited when slaves were counted fully, and thus advocated including slaves in the counts. Northern states, despite being largely anti-slavery, preferred if slaves did not count at all for the purpose of apportionment. Southern delegates had no intention of allowing slaves to vote but wished to increase their representation in the national legislature. Northerners, on the other hand, knowing that slaves would be denied the franchise, believed that they should therefore be excluded from apportionment, which would lead to increased representation of northern, non-slave states.

So, the population debate had two cleavages; first, large states and small states each benefited from different balance of power mechanisms, while the northerners and the southerners had a different set of interests. These were not perfectly overlapping sets, since the largest population states existed in both the slave south and the non-slave north. For instance, Virginia, despite its Southern location, was the largest state by population in 1790. But it also had a very large slave population. Not including slaves in the apportionment population would have left it with a population just slightly larger than Pennsylvania. Contrast that to small northern states with little or no slave populations such as Vermont, Delaware, and Rhode Island, and the small southern states such as Georgia and Kentucky.[4]

[4] The median state was Connecticut. The average population of northern states was 225,032; the Southern average was 309,332.

Apportionment caused much debate between the states, which eventually required compromises. Among these compromises was a fusion between the Virginia Plan (a large state, which called for a bicameral legislature where representation was based either on population or on wealth) and the New Jersey Plan (a small state, which called for each state to have equal representation in the legislature, mirroring the institutional arrangement established in the Articles of Confederation, though not necessarily the voting rules.) The Connecticut (the median population state) Compromise[5] created a bicameral legislature with proportional representation in the lower house and equal representation for the states in the upper house.

This still left the fraught issue of how to count population. Approximately one-half of the population of Southern states were enslaved (Ransom and Sutch 1979). At the time of the debates about the institutional structure of the U.S., a large proportion of economic prosperity in the South relied on slavery (Ransom and Sutch 1988).[6] Northerners, who had wished to abolish slavery but failed, wanted apportionment population to be based on the free population. Southerners would walk away from the union if slaves were excluded. The three-fifths compromise was agreed on between the two sides. This necessary, though unfortunate, compromise made the Constitution possible (Ballingrud and Dougherty 2018)

[5] Called at the time the 'Great Compromise'.

[6] By at least one estimate, slave capital by 1859 was 44 percent of all capital in the in five major cotton-producing states. Physical capital not including real estate was less than 10% (Ransom and Sutch 1988).

In 1790, the union would consist of fifteen states, split between five southern and ten northern states. Taken as blocks, the South was set to have ten out of the total 30 U.S. Senators (30%) with 40% of the population, while the North would have the other 70% (with 60% of the population). In the lower chamber, leaving aside the exact apportionment method, which was still yet to be determined, the South would receive between 34 and 43 seats of the total 105 (32% to 41%). Under the three-fifths compromise, the South would receive 40 (38.1%) of the lower chamber seats. Had slaves been excluded from apportionment completely the South would have received just 32% of the seats with 40% of the total population. There was also a recognition that the South would grow faster than the North. In 1800, Tennessee was added, giving the slave states two additional U.S. Senators (now 37.5%) with 43% of the population and 40.4% of the House seats. And while the northern population outpaced the southern population in subsequent decades, the relative number of southern states outpaced northern states, which increased southern representation in the U.S. Senate.

Given all the deliberation on the legislative branch, why did the founders end up settling on the Electoral College (EC)? The institutional design in the United States resulted from a series of compromises between competing interests. The EC is a blend of the U.S. Senate and the House of Representatives. The simple answer to why the EC is that the same agreements that produced the legislative institutions coalesced again to create the mechanism for electing the president. In the sense that the EC mechanically operates as the House plus the Senate, it would be fair to assume that the founders were simply pleased with the compromises made that lead to the House and Senate that little more discussion was needed.

There was far less attention paid to the election of the president during the Constitutional Convention than to the institutional design of the legislative branch. It might be deemed that the EC is the institution that nobody wanted. It was not advocated by any state, created as a compromise, or even faced much resistance. Madison's notes from the Federal Convention of 1787 indicate at least six aspects of the executive which were debated. These include whether the executive be elected by the legislature, and if from one of the members of the legislature, if the executives (governors) of the states would choose a national executive, if it were to consist of just one or more people, whether it should be little more than a person to carry out the wishes of the legislature, and of the duration of the term. But there was little debate about the process by which they be elected, or the consequences of the many choices. Benjamin Franklin (PA) seemed distracted by the question of Executive compensation. Others were worried that just a handful of states could force upon the nation their choice. Still others worried that they would retain a constituency in the legislature that would allow them to lead tyrannically.

There was little appetite for an executive that bore resemblance to the king. Indeed, much of the debate was not about adopting the best system for electing the best candidate to be executive. Rather it was an exercise in choosing a system that would convey confidence among the people, limit the power of the individual who would head the Executive, ensure that no state could dominate the appointment, ensure the choice was a national figure, and guarantee that the Executive not become a monarchy. The strong opinions that shaped the debate about the structure of the legislature did not dominate the debate on choosing the

executive.[7] James Wilson (PA), according to Madison's notes, was apprehensive about suggesting the executive be elected by the people, though it was his preference. Roger Sherman (CT) thought that any independence of the executive from the legislature to be the very essence of tyranny. Suffice to say that focus for the founders on the executive laid on the scope of its power and the constituency to which it would be loyal and not on how to best represent the people or how to ensure equality of votes.

The first motion to introduce Electors was by Mr. Wilson on June 2nd, 1787 (Farrand 1911b, pg. 73, 75). His reasoning was simply that it would produce more confidence among the people if the executive was not elected by legislature, and was separate from the State legislatures. Mr. Elbridge Gerry (Massachusetts) liked Wilson's proposal (Farrand 1911b, pg. 76), but was not sure that the people should act directly in the choice of Electors. He thought State legislatures should nominate, and Electors choose from those nominated. In this way, the people themselves would not be choosing the president, but rather indirectly through their representatives, who themselves would be independently represented. Indeed, this is quite similar to how the EC operated in the first few cycles after the Constitution was ratified. Even today, state legislatures retain some independence in choosing the slate of Electors that differs from the direct will of the voters (Foley 2019, Hasen 2020).[8]

[7] Outside of the choice between an Executive appointed by the legislature versus one chosen by the people (or indirectly by the people through Electors).

[8] This is the same Gerry whose name became synonymous with electoral manipulation; Gerrymander.

One proposal (July 19, 1787) that got a great deal of attention was that the executive be chosen by Electors. A state's share of Electors would be determined by a formula. States with populations less than 100,000 would receive one Elector, those with populations between 100,000 and 200,000 would receive two Electors, and all others would receive three. It passed in the affirmative 8-2, though was not ultimately adopted.[9] But again, these motions were made for the mode of election, not the process that would produce the votes of the Electors. Among the more absurd proposals (July 24th, 1787, (Farrand 1911b, pg. 83) would have selected Electors by lot from the national legislature; suppose there be 90 legislators from which 25 Electors be selected. 65 lottery balls of one color and 25 of another would be drawn one at a time by members of the legislature. Those who drew one of the 25 balls would have an equal vote in selecting the executive.

The first serious proposal presented to the full set of delegates of what would become the Electoral College came on September 4 (Farrand 1911b, pg. 394). By this time, the full Constitution would be signed within two weeks, and there was yet no system in place for electing the executive. Up until this point, most of the debate was on what type of power the executive would have, and whether it would be appointed by the legislature or by the people (or alternatively by the states). By early September, however, the type of legislature was now generally agreed, along with the presumption that the executive would be elected not by the legislature, and not by the people directly, but through a middle process of Electors.

[9] Subsequent motions were made for slightly different proportions receiving one, two, or three electors.

The task of planning the design of the election process of the national executive as given to a group colloquially called the ''Committee of Leftovers''. This "Committee of Eleven" reported that the executive would be chosen by Electors which would equal one for each Senator and one for each member of the House. In this proposal, States would have Electors vote for two candidates for President, where at least one of the two people resided in a different state than the Elector. Thus, an Elector from Pennsylvania could not vote for two candidates from PA. The person with the majority of votes would be President, while the person receiving the second most votes would be Vice President. Questions about what happens if no candidate receives a majority still lingered. This would turn out to be a source of conflict in the future.

As its name suggest, it happened after all other 'important' business had concluded. As the process of writing the Constitution closed, delegates stated their objections to the text as written. Many delegates contested the apportionment of the House, suggesting it too small. Others objected to the proportion needed to overturn a presidential veto. There was debate about the presidential pardon, particularly when it came to treason; it was argued that the Executive should have the right to pardon treason, and if he himself was guilty, he be impeached and tried in the Senate. Elbridge Gerry objected to the three-fifths clause, instead desiring that only freeman be enumerated. Benjamin Franklin perhaps had the most eloquent statement, explaining that he disapproved of many of the parts of the Constitution, but that in his old age he had learned that he often was wrong about things, and that he would defer to his fellow delegates.

Of all the shortcomings of the proposed Constitution, one not mentioned was the election rules for the president. If it indeed is the institution no one wanted, it also was the institution no one opposed. Long after the Constitution had been ratified, and later the Twelfth Amendment augmenting the rules for electing the executive, Madison wrote about the mood at the convention. He reminisces "[T]he final arrangement of it took place in the latter stage of the Session, it was not exempt from a degree of the hurrying influence produced by fatigue and impatience in all such Bodies" (Farrand 1911c, pg. 588).[10]

After two uncontested presidential elections in which George Washington was elected, his refusal of the third term led to the first contested election. By this time, two major political parties had formed. In 1796, John Adams won a narrow victory over Thomas Jefferson, who became Vice President (even though they were bitter rivals). Four years later, in 1800, the still fledgling democracy experienced its first electoral crisis. Brought on by a shortsighted and imprecisely worded provision in Article II, the President was elected by a majority of Electors, and the Vice President the runner up in the contest. But what if the top two challengers can finish with the same total? The Constitution required each Elector to vote for two individuals. If each Elector votes for the same two candidates, they both end up with the same number of electors. This is precisely what happened when Thomas Jefferson and Aaron Burr (both Democratic-Republicans) received the same number of votes from the Electors. The Democratic-Republican plan was for one Elector not to vote for Burr such that Jefferson would win, and Burr would finish

[10] James Madison To George Hay, August 23, 1823.

in second. The failure to execute this plan created a crisis, and it became clear that the framers had failed to envision the creation of political parties, coalitions between candidates, and strategies to manipulate the vote. The crisis was nearly exploded because the House was controlled by the Federalists, who had wished the election to remain deadlocked since their candidate, John Adams would not be re-elected. The election was settled in the House of Representatives on the 36th ballot when Alexander Hamilton convinced several Federalist to back Jefferson over Burr. This led to the passage of the XII Amendment (and Hamilton's death, as Burr eventually killed him in a duel) which separated votes for President and Vice President, preventing another crisis like the 1800 election.

The fixes found in the twelfth amendment hardly left the EC without controversial elections. Besides the well-known fight over the 2000 election, the election of 1876 is arguably the most disputed of all time. As election day returns filled telegraphs, it was clear that Democratic candidate and New York Governor Samuel J. Tilden had a large popular vote lead, over 250,000 votes. By the end of election day, Tilden had secured 184 electors, while Hayes was sitting at 165. That left 20 disputed. Tilden was just one shy of an electoral majority. One elector that Hayes had rightfully won in Oregon was disqualified because he held a federal job, which made him constitutionally ineligible. Three other states were 'too close to call', and reports were aplenty about intimidation at the polls and apparent outright fraud. The disputed electors led to the four states submitting dueling slates of electors. The constitution was unclear as to how the votes would be counted in a circumstance in which had unsettled slates. In Oregon, a Democratic governor attempted to replace the Hayes elector who was disqualified with someone

who would instead vote for Tilden, which would have ensured his victory. Eventually, a 15-man election commission was established that included five members from each the House, Senate, and Supreme Court, evenly split with one member from the Supreme Court widely viewed as independent. After the independent justice had to step down from the commission after being appointed Senator from Illinois, he was replaced by the next most independent of the remaining justices. In the end, he voted in lockstep with the Republican members of the commission, where each disputed state was delivered on party line 8-7 votes for Hayes.

An additional complication of the 1876 election was that Colorado had been officially admitted into the union in August of 1876, and it's first act as a state was to appoint electors for Hayes. No votes were cast for president in Colorado. Had Colorado not been admitted to the Union months before the election, Tilden would have secured both the popular vote and the presidency, but since Colorado's legislature chose Hayes' electors for its three votes, Tilden was denied a majority. Colorado's electors were selected by the legislature, a practice that dates to the founding but hardly ever used after the Civil War. Colorado's total population was less than 40,000, less than the national popular vote margin of victory.[11] Even if Hayes had won votes for all 40,000, he would not have won the popular vote. Without Colorado's three EC votes, however, Samuel Tilden would have been elected President. Of course, given that the election

[11] I use the vote for governor held a month before the November presidential election as a proxy for the popular vote in Colorado in 1876. John L. Routt was the elected Republican governor who defeated Bela M. Hughes (14,154 to 13,316).

result was a product of the Great Compromise of 1877, it's futile to speculate as to what deal would have been struck had the circumstances been slightly different.

In return for ending Reconstruction in the South, the 20 electors were released to vote for Hayes, giving him the presidency with a minority of popular votes. Rutherford B. Hayes, unpopular after the contest, did not run for re-election in 1880.

Justice Elena Kagan's majority opinion in *Chiafalo v. Washington* (591 U.S ___) provides a useful overview of the historical operation of the Electoral College. By way of background on the case, Electors from Washington[12] in 2016 who had been pledged to support Hillary Clinton were 'faithless' and instead cast their ballots for another person. At issue was whether the state could penalize the Electors for not supporting the Elector they pledged to support. In a 9-0 opinion, the court ruled that the Constitution allows states to impose conditions on Electors based on Article II, §1 that authorizes States to appoint Electors "in such Manner as the Legislature thereof may direct." The opinion goes on to explain that the common practice beginning even with the first election was for Electors to cast their ballots according to the votes of the state. In the earliest elections, the States' Electors were mostly chosen by the State legislature's majority party. By 1832, however, all states but South Carolina choose their Electors by popular vote (Peirce and Longely 1981). The Twelfth Amendment addressed early issues with voting for President as drafted in the Constitution which made ties go to the House of

[12] And in Colorado, where the lower court disagreed with the lower court in Washington, leading to the U.S. Supreme Court granting *certitori*.

Representatives very likely when political parties nominated two individuals to run as a team. Since the Twelfth Amendment was ratified on June 15, 1804, there have be no subsequent changes in the Constitution for electing the Executive. States have sometimes changed the way they appoint Electors, as have Nebraska and Maine, who currently appoint electors based on the popular vote winner of the Congressional district from which the Elector represents (and two at-large based on the state-wide popular vote winning candidate). Other states have returned infrequently to state legislative appointments. The names of electors do not generally appear on the ballot, even though in all states elections for president are only indirectly taken with Electors doing the actual balloting (Albright 1940). There was a historical presumption that Electors need not be identified since they were obligated to vote as instructed by the voters.[13] As Kagan describes it, the Constitution is "barebones about electors" *Chiafalo v. Washington* 591 U.S. ___ (slip op. at 10). Despite many reform efforts nationally, the EC has remained much the same as conceived during the early days of the Republic.

[13] *Ray v. Blair* 343 U.S. 214 (1952).

Chapter 1 - Measuring Malapportionment

> "[I]n some states the people are many, in others they are few; that therefore their vote here should be proportioned to the number from whom it comes." -- John Adams, as understood by Thomas Jefferson (Notes of Proceedings in the Continental Congress, 7 June to 1 August 1776)

A point of view supported by some distinguished political scientists (see e.g., Lee Oppenheimer 1999, Dahl 2003), and repeated by journalists (see e.g., Badger 2016), is that the U.S. Senate is inherently undemocratic because of the equal weight given to each state in the Senate despite the vast discrepancy in population across the states. Similarly, it is part of the common wisdom that the Electoral College (EC) is currently highly malapportioned because its two-seat bonus, based on Senate seats, over-weights small states (see e.g. Moffett 1895, Griffin 2006, Toles 2018). The U.S. House, on the other hand, is largely viewed as one that is proportional. However, in addition to structural malapportionment introduced by the three-fifth's clause of the U.S. Constitutional in the antebellum period, there are some features of House apportionment that keep it from perfect proportionality. For instance, even the most proportional of allocation methods require rounding into integer values or, as is the case in the U.S. for apportioning the House, may have guaranteed seats for some of the units regardless of their population. Such rules can create a discrepancy between apportioned seats and actual state population shares. Since there is a natural ordering in terms of proportionality of the three institutions, it is reasonable to consider deviations from proportionality by comparing the three. And since the Electoral College is a mix of the Senate and the House, the motivating question

of this chapter is 'does the EC look more like the former or the latter in terms of disproportionality?'. I examine these views empirically by comparing malapportionment in the U.S. House, the U.S. Senate and the U.S. Electoral College over the period 1790-2010 by examining multiple metrics coming from law (e.g., the *total population deviation*), political science (e.g., the *Gallagher Index*; Gallagher 1991, and the *Loosemore-Hanby Index*; Loosemore and Hanby 1971), and economics (e.g., the Gini coefficient; Lorenz 1905). Regardless of the measure used, the Senate is far more disproportionate than the EC, which looks strikingly like the House. I additionally create a counter factual "five-fifths" apportionment for the period 1790-1870 to compare the measures. I find that all the measures are flawed, but those measures that account for every unit in an institution give more plausible estimates of malapportionment than those that rely only on the largest and smallest deviation.

House districts in the modern era are almost identical in population to one another within any given state, the combination of apportionment rounding rules (the so-called integer allocation problem; Balinski and Young 2001) and the rule that no state can be denied a seat in the House of Representatives regardless of its population, introduces malapportionment into the U.S. House when calculated nationally and not for each state separately. However, in the post-*Baker v. Carr*, 369 U.S. 186 (1962) era, Ladewig and Jasinski 2008; Ladewig and McKee 2014) the House is nonetheless regarded as providing a level of representation matching population, and the same assessment is generally made for state legislative apportionment. Malapportionment across states can also occur for the U.S. House of Representatives when Congress fails to fulfill its decennial duty to reapportion the House in accord with new population

data. After the 1920 Census, Congress failed to reapportion the House. (see e.g. National Archives -- Pieces of History). Similarly, it is part of the common wisdom that the Electoral College (EC) is currently highly malapportioned because its two-seat bonus based on Senate seats over-weights small states (see e.g., Moffett 1895; Griffin 2006; Toles 2018).

To make the malapportionment measures across the three institutions comparable, I create units from states of equal size, depending on the total population of the state and the number of units in the state. This means that, when I examine the U.S. House of Representatives, I am not interested in questions of within-state variation in district population pre and post-*Baker v. Carr* or the manipulation of district populations for partisan purposes (Grofman 1990; Engstrom 2013; McGann et al. 2016). For Congress, intra-state[14] malapportionment in the U.S. is effectively zero, since, in *Vieth v. Jubelirer* 541 U.S. 267 (2004), the U.S. Supreme Court rejected a Pennsylvania redistricting plan because it didn't adhere to 'one person, one vote' with a deviation of 19 people.

The court has been effectively silent on inter-state malapportionment, leaving a potential question open about whether any deviation across states is constitutional. In *U.S. Commerce v. Montana* 503 U.S. 442 (1992), Montana argued that the method of apportionment violated Article I § 2 because under the 1941 law that established the ''method of equal proportions'' Montana was to lose one of their two seats. Had it retained its two seats, both seats would have

[14] Intra-state malapportionment is it difference between the populations within a single state. Inter-state malapportionment is the difference between the unit-populations in two or more states.

been closer to the ideal (national) district population than the one district it had under the apportionment method used. In a 9-0 ruling, the court held that ''Congress exercised its apportionment authority within the limits dictated by the Constitution''. The Supreme Court summary disposed of the district court's ruling in *Clemons v. U.S. Department of Commerce* 710 F. Supp. 2d 570 (N.D. Miss. 2010), which challenged directly inter-state malapportionment, on the grounds of lack jurisdiction.

The most common metrics used by U.S. courts to measure malapportionment across individual districts look at just two districts; the one most underrepresented and the one most over-represented. Seats-votes proportionality measures used in the electoral systems literature are adapted to the malapportionment context to look at the full distribution of population values and electoral weights. The adaption of the measure of inequality from economics, the *Gini coefficient*, does the same.

I show that apportionment equality in the Electoral College looks far more like apportionment equality for the U.S. House of Representatives than it looks like that in the U.S. Senate, regardless of which metric used. Indeed, when EC malapportionment is evaluated using the two-common metrics from the electoral systems literature to measure seats-votes disproportionality, this analysis leads to the conclusion that the EC behaves concerning seats to population comparisons much like a proportional representation system does for seats to votes comparisons, though with much smaller deviations. Similarly, a *Gini-index* based measure of EC malapportionment suggests very little bias, especially as compared to the vast discrepancies observed in income distributions.

Moreover, I also show that for both the House and the EC, the time-series data on the magnitude of the malapportionment over the period 1790-2010 is very flat regardless of which measure used, with some measures of the EC even showing a very minor downtrend in recent elections. This trend would show less disparity if we were to re-examine the antebellum period removing the provision that apportioned enslaved blacks as only three-fifths of that of all other persons or adjusted our measures to include a correction based on who was excluded from the franchise. In contrast, different metrics lead us to quite different perceptions of changes over time in malapportionment in the Senate. All measures, however, agree that the Senate is far more malapportioned than either the House or the EC (Ladewig and Jasinski 2008).

But that is not to say that continued use of the Electoral College does not pose issues of political fairness. The basic reason why EC malapportionment effects are commonly overstated is the confusion between population-based malapportionment and seats-votes disproportionality. To understand Electoral College effects, one needs to distinguish the mechanical effects of the Electoral College that we may think of as ''malapportionment related'' (i.e., due to discrepancies between a state's EC vote share and the state's population or House delegation share), which arise simply because EC vote allocations equal the size of a state's U.S. House delegation plus the size of the state's U.S. Senate delegation, from effects that are tied to the *geographic* distribution of the votes across states in each election. The former applies throughout any given redistricting decade; the latter is election specific. The election specific effects can be substantial enough to generate a partisan bias that can lead to a divergence between popular vote majority winner and the winner of the Electoral College vote (Cervas and

Grofman 2019). Evidence on this bias suggests that it has sometimes favored Democrats and sometimes favored Republicans (Grofman, Koetzle, and Brunell 1997; Pattie and Johnston 2014; Zingher 2016). In addition to the partisan distribution of voters across states, turnout differences among the states may also operate to bias outcomes to create a discrepancy between the popular vote winner and the EC winner. A third factor that could matter is the size of the House. In 2000, as Neubauer and Zeitlin (2003) point out, a larger House size might have given the election to Gore; but, given the magnitude of Trump's EC victory, the House size would have to have been increased by an implausible amount to switch the EC outcome in 2016 (Cervas and Grofman 2019). Considering the relative importance of different reasons for EC and popular vote discrepancies is beyond the scope of this study.

Historical Background

In the U.S., while malapportionment bias is often regarded as inherently undesirable from a normative perspective, it was the perceived effects on government policies stemming from under-representation of city dwellers within states that motivated much of the sentiment that agitated pre-*Baker v. Carr* reformers (see e.g. *Baker v. Carr*, 369 U.S. 186, 1962, *Reynolds v. Sims*, 377 U.S. 533, 1964) (Baker 1955; McCubbins and Schwartz 1988). The failure to reapportion after the 1920 Census was brought about because of reluctance to transfer seats from more rural states whose population was falling, in relative terms, to heavily urban states with growing populations. And, today, while there remain concerns for malapportionment in the Senate, the practical foci of current reformers are, on the one hand, on ways to control partisan gerrymandering within states and, on the other hand, the perceived partisan bias in the EC that

is now operating in a pro-Republican direction that leads reformers to seek to replace the EC with a popular vote mechanism for choosing the President or to find other mechanisms that will limit divergence between the popular vote and EC outcome.

But malapportionment, in and of itself, may or may not have direct pernicious consequences for the treatment of political parties or cognizable groups of voters with distinct interests. Singapore has high levels of parliamentary malapportionment, but that malapportionment does not appear to have effects that favor the ruling party, the PAP (Tan and Grofman 2018). In contrast, malapportionment in Japan has historically favored rural areas by over-representing rural voters and thus been a boon to the dominant party in Japan, the LDP, whose greatest strength derived from rural voters (Moriwaka 2008). Stewart and Weingast (1992) show that in the 19th century ''Republicans had manufactured [an] advantage through the strategic admittance of sparsely populated, but strongly Republican, western states. These western ''pocket'' boroughs provided Republicans with a head start in the Electoral College, and an almost insurmountable lock on the Senate'' (as cited in Engstrom 2013 pg. 94). In the current political climate, the partisan implications of malapportionment are much less clear, with over-represented states being controlled by both the Democrats and the Republicans. For instance, the two-seat bonus awarded to all states, benefiting the small population states, has had virtually no effect on the Electoral College outcomes (Cervas and Grofman 2019).[15] Moreover, there are other types of effects that malapportionment might produce in addition to direct effects on party

[15] As will be further examined in section three of this dissertation.

representation. Samuels and Snyder (2001, pg. 653), reviewing several single-country studies, concludes ''malapportionment can have an important impact on executive-legislative relations, intra-legislative bargaining and the overall performance of democratic systems.''

Addressing the partisan consequences of malapportionment is, however, outside the scope of this research note. Here the goal a straightforward and more limited task: assessing the levels of malapportionment in the House, Senate, and Electoral College over time and under several different metrics. The linkage (or absence of linkage) between malapportionment and the success of Democratic and Republican candidates for the various offices is a worthwhile investigation. I share the view of Dahl (1971) that the ''one person, one vote'' principle is a necessary component of democratic governance. Moreover, as Taagepera and Shugart (1989) have articulately put it, malapportionment is ''a pathology''. Assess malapportionment requires a way to measure it. However, different approaches to measuring malapportionment can yield us very different conclusions about its level.

The structure of the rest of this essay is straightforward. First I'll introduce the definitions of the seven measures that typify the universe of measures (total population deviation, a ratio of largest to the smallest district, the proportion of the population in units with enough seats to command a majority, the Gini Index, 80/20 percentile rank ratio, Loosemore-Hanby index, and Gallagher index). I provide graphs showing the empirical values of these seven indices over the period 1790-2010 for the U.S. House, the Senate, and the Electoral College, with some additional information about exactly how values in the various graphs were ascertained. I'll discuss the implications of the findings for both present-day malapportionment and the historical

changes in malapportionment levels in the three national U.S. electorally determined institutions, including a discussion of whether malapportionment in these three institutions has moved synchronously among them.

Empirical Comparisons of Six Measures of Malapportionment

Natural questions to ask are: ''How much and in what ways does the choice of malapportionment measure chosen affect the conclusions we reach about the level of malapportionment?'', ''How have malapportionment levels in the three institutions (the U.S. House of Representatives, the U.S. Senate, and the U.S. Electoral College) we study changed over time?'' and, ''Are there measures that, while appearing distinct mathematically, tend to give similar answers?''.

I address these questions with U.S. Census data over the period 1790 to 2010. I have chosen to recalculate apportionment in a consistent way for all Census periods. Different apportionment methods, i.e., different ways in which fractional shares of the population are rounded to create whole numbers, will lead to slightly state House totals (Huckabee 2001; Gaines and Jenkins 2009). The U.S. has used five different methods of apportionment in its history (Young 2004). The differences do not affect the substantive interpretation of malapportionment for the purposes described in this essay. However, since I am interested in over-time comparisons, it is best to apply a consistent apportionment method. I use the "Hill-Huntington" method, which has been used in the U.S. since the 1940 census (2 U.S.C. 2a), to the entire time-series and for both the U.S. House and the Electoral College. For 1790-1990, the source is the

U.S Census Bureau Population Division working paper NO. 56[16], for 2000 it is table P003 from the 2000 decennial census, and for 2010 it is from table P3 of the 2010 decennial census. Apportionment for the U.S. House and Electoral College was tabulated in R.

I make several simplifying assumptions to facilitate comparison across time.

First, the District of Columbia is not included in either the U.S. House or Senate calculations, and its population is likewise subtracted from the national population figures I use. I do not include the populations of U.S. territories (e.g., Puerto Rico); although they are U.S. citizens, they currently do not have any voting representation in U.S. political institutions. Amendment XXIII, ratified in the 1960s, gives D.C. received three electoral votes (regardless of its population). D. C. may receive additional EC votes in the future if its population is sufficiently large to warrant it, and no other state has fewer EC seats than it does. D. C. is included in the Electoral College measures for all periods beginning in 1960. D.C. population is added to the national population total for the EC only. Legislation has passed the U.S. House for the first time in U.S. history on June 26, 2020 (H.R. 51 -- 116th Congress) which would, if approved by the U.S. Senate and signed by the president, make D. C. the 51st state. If D. C. were to become a state, it would be entitled to two U.S. Senators as well as its share of the apportioned 435 members of Congress.

[16] Historical Census Statistics On Population Totals By Race, 1790 To 1990, And By Hispanic Origin, 1970 To 1990, For The United States, Regions, Divisions, And States (Gibson and Jung 2002).

Second, even though different apportionment methods have been used in different census decades, I calculate apportionment using the Hill-Huntington method (*Method of Equal Proportions*), used for apportioning the U.S. House of Representatives and Electoral College since 1941 to have consistency over time. After no apportionment in 1920 after a stalemate in Congress, reapportionment was resumed in 1930 and a rule was set in place that provided for automatic reapportionment after each census in accord with a specified apportionment formula. While that formula was changed for the 1940 census, and a still different formula had been used early in the nation's history, the differences in allocation across apportionment formulae tend to be minor (see Balinski and Young 2001, cf. Janson and Linusson 2012). Though no apportionment was done in 1920, we provide the hypothetical 1920 apportionment from the Census population using the Hill-Huntington method.

