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Political Competitiveness, Regression Discontinuity and the Incumbency Effect

Abstract

In an RDD study of the incumbency effect, observations somewhat away from the threshold separating winners and losers in an election are necessarily employed. We consider how incorporating the vote volatility of elections into a preferred index of electoral competitiveness or closeness, in contrast to the often used unadjusted vote share margin, affects the estimated incumbency effect through this route for Liberal party candidates in Canadian general elections, with emphasis on the post-1950 period. Estimation is by local linear nonparametric regression with a data driven bandwidth. We also consider how allowance for the competitiveness and outcomes of prior electoral contests alters the estimated incumbency effect. Comparisons of our results with previous work on incumbency in Canadian elections by Kendall and Rekkas (2012) in this journal are presented, along with a reproduction of their model, for the cases we consider, based on combining our refined and extended electoral data with their (volatility unadjusted) index of electoral closeness and different estimation methodology.

JEL-Codes: D720, C400.

Keywords: incumbency effect, regression discontinuity, political competitiveness, vote volatility, heterogeneity, interaction, organizational quality, reproduction.

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1. Introduction

Questions about the nature and application of the running or forcing variable used to distinguish between treatment and control, and about heterogeneous treatment effects or interactions, among other issues, arise in the design of any controlled experiment.[1] They also arise in the use of a regression discontinuity design (RDD), a quasi-experimental approach that mimics the random assignment of a controlled experiment using observational data. In this paper, we investigate how an RDD study of the overall incumbency effect for Liberal party candidates in Canadian general elections from 1867 to 2019 is affected by variations in statistical design concerning: (i) the choice of the running variable that is used to separate 'just winning' from 'just losing' party candidates, and (ii) the dependence of the incumbency effect on the history of electoral outcomes, including the competitiveness of elections and associated quality of local political organizations, and the prior sequencing of party wins and loses.

By the overall incumbency effect, following Erikson (1971), Lee (2008) and Kendall and Rekkas (2012), we mean the effect on the probability of winning in the next election (at t+1) of being a candidate for the party that previously won (at t), combined with any effect that may be associated with the incumbency of a particular individual. In the Canadian Westminster parliamentary system that we study, overall party incumbency is important because control of parliament depends on the number of seats a party wins regardless of the nature of the local candidate. Our focus on the overall incumbency effect is made concrete by defining incumbency by party whether or not the candidate is the same as in the previous election.[2]

Because we define incumbency on a party basis, the definition of a party is an important issue. When parties appear or disappear at the constituency level due to splits, mergers, births

[1] Stokes (2014) emphasizes the importance of considering these issues in the context of randomized control trials, in defence of observational studies (which have their own problems).

[2] For an attempt to separate out an individual candidate incumbency effect from a party effect assuming that the two effects are additive and that strategic exit by candidates who expect to lose does not occur, see Kendall and Rekkas (2012).

and deaths, information is lost because corresponding adjacent elections in some electoral districts cannot then be appropriately linked. To reduce the problems associated with changes in the definition of parties, we consider the overall incumbency effect for candidates of the Liberal Party of Canada, and place emphasis on estimation results that are based on post-1950 elections from 1953 to 2019, though results for the pre-1950 period are also presented. In contrast to the other major party in Canada, over the post-1950 period the formal name and basic character of the Liberal party remained more or less the same.

To separate party candidates who barely won from those who barely lost, we use a measure of electoral competitiveness that combines the volatility of votes between elections and vote share margin of party candidates into a volatility adjusted vote margin index of competitiveness or electoral closeness. This is the running variable determining 'treatment' in the RDD. The overall incumbency effect for Liberal party incumbents is then estimated over the history of Canadian general elections and for pre- and post-1950 subperiods using local linear nonparametric regression with a data driven bandwidth.

Comparisons of incumbency effects estimated using the volatility adjusted vote margin as the running variable with those based on the more often used unadjusted vote share margin are provided throughout. We also compare these results with previous work on incumbency in Canada by Kendall and Rekkas (2012). Their seminal work on incumbency in Canada employs a basic constituency level electoral data set that is similar but not identical to ours - the differences in the data sets are summarized in an Appendix - on use of an unadjusted vote share margin as the running variable, and on a different estimation methodology with fixed bandwidths. We also reproduce the Kendall and Rekkas quasi-experiment in the Appendix for the case of Liberal party candidates using our refined and extended electoral data set in combination with their (volatility unadjusted) measure of electoral closeness and their estimation technique.

