The Cost of Ranked Choice Voting

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Abstract

While some academic focus has been given to the theoretical merits of alternative voting methods, many tangible aspects have gone overlooked. This has left elections administrators without essential knowledge necessary to effectively implement these types of election reforms. This study was designed to determine whether the implementation of ranked choice voting (RCV) methods at the local level is responsible for increases or decreases to the cost of elections within the municipality that implements it. Elections costs were obtained from seven local governments which switched to RCV and seven matched control governments for ten years before and after RCV was implemented. These costs were then aggregated into standard election cycles and converted into per-capita cost. A difference-in-difference regression was used to determine how switching to RCV affected election costs both during and after the initial implementation phase. Although the RCV jurisdictions are found to spend significantly more on elections overall, any differences in election cost during or following the implementation of RCV are not found to be statistically significant. This study is unable to show that implementing ranked choice voting has been responsible for any financial savings or liabilities in the cities that have chosen to use it.

Introduction

In the United States and other modern democracies, elections are one of the most fundamental components of the maintenance of government. By extension, problems in elections and electoral processes are threats to democracies themselves...and there are a lot of problems. Noncompetitive and gerrymandered districts, winner-take-all contests, unnecessary runoffs, and plurality winners detract from the ideals of a democratic society. It is imperative for electoral problems to be properly remediated in order to preserve the role of the citizen as central to the governing process.

The endeavor of reforming elections is as complex as it is important. Perhaps the most difficult challenge is determining where supposed democratic processes fall short. In what ways are elections failing to produce fair outcomes through democratic processes? Collectively, the perceived problems are numerous. Different people and group have pointed to a plethora of different phenomena as the cause of democratic shortcomings. In some jurisdictions, elections are notorious for low voter turnout, brutally negative campaigns, and winners who do not fully represent the diversity of their constituents (Anest, 2009). Under most electoral systems, voting paradoxes are present. This has been proven in the cases of the 2016 United States Presidential Primaries and in Danish Parliamentary elections (Kurrild-Klitgaard, 2017). Winning candidates have consistently and significantly benefited from undemocratic byproducts of their electoral processes. I all forms they take, electoral problems are present and impactful.

Scholars, policymakers, and citizens alike have long decried the existence of democratic problems. Still, their grievances commonly fail to be substantiated because evidence of problems in elections is often subjective, anecdotal, or unquantifiable. This makes tools and metrics that objectively describe democratic conditions indispensable. The progress made by academics in political science generally and election science specifically has produced new tools with which to measure both the problems that exist and the solutions proposed to fix them. Still, the measures created are not all-encompassing. There are many problems that remain without the tools necessary to describe and address them.

While democratic issues are surely multi-faceted, many can be attributed to the methods employed to elect policymakers. The most common electoral method in the United States is the plurality where each voter is allowed a single vote, regardless of the number of candidates running. The votes are then counted and the candidate with the most votes is declared the winner. Some variants require that the winning candidate receive a majority of the vote and will trigger a runoff between the top candidates if this threshold is not reached, but this is not universally required. These systems are problematic because in races where a large number of candidates seek election, either the winner could be selected with less than a majority of the vote, or multiple elections must be held to narrow the field down until someone reaches majority support. These elections are also prone to spoiler effects, are infamous for ferocious and trenchant campaign tactics, and fall short of ensuring that voters are fully able to express their preferences for all of the candidates.

The systematic problems related to voting methods are difficult to fix, but that does not mean that no solutions have been proposed. Of particular interest as a reform to current election processes is a transition to ranked choice voting methods (RCV). Two of such methods, instant runoff voting (IRV) and single transferable voting (STV) are the election models endorsed by many academics in the fields of political science and statistics. By allowing voters to rank the candidates instead of selecting just a single one, RCV has been hailed for its ability to allow voters to better express their full preferences towards all of the candidates. RCV has been supported as a reform that produces better outcomes by ensuring majority support for winners, increasing turnout, discouraging negative campaign tactics, and electing candidates that better represent the diversity of their communities (Anest, 2009).

Some of these claims have been challenged by RCV critics. Specifically, the claims that RCV brings about higher voter turnout has been disputed (Endersby and Towley 2014). It has also been alleged that the exhaustion of ballots in instant runoff tabulations dilutes the vote count so much that the winner may not actually have majority support (Burnett 2015). While candidates do have to attain a majority of non-exhausted ballots cast, this can be a lower number than the total number of valid ballots cast in the election. Still, even when the winning candidate does not receive a majority of all votes cast, they will receive more support than they would have in a simple plurality election.

Both theoretically and empirically, RCV offers a more democratic electoral process than the widely-used methods currently in place in the United States. Still, RCV is not without its practical shortfalls. A voting system is only as effective as it is implemented and RCV is often implemented improperly or inefficiently. RCV may be confusing to some voters. In some instances, this has led to concerningly high numbers of ballots that are spoiled or do not properly follow RCV directions (Neely, Blash and Cook, 2005). Spoiled and otherwise improperly completed ballots often reduce the pool of valid ballots and can concentrate influence in the hands of certain factions of voters.

This demonstrates an often-overlooked aspect of election reform: implementation. Few studies have been conducted to determine how the implementation of voting reform efforts influences their effectiveness. This leaves administrators in the dark on the best practices for seeing reform efforts like RCV through. It also disincentives policymakers from supporting reform efforts. In the last century, RCV has been repealed shortly after being passed in cities and states in nearly two-thirds of the jurisdictions in which it originally passed (Santucci, 2016). This includes in municipalities like Boulder, CO; Cincinnati, OH; and Ann Arbor, MI. Each of these cities repealed RCV in favor of plurality winners or runoff elections. In many aspects, there is absolutely no empirical or objective precedent to inform the proper implementation of RCV. This is a problem.

One particular shortcoming in the understanding of RCV implementation surrounds its financial effects. Proponents of RCV have long made the claim that it can be undertaken for cheaper than traditional plurality. They claim that by eliminating the need for primary and runoff elections, RCV will be responsible for a decline in the cost of elections to the jurisdictions that oversee them. These claims have never been sufficiently substantiated. The actual cost increases or savings brought about by RCV has not been the subject of any published study. Any claims regarding the effect that RCV has on election budgets is little more than speculation. This leaves a significant void in an important area of election administration. Without an understanding of the financial impact of undertaking electoral reforms like RCV, election administrators will be flying blind when trying to effectively implement them. Does implementing RCV at the local level change the cost of elections to the municipality? This paper will seek an answer to this question. By analyzing election cost data of municipalities that have implemented RCV in the last 20 years, the monetary costs and benefits of RCV can be revealed.

Methods

In the United States, the use of ranked choice voting has largely been limited to local jurisdictions. As of early 2018, ten different municipalities are actively utilizing some form of RCV to elect local officials. The majority of these cities first implemented RCV in the years between 2007 and 2011. The use of RCV is expanding, however. Two more municipalities and the state of Maine will also implement RCV later this year. The last decade has ushered in a new era of support for RCV not seen in more than fifty years. In the middle of the twentieth century, RCV saw a similar level of support as it was adopted in dozens of cities across the country.

Both historically and currently, RCV has taken numerous different forms when used. In some jurisdictions, like Telluride, CO and Portland, ME the use of RCV is limited to only one local race, such as mayor. In other cities, however, RCV is used more extensively to elect every official at the local level. This includes the mayor, city council, sheriff, and other municipal positions. Additionally, the exact type of RCV can vary as well. In jurisdictions that use districts and each race has only one winner, RCV usually takes the form of “instant runoff voting” (IRV). When it is used in multi-winner races – usually at-large council races – it takes the form of the “single transferable vote” (STV). Going even further, both IRV and STV can utilize different methods to eliminate candidates and redistribute votes. However, no matter the form of RCV, any city that uses it should be subject to the financial effects caused by it. For this reason, each of these disparities will be negated and any municipality that uses RCV to elect local officials in any capacity will be considered an “RCV city.”

Because a significant number of the cities that currently utilize RCV have implemented it fairly recently, many records from the years surrounding its implementation remain intact and accessible. Here, each of the cities which have implemented RCV in the last twenty years and had it in place for at least three election cycles are subjects of examination. By looking at documented election costs for each city in the years surrounding RCV implementation, an aggregate spending pattern is discerned. This model is then compared with a similar model created from the election costs of control cities that do not utilize RCV over the same time period.

