



HAL
open science

Trapped by the Prisoner's Dilemma, the United States Presidential Election Needs a Coordination Device

Héloïse Cloléry, Yukio Koriyama

► **To cite this version:**

Héloïse Cloléry, Yukio Koriyama. Trapped by the Prisoner's Dilemma, the United States Presidential Election Needs a Coordination Device. 2020. halshs-03019446

HAL Id: halshs-03019446

<https://shs.hal.science/halshs-03019446>

Submitted on 23 Nov 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Trapped by the Prisoner's Dilemma, the United States Presidential Election Needs a Coordination Device

IPP Policy Brief 

n°60 

October 2020 

Héloïse Cloléry 
 Yukio Koriyama 

www.ipp.eu 

The system according to which the President of the United States of America is elected, the Electoral College, has often raised concerns. Among those, the winner-take-all rule is often criticized for potentially -and in recent years effectively- bringing to power a president who has not obtained the majority of the popular vote.

This note shows that most of the reform proposals have failed due to the structure of the problem: the US Presidential Election is trapped by the Prisoner's Dilemma. Each state would rationally choose the winner-take-all rule in order to best reflect its citizens' preferences on the federal decision. However, the outcome of such a choice, if adopted by all states, would not be desirable for the nation as a whole, because it prevents the optimal aggregation of all citizens' preferences.

A weighted proportional rule, if used by all states, would make all citizens better off by reflecting their preferences on the final decision more accurately. However, since each state has an incentive to adopt the winner-take-all rule regardless of the choice of the other states, it is impossible for all the states to adopt such a rule without a coordination device.

We therefore analyze interesting attempts to escape from this dilemma, such as the National Popular Vote Interstate Compact, and how our framework applies to representative democracy.

- The winner-take-all rule has been used almost exclusively in the US presidential elections since the 1830s, but has been criticized for various reasons. One of these is the occasional discrepancy between the election winner and the national popular vote results (e.g. George W. Bush vs. Al Gore in 2000, and Donald Trump vs. Hillary Clinton in 2016).
- The structure of the problem can be described with a game-theoretic analysis, at least partially: the Electoral College system is trapped by the Prisoner's Dilemma. States could benefit from cooperating, but they do not achieve this because each state does not have any guarantee that the other states would join a cooperative action.
- A coordination device is necessary in order to escape from the dilemma. Some interesting attempts, such as the National Popular Vote Interstate Compact, are underway.
- The same structure of the dilemma appears in representative democracy. Party discipline may induce distortion of the preference aggregation and thus may be welfare-detrimental for the society.



The Institut des politiques publiques (IPP) has been created by PSE and is developed through a scientific partnership between the Paris School of Economics (PSE) and the Groupe des écoles nationales d'économie et de statistique (GENES). The aim of the IPP is to promote quantitative analysis and evaluation of public policy using cutting edge research methods in economics.

Introduction

The world's attention is focused on whether or not US President Donald Trump will be reelected in November 2020. Mr. Trump won the last election in 2016 over Mrs. Hillary Clinton by a large margin, 306 to 232 electoral votes. However, the fact that the total number of popular votes for Mr. Trump was smaller than that for Mrs. Clinton by 2.86 million has caused a wide range of controversy. A discrepancy between the election results and the national popular vote has occurred a total of five times in the history of the United States, including twice in recent years since 2000, causing criticism against the usage of the Electoral College system.

The Electoral College is a two-stage election system, whereby in each state electors are voted for by citizens. It is then these electors who vote for a presidential candidate, according to a rule that is specified by each state.

What is often criticized is the winner-take-all rule. As of 2020, the winner-take-all rule has been adopted in all states (including Washington DC) except two, Nebraska and Maine. Under this rule, all of the electoral votes assigned to the state by the Constitution are cast for the candidate who won the state's popular vote. The controversial phenomenon described above happens largely due to the winner-take-all rule.

