(Electoral) College Miseducation

How Electoral Reform Will Not Prevent Electoral Inversions (1868–2016)

Abstract We offer a typology of possible reforms to the Electoral College in terms 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 us to classify four major variants of "reform" to the present Electoral College in a parsimonious fashion. Many of the proposals we consider have been proposed, some debated in Congress, and they include the we view as most likely to be taken seriously. We evaluate these proposals solely in terms of one simple criterion: "Would they be expected to reduce the likelihood of inversions between EC and popular vote outcomes?" We answer this question by looking at the data on actual presidential election outcomes at the state level over the entire period 1868–2016, and at the congressional district level over the period 1956–2016. We consider the implications for presidential outcomes of these different alternative mechanisms, in comparison to the actual electoral outcome and the popular vote outcome. In addition, we examine the implications of a proposal to increase the size of the U.S. House (Ladewig et al., 2008). Our results show that inversions from the popular vote happen under all proposed alternatives at nearly the same rate as under the current Electoral College rules, with some proposals actually making inversions more frequent. The major difference between the present EC rule and alternative rules is NOT in frequency of inversions, but it is in which particular years the inversions occur. As for the proposal to increase the size of the House, we show that any realistic increase in House size would have made no difference for the 2016 outcome. **Word Count: 5550**

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"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

1 INTRODUCTION

THE Electoral College we know today is not the one envisioned by the founders. The founders believed its function would be to nominate candidates, from which the House of Representatives would select. Today, *electors* are pledged in advance to particular candidates and *Electors* very rarely diverge from their pledged support, and they never have done so in a way that has proved consequential (Longley & Peirce, 1999, pg. 23-24). Moreover, outcomes are decided by the first stage of the process, in the Electoral College itself, and only once has the responsibility for choosing the president shifted to the second runoff stage that involves a congressional vote. [1] As eminent scholar Robert Dahl noted, "the elaborate machinery of the electoral college [became] little more than a way of counting votes" (2003). Nonetheless, despite these differences in how the Electoral College 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 – though now there are two states, Maine and Nebraska, where the winner take-all feature operates at the level of congressional districts, with only the two "federal" seats allocated on the basis of the state-wide outcome. [2]

In *Federalist, no. 68*, Alexander Hamilton opined about the Electoral College, "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 Electoral College is not perfect. [3] The claim that it is "excellent" would be met with far more suspicion. In the U.S., after each presidential election, especially those where popular and Electoral College vote diverged, [4] or a third-party candidacy threatens to undermine the idea that a president should represent a clear majority, proposals to abolish/replace the Electoral College (EC) are common. Indeed, the EC

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[1] In 1824, John Quincy Adams became the only president to not receive a majority (a requirement for winning in the first stage) of the Electoral College votes. The vote was splintered among multiple factions, with no candidate receiving the necessary plurality. In the election of 1876, where 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 Electoral College. The award to him of 20 disputed electoral college votes gave him a one elector victory in the EC even though he was not the popular vote winner.

[2] 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.

[3] Other than the U.S., there are no presidential democracies currently using an Electoral College to elect their president. Argentina and Bolivia once had electoral colleges (personal communication, Matthew Shugart, February 2018). Many presidential democracies elect have a runoff procedure to select a president in a multi-candidate 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, e.g., Denmark.

[4] "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, 2012).

is the provision of the U.S. Constitution that has most often had changes proposed to it (Longley & Braun, 1972, pg. 42–43; Hardaway, 1994; Longley & Peirce, 1999, pg. 133). The academic literature is also full of attacks on the Electoral College (see e.g., Edwards, 2011; Finkelman, 2002; Dahl, 2003; Bennett, 2006; Abbott & Levine, 1991. c.f., Bickel (1968) warned against sudden structural reforms, though he ultimately supported reforming the EC), though it does have a few defenders (see e.g., Best, 1975; Diamond, 1977; Hardaway, 1994; Polsby et al., 2012, pg. 237; 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 Electoral College have proved unavailing. [5]