Variables

In this study, the type of election used by a given city is the explanatory variable. Ranked choice voting methods will be contrasted with standard voting methods. These include both majority-rule voting and plurality voting. Both methods are similar. They both usually entail a primary and a general election in which each voter is awarded one vote for each seat to be filled.

Their use is both common and widespread throughout the United States. Under the plurality system, the candidate(s) with the most votes are certified as the winner(s). Under the majority system, the winning candidates must surpass a certain percentage of votes. This is usually 50 percent plus one but can be different for contests with more than one winner. A particularity associated with majority-rule voting is that when no candidate reaches the number of votes required to be elected, another runoff election is forced between the top contenders for the seat. This means that majority-rule votes can require three different elections in order to choose a winner for a single seat. Each of these elections will run a cost to the jurisdiction that oversees them.

The alternative under examination – RCV – inherently encompasses a broad range of different voting methods such as instant-runoff voting, single transferable voting, Borda counts, and Condorcet criterion. Only two of these methods – IRV and STV – have actually been used in elections in the United States. The cost of running RCV elections in these two forms has been the subject of much rhetoric. Proponents of RCV claim that it will save jurisdictions money by eliminating the need for unnecessary runoff and primary elections. Opponents argue that RCV drives up costs as it is inherently confusing to voters and can warrant public campaigns to educate the public on its use. Additionally, it requires special voting equipment in order to implement, which is often expensive to purchase. It can also require election workers work longer hours, potentially further driving up the costs.

These two classifications of voting systems are compared on the basis their financial cost. Because the interest is in the regular and ongoing aggregate cost of elections, there is a need to account for numerous relative discrepancies between cities. Different jurisdictions hold municipal elections during different times of the year and on different years themselves. In order to remediate these differences, the cost used is not the cost of particular elections or even the annual cost of elections. Instead, the aggregate biannual cost of elections is used. This is the total amount spent on all elections held in a two-year period. Additionally, in order to account for size differences in cities, the costs considered are marginal to the population of those cities. The dependent variable is thus the biannual marginal cost of elections for each city examined. This provides a fair metric with which all cities election costs can be compared equally.

Selection of Cities

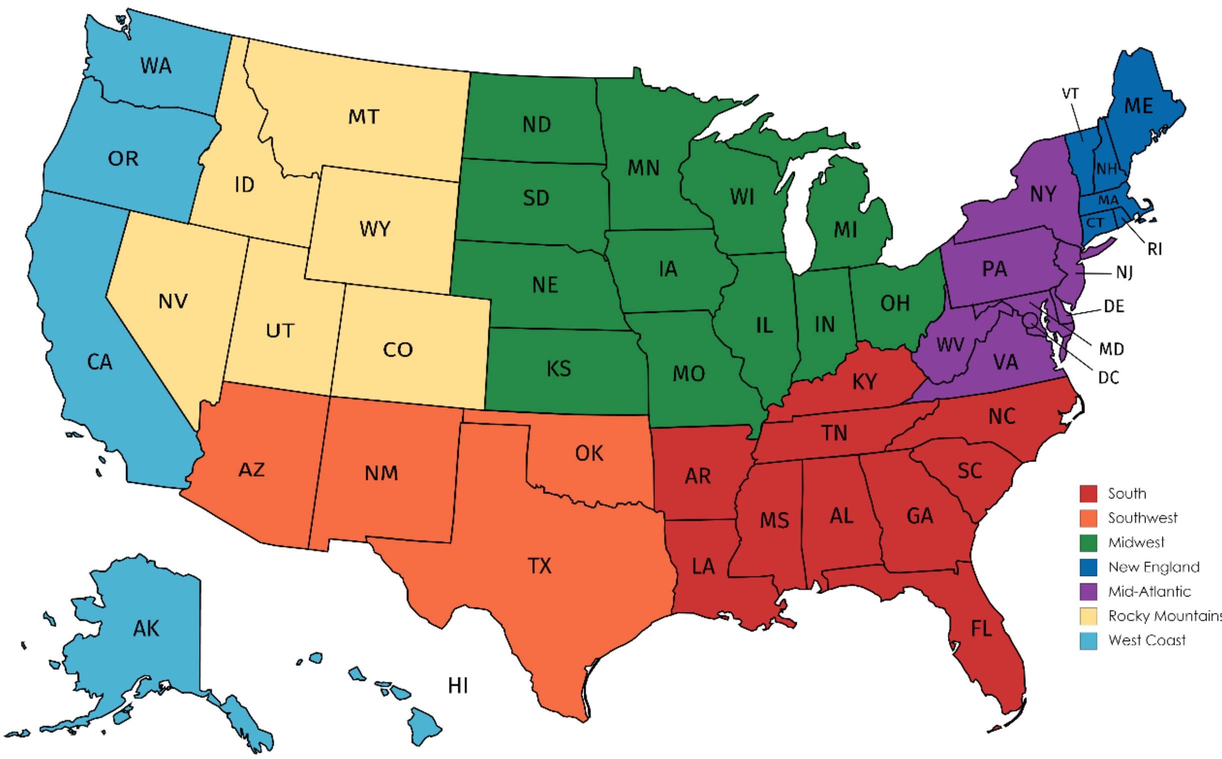
Cities that conduct elections using RCV are the focus of this study. Because only eleven cities implemented RCV in the United States during the time period of focus, a random sample of these municipalities is not appropriate. Instead, efforts were made to include every municipality that utilizes RCV for election cost data with the intention of establishing a full census. Requests were sent to Berkeley, CA; Burlington, VT; Hendersonville, NC; Minneapolis, MN; Oakland, CA; Portland, ME; San Francisco, CA; San Leandro, CA; St. Paul, MN; Takoma Park, MD; and Telluride, CO. Even though Cambridge, MA still uses RCV for its local elections, it was excluded because it first implemented RCV in the 1940s, making its data antiquated and excessively difficult to obtain. From these cities, four (Minneapolis, MN; San Francisco, CA; Hendersonville, NC; and Portland, ME) were unable to produce sufficient records of election costs for the years requested and had to be excluded.

Data from the eleven experimental RCV cities was then compared with data from control cities. Because the cities that have enacted RCV are not themselves a random sample of all municipalities throughout the country or even within their respective states, a random sample was not deemed appropriate to select the control cities. Instead, control cities were intentionally selected through a matching criterea. Six different variables were considered with the intention of identifying control cities that were as similar to the experimental cities as possible. The variables considered are outlined as follows.

Location (L)

Because state laws, regional economies, governmental structures, culture, and other similar factors could alter the cost of elections to municipalities, control cities were evaluated based on their location. Cities within the same state as their corresponding experimental city were considered to best fulfill this consideration. When no other cities within the same state closely mirrored the experimental city, cities in the same region of the country were given precedence. The regions used are shown in Image 1.

Figure 1 - Map of The United States by region



Population (P)

A city's population is one of its most defining traits. Bigger cities have larger and greater encompassing governments than small cities towns, and villages. More importantly, bigger cities generally have more expensive governments than smaller governments. For this reason, control cities were only considered if they had a population within 25% of the experimental city as of the 2010 census. Within this margin, cities with closer populations to the experimental cities were favored.

Size of Municipal Annual Budget (B)

In order to account for possible financial factors, control cities were evaluated on the amount of their annual expenditures. Both the total and marginal budget appropriations for the closest available year to RCV implementation was considered. Because municipal budgets varied significantly, total and marginal municipal appropriations for control cities had to fall within 50% of the appropriation of the respective experimental city. Cities with closer marginal and aggregate annual appropriations to the experimental city were favored.

Election Cycle (C)

Federal election cycles are four years, with elections in even-numbered years. These elections usually correspond with increased interest, higher voter turnout and increased election costs. Some states and municipalities hold their elections separately in odd-numbered years. In these cases, the aggregate and ongoing costs associated with elections can be higher than for jurisdictions that consolidate their elections on the federal cycle. Whether or not cities hold their own elections in odd-numbered years can be a factor in the total cost of elections to that city. For this reason, precedence was given to possible control cities that held elections on the same cycle as the corresponding experimental city.