The US Constitution stipulates that each state should decide its own rule by which the electoral votes are distributed to the candidates (Article Two). In the early years of the nation, various rules were used, such as district-based rules, run-off elections, appointment by the state legislature or a mixture of these. The winner-take-all rule spread to a majority of the states in the 1830s and has been used dominantly in most states ever since. Recently, an amendment to the state constitution in Colorado to shift from the winner-take-all rule to the proportional distribution rule was proposed in 2004, but was rejected by the state referendum (Colorado Amendment 36).

Many problems have long been pointed out concerning the Electoral College system. Indeed, more than 700 proposals have been made in Congress to reform or abolish the Electoral College, more than any other subject in constitutional amendment. Nevertheless, most of the attempts to reform the system have failed. **Why is it difficult to reform the Electoral College in spite of its apparently evident deficiency?**

Trapped by the Dilemma: a Game-Theoretic Analysis

A game-theoretic analysis can reveal the structure of the problem at least partially. We describe here the inter-

action between the states as a “**game**” in the sense of game theory: a setting where states make decisions with regards to a particular outcome, by taking into account what they expect from the other states' decisions. In our context, the “**players**” of the game are the states; the US constitution stipulates that each state determines the rule according to which the electoral votes are distributed to the candidates. Under the winner-take-all rule, the candidate that obtains the most popular votes in the state is awarded all of its electoral votes. Under the proportional rule, candidates obtain electoral votes in proportion to their shares in the popular vote. There also exist other types of rules.

In general, each state decides the electoral vote distribution by aggregating the citizens' preferences, using the state's popular vote. Therefore, the strategic element for a state is how to determine the distribution of electoral votes amongst the candidates, as a function of the state popular vote result.

In order to maximize the extent to which its citizens' opinions are reflected in the federal decision, it is in the best interest of the state to bet all its weights on the alternative supported by the majority of the citizens.

In modeling the decisions of states, we assume that each state's objective is to maximize the degree to which its citizens' opinions are reflected in the federal decision. Therefore, the “**payoff**” of a state in the game can be measured by the probability with which a citizen's preferred candidate coincides with the winner of the election. This “**payoff**” is what the state considers when deciding which rule to adopt: if a rule (say, the winner-take-all rule) increases the probability that the choice of citizens of a state coincides with the winner of the overall election, then this rule is preferred by the state, as compared to other rules.

In this game, the winner-take-all can be shown to be a “dominant strategy”. This means that no matter what rules other states adopt, each state's optimal strategy (its best response to those rules) is to employ the winner-take-all rule. The idea behind the claim is straightforward. In order to maximize the extent to which its citizens' opinions are reflected in the federal decision, it is in the best interest of the state to bet all its weights on the alternative supported by the majority of the citizens. Therefore, the situation where all states use the winner-take-all rule is what game theory calls a “Nash equilibrium” of the game: a situation where no state has an incentive to choose a different rule, given what the other states choose as a rule.

However, we can show that the “Nash equilibrium” is

“Pareto-dominated”, in terms of welfare analysis. This means that **it is possible to increase the payoff of all states without harming any state.**¹ This criterion is fundamental since it can provide a consensual ranking between situations. The reason for the claim is as follows. In the equilibrium, each state emphasizes the opinion of the majority to the extreme in order to increase the probability that its citizens' votes coincide with the election result as much as possible. With all states adopting such a strategy, the aggregated opinions are thus distorted. As a result, the probability that the opinions of each citizen coincides with the federal decision will decrease.

To the contrary, if the states use a weighted proportional rule which can reflect the citizens' opinions more accurately, then preferences are aggregated more precisely and thus the overall result is more desirable for all citizens in all states. However, **such a mutually favorable situation cannot be achieved by the interaction of states without coordination.**² This is because each state can deviate to the winner-take-all rule and increase its own payoff. Each player's incentive to unilaterally deviate for its own advantage prevents the realization of a socially desirable allocation. This situation is known as the Prisoner's Dilemma in game theory. As a result of the rational behavior of each agent who individually chooses an optimal action, the society fails to achieve mutually favorable outcomes.³

When faced with the Prisoner's Dilemma, game theory has provided a clear insight: it is useless to just rely on the effort of each agent to escape from the dilemma.