Third, the basis of apportionment has changed over time concerning the inclusion/weighting of African Americans and Native Americans. Article I, § 2, Clause 3 of the U.S. Constitution says ''Representatives and direct Taxes shall be apportioned among the several States which may be included within this Union, according to their respective Numbers, which shall be determined by adding to the whole Number of free Persons, including those bound to Service for a Term of Years, and excluding Indians not taxed, three-fifths of all other Persons.'' Amendment XIV repealed this provision, requiring ''representative shall be apportioned... counting the whole number of persons in each State...'' I calculate apportionment from the summation of the total free population plus three-fifths of the slave population for the U.S. House and Electoral College throughout the entire period. From 1870 on, this is equivalent to using the

total population as the basis for apportionment. Thus, the inequality that existed at the founding due to the three-fifths clause is reflected in the measure. I will address the effect of the three-fifth's clause on the measures of malapportionment later.

Lastly, I am most interested in comparisons at the state level to expedite direct comparisons between the House, the Senate, and the Electoral College. Despite severe intra-state malapportionment in the U.S. House prior to *Baker v. Carr*,[17] as noted earlier, for the House I treat each district within a state as the state's population divided by the number of members in that state, i.e., $ideal\ population\ =\ average\ population$. Apart from Maine and Nebraska, states currently award the state's total Electoral College votes based on the state-wide plurality winner. I use this state unit-rule for all states over the entire period. For all three of the institutions included in this study, I calculate the ideal population per seat as the total U.S. population divided by the total number of seats. Two for each state for the U.S. Senate, and in recent decades, 435 for the U.S. House and 538 for the EC. In effect, as noted earlier, we treat the House districts in each state as having an identical population, namely the population of the state divided by the number of House seats allocated to that state. Table 1.1 shows the minimum district, the maximum district, and the ideal district size for each of the three institutions.

Measuring Malapportionment

Regardless of whether or why malapportionment is regarded as problematic, logically prior is the question: ''How do we measure malapportionment?''. While there is a 'zoo' of

[17] See e.g., Altman (1998); Ladewig and Jasinski (2008); Engstrom (2013)

potential measures (Taagepera and Grofman 2003), I focus on a select few which are preeminent in the scholarly and legal literature. It is well recognized that no single measure of disproportionality can capture every feature of interest, and each measure has some desirable properties and some flaws (Cox and Shugart 1991; Monroe 1994; Taagepera, Selb, and Grofman 2014). The theoretical virtues of the different measures have been extensively investigated (Monroe 1994; Taagepera and Grofman 2003; Karpov 2008; Van Puyenbroeck 2008). I will not try to contribute to the literature on axiomatic comparisons of equality measures beyond some specific points regarding their relationship with malapportionment. Similarly, I will not seek to discuss which of these measures are best. I'll simply conclude that different measures pick up different facets of inequality. Thus, I disagree with Samuels and Snyder (2001) who reject the use of *total population deviation* as completely inappropriate. I am not willing to dismiss a court chosen measure of malapportionment out of hand. Instead, I will compare empirically the results from different measures.

The focus in this section will be empirical, looking at the historical measurement of U.S. political institutions (the House of Representatives, the Senate, and the Electoral College) and what the different measures say about long-term trends and overall magnitudes of disproportionality in each over the period 1790-2010. The issue of malapportioned voting units can be traced at least as far back as the Roman Republic, where voting was by units based on income level, with the wealthy greatly over-represented (Manin 1997). The measures will compare the most common measure used in U.S. Courts, along with other measures proposed by political scientists pre-*Baker v. Carr*, with applications to the population context of those found

more recently in the comparative politics literature measuring vote-seat disparities, and of the two common measures of inequality in the economics literature. The degree of concordance among some of the measures is rather surprising, as are the results about which measures are most in disagreement with other measures, and how the degree of disagreement among measures varies across the three institutions.

For simplicity of exposition, I present below definitions of all four measures used by courts or proposed by early reformers for use by U.S. courts for the case of single-seat constituencies.[18] There, states are weighed by their EC seat share. Let $p_i = persons$ in the i_{th} constituency, $P = total\ population = \sum_{i=1}^{n} p_i$, $\hat{p} = ideal\ population$, i.e., the total population divided by the total number of seats n. Constituencies are indexed by $i = 1, \ldots, n$. p_{max} is the district in the constituency with the largest population, p_{min} is the district in the constituency with the smallest population. Issues of whether to use measures based on something other than census-based population counts, such as the total citizen population or eligible voters speak to issues quite distinct from those considered in this chapter.[19] Because the central concern that motivated this chapter was malapportionment in the Electoral College, as noted earlier, all our calculations use states as the units. This means that the measure of congressional malapportionment only

[18] There are many complexities in defining malapportionment when we move from simple single-seat systems to countries with multi-seat districts and/or a mix of single and multiple seat districts, and/or a tiered system with proportional allocations or compensatory seats in the upper tier (Samuels and Snyder 2001). Because the House and Senate are single-seat constituencies, such complications arise only vis-a-vis the Electoral College.

[19] See *Evenwel v. Abbott* 578 U.S. ___ (2015).

captures inter-state differences in mean population per House districts. This is equivalent to taking constituency populations within a state to be identical.

Legal Measures of Malapportionment and early Political Science Approaches

The aftermath of *Baker v. Carr* (1962) initially led U.S. federal courts to consider several different ways to measure malapportionment (NCSL 2019). It also took a while for there to be definitive legal standards for what levels of malapportionment would be acceptable at different levels of government (NCSL 2019). But, rather quickly, the U.S. Supreme Court focused on a measure, the *total population deviation* (*TPD*, Equation 1, also referred to as *Relative Deviation* or *total maximum deviation*), which looks at the relative difference in population between the most underpopulated and the most overpopulated district to the ideal district size. Among other measures initially proposed by political scientists (see esp. Baker 1966) are the *Max/Min* (Equation 2, sometimes called *population deviation ratio*, *population variance ratio*, *overall range*, *voter equivalency ratio*, or *maximum deviation*), which is the ratio of the population in the largest district to that in the smallest; note that the *total population deviation* measures the absolute difference between seats and votes, divided by the ideal population, while the *Max/Min ratio* is based on a ratio of the largest and small districts alone. The *minimum population share*, which identifies the minimum population needed to control a majority of seats in the legislature; and the *average absolute level of deviation* (Equation 3). The last of these measures is mathematically equivalent to *Loosemore-Hanby* (Equation 4) of malapportionment; I reserve

discussion of it until the discussion of political science approaches to malapportionment, where it will be referred to it under the latter title.

The *TPD* measure is conceptually very simple, and like the other three measures, it can be used to specify a *de minimis* threshold that can serve as a ''bright-line'' test for courts. Though often called the ''total'' population deviation (or variance), it might better be called the ''maximum'' population deviation since it only describes the relationship between the two most extreme units and nothing about the nature of malapportionment in the other constituencies. Virtually every other democracy which imposes some form of ''one person, one vote'' test on its parliamentary constituencies has also adopted a *TPD* based measure, though with widely differing thresholds, most far higher than the ones adopted in the U.S. (e.g., 30% in Germany and 50% in Canada). See Handley and Grofman (2008) for a review of legal malapportionment thresholds in many countries. Readers must be careful in interpreting reported thresholds. In the U.S., courts have leveled different standards for different legislatures. For example, the threshold in Germany is stated as no more than 15% upwards or downwards from the average, and those who write about Germany may thus correctly characterize it as a 15% tolerance limit but, in our terms, this is a 30% *TPD* value.

(1) *Total population deviation* (TPD) = $\frac{(p_{max}-p_{min})}{\hat{p}}$

The *Max/Min ratio* is simply the ratio of the largest to the smallest persons per district, with a ratio of 1 indicating no malapportionment. It has also been referred to as the Voter Equivalency Ratio (Ladewig 2011).

(2) Max/Min = $\frac{p_{max}}{p_{min}}$

(3) Average absolute deviation = $\sum \frac{|p_i - \hat{p}|}{n}$

Finally, to find the *minimum population share* needed to control a majority of the seats in the legislature, for the case of single-seat constituencies, order the districts from smallest to largest by population per district. Find the population of the units up to and including the pivotal unit (m) and then divide by the total population to obtain the proportion. To calculate it for the Electoral College, take the population of each unit in the EC to be equal to each state's population divided by its number of EC seats.[20] Sometimes the resulting vote proportion is divided by two to indicate that only a majority of the votes in each constituency are needed to control the outcome in that constituency, i.e., a party that wins only the barest of majorities of votes in a bare majority of seats in a two-party competition can win the election. We will not make use of this normalizing divisor.

Adapting Political Science Measures of Seats-Votes Discrepancy to the Malapportionment Context

In contrast to the measures used in courts, when students of politics study redistricting, they utilize instead measures of malapportionment adapted from the electoral systems literature on measuring the discrepancy between party vote share and party seat share (Samuels and Snyder 2001, Sauger and Grofman 2016).

[20] This metric has also been labeled as the ''electoral percentage'' (Dixon 1968) and the *theoretical control index* (Grofman and Scarrow 1981).

The *Loosemore-Hanby Index of Distortion* (Equation 4, Loosemore and Hanby 1971) along with the closely related *Gallagher Index* (Equation 5, Gallagher 1991) are the two most common metrics used for measuring seats-votes disproportionality.[21] *Loosemore-Hanby* measures the summed absolute differences between seats and votes, while *Gallagher's Index*, often referred to as a ''Least Squares'' measure, weights each observation by the size of the deviation, i.e., it squares the deviations. Squaring the deviations puts more weight on larger deviations, while discounting smaller ones. The analogues to these two disproportionality indices in the malapportionment context are shown below.

(4) Loosemore-Hanby Index = $\frac{1}{2}\sum_{i=1}^{n}|p_i - \hat{p}|$

(5) Gallagher Index = $\sqrt{\frac{1}{2}\sum_{i=1}^{n}(p_i - \hat{p})^2}$

Adapting Economic Measures of Equality to the Study of Malapportionment

The economists use of measures of inequality is commonly found in the study of income inequality (Yntema 1933; Atkinson 1970; Foster 1985; Bai and Lagunoff 2013). A standard approach in the economic literature on inequality is to report *fractiles* or *percentile ratios*, e.g., the proportion of income held by, say, the richest 80% of the population divided by the proportion of income held by the poorest 20% of the population (Pareto 1896). Similarly, the ratio of seat shares to population shares at the 20^{th} and 80^{th} percentiles can help us understand malapportionment. The ratio approach in terms of percentile ranks like the ratio approach in

[21] There are many other measures that have been proposed.

terms of largest and smallest district population throws away some of the information about the shape of the distribution *in toto*. The percentile method is equivalent to the Max/Min approach, but instead of using the values at the 100% and the lowest percentile, it takes values that conceivably eliminate any outliers. I have chosen to measure the 80^{th} and 20^{th} percentiles for the tables and figures presented in the empirical section of the paper, but the $\frac{80}{20}$ ratio is only intended to be illustrative. It is but one of many ratios I might have used.

The percentile method provides just a crude understanding of malapportionment. The *Lorenz curve*, a graphical tool for displaying inequality first proposed in 1905 by Max Otto Lorenz (1905) is the natural way to summarize the entire distribution. On a two-dimensional scatterplot, plot the cumulative percentages of the population, on one axis and the cumulative share of income arranged from lowest to highest on the other. This is the *Lorenz curve*. Where all points on the plot are identical, $x = y$, a straight line is drawn, often called the *line of equality*. That is, the top $k\%$ of the population holds $k\%$ of the income. To provide a single measure derived from a Lorenz curve the *Gini coefficient* is used. It is defined as the ratio of the area of the cumulative frequency distribution and the area below the *line of equality*. This area allows for meaningful comparisons among Lorenz curves which intersect. It can be found through interpolation with actual data or can be calculated analytically for different assumed distributional shapes. Similarly, for a legislature or the Electoral College, plot cumulative population share versus cumulative seat share. In the context of economic inequality, the *Gini coefficient* has been called the single best measure of inequality (Morgan 1962), but, as noted earlier, I will not attempt to judge measures normatively but rather to assess their degree of concordance when applied to important real-

world applications. Another approach to equality found in the economic literature is based on voting power using a game theory measure of power such as the *Shapley-Shubik* index (Shapley and Shubik 1954) or the *Banzhaf index* (Banzhaf 1965). I will not consider this approach to inequality here.

To create a *Lorenz curve*, order districts such that $v_1 \leq v_2 \leq v_n$ where each district $i = 1, \ldots, n$ gets allocated its share of V, the total vote-share. Individual shares are $v_i = \frac{p_i}{V}$ and $1 = \sum_{i=1}^{n} p_i$. The cumulative proportion of V is then plotted on the x-axis and the cumulative population share on the y-axis. The points start with $(0,0)$ and end at $(1,1)$.

Results

TABLE 1.1 DISTRICT DEVIATION SUMMARIES FOR THE U.S. HOUSE, SENATE, AND ELECTORAL COLLEGE

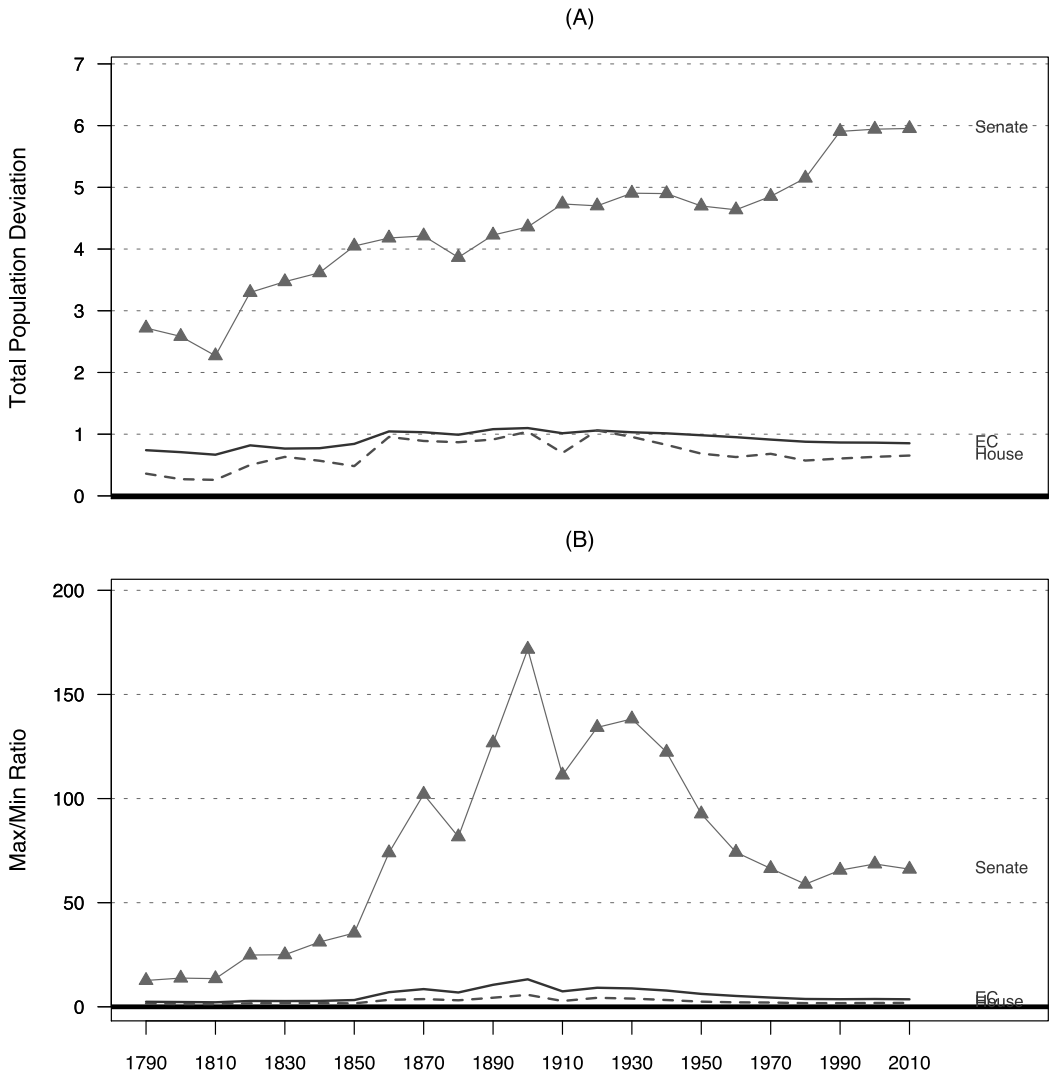
	U.S. House				Electoral College				U.S. Senate			
Year	*n*	*min*	*max*	*ideal*	*n*	*min*	*max*	*ideal*	*n*	*min*	*max*	*ideal*
1790	*105*	28,475	41,512	36,162	*135*	14,774	35,600	28,126	*30*	29,548	373,805	126,566
1800	*141*	30,893	40,672	36,091	*173*	16,068	36,923	29,415	*32*	32,136	443,074	159,024
1810	*181*	32,966	42,746	37,660	*215*	18,168	39,326	31,704	*34*	36,337	491,576	200,482
1820	*213*	33,293	55,860	45,033	*261*	16,646	46,742	36,751	*48*	27,606	686,406	199,832
1830	*240*	38,374	71,913	53,057	*288*	19,187	53,086	44,214	*48*	38,374	959,304	265,285
1840	*223*	54,415	97,574	75,790	*275*	26,028	73,516	61,458	*52*	39,042	1,214,460	325,021
1850	*234*	73,772	121,305	98,495	*296*	29,148	94,777	77,864	*62*	43,722	1,548,697	371,740
1860	*241*	52,465	175,927	129,245	*309*	17,488	122,794	100,803	*68*	26,232	1,940,368	458,060
1870	*292*	42,941	159,150	130,535	*366*	14,314	121,743	104,142	*74*	21,470	2,191,380	515,082
1880	*325*	62,266	194,327	151,912	*401*	20,755	142,763	123,121	*76*	31,133	2,541,436	649,623
1890	*356*	47,355	206,624	174,156	*444*	15,785	166,755	139,638	*88*	23,678	3,001,587	704,538
1900	*386*	42,335	243,329	193,283	*476*	14,112	186,382	156,738	*90*	21,168	3,634,447	828,969

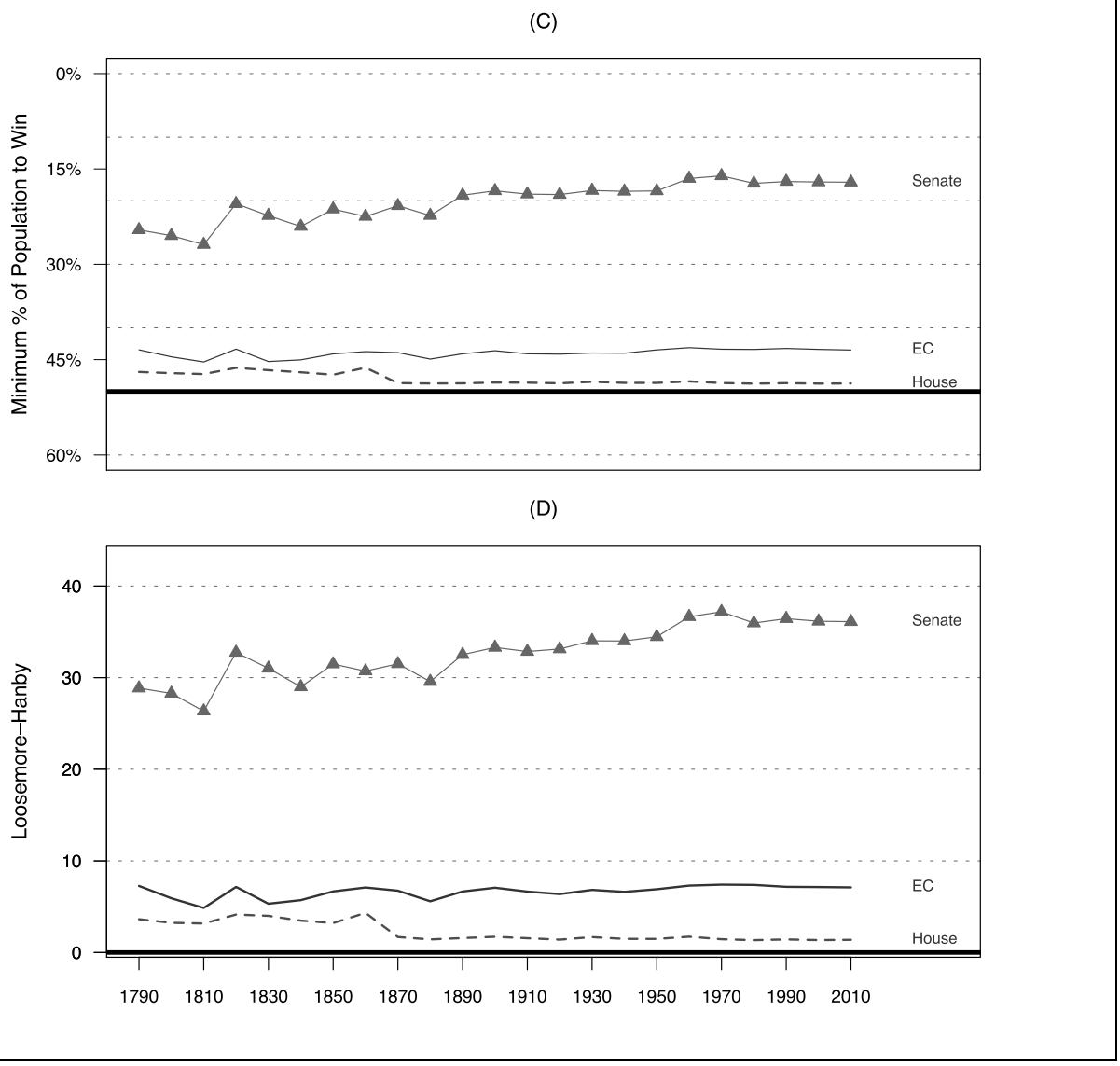
1910	*435*	81,875	228,398	210,669		*531*	27,292	202,525	172,582		*96*	40,938	4,556,807	954,596
1920	*435*	77,407	334,162	242,007		*531*	25,802	236,028	198,254		*96*	38,704	5,192,614	1,096,594
1930	*435*	91,058	359,611	281,122		*531*	30,353	267,831	230,298		*96*	45,529	6,294,033	1,273,835
1940	*435*	110,247	359,231	301,164		*531*	36,749	286,790	246,716		*96*	55,124	6,739,571	1,364,648
1950	*435*	160,083	395,948	344,587		*531*	53,361	330,819	282,288		*96*	80,042	7,415,096	1,561,408
1960	*435*	226,167	484,632	410,481		*535*	75,389	392,930	333,756		*100*	113,084	8,391,152	1,785,592
1970	*435*	300,382	617,761	465,415		*538*	100,127	444,804	377,717		*100*	150,191	9,976,567	2,024,554
1980	*435*	393,345	690,768	519,328		*538*	133,950	503,572	421,089		*100*	200,926	11,833,951	2,259,075
1990	*435*	453,588	799,065	570,352		*538*	151,196	551,112	462,286		*100*	226,794	14,880,010	2,481,030
2000	*435*	493,782	902,195	645,632		*538*	164,594	615,848	523,089		*100*	246,891	16,935,824	2,808,498
2010	*435*	526,284	989,415	708,377		*538*	187,875	677,345	573,876		*100*	281,813	18,626,978	3,081,438

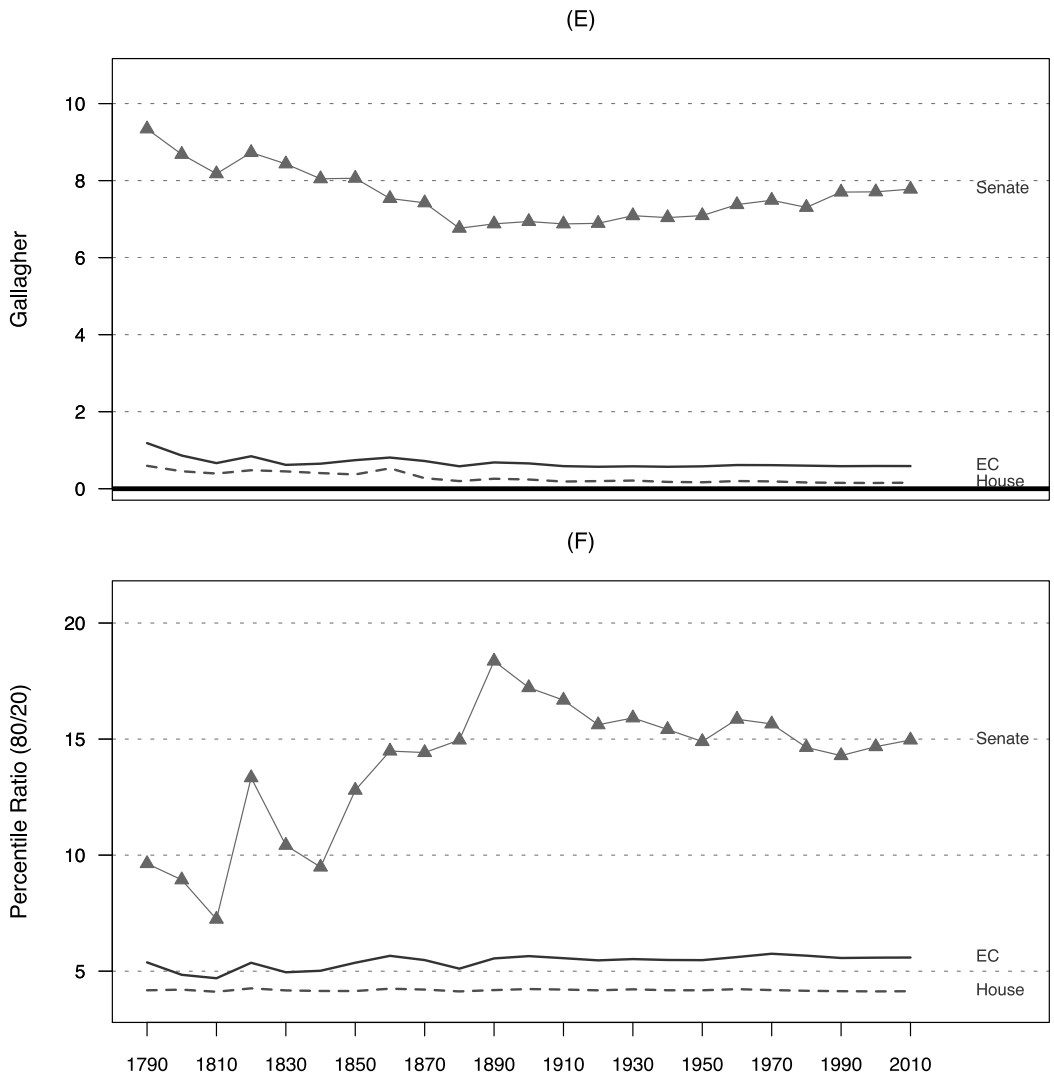
Note: In 1790, there were thirteen states which were apportioned 105 House seats. The average district populations [and number of districts] in each state are (ideal = 36,162 [105]; 33,834 [7], 27,770 [2], 35,421 [2], 34,352 [2], 34,814 [8], 34,435 [11], 35,456 [4], 35,914 [5], 33,159 [10], 32,138 [11], 33,298 [13], 34,223 [2], 34,372 [6], 28,475 [3], 33,187 [19]).

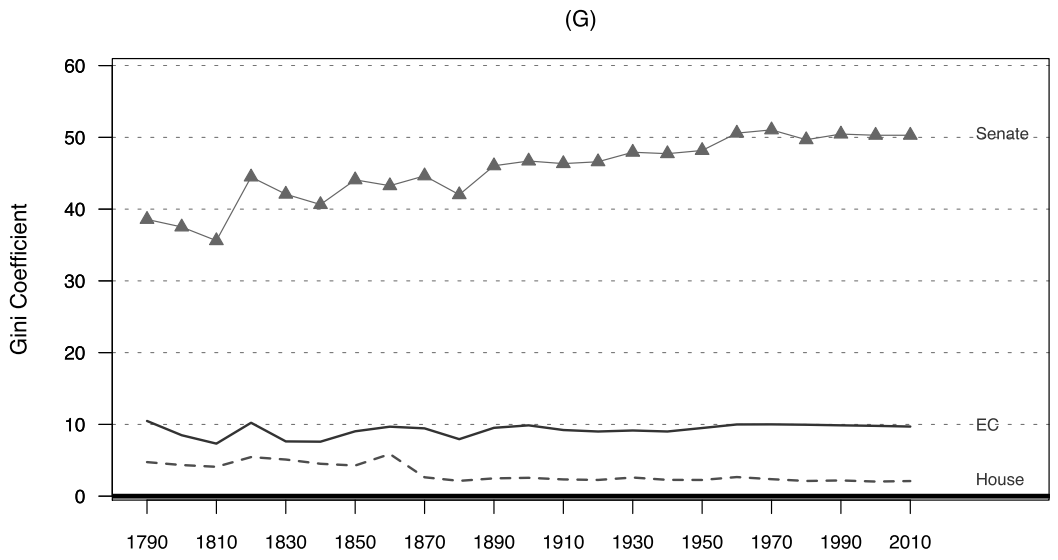
Figure 1.1 (a-g) show the comparisons across the three institutions of single-member districts for each of our seven metrics.