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 above, see also Bowler et al., 2006). Second, large states think that they benefit from the Electoral College because the winner-take-all rule makes their state more likely to be pivotal (Banzhaf III, 1968), while small states think they benefit from the Electoral College because of the two seat Senate "bonus". [6] Third, public opinion is closely divided (with a strong partisan split). [7] Fourth, as noted above, the academic and journalistic community has its skeptics about electoral college reform, with those in opposition to change noting, among other things, that proposed remedies have unknown qualities and are unlikely to cure problems such as a campaign focus on the larger states, and may bring new problems with them, e.g. 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 & Schwartz, 2016, see also Grofman & Feld, 2005). Fifth, there is little innovation by way of unique ideas for reform (Longley & Braun, 1972), and it's far from clear to what constituency a reformer would be trying to persuade. [8] Finally, after an election, attention quickly shifts to other more pressing issues and Electoral College reform goes off the political agenda. [9]

There are many complaints about the Electoral College, such as the claim that virtually all presidential campaign activity is focused on a very limited number of battleground states in a way that affects turnout

[5] "Since the Electoral College process is part of the original design of 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, https://www.archives.gov/federal-register/electoral-college/faq.html

[6] Both sides are right (Longley & Peirce, 1999, pg. 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 III, 1965) or the Shapley-Shubik value (Shapley & Shubik, 1954; see also Mann & Shapley, 1960) 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 et al., 2012; cf. discussion in Grofman & Feld, 2005; Strömberg, 2008).

[7] In nearly every poll in the Roper Center for Public Opinion Research iPOLL data bank, the public is split about eliminating the Electoral Colleges, especially along partisan lines, albeit with majorities favoring a change to popular vote. After the bitterly fought 2000 election, 41% of Republicans would have amended the Constitution while 75% of Democratic respondents would have liked to see a change, with an overall support for change of 59% and with 3% of those polled with no opinion (Cable News Network, USA Today. Methodology: Conducted by Gallup Organization, December 15 - December 17, 2000. [USGALLUP.00DC15.R28]). After the even more bitterly fought 2016 election, Gallup asked again about the Electoral College, this time 49% choose the option to amend the Constitution (Gallup Poll 2016 [USGALLUP.120216.R01]. November 28-29, 2016). Again, there was a strong partisan split. Republican support of the current system significantly increased after the election. Gallup found that only 19% of Republican or leaning Republicans favor a system where the winner is the candidate that wins the popular vote (compared to 81% of their Democratic counterparts). In 2011, the numbers were 54% and 69%, respectably, who favored amended the Electoral College to a popular vote system. (http://www.gallup.com/poll/198917/americans-support-electoral-college-rises-sharply.aspx) Aldrich et al. (2014) have modeled the circumstances where we might expect changes in preferences about the desirability of the Electoral College.

[8] "In reviewing the history of the Electoral College, it quickly becomes clear how little 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).

[9] 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 this data is displayed in Figure 1 in Appendix B.

and interest in politics in a negative ways; and there are always renewed fears about wayward electors, [10] however, we believe it fair to say that far and away the single most important criticism of the Electoral College is that it does not guarantee the election of the national popular vote winner. [11] We also recognize that a direct popular vote election for the presidency also has its critics (Gringer, 2008; Best, 1975). 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. [12] The Electoral College delivers decisive victories, [13] while 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. Another issue is based on the expectation that a national popular vote would dramatically increase the incentives for candidate proliferation.

While we recognize that there are many dimensions along which the Electoral College and proposed alternatives to it could be evaluated, both in normative and empirical terms, here we evaluate nine key alternative proposals, and the 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?" This criterion serves double duty as both a normative standard and a question to be answered empirically. We answer the empirical question by looking at the data on actual presidential election outcomes at the state level [14] 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. [15] We deliberately eschew seeking to address the normative issues, since this topic is well plowed ground in the previous EC literature. [16] There are a number of books and articles comparing the present Electoral College rules to proposed alternatives, but none of which we are aware that both use a time series going back to 1868 and includes the 2016 election, and none that empirically evaluate as many alternatives to the present EC rules as are considered here (see e.g., Longley & Braun (1972); Hardaway (1994); Grofman & Feld (2005); Polsby et al. (2012); Koza et al. (2013); cf. Barthélémy, Martin & Piggins (2014), whom we consider the most thoughtful and detailed empirical analysis most closely resembling this paper's analysis). Moreover, many studies only write about the Electoral College in normative, legal, and theoretical terms, or discuss the prospects for change, and provide no attempt at empirically estimating how a particular change in rule would have affected past voting outcomes (Wilmerding Jr., 1958; Bickel, 1968; Glennon, 1992).