When faced with the Prisoner's Dilemma, game theory has provided a clear insight: it is useless to just rely on the effort of each agent to escape from the dilemma. As we saw above in the case of the Colorado referendum, it is not beneficial for each state alone to shift to another rule.

Beisbart and Bovens (2008) estimate the voting power change due to the amendment proposed in Colorado in 2004. If all states use the winner-take-all rule, the probability for a citizen in Colorado to be pivotal, that is to make the election tilt in one direction or another, is estimated as 86% of the average of the same probabilities over all states. If Colorado adopts the proportional rule alone while all other states keep using the winner-take-all rule, it drops to 8%.

¹Using an economic jargon, we say that there exists a Pareto improvement.

²In terms of game theory, such a situation does not constitute an *equilibrium*.

³Rationality here is understood as the maximization of the agent's payoff in the game.

Historical facts also support our observation that states have no incentive to deviate once the winner-take-all rule is in use. Although various rules were used in the early years of the nation, most states have stuck to the winner-take-all rule for more than 180 years. And the attempts to amend the rule have failed, in spite of a wide range of criticisms against it.

Some kind of coordination device is necessary to escape from the dilemma, as game theory suggests.

What is a remedy? Designing a Coordination Device

An interesting example of a potential coordination tool amongst states is currently underway, called **the National Popular Vote Interstate Compact (NPVIC)**. This interstate compact is an agreement between states, where they state in advance how they will modify their electoral rules once a specific condition has been met. More specifically, the agreement stipulates that i) the states which ratify the compact should designate all electoral votes to the winner of the national popular vote. It also stipulates that ii) such an agreement would come into effect only when the total number of electoral votes allocated to the states that have ratified the compact reaches a majority of the entire Electoral College. When this condition is met, the outcome of the election will match the winner of the national popular vote. Therefore, the deviation from the winner-take-all profile does not take place by one state alone, or by a coalition of states that have joined the agreement, but by all states at once. The compact thus works as a perfect example of a coordination device.

As of October 2020, 16 states, including California, Illinois and New York, have ratified the compact, gathering 196 electoral votes. In addition, the compact has passed at least one of the state legislatures in other 9 states, counting 88 additional electoral votes. It would be interesting to see whether the total number of ratified votes reaches 270, a majority of the Electoral College, in the near future.

Another strategy of interest is **the Congressional District Method (CDM)**, currently used by the above-mentioned exceptional states, Nebraska and Maine. Two votes, assigned to each state as the number of the US Senate members, are distributed to the winner of the state popular vote, and the rest, assigned as the number of the House of the Representatives members, is distributed independently to the winner of the popular vote in each district. CDM can be thus seen as a mixture of the winner-take-all rule and the proportional rule.

Kikuchi and Koriyama (2019) illustrate how these strategies compare to the winner-take-all rule if they were adopted. They do so by simulating what the outcome

Table 1: Estimated payoffs in the US presidential election.

Electoral votes	States	WTA	PR	CDM
55	CA	0.236	0.261	0.251
38	TX	0.149	0.173	0.168
29	FL, NY	0.112	0.130	0.128
20	IL, PA	0.076	0.089	0.089
18	OH	0.068	0.080	0.080
16	GA, MI	0.061	0.071	0.072
15	NC	0.057	0.067	0.067
14	NJ	0.053	0.062	0.063
13	VA	0.049	0.058	0.059
12	WA	0.045	0.053	0.055
11	AZ, IN, MA, TN	0.042	0.049	0.050
10	MD, MN, MO, WI	0.038	0.044	0.046
9	AL, CO, SC	0.034	0.040	0.042
8	KY, LA	0.030	0.035	0.038
7	CT, OK, OR	0.026	0.031	0.034
6	AR, IA, KS, MS, NV, UT	0.023	0.027	0.029
5	NE, NM, WV	0.019	0.022	0.025
4	HI, ID, ME, NH, RI	0.015	0.018	0.021
3	AK, DE, DC, MT, ND, SD, VT, WY	0.011	0.013	0.017

Notes: Kikuchi and Koriyama (2019) simulate the outcome of the elections and compare the welfare of each state under different rules. Simulations are based on the apportionment in 2016, via Monte Carlo simulation with 10^{10} iterations. The estimated standard errors are in the range between 3.9 and 4.1×10^{-6} and are not displayed here. The abbreviations used are the ones of the [US Postal Service](#).

