

Electoral College Alternatives and US Presidential Elections

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Abstract

The President of the United States is chosen directly by the Electoral College, although indirectly the citizens select the President. Different states currently employ two systems of electoral-vote allocation under the Electoral College framework: the widely adopted winner-take-all system and the system adopted by Maine and Nebraska. The properties of these two systems are analyzed against the backdrop of majority rule and the notion that every vote counts. Two variants of the existing systems are then introduced, using intuitive proportional rules to allocate electoral votes under the Electoral College. These proposed systems are compared to the existing winner-take-all system and to the Maine-Nebraska system. Further, the outcomes of three historical Presidential Elections are considered under different electoral allocation systems. This study highlights basic properties of the Electoral College and possible variants of the current system so that better judgments can be made in future debates.

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I. INTRODUCTION

The beliefs of many Americans in majority rule and in every-vote-counts were severely challenged by the 2000 Presidential election. As vote counting and recounting in Florida dragged on, many citizens renewed their acquaintance with the Electoral College and confronted the reality that the country does not directly vote for the President.¹

Understandably, alternatives to the existing winner-take-all system were discussed and reforms were proposed almost immediately after the election. The two usual proposals are election by direct popular vote and choosing electors by district, but other options exist. This paper points out weaknesses of the two familiar proposals and introduces two alternatives under the Electoral College framework: the Perfect Proportion system and the Integral Proportion system. While studying the strengths of these systems, it is stressed that a candidate can win the popular vote but lose the election under any electoral allocation system.

The framers of the Constitution established the Electoral College. Each state has a number of electors equal to the number of senators plus the number of districts or congressmen in that state.^{2,3} The electors vote for the President and the Vice President through majority rule.^{4,5} How electors are selected in each state is not specified in the Constitution. From the beginning, a few states allowed direct election by the voters, and the idea that the winner of the popular vote should take all the electoral votes in a state was adopted.⁶ Meanwhile, a few other states did not allow their voters to cast ballots for the President, and the electors were chosen by their respective legislatures.⁷ However, by 1836 the roots of the present “winner takes all” system,

¹ In the US Presidential Election, voters officially vote for a slate of electors in their state that is associated with a political party and its candidates. Once elected, the slate of electors cast their vote for the candidate in the Electoral College meetings. Hence voters only vote for the president indirectly. Details follow in the text.

² Although the District of Columbia is not a state, the 23rd Amendment assigned 3 electoral votes to the District. In this paper any mention of all states is meant to include Washington DC.

³ At the time of the 2000 election, there are 538 electoral votes in the US Electoral College, since there are 100 senators, 435 congressmen, and 3 electoral votes associated with the District of Columbia. Following the 2000 Census, the total number of electoral votes would be fixed, but the number of districts and hence the number of electoral votes in each state would be reapportioned according to population changes since the 1990 census.

⁴ Each state’s electors gather together and vote in their individual states instead of all electors from all states getting together in one place to cast their ballots. This is designed to avoid collusion among electors from different states.

⁵ If no majority is reached among the votes cast by all electors, then Congress decides which candidate will become President or Vice President. The House votes for President and the Senate for Vice President.

⁶ In the first Presidential Election after the establishment of the Electoral College in 1789, of the 10 states choosing presidential electors, only Delaware, Maryland, Pennsylvania and Virginia allowed direct election by the voters.

⁷ In the 1789 election, Connecticut, Georgia, New Jersey, and South Carolina chose their electors without a direct popular vote.

where the winner of a statewide popular plurality vote gets all the electoral votes from that state, was firmly in place.⁸

The US Presidential Election has been run mainly under this winner-take-all Electoral College system at the state level. Called the E system in this paper, it is currently adopted by all states except Maine and Nebraska. The Electoral College is generally considered a success, though detractors frequently attempt to alter or abolish the system in Congress. While it is not the intention to defend the merits of the Electoral College, this paper does mention some of its strengths and weaknesses. The paper also endorses and investigates the possibility of keeping the institutional structure of the Electoral College while changing how each state allocates its electoral votes. In particular, to allocate electoral votes within a state, consider replacing the winner-take-all system by a proportional system. Two variants of a proportional system are a perfect proportional system using fractions and an integral proportional system using whole numbers. These intuitive electoral-vote allocation rules endorse the notion of every-vote-counts more strongly while preserving the important properties of the Electoral College. Further, the integral proportional system could also help minimize potential vote counting difficulties in elections.

Why have there been so many attempts to change the system? The main reason is that a president can be elected without winning a majority of the popular vote.⁹ Worse, a president can be elected without winning a plurality of the popular vote.¹⁰ These possibilities seem to violate the ideas of one-person-one-vote and of every-vote-counts: if every vote counts, how could the winner of the majority vote not gain the presidency? If the Electoral College is capable of producing these outcomes, and these possibilities become realities often enough to make us uncomfortable, shouldn't the system be changed so that every vote counts equally? Or if that is not possible, could the system be improved to strengthen the notion of equal votes without violating the Constitution? Can the election process be revised to minimize the likelihood that a candidate becomes President without winning a majority or a plurality of the popular vote? If the current Presidential Election process is to be changed, some natural alternatives present themselves.

The first alternative is to allow a direct popular vote for a President. Though it means that every vote counts as much as any other, this approach clearly was not what the framers of the Constitution had in mind. The Constitution did not specify popular voting in each state, let alone the whole country. Through the electors of the various states, the Constitution leaves the election of the President in the hands of the state legislatures. This means that the founding

⁸ This was true for 25 out of 26 states by 1836, South Carolina being the exception.

⁹ In fact, a president with a minority of the popular vote has won the Electoral College vote 16 times in U.S. history. In 1992 and 1996, Clinton won only 43 percent and 49 percent of the popular vote, respectively. Most recently in 2000, Bush won 48.26 percent of the popular vote.

¹⁰ In 1876, Rutherford B. Hayes was elected president, beating Samuel J. Tilden without winning a plurality of popular votes. Likewise, in 1888, Benjamin Harrison, defeating Grover Cleveland, was elected President. In the most notorious case of all, in 1824, John Quincy Adams beat Andrew Jackson although Jackson received a plurality of the popular votes and electoral votes initially. Most recently in 2000, George W. Bush defeated Al Gore even though Gore won the plurality contest.

fathers emphasized the interests of the states, not of individual citizens, in the election of the President. Moreover, the Electoral College arrangement can minimize the problem of vote counting, as only a few states with close votes may have to do any recounting.¹¹

The next alternative preserves the Electoral College framework, but replaces the winner-take-all allocation system by an allocation method that allows the splitting of the slate of electors to reflect the popular vote in the state. This has been done occasionally throughout US history.¹² One method is to allocate electors by popular vote per district.¹³ Most recently, in 1969 Maine authorized each district's electoral vote to be decided by the popular vote, with the two remaining electoral votes going to the state's majority or plurality winner.¹⁴ Nebraska also adopted this electoral allocation system in 1996.¹⁵ Currently, these are the only states adopting the elector-by-districts system, although historically many states experimented with it. This paper will refer to the latter system as the Maine-Nebraska model, or the E^{mn} system, and will expand on its properties.

The goal of this paper is to consider alternatives to the direct popular vote and the existing widely adopted winner-take-all E system, and to gain a deeper understanding of different alternatives within the Electoral College framework established by the founding fathers. To this end, the properties of the E system are discussed first. Many of these properties are familiar. Next the properties of the E^{mn} system are investigated. Among its undesirable characteristics, a candidate in a state could lose the electoral vote even though he wins the popular vote. This can happen if the E^{mn} system is adopted by states larger than Maine and Nebraska: those with at least 7 electors.¹⁶ I consider this a defect and hence consider alternative proportional allocation systems for electoral votes.

The most intuitive proportional electoral-vote allocation system would be to perfectly apportion the number of electoral votes by the popular vote in the state.¹⁷ For example, if 51.29 percent of the state's votes go to a candidate, and if the state has 8 electors, then the state should allocate 4.1032 (= 0.5129*8) electoral votes to the candidate in question. This system will be designated the perfect proportional allocation system E'. A couple of problems with this system

¹¹ Imagine a scenario in which every popular vote counts, many counties, or districts bicker over vote-counts, and every high court in the Land participates in the vote counting debate in the weeks following Election Day.