FIGURE 1.1 MEASURES OF MALAPPORTIONMENT: 1790-2010


(A)
Total Population Deviation
7
6
5
4
3
2
1
0
Senate
EC
House
(B)
Max/Min Ratio
200
150
100
50
0
Senate
1790
1810
1830
1850
1870
1890
1910
1930
1950
1970
1990
2010


(C)
Minimum % of Population to Win
0%
15%
30%
45%
60%
Senate
EC
House
(D)
Loosemore–Hanby
40
30
20
10
0
Senate
EC
House
1790
1810
1830
1850
1870
1890
1910
1930
1950
1970
1990
2010


(E)
Gallagher
10
8
6
4
2
0
Senate
EC
House
(F)
Percentile Ratio (80/20)
20
15
10
5
Senate
EC
House
1790
1810
1830
1850
1870
1890
1910
1930
1950
1970
1990
2010



Note: The solid black line indicates perfect voter equality.

All seven of the metrics in Figure 1.1 support the claim that EC malapportionment is far closer to low levels of House malapportionment than it is to the high levels of U.S. Senate malapportionment. For the *total population deviation*, as a matter of mathematical necessity, if the most over-represented and most under-represented state in the EC is the same as their counterpart in the U.S. House, malapportionment in the EC must be larger than malapportionment in the U.S. House. Indeed, if we compare the most recent values we get for those measures to their equivalents in the seats-votes disproportionality context, both the U.S. House and even the U.S. Electoral College exhibit low levels of disproportionality. The levels shown in Figure 1.1 d & e, while not as small as the party-based disproportionalities reported for

the most highly proportional electoral rules in use world-wide, those of Netherlands[22] and Israel[23] are comparable to the partisan disproportionalities in other western European democracies. For example, tabulating data from Döring and Manow (2017, Table 3: pg. 159) shows that proportional countries have an average *Gallagher* value of 3.89 and majoritarian countries average 11.12. The U.S. House in 2010 was 0.157, the EC was 0.589, and the Senate 7.78.

All seven measures also show a relatively flat pattern of malapportionment for the House and the EC, in general, and especially over the past several decades. While, as noted above, the U.S. Senate is by far the most disproportionate of the three institutions under all measures, unlike what we find for the House and the EC, there are substantial differences across the measures in the overtime pattern of Senate malapportionment. For example, the *Total Population Deviation* metric shows the Senate rather steadily exhibiting ever-higher levels of malapportionment, though recently leveling off; the *Gini coefficient* and the *Loosemore-Hanby index* show a similar upward pattern, but not as steep, as does the *minimum population share*. The y-axis is flipped in Figure 1.1 (c) to match the other figures such that when inequality increases, the line plot goes up. While voting majorities are not typically determined by state size, this finding raises the prospects of significantly less than 50% of the population controlling the majority of votes in the U.S. Senate. But the *Max/Min ratio*, in contrast, tends to ebb and flow over time, albeit with the present values still considerably higher than those in the United States' earliest history; the same

[22] 2017 Dutch Election: *Loosemore-Hanby* - 1.3, *Gallagher* - 6. Data source: https://www.kiesraad.nl/

[23] 2015 Knesset Election: Loosemore-Hanby - 1.5, Gallagher - 7. Data source: https://www.knesset.gov.il

is true for the Percentile (80/20) ratio, though levels in 2010 are closer to the high levels of the late 19^{th} century than the levels at the founding. Finally, the *Gallagher index* shows first a gradual fall and then a more gradual rise.

I show in Table 1.2 correlations across the seven measures.

TABLE 1.2 CORRELATIONS FOR SEVEN MEASURES OF MALAPPORTIONMENT

	TPD	Max/Min	MWP	L-H	Gallagher	Percentile	Gini
TPD	1 1 1						
Max/Min	0.9 0.92 0.51	1 1 1					
Minimum Winning Population	0.46 -0.32 -0.9	0.41 -0.13 -0.56	1 1 1				
Loosemore-	-0.44 0.37 0.88	-0.38 0.18 0.41	-1 -0.97 -0.98	1 1 1			
Gallagher	-0.42 -0.39 -0.57	-0.3 -0.3 -0.86	-0.94 -0.08 0.57	0.95 0.12 -0.43	1 1 1		
Percentile	0.32 0.66 0.71	0.4 0.46 0.83	-0.26 -0.85 -0.82	0.24 0.9 0.71	0.27 -0.19 -0.8	1 1 1	
Gini	-0.4 0.33 0.92	-0.34 0.18 0.52	-0.99 -0.96 -0.99	1 0.97 0.98	0.95 0.26 -0.55	0.3 0.84 0.79	1 1 1

Note: The top entry is for the U.S. House, the middle entry is the Electoral College, and the bottom is th U.S. Senate.

Since the first two of the measures, *TPD* and *Max/Min*, focus on the same two constituencies (the largest and smallest), there is an expectation that these two disproportionality

measures should correlate highly with one another. Though they are the same with-in each institution, it is not necessarily the case the more or least represented constituencies be the same in the House or Senate or EC. They are quite highly correlated for both the U.S. House and the Electoral College, with a correlation exceeding $r = 0.90$ for each institution. But the same is not true for the U.S. Senate, as the correlation between these two measures is much lower, though still positive at $r = 0.51$. The reduced correlation in the Senate between the two measures is due in part to the admission of extremely small states into the union in the mid-nineteenth century (Stewart and Weingast 1992; Engstrom 2013), since the ratio measure is even more strongly dependent on extreme values than the difference measure. For instance, Nevada entered the union in 1864 with a census population in 1860 of 6,857 (1870's population of 42,491 for the calculations.)

Minimum winning population is strongly correlated with the *Gini coefficient* for all three institutions, as is *Loosemore-Hanby*. Similarly, *Loosemore-Hanby* and the *Minimum winning population* are also highly correlated with each other. Thus, whatever the differences in the axiomatic properties of these three metrics, in practice, at least for the historical data on the three U.S. institutions we examine, they tend to move in parallel. In factor analytic terms, these three measures scale on the same dimension.

In contrast, *Gallagher* and *Max-Min ratio* exhibit divergent patterns with the other measures for some of our three institutions. *Max/Min* and *Percentile* are positively correlated to similar degrees across the three institutions, and *Max/Min* and *Gallagher* are negatively correlated for all three, *Max/Min* and the rest of the measures have correlations that are

sometimes positive and sometimes negative. The inconsistency of the *Max/Min* measures raises some serious concerns about its reliability for measuring malapportionment. As the reader will recall, this is the measure the courts regularly turn to when striking down districting plans for failing to meet the 'one person, one vote' standard.

We might have expected *Loosemore-Hanby* and *Gallagher* to be highly correlated since they are very similar in mathematical form, but empirically their correlation varies by institution. For the U.S. House, they are highly correlated ($r = 0.95$); for the EC, they are likewise positively correlated ($r = 0.12$); for the U.S. Senate, they are negatively correlated ($r = -0.43$). More generally, The *Gallagher* measure is negatively correlated with most other measures.[24] This difference in the strength of correlation across institutions reflects the discounting by *Gallagher* of the contribution to malapportionment of very small jurisdictions, a factor which plays a more important role in shaping values in the Senate and the EC than it does in the House.

The Paradox of Malapportionment

Although I have made a point to limit the analysis to the measurement of malapportionment, more should be said about the axiomatic properties that might make them more or less useful at capturing the spirit and theoretical properties that are useful for evaluating an institution. To this end, in the period 1790 to 1870, the non-free population in the U.S. was

[24] With the exceptions of minimum winning population for the Senate, which has a correlation of $r = 0.57$, Percentile in the House ($r = 0.27$), and the Gini Coefficient for the House and EC ($r = 0.95, r = 0.26$).

counted (for apportionment) as three-fifths of a free person. If all people were apportioned with the same weight, the institution would be more equal and thus have less malapportionment.

TABLE 1.3 EFFECT OF THREE-FIFTHS APPORTIONMENT ON CONGRESSIONAL REPRESENTATION, 1790

State	Actual House	Counterfactual	Change
Connecticut	7	7	-
Delaware	2	2	-
Georgia	2	2	-
Kentucky	2	2	-
Maryland	8	9	⇑ 1
Massachusetts	11	10	⇓ 1
New Hampshire	4	4	-
New Jersey	5	5	-
New York	10	9	⇓ 1
North Carolina	11	11	-
Pennsylvania	13	12	⇓ 1
Rhode Island	2	2	-
South Carolina	6	7	⇑ 1
Vermont	3	2	⇓ 1
Virginia	19	21	⇑ 2

Note: The column labeled "Actual House" is each state's congressional delegation with the three-fifths clause in effect. The column labeled "Counterfactual" is the congressional delegations with all persons counted as five-fifths. Both apportionments use the Hill-Huntington rule.

I compare for the U.S. House (and Electoral College) the differences between apportioning the antebellum period (1790-1870) as it happened and a counter-factual where each person, free or slave, received the whole weight of representation. Table 1.3 shows how congressional representation would have changed in 1790 under a five-fifths rule of enumeration for all people. When everyone is counted equivalently, malapportionment is reduced. In this

example, the counter-factual, where slaves are counted as whole people, should result in lower levels of malapportionment across all measures. The magnitude of the difference will help to illustrate which measures are most robust. Since the three-fifths clause only affected apportionment before 1870, we limit this section of the analysis to those years, 1790-1860. The slave population in the U.S. in 1790 equaled 17.8% overall. In the six Southern states[25] slaves were 34.5% of the population. The three-fifths clause increased the Southern apportionment base by 31.2% and represented 10.1% of the entire apportionment base.

The U.S. slave population by 1860 was 3.9 million, representing about 12.6% of the total U.S. population. 57.2% of South Carolina's 1860 census population was slave, which, when discounted by a factor of two-fifths for apportionment, South Carolina suffered a loss of 241,000 voters. Thus, South Carolina, like many other southern states, received only approximately 65% of their U.S. House seats and Electoral College votes. But while northern, non-slave states benefit from this arrangement, it was indeed Southerners who ultimately compromised on three-fifths, since this greatly increases their representation in the federal government compared to the north's proposed apportionment which would have not counted slaves at all. Over fourteen percent of all Americas were counted as slaves during the eighty-year antebellum period. The compromise made at the founding of the nation affected representation through systematic malapportionment directed at heavily African American states. Recalling the measures used in

[25] Southern states in 1790 include Georgia, Kentucky, North Carolina, South Carolina" Tennessee, Virginia. Maryland, despite never succeeding, had a large slave population and therefore could be included in this list.

the above sections, I look at the differences between the U.S. House as apportioned with all residents counted in the way we have since 1870 and compare that to how it was counted before 1870. This difference-in-difference design gives us leverage to see which of the measures are responsive to a clear difference in malapportionment.

Readers are urged to keep in mind that, in the way in which malapportionment is calculated, while the districts allocated to each state might change, the total population is the same for both sets. That means that if State A is apportioned 2 members from a population of 10,000 under one rule, but only 1 member from the same 10,000 population under a second rule, and the total members are unchanged, they will have received more representation under rule one. In the equivalent setup for seats-votes in the comparative politics literature, it is the translation of votes for a party into their seats-share. So, what percentage of seats for each party is associated with what percentage of the votes? For instance, keeping with the earlier example of South Carolina (SC) in 1860, you'll recall that the total population was 703,708 of which 402,406 were slaves. Under the apportionment in a place where slaves were counted as three-fifth, SC received four congressional districts (six EC Electors). Using the Hill-Huntington apportionment formula, had the constitution counted slaves in the same manner they did a free person, they would have been entitled to five congressional districts (seven EC Electors). In effect, each member of congress should have represented 140,742 people, but instead, they represented 175,927. Likewise, since the total members of congress were determined before apportionment, a state with no slaves would benefit from the reduced weight of slaves. New Jersey, with its population of 697,346, all of which counted as whole people, was only entitled

to five congressional districts (averaging 139,469 constituents), but instead received six (at 116,224 persons per district).

Unlike the analyses in the prior sections of this paper, here there is an intuition about expected levels of malapportionment. Given that there is a 'control' measure, i.e., malapportionment that exist given the constitutional rule, and a 'treatment', malapportionment levels when apportionment is done more equitably, I can test whether the values are different. Since the expectation is that appointment based on the whole population will *always* have lower malapportionment, we set up the hypothesis such that:

Hypothesis 1a: The level of malapportionment will always be lower in the counter-factual example, compared to malapportionment when slaves are counted for apportionment as only three-fifths a person.

The corollary hypothesis is:

Hypothesis 1b: Regardless of the metric, there is the same proportion reduction in malapportionment corresponding to the known reduction in malapportionment.

The first thing to notice in Table 1.4 that the *range* between the maximum and the minimum district is not uniformly lower for the more equal apportionment. That is, in 1840, the largest and small deviations for both apportionments are identical. The reason for this is that those districts, the minimum, and maximum deviations, happen to both come from states in which there are no slaves, and happen to coincide for both apportionments. In all other years, the difference between the max and min deviations for the whole apportionment is smaller. This leads me to conclude that measures of malapportionment that focus on just two districts are not robust to a reduction of malapportionment, creating a *paradox of malapportionment*.

Mathematically, the Max/Min measure, the TPD measure, and (less plausibly) the Percentile (80/20) measure could lead to situations where an institution that has less overall inequality shows none-the-less more malapportionment. In the same way that a *paradox of apportionment* (Balinski and Young 2001; Young 2004) happens when seats are added but the population remains the same and a state loses representation, a paradox of malapportionment is when an electoral system is more equitable but the measure of disproportionately increases. These observations lead to the necessary conclusion that measures of malapportionment that rely on just the largest and smallest district are incompatible with the goal of understanding malapportionment. We further contend that these measures should *only* be used to answer questions about the range of malapportionment, or the worst cases. Court use of TPD and Max/Min for purposes of evidence of any malapportionment makes sense since, if malapportionment exists between any two districts then it follows that checking the most extreme can inform the court in a bright-line way.

TABLE 1.4 APPORTIONMENT IN THE ANTEBELLUM PERIOD UNDER TWO SETS OF RULES

Year	Total Population	Total Slaves	Slave %	Antebellum		Whole Apportionment	
				min	max	min	max
1790	3,929,214	697,681	17.80%	28,475	41,512	29,548	42,712
1800	5,308,483	893,594	16.80%	30,893	40,672	32,136	38,616
1810	7,239,881	1,191,362	16.50%	32,966	42,746	35,080	39,337
1820	9,638,453	1,538,022	16.00%	33,293	55,860	33,293	55,211
1830	12,860,702	2,009,043	15.60%	38,374	71,913	38,374	57,172
1840	17,063,353	2,487,355	14.60%	54,415	97,574	54,415	97,574
1850	23,191,876	3,204,313	13.80%	73,772	121,305	73,772	106,296
1860	31,443,321	3,953,758	12.60%	52,465	175,927	52,465	174,620

Note: Antebellum columns indicate apportionment done with slaves counted as three-fifths. Whole apportionment apportions the House counting all enumerated individuals equally.

The paradox of malapportionment is not something that is to be expected for any of the other measures used in this essay. *Minimum population needed to control a majority* has the virtue of being a direct, additive measure of malapportionment. Districts are ordered such that those with the highest deviations (in the negative direction) are added district with the next least large deviation until the population of those districts reaches 50%. In this way, the measure ignores a large portion of the districts. The same procedure happens for the *Gini index*. *Gallagher* and *Loosemore-Hanby* indices operate in a different way, but both are immune to the paradox. For *Gallagher*, deviations are squared and for *Loosemore-Hanby*, deviations' absolute values are averaged. In both cases, when overall malapportionment is reduced, the deviations are likewise reduced, leading the measurements to report lower levels of disproportionalities. Table 1.5 shows the measures of malapportionment for each of the eight years during the

antebellum period for both apportionments. I also report the percent difference between the two.

TABLE 1.5 COMPARING MEASURES OF MALAPPORTIONMENT IN THE ANTEBELLUM PERIOD WITH A COUNTERFACTUAL FULL APPORTIONMENT

Apportionment in the Antebellum period

Year	TPD	Max Min	Minimum Winning	Loosemore Hanbly	Gallagher	Percentile	Gini
1790	0.361	1.458	0.469	3.634	0.595	4.176	4.745
1800	0.271	1.317	0.471	3.237	0.453	4.204	4.336
1810	0.260	1.297	0.473	3.166	0.394	4.113	4.092
1820	0.501	1.678	0.463	4.144	0.480	4.260	5.448
1830	0.632	1.874	0.467	4.002	0.450	4.171	5.104
1840	0.569	1.793	0.470	3.479	0.406	4.147	4.513
1850	0.483	1.644	0.474	3.213	0.371	4.144	4.269
1860	0.955	3.353	0.463	4.328	0.530	4.245	5.869

Counterfactual Apportionment (Everyone counted as whole)

Year	TPD	Max Min	Minimum Winning	Loosemore Hanbly	Gallagher	Percentile	Gini
1790	0.364	1.446	0.490	1.587	0.342	3.995	2.312
1800	0.180	1.202	0.490	1.477	0.215	4.065	1.902
1810	0.113	1.121	0.493	1.058	0.142	4.060	1.475
1820	0.487	1.658	0.487	1.602	0.252	4.161	2.385
1830	0.354	1.490	0.492	1.245	0.200	4.110	1.987
1840	0.569	1.793	0.490	1.234	0.204	4.112	1.865
1850	0.330	1.441	0.493	1.179	0.167	4.074	1.694
1860	0.945	3.328	0.482	2.010	0.322	4.196	3.115

Note: The top table measures malapportionment as it happened, while the bottom table shows the measures if slaves were counted the same as free persons.

Table 1.5 shows that Hypothesis 1a is not true. In both 1790 and 1840, the *TPD* measure does not uniformly show less malapportionment when all people are counted for apportionment (W). Additionally, as stated earlier, 1840 shows that the *Max/Min* measure is subject to the

paradox of malapportionment. All the other measures show uniformly less malapportionment in the counter-factual dataset where apportionment is calculated in a more equal way. The positive change in the *Minimum Winning Population* measure simply reflects the fact that it takes a greater proportion of the population to elect a majority in the U.S. House, as expected.

As for Hypothesis 1b, I *TPD* and *Max/Min* outright as giving misleading information regarding the amount of inequality. It becomes tricky to judge if a measure is showing a robust adjustment to the changing inequality in an institution. Simply looking at the average change between the two apportionments gives a potentially bias perception since the way it measures in the first place may not be an accurate reflection of the inequalities. Therefore, I measure the change relative to a perfectly equal institution, i.e., one where 'one person, one vote' holds. For *Max/Min*, that would mean a ratio of 1:1. For the *Gini index*, that would mean a coefficient of 1. For *Minimum winning population*, equality would mean 50% of the population holds 50% of the voting power. So, to look at the change relative to the baseline, I take the value of the malapportionment measure and find its deviation from ideal and do the same for the corresponding measure for the counterfactual. I then look at the difference between the two apportionment measures relative to their baseline. I'll then average over the eight elections.

TABLE 1.6 APPORTIONMENT IN THE ANTEBELLUM PERIOD UNDER TWO SETS OF RULES

	TPD			Max Min		
	A	*W*	*Δ%*	*A*	*W*	*Δ%*
1790	-0.361	-0.364	1.0%	-0.458	-0.446	-2.7%
1800	-0.271	-0.180	-33.7%	-0.317	-0.202	-36.3%
1810	-0.260	-0.113	-56.5%	-0.297	-0.121	-59.1%
1820	-0.501	-0.487	-2.9%	-0.678	-0.658	-2.9%
1830	-0.632	-0.354	-44.0%	-0.874	-0.490	-44.0%
1840	-0.569	-0.569	0.0%	-0.793	-0.793	0.0%
1850	-0.483	-0.330	-31.6%	-0.644	-0.441	-31.6%
1860	-0.955	-0.945	-1.1%	-2.353	-2.328	-1.1%
			-21%			-22%

	Minimum Winning Population			Loosemore Hanbly			Gallagher		
	A	*W*	*Δ%*	*A*	*W*	*Δ%*	*A*	*W*	*Δ%*
1790	0.031	0.010	-66.9%	-3.634	-1.587	-56.3%	-0.595	-0.342	-42.5%
1800	0.029	0.010	-64.2%	-3.237	-1.477	-54.4%	-0.453	-0.215	-52.5%
1810	0.027	0.007	-72.7%	-3.166	-1.058	-66.6%	-0.394	-0.142	-64.1%
1820	0.037	0.013	-65.4%	-4.144	-1.602	-61.3%	-0.480	-0.252	-47.6%
1830	0.033	0.008	-75.3%	-4.002	-1.245	-68.9%	-0.450	-0.200	-55.4%
1840	0.030	0.010	-67.1%	-3.479	-1.234	-64.5%	-0.406	-0.204	-49.8%
1850	0.026	0.007	-72.4%	-3.213	-1.179	-63.3%	-0.371	-0.167	-55.0%
1860	0.037	0.018	-52.0%	-4.328	-2.010	-53.6%	-0.530	-0.322	-39.3%
Average			-67%			-61%			-51%

	Percentile			Gini		
	A	*W*	*Δ%*	*A*	*W*	*Δ%*
1790	-3.176	-2.995	-5.7%	-4.745	-2.312	-51.3%
1800	-3.204	-3.065	-4.3%	-4.336	-1.902	-56.1%
1810	-3.113	-3.060	-1.7%	-4.092	-1.475	-64.0%
1820	-3.260	-3.161	-3.0%	-5.448	-2.385	-56.2%
1830	-3.171	-3.110	-1.9%	-5.104	-1.987	-61.1%
1840	-3.147	-3.112	-1.1%	-4.513	-1.865	-58.7%
1850	-3.144	-3.074	-2.2%	-4.269	-1.694	-60.3%
1860	-3.245	-3.196	-1.5%	-5.869	-3.115	-46.9%
Average			-3%			-57%

Note: Table organized such that the numbers under A are those that count slaves as three-fifths, W the counterfactual when slaves are counted the same as free persons. Delta represents the difference between the two. The bottom row is the average over the eight Census periods. Measures are the difference, in each year, from the baseline of equality. The change is then calculated by taking the difference relative to the more malapportioned and then averaged across years.

As Table 1.6 indicates, four of the measures of malapportionment show between 50% and 67% reduction in average malapportionment over the eight antebellum elections. Two of

the measures show around 20% reduction on average, while the *Percentile* measure shows no change between the two apportionments. During the period 1790-1870, slaves represented around 14.5% of the total population. The representation of these individuals was discounted by two-fifths, which corresponds to states where these slaves reside receiving 5.8% less apportionment. Even without full representation, the U.S. House has a high level of equality in the translation of people to seats in the institution. This section has shown that giving non-free people full representation further reduces inequality by as much as 67%.

Discussion

The goals of this chapter have (1) been to address the magnitude of bias derived from the purely mechanical effects of rules determining the relationship between seat share and state population share in historical perspective for three important U.S. institutions, and (2) to assess the degree to which measures of inequality/disproportionality common in the disciplines of law, political science, and economics, when adapted to the malapportionment context, yield different answers to determining malapportionment inequality over time for the three institutions, and (3) to assess the robustness of the measures to known changes in inequality.

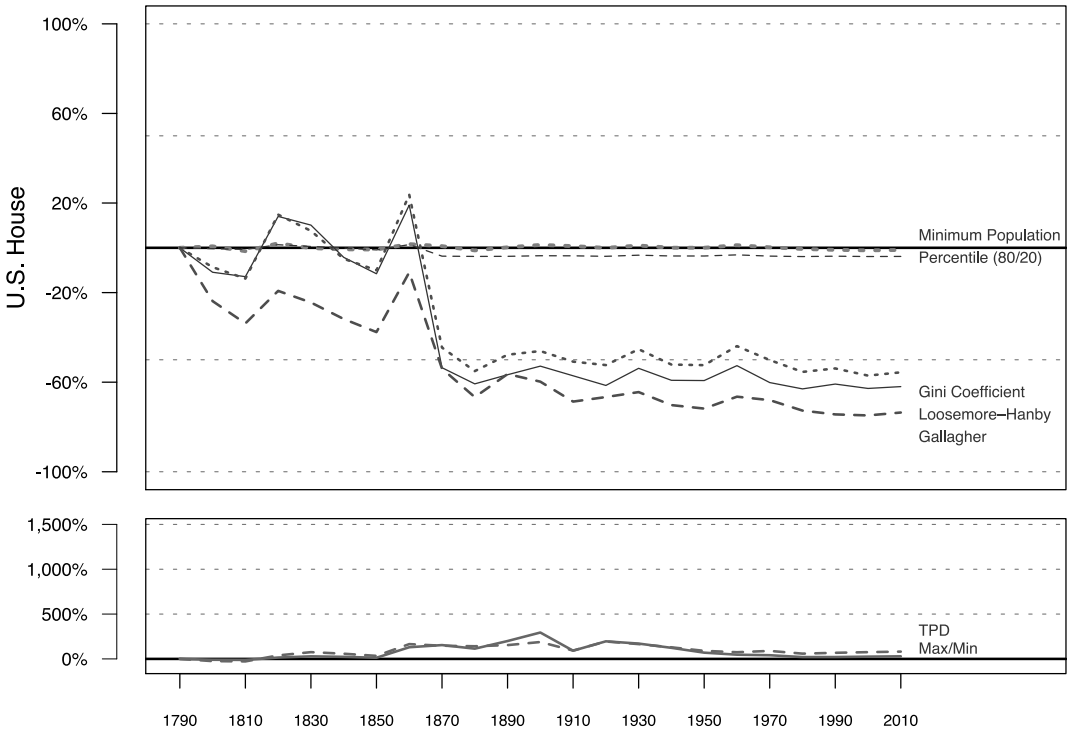
The principal finding is a clear one: in practice, Electoral College malapportionment is not very much larger than malapportionment in the U.S. House of Representatives and EC malapportionment is far lower than the malapportionment we find in the U.S. Senate. The Electoral College may be regarded as essentially a mixture between an upper and a lower chamber, but far more closely resembling the latter. Samuels and Snyder (2001) offer analysis of

malapportionment in a comparative perspective which shows that malapportionment levels in upper chambers are characteristically much greater than in lower chambers.

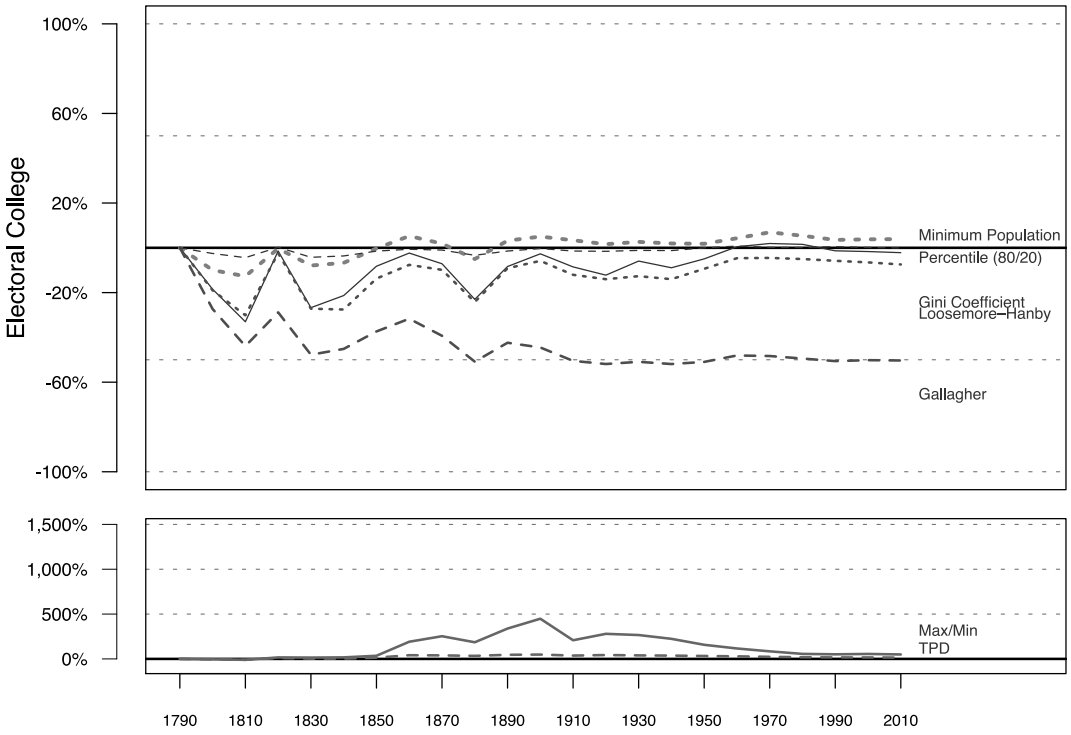
Moreover, the analyses presented above demonstrate that despite the freezing of the House size and the logical presumption that malapportionment in the EC should therefore increase, the discrepancy between popular vote outcome and EC outcome that occurred in 2016 cannot be blamed on an increasing EC malapportionment in recent decades. It can be shown that increasing the U.S. House by a reasonably small number would have led to a Gore victory (Neubauer and Zeitlin 2003; Barthélémy, Martin, and Piggins 2014. Contemporary levels of EC malapportionment are, by virtually all measures, presently at or slightly below historical levels.