Election Jurisdiction (J)

Many municipalities do not run their own elections. Instead, they contract election services to counties and less commonly, private organizations. Counties and private companies are often able to achieve economies of scale that cities cannot by coordinating elections for numerous jurisdictions simultaneously. This is especially true in the cases of smaller municipalities. With this consideration in mind, municipalities whose elections are run by the same respective entity as the RCV municipality were favored as control cities.

Political Makeup (PVI)

Ranked choice voting is a progressive reform. Denying its connection to politics would be both misleading and academically irresponsible. While RCV itself is not inherently partisan, there are discernable political patterns in the cities in which it has been implemented. In order to account for the political culture and ideology of the municipalities, control cities were evaluated for their political makeup. The Partisan Voting Index (PVI) in the last two presidential elections was used to determine the political makeup of each city. Cities which more closely corresponded to the experimental city were favored.

No control city perfectly matched the experimental city that it was matched to. In the case of each RCV city, numerous potential control cities fit the general criteria outlined. A simple mathematical process categorized the candidate control cities numerically. Each city started with five points. Cities lost one point each for being from a different state, being from a different region, conducting elections on a different cycle, and having a different entity responsible for conducting elections than the corresponding RCV city. Cities also lost points equivalent to the percentage it differed from the RCV city in aggregate budget size, marginal budget size, and political makeup. Finally, each city lost points equivalent to four times the percentage it differed from the experimental city in population.

$$Similarity = 5 - (\Delta L \cdot 2) - \Delta B - (\Delta P \cdot 4) - \Delta B - \Delta J - \Delta PVI$$

For each RCV city, the candidate city with the highest score was used in the study as its matched control. The cities with the second and third highest score were retained as secondary and tertiary alternates. Only in cases where the selected control city was unable to produce sufficient election cost data, was the second candidate city utilized instead. This option was never utilized as each election cost data for every control city was obtained. The criteria and calculations used to evaluate the similarity of control cities to their experimental cities can be found in its entirety in Appendix A.

Constants

The data collected for this study represents a large range of time. The elections examined were conducted over two decades between 1996 and 2016. This presents the possibility that cost data could be affected by ongoing economic factors. In order to account for this and ensure that data from each year is comparable, all election costs were adjusted for inflation according to the annual Consumer Price Index (CPI) to their 2017 equivalent.

The data also represents a diverse set of cities. The cities range from San Jose, Ca – which at 945,000 residents is the tenth most populous in the nation, to Telluride, CO with just over 2000 inhabitants. This represents a relative difference of over 40,000%. In order to ensure that data could be compared between cities of vastly different sizes, the actual cost was first divided by the city’s total population. This reduced election costs to the marginal or per-capita cost instead of the total cost.

The cities examined held elections in cycles. Typically, municipal elections are held only every other year. The same is true for state and federal elections. Whether municipalities hold their elections on the same cycle as states and the federal government or not, this causes a natural pattern where election costs typically oscillate between relatively higher and lower expenditures in one-year increments. In order to account for this, election costs were aggregated into two-year summations beginning on January 1 of odd-numbered years and ending on December 31 of even-numbered years.

The cities examined implemented RCV during different election cycles. This makes comparing budgets before and after implementation difficult when the costs are plotted on the same timeline. Instead of using an actual timeline, the costs were considered relative to the year that RCV was implemented in the experimental city. This enabled direct comparisons between cities that implemented RCV in different election cycles.

Data and Analysis

Hypotheses

The action of interest for this study is a tangible change in elections to RCV. Logistically, this change comes after the policy is conceived, introduced, debated, and passed by policymakers. In some cases, the time lapse between these steps and RCV implementation is close to a decade or more. The actual changes that take place in the switch to RCV include things like purchasing new equipment and software, training (or retraining) elections administrators and staff, educating the public about the new voting methods, and conducting elections in accordance with RCV practices.

These changes are not all sustained activities despite the fact that RCV becomes the permanent model for conducting elections. This means that any cost changes that stem from differences in the ways elections are conducted should be permanent so long as RCV is utilized in the municipality. The other activities, however, are not expected to be ongoing. They are one-time actions. As such, any cost differences that they cause should also be acute to the election cycle that they occur in. This distinction breaks the timeline of RCV implementation into three phases.

First, there is the “before implementation” ($T0$) period which represents all elections prior to the first short-term expenditures. Next is the “during implementation” ($T1$) phase. This consists of the expenses associated with actually switching to RCV in the first election cycle that utilizes it. This is similar to an adjustment period for the elections officials and the voting citizens. Finally, there is the “after implementation” ($T2$) phase. This consists of the elections that take place after RCV is fully in use. By this time, administrators and citizens should be acquainted with RCV and fully prepared to conduct elections using it. This understanding of RCV implementation informs hypotheses of how RCV will or will not influence the cost of elections.

Hypothesis 1

$H_{0,1}$: *The average cost of election cycles before implementation is the same in RCV cities and control cities.*

$$H_{O,1}: \mu_{T0,RCV} = \mu_{T0,CONTROL}$$

$H_{A,1}$: *The average cost of election cycles before implementation is not the same in RCV cities and control cities*

$$H_{A,1}: \mu_{T0,RCV} \neq \mu_{T0,CONTROL}$$

Because no tangible actions have been taken to begin implementing RCV at this stage, there is no discernable reason that election costs should be different in experimental cities than in control cities. All cities utilize plurality or majority-rule elections and no cities have undertaken any significant actions that should cause significantly higher or lower election costs than the other. Additionally, control cities were chosen because of their similarity to corresponding RCV cities on things like size, budget, and location. This is sufficient to satisfy the parallel trend assumption. While it is possible that an unknown variable that is inherently present or absent in RCV cities influences how much the city spends on elections in the years before RCV is implemented, such a variable should continue after RCV is implemented and can therefore be accounted for in calculated regressions.

Hypothesis 2

$H_{O,2}$: *The average change to the cost of election cycles during implementation is the same in RCV cities and control cities.*

$$H_{O,2}: \Delta\mu_{T1,RCV} = \Delta\mu_{T1,CONTROL}$$

$H_{A,2}$: *The average change to the cost of election cycles during implementation is not the same in RCV cities and control cities.*

$$H_{A,2}: \Delta\mu_{T1,RCV} \neq \Delta\mu_{T1,CONTROL}$$

The initial implementation phase may be the busiest for RCV cities. Municipalities are on the hook for updated or new voting machines and tabulation software. The election officials must learn about the inner workings of RCV in order to run the elections. Some cities also undertake voter education efforts. All of these constitute costs that are likely to increase total spending on elections; some of them could be quite substantial. While any additional costs borne during the initial implementation should vary by municipality, it seems at least possible that they will constitute a significant aggregate cost. Based on this observation, it is reasonable to predict that the cost of elections will be different in the election cycles surrounding the initial implementation of RCV.

Hypothesis 3

$H_{O,3}$: *The average change to the cost of election cycles after implementation is the same in RCV cities and control cities.*

$$H_{O,3}: \Delta\mu_{T2,RCV} = \Delta\mu_{T2,CONTROL}$$

$H_{A,3}$: *The average change to the cost of election cycles after implementation is not the same in RCV cities and control cities.*

$$H_{A,3}: \Delta\mu_{T2,RCV} \neq \Delta\mu_{T2,CONTROL}$$

In the election cycles succeeding the implementation of RCV, there are not any additional foreseen short-term or infrastructural costs that would not also be borne by the maintenance of plurality or majority-rule voting methods. RCV is touted for its ability to eliminate unnecessary elections entirely. With RCV, runoff elections are rendered unnecessary as the ballots can be tabulated to determine a definite majority winner every time. In the same capacity, RCV would allow primaries to be skipped as a majority winning candidate can be determined even when there are many candidates in the same race. Not all jurisdictions that implement RCV do so without primaries, but the option does allow municipalities to forgo them. By allowing municipalities to hold fewer elections, RCV may offer a means to similarly reduce the aggregate cost of elections. With this premise, it can be predicted that election costs will be different for RCV municipalities in the years following RCV implementation.