¹² For example, in 1789 Massachusetts and New Hampshire combined direct election by the voters with choice by the legislature.

¹³ For example, in 1824, Illinois, Kentucky, Maine, Maryland, Missouri and Tennessee elected their respective electors by popular vote per district. However, shortly thereafter, most states abandoned the popular vote per district. See note 8.

¹⁴ Maine was the first state in 80 years to do so.

¹⁵ Because Maine and Nebraska allow each district to choose its own candidate, a splitting of the slate of electors is possible, but this has not yet occurred.

¹⁶ As of the 2000 election, Maine has 4 electors and Nebraska has 5 electors.

¹⁷ This means that the human electors would have to be abolished.

present themselves. A minor one is the need to use many decimal places. Imagine one day when the media has to read off and newspapers need to print the many decimals associated with the electoral votes for each state. Does anyone want to contemplate and to compare such numbers?¹⁸ The second issue is more problematic: under the perfect allocation system, a precise count of the votes is important and hence much effort has to be spent by all states after the election. In other words, problems similar to the nationwide popular vote will manifest themselves again. It is true that the voting controversy in Florida and elsewhere may (hopefully) lead to reforms and better use of technology that take counting problems out of the equation. But the fraud issue in voting may become more problematic. In light of these issues, consider yet another proportional system of allocating electoral votes.¹⁹

The next alternative is intuitive and makes use of natural numbers. It is proposed that the slate of electors in a state is split roughly in proportion to the state's popular vote, with the modification that the plurality winner receives a favorable marginal adjustment. For example, take the earlier example where 51.29 percent of the votes in the state go to candidate A, and the state has 8 electors. As a perfect reflection of the popular vote requires giving $0.5129 \times 8 = 4.1032$ votes to A, it seems reasonable to allocate 5 electoral votes to A. This way, while receiving the most electoral votes, the plurality winner gets a small favorable adjustment, unlike the existing E system under which the plurality winner garners all the electoral votes. After awarding some electoral votes to the plurality winner, the process continues in a similar fashion to allocate the remaining electoral votes to the rest of the candidates. In particular, most of the remaining electoral votes are given to the next plurality winner. The allocation process stops when no more electoral vote is left. Note that this allocation system, to be referred to as the integral proportional system, or the E* system, preserves partially the preferences of popular voters. The plurality winner gets the most votes, but the minority winner (the candidate with the second most votes) may get some electoral votes as well. Even a third place finisher in the popular vote might win an electoral vote or two.

Since there is a range in which the plurality winner gets a certain number of electoral votes, this system has the virtue that close votes in some states may not matter as much as it does under the winner-take-all system. For example, in a state with 7 electoral votes, as long as A, the plurality winner, has a margin of victory of between 43 percent and 57 percent, he will receive 4 out of the 7 electoral votes. This is true because $0.43 \times 7 = 3.01$ and $0.57 \times 7 = 3.99$; with the favorable marginal adjustment, the candidate receives 4 electoral votes either way. If candidate A were to lose the popular battle to candidate B with 42% of the popular vote, he would have garnered 3 electoral votes instead. In this example, whether candidate A wins 42 percent or 43 percent of the popular vote translates to a difference of 1 electoral vote. Under the winner-take-all system E, it is a matter of 7 electoral votes. With this distinguishing feature and the simplicity of natural numbers, the integral proportional system presents itself as a serious contender as an alternative to the existing winner-take-all system.

¹⁸ With the current technology, the calculation can easily be done. But the point here is that it is not as easily remembered or understood by voters. On the other hand, rounding off to 1 or 2 decimals will probably work fine most of the time.

¹⁹ Still, the investigation of the properties of the perfect allocation system E' is important because it shows us what outcome, no matter how undesirable, might be possible as long as the Electoral College framework is retained.

If adopted by all states, the perfect allocation system E' and the integral allocation system E* under the Electoral College framework retain the goals set forth in the Constitution by respecting the interests of the states. Further, both systems pay more respect to the will of the people, both majority and minority alike. The paper hence turns to investigating properties of the E' and the E* systems, as compared to the E^{mn} system, and more importantly, as compared to the E system. It will be pointed out that as long as the Electoral College is retained, there is no guarantee that the nationwide popular vote winner will become President. This is true because the nationwide popular vote may not be consistent with the interests of the states.

After discussing the properties of all the systems, the incentive for different states to change the status quo are discussed. Presidential Election votes from 2000, 1968, and 1960 are also computed according to the proposed E' and E* systems. The 2000 election inspired the research of this paper because of the tight popular vote and the unprecedented controversial vote count involving many court battles. The 1968 election was chosen because of the major third party effect: Nixon won the presidency with only 43.4 percent of the popular vote to Hubert Humphrey's 42.7 percent and George Wallace's 13.5 percent. The 1960 election left many with the suspicion that fraud in several states allowed Kennedy to defeat Nixon. The paper then concludes with the findings and reiterates the lessons learned.

The main text of the paper uses simple examples in table form to illustrate properties of the different systems. These properties are listed as observations, and will be analyzed assuming that all states adopt the same system. Often these observations are examples counter to properties desired by many people. Most historical examples are relegated to footnotes or appendixes.

II. THE CURRENT SYSTEMS

A. Properties of the Winner-take-all or E System

This paper abstracts from the voters participation problem and creates simplified examples to help illustrate the issues at hand.^{20, 21} To this end, assume that for approximately every 25 voters in a state, there is one district assigned to the state.²² Hence, a state with 75 voters has 3 districts. Adding the two senators gives the state a total of 5 electoral votes.

²⁰ In reality, not all citizens vote, and voter participation rates change from jurisdiction to jurisdiction.

²¹ The paper also abstracts from the so-called "faithless electors" problem. Faithless electors are people elected to cast their ballots in the Electoral College on behalf of a particular Presidential candidate but who cast their votes for someone else. No Constitutional provision or Federal law requires electors to vote in accordance with the popular vote in their States, hence the possibility of a faithless elector. Some states do have laws that faithless electors may be subject to fines or may be disqualified for casting an invalid vote and be replaced by substitute electors. This paper assumes that all electors cast votes consistent with the popular vote in the state.

²² Since the congressional districts are only reassigned once every decade and since voter participation can change from election to election, the examples mostly assume 25 voters in a district, but sometimes due to the nature of the example, more voters are assumed.

Further, all examples have only a few states, and these states together will be referred to as the nation or all the states.²³ Given that the concern is to see how popular votes are translated into electoral votes, and how the interaction among popular votes differs from the interaction among electoral votes, the examples serve to demonstrate the underlying competing or augmenting forces at work across all states under the Electoral College system. In the examples, S_i denotes State i . P_a and P_b denote the numbers of popular votes cast for candidates A and B in an individual state. Likewise, E_a and E_b denote the numbers of electoral votes cast for candidates A and B in a state. The notation $P:A$ and $E:A$ represent the fact that the popular vote winner or the electoral vote winner is A for all states.

1. Observation 1

Under E, a close popular vote can generate either an electoral landslide or a close electoral vote. A landslide in the popular vote can generate either a close electoral vote or an electoral landslide.

Table 1 and Table 2 show a simplified nation with two small states and one large state, with three times as many voters in the large state as in each of the small states. The tables present two different scenarios under which close popular votes leave a majority in the nation favoring candidate A, yet either a landslide or a close outcome can occur in the Electoral College vote. In Table 1 slight majorities in S1 and S2 favor candidate A and this creates a landslide in electoral votes for A. However, in Table 2 the slight majorities in S2 and S3 favor A and this leads to a close majority win in the Electoral College for A.

Table 1

	P_a	P_b	P_a+P_b	E_a	E_b
S1	38	37	75	5	
S2	13	12	25	3	
S3	12	13	25		3
Sum	63	62	125	8	3

P : A
close vote

E : A
landslide

²³ Attention is mainly focused on races between two candidates, but occasionally cases with more than two candidates are discussed.