The goal of this paper is to examine possible reforms to the Electoral College 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 which have actually previously been debated in Congress. In addition, we examine the implications of a

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[10] "The people know the candidates of President and Vice President; rarely do they know the identity of the electors for whom they actually 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 The Electoral College Primer 2000, Longley & Peirce (1999, pg. 110).

[11] For issues of problematicity of the meaning of "popular vote winner", see Gaines (2001).

[12] The last seven elections have been decided by under five percentage points.

[13] The Electoral College 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% of the state's electoral slate. By definition, Electoral College victories are always over 50%, while popular votes have been as low as 38% (in 1860). No president has won with a smaller percentage of the Electoral College then popular votes.

[14] The District of Columbia received three seats after the passage of the Twenty-Third Amendment in 1961.

[15] Of course we recognize that candidates will adapt strategies to the rules in use, but we still believe it a worthwhile exercise to examine how the previous voting patterns would have affected outcomes under different electoral college formulae.

[16] In reading the literature and in presentation of our results at conferences and colloquia, it is clear that 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.

proposal to increase the size of the U.S. House (Ladewig et al., 2008). Quite to our surprise, our 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 Electoral College rules, with some proposals actually making inversions more frequent. The major difference between the present EC rule and alternative rules is NOT in frequency of inversions, but it is in which particular years they occur. As for the proposal to increase the size of the House, we show that any realistic increase in House size would have made no difference for the 2016 outcome.

We utilize only the Democratic and Republican two-party vote shares in looking at outcomes under different electoral college formulae. We make the choice of two-party vote despite the fact that third-party candidacies sometimes represent a large proportion of the total vote, such as in 1968, when the leading popular vote getter, Richard Nixon, won just 43.42% of the total votes. [17] The effects of third party candidacies on electoral outcomes is certainly worth further investigation but is beyond the scope of the present essay. Moreover, we expect 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 Electoral College we consider here. Of course we recognize that candidates will adapt strategies to the rules in use, and that choice of rules may affect candidate entry decisions, [18] but we still believe it 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, we must interpret the results, such as shown in Table 2 later in the text, as *ceteris paribus* ones. [19]

2 Proposals for Electoral College Reform

The Electoral College is often thought of as having two undesirable design features. [20] The first of these is the allocation of Electoral College 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 Electoral College votes are allocated to each state, with objections to the two-state federal bonus as generating malapportionment, and thus overweighting or underweighting certain states. Many critics of the Electoral College would be satisfied only if both features were eliminated and the Electoral College 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 Electoral College reform has been centered on the state compact to bind electors to vote for the national popular vote winner, [21] many other more limited proposals for

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[17] That is, nearly 14% of the vote went to candidates who did not finish in the top two. If we had a good way of determining the preferences of voters for these other candidates had only the two mainstream candidates been on the ballot, we might find that Hubert Humphrey might have led in the popular vote. George Wallace's independent campaign drew support primarily from the south, capturing 46 electoral votes from five southern states. 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 Electoral College.

[18] Speaking about the third-party candidacy of Ross Perot in 1992, Bill Clinton strategist James Carville said it was "the single most expensive act of masturbation in the history of the world." As quoted in the Los Angeles Times: https://lat.ms/2L1dwPD We thank Joshua Zingher for this reference on twitter.

[19] In the same tweet in which President Trump said that the Electoral College 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 Electoral College. 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, pg. 75) has called the popular vote a "nebulous quantity".

[20] Longley & Braun (1972, pg. 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 our simulations we don't address. The remaining two are those that we consider in this paper.

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

changing the EC have been proposed. [22] These include replacing the present EC either with an election based on winning the national vote (though usually with a runoff rule if the plurality victory margin is not that large), or replacing it with a scheme that makes the EC allocation to the candidates in each state more proportional to each candidate's share of the statewide vote. Because there have been many different alternatives proposed, [23] we want a simple and parsimonious means to classify proposed reforms. We do so by focusing on the two key structural feature of the present Electoral College identified above: seat allocations that are not directly proportional to population and winner-take-all outcomes at the state level. However, we do not include in our set the proposal to bind 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. We also do not include 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 for us to reliably estimate the implications of their use in past elections.