Findings

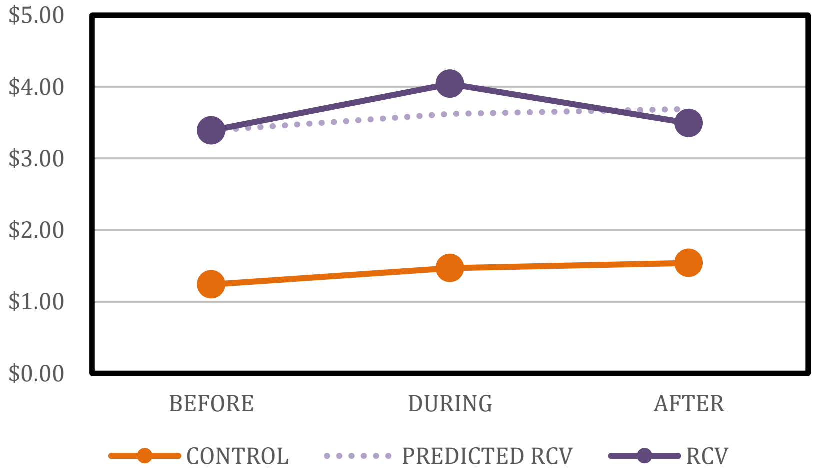
Data were collected from 14 different municipalities on the cost of municipal elections. In total, election costs from 239 elections were aggregated into 111 election cycle totals. Each of these election cycles was then given two different quantifiers to identify its status as a control or experimental election cycle, and its status relative to RCV implementation. Election cycles that occurred in control jurisdictions were quantified as 0, while RCV (treatment) jurisdictions were quantified as 1. Similarly, election cycles that took place before RCV was initially implemented were quantified as $T0$. Election cycles where RCV was initially implemented were quantified $T1$, and cycles succeeding initial implementation were quantified $T2$.

These quantifiers created six different categories which election cycles could fall under. For each category, the mean and standard deviation were calculated. This is shown numerically in table 2 and graphically in figure 2. A full table of all election cycle costs is available in Appendix B.

Table 2: Election cycle costs

		Before ($T0$)	During ($T1$)	After ($T2$)
Control (*0*)	μ	$1.24	$1.46	$1.54
	σ	0.356	0.819	0.485
RCV (*1*)	μ	$3.39	$4.04	$3.49
	σ	0.485	1.162	0.721

Figure 2: Average marginal election cost



This categorization allowed a difference-in-difference regression to be run on the election costs in two different capacities. First, election cycles where RCV was initially implemented could be compared to the cycles prior to its implementation. This allowed any election cost increases or decreases caused by RCV at its implementation point to be identified. This calculation is shown as follows.

Table 3 – During implementation difference in difference regression

Cost	Coef.	SE	Z-Score	P-Score	[95% Conf.	Int.]
T	0.227	0.819	0.28	0.784	-1.409	1.860
RCV	2.151	0.513	4.20	0.000	1.128	3.175
T & RCV	0.424	1.162	0.37	0.716	-1.895	2.744
_cons	1.236	0.356	3.47	0.001	0.525	1.947

Before examining the effects of introducing RCV into experimental municipalities, one observation is prevalent about the control and RCV groups. In the years before RCV was implemented, the cities that would implement it spent more per election cycle than control cities. While control municipalities spent just $1.24 per person per cycle, RCV cities spent $3.39. This is an initial difference in expenditures of $2.15. Put another way, RCV cities initially spent nearly three times more on elections than the control cities. Given that the standard deviation of this difference was just 0.485, this difference is statistically significant. The average cost of elections in control cities initially falls 4.43 standard deviations from that of control cities. This equates to a p-score of less than 0.001. The first null hypothesis – that the average cost of election cycles before implementation in RCV cities will be the same as control cities can be rejected.

This regression also shows that RCV election cycles were on average more expensive during the implementation phase than before it and that RCV cities election expenses increased by a larger magnitude on average than control cities during the implementation election cycles. Control cities saw average election cycle cost increases of $0.23 per person while RCV cities saw marginal expenditures rise by an average of $0.65. This revealed that RCV cities saw an average election cycle cost increase of $0.42 per person more than would be otherwise expected when they first implemented RCV. Not only is this cost difference quite small, it also carries a standard error of 1.162. This places the observed difference at less than 0.4 standard deviations from the observed difference of the control sample. This gives the regression a p-score of 0.784. This $0.42 difference observed in RCV cities is not statistically significant. For this reason, the null hypothesis that the average change to the cost of election cycles during the implementation of RCV is the same as control cities cannot be rejected.

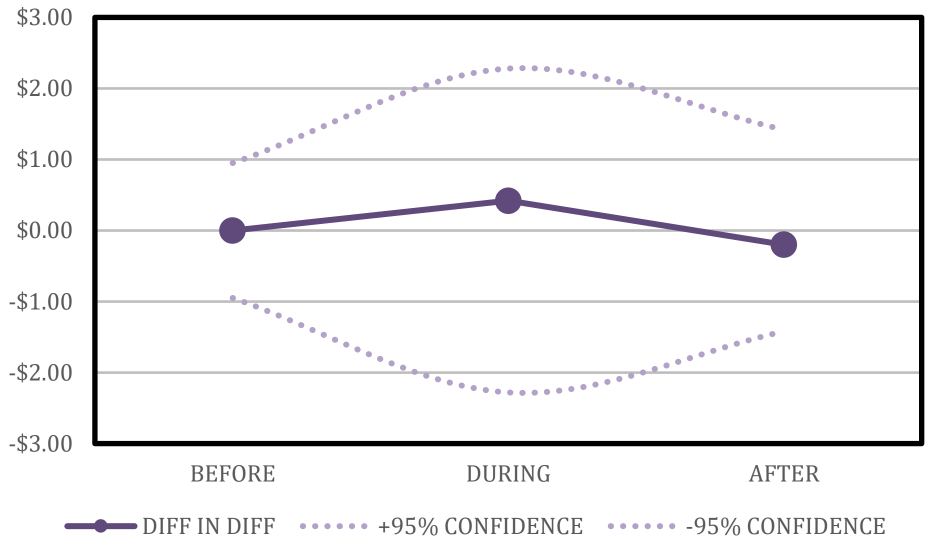
The second calculation examined the ongoing costs of RCV elections after implementation. All election cycles quantified as $T2$ were compared with the elections quantified as $T0$. By comparing these election cycles directly and omitting cycles quantified as $T1$, it was possible to determine how much it has cost to facilitate RCV elections on an ongoing basis after its initial implementation. This calculation is shown below.

Table 4 – After implementation difference in difference regression

Cost	Coef.	SE	Z-Score	P-Score	[95% Conf.	Int.]
T	0.306	0.541	0.57	0.574	-0.769	1.381
RCV	2.151	0.485	4.43	0.000	1.188	3.115
T & RCV	-0.204	0.721	-0.26	0.792	-1.735	1.327
_cons	1.236	0.337	3.67	0.000	0.566	1.905

Like the first regression for *T*1, this regression for *T*2 shows that election cycles cost significantly more in RCV cities than in control cities. While control cities saw an average marginal increase in expenditures on elections of \$0.30, RCV cities averaged a \$0.10 marginal increase in spending on elections per cycle. This equates to a difference of \$0.20 in favor of RCV jurisdictions. This difference is smaller than the one observed during the RCV implementation (*T*1). It also has a smaller standard error of 0.721. This places the observed decrease in cost of elections after RCV implantation one-quarter of a standard deviation from where it was predicted to be. It carries a p-score of 0.792. Just as with the first regression, this difference is not statistically significant. Consequently, the second hypothesis – that the average change to the cost of election cycles after implementation in RCV cities is not the same as control cities also cannot be rejected.

Figure 3: Difference in difference of RCV election cycle costs



Discussion

Challenges and Limitations

There are a few considerations that should be made in order to place this study in the proper context. First, it is possible that the data examined were affected by nonresponse bias. This study sought to collect election cost information from eleven RCV municipalities and eleven matched control municipalities. Of these jurisdictions, four were unable to produce records that were reliable and comprehensive enough to be included in the analysis. This amounted to a response rate of 64% percent. Of the cities that could not produce sufficient records, all four were RCV cities. This was particularly unfortunate as it required the exclusion of the data from the city's matched control as well. It also puts forth the possibility that each of the RCV cities that could not produce election cost data share some unknown but important characteristic that would go underrepresented by their exclusion.