FIGURE 1.2 PERCENT CHANGE IN MALAPPORTIONMENT FROM U.S. FOUNDING, 1790-2010

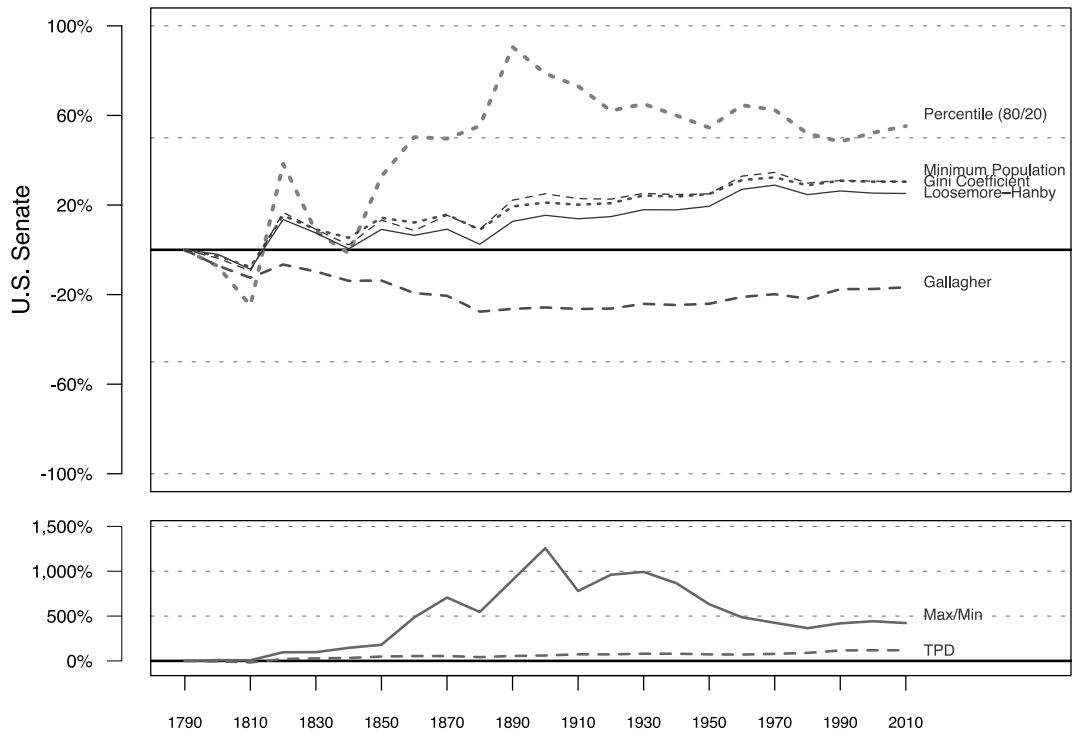
U.S. House



U.S. Electoral College


Electoral College
100%
60%
20%
-20%
-60%
-100%
Minimum Population
Percentile (80/20)
Gini Coefficient
Loosemore–Hanby
Gallagher
1,500%
1,000%
500%
0%
Max/Min
TPD
1790
1810
1830
1850
1870
1890
1910
1930
1950
1970
1990
2010

U.S. Senate



Note: Because of the wide disparities for the Max/Min and TPD measure compared to the other five, we have plotted them separately on different scales.

The second major set of findings has to do with the degree of agreement among various malapportionment measures. The graphs presented in Figure 1.1 help to show whether malapportionment has increase, decreased, or stayed flat since the country's founding under our various measures. Table 1.2 looks at the linear correlations among the seven measures. **Error! Reference source not found.** presents the same data as in Figure 1.1 but in a way that facilitates comparisons across our different metrics. **Error! Reference source not found.** reveals that: (a) C omparing 2010 and 1790, for the U.S. House, all the measures show decreasing amounts of

malapportionment (with the partial exception of *Percentile* and *Minimum Population*, which are stagnant over time). (b) The seven measures of malapportionment in the Electoral College show a similar decreasing pattern over time, though now it takes a slightly lower percentage of people to reach a majority in the EC. The *Gallagher* measures show a significant decrease in malapportionment since the founding, in contrast to the more limited changes found in the other measures. (c) In contrast, for the U.S. Senate, six of the seven measures show higher levels of malapportionment in 2010 than in 1790, while *Gallagher* shows a downwardly sloping pattern. Furthermore, (d) unlike the monotonically, whether positive or negative, found for the Senate in the other five measures, *Max-Min ratio* and the closely related *Percentile ratio* exhibits non-monotonic patterns for the Senate over the period 1790-2010. (e) Five of the seven measures, all but *Gallagher* and *Max/Min*, correlate very strongly with one another and can, in factor analytic terms, be considered as scaling on a single dimension for all three institutions. (f) However, concerning comparability across measures, the results about the *Gallagher index* are equally important. While, in the context of seats-votes disproportionalities, *Gallagher* is a metric that has recently been given a great deal of favorable attention, its lack of strong correlations with other measures, with negative correlations for two of our three institutions, suggests a sharp note of caution vis-a-vis its use in the context of malapportionment. Gallagher (1991) provides comparisons of the *Gallagher index* (which he refers to as the *least squares index*) with other measures in the context of national-level seats-votes relationships. In that context, he finds considerable similarity in results across measures.

Conclusions

The axiomatic properties of these different measures offer little guidance as to which measure should be used for measuring malapportionment. I deflect on the question of which is the best of these measures to use for understanding malapportionment in a political institution and instead suggest that it depends on the question being asked. Small changes in population or apportionment methods can lead to rather drastic deviations in individual districts. Apportionment methods themselves create a range of which the maximum and minimum district must be constrained. Since the U.S. Senate is not bound by apportionment, metrics that rely on the extreme deviations are free to increase without limit. Consider again the U.S. Senate; while most measures show between 20 and 60 percent increases in malapportionment since the founding, the Max/Min ratio shows a 500% increase. While it is true that the most over-represented state is significantly far from the ideal or average size state, the magnitude of *most* state's deviations is not nearly as large. I view this measure (along with *TPD*) as being a strawman for those who would argue that the U.S. system of representation is broken. That is not to suggest that the present author does not view the levels of malapportionment in the U.S. Senate to be un-problematic. I simply observe that the three measures of malapportionment that rely on just two district deviations are the three measures that show the most increase since the founding. The four measures that incorporate information about the deviations of all districts give estimates of malapportionment that are smaller in magnitude. The *Gallagher* index indicates that malapportionment has decreased by 20% in the U.S. Senate since the founding, whereas every other measure of malapportionment indicates *at least* a 20% increase.

As the line-graphs jump around haphazardly, those interested in showing that the U.S. House has become significantly more equitable might point to the *Gallagher* index. Surprisingly, most discussions of the *one person, one vote* revolution leave out the continuing discrepancies in district size across states in the U.S. House. However, see Ladewig (2011), who shows that interstate malapportionment can exceed 9,000% that of intra-state malapportionment found unconstitutional. Meanwhile, none of the measures point to any severe malapportionment of the House; even given the standard of strict proportionality expected of the U.S. House, none of the measures level a concern that some might find alarming.

But the House is not without malapportionment concerns. Consider the known inequality that arises when (particularly a small) state is suddenly apportioned one fewer seat and goes from having a relatively low deviation from the national ideal to suddenly having one of the largest deviations. Residents of Montana have argued (*U.S. Commerce v. Montana* 503 U.S. 442 (1992)) that the apportionment formula of "Hill-Huntington" creates a deviation that is worse than if under different apportionment methods; a ratio of person's per representative of 799,065:1 (a deviation of 228,713 from ideal); but if they had two representatives, the ratio decreases to 399,533:1 (a deviation of 170,819). It is not clear where that district would come from, because increasing the size of the House by one would have given Washington its ninth district, which would have reduced its deviation from the ideal. Certainly, residents of Montana suffer from poor representation in both the U.S. House (though they are benefited by the two-seat bonus in the Electoral College, they still end up with less influence than they might have). Congress has taken action to freeze the size of the U.S. House in the 1929 Permanent

Apportionment Act may have resulted in increased deviations. There is no such trend in the data, at least up until 2010. It is worth noting, however, that increasing the size of the House would reduce disproportionalities overall in both the U.S. House and the Electoral College. Indeed, after the 1830 apportionment, the size of the House decreased by 7%; though its effect on our measures was mixed, appearing *more* proportional in four of the seven measures. Likewise, adding D. C. as the 51st state, and Puerto Rico as the 52nd would change the levels of malapportionment in the U.S. Senate. But, because the population of D. C. is not large, it would be over-represented compared to the ideal, while Puerto Rico would be under-represented.

Shrouded with uncertainty about how to properly weight deviations from proportionality, I, like those in comparative political science literature on vote-seats disproportionality, end with the disappointing conclusion that there appears to be no dominant measure of malapportionment that in an unbiased way captures all the inequities we may be interested in. The court's reliance on measures that look at either the range between the extremes, some ratio of the two, or the relationship between the extremes and ideal make sense exclusively as a bright-line test measuring if any malapportionment exists. A measure that looks at the individual influence of each person, such as *minimum population* needed for control or the *Gini coefficient* convey highly relevant and easily interpretive numbers. They also provide for summaries of the deviations that do not depend on institutional complexities such as the number of seats. Understanding disproportionality in the way that the economic measures do date back to at least 1896 with Vilfredo Pareto's "Cours d'Économie Politique", where he showed that 80% of the land in Italy was controlled by 20% of the people (Pareto 1896). Likewise, we can show that a

controlling majority (50%) of the Electoral College is held by 43% of the people. We compare this to the U.S. Senate, which in 2010, 50% of the votes is controlled by 17% of the population. The Gallagher and Loosemore-Hanby are favored by students of comparative political science, their outputs do not have a clearly defined interpretation, and their respective handling of the weights of the deviations beg for context when there often is not one to give. The feature that makes the *Gallagher index* much less favorable is that it treats large deviations of a small number of constituencies differently than it treats small deviations among many seats, even if the total deviation is the same. Similarly, *Loosemore-Hanby* is sensitive to the number of districts, making it hard to compare over time. Four of the measures of malapportionment (Loosemore-Hanby, Gallagher, Gini coefficient, and minimum population) range between 0 and 1. We view this as a benefit for our cognitive ability since it allows disproportionality to be expressed as a percent. However, three of the four, excluding *minimum population*, can lead to potential paradoxes when the number of districts or the shape of the distribution changes.[26]

The results of this chapter fly in the face of the common wisdom about how badly malapportioned the EC supposedly is. The explanation for the mismatch between expectations and reality is that the states with the greatest seats to population advantage in the EC do not make up a large share of the EC vote. While malapportionment effects in the EC, like those for the House, seem minor, the results about population equality for the Senate, however, are quite

[26] Though I did not bring up the shortcomings of the *Gini coefficient*, the measure can often run into trouble when the distribution of incomes is not consistent, arising in situations when comparing two distributions (Atkinson 1970; Gastwirth 1972).

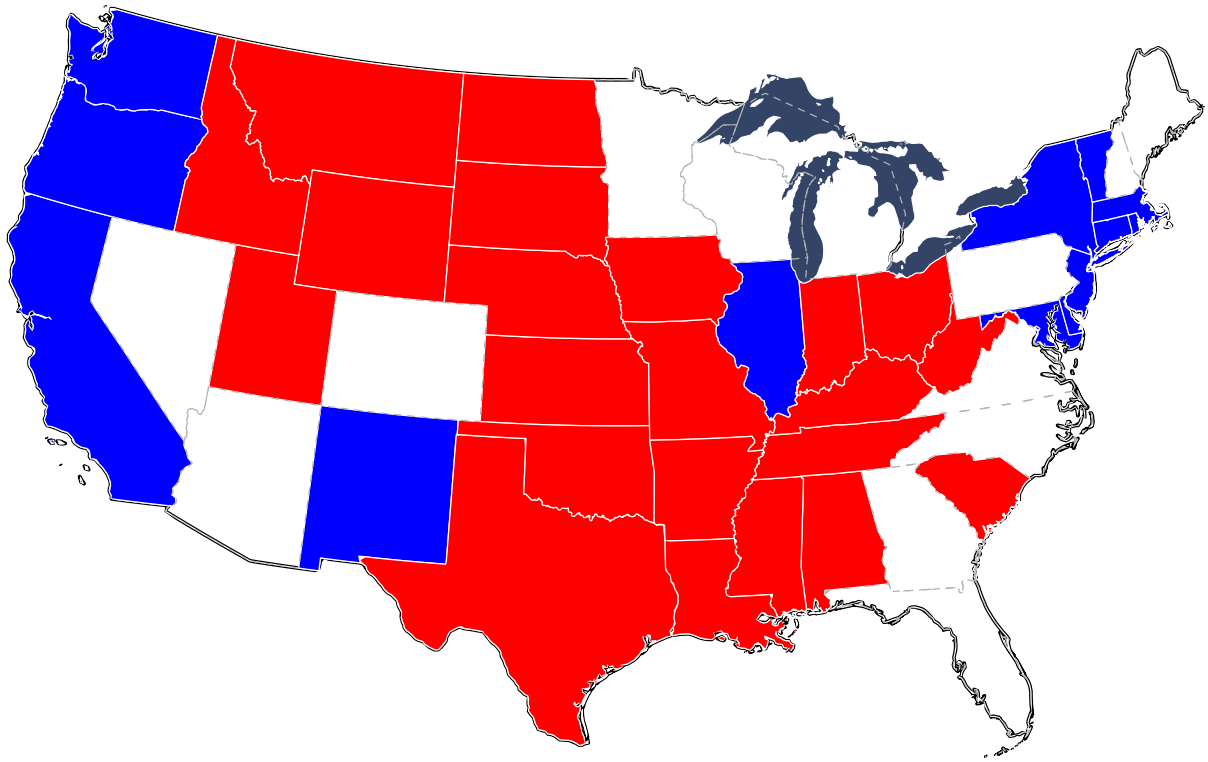
different. The U.S. Senate presents a more serious challenge to our understanding of the majoritarian principle of democracy. When discussing 'one person, one vote'; When a noted democratic theorist Dahl (2003) asks, ''How Democratic Is the American Constitution?'' at least concerning malapportionment, it is the Senate rather than the Electoral College for which this question is most relevant.

Chapter 2 - Non-Competitive Advantage: Why All States are Important for Winning in the Electoral College

The division between Red America and Blue America has become part of ordinary citizens' understanding of US politics. Choropleth (colored maps, see Figure 2.1) maps are now an indispensable aspect of election coverage, visually emphasizing how geography matters. CNN and other broadcasters are able, with the push of a button, to display historical comparisons of voting patterns at various levels of electoral geography. However, institutional rules such as the US Electoral College structure campaigning incentives so that candidates need to allocate their limited resources and time with the goal of increasing their likelihood of gaining the needed 270 Electoral College (EC) majority. Thus, the campaigning of the candidates tends to be focused on the so-called ''purple states'', i.e., the competitive states where campaigning might be assumed to make a difference (Shaw 1999b, 2006). For example, on the Sunday before Election Day 2016, Donald Trump visited five states, Florida, North Carolina, Pennsylvania, New Hampshire and Michigan. Four of the five states ended up as the four closest states as measured by the final two-party vote margin. On CNN, on election night in 2016, Wolf Blitzer quipped to Jake Tapper that "Jake, [this is] another presidential race where all eyes right now are on Florida", to which Tapper responded "It's one of the critical states in this race. Donald Trump himself has said he doesn't see a path to the presidency for himself without the state of Florida, the 29 electoral votes." Tapper went on to say, ''the Clinton campaign knows they need Florida. They have been saying for some time they feel better about Florida than they do about states such as North Carolina, …, Ohio, or Iowa''. The fifth, North Carolina, had gone to the Democratic

candidate in the previous two elections but was a southern state where Republicans were quite successful in state and federal elections. Trump won North Carolina.

FIGURE 2.1 EXAMPLE OF A CHOROPLETH MAP - NON-COMPETITIVE STATES AND BATTLEGROUNDS 2016



Note: Choropleth shows the 2016 election results, with the states shown in white being those where the t
o-party vote was between 47% and 53%. These are the 'battlegrounds'.

The focus of attention on the competitive states is enhanced by the horse-race style coverage of presidential elections by the media, who refer to such states as ''battleground'' states (Lipsitz 2009). Such states are the ones most likely, over the course of a campaign, to ''swing'' from one candidate to the other. Often such states are taken, at least implicitly, to be

the ones determinative of the presidential contest's winner, with the largest of the battleground states in terms of EC votes seen as especially critical. In contrast, outcomes in noncompetitive states, because they will come as ''no surprise'', tend to be treated by the media as completely uninteresting and also largely irrelevant. If, indeed, campaigns focus exclusively on a set of battlegrounds, other states might suffer lower citizen engagement (Gimpel et al 2007; Lipsitz and Teigen 2010), depressed voter turnout (Aldrich 1993; Duffy and Tavits 2008; Geys 2006), and worse representation (Downs 1957; Stokes 1999).

However, while results in these noncompetitive states may not come as surprising, they play an important role in shaping both election outcomes and campaign strategies. The view that the noncompetitive states are largely irrelevant has been strongly challenged by Brams and Kilgour (1997).[27] These authors point out that each candidate's electoral votes can be thought of as coming from two sources: noncompetitive states—with outcomes effectively decided before the election—and the competitive states that support him or her on Election Day. But it is not simply that the EC votes received in noncompetitive states are just as important in determining the presidential winner as the EC votes received in the competitive states, but also that the readily foreseeable outcomes in noncompetitive states can ''load the electoral dice'' by requiring the candidate with fewer expected easy victories to do remarkably well in the more competitive states in order to win. For example, in 2012, Brams and Kilgour (p. 101) point out: ''Because

[27] Brams and Kilgour's *Public Choice* paper will be referred to by their names and with the BRAMS AND KILGOUR acronym interchangeably throughout this essay.

Barack Obama had a 233-191 electoral vote lead over Mitt Romney in the 42 noncompetitive states and the District of Columbia, he needed only 37 of the 114 electoral votes in the competitive states to win with a majority of 270 electoral votes, whereas Romney needed 79''. Indeed, at the extreme, the outcomes in states essentially safe for one party might involve enough electoral votes so as to render outcomes in the more competitive states the ones that are irrelevant. In 1984, Ronald Reagan won 49 out of 51 states (including Washington, DC). Norman Ornstein, writing before the election, said ''Incumbent presidents don't often lose, particularly presidents presiding over 6% real growth and low or non-existent inflation.''[28]

Moreover, when there is a partisan imbalance in EC vote share expected from the noncompetitive states there is also a potential for choice of (slightly) different campaign strategies by the advantaged and the disadvantaged candidate (Strömberg 2008; Shaw and Althaus 2017). The trailing candidate may be forced to campaign in states where the probability of success is low. Another impact of the different degrees of competitiveness across states is tied to the different levels of visible campaign activity in competitive and noncompetitive states. Greater exposure to a campaign can lead to a positive impact on voter interest and political engagement and to higher turnout, with some studies finding the differences across levels of campaign exposure particularly high for low-income individuals (Gimpel et al. 2007; Lipsitz and Teigen 2010).

[28] Quoted in CQ Press, http://library.cqpress.com/cqresearcher/document.php?id=cqresrre1984091400.

Brams and Kilgour specify an indicator, *Winningness*, of the extent to which the virtually certain outcomes in noncompetitive states structure the expected election outcome overall in a two-candidate, plurality rule contest. For simplicity posit that each of the battleground states is equally likely to go for either candidate, and there are m such states; *Winningness* is the proportion of the 2^m combinations of zeroes and ones in which the candidate who is ahead in the noncompetitive states is the winner (adding the seats won in competitive states found in that particular combination to the already ''known'' votes in the noncompetitive states). The *Winningness* value for the Democratic candidate is simply one minus the *Winningness* value for the Republican candidate.

Note that the greater the advantage a given candidate has in the noncompetitive states, the greater will be the expected proportion of the 2^m outcomes in which that candidate is the winner of an Electoral College majority, since the candidate ahead in EC votes won in noncompetitive states will need fewer votes from the competitive seats to amass a winning majority than will the other candidate. For example, in 2012, with m=8 competitive states, under the equiprobability assumption, Brams and Kilgour (2017, p. 101) point out that 207 (80.9%) of the 256 splits would result in a win for Obama, whereas only 49 (19.1%) would result in a win for Romney, giving Obama 4.22 times more ways of winning than Romney".

Brams and Kilgour (2017, pp. 101-102) offer two other closely linked indicators that can be used to measure the extent to which outcomes are predictable: *Vulnerability* and *Fragility*. *Vulnerability* is defined as ''the proportion of the coalitions in competitive states in which a single competitive state, by switching to the other candidate, either can cause a change in the winner

or create a tie...''; while ''*Fragility* is measured by the expected number of competitive states in a winning coalition that can disrupt victory in this way.'' Both of the latter measures are well defined only for those election years in which no candidate has a large enough EC vote share in the noncompetitive seats to constitute a majority of the Electoral College. Each must be calculated separately for each party. *Winningness* is defined for all elections.

Brams and Kilgour, using a definition of non-competitive state as one wherein the winner's vote share in a two-party race is expected to be above 53%,[29] calculate *Winningness*, *Vulnerability* and *Fragility* for four recent elections: 2000, 2004, 2008 and 2012. Here, I extend their analysis to include all 38 presidential elections in the modern two-party era, from 1868 to 2016. In the next section, important findings of the historical analyses for the Brams and Kilgour measures will be the focus, evaluating how well each of the three measures (and all three together) predict EC winners and EC seat shares in these 38 elections.

TABLE 2.1 EXTENDING BRAMS AND KILGOUR'S THREE MEASURES OF SETUP POWER

[29] In races with third parties, a margin of victory no greater than 6%. For the purposes of this chapter, the concern is with the two highest vote earners and calculate accordingly.

Year	Winningness		Vulnerability		Fragility		Actual
	Democra	*Republic*	*Democra*	*Republic*	*Democra*	*Republic*	*Rep. EC*
1868	1	0	0	0.725	0		
1872	1	0	0	0.82	0		
1876	0.191	0.809	0.917	0.446	4.554	1.097	0.497
1880	0.308	0.692	0.881	0.611	3.061	1.365	0.577
1884	0.315	0.685	0.862	0.569	3.519	1.62	0.454
1888	0.575	0.425	0.667	0.785	2.144	2.905	0.581
1892	0.27	0.73	0.895	0.534	4.005	1.499	0.39
1896	0.979	0.021	0.095	1	0.159	7.419	0.611
1900	1	0	0	0.653	0		
1904	1	0	0	0.721	0		
1908	1	0	0	0.677	0		
1912	0	0	1	0.043	0		
1916	0.158	0.842	0.824	0.319	5.464	1.028	0.48
1920	1	0	0	0.761	0		
1924	1	0	0	0.744	0		
1928	1	0	0	0.836	0		
1932	0	0	1	0.111	0		
1936	0	0	1	0.015	0		
1940	0	0	1	0.154	0		
1944	0.009	0.991	1	0.05	9.85	0.093	0.186
1948	0.012	0.988	1	0.067	9.146	0.115	0.377
1952	1	0	0	0.832	0		
1956	1	0	0	0.861	0		
1960	0.699	0.301	0.496	0.799	1.861	4.325	0.41
1964	0	0	1	0.097	0		
1968	0.824	0.176	0.383	0.874	1.053	4.848	0.595
1972	1	0	0	0.968	0		
1976	0.306	0.694	0.775	0.494	4.714	2.092	0.448
1980	1	0	0	0.909	0		
1984	1	0	0	0.976	0		
1988	1	0	0	0.792	0		
1992	0.00004	1	1	0.001	15.333	0.001	0.312
1996	0	0	1	0.296	0		
2000	0.631	0.369	0.549	0.727	2.198	3.724	0.504
2004	0.725	0.275	0.52	0.854	1.45	3.773	0.532
2008	0	0	1	0.323	0		
2012	0.191	0.809	0.939	0.449	3.592	0.85	0.383
2016	0.507	0.493	0.694	0.703	2.638	2.711	0.567

Full results from the calculations can be found Table 2.1. In the process of replicating Brams and Kilgour's (2017) analyses, I found a few minor errors that I reported to the authors and corrected in these calculations; those corrections explain the differences in the numbers reported in Table 2.1 for the elections of 2000 and 2004, and those reported in Table 4 of Brams and Kilgour.

Winningness, Vulnerability and Fragility, 1868-2016

Over this entire period, as commonsense would predict, when *Winningness* is high, *Vulnerability* and *Fragility* are both low (with correlations ranging from −0.88 to −0.98), while the correlations between the latter two variables are quite positive (ranging from 0.80 to 0.91). See Table 2.2; Table 2.3. The Pearson correlations reported in Table 2.2; Table 2.3 involving *Vulnerability* and *Fragility* are calculated only for the elections wherein outcomes can be affected by what happens in the competitive states.[30]. The Pearson correlations reported in Table 2.2; Table 2.3 involving *Vulnerability* and *Fragility* are calculated only for the elections wherein outcomes can be affected by what happens in the competitive states.[31]

[31] In Table 2.1, *Vulnerability* and *Fragility* are defined in all elections that are competitive (17/38), and because the sample is split for Republicans and Democrats, for years in which that party's candidate had a *Winningness* of 1 (*Vulnerability* and *Fragility* are always zero in these cases).

TABLE 2.2 CORRELATIONS AMONG THE WINNINGNESS, VULNERABILITY, AND FRAGILITY VARIABLES FOR THE REPUBLICAN AND DEMOCRATIC PARTIES AND WITH REPUBLICAN ELECTORAL COLLEGE SEAT SHARE: 1868–2016

	Winningness	Vulnerability	Fragility	EC outcome (DEM)
Democratic party correlations				
Winningness	1	-0.957	-0.981	0.901
Vulnerability	-0.957	1	0.910	-0.855
Fragility	-0.981	0.910	1	-0.718
EC outcome	0.901	-0.855	-0.718	1
	Winningness	Vulnerability	Fragility	EC outcome (REP)
Republican party correlations				
Winningness	1	-0.978	-0.876	0.901
Vulnerability	-0.978	1	0.804	-0.883
Fragility	-0.876	0.804	1	-0.774
EC outcome	0.901	-0.883	-0.774	1

Note: Winningness defined for all elections. Vulnerability and Fragility only defined for 24/38 elections f the Democratic candidate, and for 31/38 for the Republican candidate.

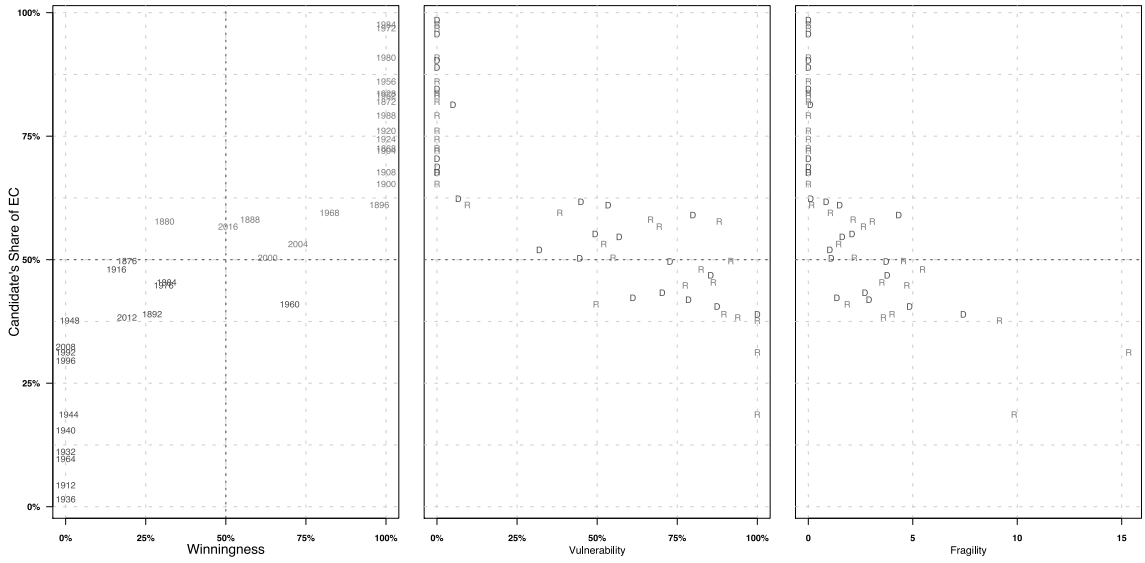
TABLE 2.3 CORRELATIONS AMONG THE WINNINGNESS, VULNERABILITY, AND FRAGILITY (RESTRICTED MODELS): 1868– 2016

	Winningness	Vulnerability	Fragility	EC outcome (DEM)
Democratic party correlations (restricted model)				
Winningness	1	-0.947	-0.973	0.726
Vulnerability	-0.947	1	0.886	-0.807
Fragility	-0.973	0.886	1	-0.667
EC outcome	0.726	-0.807	-0.667	1
	Winningness	Vulnerability	Fragility	EC outcome (REP)
Republican party correlations (restricted model)				
Winningness	1	-0.964	-0.810	0.726
Vulnerability	-0.964	1	0.705	-0.658
Fragility	-0.810	0.705	1	-0.759
EC outcome	0.726	-0.658	-0.759	1

Note: Restricted models are defined only on the elections in which Winningness is neither 0 or 1 (17 of 38). Vulnerability and Fragility took value 0 in Table 2.1 when Winningness is 1 since the candidate wh wins all the coalitions cannot be vulnerable or have fragile coalitions. Here, only elections which were decided by competitive states are used to calculate the Pearson Pairwise Correlations.

While the various measures proposed by Brams and Kilgour (2017) are of theoretical interest, in and of themselves, this essay focuses on how these measures address the bias imposed on likely Electoral College outcomes from having a substantial proportion of voting outcomes already known in advance. When there is a disproportion between the two major party's noncompetitive share of Electors, the EC favors one political party. Brams and Kilgour note (2017, p. 111) that the sign on the *Winningness* advantage correctly predicts the winners in all four of the presidential contests they study. While interesting, the limited timeframe of Brams and Kilgour's study suggests that replicating that analysis for all 38 elections might add value by verifying its veracity. I find that their observation holds for all but two elections: 1880 and 1960. This is a very good predictive performance by the *Winningness* variable. Even if I consider just the 17 elections for which the winner was determined by the competitive states, this is a success rate of 88%. While these two elections were very close in two-party vote margin, and thus might be regarded as hard to predict, they were less so electorally. In 1960, John F. Kennedy won the EC vote by 9.1% and, in 1880, James Garfield won by 7.5%. In neither election were third-party candidacies consequential in affecting relative two-party shares.