Table 2

	Pa	Pb	Pa+Pb		Ea	Eb
S1	37	38	75			5
S2	13	12	25		3	
S3	13	12	25		3	
Sum	63	62	125		6	5

P : A
close vote

E : A
close vote

Table 3 and Table 4 show two scenarios under which the landslide popular votes across states are the same, while the electoral outcome can be close or a landslide.

Table 3

	Pa	Pb	Pa+Pb		Ea	Eb
S1	37	38	75			5
S2	20	5	25		3	
S3	17	8	25		3	
Sum	74	51	125		6	5

P : A
landslide

E : A
close vote

Table 4

	Pa	Pb	Pa+Pb		Ea	Eb
S1	49	26	75		5	
S2	13	12	25		3	
S3	12	13	25			3
Sum	74	51	125		8	3

P : A
landslide

P : A
landslide

Consider next a comparison of Table 1 and Table 4. In both tables the popular votes in the small states S2 and S3 are close and the majorities go in the opposite direction. So the electoral votes from the two small states “cancel” each other, and the large state becomes the sway vote. The many electors from the large state, with the help of the electors from the small state, create a landslide in electoral votes. Meanwhile, depending on the popular vote margin in the large state, the margin for the nationwide popular vote can either be small or large.

Now compare Table 2 and Table 3. In these tables, the popular vote in each small state favors one candidate, while the large state favors the other candidate. This can lead to a close vote in the Electoral College if the sum of the electors from the small states is close to the

number of electors in the large state. Since a winner takes all electoral votes in each state, a slight or a large majority in the state’s popular vote garners the same electoral votes. The strength of these majorities from all the states then determines whether the nationwide popular vote is a close vote or a landslide.

The above comparisons illustrate that, under the E system, *there is no consistent relationship between the popular vote margin and the electoral vote margin.* But this suggests the more troubling possibility that there may be no relationship between the outcome of the E system and the result of the nationwide popular vote. This is indeed the case as the next two observations indicate.

2. Observation 2

The winner of the E system does not necessarily win the simple popular vote for the nation.²⁴ That is, a candidate can become the winner of the E system and hence the President with a minority of the popular vote. This possibility is called the nationwide inconsistency problem because the E outcome does not reflect the P outcome for all states.

Table 5 illustrates a case under which all states are identical in size and have the same number of electors. There is a slight majority for candidate A across all states. However, because two out of three states prefer candidate B, the Electoral College selects B as the President, despite the nationwide popular majority vote for A.

Table 5

	Pa	Pb	Pa+Pb	Ea	Eb
S1	14	11	25	3	
S2	12	13	25		3
S3	12	13	25		3
Sum	38	37	75	3	6

P : A

E : B

This example clearly demonstrates an important property of the Electoral College system: the candidate with the most popular votes does not necessarily become President, as winning the popular vote does not guarantee winning the electoral vote. More importantly, the example shows that *even if* all states had the same number of residents and voters, there is still no guarantee that the winner of the nation’s popular vote will win the Electoral College vote. In practice, with different states having different numbers of electors, the problem is further compounded. This problem—that the electoral outcome can differ from the simple popular vote outcome across all states—will be referred to as the nationwide inconsistency problem.

²⁴ See note 10.

So far, overall features of the E system *across all states* have been discussed. Next consider two straightforward limited features of the E system *within a state*. These are important for comparisons with alternative systems within the Electoral College setting.

3. Observation 3

The winner-take-all Electoral College outcome is consistent with the statewide popular vote, or, is “statewide popular-vote consistent.” However, the E outcome does not measure the extent of voter-preference. That is, under the E system, the winner of the electoral vote also wins the popular vote in the state; but the number of electoral votes obtained by a presidential candidate does not reflect the popular margin by which this candidate won in that state.

The statewide consistency property is trivial because the winner of the popular vote takes all the electoral votes in a state under the E system. However, as observations show, the E outcome does not indicate or reflect the margin of victory in the state, since both slight and large margins of victory produce the same number of electoral votes in a state.

As long as a candidate receives one more vote than any other candidate in the state, he wins the popular vote and garners all electoral votes under E. This is a “single threshold” property; once the number of votes reaches this threshold, any additional votes for this candidate do not matter. However, when popular votes across all states are tabulated to form electoral votes, a single threshold will not reflect votes in a state as well as using multiple thresholds, which involves splitting the slate of electors in a state. This alternative will be analyzed after briefly discussing the Maine-Nebraska system.

4. Concluding Remarks on the E System

Recapping the main properties of the E system, the E outcome reflects voter preferences within a state, but the electoral vote does not indicate whether the popular vote was close or a landslide. Across all states, the winner under the E system does not have to win the nationwide popular vote and the winning electoral vote margin bears no relationship to the popular vote’s winning margin.

B. Properties of the Maine-Nebraska Model or the E^{mn} System

As noted, the elector-by-district model, currently used by Maine and Nebraska, was adopted by many other states at various times in the past. It is intuitively appealing because it respects the preferences of different congressional districts and presumably should reflect the preferences of all voters. Unfortunately, it may not adequately reflect the popular vote in the entire state. The question then is how fine a unit should be used to partition votes in determining our national leader? This issue will be addressed later. The next two observations point out a desirable feature of the E^{mn} system, then a problematic aspect. Examples in this section refer to different

districts of *one state*, unlike the previous examples dealing with different states. To facilitate the discussion, assume that each district has about 25 voters.

1. Observation 4

The E^{mn} outcome may reflect statewide voter preferences better than the E outcome.

In general, the E^{mn} system is expected to produce a better representation of the voter sentiment than the winner-take-all system E . This is illustrated in Table 6. The state in question has 3 districts and 5 electors. Since candidate A wins the popular vote, he receives all the electoral votes under E , 5 to 0 against his opponent. If each district assigns its electoral vote, then candidate B receives 2 electoral votes because D1 and D2 vote for him. As candidate A wins the majority vote in district D3 as well as the state, he garners 3 electoral votes (one for winning the district, and two for winning the state majority). Candidate A is ahead in this state when the votes are split. It is clear that in this case the E^{mn} votes reflect the popular votes in the state better than the E system.

Table 6

	Pa	Pb	Ea	Eb	$E^{mn}a$	$E^{mn}b$
D1	12	13				1
D2	12	13				1
D3	20	5			1	
State	44	31	5	0	3	2

P : A

E : A

$E^{mn} : A$

2. Observation 5

The E^{mn} system has a statewide inconsistency problem: it can provide an electoral winner that is inconsistent with the popular vote in the state. In particular, the E^{mn} outcome can be inconsistent with the statewide popular vote if the state has at least 5 districts and 7 electoral votes.

Table 7 shows that voters in two districts (D1 and D2) give majorities to candidate A, hence two electoral votes go to A. Furthermore, because the state's majority voters prefer A, 2 more electoral votes are assigned to A. That is, $E^{mn}a = 2 + 2 = 4$. Given that B did not win the majority vote, his electoral vote equals the number of districts voting for him. That is, $E^{mn}b = 1$. Note that in Table 7, the majority of the electoral votes go to candidate A, and this outcome matches the majority preference of the state's population. One might argue that the E^{mn} margin of 4 to 1 for candidate A does not reflect the popular margin well. But at least the outcome is consistent.

Table 7

	Pa	Pb	E^{mn}a	E^{mn}b
D1	13	12	1	
D2	13	12	1	
D3	12	13		1
State	38	37	4	1

P : A**E^{mn} : A****Table 8**

	Pa	Pb	E^{mn}a	E^{mn}b
D1	20	5	1	
D2	12	13		1
D3	12	13		1
D4	12	13		1
D5	12	13		1
State	68	57	3	4

P : A**E^{mn} : B**

In Table 8, even a landslide in the popular vote in a different state leaves candidate A a loser to candidate B in terms of electoral votes. That is, although candidate A is heavily favored by the voters in the state, he is behind in the electoral votes under the elector-by-district system. Therefore, the E^{mn} outcome does not necessarily match the popular outcome in choosing the winner.