Second, the data used in this study was less extensive than would have been optimal. It was obtained from no more than fourteen different municipalities. It encompassed no more than 111 election cycles, which were broken down into six different classifications. This sample size is less than optimal. Unfortunately, the nature of RCV elections limits the quantity of data available. The number of jurisdictions that have undertaken electoral reform to utilize RCV is relatively small. This will continue to be a limiting factor in data collection until RCV becomes a more prevalent voting method. Additionally, time itself made some election cost data difficult, if not impossible to obtain. Both legal document retention schedules and technological advancements presented barriers to older and antiquated information. Unfortunately, these will likely continue into the foreseeable future and will consequently remain obstacles to future knowledge.

Third, the type of RCV implemented in each examined city varied both in the exact processes used and the extent to which it was used. In different jurisdictions, RCV was used in single-winner and multi-winner races. In most single-winner races, the "instant runoff" method was used. In multi-winner races, however, multiple different tabulation rules were utilized to select winners. In some cities, RCV was only used in some of its electoral races. In Telluride, CO, for example, RCV was only used in the mayoral race. This varying use of RCV could have influenced the extent to which its implementation affected election costs.

Finally, the findings from this study are not meant to be representative of all cities throughout the United States. While the cities examined come from ten different states in all regions of the country, they are not a representative sample of American Cities. Cities that have chosen to implement RCV are not random. They have many traits that make them a unique group of municipalities. By even choosing to implement RCV, they could be considered outliers in the context of American cities. Because the cities that make up this study are not a random or representative sample of the entire country, neither are the findings derived. This limits any conclusions to being descriptive of what has happened thus far in jurisdictions that RCV has been implemented. It would be improper to expect the conclusions of this study to perfectly predict what would happen in other cities that chose to implement RCV in the future.

Conclusion

Overall, election cycle cost data of cities that have implemented RCV shows that any change to the cost of elections either during or after the switch to RCV is not statistically significant. The observed cost change during RCV implementation was a small $0.42 increase that equated to less than one-half of a standard deviation of what would be expected. A similar observation was made for elections following RCV implementation where the $0.20 savings were approximately one-quarter of a standard deviation from what was expected. Neither monetary savings nor additional expenses can be directly attributed to the use of RCV at the municipal level.

One interesting finding was that cities that utilized RCV spent inordinately more on elections than cities that did not. This was substantiated by an observed cost that was more than five standard deviations greater than predicted. This finding was true before, during, and after RCV was implemented. It can be presumed from this finding that the cities that have implemented RCV thus far truly are unique in some regard. Despite attempts to control for variables that could inflate election spending, there are one or more unknown factors existent in the cities that have chosen to utilize RCV that have consistently increased their election expenditures. This was the case long before RCV became a viable reform and endured relatively uniformly in the years after it became codified.

As the United States continues to search for meaningful and effective improvements to its democratic institutions, continued study of the costs of ranked choice voting and other reform efforts will only become more important. Many barriers that confined this study should be lifted in the future decades. As more and more jurisdictions become familiar with and experiment with voting reform efforts, more data will become available. At the time of this publication, governments across the country are on the verge of enacting their own reforms utilizing RCV. In 2018 alone, Santa Fe, NM, Benton County, OR, and the entire State of Maine are set to use RCV in their elections for the first time. This bodes well for future research.

The continued study of the costs and other implementation concerns of these reforms will continue to be of the utmost importance. Objective and unbiased research will serve as a foundation for elections administrators as they undertake the endeavor of implementing drastic reforms to our electoral process. Without a thorough understanding of the methods that are chosen for implementation and the effects they will have, otherwise effective and worthwhile reforms may be mismanaged by unnecessarily inept public administrators. The continued academic scrutiny of the implementation of alternative voting methods, such as ranked choice voting, will help to foster a culture of election administration that is adequately informed and empowered to undertake profound and integral changes to our democratic process.

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Appendix A

Table A1 - Information on experimental RCV cities

City	State	Region	Population (2010)	City Budget Size	Budget per Capita	Election Cycle	Election Jurisdiction	Political Lean
Berkeley	CA	West Coast	112,580	$ 298,578,455	$ 2,652.14	Even	County	84.5%
Oakland	CA	West Coast	390,724	$ 839,900,000	$ 2,149.60	Even	County	83.2%
San Francisco	CA	West Coast	805,193	$ 1,506,655,000	$ 1,871.17	Even	County	84.0%
San Leandro	CA	West Coast	84,950	$ 91,254,815	$ 1,074.22	Even	County	78.3%
Telluride	CO	Rocky Mtns.	2,325	$ 16,549,896	$ 7,118.23	Odd	County	69.5%
Portland	ME	New England	66,194	$ 257,592,919	$ 3,891.48	3- years	City	56.9%
Takoma Park	MD	Mid-Atlantic	16,715	$ 14,704,393	$ 879.71	Odd	City	73.4%
Minneapolis	MN	Midwest	382,578	$ 1,107,800,000	$ 2,895.62	Odd	City	63.2%
St. Paul	MN	Midwest	285,068	$503,343,270	$ 1764.70	Odd	County	66.2%
Hendersonville	NC	South	13,137	$ 27,951,390	$ 2,127.68	Odd	County	35.1%
Burlington	VT	New England	42,417	$ 160,444,280	$ 3,782.55	3-years	City	70.3%

Table A2 - Information on primary control cities

City	State	Region	Population (2010)	City Budget Size	Budget per Capita	Election Cycle	Election Jurisdiction	Political Lean
Santa Clara	CA	West Coast	116,468	$ 500,943,000	$ 4,301	Even	County	71.6%
	SAME	SAME	3.45%	46.17%	41.29%	SAME	SAME	12.9%
Anaheim	CA	West Coast	336,265	$ 926,903,219	$ 2,756	Even	County	47.9%
	SAME	SAME	13.94%	10.36%	28.23%	SAME	SAME	35.3%
San Jose	CA	West Coast	945,942	$ 1,309,599,726	$ 1,384	Even	County	71.6%
	SAME	SAME	17.48%	13.08%	26.01%	SAME	SAME	12.4%
Chico	CA	West Coast	86,187	$ 99,899,024	$ 1,159	Even	County	44.6%
	SAME	SAME	1.46%	2.42%	0.95%	SAME	SAME	33.7%
Snowmass Village	CO	Rocky Mtns.	2,826	$ 25,236,944	$ 8,930	Odd	County	68.8%
	SAME	SAME	21.55%	23.03%	1.22%	SAME	SAME	0.6%
Pawtucket	RI	New England	71,148	$ 277,034,399	$ 3,894	Even	City	71.4%
	DIFFERENT	SAME	7.48%	6.30%	12.83%	DIFFERENT	SAME	14.5%
Hyattsville	MD	Mid-Atlantic	17,557	$ 14,410,443	$ 821	Odd	City	89.7%
	SAME	SAME	5.04%	8.31%	12.71%	SAME	SAME	16.3%
Cleveland	OH	Midwest	396,815	$ 1,067,303,443	$ 2,690	Odd	County	67.3%
	DIFFERENT	SAME	3.72%	6.76%	10.10%	SAME	DIFFERENT	4.2%
Toledo	OH	Midwest	287,208	$ 610,895,792	$ 2,127	Odd	County	60.2%
	DIFFERENT	SAME	0.75%	5.99%	6.69%	SAME	SAME	6.0%
Newton	NC	South	12,968	$39,564,461	$3,051	Odd	County	32.2%
	SAME	SAME	1.29%	14.20%	15.69%	SAME	SAME	3.0%
Norwich	CT	New England	40,318	$165,455,785	$4,104	Odd	City	54.5%
	DIFFERENT	SAME	4.95%	3.12%	8.49%	DIFFERENT	SAME	15.9%