While this simple classification lend itself naturally to a 2 x 2 format, [24] there are variants within each element that we wish to take into account, such as keeping the winner-take-all feature, but applying it at the level of congressional districts. Similarly, when we consider ways to make Electoral College results more proportional, we need to distinguish between allocations based on House seat share and allocations based strictly on population. [25] Additionally, we offer two types of proportional representation, one that allows for fractional shares of electoral college seats, the other awarding only whole seats. The whole-number proportionality rule used is the same that is used for apportionment of the House of Representative, namely the method of equal proportions. Though not usually called so, the direct national popular vote is the most pure form of proportional representation. It creates an electoral college the size of the electorate (with the exception of needing a majority, as a simple plurality would suffice), but is also winner-take-all, which makes it appear as non-proportional. [26] Only whole electors are allocated, which allows for the continued physical meeting of electors in December at their representative state legislatures. [27] What we end up with are ten variants. Using this simple classification scheme allows us to capture almost all the reforms that have been or are likely to be taken seriously, including those which have actually previously been debated in Congress.In toto, we offer three alternatives where the state-level unit-rule is maintained and seven alternatives where the unit-rule is eliminated. These ten total alternates include five which keep the state-wide two-seat bonus, five that eliminate the bonus, and two that eliminate electors altogether. We provide in Appendix B a section which reallocates the number of Electors based on the ideal size of the US House, namely one based on the cube root of the population. Table 1 identifies each of our ten variants,including the current EC and popular vote percentages, with

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[22] By some estimates, over 700 attempts to change or abolish the Electoral College have been advocated or proposed (Hardaway, 1994). Most of these proposals are simply rehashing previously failed attempts (Schwarz, 2000).

[23] Proposals range from reasonable to absurd. CITE writes about a proposal in XXXX that would have XXXX XXXX. Most proposals are written for political expediency (Bowler et al., 2006), such as the Democrats pushing for a Direct Vote in the 2000's because it's 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've only won the Electoral College twice (in 2008 and 2012).

[24] 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

[25] For states that enter the Union after a Census has been taken but are still allocated Electoral College seats, we take the population in the subsequent Census.

[26] The US Census has used this method since 1940. For more details see 2 U.S.C § 2a (1941), https://bit.ly/2vwdHwC

[27] We recognize that there are many different formulas that can be used to allocate seats, and that the differences might, in the words of Gallagher (1991, pg. 33), might "produce significantly different seat allocations for a given distribution of votes…" Similarly, Gaines & Jenkins (2009) observe that when the direct vote is particularly close, choice of apportionment method might be determinative (see esp. Balinski & Young, 1982, for a full treatment of divisor methods). Gallagher (1991) observes that "each PR method minimizes disproportionality according to its own principles". For the purposes of this essay, we only look at the alternative results based on the apportionment currently used by the US Census for determining Electoral College seats.

their structural features identified. We provide in an Appendix B a more technical description of each of these options in mathematical notation.

TABLE 1 ABOUT HERE

Table 2 shows actual popular vote and EC vote shares and also simulated seat share under each of our ten Electoral College variants. Cells that are in bold show inversion years.

TABLE 2 ABOUT HERE

There are number of interesting results shown in Table 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 Column 2 and Column 3 of Table 2, in only three elections in American history has the two-seat bonus feature of the Electoral College been decisive in reversing an election result. The first time this happened was in 1876 when the two-seat bonus benefited the Republican candidate, [28] then again in 1916 when it benefited the Democratic candidate, and finally again in 2000 when it benefited the Republican candidate. However, we would also observe that the over 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 2's first two columns reveals several instances where a *reversal* <u>almost</u> happened. In most of these instances, the Democratic candidate came out on top, e.g., 1960. [29]

Second, while proportionality variants of EC allocations clearly can dramatically change the magnitude of seats outcomes relative to votes outcomes, it is only in the period from 1880 to 1900 that we see repeated 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, we note that 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 Electoral College. 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 & 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. [30] In 1960, 1976, and 2012, [31] for example, the outcomes would have been reversed (all three times benefiting the Republican candidate) if we allocated based on the results *within* Congressional Districts plus the plurality state winner getting two bonus seats. 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).