This E^{mn} reversal in outcome is considered an undesirable property of an electoral vote system. The majority vote in a state ought to be respected by allocating a majority of the electoral votes to the candidate who collects the most popular votes. Readers may have noted the differing number of districts in Table 7 versus Table 8. This statewide inconsistency can only appear if the state has a sufficient number of districts.

If the same candidate wins the popular vote in every district in a state, then the E^{mn} outcome will always be consistent with the popular outcome. Otherwise, this may not be the case. Assume that candidate A wins 1 district with a large margin, whereas candidate B wins the remaining N districts with only 1 vote to spare in each district. Further assume that candidate A wins the statewide popular vote. For the E^{mn} outcome to reverse the popular outcome, the N electoral votes garnered by candidate B (from the N districts) must exceed the 3 electoral votes collected by candidate A (1 district and 2 for winning the state's popular vote). As N must exceed 3, the total number of districts in the state (N+1) must be greater than or equal to 5. Alternatively, the number of electors in the state must be at least 7.

Since currently Maine has 4 electors and Nebraska has 5, neither state could produce an electoral majority opposite to the popular majority. But if a state with at least 7 electoral votes adopts E^{mn} , it would be possible for its electoral vote to go against its popular vote.

3. Observation 6

The E^{mn} system can be unstable: given a change in the residency distribution of the voters, the consistency of the E^{mn} outcome can change even with no change in overall voter preference in the state.

A change in the residency distribution of the majority voters within the state can affect the E^{mn} outcome. Table 9 and Table 10 show voter preferences in a state with 5 districts, and with identical popular votes favoring candidate A by a slight margin of victory. In Table 9, only D1 produces a majority vote for A, and A loses the electoral vote despite a win of the popular vote. Now consider the case in which two candidate-A supporters move from D1 to D2 (Table 10). These moves produce a popular majority vote within D2, without losing the majority vote in D1. The additional electoral vote from D2 then gives the electoral victory to candidate A, which happens to match the sentiment of the majority of state voters.

Table 9

	Pa	Pb	$E^{mn}a$	$E^{mn}b$
D1	16	11	1	
D2	12	13		1
D3	12	13		1
D4	12	13		1
D5	12	13		1
State	64	63	3	4

P : A

$E^{mn} : B$

Table 10

	Pa	Pb	$E^{mn}a$	$E^{mn}b$
D1	14	11	1	
D2	14	13	1	
D3	12	13		1
D4	12	13		1
D5	12	13		1
State	64	63	4	3

P : A

$E^{mn} : A$

These two scenarios illustrate the second unsettling property of the E^{mn} model. The outcome of the electoral vote should not depend on the residency distribution of the voters. The example suggests that the E^{mn} system might provide a greater impetus to state legislatures to engage in gerrymandering, the practice of creatively carving out the boundaries of congressional districts when they are modified following a decennial census. For example, a state where the Republicans have a majority in the state legislature might concentrate Democratic neighborhoods in one or two districts, ceding control there in return for a higher probability of maintaining dominance in other districts. Under E^{mn} this also would tend to maximize electoral votes for the party in power. Also, citizens frequently move from one district to another within the same state. Should the selection of our national leader depend on which district someone happens to reside during the election? To raise the question suggests that the answer should be negative.

4. Observation 7

The winner of the E^{mn} system does not necessarily win the simple popular vote for the nation. That is, the E^{mn} outcome may be inconsistent with the nationwide popular vote.

The nationwide inconsistency property of the E^{mn} system originates from the structure of the Electoral College. Given that all allocation systems discussed are under the Electoral College framework, they all share this undesirable nationwide inconsistency property. Under E^{mn} , as each state's electoral votes may not be consistent with its popular vote, the nationwide electoral outcome need not be consistent with the nationwide popular outcome after aggregating all the states.

5. Concluding Remarks on the E^{mn} System

To recap the properties of the E^{mn} system, the system seems intuitively appealing and its outcome is expected to reflect the statewide popular vote better than the E system. Unfortunately, sometimes it doesn't. Under the E^{mn} system, the state popular vote may not win the electoral vote, if the state has at least 7 electors. Further, the outcome is sensitive to the residency distribution of voters in a state. Lastly, if adopted by all states, the E^{mn} outcome may not be consistent with the nationwide popular vote.

Counter to intuition, the E^{mn} system does not always fare much better than the E system.²⁵ Like the E system, the E^{mn} system may not be nationwide consistent with the popular vote. Unlike the E system where the electoral vote is always consistent with the statewide popular vote, the E^{mn} system cannot assure this. The force that gives the district-residency distribution the power to impact the state's electoral vote is similar to the force that gives the state-residency distribution the power to impact the nation's electoral vote. Some may argue that to select a national leader in a manner that respects the principle of federalism, it may be logical to accept

²⁵ The Economist magazine wrote an editorial suggesting that the Maine-Nebraska system should be widely adopted. See The Economist, November 18, 2000 (p.42).

the nationwide inconsistency property of the Electoral College framework. But the statewide inconsistency issue is a different matter. It may not be logical to take the district as a unit and build in the interest of the district to determine the electoral vote for a president. If the interests of different districts vary, then the electoral vote that supposedly represents the state's interest may easily flip-flop (as was shown in Table 9 and Table 10). And the electoral vote may not be consistent with the preference of the majority of the state's population (as was shown in Table 8 or Table 9).

All this suggests considering alternative proportional systems that incorporate a state's popular vote under the Electoral College framework. Two intuitive alternatives are the perfect proportional system E' and the integral proportional system E*. The E' system would accept fractional numbers of electoral votes that perfectly reflect the proportion of the popular vote for each candidate. The E* system would only take integral numbers of electoral votes and allocate them in a way that approximately reflects the popular vote in a state with a tilt towards the plurality winner. In these proposed systems, individual districts play no role. Like the existing E system, the state is the unit under which the popular vote is tabulated and included in the electoral votes.

III. POSSIBLE VARIANTS TO THE CURRENT SYSTEMS

A. The Perfect Proportional System E' and the Integral Proportional System E*

Under the perfect proportional system E', if a state has N electors and candidate A receives $\alpha\%$ of the popular vote, then the number of electoral votes assigned to candidate A is $\alpha\%$ times N. The slate of electors in a state is split in as many ways as there are candidates.

Under the integral proportional system E*, the electoral vote received by a candidate is always a whole number. Assume that there are N electors in the state and three candidates, A, B, and C receive $\alpha\%$, $\beta\%$ and $\gamma\%$ of the popular vote, respectively. Assume further that $\alpha > \beta > \gamma$ and hence candidate A is the plurality winner. Then the number of electoral votes assigned to candidate A is the larger of the following two quantities: (1) the largest integer greater than $\alpha\%$ times N; or (2) the largest integer greater than or equal to half of the electoral votes.^{26, 27} If there is any residual electoral votes, the number of electoral votes will be similarly assigned to B. That is, the number of electoral votes assigned to B is the larger of the following two quantities: (1) the largest integer greater than $\beta\%$ times N and less than or equal to the number of remaining electoral votes; or (2) the largest integer greater than or equal to half of the remaining electoral votes. If any votes are left, assign them to candidate C. In this way, the E* system splits the

²⁶ To guarantee that the popular vote winner garners the most electoral votes, it is important to assign him at least half the electoral votes.

²⁷ There is still the issue of a tie vote. Currently some states resolve a tie by chance. For example, Florida state law stipulates that candidates should draw lots to determine who shall be elected to the office. Likewise, New Mexico state constitution calls for a game of chance, the type of game to be determined by a judge, to resolve a tie.

slate of electors in favor of the majority winner by assuring that his proportion of electoral votes is close to but greater than his proportion of popular votes.

The two proportional allocation systems investigated split the slate of electors in a state. Given that more than two candidates can garner substantial popular votes, more than two candidates can receive electoral votes under E' and E*.²⁸ Hence, if either of the two proposed allocation systems were to be adopted, one might want to change the constitution to allow the winner of a plurality of electoral votes to win the Presidency of the United States.²⁹

Some supporters of the Electoral College argue that the existing winner-take-all system tends to magnify the victory margin of the winner, and that this is desirable. The perfect proportional system does not keep this property. The integral proportional system does retain some magnification of the margin of the winner.^{30, 31}

Next turn to the properties of the E' and the E* systems, and compare them to the E^{mn} and the E systems.