Table A3 - Information on first alternate control cities

City	State	Region	Population (2010)	City Budget Size	Budget per Capita	Election Cycle	Election Jurisdiction	Political Lean
Roseville	CA	West Coast	118,788	$ 483,261,192	$ 4,068	Even	County	40.1%
	SAME	SAME	5.51%	46.22%	38.58%	SAME	SAME	44.40%
Sacramento	CA	West Coast	466,488	$ 707,000,000	$ 1,516	Even	County	57.8%
	SAME	SAME	19.39%	15.82%	29.49%	SAME	SAME	25.4%
Austin	TX	Southwest	790,390	$ 2,656,801,000	$ 3,361	Even	County	63.3%
	DIFFERENT	DIFFERENT	1.84%	19.56%	21.80%	SAME	SAME	20.7%
Redwood City	CA	West Coast	76,815	$ 95,229,518	$ 1,240	Even	County	73.9%
	SAME	SAME	9.58%	4.36%	15.41%	SAME	SAME	4.5%
Frisco	CO	Rocky Mtns.	2,683	$ 14,166,384	$ 5,280	Odd	County	59.8%
	SAME	SAME	15.40%	36.45%	44.93%	SAME	SAME	9.7%
Greenwich	CT	New England	62,610	$ 287,226,070	$ 4,588	Odd	City	56.5%
	DIFFERENT	SAME	5.41%	11.50%	17.89%	DIFFERENT	SAME	0.4%
Greenbelt	MD	Mid-Atlantic	23,068	$ 25,848,394	$ 1,121	Odd	City	89.7%
	SAME	SAME	38.01%	47.49%	6.87%	SAME	SAME	16.3%
Cincinnati	OH	Midwest	296,943	$ 1,170,400,000	$ 3,941	Odd	County	52.2%
	DIFFERENT	SAME	22.38%	18.16%	5.44%	SAME	DIFFERENT	11.0%
St Louis	MO	Midwest	319,294	$ 503,343,270	$ 1,576	Odd	City	81.2%
	DIFFERENT	SAME	12.01%	16.10%	25.09%	SAME	DIFFERENT	15.1%
Henderson	NC	South	15,368	$28,159,986	$1,832.38	Odd	County	62.80%
	SAME	SAME	16.98%	5.74%	19.43%	SAME	SAME	27.70%
Arlington	MA	New England	42,844	$126,306,310	$2,948.05	Odd	City	64.45%
	DIFFERENT	SAME	1.01%	21.28%	22.06%	DIFFERENT	SAME	5.85%

Table A4 - Information on second alternate control cities

City	State	Region	Population (2010)	City Budget Size	Budget per Person	Election Cycle	Election Jurisdiction	Political Lean
Lansing	MI	Midwest	114,344	$ 192,448,297	$ 1,683	Odd	City	62.2%
	DIFFERENT	DIFFERENT	1.57%	43.85%	44.71%	DIFFERENT	DIFFERENT	22.30%
Santa Ana	CA	West Coast	324,528	$ 482,090,685	$ 1,486	Even	City	47.9%
	SAME	SAME	16.94%	48.15%	37.57%	SAME	DIFFERENT	35.3%
Detroit	MI	Midwest	713,777	$ 1,983,454,000	$ 2,779	Odd	County	70.0%
	DIFFERENT	DIFFERENT	11.35%	14.69%	29.38%	DIFFERENT	SAME	14.0%
Redding	CA	West Coast	89,861	$ 98,294,340	$ 1,094	Even	City	30.9%
	SAME	SAME	5.78%	7.71%	1.83%	SAME	DIFFERENT	47.4%
Leadville	CO	Rocky Mtns.	2,602	$ 5,577,136	$ 2,143	Odd	County	59.8%
	SAME	SAME	11.91%	70.64%	73.77%	SAME	SAME	9.7%
Fairfield	CT	New England	61,337	$ 278,465,591	$ 4,540	Odd	City	71.4%
	DIFFERENT	SAME	7.34%	23.23%	17.15%	DIFFERENT	SAME	14.5%
New Carrollton	MD	Mid-Atlantic	12,135	$ 5,332,485	$ 439	Even	City	89.7%
	SAME	SAME	27.40%	68.41%	56.48%	DIFFERENT	SAME	16.3%
New Orleans	LA	South	343,829	$ 644,309,358	$ 1,874	Odd	City	80.6%
	DIFFERENT	DIFFERENT	10.13%	53.08%	47.79%	SAME	SAME	17.4%
Madison	WI	Midwest	233,209	$ 323,724,474	$ 1,388	Odd	City	71.4%
	DIFFERENT	SAME	18.19%	35.69%	21.38%	SAME	DIFFERENT	5.2%
Eden	NC	South	15,527	$33,253,800	$2,141.68	Odd	County	36.5%
	SAME	SAME	18.19%	23.17%	35.00%	SAME	SAME	1.4%
Everett	MA	New England	41,667	$182,960,373	$4,391.01	Odd	City	64.5%
	DIFFERENT	SAME	1.77%	30.03%	28.77%	DIFFERENT	SAME	5.8%

Table A5 - Similarity of control cities to corresponding experimental RCV cities

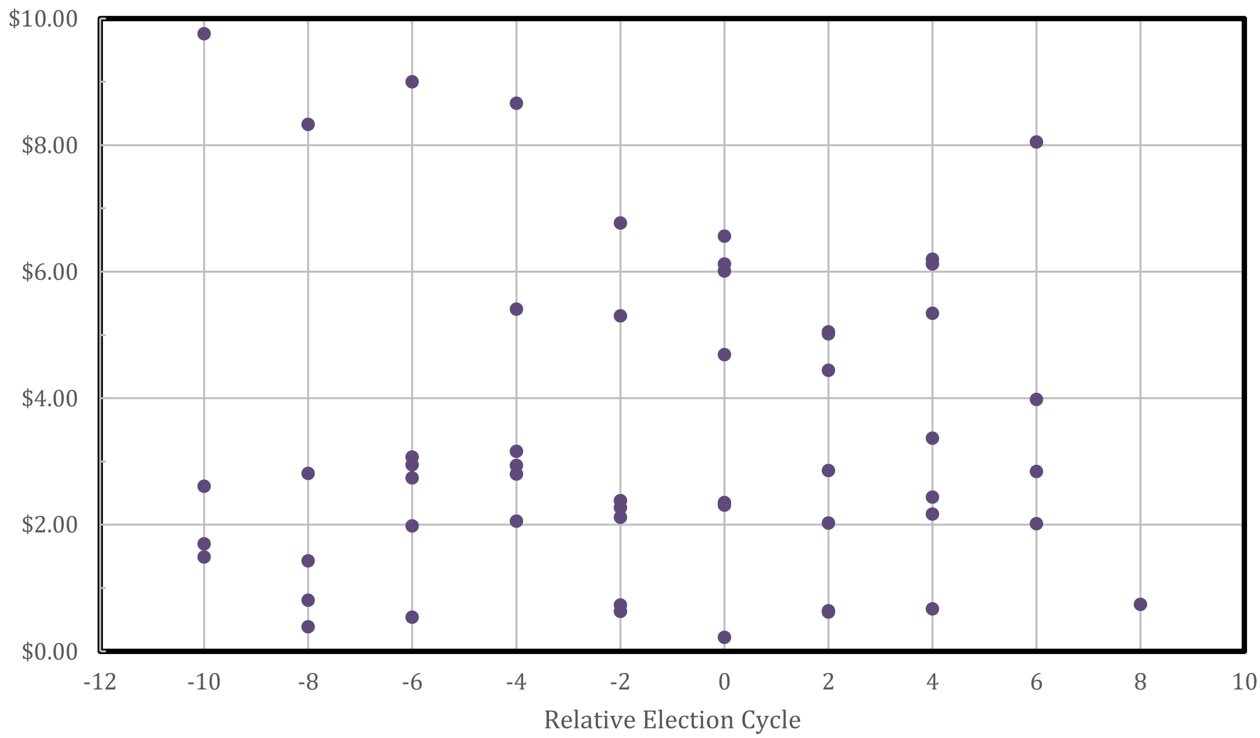
RCV City		Primary Control City			Secondary Control City			Tertiary Control City		
City	State	City	State	Similarity	City	State	Similarity	City	State	Similarity
Berkeley	CA	Santa Clara	CA	3.86	Roseville	CA	3.49	Lansing	MI	-0.17
Oakland	CA	Anaheim	CA	3.70	Sacramento	CA	3.52	Santa Ana	CA	2.11
San Francisco	CA	San Jose	CA	3.79	Austin	TX	2.31	Detroit	MI	0.97
San Leandro	CA	Chico	CA	4.57	Redwood City	CA	4.37	Redding	CA	3.20
Telluride	CO	Snowmass Village	CO	3.89	Frisco	CO	3.47	Leadville	CO	2.98
Portland	ME	Pawtucket	RI	2.36	Greenwich	CT	2.49	Fairfield	CT	2.16
Takoma Park	MD	Hyattsville	MD	4.43	Greenbelt	MD	2.77	New Carrollton	MD	1.49
Minneapolis	MN	Cleveland	OH	2.64	Cincinnati	OH	1.76	New Orleans	LA	1.41
St. Paul	MN	Toledo	OH	3.78	St. Louis	MO	1.96	Madison	WI	1.65
Hendersonville	NC	Newton	NC	4.62	Henderson	NC	3.79	Eden	NC	3.68
Burlington	VT	Norwich	CT	2.53	Arlington	MA	2.47	Everett	MA	2.28