Reading note: In California, the probability that each citizen's preferred candidate wins the election is 23.6% higher than random success if all states choose the winner-take-all rule. This probability goes up to 26.1% if all states use the proportional rule instead.

of the elections would have been in 2016 had different rules applied. Table 1 shows the estimated expected payoffs based on the apportionment in 2016. The payoff is measured by the marginal (i.e. above the random success) probability that each citizen's preferred candidate wins the election.

We observe that the proportional rule “Pareto-dominates” the winner-take-all rule, as predicted by the theory: **for all states, the average probability that their citizens' preferred candidate wins the election under the proportional rule (PR column) is greater than under the winner-take-all rule (WTA column).** That is, the payoffs are higher for *all* states with the proportional rule than the winner-take-all rule, if the rule is used *by all states at the same time*.

Another interesting observation is that CDM also Pareto dominates the winner-take-all rule. Therefore, if it is used by all states simultaneously, we can improve the expected payoff of all states without harming any state's welfare. Moreover, even compared to the proportional rule, which is known to be “Pareto optimal” (i.e. never Pareto dominated by any other profile), payoffs with the CDM rule are improved for 44 states (including DC). The seven most populated states are worse off.

Kikuchi and Koriyama (2019) show more generally that the CDM (i) reduces the inequality among states, and (ii) is advantageous for the states with small populations, as

compared to the situation where any other rule is uniformly used by all states. If the policy maker prioritizes either the reduction of inequality across states or minority protection, then the Congressional District Method can be considered as an effective solution.

A lesson from the above observations is that an institutional design approach would be useful in order to obtain desirable properties in collective decision making. There is no doubt that it is necessary to design a coordination device carefully, in order to escape from the dilemma.

A Structural Problem in Representative Democracy: an Example of the French Legislature

The same structure of the dilemma can be found in a representative democracy where social decisions are made collectively by the representatives of the groups. Party discipline is such an example.

In most democratic societies, the legislative process proceeds with the votes cast by the legislators who belong to a political party. Parties often impose disciplinary measures in order to fully reflect the party's supported policy to the final vote outcome. **However, the majority opinion of the party does not necessarily coincide with the preferences of all legislators,** let alone those of the entire constituency.

The structure of the problem is the same as in the Electoral College described above. Each party's rational strategy is to impose its party discipline in order to maximize the probability that its favored policy wins the vote. All parties thus have an incentive to use a discipline. However, the distortion of the legislators' opinions caused by the discipline prevents optimal preference aggregation. As a consequence, such an outcome is not socially optimal, since it fails to aggregate the opinions of the legislators, and thus of the constituencies.

Cloréry and Koriyama (2020) estimate the effect of party discipline on the vote outcome in France. They use the voting records in the 14th legislature of the French Fifth Republic from 2014 to 2017. The average alignment rates in this period were between 95.7% and 100% across parties, suggesting that some degree of discipline was at work.

Figure 1 shows the comparison of the actual vote outcome and the estimated outcome without discipline. Win or loss of a party is defined by whether the alternative voted by the majority of the party members coincides with the final outcome or not.