1. Observation 8

The E' and the E outcomes are consistent with the statewide popular vote while the E^{mn} outcome may not be. In general, the E' and the E* electoral vote assignments reflect statewide voter preferences better than the E^{mn} electoral vote.*

Table 11 takes the voter preference presented in Table 8, where the E^{mn} winner does not win the popular vote, and shows the electoral votes assigned to each candidate under the proposed E' and the E* systems. The state in question has 7 electoral votes and candidate A receives

²⁸ A proportional allocation system might therefore encourage more candidates, which some people would not consider a good feature. For example, a one-issue candidate might hope to promise his electoral votes to a candidate who promises to support his issue. The E* system should minimize this impact since some threshold must be achieved before gaining any electoral votes.

²⁹ If no candidate receives a majority of electoral votes, the constitution states that the House of Representatives determines who becomes President. Since a lack of a majority becomes more likely under E' or E*, widespread adoption of either system should probably be accompanied by a constitutional amendment that a candidate need only win a plurality of electoral votes to become President.

³⁰ Strictly speaking, the degree of magnification under the E system is not uniform across all states either. This is due to the different number of electors assigned to the states. For example, in California, a 51% win in the popular vote can be parlayed into 54 electoral votes while in Delaware, a 51% win can only be turned into 3 electoral votes. Alternatively, from the 2000 Presidential Election, the extra 79,382 votes in Arizona that went to Bush turned into 8 electoral votes for him. The extra 79,474 votes cast for Bush in North Dakota only generated 3 electoral votes. (The votes in Arizona were: Bush 715,112 and Gore 635,730. The votes in North Dakota were: Bush 175,572 and Gore 96,098.) Likewise, the degree of magnification under the E* system is not uniform across all states, because it depends on the margin of victory and because different numbers of electors are assigned to the states.

³¹ Under E the electoral vote magnification is insensitive to the margin of victory once the threshold of victory is crossed. Under E*, the electoral vote magnification may depend on the margin of victory to some extent. Also, under E* the minority popular vote may not be totally de-magnified to zero, as is the case under E.

$68/(68+57) = 0.544$ of the popular votes cast. As 3.808 equals $0.544*7$, this is the number of electoral votes received by candidate A under E'. Given that $57/(68+57)=0.456$, 3.192 ($=0.456*7$) is the number of electoral votes assigned to candidate B. Under E' candidate A receives more electoral votes than candidate B because electoral votes perfectly reflect fractions of the popular vote going to either candidate. In particular, the ratio of the number of popular votes for A and that for B (the ratio of 68 to 57) and the ratio of the number of E' votes for A and that for B (the ratio of 3.808 to 3.192) are equal: they are both 1.193.

Since candidate A receives the most popular votes and since the perfect proportional number is 3.808, rounding up to a whole number means that 4 electoral votes are assigned to candidate A under E*. The remaining 3 electoral votes are assigned to candidate B. Again, under E* candidate A receives more electoral votes than candidate B, although under E^{mn} candidate A receives fewer electoral votes.

Table 11

	Pa	Pb	E^{mn}a	E^{mn}b	E'a	E'b	E*a	E*b
D1	20	5	1					
D2	12	13		1				
D3	12	13		1				
D4	12	13		1				
D5	12	13		1				
State	68	57	3	4	3.808	3.192	4	3
	P : A		E^{mn} : B	E' : A			E* : A	

In general, because both the E' and the E* systems always assign the largest number of electoral votes to the popular winner in the state, and the next largest number of electoral votes to the next popular winner, etc, these numbers are superior to the E^{mn} assignment of electoral votes. The E' and the E* votes reflect the state's popular vote in two ways. First, the E' and the E* outcomes are always statewide popular-vote consistent, since they count each voter in the state equally, disregarding the district a voter resides in. Second, in the case where even the E^{mn} outcome is statewide popular-vote consistent, the E' and the E* electoral votes reflect the popular majority vote, but the E^{mn} electoral votes bears little relationship to the statewide popular vote.

2. Observation 9

Like the winner-take-all system E, the E' and the E outcomes are always statewide popular-vote consistent with the popular vote in producing a winner. Further, the E' and E* electoral votes reflect statewide popular votes better than the E electoral votes.*

As indicated in the previous observation, the statewide popular vote winner always wins the largest proportion of electoral votes under E' or E* because winning the popular vote means that

he gets the most electoral votes in the state under either proportional system. That the electoral votes under E' and under E* reflect the statewide voter preference better than that under E is also intuitive. The E' and the E* systems allow the possibility of assigning some electoral votes to other candidates, while under the E system, the second place winner does not garner any votes.³² For example, in a state with 3 electors, under E' any winner garners some votes so that the E' system reflects the popular vote sentiment much better than the winner-take-all system E. Likewise, under E*, a popular winner who collects less than 2/3 of the popular votes gets only 2 electoral votes. A second candidate who garners most of the remaining popular votes receives 1 electoral vote. This 2-1 allocation of electoral votes under E* is also a better reflection than the 3-0 allocation of electoral votes under E.

3. Observation 10

Like the winner-take-all system E, the E' and the E outcomes may be nationwide inconsistent with the popular vote. That is, under E' or E*, it is possible for a minority popular winner to garner a majority of the electoral votes and become president.*³³

Table 12 uses the voter preference from Table 5 to show how the E' and the E* electoral vote allocations differ from that of the E system. In this example, across all states candidate A wins the popular vote with a slight majority. However, because the majorities in two states vote for candidate B, the winner-take-all system declares candidate B the winner. Similarly, since being a majority winner in a state means that a premium of electoral votes is awarded to the candidate, B also wins the integral proportional system E*. However, candidate A is the winner under the perfect proportional system E' because the winning margins in states S2 and S3 for candidate B are not large enough to overwhelm the winning margin in S1 for candidate A.

Table 12

	Pa	Pb	Ea	Eb	E'a	E'b	E*a	E*b
S1	14	11	3		1.68	1.32	2	1
S2	12	13		3	1.44	1.56	1	2
S3	12	13		3	1.44	1.56	1	2
Sum	38	37	3	6	4.56	4.44	4	5
Winner	A		B		A		B	
Consistency with P			No		Yes		No	

³² This is true as long as the proportion of popular votes garnered by the minority winner is fairly large under E*.

³³ Like the E system, there is still no relationship between the popular vote and the nationwide electoral vote under the E* system. That is, 1. Observation 1 still applies to the E* system.

B. The Proportional Systems and the Existing Systems

The outcomes illustrated in Table 12 seem comforting. After all, the political authority did its best to give the right proportions of electoral votes to different candidates according to voter preferences in the state. Hence the perfect proportional allocation system E' is expected to provide the best representation in terms of electoral votes. Unfortunately, this example may generate a false sense of security that the outcome under E' is always consistent with the popular vote across all states. In fact this is not the case, as examples in Appendix 1 show.

Examples in Appendix 1 show that it is plausible under any Electoral College system to have a Presidential Candidate losing the election while winning the popular vote. The examples illustrate the unstable properties of any allocation system under an Electoral College. If the number of districts, voter participation, or margins of victory change slightly, the popular winner and the winners of different electoral allocation systems can change. Indeed, this lack of a fixed relationship between outcomes of different electoral allocation systems and the popular vote is the price that must be paid to preserve the Electoral College.

IV. HISTORICAL EXAMPLES

To ease any doubt that the previous examples are artificial, three more historical examples are presented. First, Appendix 2 reworks the 2000 Presidential Election using data from cbsnews.com downloaded on Dec 16, 2000. As the source only provided votes for the top four candidates, sum the votes for Gore, Bush, Nader, and Buchanan in each state and assume that that is the total number of votes in this state.³⁴ Although Gore won the nationwide popular vote, Bush ended up winning the Presidency by garnering 271 electoral votes to Gore's 267. When computed under the perfect allocation system, Bush wins with 261.01 to Gore's 259.89 electoral votes.³⁵ Under the integral allocation system, Bush still wins with 272 to Gore's 263 electoral votes. (In this case, Nader receives 3 electoral votes.) Note that in this election, all allocation systems under the Electoral College framework provide outcomes that are inconsistent with the popular vote.