Appendix B

Table B1 – RCV Election Cycles Marginal Costs[1]

RCV City	-10	-8	-6	-4	-2	0	+2	+4	+6	+8	+10
Berkeley, CA		$0.39	$2.74	$2.94	$2.27	$6.12	$4.44	$5.34	$8.05	N/A	N/A
Burlington, VT	$2.61	$1.43	$3.07	$2.80	$2.12	$2.31	$2.03	$3.37	N/A	N/A	N/A
Oakland, CA	$1.70	$2.81	$1.98	$3.16	$2.38	$6.01	$2.86	$2.44	$3.98	N/A	N/A
San Leandro, CA			$0.54	$2.06	$0.63	$2.35	$0.62	$2.17	$2.84	N/A	N/A
St. Paul, MN			$2.95	$5.41	$5.30	$4.69	$5.05	$6.20	N/A	N/A	N/A
Takoma Park, MD	$1.49	$0.81			$0.73	$0.22	$0.64	$0.67	$2.02	$0.74	N/A
Telluride, CO	$9.76	$8.33	$9.00	$8.66	$6.77	$6.56	$5.02	$6.12	N/A	N/A	N/A

Image B1 – Marginal Cost of Election Cycles in RCV Jurisdictions



[1] Some jurisdictions included in this study have implemented RCV less than 10 years from its completion. Cycles that have yet to occur are denoted as N/A.

Table B2 – Control Election Cycles Marginal Costs

Control City	-10	-8	-6	-4	-2	0	+2	+4	+6	+8	+10
Santa Clara, CA	$0.73	$0.27	$1.53	$1.26	$2.92	$3.39	$2.30	$1.21	$3.24	N/A	N/A
Norwich, CT		$2.07	$2.16	$3.38	$2.00	$2.15	$2.43	$3.10	N/A	N/A	N/A
Anaheim, CA	$0.36	$0.33	$0.41	$0.50	$0.57	$0.50	$0.38	$1.06	$0.69	N/A	N/A
Chico, CA	$1.86	$0.38	$1.06	$1.07	$0.96	$0.67	$0.98	$0.78	$1.10	N/A	N/A
Toledo, OH		$1.02	$1.59	$0.87	$1.58	$1.03	$1.36	$0.98	N/A	N/A	N/A
Hyattsville, MD				$0.98	$1.52	$1.71	$1.25	$1.52	$1.12	$2.41	N/A
Snowmass Village, CO	$0.87	$1.08	$1.74	$0.55	$2.45	$0.78	$0.91	$2.48	N/A	N/A	N/A

Image B2 – Marginal Cost of Election Cycles in Control Jurisdictions

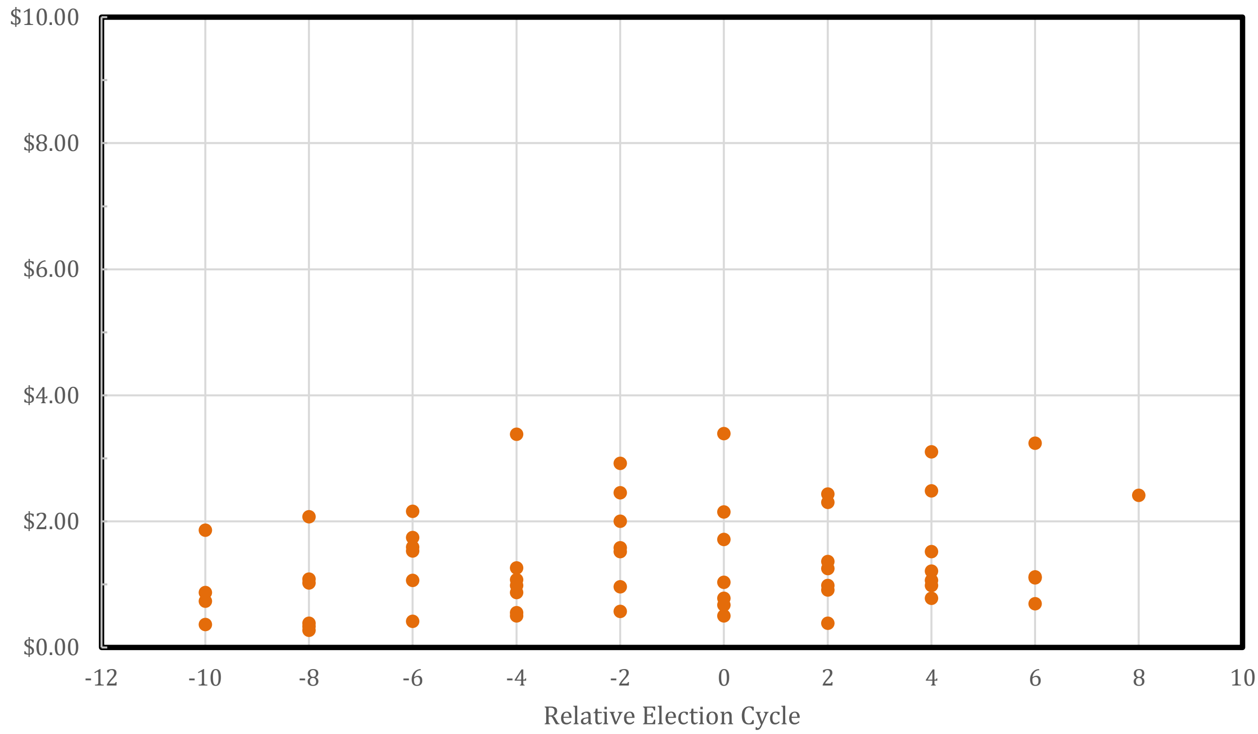


Table B1 – All RCV Cost Data

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
Berkeley	California	2010	6	$8.05	1	1	1
Berkeley	California	2010	4	$5.34	1	1	1
Berkeley	California	2010	2	$4.44	1	1	1
Berkeley	California	2010	0	$6.12	0	1	0
Berkeley	California	2010	-2	$2.27	-1	1	0
Berkeley	California	2010	-4	$2.94	-1	1	0
Berkeley	California	2010	-6	$2.74	-1	1	0
Berkeley	California	2010	-8	$0.39	-1	1	0
Burlington	Vermont	2006	4	$3.27	1	1	1
Burlington	Vermont	2006	2	$2.03	1	1	1
Burlington	Vermont	2006	0	$2.31	0	1	0
Burlington	Vermont	2006	-2	$2.12	-1	1	0
Burlington	Vermont	2006	-4	$2.80	-1	1	0
Burlington	Vermont	2006	-6	$3.07	-1	1	0
Burlington	Vermont	2006	-8	$1.43	-1	1	0
Burlington	Vermont	2006	-10	$2.61	-1	1	0
Oakland	California	2010	6	$3.98	1	1	1
Oakland	California	2010	4	$4.24	1	1	1
Oakland	California	2010	2	$2.86	1	1	1
Oakland	California	2010	0	$6.01	0	1	0
Oakland	California	2010	-2	$2.38	-1	1	0
Oakland	California	2010	-4	$3.16	-1	1	0
Oakland	California	2010	-6	$1.98	-1	1	0
Oakland	California	2010	-8	$2.81	-1	1	0
Oakland	California	2010	-10	$1.70	-1	1	0
San Francisco	California	2004	10	$15.67	1	1	1
San Francisco	California	2004	8	$10.25	1	1	1
San Francisco	California	2004	6	$9.15	1	1	1
San Francisco	California	2004	4	$12.34	1	1	1
San Francisco	California	2004	2	$13.65	1	1	1
San Francisco	California	2004	0	$15.50	0	1	0
San Francisco	California	2004	-2	$10.99	-1	1	0
San Leandro	California	2010	6	$2.84	1	1	1
San Leandro	California	2010	4	$2.17	1	1	1
San Leandro	California	2010	2	$0.62	1	1	1