Our estimation suggests that the ruling parties -socialist, radical left and the ecologists- are better off when parties

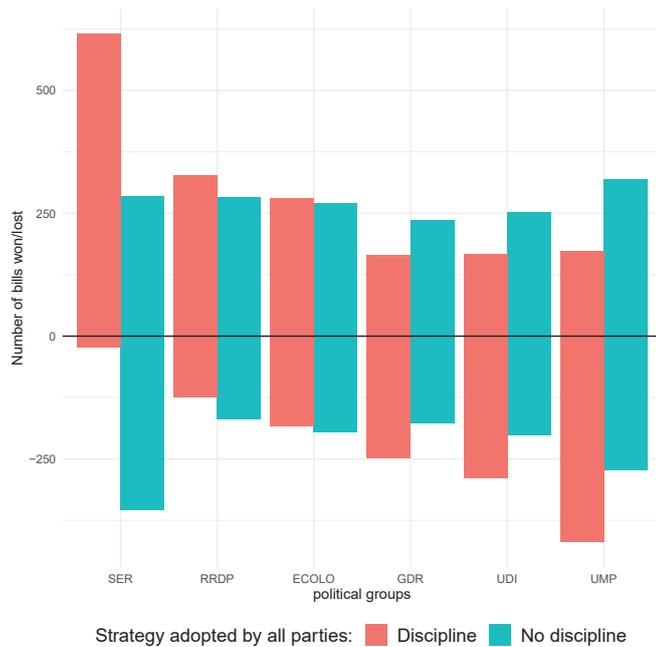


Figure 1: Number of wins and losses by party in the 14th legislature in French Fifth Republic from 2014 to 2017: comparison of actual results and estimated ones without party discipline.

Notes : The different acronyms stand for the political groups formed in the National Assembly: SER for *Socialiste, écologistes et républicains*; RRDP for *Radical, républicain, démocrate et progressiste*; ECOLO for *Ecologiste*; GDR for *Gauche démocrate et républicaine*; UDI for *Union des démocrates et indépendants*; UMP for *Union pour un mouvement populaire*.

Reading note: In the actual results, the socialist party (SER) obtained their desired outcome for 615 bills, but lost for 23 in the National Assembly. If all parties had committed not to use discipline, the socialist party would have won for only 284 bills, and lost for 354.

use discipline, while the parties from the opposition -right wing and the centrists- would be better off if none of the parties were to use discipline. **In general, discipline favors the ruling parties and disfavors the oppositions.** When a party occupies a majority of the seats in Parliament, it can theoretically pass any preferred alternative by enforcing strict discipline. Thus, social decisions with discipline tend to be biased in favor of the ruling parties, while no discipline can balance the vote towards the outcomes that satisfy parties in proportions closer to the composition of the Assembly.

Again, in order to obtain a welfare improvement, a coordination device is necessary. In this case, a policy which restricts party discipline may be effective. Less radically, it may be useful to design and integrate an institutional rule which discounts the extent to which excessively aligned opinions are aggregated.

Conclusion

In collective decision making among groups, each group has an incentive to emphasize their opinions excessively. As a result, optimal preference aggregation may be hindered. This is a structural problem which may appear in different levels of democratic decision making among groups, ranging from the US Presidential Election to the French national legislature.

The dilemma analyzed here appears ubiquitously, both in private and public institutions. When collective decisions are made in a society which consists of distinct groups, it is well-known in game theory that a long-term relationship works as a coordination device, since the benefit from long-term cooperative actions exceeds the one-shot gain from myopic self-interested actions.⁴ Mechanism design is the field of study which analyzes the properties of the policies, taking into account the agents' incentives. Knowledge from game theory suggests that commitment plays a crucial role when implementing such policies.

A careful design of the mechanism is necessary in order to escape from the structural problems in collective decision making. For that, game-theoretic analysis may help.

Authors

Héloïse Cloréry is a PhD student at CREST-Ecole Polytechnique, IP Paris.

Yukio Koriyama is a Professor at CREST-Ecole Polytechnique, IP Paris.

References

Beisbart, Claus and Luc Bovens (2008). "A power measure analysis of Amendment 36 in Colorado". *Public Choice* 134.3-4, pp. 231-246.

Cloréry, Héloïse and Yukio Koriyama (2020). "Measuring Party Discipline".

Kikuchi, Kazuya and Yukio Koriyama (2019). "The Winner-Take-All Dilemma".

⁴This field of study is known as repeated games.

Notes IPP

Editorial board: P. Boyer, A. Bozio, J. Grenet
 Managing editors: P. Dutronc-Postel, A. Rain