We proceed as follows. Section two begins with some methodological considerations, leading to a preliminary look at the data in a manner that motivates our interest in the effects on the incumbency effect of incorporating volatility into a measure of electoral competitiveness, and the effects of allowing for the prior nature and outcome of election contests. The measurement of close elections using unadjusted vote share margins and volatility adjusted margins is discussed in section three. In section four, the election data that we used is discussed and the two measures of competitiveness are carefully compared. In section five, both measures are used as the running variable in estimation of the overall incumbency effect for Liberal party candidates. A comparison of our results with corresponding results of Kendall and Rekkas (2012) is also provided here. The interaction of selected historical aspects of election contests with the incumbency effect is investigated in section six. Section sven concludes the main text. Differences between the data set used here and that of Kendall and Rekkas are summarized in an Appendix, where our reproduction of the Kendall and Rekkas study for Liberal candidates is also presented.

2. Selected features of the RDD study of incumbency and a preliminary investigation of their relationship to the Canadian data

Erikson (1971) was the first to point to the critical problem facing anyone interested in estimating the incumbency effect. The best candidate in an electoral district will likely succeed, become the incumbent and go on to win successive elections because they are better than their challengers. This quality advantage, if it exists, may explain why incumbents are observed to repeatedly win elections. To separate any effect due to candidate quality from the effect of incumbency by itself, Erikson looked at the difference between the rates of success of new incumbents in their first and second elections. Following Erikson's paper other strategies were proposed by Garand and Gross (1984), Gelman and King (1990), Cox and Katz (1996) and others. In a 2008 paper, Lee proposed using a regression discontinuity design (RDD) to identify the incumbency effect by treating winning and losing candidates in close elections as if they are randomly selected subjects from a

pool of candidates. This approach has subsequently been used by many authors – see, for example, Kendall and Rekkas (2012), Anagol and Fujiwara (2016) and Ariga et al (2016) among others.

The required local randomization at the discontinuity or threshold does not hold if winners and losers near the threshold are dissimilar in terms of observable characteristics. Caughey and Sekhon (2011) found that in the U.S House, incumbents disproportionally win close elections, and that covariates of close winners and close losers differ significantly. However, after studying more than 40,000 close elections in different countries, including Canada, Eggers et al (2015) found no particular sorting around the threshold. In any event, as discussed by Cattaneo, Fransen and Titiunik (2015), de La Cuesta and Imai (2016) and Cattaneo, Idrobo and Titiunik (2020), a local randomization assumption is not required to identify the causal effect of incumbency if a weaker local continuity assumption holds instead: that the conditional expectation function of each potential outcome for any candidate does not jump at the threshold. In that case, characteristics of winners and losers may differ systematically around the threshold as long as only their treatment status as winners or losers changes abruptly.[3]

In both approaches, elections somewhat away from perfectly competitive ones, where winners are almost tied with losers, must be used because there are not enough almost perfectly competitive election contests to allow precise estimation. This means that the measure of electoral competitiveness used matters because this variable determines the choice of elections on which results of estimation depend, whether one uses a data driven or a pre-set bandwidth.

Often assignment of a candidate to incumbency status is determined by the candidate's vote share margin, defined as that candidate's vote share minus the largest share of any other candidate. For this running variable, which is often used as the basis for measuring electoral

[3] See la Cuesta and Imai (2016, 381-82) and the references cited therein for further discussion of the continuity assumption. Local randomization always implies continuity at the threshold. But the opposite is not the case.

competitiveness - see, for example, Mayhew (1974), Daniel and Lott (1997), Masket and Lewis (2007), and Singh, Lago and Blais (2011) among many others - the threshold value that separates winners and losers is zero. Away from zero, we would like to use observations on elections for which this vote margin is still 'small'. However, whether a vote margin is 'small' and the election 'close' does not depend only on the vote margin except when the election is tied. Electoral competitiveness also depends on the volatility of the vote – the tendency of voters to switch their votes among competing candidates across adjacent elections, a fact that was recognized some time ago by Przeworski and Sprague (1971) and Elkins (1974).[4] A small vote margin can be effectively 'large', and the election uncompetitive or not close, if volatility is quite low, and vice-versa.