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[28] 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.

[29] 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 those votes were counted, perhaps made him a reversal president.

[30] Blatant partisan gerrymandering was made more likely by the Supreme Court's consistent refusal to reign in this practice. (McGann et al., 2016).

[31] There is an especially large difference when allocating by Congressional District in 2012, due in no small part by 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).

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

An EC Based on an Expanded US House

Now we turn to the last structural variation on the present Electoral College rules that we consider. Ladewig et al. (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. [32] The cube root of the US population in 2010 was $\sqrt[3]{309,785,186} = 676$. Using this House size, a congressional seat's average size would be just 458,262 people. [33] As it turns out, this would have insured 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 Electoral College malapportionment and outcome effects change if we increased the size of the House to make the allocation rule in that body more nearly proportional to the population of the state by using the cube root of population to determine House size?

One way in which House size could become determinative is when a reversal actually 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 Electoral College. Recalculating the 2016 election for a House size of 676 (but now excluding the two bonus seats for each senator) yields Donald Trump 380 out of the 676 electors (56.2%). Again, as with the current Electoral College 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 seats, the EC is also larger. Since Trump won 306 out of 538 (56.8%) 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). In Appendix Appendix B, we also include a table that compares the Popular Vote and Electoral College under present apportionment with those using the Cube Root Rule of assembly size for the entire time period of our study. In the year 1912, the cube root EC size is actually larger than the actual EC size. [34] 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 Electoral College, a result previously pointed out by Neubauer & 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, thus reducing inversions by two. [35]

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[32] 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 U.S. in the last 100 or so years being one of the most notable exceptions.

[33] In addition to the work of Ladewig et al. (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 & Zeitlin (2003); Barthélémy et al. (2014); Miller (2014)).

[34] In that Appendix, we also provide comparisons to cube root results for the Electoral College 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 we cannot know the partisan composition of a House Delegation that has never existed, and the Popular Vote rules would be the same regardless of the House size.

[35] The effect in 1876 is hard to assess given the log-rolling 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.

3 DISCUSSION

Using election results from the period 1868 to 2016, we have constructed a total of fourteen counterfactual variants on the Electoral College for the purpose of comparing the actual EC results 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 relative small number of inversions as vindication for the founders (Hardaway, 1994). If we look at modifications to the Electoral College such as eliminating the two-state bonus, allowing for a more proportional distribution of electors, or switching to House district based outcomes, we discover that at best they 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 electoral college 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. We also considered the implications of a proposal by Ladewig et al. (2008) to increase the size of the House (and thus of the Electoral College) by picking a House size that was proportional to the cube root of population. Here we found that 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 Electoral College has proved a robust institution that usually produces clear victories which 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 on the basis of statehood has been shown in this essay to be generally non-determinative of election outcomes.

Reformers should also acknowledge that the Electoral College "wrong winner" is no less legitimate then any legislation passed by Senators representing a minority of the population, 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. [36] As if that were not enough reason to be skeptical about the insistence on majoritarianism in the Electoral College, in the process by which the Electoral College 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. [37] 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 constitute a constitutional change. Additionally, when it comes to state ratification, state legislatures are often so severely gerrymandered that a majority of voters fails 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 sum to just 38.4% of the total population. [38] While it is clear that 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 US Constitution.

Without informed examination, one might assume the EC to be an archaic institution that does more harm than good. Though not perfect, a fact that the framers were perfectly aware of, nor are alternative

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[36] Reformers who demand majoritarian winners as normative doctrine of democracy should look no further than the multi-party coalition governments common in 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.

[37] As of the 2010 census, the lowest population two-thirds states represented just 30% of the total population. Conversely, 34 senators from the seventeen smallest states with a total population of 21,031,314 (6.8%) could block any amendment.