Table 13 further sorts pairs of states from the 2000 Presidential Election to see the consistency issue between different electoral college allocation systems and the popular vote across states. The criterion is to choose pairs of states that produce an E outcome that is inconsistent with the popular outcome across the two states.³⁶ In the case of Hawaii and South Dakota, the E , E' , and E^* outcomes are all opposite from the popular outcome across states. In

³⁴ Details of the electoral votes assigned in each state are found in the Appendix.

³⁵ With only 261.01 electoral votes, election of the President would actually fall to the House of Representatives unless the constitution was amended to let a plurality of electoral votes determine the winner.

³⁶ Since only votes for Gore and Bush are examined and votes going to the other candidates are ignored, the sum of electoral votes going to Gore and Bush need not equal the number of electors for each state. However, for the pairs of states chosen, neither Nader nor Buchanan won any electoral vote under E^* . Hence the sum of the electoral votes going to Gore and Bush always equal the number of electors for the state in question.

the remaining three comparisons, the perfect proportional system and the integral proportional system both generate results consistent with the popular vote although the winner-take-all system does not.

Table 13

	Pg/T	Pb/T	Pg	Pb	Eg	Eb	E'g	E'b	E*g ₁	E*g ₂	E*b ₁	E*b ₂
Hawaii 4	0.561	0.377	205,209	137,785	4		2.245	1.507	3			1
South Dakota 3	0.380	0.609	118,750	190,515		3	1.14	1.828		1	2	
Total			323,959	328,300	4	3	3.384	3.336				
Total of E*									4		3	
Winner				Bush	Gore		Gore		Gore			
Consistent w/ P					No		No		No			
Vermont 3	0.512	0.412	148,166	119,273	3		1.536	1.236	2			1
Wyoming 3	0.287	0.700	60,421	147,674		3	0.86	2.101		0	3	
Total			208,587	266,947	3	3	2.396	3.338				
Total of E*									2		4	
Winner				Bush		Tie	Bush				Bush	
Consistent w/ P					No	No	Yes				Yes	
Oregon 7	0.474	0.470	719,165	712,705	7		3.32	3.291	4			3
N. Hampshire 4	0.472	0.484	265,853	273,135		4	1.886	1.938		1	3	
Total			985,018	985,840	7	4	5.207	5.229				
Total of E*									5		6	
Winner				Bush	Gore		Bush				Bush	
Consistent w/ P					No		Yes				Yes	
Massachusetts 12	0.603	0.328	1,610,175	876,906	12		7.232	3.938	8			4
Georgia 13	0.438	0.558	1,110,755	1,416,085		13	5.69	7.254		5	8	
Total			2,720,930	2,292,991	12	13	12.92	11.19				
Total of E*									13		12	
Winner				Gore		Bush	Gore		Gore			
Consistent w/ P					No	No	Yes		Yes			

Pg/T & Pb/T are the percentages of popular votes gained by Gore and by Bush, respectively.
Pg and Pb are the actual numbers of popular vote received by Gore and Bush.
Eg and Eb are votes garnered by Gore and Bush under the E system.
E'g and E'b are votes collected by Gore and Bush under the E' system.
E*g₁ and E*g₂ are votes allocated to Gore as the first place and the second place popular vote winner, respectively.

Finally, Table 14 presents hypothetical outcomes under E' and E* along with the historical popular and electoral votes garnered by each candidate under E for three elections. In 1960, Nixon would have won the election if the integral proportional system E* was used, but Kennedy

would have still won the election if E' was used.³⁷ In 1968, the third candidate in terms of popular votes, George C. Wallace, garnered 46 electoral votes under E. Computations show that all allocation systems would have declared Nixon the winner.³⁸

³⁷ Because the District of Columbia did not have any electors in 1960, the total number of states is 50.

³⁸ Recall that under E' and E*, it is necessary to declare an electoral vote plurality winner to be the President to avoid the current requirement under which the House of Representatives determines the winner.

Table 14

1960	States	P	E	E'	E*
Kennedy (D)	23	34,221,344	303	266.13	265
Nixon (R)	26	34,106,671	219	263.71	267
Byrd	1		15	7.17	5
Total	50	68,328,015	537	537.01	537
Winner		Kennedy	Kennedy	Kennedy	Nixon
Consistency with P winner			Yes	Yes	No

1968	States	P	E	E'	E*
Humphrey (D)	14	31,274,503	191	225.91	220
Nixon (R)	32	31,785,148	301	232.67	257
Wallace	5	9,901,151	46	79.42	61
Total	51	72,960,802	538	538.00	538
Winner		Nixon	Nixon	Nixon	Nixon
Consistency with P winner			Yes	Yes	Yes

2000	States	P	E	E'	E*
Gore (D)	21	50,148,801	267	259.89	263
Bush (R)	30	49,790,449	271	261.01	272
Nader	0	2,772,967	0	14.61	3
Buchanan	0	449,095	0	2.49	0
Total	51	103,161,312	538	538.00	538
Winner		Gore	Bush	Bush	Bush
Consistency with P winner			No	No	No

Under E, the 267 electoral votes for Gore included the vote that a Faithless elector from DC should have cast for him.

In 2000, the popular vote in Florida was very close and Florida's 25 electoral votes meant that whoever won Florida would win the Presidency under the winner-take-all system. Hence there were many debates on how to count pregnant chads and various legal battles. The E* outcome has Bush winning 272 electoral votes to Gore's 263 votes, with 3 votes going to Nader. If the election were held under the E* system, Bush would have garnered 13 electoral votes as

opposed to Gore's 12 electoral votes. But even if Gore had won Florida, Bush would have garnered 12 votes and Gore 13 votes. Then under E*, the grand totals of electoral votes for Bush and Gore would have been 271 and 264 respectively; and Bush would still have won. Hence, the unprecedented battle in the Florida vote count would not have mattered if the integral proportional system had been adopted.

V. LESSONS AND CONCLUSION

The 2000 election led to much talk in Congress about reforming the election process. Numerous failed reform attempts made over the course of US history cast serious doubt whether any reform can ever be enacted. On the other hand, reform is impossible if no attempt is ever made. In order for any possible reform to occur, all must fully understand the properties of the existing systems adopted by states under the umbrella of the Electoral College.

Dissatisfaction with the status quo results from recognizing that the popular vote outcome need not jibe with the Electoral College outcome. Thus, there is a demand for a system that better reflects actual popular voting outcomes. Naturally, a direct popular vote for the President would accomplish this. However, this practice clashes directly with the intention of the constitution's framers who focused on representation by states, using the Electoral College mechanism. Although the number of electors assigned to each state is determined by population, the manner of selecting electors is left to each state, and the practice of a popular vote (even within a state) was not endorsed in the Constitution.

The principles of federalism and the interests of the states underlie the Constitution. If these principles are to be sustained, the Electoral College should be maintained. If the principle of equality of voters is to be enhanced, a fundamental question is the following. *How should the interest of the state be determined by its citizens?* Two models are used at present: winner-take-all and Maine-Nebraska. For all practical purposes, the winner-take-all model currently decides the Presidential Election; it is precisely this model that many people believe needs improvements.

One frequently proposed alternative is the Maine-Nebraska model. Should the interest of a state be determined by the interests of its districts? If so, then the Maine-Nebraska system has some attractions. After all, voters from each district decide on the interest of the district and different districts together decide the interest of the state and therefore the allocation of electors for different candidates. Unfortunately, because the winner of the popular vote in a large state may not garner the most electoral votes from the state, this could generate inconsistent outcomes between the popular and electoral votes.³⁹ Further, if the principle of voter equality is to complement the interests of the states in selecting a President, why go through an unnecessary layer of districts? Although the Maine-Nebraska model has intuitive appeal at first blush, it is not satisfactory.

³⁹ Recall that the outcome under the Maine-Nebraska model may be inconsistent with a state's popular vote provided that the state has at least 7 electors.