FIGURE 2.2
COMPARING WINNINGNESS, VULNERABILITY, AND FRAGILITY TO ELECTORAL COLLEGE OUTCOMES.



Note: Candidate's Share of EC is from the Republican perspective in plot one. The Candidate's Share of EC is labeled ''D'' for the Democratic candidate, and ''R'' for the Republican candidate in the Vulnerability and Fragility plots.

A more difficult test for the predictive usefulness of *Winningness* and the two other variables is to ask how well they predict final EC vote share outcomes. Figure 2.2 plots *Winningness*, *Vulnerability* and *Fragility* scores against the final EC final vote share. These three variables are, in fact, highly correlated with EC outcomes, with the correlation for *Winningness* at 0.90, that for Republican (Democratic) *Fragility* at $-0.76(-0.67)$, while that Republican (Democratic) *Vulnerability* is $-0.66(-0.81)$.[32]

The plot in Figure 2.2 shows that in most years, *Winningness* is such that the outcome is expected to be determined solely by what happens in the noncompetitive states, i.e., a

[32] Because of the frequent occurrence of values of 0 or 1, a perfect linear fit is impossible.

Winningness value of zero or one. In the four elections analyzed in Brams and Kilgour (2017), only one, 2008, fell into this category. Had Brams and Kilgour extended their data back somewhat further in time to 1980, however, they would have found that in that election and in each of the four following elections, one of the two candidates had locked up enough votes in noncompetitive states to win the election. In 1992, Bill Clinton was just seven EC votes shy of having enough a majority in noncompetitive states and could have lost the election in only five of the more than 130,000 different combinations of electoral outcomes among the competitive states, i.e., $Winningness > 0.99$.

I conducted regression analyses with all three Brams-Kilgour measures as independent variables and Democratic EC vote share as the dependent variable. As expected, the very high correlations among the three variables meant that adding *Vulnerability*, *Fragility*, or both, to *Winningness* did not increase the adjusted R^2, and only one of the three variables was statistically significant in any of the models. Also, when *Vulnerability* and *Fragility* are included, separate equations for each party are required, and that reduces the number of cases. For the 38-election period, the best fitting model in terms of adjusted R^2 is the simple bivariate regression in which *Winningness* alone predicts the EC outcome, with an adjusted R^2 value of 0.81. Results from this simple regression are shown in Table 2.4.

TABLE 2.4 REGRESSION TABLES USING THE 5% DEFINITION OF COMPETITIVE

	Full Model		Restricted Model	
Non-Competitive Advantage	0.568*** (-0.026)		0.696*** (-0.067)	

Winningness		0.551*** (-0.046)		0.432*** (-0.055)
Constant	0.522*** (-0.011)	0.255*** (-0.031)	0.530*** (-0.016)	0.333*** (-0.032)
N	38	36	24	22
Adjusted R2	0.929	0.801	0.821	0.742

Note: Restricted models only include elections where at least one competitive state could change the result

*** p<0.01; ** p<0.05; * p<0.1 Standard Errors in Parenthesis

In Appendix A, I consider how analyses would change if the definition of a noncompetitive state was altered. While the analyses in the Appendix show that the choice of range to define a competitive state can matter somewhat, to maximize the compatibility with Brams and Kilgour (2017), and because their ±3% margin is a plausible one in the context of predicting EC outcomes, I will use the Brams and Kilgour plus or minus three percentage point definition of competitive state in the remainder of the essay.

Accuracy of ex-post classification of states as noncompetitive

Brams and Kilgour first justify the use of the ex-post criteria by which they classify competitive and noncompetitive by pointing out that, empirically, the fit between ex ante and ex post evaluations of competitive states is very good. Pre-election polls do a good job of predicting final outcomes to within a small margin of error (Soumbatiants et al. 2006) - though, of course, that margin of error may be enough to generate an erroneous prediction. Still, highly uncompetitive states are unlikely to change partisan direction over the course of a single election cycle. Brams and Kilgour point out that the ±3% value they use to define a competitive state corresponds with the usual pre-election polling margin of error. When a state polls outside this three-percentage point margin, it generally is seen as not winnable by the trailing candidate,

although more errors in prediction do occur than would be suggested by the 95% confidence limits (Gelman and King 1993; Shirani-Mehr et al. 2018).[33] Collectively, moreover, a large number of competitive states may result in an unexpected outcome if those states go disproportionately for one candidate. Thus, close elections nationally bear resemblances to the flip of a coin.

However, campaigning choices are only ''imperfectly correlated'' with the degree to which a state is competitive (Shaw and Althaus 2017). In general, there is no expectation campaign spending or campaign appearances to be *only* in competitive states, since candidates also spend some money and make some appearances for reasons not directly related to boosting their own campaign chances, e.g., to help down-ticket candidates or to build for the future. Bartels (1985) has pointed out that campaigns have what he calls both ''instrumental'' and ''ornamental'' reasons for staging campaign events. Attending an event in a swing state, where a candidate's presence could increase turnout is instrumental, while visiting a state to satisfy state parties might be ornamental. Hillary Clinton spent over $600,000 in Arizona, perhaps trying to influence lower ticket races by increasing mobilization efforts. Ultimately, Arizona, a state that has had a strong Republican tradition, became competitive in 2016. Also, some major media markets cover more than one state. And the differential cost of campaigning may increase the desirability of campaigning in some small states where advertising costs are relatively

[33] Another reason for choosing the ±3% value is a pragmatic one discovered after robustness checks for this essay; over both recent elections and the longer historical data: ±3% value has (marginally) greater predictive power than the often used ±5% definition of competitive state (see Appendix A).

inexpensive (Shaw 1999a,b; Stratmann 2009; Shaw and Althaus 2017). Finally, there is uncertainty about time trends, and the need to have alternative routes to victory.

Shaw and Althaus (2017) have collected the most complete data on campaign appearances and campaign expenditures by both parties for most of the post-WWII era and show that the candidates of the two major parties were in agreement as to which are the states in which to invest campaign resources.[34] In addition to reasons not directly connected with the presidential election contest, a leading presidential candidate and a trailing candidate face somewhat different strategic tasks. Sometimes a trailing candidate must opt for campaigning in a state expected to be won by the opponent, since doing so may open the only possible path to victory and/or may tempt an opponent to divert resources to protect a ''base'' state that could be better spent elsewhere. Strömberg (2008) suggests a hockey metaphor; as a game winds down, a trailing team looking to increase the probability of tying the game pulls their goalie to provide more offensive potential, taking the risk of giving up another goal. A leading team would instead probably act to protect its lead, replacing offensive players with defensively skilled players. As Shaw and Althaus (2017) put it: ''campaigns often hone in on less competitive states when their overall position is weak''.

As both Grofman and Feld (2005) and Strömberg (2008) argue, the expectation is that competitiveness, along with the number of EC votes at stake in a state, would be key determinants of campaigning. This conclusion differs from that of early political science literature

[34] Perfect symmetry is not expected and not found in the candidates' opinions.

on campaign strategies which claimed that the most populous states would receive the bulk of campaign activities. For example, Brams and Davis (1974) offered a model that predicted campaign allocations proportional to the electoral votes of each state raised to the power of 3/2. For an early critique of the view that campaigning would necessarily focus on the most populous states, see Colantoni et al. (1975). See also Wright (2009) and Miller (2012). Similarly, Shaw and Althaus (2017) posit that ''campaign resources will be disproportionately, but not exclusively, concentrated in battleground states''.

I conducted an additional robustness check on the use of an ex-post measure of political competitiveness by relying on Shaw and Althaus (2017) classifications of battleground/target states. I find that their ex ante measure and this ex post competitiveness measure are highly correlated when battleground targets from either campaign or from only those in which the campaigns agree about the battleground status of the state are included.

In 2012, Brams and Kilgour note that 99.6% of advertising money was spent in the ten states identified as battlegrounds by FairVote.org. Of those ten states, eight are included in the ex post set of competitive states, while the other two were the next closest states in terms of margin of victory. Similarly, in 2012, 87% of campaign events were held in the set of eight states viewed post hoc as competitive.[35] Evidence confirms the congruence between post hoc measures of competitiveness and ex ante expectations of competitiveness for two additional

[35] Data aggregated from FairVote.org, with original data from CNN:
http://www.fairvote.org/presidential_tracker_2012#2012_campaign_events

recent elections, those in 2004 and in 2016.[36] In the 2016 election, the campaigns and campaign-related Political Action Committees (PACs) spent 82% of advertising money in the states retrospectively classified as competitive.[37] Moreover, the only competitive state not targeted by either campaign was Minnesota, a state in which Democratic candidates have the longest winning streak. Similarly, candidate rallies or events at which the presidential or vice-presidential candidate appeared in 2016, the major party candidates held 79% of all events in the 13 states that labeled competitive post hoc.

Some studies have claimed that the number of battleground states has narrowed (Gimpel et al. 2007). What is arguably the most comprehensive study to date, looking from 1952 onward, finds little change in the number of battleground states over time (Shaw and Althaus 2017). I can contribute to this debate by examining the change in the number of competitive states over a much longer time horizon.

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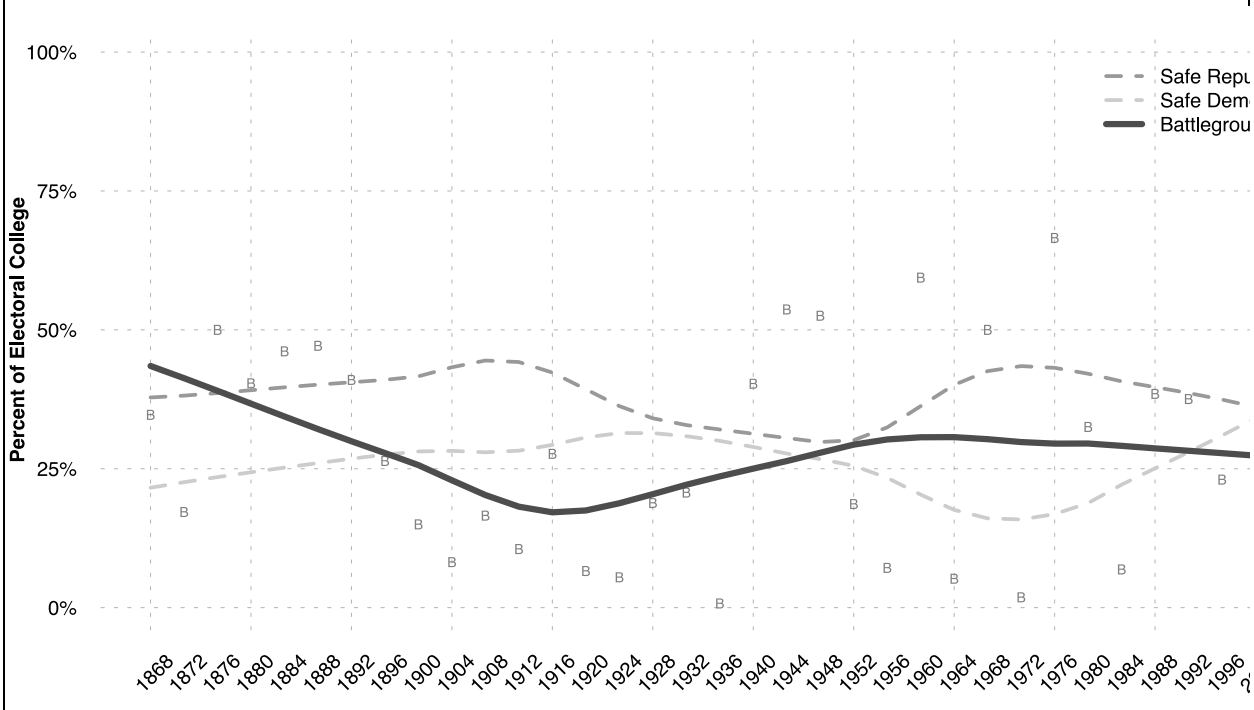
[36] Older elections also largely conform to these expectations. Detailed campaign activities for the 1976 election are available because they were submitted into evidence for the hearing before the Subcommittee on the Constitution of the Committee on the Judiciary (S.J. Res. 28, 1979) on a bill that would abolish the Electoral College and establish a direct popular vote. The data were first used by Bartels (1985). That election shows a similar pattern of campaign activities focused on the competitive states, though there were many more (25) competitive states in 1976 than in the two most recent elections of 2012 and 2016. In 1976, 78% of all campaign events were held in the 25 battleground states, and 78% of all campaign television and radio ads were broadcast there.

[37] Data compiled from AdAge.com, based on state-specific ad buys between October 21, 2016, and Election Day. http://adage.com/article/campaign-trail/states-where-trump-clinton-spending-most-on-advertising/306377/]

Figure 2.3 shows the percentage of competitive states using the measure of that concept in this paper, with a running average also shown by plotting a locally weighted polynomial regression. The post-1952 data are compatible with Shaw and Althaus's (2017) assertion of little change in the number of battleground states in recent presidential elections, though some evidence exists of fewer competitive Electors. However, over the longer time series, there are relatively few competitive states than in the 1868-1900 period, and the percentage of competitive states is more stable (smaller standard deviation) than it was before 1988.

FIGURE 2.3 PERCENTAGES OF COMPETITIVE STATES OVER TIME: 1868-2016



Note: Smoothed lines are locally weighted polynomial regressions with smoothness set at f = 0.5. These es are intended to show over time patterns among noisy data.

Shaw and Althaus (2017) also expect the ability of campaigns to more optimally allocate their resources should increase over time with more sophisticated survey and targeting tools. It is relatedly expected that sharper polarization allows for more accurate predictions of which states are likely to be competitive and which are not. I can examine this question by comparing the Shaw and Althaus measure of what states were viewed as battleground states as judged by the behavior of each campaign and the post hoc measure of competitiveness. The average level of competitiveness in their battleground states in Table 2.5.

TABLE 2.5 AVERAGE VICTORY MARGINS IN BATTLEGROUND STATES AS DEFINED BY SHAW AND ALTHAUS

Year	Base Democratic		Battleground		Base Republican	
	Democratic	Republican	Democratic	Republican	Democratic	Republican
1952	11.9	12.6	12.9	12.3	27.9	28.0
1956	15.3	19.1	16.9	14.6	27.1	24.3
1960	12.0	11.0	6.7	4.4	8.7	10.4
1964	33.3	35.7	26.8	27.8	19.3	12.4
1968	15.7	19.2	6.9	6.5	16.2	14.5
1972	19.8	20.5	19.5	26.5	36.7	33.0
1976	13.2	18.9	3.5	5.7	12.8	11.5
1980	8.5	9.6	14.7	10.6	40.3	31.0
1984	17.3	14.7	17.8	16.8	30.9	27.9
1988	15.6	14.3	5.2	7.0	17.0	17.8
1992	21.7	22.3	7.0	5.9	9.6	11.3
1996	24.0	25.0	7.9	7.8	11.2	11.8
2000	26.3	26.0	4.9	5.8	23.5	25.8
2004	18.6	19.5	3.0	4.2	21.2	22.2
2008	28.4	28.4	8.4	7.7	18.1	17.2
2012	25.4	26.3	5.4	5.7	21.4	21.4
2016	19.1	24.1	2.9	3.6	24.7	25.4

Note: Classifications and data courtesy of Daron Shaw via personal communication. Numbers represent the unweighted means by classification. Each party has its own strategy, so averages were taken for each party's strategy separately. Same conclusions hold if all targets are included as battlegrounds, or only those where there is concurrence.

Table 2.5 shows that, since 1988, the states Shaw and Althaus (2017) find to be battleground states as judged by campaigning, also are consistently highly competitive. However, this consistency does not hold in the election cycles from 1952 to 1984, although low ex post competitiveness in battleground states is found in three of these presidential election years. Thus, at least for the recent period, the only period for which relevant campaign data exists, using post hoc measures of competitiveness as a proxy for campaign strategies is reasonable.[38]

In the subsequent section, I offer a simple alternative measure based on the Brams and Kilgour intuition about the importance of the imbalance in partisan breakdown of EC seat shares in the noncompetitive states. this measure, which I label *Non-Competitive Advantage*, is as predictive of the final EC outcomes and somewhat more predictive of final EC vote percentages than any of the measures proposed by Brams and Kilgour (2017). In sum, both *Winningness* and *Non-Competitive Advantage* perform very well.

Using partisan imbalance in noncompetitive states to predict Electoral College outcomes

[38] In 1964, the Goldwater campaign treated 23 states as battlegrounds (Shaw and Althaus 2017). The Goldwater campaign focused on the South, seeking to mirror the Dixiecrat revolt and pry southern states from the hands of the Democratic party which, except for the Dixiecrat revolt of 1948, had been winning them by large margins. Goldwater's campaign went poorly except in the deep South, winning only a handful of states. All but one of the states he won were states his campaign treated as battlegrounds. The one exception was a very narrow win.

Like Brams and Kilgour (2017), it is my belief that outcomes in noncompetitive states are critical in understanding final Electoral College winners. In this section, I expand that insight by offering a simple measure that jointly performs as well or better than the Brams and Kilgour variables in predicting final EC outcomes.

To present this measure, some notation is useful. First, partition the states into the set of competitive (battleground) states, C_{ji}, and the set of noncompetitive states, NC_{ji}; j indicates the election year, i indicates the state. Each state contains a set of Electors equal to its apportioned amount plus two for each state, as determined by the constitution (U.S. Const. amend. XII); $Electors_i = e_1, e_2, e_3, \dots, e_n$. The number of Electors in a competitive state are labeled as $Electors(C_{ji})$ and the Electors in a noncompetitive state are labeled as ($ElectorsNC_{ji}$). Therefore, $Electors(total_j) = \sum Electors(C_{ji}) + \sum Electors(NC_{ji})$. Democratic victories (in Electors) in noncompetitive states are labeled NCD_j, and the noncompetitive Electors won by Republicans are labeled NCR_j.

There are two quantities in which I am interested in; on the one hand, the partisan balance of seats in the noncompetitive states ($NCD_j - NCR_j$) and, on the other hand, in the share of the states that fall into the noncompetitive category $\left(\sum Electors(NC_{ji})/Electors(total_j)\right)$. The variable of inquiry is the difference between the two-candidate's noncompetitive electoral totals, divided by the total number of EC votes:

$$Non - Competitive\ Advantage = \frac{NCD_j - NCR_j}{Electors(total_j)}$$

This measure is standardized, thus allowing for the comparison of effects across elections (when the total apportionment is different). When one party has a big advantage in noncompetitive electoral votes, it will be more likely to win the election. Brams and Kilgour reflect this intuition by examining coalitions among competitive states and determining outcomes under the explicit assumptions that the competitive state outcomes occur independently of one another and with an equal probability of victory for the two parties in each.[39] These strong assumptions are not required. But the same intuition drives the model of *Non-Competitive Advantage* as that in the work of Brams and Kilgour, or the main hypothesis tested here:

Hypothesis 2a - The candidate who has a larger advantage in electors from the noncompetitive states will have more options in terms of possible wins in competitive states leading to Electoral College victory.

Table 2.6 shows ex post values for the Democratic and Republican EC vote shares in the noncompetitive states in the first two columns, and it also shows the final EC vote outcome both as a number and as a percentage of the electoral vote total. In addition, a column that reports the difference between the Democratic and Republican EC votes in the noncompetitive states, and a further column showing that difference normalized by total EC votes, i.e., a column that shows Non-Competitive Advantage. Minor party candidacies are likely to be a problem for our analyses only in situations when they receive Electoral College votes. This has not been the case

[39] Both of these assumptions as quite reasonable ones to make for purposes of model tractability, but there is an expectation for them to be falsified if electoral tides sweep in a particular direction and thus create interdependencies in vote outcomes in the competitive states.

in recent elections, as no minor party candidate has won a state since George Wallace in 1968. In their assessment of minor party impact, Pattie and Johnson (2014) do not find substantial effects, and they also note that such effects have often differed in their partisan impacts. To provide a consistent coding across all elections in the dataset, minor party votes are ignored, and contests are assumed as between the two major party candidates in terms of two-party vote share.

TABLE 2.6 ELECTORAL COLLEGE DATA FOR CALCULATION OF NON-COMPETITIVE ADVANTAGE, 1868-2016

Year	Non-competitive EC seats		Electoral College outcomes				Differences	
			Seats		Percent			
	Rep	Dem	Rep	Dem	Rep	Dem	Seats	Proportion
1868	153	37	211	80	0.725	0.275	116	0.399
1872	269	34	300	66	0.82	0.18	235	0.642
1876	64	119	182	184	0.497	0.503	-55	-0.15
1880	95	125	213	156	0.577	0.423	-30	-0.081
1884	93	123	182	219	0.454	0.546	-30	-0.075
1888	112	100	233	168	0.581	0.419	12	0.03
1892	112	150	173	271	0.39	0.61	-38	-0.086
1896	203	126	273	174	0.611	0.389	77	0.172
1900	258	122	292	155	0.653	0.347	136	0.304
1904	317	120	343	133	0.721	0.279	197	0.414
1908	283	120	327	156	0.677	0.323	163	0.337
1912	8	467	23	508	0.043	0.957	-459	-0.864
1916	171	213	255	276	0.48	0.52	-42	-0.079
1920	382	114	404	127	0.761	0.239	268	0.505
1924	366	136	395	136	0.744	0.256	230	0.433
1928	379	52	444	87	0.836	0.164	327	0.616
1932	8	413	59	472	0.111	0.889	-405	-0.763
1936	8	519	8	523	0.015	0.985	-511	-0.962
1940	27	290	82	449	0.154	0.846	-263	-0.495
1944	31	215	99	432	0.186	0.814	-184	-0.347
1948	37	215	200	331	0.377	0.623	-178	-0.335
1952	379	53	442	89	0.832	0.168	326	0.614
1956	446	47	457	74	0.861	0.139	399	0.751
1960	132	86	220	317	0.41	0.59	46	0.086
1964	47	463	52	486	0.097	0.903	-416	-0.773
1968	175	94	320	218	0.595	0.405	81	0.151
1972	511	17	521	17	0.968	0.032	494	0.918
1976	66	114	241	297	0.448	0.552	-48	-0.089
1980	344	19	489	49	0.909	0.091	325	0.604
1984	498	3	525	13	0.976	0.024	495	0.92
1988	289	42	426	112	0.792	0.208	247	0.459
1992	73	263	168	370	0.312	0.688	-190	-0.353
1996	66	348	159	379	0.296	0.704	-282	-0.524
2000	189	171	271	267	0.504	0.496	18	0.033
2004	213	183	286	252	0.532	0.468	30	0.056
2008	145	291	174	364	0.323	0.677	-146	-0.271
2012	191	233	206	332	0.383	0.617	-42	-0.078
2016	188	187	305	233	0.567	0.433	1	0.002

Note: Competitive states are determined by the winning party garnering no more than 53% of the two-party vote

The first test of Hypothesis 2a and the predictive usefulness of the Non-Competitive Advantage variable by looking to see how often the party with the advantage in the noncompetitive states wins the EC vote. As does the *Winningness* measure, in all four of the elections from 2000 through 2012, Non-Competitive Advantage correctly predicts the presidential election outcome. Indeed, in all but two of the 38 elections (1880 and 1960), the party with a Non-Competitive Advantage goes on to win the election, the same strong predictive accuracy as the *Winningness* measures (95% success rate). Interestingly, the two errors are the same two elections that *Winningness* fails to predict. The failure of the models to correctly classify states is tied directly to two empirical realities of elections: closely competitive elections (and inversions, where one candidate wins the popular vote and the other wins the Electoral College) are, by definition more difficult to predict. Candidates who outperform their rivals in battlegrounds can overcome noncompetitive disadvantages, but only when the disadvantage isn't so great as to be deterministic. The 1880 election appears to be the former, while 1960 appears to be the latter.

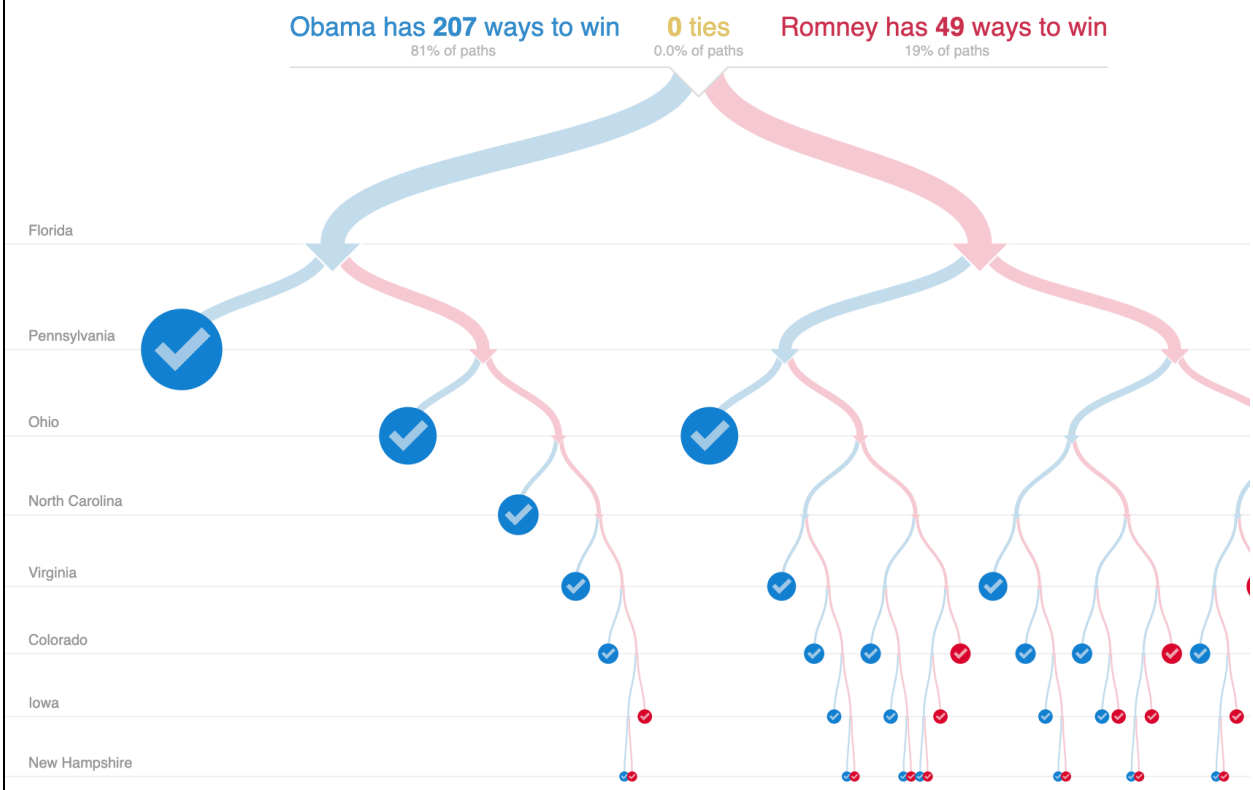
Next, Republican EC vote share is regressed on the *Non-Competitive Advantage* variable. There is a very strong and significant relationship between the two measures, and the simple regression between them yields an adjusted R^2 of 0.96. Compare this regression with one that models the same dependent variable with *Winningness* as the predictive variable; the adjusted R^2 of the *Winningness* model is 0.81, lower than that for *Non-Competitive Advantage* at 0.96. While the very simple Non-Competitive Advantage variable does better in predicting final seat shares than any (or all) of the three variables from Brams and Kilgour (2017),

Winningness and *Non-Competitive Advantage* do equally as well at predicting the directionality of EC outcomes.

To further illustrate the importance of *Non-Competitive Advantage*, an example of how the relative proportion of "safe" Electors affects pathways to victories is necessary. Say, for instance, that the electoral system has 538 Electors, and Party A has 191 Electors that are safely in their camp, while Party B is expecting to win 233 Electors. The 42 Elector difference defines the *Non-Competitive Advantage* (normalized by dividing by 538, 7.8%). Because a Party only needs to win 271 Electors to win in the Electoral College, Party B needs only 38 more Electors, while Party A needs to win 80 additional Electors from the battlegrounds. This setup is precisely the prospect incumbent President Barack Obama (Party B) faced in 2012 against Mitt Romney (Party A). Although it may not seem like a huge advantage on its face, in terms of pathways to victory, Obama had 207 potential outcomes compared to Romney's 49 Electors. So, even if each of the two major party's candidates were equally likely to win in each of the eight battlegrounds, Obama still had over four times the pathways to victory.

Put differently, Obama would be expected to win 81% of the time given the distribution of safe states. I have constructed an interactive graphic that shows the pathways to victories in 2008, and how assigning states as safe for one of the candidates affects the further paths to victory. It can be view at: http://jonathancervas.com/dissertation/interactives/nca/ and a static version is displayed in Figure 2.4. All states not listed are "safe" for one of the two parties. While they are safe, I reiterate that they are not unimportant, since they shape the pathways to victory.

FIGURE 2.4 PATHWAYS TO VICTORY



Note: The blue circles represent paths that Obama wins. The Red circles are paths where Romney emerg as the winner. Pathways to victory are not equal to the number of nodes, but rather the number of node plus the combination of other battlegrounds not needed for that node. The nature of the plot is based conditional probabilities, i.e., if Obama wins FL, what paths remain viable for Romney. In this case, the left node shows that if Obama wins FL, Romney MUST win PA, otherwise Obama wins.