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
San Leandro	California	2010	0	$2.35	0	1	0
San Leandro	California	2010	-2	$0.63	-1	1	0
San Leandro	California	2010	-4	$2.06	-1	1	0
San Leandro	California	2010	-6	$0.54	-1	1	0
St. Paul	Minnesota	2011	4	$6.20	1	1	1
St. Paul	Minnesota	2011	2	$5.05	1	1	1
St. Paul	Minnesota	2011	0	$4.69	0	1	0
St. Paul	Minnesota	2011	-2	$5.30	-1	1	0
St. Paul	Minnesota	2011	-4	$5.41	-1	1	0
St. Paul	Minnesota	2011	-6	$2.95	-1	1	0
Takoma Park	Maryland	2007	8	$0.74	1	1	1
Takoma Park	Maryland	2007	6	$2.02	1	1	1
Takoma Park	Maryland	2007	4	$0.67	1	1	1
Takoma Park	Maryland	2007	2	$0.64	1	1	1
Takoma Park	Maryland	2007	0	$0.22	0	1	0
Takoma Park	Maryland	2007	-2	$0.73	-1	1	0
Takoma Park	Maryland	2007	-8	$0.81	-1	1	0
Takoma Park	Maryland	2007	-10	$1.49	-1	1	0
Telluride	Colorado	2011	4	$6.12	1	1	1
Telluride	Colorado	2011	2	$5.02	1	1	1
Telluride	Colorado	2011	0	$6.56	0	1	0
Telluride	Colorado	2011	-2	$6.77	-1	1	0
Telluride	Colorado	2011	-4	$8.66	-1	1	0
Telluride	Colorado	2011	-6	$9.00	-1	1	0
Telluride	Colorado	2011	-8	$8.33	-1	1	0
Telluride	Colorado	2011	-10	$9.76	-1	1	0
Berkeley	California	2010	6	$8.05	1	1	1
Berkeley	California	2010	4	$5.34	1	1	1
Berkeley	California	2010	2	$4.44	1	1	1
Berkeley	California	2010	0	$6.12	0	1	0
Berkeley	California	2010	-2	$2.27	-1	1	0
Berkeley	California	2010	-4	$2.94	-1	1	0
Berkeley	California	2010	-6	$2.74	-1	1	0
Berkeley	California	2010	-8	$0.39	-1	1	0
Burlington	Vermont	2006	4	$3.27	1	1	1
Burlington	Vermont	2006	2	$2.03	1	1	1

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
Burlington	Vermont	2006	0	$2.31	0	1	0
Burlington	Vermont	2006	-2	$2.12	-1	1	0

Table B2 – All Control Cost Data

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
Santa Clara	California	2010	6	$3.24	1	0	0
Santa Clara	California	2010	4	$1.21	1	0	0
Santa Clara	California	2010	2	$2.30	1	0	0
Santa Clara	California	2010	0	$3.39	0	0	0
Santa Clara	California	2010	-2	$2.92	-1	0	0
Santa Clara	California	2010	-4	$1.26	-1	0	0
Santa Clara	California	2010	-6	$1.53	-1	0	0
Santa Clara	California	2010	-8	$0.27	-1	0	0
Santa Clara	California	2010	-10	$0.73	-1	0	0
Norwich	Connecticut	2006	4	$3.10	1	0	0
Norwich	Connecticut	2006	2	$2.43	1	0	0
Norwich	Connecticut	2006	0	$2.15	0	0	0
Norwich	Connecticut	2006	-2	$2.00	-1	0	0
Norwich	Connecticut	2006	-4	$2.38	-1	0	0
Norwich	Connecticut	2006	-6	$2.16	-1	0	0
Norwich	Connecticut	2006	-8	$2.07	-1	0	0
Newton	North Carolina	2007	4	$1.00	1	0	0
Newton	North Carolina	2007	2	$0.89	1	0	0
Newton	North Carolina	2007	0	$1.07	0	0	0
Newton	North Carolina	2007	-2	$0.67	-1	0	0
Newton	North Carolina	2007	-4	$0.64	-1	0	0
Newton	North Carolina	2007	-6	$0.63	-1	0	0
Newton	North Carolina	2007	-8	$0.58	-1	0	0
Newton	North Carolina	2007	-10	$0.56	-1	0	0
Anaheim	California	2010	6	$0.69	1	0	0
Anaheim	California	2010	4	$1.06	1	0	0
Anaheim	California	2010	2	$0.38	1	0	0
Anaheim	California	2010	0	$0.50	0	0	0
Anaheim	California	2010	-2	$0.57	-1	0	0
Anaheim	California	2010	-4	$0.50	-1	0	0
Anaheim	California	2010	-6	$0.41	-1	0	0
Anaheim	California	2010	-8	$0.33	-1	0	0
Anaheim	California	2010	-10	$0.36	-1	0	0
San Jose	California	2004	10	$2.22	1	0	0
San Jose	California	2004	8	$2.30	1	0	0

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
San Jose	California	2004	6	$2.90	1	0	0
San Jose	California	2004	4	$3.63	1	0	0
San Jose	California	2004	2	$2.29	1	0	0
San Jose	California	2004	0	$3.57	0	0	0
San Jose	California	2004	-2	$0.63	-1	0	0
San Jose	California	2004	-4	$0.23	-1	0	0
San Jose	California	2004	-6	$0.47	-1	0	0
San Jose	California	2004	-8	$0.53	-1	0	0
Chico	California	2010	6	$1.10	1	0	0
Chico	California	2010	4	$0.78	1	0	0
Chico	California	2010	2	$0.98	1	0	0
Chico	California	2010	0	$0.67	0	0	0
Chico	California	2010	-2	$0.96	-1	0	0
Chico	California	2010	-4	$1.07	-1	0	0
Chico	California	2010	-6	$1.06	-1	0	0
Chico	California	2010	-8	$0.38	-1	0	0
Chico	California	2010	-10	$1.86	-1	0	0
Chico	California	2010	-12	$0.25	-1	0	0
Toledo	Ohio	2011	4	$0.98	1	0	0
Toledo	Ohio	2011	2	$1.36	1	0	0
Toledo	Ohio	2011	0	$1.03	0	0	0
Toledo	Ohio	2011	-2	$1.58	-1	0	0
Toledo	Ohio	2011	-4	$0.87	-1	0	0
Toledo	Ohio	2011	-6	$1.59	-1	0	0
Toledo	Ohio	2011	-8	$1.02	-1	0	0
Hyattsville	Maryland	2007	8	$2.41	1	0	0
Hyattsville	Maryland	2007	6	$1.12	1	0	0
Hyattsville	Maryland	2007	4	$1.52	1	0	0
Hyattsville	Maryland	2007	2	$1.25	1	0	0
Hyattsville	Maryland	2007	0	$1.71	0	0	0
Hyattsville	Maryland	2007	-2	$1.52	-1	0	0
Hyattsville	Maryland	2007	-4	$0.98	-1	0	0
Snowmass Village	Colorado	2011	4	$2.48	1	0	0
Snowmass Village	Colorado	2011	2	$0.91	1	0	0
Snowmass Village	Colorado	2011	0	$0.78	0	0	0
Snowmass Village	Colorado	2011	-2	$2.45	-1	0	0

City	State	Year Implemented	Relative Cycle	Cycle Cost	Time Quantifier	Control Quantifier	Active RCV
Snowmass Village	Colorado	2011	-4	$0.55	-1	0	0
Snowmass Village	Colorado	2011	-6	$1.74	-1	0	0
Snowmass Village	Colorado	2011	-8	$1.08	-1	0	0
Snowmass Village	Colorado	2011	-10	$0.87	-1	0	0