However, there are some attractive alternatives available. Other than the winner-take-all system, the most intuitive system is the perfect proportional system. This system has the virtue of keeping the principles of federalism and of “every vote counts equally” in the state, as the fraction of electoral votes assigned to any candidate reflects precisely his fraction of popular votes in the state. Minor problems with this system are that vote counting becomes important and that fractional numbers of electoral votes must be accepted. However, a worthwhile feature of this system is that it captures the principles set forth in the constitution and the newer concept of equality of all voters (as close as possible).

Another alternative that maintains the compromise between federalism and respect for voter preference is the integral proportional system. This system gives an imperfect proportion of electoral votes to the plurality winner in a state. The number assigned to the winner always favors him by apportioning the next integer that is larger than the fraction of the popular vote garnered by him. It is always greater than half the total electoral votes in the state to ensure the principle of plurality. A major virtue of the integral proportional system is that the margin of victory is magnified whereas the minority voter preferences are not forgotten. Given that the winner-take-all system magnifies the margin of victory of the plurality winner to the extreme and completely ignores other votes, the integral system is an improvement in preserving voter preference from a state. It has two additional virtues. It is elegant because it deals with whole numbers and close votes in some states do not matter.⁴⁰ This means that the vote counting and recounting problem is minimized.⁴¹ The likelihood of fraud may also be minimized since results are less sensitive to small changes in vote counts.

However, as the Electoral College framework is retained, *no allocation system of electoral votes* can assure that the nationwide popular vote winner becomes President. The outcome of the electoral vote in a state, and hence the outcome of the Electoral College vote, depends on the margins of victory but not on voter participation rates in that state. The outcome of the nationwide popular vote depends on voter participation in every state but not on the margins of victory in each state. Therefore, as long as the nation accepts the principles set forth in the Constitution and wants to retain the Electoral College framework, there can be no expectation that the popular vote winner will necessarily win the Presidency.

How likely is it that a state will be willing to change its system? The state legislature of a fairly strong Democratic state or a fairly strong Republican state would not be willing to split its electoral votes. After all, why not keep all the electoral votes for their party? However, election results from 1960, 1968, 1992, and 2000 show that 29 states changed their party line in choosing a presidential candidate. Almost sixty percent of the states switch the party line in choosing their presidential candidate - this is not a small figure. Hence there is no comfort in maintaining the status quo of winner-take-all system as far as presidential election goes.

⁴⁰ For example, in a state with 3 electors, as long as a plurality winner wins somewhat less than 2/3 of the popular votes, the margin of victory is not very important as he collects 2 electoral votes from the state. Similarly, in a state with 9 electors, as long as the margin of victory of a majority winner falls safely in between 55.6% (5/9) and 66.7% (6/9), the precise margin does not matter and he receives 6 votes.

⁴¹ If the integral proportional system had been adopted, the 2000 vote count fiasco in Florida could have been avoided. Presumably, similar vote count issues can be minimized in the future as well.

Currently the media reports that some members of Congress and state legislatures are proposing changes in the presidential election process. The Maine-Nebraska model is often mentioned. As observed, the compatibility of outcomes between any Electoral College system and the popular vote is tenuous. If only a few states are convinced to switch from the status quo, then more unpleasant and seemingly unfair results are sure to follow. It would seem preferable to have a reform adopted by all states, not just a few.

Appendix I. Under any Electoral College System One Can Win the Popular Vote but Lose the Election

The following example shows how easy it is under any Electoral College system to have someone losing the election and winning the popular vote. Table 15 examines the case of two states and compares popular vote outcomes across the two states with the different electoral vote outcomes. The idea is that the interaction between two states can lead to an understanding in the case of many states. In particular, the table gives the number of districts (#D), the average number of voters in each district (V per D), and the percentages of voters selecting candidates A and B (% for A and % for B, respectively).⁴² Section A provides the basic setting in which the outcomes are similar to those in Table 12: the E' outcome is consistent with the popular vote across states while the E and the E* outcomes are inconsistent. Sections B through E illustrate small changes from that depicted in section A, with the changes appearing in bold.

This example illustrates the possibility of an inconsistent outcome under E' – the perfect proportional system. Section B shows that if the number of districts in S1 is 6 rather than 5, then the E' outcome is inconsistent with the nationwide popular outcome while the E and the E* outcomes are consistent. Section C shows what happens when, instead of a larger number of districts in S1, the number of voters in S2 is smaller. These examples show that no Electoral College outcome is always consistent with the popular outcome.

⁴² The numbers appearing under the columns V per D, Pa, and Pb should be measured in units of 100,000.

Table 15

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		# D	V per D	% for A	% for B	Pa	Pb	Ea	Eb	E' a	E' b	E*a	E* b
(A)	S1	5	25	0.542	0.458	67.75	57.25	7		3.794	3.206	4	3
	S2	5	25	0.45	0.55	56.25	68.75		7	3.15	3.85	3	4
	S1 & S2					124	126	7	7	6.944	7.056	7	7
							P: B	E: tie			E': B	E*: tie	
	Consistency with the P outcome								No	No		Yes	No
(B)	S1	6	25	0.542	0.458	81.3	68.7	8		4.336	3.664	5	3
	S2	5	25	0.45	0.55	56.25	68.75		7	3.15	3.85	3	4
	S1 & S2					137.55	137.45	8	7	7.486	7.514	8	7
							P: A	E: A			E': B	E*: A	
	Consistency with the P outcome								Yes			No	Yes
(C)	S1	5	25	0.542	0.458	67.75	57.25	7		3.794	3.206	4	3
	S2	5	20	0.45	0.55	45	55		7	3.15	3.85	3	4
	S1 & S2					112.75	112.25	7	7	6.944	7.056	7	7
							P: A	E: tie			E': B	E*: tie	
	Consistency with the P outcome								No			No	No
(D)	S1	6	25	0.542	0.458	81.3	68.7	8		4.336	3.664	5	3
	S2	5	25	0.42	0.58	52.5	72.5		7	2.94	4.06	2	5
	S1 & S2					133.8	141.2	8	7	7.276	7.724	7	8
							P: B	E: A			E': B	E*: B	
	Consistency with the P outcome								No			Yes	
(E)	S1	6	25	0.568	0.432	85.2	64.8	8		4.544	3.456	5	3
	S2	5	25	0.42	0.58	52.5	72.5		7	2.94	4.06	2	5
	S1 & S2					137.7	137.3	8	7	7.484	7.516	7	8
							P: A	E: A			E': B	E*: B	
	Consistency with the P outcome								Yes			No	

As the first three sections of Table 15 investigate the unpleasant property of the E' system, the outcomes under E and E* are always identical. The next two sections look into the impact on outcomes given changes in the winning margin in the popular votes. In section D, increasing the

margin of victory for candidate B in S2 from section B reverses the winner between the E system and the E* system. In particular, both the E* outcome and the E' outcome are compatible with the popular outcome while the E outcome is not. Presumably, these are the outcomes that are hoped for in this study, since alternative systems that supposedly provide better electoral presentations of the popular votes relative to the widely adopted winner-take-all system are proposed. Unfortunately, this is also not always the case.

Section E in Table 15 shows that if the winning margin for candidate A in S1 increases, the outcomes are completely different. In this case, only the E outcome is consistent with the popular vote. The table illustrates the unstable properties of all outcomes: if the numbers of districts, voter participation, or margins of victory change slightly, the popular winner can change as well as the winners under the different electoral allocation systems. Further, the lack of a fixed relationship between the outcomes of the different electoral allocation systems and the popular outcome is prominent in the example. It seems likely that any of the scenarios exhibited in Table 15 can occur in reality.