Notice especially how Obama's chances change if he were to have won in Florida; The number of paths to victory reduces to just three for Romney, but Obama now has 98% of the paths with 125 combinations. This exercise is mathematically determined by first figuring out the number of paths to victory, which equals 2^n where $n = \text{number of states}$, and then determining which proportion of those combinations produce victories for which candidate. This is the intuition behind Brams and Kilgour's *Winningness* measure.

Discussion

Brams and Kilgour (2017) begin by suggesting that the road to power through noncompetitive states dictates the terms under which a presidential election is contested. This is an often understated or ignored aspect to the Electoral College. While competitive states receive the bulk of campaign activities like television and radio advertising, campaign field offices, and visits from the candidates and their surrogates, the media ''horse-race'' coverage about 'swing states' and 'battleground states' take attention away from the extent to which safe seats matter for electoral outcomes. Partisan balance in noncompetitive states matters since the candidate who enjoys a Non-Competitive Advantage has many additional pathways to the presidency, and thus one candidate can begin the presidential contest severely handicapped.

In this chapter, I extended Brams and Kilgour's (2017) analyses of Winningness, Vulnerability and Fragility beyond the four recent elections they analyze to include not just 2016, but all elections between 1868 and 2016. Thus, I have added 34 elections to the investigation. A new and simpler variable based on the logic of the Brams and Kilgour argument has been proposed, namely, Non-Competitive Advantage. It is defined as the difference in safe EC votes between the parties, normalized by total EC votes. The candidate holding the edge in Winningness and Non-Competitive Advantage have gone on to win in all but two of the 38 US presidential elections since 1868. In the two mis-predicted elections, the partisan advantage in noncompetitive electoral votes was very slim. Moving from attempting to predict a dichotomous outcome variable (win or lose the election) to seeking to predict final EC vote shares, both Winningness and the new Non-Competitive Advantage variable are strongly predictive of EC

vote shares. The predictive edge is with the simpler variable (R^2 of 0.96 versus one of 0.81). Occam's Razor, *Lex parsimoniae*, suggests that Non-Competitive Advantage is the superior measure.

In toto, these results are very supportive of recent Public Choice and economics scholarship on optimal campaigning. Campaigns have clear incentives to concentrate resources in the most competitive states rather than focus simply on the most populous ones, and recent campaigns (since the 1980s) show a closer correspondence between post-election closeness of EC votes and the expenditure of campaign resources. However, there are relatively few competitive states in more recent election cycles than in those before the twentieth century. More specifically, the results support, with a much more extensive dataset, the key intuition in Brams and Kilgour (2017) that noncompetitive states play a foundational role in shaping the election of the US president. As with Brams and Kilgour's Winningness, this new measure shows that the more potential paths to victory a presidential candidate has, the larger is the candidate's expected EC vote share. Moreover, the candidate who has the edge in the noncompetitive EC votes is almost always elected to the White House.

These results complement a broader literature on the Electoral College (EC), which has both empirical, theoretical and normative components. Normatively, a debate is ongoing between those who see popular vote decisions as the only legitimate way to elect a president, and those who view the Electoral College as a result of a political bargain reflecting federalist efforts to balance popular votes and states as the bases of representation (Hirsch 2008; Edwards 2004; Ross 2012). This debate is tied to proposals about alternative ways of electing the US

president. Such proposals tend to surface after each presidential election, especially those (like 2000 and 2016) when a divergence occurs between the popular vote and the EC vote. Theoretically, one can argue about the degree to which the weighted voting rule used in the Electoral College disproportionately empowers citizens of small-population states versus those of more populous states. That controversy is couched most in terms of game-theoretic indices of power, such as the Banzhaf Index or the Shapley-Shubik value (see, e.g., Banzhaf 1968; Owen 1975; Duffy and Matros 2015). Empirical debates have arisen about such issues as the degree of partisan bias imposed by EC apportionment (Grofman et al. 1997; Johnston et al. 2004; Pattie and Johnston 2014; cf. Ladewig and Jasinski 2008), and the nature of optimal campaigning under the Electoral College system (see, especially, Shaw 2006; Strömberg 2008). This is the topic that will be explored more fully in the next chapter. I will address the empirical observation that the Electoral College inevitably leads to inversions. In the conclusions of this dissertation, I will discuss the 2020 election considering these findings on the pathways to victory.

Chapter 3 - Are Inversions Inevitable? Eight Counterfactual Ways of Electing the President

> ''The Electoral College is a disaster for democracy.'' -- Donald Trump (November 6, 2012)
>
> ''The Electoral College is actually genius in that it brings all states, including the smaller ones, into play.'' -- President-Elect Donald Trump (November 15, 2016)

The Electoral College (EC) we know today is not the one envisioned by the founders. The founders believed its function would be to nominate candidates, from which nominees the House of Representatives would select. Today, Electors are pledged in advance to candidates and Electors very rarely diverge from their pledged support, and they never have done so in a way that has proved consequential (Longley and Peirce 1999:23-24). In *Chiafalo v. Washington*, 591 U.S. ___, the U.S. Supreme Court has reiterated that states have the right to punish Electors who fail to vote for the candidate they are pledged for. In the court's opinion, they specifically refer to this tradition: ''The Constitution's text and the Nation's history both support allowing a State to enforce an elector's pledge to support his party's nominee - and the state voters' choice - for President.'' (slip opin. p. 9). Moreover, outcomes are decided in the first stage of the process, in the EC itself. Only once has the responsibility for choosing the president shifted to the second runoff stage, which involves a congressional vote. In 1824, John Quincy Adams became the only president to not receive a majority (a requirement for winning in the first stage) of the EC votes. The vote was splintered among multiple factions, with no candidate receiving the necessary plurality. In the election of 1876, politicking in Congress determined which of several competing

slates of Electors were to be accorded legitimacy. The outcome of what has been called the ''Compromise of 1877'' was still recorded as a victory for Rutherford Hayes within the EC, even though neither major candidate had received a majority initially. Hayes was awarded 20 disputed EC votes that gave him a one-elector victory in the EC despite not winning the popular vote.

As eminent scholar Robert Dahl (2003) noted, ''the elaborate machinery of the electoral college [became] little more than a way of counting votes.'' Nonetheless, despite these differences in how the EC now operates, its two most basic features have remained in place: seat allocations that are not fully proportional to population, with allocations based on the combination of congressional seats and U.S. Senate seats in the state; and winner-take-all (unit-rule) outcomes at the state level. States have a constitutional right to determine how to award Electors, and indeed two states, Maine and Nebraska, adopted a variation on the winner-take-all feature which operates at the level of congressional districts, with only the two ''federal'' seats allocated based on the state-wide outcome. Maine adopted this rule in advance of the 1972 presidential election, while Nebraska enacted it starting with the 1992 election. A split has occurred once in each of these states. In 2008, Barack Obama won Nebraska's second congressional district, picking up a Democratic electoral vote in that state for the first time since 1964. In 2016, Donald Trump won Maine's second congressional district.

In Federalist, No. 68, Alexander Hamilton opined about the EC, ''I… hesitate not to affirm that if the manner of it be not perfect, it is at least excellent.'' Both then and now, most agree that the EC is indeed far from perfect. Many first-past-the-post elections have a runoff procedure to select a president in a multicandidate contest such that, if no candidate receives a certain

percentage of the vote, there will be a second round involving two or more of the candidates with the most votes (Birch 2003). All parliamentary democracies choose their executive via an indirect form of election. While the prime minister will normally need to command majority support in the national parliament, a prime minister can sometimes govern with only minority support. Minority governments can be quite common in some countries, for example, Denmark. The claim that it is ''excellent'' would be met with far more suspicion. In the United States, after each presidential election, especially those where popular and EC vote diverged,[40] or a third-party candidacy threatens to undermine the idea that a president should represent a clear majority, proposals to abolish/replace the EC are common. Indeed, Article II, Section 1 (i.e., the provision establishing the method for electing the executive) is the provision of the U.S. Constitution that has most often had changes proposed to it (Longley and Braun 1972:42-43; Hardaway 1994; Longley and Peirce 1999:133). The academic literature is also full of attacks on the EC (see, e.g., Edwards 2011; Finkelman 2002; Dahl 2003; Bennett 2006; Abbott and Levine 1991),[41] though it does have a few defenders (see, e.g., Best 1975; Diamond 1977; Hardaway 1994; Miller 2012b; Polsby et al. 2012; Ross 2012). And yet, since the adoption of the 12th amendment, there have been no further changes to its structure, and attempts to eliminate the EC have proved unavailing. Since the Electoral College process is part of the original design of

[40] ''Diverge,'' ''reverse,'' ''wrong winner,'' ''misfire,'' ''divided verdict,'' ''reversal of winners,'' ''representative inconsistency,'' ''compound majority paradox,'' ''referendum paradox,'' ''majority defeat,'' and ''inversion'' have all been used to describe a situation when the winner of the most votes does not win the presidency (Miller 2012a).

[41] Bickel (1968) warned against sudden structural reforms, though he ultimately supported reforming the EC.

the U.S. Constitution it would be necessary to pass a Constitutional amendment to change this system …Under the most common method for amending the Constitution, an amendment must be proposed by a two-thirds majority in both houses of Congress and ratified by three-fourths of the States (National Archives and Records Administration).

There are many reasons why reformers have been unsuccessful. First, the winner of the previous election has little incentive to change the rules that elected him (see the Trump quotes in the epigraph; see also Bowler, Donovan, and Karp 2006). Second, large states think that they benefit from the EC because the winner-take-all rule makes their state more likely to be pivotal (Banzhaf 1968), while small states think they benefit from the EC because of the two-seat Senate ''bonus.'' Both sides are right (Longley and Peirce 1999:153). However, when we look at the likelihood that an individual voter in any given state will be pivotal (e.g., using game-theoretic indices of pivotality such as the Banzhaf index, (Banzhaf 1965); or the Shapley-Shubik value, (Shapley and Shubik 1954); see also Mann and Shapley 1962); as far back as Owen (1975), it has been recognized that these two effects - greater large state pivotality and small state overrepresentation relative to population - tend in opposite directions, making the *a priori* ''power'' scores of individual votes to influence EC outcomes much more similar across states than one might think (see Gelman, Silver, and Edlin 2012 ; cf. discussion in Grofman and Feld 2005; Strömberg 2008). Third, public opinion is closely divided (with a strong partisan split). In nearly every poll in the Roper Center for Public Opinion Research iPOLL data bank, the public is split about eliminating the EC, especially along partisan lines, albeit with majorities favoring a change to popular vote. After the bitterly fought 2000 election, 41 percent of Republicans would

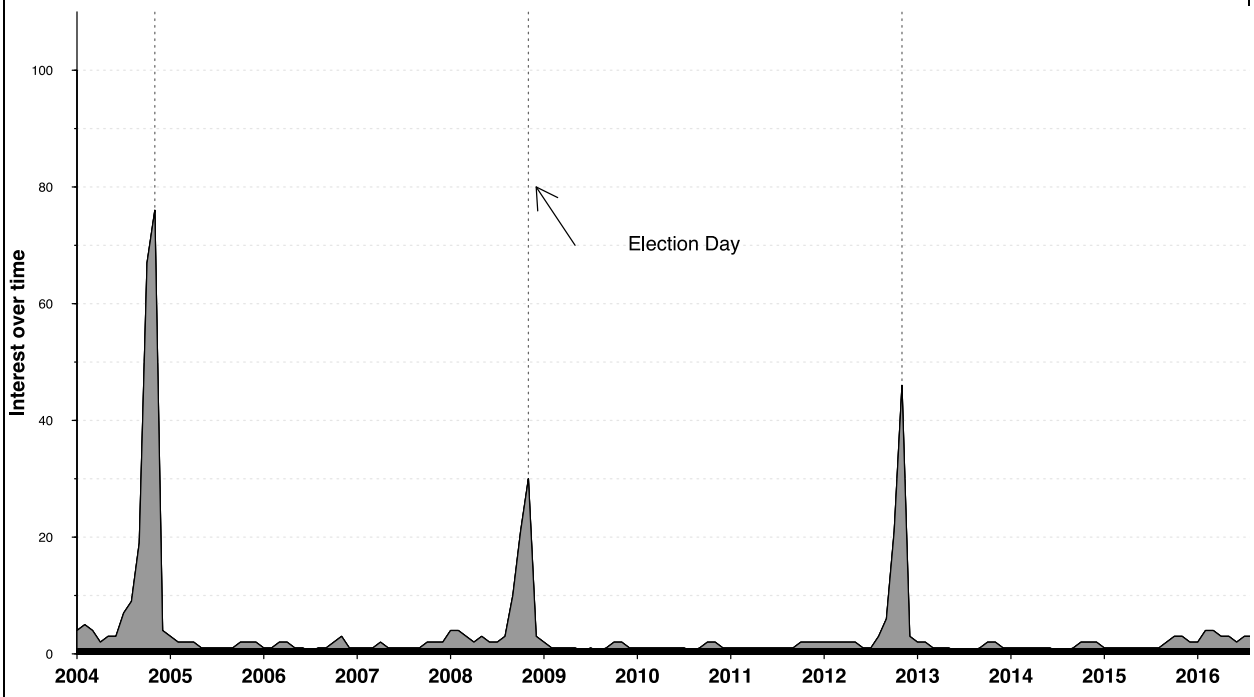
have amended the Constitution while 75 percent of Democratic respondents would have liked to see a change, with an overall support for change of 59 percent and with 3 percent of those polled with no opinion.[42] After the even more bitterly fought 2016 election, Gallup asked again about the EC, this time 49 percent choose the option to amend the Constitution.[43] Again, there was a strong partisan split. Republican support of the current system significantly increased after the election. Gallup found that only 19 percent of Republicans or leaning Republicans favor a system where the winner is the candidate who wins the popular vote (compared to 81 percent of their Democratic counterparts). Aldrich, Reifler, and Munger (2014) have modeled the circumstances where we might expect changes in preferences about the desirability of the EC. Fourth, as noted above, the academic and journalistic community has its skeptics about EC reform. Those in opposition to change note that among other things, proposed remedies have unknown qualities and are unlikely to cure problems such as a campaign focus on the larger states. Reform may bring new problems with them, for example, party proliferation, and blackmail potential by minor parties now able to win pledged Electors whose vote switches could determine a presidential election outcome (see, e.g., Ross 2012; DeWitt and Schwartz 2016; see also Grofman and Feld 2005). Fifth, there is little innovation by way of unique ideas for reform (Longley and Braun 1972), and it is far from clear what constituency a reformer would be trying to persuade. In reviewing the history of the Electoral College, it quickly becomes clear how little

[42] (Cable News Network, USA Today. Methodology: Conducted by Gallup Organization, December 15 to December 17 2000 [USAIPOCNUS2000-56])

[43] (Gallup Poll 2016 [USGALLUP.120216.R01] November 28-29 2016)

anybody has to offer that is new. All the plausible reform ideas, and all the arguments for and against them, have been debated and rehashed for well over a century, in terms that have remained virtually unchanged (Schwarz 2000). Finally, after an election, attention quickly shifts to other more pressing issues and EC reform goes off the political agenda. Google Trends reveals spikes in the popularity of searches of the term ''Electoral College'' in the months before a presidential election; search numbers quickly diminish to near zero shortly after the election. Some of these data are displayed in Figure 3.1.

FIGURE 3.1 ELECTORAL COLLEGE GOOGLE TRENDS



Note: Numbers represent search interest relative to the highest point on the chart for the given region ar time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as pop ar. A score of 0 means there was not enough data for this term'' (Google Trends). The term was at its pe search in the days following the 2016 election (an inversion).

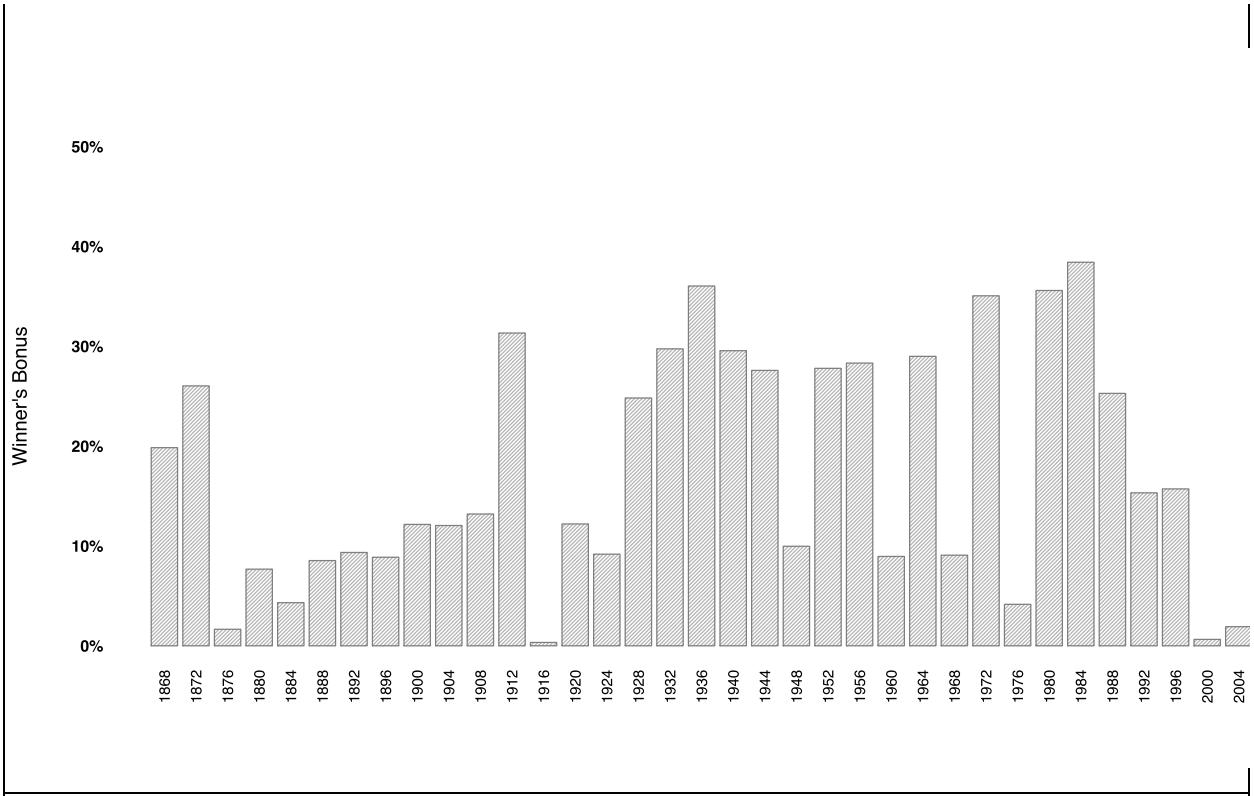
There are many complaints about the EC. One such claim is that virtually all presidential campaign activity is focused on a very limited number of battleground states in a way that affects turnout and interest in politics such as to depress both (the subject of Chapter 2). There are always renewed fears about wayward Electors; ''The people know the candidates of president and vice president; rarely do they know the identity of the Electors for whom they vote. Such 'go-betweens' are like the appendix in the human body. While it does no good and ordinarily causes no trouble, it continually exposes the body to the danger of political peritonitis'' (Henry Cabot Lodge, as cited in Longley and Peirce 1999:110). This claim was addressed in *Chiafalo v. Washington*, however, the court's opinion only allows states to enforce Elector's pledges, not to stop Electors from legally casting 'faithless' votes.

It is fair to say that far and away the single most important criticism of the EC is that it does not guarantee the election of the national popular vote winner.[44] A direct popular vote election for the presidency also has its critics (Best 1975; Gringer 2008). Opponents of change to the popular vote note the possibility of a bitterly divided and close election, not unlike those we have experienced much of the past few decades and reminiscent of the late 1800s. The last seven elections have been decided by under 5 percentage points (of the two-party vote). The EC delivers decisive victories. The EC often appears to give the president-elect a landslide victory even when the popular vote is close. This is a result of the winner-take-all rules that translate even small pluralities into 100 percent of the state's electoral slate. EC victories are always over

[44] For issues regarding the meaning of ''popular vote winner,'' see Gaines (2001) .

50 percent, while popular votes have been as low as 38 percent (in 1860). Figure 3.2 shows for the 1868-2016 period the 'winner's bonus'. The winner's bonus is the difference between the electoral winner's victory in the EC and their popular vote percentage. Note that since George H.W. Bush's sizable bonus, the winner's bonus has not been particularly significant. Additionally, in two of those years, 2000 and 2016, the EC winner received less than 50% of the popular vote. No president has won with a smaller percentage of the EC than aggregated national popular vote percentages (i.e., Lincoln won 59.4 percent of the EC, but only 39.65 percent of the popular vote). A close direct vote might lead to a nationwide recount that might take months or even years to complete, leaving the country in a constitutional crisis. In a situation where no president is selected before inauguration day, the Speaker of the House would become interim President. Another issue is based on the expectation that a national popular vote would dramatically increase the incentives for candidate proliferation.

FIGURE 3.2 WINNER'S BONUS IN THE ELECTORAL COLLEGE



Note: The winner of the Electoral vote has shares of the EC that often far exceed the margin of the popul vote. This can help create the illusion of a decisive victory. Winner's bonus is defined as the difference b ween the two-
party share of Electoral College vote and the Popular Vote share of the winning presidential candidate.

There are many dimensions along which the EC and its proposed alternatives could be evaluated, both in normative and empirical terms, here I evaluate eight key alternative proposals, and additionally applied (where appropriate) those alternatives to a proposed change in size of the House of Representatives, solely in terms of one simple criterion: ''Would they be expected to reduce the likelihood of inversions between EC and popular vote outcomes?'' Although this criterion serves double duty, we eschew the normative standard and focus on the empirical. We address the empirical question by looking at the data on actual presidential election outcomes

at the state level[45] over the entire period 1868-2016, and at the congressional-district level over the period 1956-2016, taking turnout levels and vote choice as given. Of course, candidates would adapt strategies to the rules in use, but it is a worthwhile exercise to examine how the previous voting patterns would have affected outcomes under different EC formulae. The normative aspect is well-plowed ground in the previous EC literature and is not repeated here. Many political scientists hold the popular vote principle to be sacrosanct. Nonetheless, it is useful to remind readers that only one state voted for the popular election of the president during the Constitutional Convention, while nine voted against. Popular election of the president was again brought up in Congress as a proposed amendment in 1816, and since then has been proposed in Congress at least 100 times, every time failing. There are a number of books and articles comparing the present EC rules to proposed alternatives, but none of which that both use a time series going back to 1868 and include the 2016 election, and none that empirically evaluate as many alternatives to the present EC rules as are considered here (see, e.g., Longley and Braun 1972; Hardaway 1994; Grofman and Feld 2005; Polsby et al. 2012; Koza et al. 2013; cf. Barthélémy et al. 2014 for some thoughtful and detailed empirical analysis and the one most closely resembling this article's analyses). Moreover, many studies only write about the EC in normative, legal, and theoretical terms, or discuss the prospects for change, and provide no attempt at empirically estimating how a changes in rules would have affected past voting outcomes (Wilmerding 1958; Bickel 1968; Glennon 1992). One interesting potential legal avenue

[45] The District of Columbia received three seats after the passage of the 23rd Amendment in 1961.

to reform comes from Bullock, Gaddie, and Wert (2009), who examine the potential for a Voting Rights Act based challenge to the EC winner-take-all rule that would parallel voting rights challenges to at-large elections.

The goal of this chapter is to examine possible reforms to the EC in terms of the consequence of changes to its two most important structural features: seat allocations that are not directly proportional to population and winner-take-all outcomes at the state level. This typology allows for a parsimonious way to classify the reforms that have been or are likely to be taken seriously, including those that have previously been debated in Congress. In addition, the implications of a proposal to increase the size of the U.S. House (Ladewig and Jasinski 2008) is considered. Quite surprisingly, the empirical results show that over the full time period, inversions from the popular vote happen under all proposed alternatives at nearly the same rate as under the current EC rules, with some proposals making inversions more frequent. The major difference between the present EC rule and alternative rules is not in frequency of inversions, but in which years they occur. As for the proposal to increase the size of the House, any realistic increase in House size would have made no difference for the 2016 outcome.

Only the Democratic and Republican two-party vote shares are used in looking at outcomes under different EC formulae. The choice of two-party vote is made even though third-party candidacies sometimes represent a large proportion of the total vote. For example, in 1968, when the leading popular vote recipient, Richard Nixon, won just 43.42 percent of the total votes. That is, nearly 14 percent of the vote went to candidates who did not finish in the top two. If there was a good way of determining the preferences of voters for these other

candidates had only the two mainstream candidates been on the ballot, Hubert Humphrey would have led in the popular vote among the top two candidates. George Wallace's independent campaign drew support primarily from the South, capturing 46 electoral votes from five southern states. However, even had Humphrey won all 9.9 million of Wallace's voters and the 46 EC votes that accompanied them, he still would have lost in the EC. The effects of third-party candidacies on electoral outcomes is certainly worth further investigation but is beyond the scope of the present essay. Moreover, it is expected that most, if not all, of the problems identified with third-party candidacies would be the same or greater under the alternative versions of the EC we consider here. In the same tweet in which President Trump said that the EC was ''genius,'' he also claimed that he would have won the popular vote if, rather than the present EC system, who won the popular vote decided who got elected president. Under that rule for deciding outcomes he said he would have campaigned in populous states that were being conceded to the Democrats under the present winner-take-all feature of the EC. But, of course, if he had changed his strategy so, too, would his Democratic opponent have been able to do a better job of motivating turnout among her supporters. Gaines (2001:75) has called the popular vote a ''nebulous quantity.'' Of course, candidates will adapt strategies to the rules in use, and that *a priori* rules may affect candidate entry decisions, but it is still a worthwhile exercise to examine how the previous voting patterns would have affected outcomes in the 38 presidential elections we review. However, because of such estimation complexities, interpretate the results, such as shown in Table 3.2, as *ceteris paribus* ones.

Proposals for Electoral College Reform

The EC is often thought of as having two undesirable design features.[46] The first of these is the allocation of EC seats in each state on a winner-take-all basis rather than either allocating candidate votes proportionally on a state-by-state basis, or nationally in the form of a direct popular vote. The second design feature is the way in which EC votes are allocated to each state, with objections to the two-state federal bonus as generating malapportionment, and thus overweighting or underweighting certain states. To a lesser extent, the malapportionment that arises from rounding into integers can cause disproportionalities. Many critics of the EC would be satisfied only if both features were eliminated and the EC was replaced with direct popular election of the president; others are prepared to see modifications made in one or both features.

While most of the current attention on EC reform has been centered on the state compact to bind Electors to vote for the national popular vote winner,[47] many other more limited proposals for changing the EC have been introduced. By some estimates, over 700 attempts to change or abolish the EC have been advocated or proposed (Hardaway 1994). Most of these proposals are simply rehashing previously failed attempts (Schwarz 2000). In addition to replacing the present EC either with an election based on winning the national popular vote (though usually with a runoff rule if the plurality victory margin is not above some threshold), or replacing it with a scheme that makes the EC allocation to the candidates in each state more

[46] Longley and Braun (1972:18) identify five features, one of which (inversion) flows from the others, moving beyond the first stage, which is highly unlikely without a strong regional third-party candidate, and the faithless elector, which in the simulations of this chapter are not addressed.

[47] S.J. Res 28 1979; National Popular Vote Bill—enacted in 11 states.

proportional to each candidate's share of the state-wide vote, there have been many different alternatives proposed. Proposals range from reasonable to absurd. Longley and Braun (1972:69) write about a proposal in 1808 by Sen. James Hillhouse (Federalist—CT) that would have had all senators elected to one three-year term, such that a third of them would retire each year; the president would then be chosen randomly among those retiring senators. Most proposals are written for political expediency (Bowler, Donovan, and Karp 2006), such as the Democrats pushing for a direct vote in the 2000s because it is seen as being more favorable to their electoral chances. While the Democrats have won the popular vote in four of the previous five elections, they have only won the EC twice (in 2008 and 2012).

In this chapter, I propose a simple and parsimonious means to classify proposed reforms by focusing on the two key structural features of the present EC identified above: seat allocations that are not directly proportional to population and winner-take-all outcomes at the state level. However, not included in the set the proposals the interstate compact that binds the states to report a slate of Electors consistent with the popular vote outcome, even though that proposal has recently attracted a lot of attention, since that is simply the popular vote outcome by another mechanism. Also excluded are proposals that require voters to rank-order candidates because a lack of data on the preference ordering of candidates among the electorate makes it impossible to reliably estimate the implications of their use in past elections.

TABLE 3.1 VARIANTS OF ELECTORAL COLLEGE REFORM

No.	Name	Two-Seat Bonus	Unit Rule	Number of Inversions
C1	EC	√	√	4
C2	EC without two-seat bonus		√	3
C3	State-unit population proportionality		√	3
C4	Whole-number proportionality with two-seat bonus	√		2
C5	Whole-number proportionality without two-seat bonus			3
C6	Fractional proportionality with two-seat bonus	√		3
C7	Fractional proportionality without two-seat bonus			1
C8	District rule with two-seat bonus	√	√+	5*
C9	District rule without two-seat bonus		√+	5*
C10	Direct popular vote			–

Note:
+ district-level winner-take-all rule.
*The number of inversions is five (31.25 percent) for the 16 elections for which we have district-level dat
In comparison, in the full set of 38 elections, thre are at most four inversions (10.5 percent).