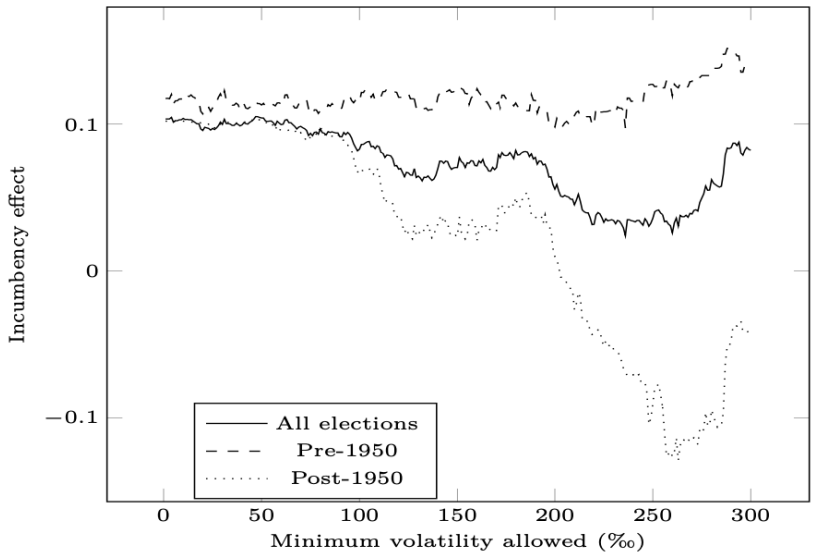
This reasoning suggests that to select elections that depart from those exactly at the threshold, it may be better to use an index of electoral competitiveness that adjusts vote margins to incorporate volatility. Figure 1 illustrates the potential importance of doing so in a study of the overall incumbency effect using data for Canadian general elections from 1874-2019. It presents preliminary estimates of the incumbency effect for Liberal party candidates based on local linear regressions (outlined later in the paper) that employ unadjusted vote share margins when the data used in each regression are successively restricted according to a rising minimum level of vote volatility (the precise measurement of which is also described later). We see in the figure that as the minimum volatility in a constituency election allowed into the sample is increased, the estimated incumbency effect for the resulting sample of constituencies decreases.[5] Dividing the sample into pre- and post-1950 subsamples shows that restricting volatility affects the incumbency effect differently in the two subsamples.

[4] See also Budge (1982), Taagepera and Grofman (2003), Baldini and Pappalardo (2009), Powell and Tucker (2014), and Ferris, Winer and Grofman (2016).

[5] The sample for estimation starts with the third election in 1874 to accommodate the calculation of vote volatility across adjacent elections.

The results illustrated in the figure are ad hoc. But they suggest to us that it is worthwhile to go further and employ a proper volatility adjusted vote share margin as a running variable rather than the unadjusted vote margin**.** It turns out that the set of highly competitive elections based on use of volatility adjusted vote share margins differs by as much as 30% from the set defined by unadjusted winning margins, that elections deemed highly competitive by both measures are also ordered differently and, as a result, that the RDD estimate of the incumbency effect depends on which measure is employed.

Figure 1: Preliminary estimates of the Liberal party incumbency effect as the minimum vote volatility allowed for any constituency is increased, Canadian general elections 3-43, 1874 – 2019 and pre- and post-1950



Note: The incumbency effect in Figure 1 is computed by incrementing the minimum vote volatility allowed by 0.5% beginning at 0 and redefining the set of constituencies used in the regressions accordingly. The first point of the graphs in Figure 1 is therefore the RDD estimate of the incumbency effect without any restriction on volatility. Each estimation has its own data driven bandwidth because every sample depends upon the minimum level of volatility. Similar results obtain with a fixed bandwidth of 5% or 10%.

The possibility that there are heterogeneous effects or interactions within the treated group is always of concern in an RDD study of incumbency, as in any experiment. The estimated effect of incumbency is an average one defined over all those who are included in the quasi-

experiment.[6] This does not rule out the existence of a systematic difference in the outcome within the sample considered even though all factors determining behavior other than incumbency may be balanced in the winning and losing groups.

One characteristic that may be relevant to the success of a party's candidate is the quality of the organization that stands behind them. A significant dimension of this quality is the resources an organization brings to the election contest. Consider Figure 2, which presents spending of individual constituency specific parties relative to the official constituency spending limit for general elections (at time t) by the party's vote share margin in the previous election (at t-1), and in the same election (at t). Elections 39, 40 and 41 for which such data are available are depicted.[7]