[38] Again conversely, thirteen state legislatures from the smallest population states could prevent ratification with a total population of 12,562,969 (4.1%).

setups. At best the adaptations result in similar outcomes, and at worse could lead to severe constitutional crises. Changes that would eliminate winner-take-all and move to district unit rules would almost definitely lead to political maneuvering and even more extreme gerrymandering, and almost certainly would result in more instances of electoral inversion. All in all, it is in our opinion that making changes to the system of electing the president should be looked at in the most skeptical terms given the little amount of potential good and the great uncertainty in terms of unintended consequences.

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Table 1 Variants of Electoral College Reform

#	Name	Two-Seat Bonus	Unit Rule	Number of Inversions
1	EC	√	√	4
2	EC without bonus		√	3
3	State-Unit Population Proportionality		√	3
4	Whole-Number Proportionality with 2 seat-bonus	√		2
5	Whole-Number Proportionality without 2 seat-bonus			3
6	Fractional Proportionality with 2 seat-bonus	√		3
7	Fractional Proportionality without 2 seat-bonus			1
8	District-Rule with 2 seat-bonus	√	√[+]	5[*]
9	District-Rule without 2 seat-bonus		√[+]	5[*]
10	Direct Popular Vote			–

[+] District-level Winner-Take-All Rule

[*] 31.25% of elections we have data for, compared to the 10.5% of the 38 elections in this studies for the actual EC.

Table 2 Concordance of Popular Vote with Winner in Ten Variants of the Electoral College

Year	Popular Vote	Electoral College	Electoral College without Two Seat	Population Weighted State Unit	Whole Number Proportionality with Two Seat	Whole Number Proportionality without Two Seat	Fractional Proportionality with Two Seat	Fractional Proportionality without Two Seat	District Specific with Two Seat	District Specific without Two Seat
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%	37.531%	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%

Appendix A – Cube Root Adjusted Electoral College

This appendix provides the simulations for an Electoral College anda number of alternatives by adjusting the total number of electors such that the US House portion is equal to the cube-root of the population. As the size of the House increases, disproportionality is reduced. We provide data for the five alternatives that lend themselves to such analyses. Just like the alternatives in the main text of this article, 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% and produce and inversion. We see this as rather redeeming to the Electoral College as currently constructed, because *only* in very close elections is there a legitimate probability of reversal. We also 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. [1]

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[1] Population growth and differences in migration patterns throughout a decade lead to sub-optimal appropriation, which is most significant in the election preceding a new census.

Table A.1 Cube Root Adjusted Electoral College

Year	Apportionment	Popular Vote	Electoral College	Cube Root Electoral College	Cube Root Whole Number Proportionality with Two Seat	Cube Root Whole Number Proportionality without Two Seat	Cube Root Fractional Proportionality with Two Seat	Cube Root Fractional Proportionality without Two Seat
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%

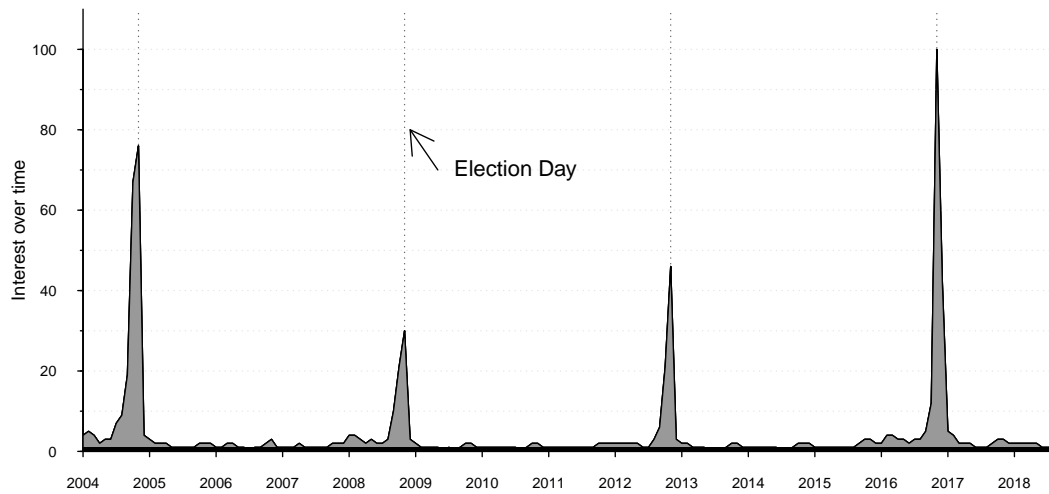**Appendix B – Electoral College Google Trends**