While this simple classification lends itself naturally to a 2 × 2 format, there are variants within each element that can be considered, such as keeping the winner-take-all feature, but applying it at the level of congressional districts.[48] Similarly, when considering ways to make EC results more proportional, I distinguish between allocations based on House seat share and allocations based strictly on population. For states that enter the Union after a census has been taken but are still allocated EC seats, I take the population in the subsequent census. Additionally, there are two types of proportional representation considered. One that allows for fractional shares of EC seats, the other awarding only whole seats. The whole-number

[48] Winner-take-all and two-seat bonus, winner-take-all and no bonus, no winner-take-all (proportional) and two-seat bonus, no winner-take-all and no bonus.

proportionality rule used is the same that is used for apportionment of the House of Representatives, namely, the method of equal proportions.[49] In the latter, whole Electors are allocated, which allows for the continued physical meeting of Electors in December at their representative state legislatures.[50] For the purposes of this chapter, only the alternative results based on the apportionment currently used by the U.S. Census, the ''Hill-Huntington'' method, is used for determining EC seats.

There are 10 institutional procedures for aggregating votes used in this chapter, including the current EC and the popular vote. Using this simple classification scheme allows for capturing almost all the reforms that have been or are likely to be taken seriously, including those that have previously been debated in Congress. *In toto*, three versions where the state-level unit-rule is maintained and seven variants where the unit-rule is eliminated or altered. These 10 total electoral rules include four that keep the state-wide two-seat bonus (1, 4, 6, 8 in Table 3.2), six that eliminate the bonus (2, 3, 5, 7, 9, 10), and three that eliminate Electors (5, 7, 10). Later, I provide data on a procedure that reallocates the number of Electors based on the ideal size of the U.S. House, namely, one based on the cube root of the population.

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[49] The U.S. Census has used this method since 1940. For more details, see 2 U.S.C. §2a (1941).

[50] There are many different formulas that can be used to allocate seats, and that the differences might, in the words of Gallagher (1991:33), ''produce significantly different seat allocations for a given distribution of votes…''Similarly, Gaines and Jenkins (2009) observe that when the direct vote is particularly close, choice of apportionment method might be determinative (see, especially, Balinski and Young 1982, for a full treatment of divisor methods). Gallagher (1991) observes that ''each PR method minimizes disproportionality according to its own principles.''

I begin with some notation to elucidate how we will measure these Electoral College alternatives. The focus of this data exercise is on all elections since 1868, Y. In each year, there is a set of states, $S\{Alabama_y, Alaska_y, \ldots, s_y\}$, which all receive a proportion of the EC, $Electors_{ys}$, as determined by the US Constitution.

The equation for the *Popular Vote* (C10) is simply,

(C10) [51] Popular Vote = $\frac{\sum DemVotes_{ys}}{\sum (DemVotes_y + RepVotes_y)}$

which translates into the national summed percentage of votes for the Democratic candidate, with the two-party vote total in the denominator and third-party votes excluded. This is, of course, the most proportional to the voters, but not necessarily to the population since turnout rates might vary by state (Grofman et al 1997). It also happens to be the reform that has generated the most demand since it's the only system that can guarantee a plurality winner takes the office.

The actual Electoral College (C1, C2), assuming unit-rule for all states, is determined by the following equation,

(C1, C2) EC =

$$\frac{\sum Electors_{ys} \times [(1 \times DemVotes_{ys} > RepVotes_{ys}) + (0 \times RepVotes_{ys} > DemVotes_{ys})]}{\sum Electors_y}$$

The first of the alternatives we consider sets an Electoral College vote share equal to the size of the state's delegation in the U.S. House divided by the total number of seats in the House,

[51] The equations are numbered to match Table 3.1.

i.e., an Electoral College with the two seat Senate bonus removed. It will be referred to as an Electoral College without 2-seat bonus (C2). For the purposes of this calculation, Washington D.C. will still be counted for one house vote in periods after 1960 despite not having a voting member of the House of Representatives. As per the twenty-third amendment, adopted in 1961, D.C. is allocated three Electoral College votes regardless of its population. The equation is the same as the Electoral College (C1), except every $Electors_{ys}$ is first subtracted by two.

The second sets the Electoral College vote share as identical to the state's share of the national population, with fractional allocations to allow for (nearly) perfect proportionality, i.e., an Electoral College that corrects for both House malapportionment and malapportionment due to the two seat Senate bonus. We refer to the second as a State-Unit Population Proportionality (C3). Here, instead of the total Electors equaling 538, it is set to 1, or 100%, and each state gets exactly the percentage of this EC as their census year population, and the winning candidate is the one that wins enough states such that their share of the states' allocations surpasses 50% of the population.

(C3) State-Unit Population Proportionality =

$$\frac{\frac{\text{Population}_{ys}}{\sum \text{Population}_{ys}} \times \left\{ \begin{array}{c} 1 \times \left(\text{DemVotes}_{ys} > \text{RepVotes}_{ys}\right) \\ +\, 0 \times \left(\text{RepVotes}_{ys} > \text{DemVotes}_{ys}\right) \end{array} \right\}}{\sum \text{Population}_{y}}$$

In the same way that one might expect campaigns to employ a different strategy then with the Electoral College, a proportionality rule such as a state population allocation might encourage regional candidates or smaller parties to run because it would not be necessary to win a majority of states or votes, since the winner would be the candidate who can attract enough

support in a subset of states that is greater than any other candidate. Essentially, even though seats are awarded nearly proportionately, this rule would change the nature of campaigns for the highest office. Any increase in the number of viable candidates who go on to win Electoral College seats would result in the winner of an election winning smaller pluralities. With the winner-take-all feature maintained, which results in an unbalanced distribution of votes in some states, we would expect to result in more frequently split popular and Electoral votes. For the purposes of this chapter, I treat the actual results as if they happened under the alternative rules.

The third proposal is to create an Electoral College that allocates its votes in a proportional or more proportional way to the state's share of the present EC, rather than in terms of winner-take-all. Here there are two main variants, each of which have two minor distinctions. The first major variant uses the current allocation of EC seats, the second allocates Electors based on representation in the House of Representatives, i.e., with the two-seat bonus eliminated. For the minor variations, *Whole-Number Proportionality* (C4, C4) for both the Electoral College and House delegation sizes are given by the following series of equations:

$$n = \sum U\,S\ House\ Seats$$

$$seat = \{1,2, \dots, seat_n\}$$

$$Quota_{ys} = \frac{1}{\sqrt{seat_n \times (seat_n - 1)}}$$

$$\text{Priority Number} = \begin{Bmatrix} \text{Quota}_1 \times \text{DemVotes}_{ys} ; \text{Quota}_2 \times \text{DemVotes}_{ys} ; \cdots ; \text{Quota}_n \times \text{DemVotes}_{ys} \\ \text{Quota}_1 \times \text{DemVotes}_{ys} ; \text{Quota}_2 \times \text{DemVotes}_{ys} ; \cdots ; \text{Quota}_n \times \text{DemVotes}_{ys} \end{Bmatrix}$$

Where the *Priority Numbers* are ordered and the *n* - top priority numbers are allocated to each party.

$$Electors_{1-n} \supseteq Priority\ Number_y$$

(C4, C5) Whole Number Proportionality = $\frac{\sum Electors_{yDEM}}{\sum Electors_y}$

The second minor variation is the *Fractional Proportionality* (C6), where Electors are abolished, and candidates receive their share of the state-wide vote rounded to the third decimal. This variant has been proposed numerous times and was passed by the US Senate in 1950 under what was known as the Lodge-Gossett amendment (S.J. Res. 2 of the 81st Congress). The *Fractional Proportionality* (C6) alternative results in an increase in proportionality from *Whole-Number Proportionality* but is less proportional then *Popular Vote*, because it sets the number of Electors each state gets but relaxes the unit-rule nature of the election. It failed ratification in the House of Representatives (Koza 2013). The equation is as follows,

(C6, C7) Fractional Proportionality = $\frac{\sum\left(\frac{DemVotes_{ys}}{DemVotes_{ys}+RepVotes_{ys}}\right)}{\sum Electors_y}$

The other frequently proposed variant is one in which EC votes are allocated by giving one seat for each House district won, and a two-seat bonus for the candidate who wins the *Popular Vote* in the state. This variation emulates the rules presently practiced in the states of Maine and Nebraska. Maine adapted this rule in advance of the 1972 presidential election, while Nebraska enacted it starting with the 1992 election. A split has occurred once in each of these states. In 2008, Barack Obama won Nebraska's 2nd Congressional District, picking up a Democratic Electoral vote in that state for the first time since 1964. In 2016, Donald Trump won Maine's 2nd Congressional District. This is referred to as the District Rule. It has two minor variations, with (C8) and without (C9) two seat-bonus. Although this plan is more proportional then the state-unit rule plans including the current Electoral College, it is not a proportional plan

since it still awards Electors on a winner-take-all basis, except now at the Congressional District level. Given the potential for partisan gerrymanders, this plan may end up being less proportional then a winner-take-all state rule. It is akin to a plan advocated by Senator Karl E. Mundt (R-SD), which was opposed by then Senator John F. Kennedy (D-MA).[52]

(C8, C9) District Rule =

$$\frac{\begin{array}{c}\sum[1 \times (DemVotes_{yd} > RepVotes_{yd}) + \quad 0 \times (RepVotes_{yd} > DemVotes_{yd})] \\ +\sum[\omega \times (DemVotes_{yd} > RepVotes_{yd}) + \quad 0 \times (RepVotes_{yd} > DemVotes_{yd})]\end{array}}{\sum \text{Electors}_y}$$

District Rule with two-seat bonus sets ω to 2 while the District Rule without two-seat bonus instead sets it to zero.

In addition, in the subsequent section, I briefly consider an additional type of change, one based on the suggestion in Ladewig and Jasinski (2008) that the House size be decennially adjusted to reflect the cube root of U.S. population. The idea is that increasing the size of the House should increase the proportionality of EC outcomes, and hence make the EC vote look more like the *Popular Vote*. This proposal can be seen as an attempt to avoid change in the present Electoral College that would be impossible to achieve without a Constitutional amendment while still assuring concordance with *Popular Vote* outcomes by creating a compact of all the states such that they would report Electoral College results as if the national *Popular*

[52] S.J.Res. 12, 90th Cong., first sess.

Vote winner was the winner in the state. This proposal would only take an act a Congress, since it sets the size of the US House and thus the percentage of Electors that are allocated via population.

$$\text{Cube Root House Size} = \sqrt[3]{\sum \text{Population}_{ys}}$$

Instead of locking the size of the US House at 435, this rule would apportion seats using method of equal proportions (as described in equation (C4), and *n* is replaced with the Cube Root House Size rounded down to the nearest integer. This new apportionment is applied to all the alternative Electoral College rules.

Table 3.2 shows actual popular vote and EC vote shares and simulated seat share under each of our additional eight EC variants. Cells that are in bold Shaded cells show inversion years.

TABLE 3.2 CONCORDANCE OF POPULAR VOTE WITH WINNER IN 10 VARIANTS OF THE ELECTORAL COLLEGE

Year	Popular Vote (%)	Electoral College (%)	Electoral College Without Two Seats (%)	Population Weighted State Unit (%)	Whole-Number Proportionality with Two Seats (%)	Whole-Number Proportionality Without Two Seats (%)	Fractional Proportionality with Two Seats (%)	Fractional Proportionality Without Two Seats (%)	District Specific with Two Seats (%)	District Specific Without Two Seats (%)
1868	47.337	27.491	28.444	29.086	46.048	46.667	46.999	47.315		
1872	44.062	18.033	18.493	18.471	42.35	41.781	43.712	44.019		
1876	51.518	49.864	51.195	51.799	51.22	51.877	51.398	51.871		
1880	49.949	42.276	40.273	40.326	50.407	51.195	50.857	50.944		
1884	50.295	54.613	55.077	55.34	50.623	51.692	51.25	51.381		
1888	50.43	41.895	40.615	41.038	52.369	52	52.16	52.242		
1892	51.69	61.036	63.202	64.439	52.252	53.09	52.059	53.144		
1896	47.793	38.926	36.415	36.242	50.336	49.02	50.414	49.636		
1900	46.832	34.676	33.894	33.655	50.336	50.42	49.983	49.85		
1904	39.988	27.941	28.238	28.312	44.118	44.56	45.485	45.781		
1908	45.495	32.298	31.714	32.031	49.482	49.361	49.47	49.549		
1912	64.344	95.669	96.092	96.04	70.433	70.575	67.456	67.518		

1916	51.644	51.977	49.655	49.911	57.25	56.782	56.16	55.859		
1920	36.118	23.917	24.138	24.55	39.171	38.391	41.008	40.818		
1924	34.785	25.612	25.747	25.776	38.795	38.161	40.596	40.538		
1928	41.202	16.384	16.322	15.888	42.75	42.529	44.05	44.124		
1932	59.149	88.889	89.195	88.708	65.348	64.598	63.183	62.976		
1936	62.459	98.493	99.08	99.054	67.985	68.966	65.99	65.941		
1940	55	84.557	85.747	85.79	60.64	60.69	59.185	59.125		
1944	53.774	81.356	82.759	82.449	58.945	58.391	57.494	57.576		
1948	52.37	62.335	61.839	61.801	55.367	55.172	53.995	54.004		
1952	44.548	16.761	16.322	17.307	43.879	44.368	45.395	45.696		
1956	42.248	13.936	13.793	13.829	42.185	42.759	43.547	43.621	22.659	24.083
1960	50.083	59.032	61.556	61.685	51.024	50.801	50.333	50.545	47.486	47.368
1964	61.346	90.335	90.826	90.894	61.524	61.697	59.6	59.769	85.688	85.092
1968	49.594	40.52	42.202	42.573	49.442	49.541	49.291	49.44	41.636	43.578
1972	38.214	3.16	2.982	3.297	35.13	35.092	37.394	37.531	11.896	13.761
1976	51.052	55.204	57.11	57.366	50.929	50.917	51.079	51.204	49.907	50.575
1980	44.695	9.108	8.028	8.136	43.309	42.661	44.69	44.93	26.58	29.587
1984	40.83	2.416	2.064	2.081	38.662	38.303	40.547	40.738	12.825	14.908
1988	46.098	20.818	20.642	20.418	45.167	45.183	45.958	46.028	29.926	31.881
1992	53.455	68.773	69.725	71.517	53.532	54.358	53.197	53.361	60.037	58.945
1996	54.735	70.446	72.248	72.543	54.647	55.275	54.523	54.72	64.126	64.45
2000	50.27	49.628	51.606	51.713	50.186	49.771	49.958	50.385	44.981	45.413
2004	48.756	46.84	48.624	48.764	47.955	47.248	48.439	48.755	41.078	41.514
2008	53.688	67.658	70.183	69.946	53.717	54.587	53.471	53.775	55.948	55.734
2012	51.965	61.71	63.761	64.925	50.929	51.606	51.534	51.891	48.885	47.936
2016	51.112	43.309	43.807	43.692	50.186	50	50.629	51.247	46.097	47.248

Note: Percentages are of the Democratic candidate using the alternative rules. All calculations are of the two-party vote. Shaded cells are those in which the new rule disagrees with the popular vote.

There are several interesting results shown in Table 3.2. First, malapportionment effects, and especially the effects of the two-state bonus, are not that large. For example, in 2016, Donald Trump would have been elected even had there been no two-seat bonus. In fact, he would have won in all the different unit-rule configurations, only losing when a proportional rule such as the popular vote is instituted. Indeed, as can be derived from the differences between Columns 2 and 3 of Table 3.2, in only three elections in American history has the two-seat bonus feature of the EC been decisive in reversing an election result. The first time this happened was in 1876 when the two-seat bonus benefited the Republican candidate. However, as noted

previously, this was an election that was decided not by the votes of the people but instead by a deal between the Democratic and Republican candidates that involved the federal government ending Reconstruction in the South. In 1916, when it benefited the Democratic candidate, and finally again in 2000 when it benefited the Republican candidate. However, over the last seven elections, the two-seat bonus has consistently favored the Republican candidate, even when it has not had an impact on election outcome. On the other hand, glancing through Table 3.2's first two columns reveal several instances where a reversal almost happened. In most of these instances, the Democratic candidate came out on top, for example, in 1960. In such situations, very small permutations in vote shares at the state level can, because of the unit-rule, take a popular vote and EC convergence and reverse them. In 1960, inconsistencies in popular vote totals and controversial methods for counting the popular vote, especially in Alabama, have led some to argue that Nixon in fact won the popular vote. Nobody, including Nixon himself, believed that the questioned votes would have changed the EC outcome. However, a few votes in specific states would have made Nixon president, and depending on how votes in other places were counted, perhaps made him a reversal president.

Second, while proportionality variants of EC allocations clearly can dramatically change the magnitude of seat outcomes relative to vote outcomes, it is only in the period from 1880 to 1900 that there is evidence of changes in the presidential winner based on choice of a proportional as opposed to a winner-take-all rule, though, of course, we also see this in 2000 and 2016.

Third, the ''reform'' that would have the most dramatic effect on recent elections is a winner-take-all rule based on district outcomes. In recent elections where a Democratic Party candidate won the election, such a rule would reverse the EC. That such inversions provide net benefits to the Republican Party can be explained by the degree to which Democratic voting strength is inefficiently concentrated in urban districts (Chen and Rodden 2013), and the degree to which there is greater Republican unified control of state legislatures and governorship than is true for Democrats, giving Republicans a much greater opportunity to engage in successful partisan gerrymandering of congressional district lines. Blatant partisan gerrymandering was made more likely by the Supreme Court's consistent refusal to rein in this practice (See *Vieth v. Jubelirer*, 541 U.S. 267 (2004), *Gill v. Whitford* 585 U.S. ___ (2018), and most recently *Rucho v. Common Cause* 588 U.S. ___ (2019)). In 1960 1976, and 2012, for example, the outcomes would have been reversed (all three times benefiting the Republican candidate) if congressional districts result plus the plurality state winner getting two bonus seats rule had been used. There is an especially large difference when allocating by congressional district in 2012, due in no small part to the aggressive House gerrymandering that took place in the census before the election, mostly to the benefit of Republicans (McGann et al. 2016). Since benefit from incumbency advantage reduces the vote shares of challengers, *ceteris paribus*, once incumbents are in place whose election is in part or largely due to gerrymandering, apparent partisan bias in subsequent elections may appear lower (Theodore Arrington, personal communication, February 2017). In 1976, however, not giving the two-seat bonus to the state plurality winner reverses yet again back to the actual winner, Jimmy Carter (i.e., benefits the Democratic candidate).

Fourth, if we want to understand inversions we must look to when popular vote elections are close. As mathematician Sam Merrill has argued, whether an inversion happens is essentially a coin-flip as the popular vote approaches 50 percent (Merrill 1978).

An EC Based on an Expanded U.S. House

Now I turn to the last structural variation on the present EC rules that we consider. Ladewig and Jasinski (2008), drawing on ideas in Taagepera (1972), have proposed that the House size should be decennially adjusted to equal the cube root of U.S. population. Taagepera (1972) argued that, for optimal communication purposes between representatives and those they represent, an assembly size should be the cube root of the polity's population. He also demonstrated that this model did a rather good job in explaining actual assembly size in the world's democracies, with the United States in the last 100 or so years being one of the most notable exceptions.] The cube root of the U.S. population in 2010 was $\sqrt[3]{309{,}785{,}186} = 676$. Using a House size equal to 676, a congressional seat's average size would be just 458,262 people.[53] As it turns out, this would have ensured that, had congressional size been increased in 2010 according to this formula, even the smallest state would have received at least one congressional seat based solely on the state population. How would EC malapportionment and outcome effects change if we increased the size of the House to make the allocation rule in that

[53] In addition to the work of Ladewig and Jasinski (2008), the effects on presidential outcomes under the EC of increasing/varying the size of the House have been studied by other authors (e.g., Neubauer and Zeitlin 2003; Barthélémy et al. 2014; Miller 2014).

body more nearly proportional to the population of the state using the cube root of population to determine House size?

One way in which House size could become determinative is when a reversal happens, so the popular vote winner has lost the election. Under this circumstance, as the House size grows to approximate the population size, eventually the popular vote winner will also win the EC. Recalculating the 2016 election for a House size of 676 (but now excluding the two bonus seats for each senator) yields Donald Trump 380 of the 676 Electors (56.2 percent). Again, as with the current EC and the version that simply omitted the bonus Senate-based Electors, Trump would still have won the White House even if the House size were 676. In this EC rule, he wins by 84 Electors. Although this is a larger number of Electors, the EC is also larger. Since Trump won 306 of 538 (56.8 percent) Electors in 2016, his percentage would, as expected, slightly decrease under the cube root rule.

Trump won a plurality in the majority of states, so the same Trump victory still occurs if we add in the two-seat ''federal bonus.'' In 2016, for House size to matter required a House size so huge as to be unrealistic: the effects of increasing House size do not affect the outcome in 2016 for any House size under at least 800 (data omitted for space reasons). Table 3.3 compares the popular vote and EC under present apportionment with those using the cube root rule of assembly size for the entire time period of our study.

Table 3.3 also provides comparisons to cube root results for the EC without the two-seat bonus, and the whole-number and fractional proportionality rules, both with and without two-

seat bonus. The district-based measures cannot be calculated since the partisan composition of a House delegation that has never existed is unknown, and the popular vote rules would be the same regardless of the House size. In the year 1912, the cube root EC size is larger than the actual EC size. In 2000, an increase in the size of the House could have mattered in that, in most House sizes starting above 493, including all of them above 655 (the cube root law value), the popular vote winner, Gore, would also have won the EC, a result previously pointed out by Neubauer and Zeitlin (2003) . The years in which a cube root allocation would have changed the outcomes are limited to just 1876 and 2000, which were already reversed, but reducing inversions by two. The effect in 1876 is hard to assess given the logrolling involved. Mathematically, based solely on the criteria of popular votes counted on a state-by-state basis, a cube-root-based apportionment would have resulted in the election of the runner-up, Samuel J. Tilden.

TABLE 3.3 CUBE ROOT ADJUSTED ELECTORAL COLLEGE

Year	EC No.	Popular Vote (%)	Electoral College (%)	Electoral College Cube Root (%)	Cube Root Whole-Number Proportionality with Two Seats (%)	Cube Root Whole-Number Proportionality without Two Seats (%)	Cube Root Fractional Proportionality with Two Seats Seats (%)	Cube Root Fractional Proportionality without Two Seats Seats (%)
1868	305	47.337	27.491	28.852	46.900	46.230	47.593	48.055
1872	315	44.062	18.033	18.73	42.416	42.857	44.183	44.699
1876	336	51.518	49.864	51.786	51.214	52.381	51.959	52.655
1880	336	49.949	42.276	40.179	50.971	51.19	50.988	51.125
1884	366	50.295	54.613	54.918	51.584	52.186	51.271	51.422
1888	366	50.430	41.895	40.437	53.620	52.459	52.115	52.195

1892	369	51.69	61.036	64.228	52.954	53.659	53.730	55.628
1896	396	47.793	38.926	36.616	51.029	49.747	49.739	48.632
1900	396	46.832	34.676	34.091	50.000	50.505	49.901	49.72
1904	420	39.988	27.941	28.095	44.314	44.524	45.874	46.327
1908	424	45.495	32.298	32.075	48.45	49.528	49.565	49.684
1912	425	64.344	95.669	96.000	69.482	70.353	67.404	67.471
1916	450	51.644	51.977	50.222	56.960	56.667	55.969	55.546
1920	450	36.118	23.917	24.444	39.194	38.444	40.952	40.703
1924	472	34.785	25.612	25.424	38.908	38.983	40.185	40.013
1928	472	41.202	16.384	15.890	42.958	42.797	43.954	44.015
1932	472	59.149	88.889	88.771	65.493	65.042	63.128	62.874
1936	496	62.459	98.493	98.992	68.581	68.548	65.905	65.831
1940	496	55.000	84.557	85.685	60.304	60.081	59.084	58.995
1944	507	53.774	81.356	82.446	58.375	58.383	57.574	57.679
1948	507	52.37	62.335	61.933	54.561	54.635	53.973	53.978
1952	507	44.548	16.761	17.160	44.776	45.168	45.866	46.293
1956	531	42.248	13.936	13.936	42.584	42.185	43.733	43.849
1960	531	50.083	59.032	61.77	50.555	50.847	50.555	50.82
1964	563	61.346	90.335	91.119	60.902	61.634	59.882	60.104
1968	563	49.594	40.520	42.629	49.173	49.556	49.555	49.754
1972	563	38.214	3.160	3.197	35.789	35.524	37.684	37.878
1976	587	51.052	55.204	57.411	50.943	50.937	51.279	51.434
1980	587	44.695	9.108	8.007	43.977	43.612	45.050	45.341
1984	609	40.830	2.416	2.135	39.100	39.737	40.803	41.019
1988	609	46.098	20.818	20.525	45.992	45.813	46.058	46.138
1992	609	53.455	68.773	71.757	53.586	53.695	53.501	53.703
1996	628	54.735	70.446	72.452	54.932	55.255	54.819	55.040
2000	628	50.270	49.628	51.592	49.726	50.159	50.469	50.923
2004	655	48.756	46.840	48.855	47.952	48.702	48.701	49.000
2008	655	53.688	67.658	70.076	53.765	54.198	53.758	54.051
2012	655	51.965	61.710	65.038	51.651	52.214	52.131	52.523
2016	676	51.112	43.309	43.787	50.900	51.183	51.212	51.785

Note: Column 2 (EC No.) is the total number of electors awarded based on the cube root of the population. In 1912, the cube root and actual House size are essentially the same. Since then, the size of the House, which was frozen after this, is smaller than ideal. Shaded cells are those in which the new rule disagrees with the popular vote.

The cube-root-based apportionment adjusted reforms produce a similar number of inversions, with only the most proportional alternatives minimizing the occurrences. Still, every alternative in this set produces at least one reversal, with several years being near misfires. In only one year, 1900, is the popular vote margin greater than 2 percent and produces an inversion. It is important to note that 1900 is the last year where apportionment uses 1890 census populations, and that position makes for maximal disproportionality within a given census period. Population growth and differences in migration patterns throughout a decade lead to suboptimal appropriation, which is most significant in the election preceding a new census.

These findings are rather redeeming for the EC as currently constituted. The results for a cube-root-based EC confirm the earlier findings and highlights that only in very close elections is there a legitimate probability of reversal.

Discussion

Reflecting on his decision to put aside his misgivings about the constitution as proposed and to sign, Benjamin Franklin wrote ''I confess that there are several parts of this constitution which I do not at present approve, but I am not sure I shall never approve them: For having lived long, I have experienced many instances of being obliged by better information or fuller consideration, to change opinions even on important subjects, which I once thought right, but found to be otherwise… I agree to this Constitution with all its faults, if they are such; because I think a general Government necessary for us, and there is no form of Government but what may be a blessing to the people if well administered'' (Farrand 1911b). Using election results from the period 1868 to 2016, I have constructed a total of 13 counterfactual variants on the EC for

the purpose of comparing the actual EC results and popular votes with those from various proposed reforms. Presidential elections have seen four occasions in the modern political party era of American history in which outcomes of the popular vote and the EC vote diverge, with two of these coming within the past two decades. While some may argue that even once is too much, others view the relatively small number of inversions as vindication for the founders (Hardaway 1994). Modifications to the EC, such as eliminating the two-state bonus, allowing for a more proportional distribution of Electors, or switching to House-district-based outcomes, at best reduce the number of inversions by one, from four to three and, at worst, with the House-district-based outcomes, they actually increase the number of inversions. Moreover, with the partial exception of 2016, the years in which inversions occur under alternative EC arrangements are different from those in which they occurred under present EC rules. Thus, changing the rules in the ways identified above seems to serve no useful purpose. It does not eliminate or even substantially reduce the prevalence of inversions; all it does is change the years in which they occur. Proposals to increase the size of the House (and thus of the EC) by picking a House size that was proportional to the cube root of population similarly does little to lessen inversions. The election results in 2016 would have been unchanged, though the net effects of this rule over the entire time period do reduce the number of inversions by two.

While certainly far from perfect, the EC has proved a robust institution that usually produces clear victories that match the plurality winner. Moreover, the alternatives to it identified above, with the partial exception of a rather large increase in the size of the House of Representatives, have virtually the same flaw in terms of likelihood of creating a reversal between

popular vote winner and EC winner, with some even worse. And the two-seat bonus afforded based on statehood has been shown in this essay to be generally non-determinative of election outcomes.

Reformers should also acknowledge that the EC ''wrong winner'' is no less legitimate than any legislation passed by senators representing a minority of the population (see chapter 1), or Supreme Court decisions that largely are immune from public opinion, and somewhat less affected by electoral tides due to the long length of service on the Court and the absence of a mandatory age-linked retirement. Reformers who demand majoritarian winners as normative doctrine of democracy should look no further than the multiparty coalition governments common in proportional representation (PR) systems. Leaders emerge through post-election negotiation, and their party may not even receive a plurality of the votes, though the largest party normally gets first chance to put together a winning majority coalition. As if that were not enough reason to be skeptical about the insistence on majoritarianism in the EC, in the process by which the EC would change through constitutional amendment, senators from the 34 states with the smallest population could vote for a change without the input of a popular majority. As of the 2010 census, the lowest population two-thirds states represented just 30 percent of the total population. Conversely, 34 senators from the 17 smallest states with a total population of 21,031,314 (6.8 percent) could block any amendment. A bill would still need to pass the House regardless of action in the Senate, but extreme gerrymandering also means that a minority of the population can, in effect, carry out a constitutional change. Additionally, when it comes to state ratification, state legislatures are often so severely gerrymandered that a majority of voters

fail to elect a majority of legislators, and often seats are so noncompetitive they regularly fail to garner competition at all. Ratification by 38 states is required, and those smallest 38 states amount to just 38.4 percent of the total population. Again conversely, 13 state legislatures from the smallest population states could prevent ratification with a total population of 12,562,969 (4.1 percent). While reformers who believe only in strict majoritarianism are right to criticize the EC, they should first look to reform the other more disproportionate aspects of the U.S. Constitution.