Appendix 2 - Election 2000

Source: <http://cbsnews.com/campaign2000results/election/index.html> (Downloaded 12/16/2000)

State	T	E	Al GORE					George W. BUSH					Ralph NADER				Pat BUCHANAN			
			Pg/T	Eg	E'g	E*g ₁	E*g ₂	Pb/T	Eb	E'b	E*b ₁	E*b ₂	Pn/T	En	E'n	E*n ₃	Pp/T	Ep	E'p	E*p
Total	103,161,312	538		267	259.89	158	105		271	261.01	166	106		0	14.61	3		0	2.49	0
Alabama	1,664,912	9	0.418	0	3.77		3	0.567	9	5.10	6		0.011	0	0.10		0.004	0	0.03	
Alaska	227,363	3	0.283	0	0.85		1	0.598	3	1.80	2		0.100	0	0.30		0.019	0	0.06	
Arizona	1,404,257	8	0.453	0	3.62		3	0.509	8	4.07	5		0.030	0	0.24		0.008	0	0.07	
Arkansas	916,779	6	0.459	0	2.75		2	0.515	6	3.09	4		0.014	0	0.09		0.012	0	0.07	
California	10,608,225	54	0.539	54	29.12	30		0.418	0	22.59		22	0.038	0	2.07	2	0.004	0	0.22	
Colorado	1,724,478	8	0.428	0	3.43		3	0.513	8	4.10	5		0.053	0	0.42		0.006	0	0.05	
Connecticut	1,406,857	8	0.566	8	4.53	5		0.388	0	3.10		3	0.043	0	0.34		0.003	0	0.03	
Delaware	326,782	3	0.553	3	1.66	2		0.419	0	1.26		1	0.025	0	0.08		0.002	0	0.01	
Dist.of Columbia ~	188,949	3	0.857	3	2.57	3		0.090	0	0.27		0	0.053	0	0.16		0.000	0	0.00	
Florida	5,939,934	25	0.490	0	12.26		12	0.490	25	12.26	13		0.016	0	0.41		0.003	0	0.07	
Georgia	2,537,761	13	0.438	0	5.69		5	0.558	13	7.25	8		0.000	0	0.00		0.004	0	0.06	
Hawaii	365,674	4	0.561	4	2.24	3		0.377	0	1.51		1	0.059	0	0.24		0.003	0	0.01	
Idaho	482,340	4	0.287	0	1.15		1	0.697	4	2.79	3		0.000	0	0.00		0.016	0	0.06	
Illinois	4,728,000	22	0.548	22	12.05	13		0.427	0	9.40		9	0.022	0	0.48		0.003	0	0.07	
Indiana	2,159,582	12	0.417	0	5.00		5	0.575	12	6.90	7		0.000	0	0.00		0.008	0	0.10	
Iowa *	1,307,663	7	0.488	7	3.42	4		0.485	0	3.40		3	0.022	0	0.16		0.004	0	0.03	
Kansas	1,052,679	6	0.373	0	2.24		2	0.586	6	3.52	4		0.034	0	0.20		0.007	0	0.04	
Kentucky	1,534,770	8	0.415	0	3.32		3	0.567	8	4.53	5		0.015	0	0.12		0.003	0	0.02	
Louisiana	1,749,802	9	0.451	0	4.06		4	0.528	9	4.76	5		0.012	0	0.11		0.008	0	0.07	
Maine *	642,999	4	0.492	4	1.97	3		0.443	0	1.77		1	0.059	0	0.24		0.007	0	0.03	
Maryland	1,919,400	10	0.570	10	5.70	6		0.402	0	4.02		4	0.027	0	0.27		0.002	0	0.02	
Massachusetts	2,671,925	12	0.603	12	7.23	8		0.328	0	3.94		4	0.065	0	0.78		0.004	0	0.05	
Michigan	4,172,659	18	0.513	18	9.24	10		0.467	0	8.40		8	0.020	0	0.36		0.000	0	0.00	
Minnesota *	2,427,334	10	0.481	10	4.81	6		0.457	0	4.57		4	0.052	0	0.52		0.009	0	0.09	
Mississippi	960,407	7	0.417	0	2.92		2	0.572	7	4.00	5		0.008	0	0.06		0.002	0	0.02	
Missouri	2,348,641	11	0.473	0	5.20		5	0.506	11	5.57	6		0.016	0	0.18		0.004	0	0.05	
Montana	407,241	3	0.337	0	1.01		1	0.589	3	1.77	2		0.060	0	0.18		0.014	0	0.04	
Nebraska	650,741	5	0.331	0	1.66		1	0.628	5	3.14	4		0.035	0	0.18		0.005	0	0.03	
Nevada	601,239	4	0.466	0	1.86		1	0.502	4	2.01	3		0.025	0	0.10		0.008	0	0.03	
New Hampshire *	563,747	4	0.472	0	1.89		1	0.484	4	1.94	3		0.039	0	0.16		0.005	0	0.02	
New Jersey	3,100,339	15	0.564	15	8.45	9		0.404	0	6.07		6	0.030	0	0.45		0.002	0	0.03	
New Mexico *	594,681	5	0.481	5	2.41	3		0.481	0	2.40		2	0.036	0	0.18		0.002	0	0.01	
New York	6,260,288	33	0.602	33	19.86	20		0.357	0	11.79		12	0.036	0	1.18	1	0.005	0	0.18	

State	T	E	AI GORE					George W. BUSH					Ralph NADER				Pat BUCHANAN				
			Pg/T	Eg	E'g	E*g ₁	E*g ₂	Pb/T	Eb	E'b	E*b ₁	E*b ₂	Pn/T	En	E'n	E*n ₃	Pp/T	Ep	E'p	E*p	
North Carolina	2,852,930	14	0.433	0	6.07		6	0.563	14	7.89	8			0.000	0	0.00			0.003	0	0.04
North Dakota	288,530	3	0.333	0	1.00		1	0.609	3	1.83	2			0.033	0	0.10			0.025	0	0.08
Ohio	4,552,370	21	0.465	0	9.77		10	0.504	21	10.58	11			0.025	0	0.53			0.006	0	0.12
Oklahoma	1,227,675	8	0.386	0	3.09		3	0.606	8	4.85	5			0.000	0	0.00			0.007	0	0.06
Oregon *	1,516,099	7	0.474	7	3.32	4		0.470	0	3.29		3		0.051	0	0.36			0.005	0	0.03
Pennsylvania	4,849,053	23	0.508	23	11.69	12		0.467	0	10.74		11		0.021	0	0.49			0.003	0	0.08
Rhode Island	413,485	4	0.615	4	2.46	3		0.321	0	1.28		1		0.059	0	0.23			0.005	0	0.02
South Carolina	1,407,517	8	0.411	0	3.29		3	0.572	8	4.57	5			0.015	0	0.12			0.003	0	0.02
South Dakota	312,579	3	0.380	0	1.14		1	0.609	3	1.83	2			0.000	0	0.00			0.011	0	0.03
Tennessee	2,058,181	11	0.475	0	5.23		5	0.513	11	5.65	6			0.010	0	0.11			0.002	0	0.02
Texas	6,376,321	32	0.381	0	12.19		12	0.595	32	19.05	20			0.022	0	0.69			0.002	0	0.06
Utah	758,840	5	0.266	0	1.33		1	0.675	5	3.37	4			0.047	0	0.23			0.012	0	0.06
Vermont	289,431	3	0.512	3	1.54	2		0.412	0	1.24		1		0.068	0	0.21			0.008	0	0.02
Virginia	2,717,610	13	0.449	0	5.84		6	0.527	13	6.85	7			0.022	0	0.28			0.002	0	0.03
Washington	2,466,689	11	0.506	11	5.56	6		0.450	0	4.94		5		0.042	0	0.46			0.003	0	0.03
West Virginia	634,337	5	0.459	0	2.29		2	0.520	5	2.60	3			0.016	0	0.08			0.005	0	0.02
Wisconsin *	2,580,398	11	0.481	11	5.29	6		0.479	0	5.26		5		0.036	0	0.40			0.004	0	0.05
Wyoming ~	210,819	3	0.287	0	0.86		0	0.700	3	2.10	3			0.000	0	0.00			0.013	0	0.04

* The states that have the plurality effects.

~ The two states who allocate all the E* votes to the majority winner.

Pa/T- the fraction of popular vote going to candidate A.

Ea - the number of electoral votes allocated to candidate A under winner-take-all electoral allocation system E.

E'a - the number of electoral votes allocated to candidate A under perfect proportional electoral allocation system E'.

E*a - the number of electoral votes allocated to candidate A under integral proportional electoral allocation system E*.

(The subscript j refers to votes won because candidate A comes in jth garnering the most popular votes.)