Fig. 1 Electoral College term search Google Trends

Note: "Numbers represent search interest relative to the highest point on the chart for the given region and time. A value of 100 is the peak popularity for the term. A value of 50 means that the term is half as popular. A score of 0 means there was not enough data for this term." – *Google Trends*

The term was at it's peak search in the days following the 2016 election (an inversion).

Appendix C – Formal Definition of the Ten Electoral College Variants Being Compared

We begin with some notation to elucidate how we will measure these Electoral College alternatives. We are interested in all elections since 1868, $Y\{1868, 1869, \ldots y, 2016\}$. 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 (1) is simply,
Popular Vote =

$$\frac{\sum DemVotes_{ys}}{\sum (DemVotes_y + RepVotes_y)} \tag{1}$$

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 (2), assuming unit-rule for all states, is determined by the following equation,

EC =

$$\frac{\sum Electors_{ys} \times [(1 \times DemVotes_{ys} > RepVotes_{ys}) + (0 \times RepVotes_{ys} > DemVotes_{ys})]}{\sum Electors_y} \tag{2}$$

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, i.e., an electoral college with the two seat Senate bonus removed. We refer to it as a Electoral College without 2-seat bonus. [1] The equation is the same as the Electoral College (2), 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 (3). 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.

State-Unit Population Proportionality =

$$\frac{\frac{Population_{ys}}{\sum Population_{ys}} \times \left(\begin{array}{ccc} 1 & \times & (DemVotes_{ys} > RepVotes_{ys}) \\ + 0 & \times & (RepVotes_{ys} > DemVotes_{ys}) \end{array} \right)}{\sum Population_y} \tag{3}$$

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 essay, we 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

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[1] 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.

(4) for both the Electoral College and House delegation sizes are given by the following series of equations:

$$n = \sum US\ House\ Seats$$
$$seat = \{1, 2, \ldots, seat_n\}$$
$$Quota_{ys} = \frac{1}{\sqrt{seat_n \times (seat_n - 1)}}$$

Priority Number =

$$\left\{ \begin{array}{cccc} Quota_1 \times DemVotes_{ys}; & Quota_2 \times DemVotes_{ys}; & \ldots & ; & Quota_n \times DemVotes_{ys} \\ Quota_1 \times RepVotes_{ys}; & Quota_2 \times RepVotes_{ys}; & \ldots & ; & Quota_n \times RepVotes_{ys} \end{array} \right\}$$

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

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

Whole Number Proportionality =

$$\frac{\sum Electors_{yDEM}}{\sum Electors_y} \tag{4}$$

The second minor variation is the Fractional Proportionality (5), which 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 actually 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 (refvar:FracProp alternative results in an increase in proportionality from Whole-Number Proportionality but yet 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 et al., 2013). The equation is as follows,

Fractional Proportionality =

$$\frac{\sum \left(\frac{DemVotes_{ys}}{DemVotes_{ys} + RepVotes_{ys}} \right)}{\sum Electors_y} \tag{5}$$

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. [2] We refer to this as the District Rule (6). It has two minor variations, with and without two seat-bonus. [3] 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). [4]

District Rule =

$$\frac{\sum [(1 \times DemVotes_{ys}\ RepVotes_{ys}) + (0 \times RepVotes_{ys}\ DemVotes_{ys}] + \sum [(\omega \times DemVotes_{ys}\ RepVotes_{ys}) + (0 \times RepVotes_{ys}\ DemVotes_{ys}])}{\sum Electors} \tag{6}$$

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

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[2] 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.

[3] 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.

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

In addition, in the subsequent section, we 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. [5]

Cube Root House Size =

$$\sqrt[3]{\sum Population_{ys}} \tag{7}$$

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 (4)), and we replace *n* with the Cube Root House Size rounded down to the nearest integer. We can then use the new apportionment to apply to all the alternative electoral college rules.

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[5] 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 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.