Without informed examination, one might assume the EC to be an archaic institution that does more harm than good. The EC is not perfect, a fact that the framers were perfectly aware of. All plausible alternatives, except for the popular vote or something that is its equivalent, do not cure the problem of inversions. Moreover, many have new and severe problems of their own. For example, changes that would eliminate the state-level winner-take-all and move to district unit-rule would almost definitely lead to political maneuvering and even more extreme gerrymandering (as would increasing the size of the House). And, in an age of hyper-polarization, with the potential for a close national outcome, the direct popular vote creates problems with respect to a proliferation of election challenges (Hasen 2013). At best the adaptations result in similar outcomes, and at worse could lead to severe constitutional crises. All in all, making changes to the system of electing the president should be looked at with a high degree of skepticism.

Chapter 4 - Conclusions and Extensions

This dissertation is an attempt to measure structural biases in the Electoral College empirically. These are the mechanical aspects to the electoral mode. I have put the microscope on three potential structural biases; (1) malapportionment and population deviations that result in over and underweighting of some voters, (2) whether some states are rendered irrelevant by creating incentives for campaigns to focus on only a subset of states, and (3) the election of candidates with fewer supporter than their opponent.

My focus has been on whether voters and the population more generally have equal input into the selection of the president. The EC has operated in the same basic manner since 1803 when the XII amendment fixed some of the initial problems. The exception here is that the Constitution allows states to determine their own method for appointing Electors. States have at times chosen to allow the state legislature to vote for Electors directly and more recently for Electors to be determined by the winner at the congressional district level. The feature that created the greatest disparity in vote-equality between the people of the different states, the three-fifth's clause, was eliminated after the Civil War. The remaining flaws of the EC are mostly indirectly related to its institutional arrangement. The two-state bonus Electors has the potential to affect the result by over-weighting small states, but in practice this has generally (2000 being a notable exception) not been determinative.

The veracity of the claim that the Electoral College is biased needs to be analyzed by looking at mechanical effects. So, if votes are largely proportionately distributed in the EC, the

two-seat Senate bonus is non-determinative, and the winner-take-all is a chose made by states and not a feature the Constitutional design, those who malign the Electoral College have misguided their angst. Those who believe that any system that elects a person with less than a majority (or plurality) of the votes is fundamentally flawed need to look no further than the potential for majority-preference candidates losing in popular contest due to the presences of minor parties. In this dissertation, I have not written about potential institutions that lead to more majoritarian outcomes because that is far beyond the scope of this, but reformers have suggested the use of rank-choice voting to ensure that Condorcet winners -- that is, a candidate preferred over all other pairs of alternatives -- is elected.

The set of biases I examine is certainly not exhaustive. Political aspects, including partisan-linked bias and the vote choice and efficacy of minorities, are separate, though not less important questions. Pivotality as measured by Banzhaf (1965) and others (see e.g., Shapley and Shubik 1954), has not been used here as a standard of equality. Disenfranchising a segment of the population, even when providing them formal representation in the institution, implies that outcomes are derived from an undemocratic practice. It is also important to note that turnout-related differences between racial groups or even between states can be linked to disenfranchisement. I have purposely avoided topics including turnout and other partisan-linked biases. I've taken these to be separate, non-mechanical issues. This is admittedly a limitation to the observations I have made in this dissertation. I have additionally shirked any normative objections to the EC. My lack of attention to partisan biases and racial effects should not be read as a denial of their existence. Rather, I find it important to separate the two sources of bias. On

the one hand, some biases are mechanical, i.e., they are structurally tied to the institutional arrangement. These are the ones that I focused on in chapters one, two, and three. On the other hand, there are partisan-related biases that are outcome-based relationships between the structural biases and the parties. Claims that the EC is biased in favor of a party (or against a party or set of parties) are related to these.

I avoid the very important questions about representation from an individual or behavioral perspective. In my own life, I often hear in the days before an election that an individual has a "choice between two evils", implying that neither candidate is very good. Institutional arrangements of the EC and single-member electoral districts create incentives for candidates to position their public policies towards the "median voter" (Downs 1957). But any system which is selecting a singular leader will create incongruence between the leader and its constituents. Multi-level electoral systems, such as primary elections preceding a general election and the Electoral College, which involves a primary and a multi-stage general election, often miss the median voter (Owen and Grofman 2006; Grofman, Troumpounis, and Xefteris 2018; Bafumi and Herron 2010). I set aside whether the leader has congruent policy preferences with the mass public, or even with a subset of the electorate that some indicate are benefited from the mode of election. Normative questions about whether the system chose "good" leaders, or even analyses of the qualities of leaders who are selected at all are left to others.

I have also neglected a potentially very important problem of third and other minor party spoiler candidates. This may be especially prescient given that inversions might result from these minor parties siphoning off voters who might otherwise prefer the electoral loser. For instance,

many people contend that had Ralph Nader not been on the ballot in Florida in 2000 that Al Gore would have received in excess of the 537 votes he needed to reach a plurality, and thus deliver him the electoral votes and the presidency. Ned Foley (2020) describes the relationship between majority vote winners (in contrast to plurality) and electoral winners showing many more of what he deems non or dubious "Jeffersonian winners" than there have been inversions in American history. All of this is to say that although I focus on the mechanical aspects of the EC, there are other potential sources of bias that might lead to greater concern about the fairness of the system.

I now recap the contributions of the three previous chapters on measuring the mechanical fairness of the EC.

Summary of chapter one

Chapter one described direct measures of bias between the seat shares and votes shares of individuals and how they vary by state. This malapportionment exists through the force of two structures, (1) voting imbalances that result from the rounding of fractions (e.g. a state has some fraction of the vote that corresponds to some fraction of apportionment, but these two fractions would never match identically) into whole numbers (and for the first eight elections, that which resulted from slaves being apportioned as only three-fifths a free person), and (2) from that minimum threshold of three Electors per state regardless of the population size.

To examine whether these malapportionment numbers were large, I used a classic identification technique of comparing the EC malapportionment to using reference groups. In

addition to comparing to the two other institutions (U.S. House and Senate), I compared across multiple measures of malapportionment from political science, economics, and law. In this two by two comparison design, I find that the Electoral College's malapportionment looks far more like the malapportionment found in the U.S. House than in the U.S. Senate, which is to say that it is only minimal disproportionate.

Additionally, it does not seem to matter which measure one uses to calculate this malapportionment, since they are all in vast agreement. Overall, however, I find that the measures from economics tend to provide the most interpretable estimates. The two measures perform particularly well are the Gini Index and the Minimum population needed to win a majority. Both measures utilize information from all units. The Gini Index summarizes inequality in voting equality standardized between 0 and 1 where 0 indicates perfect inequality and 1 indicates perfect equality. The minimum population needed to win a majority is the basic intuition that 50% of the population should be able to control a majority in an institution. The measure shows the proportion of the population that controls the majority and the deviation from 50% indicates the amount of inequality. These two measures are superior to the others analyzed because they provide the most intuitive meaning and are immune to paradoxes that violate some important axioms. I showed this to be the case by creating a quasi-natural experiment where I was able to reduce the inequality in the U.S. House (and thus the EC) by counting slaves originally enumerated as three-fifths a whole person instead as five-fifths. Comparing the measures of malapportionment using these two sets of data, I determined that

measures that focus only on two units instead of the whole set of units tend to show too small of a reduction in malapportionment from what is expected, and sometimes show an increase.

Summary of chapter two

In chapter two, I begin with Brams and Kilgour's (2017) insight about the setup power of noncompetitive states. They propose three measures of advantage a party might have by having secured support non-competitive states. My focus is on one of their measures, *Winningness,* which is highly predictive of electoral outcomes in presidential elections. I further show that a new measure - what I call *Non-Competitive Advantage* – defined as the difference between one party's Electors in noncompetitive states and the other major party's noncompetitive Electors (normalized by the total number of Electors) is both simpler and more predictive of election outcomes. This measure is based on the intuitions of conditional probability, specifically of winning the Electoral College. That is, the probability that a party wins the election when they have $k\%$ of the Electors wrapped up before the election. When a party is far ahead in the number of safe Electors, they have many more paths to victory than their opponent. This becomes a powerful insight for forecasting elections. Campaigns have a general sense of which states they are likely to win. They can then assess how likely they are to be successful conditional on how many additional states, the battlegrounds, they will need to win. It additionally shapes which of the battlegrounds they should allocate campaign resources. Having a *Non-Competitive Advantage* means that a campaign needs to win in fewer competitive states to win a majority of all Electors.

This insight becomes increasing relevant when one takes a longer view of the campaign beyond the horse-race. While so much media attention is paid to the final months of a presidential campaign, the political parties are constantly adapting policy positions to make them more competitive in more places. In turn, the incentives of a presidential campaign are shaped by how effectively the party does in persuading votes in non-competitive states. It is important to keep in mind that states do not choose the designation of "battleground", but that is instead a result of the currently political landscape. And although the battleground states seem to be the most important in November, the noncompetitive states continue to be important but in a much different way.

Summary of chapter three

One common (recent) claim is that the Electoral College favors the Democrats. This claim is often made based on recent empirical occurrences of inversions (2000,2016). The Democrats have won the popular vote in four of the past five elections (all but 2004, in which George W. Bush won re-election in a very closely divided election), yet, they have only succeeded in two of those electorally. I addressed this concern in chapter three.

The Electoral College has two distinct features that are believed to contribute to inversions: the two Elector Senate-bonus, and the winner-take-all unit rule. By turning on and off these features using actual election results, I show that these features are either not deterministic of inversions, or in some cases create inversions when one did not happen under the actual Electoral College rules in use now. Indeed, by changing the winner-take-all rule so that each congressional district instead determined the Elector, the inversion rate increased from 4/38

(11%) under the actual rules to 5/16 (31%) when a two-seat bonus exists and 4/16 (25%) when it does not. Only the most proportional of rules, Fractional Proportionality without a two-seat bonus, reduces inversions near zero, but even in this case 1880 continues to be an inversion.

Is the EC biased?

The observation of an inversion in an election is an important indicator of bias, but it is limited by the discrete nature of a single election. We can only observe an election with the actual results. But having only one data-point does not allow for evaluation of uncertainty of bias and statistical significance. If the popular vote winner would have won slightly more votes in specific states, there might have instead been a concordance between the popular vote and the electoral vote. Perhaps the inversion observed was instead a chance event, a flux. It can be expected that any system where votes at one level are aggregated and combined with votes at a second level can result in situations where a majority of the first votes are not enough to win in the second stage. That is, only when the election is held by a national popular vote can we expect zero inversions. However, a national popular vote does not prevent a winning candidate from receiving fewer than 50% of the vote, and minor party candidates can prevent a Condorcet winner from attaining the presidency (Kselman and Niou 2009).

This result is apparent not only in the Electoral College, but in the U.S. House, Senate, in presidential caucuses, and other countries. It certainly would be a cause of alarm if these inversions became more frequent or even regular. Similarly, if the popular votes far exceed those of another party, and that party fails to win, majorities will become frustrated and could serious concern and possible crisis. The experience of the late 1870s into the 1890s provides some

historical relevance on this subject. Elections during this period known as the Gilded Age were extremely close, much like they have been in the 2000s. Likewise, inversions were much more likely. Once the extreme polarization of those times eased and more popular mandates replaced the close elections, inversions were completely eliminated for over 100 years.

There is consensus among academics that it is only in close national elections that divergence is likely (Merrill, 1978; Gelman, Katz, and King, 2002; Miller, 2012). For example, Merrill (1978) estimates that the ''reversal likelihood dies off rapidly to near zero if the winning party receives from 2 to 3 percent more than a majority of the popular vote,'' with similar results in Miller (2012) incorporating more recent data. However, it is also clear that popular vote closeness, while necessary for reversals, is not a sufficient cause. There is further agreement that close elections are now very likely because the country is so polarized and so balanced in partisan terms at the state level. The popular vote margin was lower in 2004 (a non-inversion year) than it was in 2016 (a year with an inversion), and even the elections of 2008 and 2012 were won with a two-party vote share of only 53.7% and 52.0%, respectively.

If inversions are indeed "inevitable", might the fact that two of the past five elections resulting from inversion be a signal that the institution that was at one time functioning well is no longer? The mechanical effects from this dissertation suggest that this is not particularly concerning. The Electoral College has existed and operated in the same way since the passage of the twelfth amendment in the early 1800s. Elections where the popular vote is close give the appearance of electoral breakdown and these effects become more obvious.

The problems in legitimacy caused by the popular vote winner failing to win the presidency are exacerbated by close elections becoming more likely. Indeed, inversions are already certain to be more frequent in the twenty-first century than there were in the twentieth since there were exactly zero inversions in the previous century. In the light of these observations, in conjunction with the fact that Democrats have won the popular vote in every election between 1992 and 2016, with the sole exception of 2004 (which they lost only narrowly), it no surprise that there is a strong push for doing away with the Electoral College now coming from Democrats.

The changing demography of the electorate (the growth of the Hispanic electorate is particularly notable) is seen as making it more likely for the Democratic candidate to be the popular vote winner than the Republican candidate. Without an equal force in making them the EC winner, they are more likely to be the victim of an EC reversal. This is true at least until the point when the Hispanic population, in conjunction with other Democratic constituencies, begin to exceed the voting strength of traditionally Republican groups in states currently safe for Republicans. At that point, Democrats may be seen to be favored in both the popular vote and the Electoral College. Look no further than the state of Texas. Texas is both among the fastest-growing states and one that is rapidly changing in its demographic composition. Evidence of its partisan evolution can be seen in the 2018 U.S. Senate race, where Democratic challenger Beto O'Rourke won 48.7% of the two-party vote against a sitting U.S. Senator. More recently, Joe Biden, the Democratic challenger to incumbent President Donald Trump, has invested for the

first time in Texas, recognizing the opportunity to flip the state.[54] Texas currently has 38 Electors, a number that is expected to increase after the 2020 Census. Had Clinton won Texas, she would have finished with 271 Electors, enough to deliver a victory.

The claim that there was substantial pro-Republican bias in the Electoral College in the 1980s is rebutted by Gelman, Katz, and King (2002) using the stochastic version of uniform swing (Butler 1951; Tufte 1973; Grofman 1983) to determine a votes-seats curve and to then to estimate bias at a fifty percent vote share. They conclude: ''In the 1980s, commentators talked about a Republican "lock"' on the Electoral College, but really what was happening was that Republicans were winning presidential elections by getting many more popular votes than the Democrats.'' Similarly, the fact that, except in reversal years, EC seat share can dramatically exceed popular vote share is not necessarily a sign of bias, but may simply reflect the natural operation of a winner's bonus in winner-take-all politics at the state level in a plurality system (Tufte, 1973; Grofman, 1982). See Figure 1.1 for a time-series plot showing the winner's bonus.

Wegman (2019: 237), for example, asserts that although both Democrats and Republican think a switch to the popular vote will now help Democrats ''waltz to electoral victory every time'' as well as its corollary, ''that the Electoral College is systematically biased in favor of Republicans," both claims "are wrong.'' Throughout the 1970s and 1980s, it was widely accepted that Republicans had an Electoral College "lock" that made it all but impossible for them to lose the White House. The facts seemed to bear this out: between 1968 and 1988, Republicans won

54 NPR, July 14, 2020 - https://www.npr.org/2020/07/14/890753387/with-polls-showing-a-close-race-joe-biden-goes-on-the-airwaves-in-texas

every election but one, in 1976, and even that was a squeaker. Then Bill Clinton won easily in 1992 and 1996, and Barack Obama did the same in 2008 and 2012. Suddenly it was the Democrats who had the built-in advantage: the so-called "blue wall" that couldn't be breached – until, in 2016, it was. (Wegman 2019: 237).

In other words, the notion of potential abrupt reversibility in the directionality of EC partisan bias advantage, e.g., the fact that a Democrat (Clinton) won in a period when it was the Republican party that was believed to be advantaged by the Electoral College, and then the fact that a Republican (Trump) won in a period when it was the Democrat candidate that partisan bias was expected to benefit, create a skepticism that, in future elections in this century, EC reversals will necessarily favor Republicans.

Conclusions

Objections to the mode of electing the president in the United States can come in two forms: (1) it fails to produce majoritarian winners and (2) it is biased against selective groups or individuals. Ultimately the question of interest is 'is this method, the Electoral College, a good system for selecting the best individuals with whom the most people agree best represents them?'. Answers to the first two are empirically based and lack a clear normative statement. The overarching third question is a mix of the empirical and normative sort. I have purposely avoided the normative question. What is best, given endless possibilities? As Voltaire astutely observed ''The perfect is the enemy of the good'' (from La Bégueule, 1772). Critics of the EC often perpetuate the Nirvana Fallacy; that is, they fantasize of a perfect solution. The Nirvana Fallacy involves comparing things that exist with unrealistic things. Attacking any institution as imperfect

is not difficult, since all have flaws. Constructing a better alternative that makes all veto players better off is a near-impossible task; evidence of this can be seen in that the U.S. Constitution has only been amended 26 times -- once overturning another amendment.

Even when addressing empirical flaws like the propensity for inversion or malapportionment, it is legitimate to suggest that even a system that gives the occasional "wrong answer" is still virtuous. However, different ways of measuring these phenomena often give contradictory responses. In an unrelated conversation I had with A Wuffle about equality, he suggested it is most obvious to everyone what about the world is unfair, but it is far harder to determine what is fair. In many ways, our electoral systems suffer from this same perception problem. It is easy to point out that there are different voting power index scores for individuals in different states, or that apportioning based on total population instead of voting-eligible population skews representation towards geographic areas with more non-citizen or states with a lower median age. It is much more difficult to normatively state precisely what combination of governing rules provides for a fair system; fairness, of course, is in the eye of the beholder.

As I write the final words of this dissertation, I feel compelled to write about voting rights. For many, evidence of malapportionment, the increased number of non-majority election outcomes, and cases of voter disenfranchisement through many avenues including partisan gerrymandering represent a democracy lost. I too often feel disheartened about the lack of progress in fulfilling the expectations of the 13th, 14th, and 15th amendments, or that democracy is failing to live up to its promises of life, liberty, and the pursuit of happiness. I hope this dissertation provides some evidence that even if things seem bad, by historical perspective they

are at a minimum no worse, and in most ways better. I am reminded of John Lewis's signature phrase "make good trouble" and think about how hard many have fought to have the rights we currently enjoy. Though flawed, American democracy is a proud tradition with many virtues. For its many problems, solutions are within the ability of the next generation to transcend. I am optimistic that the American political institutions are resilient, and though crafted imperfectly, are far better than many of the alternatives.

I began by invoking the infamous language of the constitution as it was initially written counting slaves as only three-fifths of a person. I had to pause the final paragraphs of this conclusion to write about President Trump's executive action to change the population base for apportionment to exclude certain persons, which for many harkens back to the repugnant compromise at the founding. Trump's memo would effectively reduce the share of the total population in the nation by an amount equal to the number of immigrants that live in the U.S. but do not have legal paperwork, something that has no historical precedent. Under the three-fifth's clause, slaves too were treated as not worthy of formal representation.

There is a lack of an affirmative right to vote in the constitution. The Supreme Court has defanged the Department of Justice their authority to provide oversight on historically discriminatory jurisdictions. States have enacted policies cloaked as a reform that adds burdens to voting. And while some states are making it more difficult to vote, others are expanding early voting and reducing barriers. Yet, the franchise has been extended to more individuals than at any time in the nation's history, including the decedents of slaves, women, and those between the ages of 18 and 21. As I've shown in this dissertation, save for the U.S. Senate, votes are

effectuated with vast equality, allowing each voter to have a nearly equal ability to contribute to the election of the candidate of their choice.

There are some reasons to believe that the Electoral College may be broken, delivering results in contradiction to the plurality (though never the majority). It is true that malapportionment in the U.S. Senate, and thus the Electoral College, could conceivably get worse, making it more difficult for some people to elect their candidate of choice. But it is also true that the system has some self-correcting features, such as regular apportionment that transfers Electors from slow-growing or shrinking states to faster-growing states. And as has been shown, even when there is a perception that the Electoral College favors one of the parties, candidates from the opposition party have had success. I have also shown that inversions are not strictly a result of the two-seat Senate bonus and eliminating the winner-take-all unit rule would not eliminate inversions. Indeed, some reforms could make the frequency of inversions increase.

Demography and geography are not destiny. Politics are dynamic. Political parties adopt strategies to be competitive within the structural system as designed. This has historically led to a stable two-party system of government. In times of polarization between the two parties, political institutions appear to be broken more often than when one party is dominating our politics. This is unsurprising but leads to more "sore-losers" — those who do not accept the outcome of fair elections under commonly held rules because they worked against their candidates or policies. We need to be careful to differentiate between broken systems, which I define as ones that reduce the ability, under democratic norms, to enact majority policies, and systems that are working in the correct ways but have outcomes that are perceived as being

broken. While imperfect, the constitution has always only promised to create a “more perfect union”. It is our burden to continue making the Union more perfect.

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Appendix A

How analyses would change if the definition of noncompetitive changed

Brams and Kilgour (2017: 110-111) discuss their choice of the domain of competitiveness as ±3% of two-party vote. One justification is that this range is close to the usual margin of error in state polls. A second justification for this choice of range is a pragmatic one: there are computability issues in that, when we expand the range of competition, we have many more combinations to analyze. But there is also a good theoretical reason to favor this choice: for this range, the assumption they use that all states in this range had an a priori equal probability of being won by either party seems plausible. Nonetheless, it is useful to consider the robustness of their measures to alternative specifications of the range used to define a competitive seat. In Table 0.1, for the four elections they consider, and for 2016, I show the comparisons between the values they derive for a ±3% definition and the more conventional ±5% definition of a competitive state.

TABLE 0.1 COMPARISONS OF RESULTS FOR THE WINNINGNESS, VULNERABILITY, AND FRAGILITY VARIABLES FOR THE REPUBLICANS FOR A ±3% AND A ±5% DEFINITION OF COMPETITIVE STATE: 2000-2016

Year	Competitive States (ECvotes)		Winningness (Ratio)		Vulnerability (Ratio)		Fragility (Ratio)	
	±3	±5	±3	±5	±3	±5	±3	±5
2000	16 (178)	21 (221)	1.71	0.5	0.76	1.47	0.59	2
2004	12 (142)	20 (209)	2.64	2.9	0.61	0.55	0.38	0.35
2008	7 (102)	15 (159)	0	0		125.92		1187.27
2012	8 (114)	15 (193)	0.24	0.35	2.09	1.85	4.22	2.83

2016	12 (163)	16 (224)	1.03	0.31	0.99	1.89	0.97	3.22

Note: All ratios are REP over DEM, therefore when the ratio is 1, both candidates have the same numbe of winning coalitions among the competitive states.

Changing the states that are considered non-competitive changes the number of seats from the competitive states a party needs to win the election. In the parlance of voting power literature, we might say such changes in the definition of competitive state changes the "effective" quota, i.e., the number of competitive EC seats a candidate needs to win above and beyond expected wins in "safe" seats (Banzhaf 1968). However, increasing the number of states defined as competitive does not give rise to an expectation of a monotonic change in the three Brams and Kilgour variables. It is possible that the set of new states are more (less) vulnerable or more (less) fragile than those previously included. Also, if a large state is just outside the competitive range under the narrow definition, but is now competitive under the less restrictive definition, it could increase the number of coalitions that are wins for the disfavored party, but not change anything for the leading party's candidate.

From Table 0.1, we see that in some cases the changes in other variables are small, even though the number of competitive states may have changed considerably, while in other cases the differences when we change the definition of competitive state are quite large.

For example, in 2016, when we switch from a ±3% definition of competitive to a ±5% definition of competitive, the election previously characterized as very close now is seen as less close. Using Brams and Kilgour's definition of competitive, Donald Trump had a one seat EC lead in non-competitive states, and by virtue of winning the majority of the competitive EC seats,

won the election. Using the more traditional ±5% definition of a competitive seat, Clinton would have had a 50 EC seat starting advantage, having 182 safe EC seats to Trump's 132. Shifting the definition of competitive state, *Winningness* would now have predicted a Clinton victory and, given the size of the *Winningness* score (0.77), she would be predicted to win by a large margin. Hillary Clinton won the popular vote by over 3 million votes, but still lost the Electoral College.

Even though the number of competitive states increases by just three in 2016, as judged by *Winningness*, the Republican candidate goes from a slight favorite to a big underdog! In the states that finished with the winning candidate garnering less than 53% of the vote, if results were determined simply by flipping a fair coin, Trump would have been expected to have won 3% more of the feasible coalitions than Clinton. In contrast, if we shift our definition of competitive state to ±5%, Clinton would have instead been expected to won 3.3 times more coalitions under the same equiprobability assumption.

A similar dramatic shift in estimated win probabilities occurs in 2000. Bush had a slight advantage in competitive states using the Brams and Kilgour definition of competitive state, but he had many fewer outlets to victory under the broader ±5% definition.

2004 and 2012 offer a different kind of result. Although the number of states counted as competitive drastically increases in both years when we change the definition of a non-competitive state, changes in results are minimal. The Republican candidates in each of these elections gain a slightly higher percentage of winning coalitions, while in both cases decreasing their *Vulnerability* and *Fragility* among those coalitions.

Finally, let me turn to 2008. Whereas Obama had enough EC seats in the non-competitive states in 2008 using the plus or minus 3% definition, he was twelve seats shy of victory using the less restrictive plus or minus 5% definition Few would, at the time, have believed that the outcome was certain. McCain did not; he raised and spent over $300 million dollars in his quest for the presidency, though considerably outspent by Obama. McCain raised $368 million to Obama's $730 million.[55] Obama remained the favorite even when we expand the definition of competitive states. Under the former definition, Obama's quota is effectively zero in the competitive states, while under the latter definition it becomes twelve. Since the number of non-competitive states decreased in 2008 by changing the definition, the number of competitive ones increased from 102 to 159. Nonetheless, in 2008, Obama remains far enough ahead in non-competitive states that McCain would be predicted to have had virtually no chance of victory. McCain wins 22 of the coalitions out of 32,768 using ±5% definition of a competitive state -- a percentage low enough to round to zero.

What seems to be most important is that, in both 2000 and 2016, years in which the popular vote and the Electoral College diverge, when we change the definition of competitive state to ±5%, the candidate with the higher *Winningness* is no longer the winning candidate This reduced predictive power for the ±5% definition provides us with further justification for the choice made in the text to retain the Brams and Kilgour ±3% definition of what constitutes a competitive state.

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[55] http://www.opensecrets.org/pres08/}

The definition of competitive state also changes the various regression results mentioned in the text, but the results are not especially interesting. The changes are minor and parallel the insights we gain from analyzing results in Table 2.4, namely that going from a ±3% definition of competitive seat to a ±5% definition of competitive seat reduces the predictive accuracy of *Winningness*. See Table 0.1.

This shift in the definition of what constitute a competitive state also reduces the predictive power of the *Non-Competitive Advantage* variable, but not substantially. For example, using the ±5% definition of competitive, the Non-Competitive Advantage bivariate regression has an R^2 of 0.92, as compared to 0.96 for the B-K definition. Moreover, it does not affect the relative predictive power of *Winningness* and *Non-Competitive Advantage*; the latter still does better at predicting seat share, while both apparently do equally well at predicting EC outcomes treated dichotomously. \footnote{Using the ±5% classification of competitive state, Non-Competitive Advantage accurately predicts 33/38 elections (the errors are the 1880 and 1960 elections -- ones that are also mispredicted when using the ±3% competitive definition -- and the 1888, 1960, and 2016 elections); while *Winningness* incorrectly predicts between 4 and 6 elections using the ±5% classification. The reason for the "uncertainty" about the predictive power of the *Winningness* variable is that due to computational difficulties in calculating results across 2^k coalitions when k is large, we were unable to provide *Winningness* calculations for the ±5% definition of competitive seats for two years: 1960 (a year that *Non-Competitive Advantage* incorrectly predicts) and for 1976.

Along with checking the robustness of defining competitiveness as ±3% by increasing the threshold to ±5%, we might also move it downward to ±1.5. Doing so naturally limits the number of competitive states, increases the number of non-competitive states, and highlights how well the measure can predict in the most marginal of cases. I have conducted a robustness check by changing the definition of competitive downward so the largest margin of victory for a competitive state is now 3%. As expected, the number of battleground states decrease when we do that. When competitiveness is defined by a margin of victory that is ±5%, there are an average of 16.3 states that are competitive. When it is ±3%, there are 10.9 battlegrounds on average. When it is ±1.5, the average number of battlegrounds falls to 6, and in two years there are zero battlegrounds[56] (1924, 1972) and in two others just one (1920,1936). As the definition of competitive is constrained closer to 0, very few states will be considered battleground, and the ability to predict should increase towards 100%.

In twenty-four out of thirty-six elections, *Winningness* perfectly predicts the election, as it does in Brams and Kilgour original essay in 2008. As stated in the text, *Non-Competitive Advantage* can be measured in all elections. As was the case in other variants of competitiveness, a definition of ±1.5 yields a success rate of 36/38 elections. This time, 1960 and 1884 are not correctly predicted. When I unpack the information in the competitive states in 1884, the closest of the competitive set was New York, which had 36 EC votes and was the largest state in terms

[56] When there are no battlegrounds, the non-competitiveness measure will, of course, perfectly predict results since every state which gave a plurality to the Democratic candidate will be assigned those EC votes, and likewise for the Republican candidate.

of population. Moreover, the Democratic candidate won five of the six competitive states, securing the victory. The Non-Competitive Advantage was quite small, suggesting that slight changes in vote shares would have led the measure to accurately predict the election. The same can be said in 1960, but unlike 1884, 16 states were still competitive even when restricting competitiveness to ±1.5. In sum, this robustness check simply reinforces the previous results.