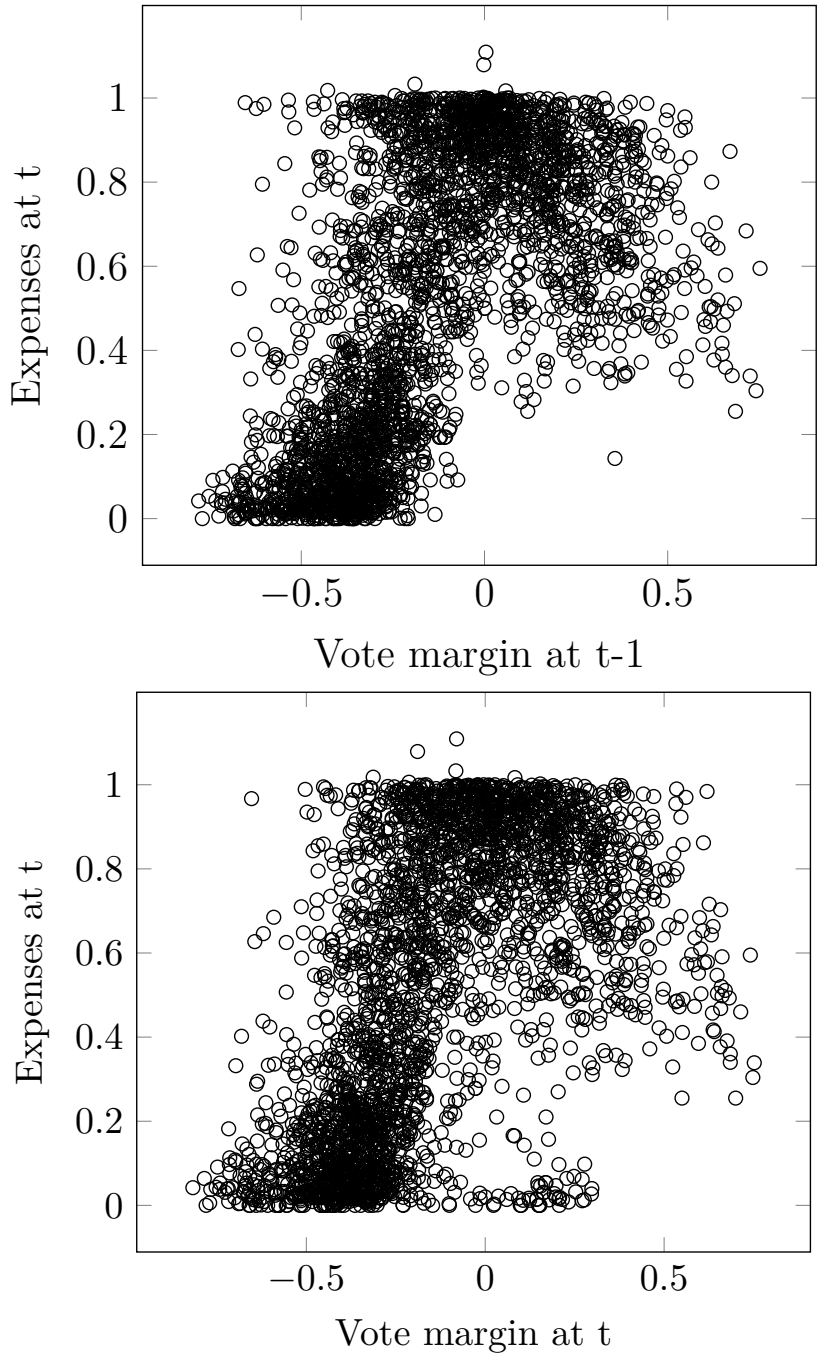
The left panel of the figure shows that highly competitive elections, where the unadjusted vote margin is close to zero at time t-1, always involve party campaign spending in the next election (at t) at or close to the limit allowed. We also see, in the right panel, that most highly competitive elections at time t also involve spending at medium to high levels in the same elections although, in this panel, some close elections at t evidently involve low spending at t. In both panels, large loses for parties in the previous or the current election, and corresponding negative vote margins, are associated with lower spending then are close elections.

One interpretation of the patterns revealed by Figure 2 is that local organizations that were involved in a highly competitive election in the recent past are capable of and find it necessary to raise as much funding as the law permits to fight what is likely to be a subsequent close contest. (By comparison to the left panel, it is also tempting to think of the low spending contests around the zero vote share at t as unexpectedly close contests.) It is reasonable to

[6] It is also a local effect, strictly applicable in a small neighborhood of the threshold.

[7] Campaign spending in the 39th, 40th and 41st federal elections is considered here because *all* constituencies in these elections have the same boundaries as in the previous election and, thus, a well-defined party incumbent. Moreover, spending limits introduced in 1974 were enforced in these elections.

Figure 2: Spending of individual constituency specific parties relative to the official constituency spending limit, for general elections (at time t) by the party's vote share margin in the previous election (at t-1) or in the same election (at t); 39th, 40th and 41st Canadian general elections.



Note: Each circle in the figure represents one party's spending in a constituency relative to the official constituency specific limit. Five major parties are represented. The vote share margin graphed is the party's vote share in the election specified minus the largest vote share obtained by some other party in that election.

suspect that this behavior of party organizations may have a quantitatively important effect on the electoral success of a party's candidates in subsequent elections, at least for a period time, whether they are incumbents or not.

Another possibility is that a higher level of competition in the constituency in the recent past enhances the importance of other dimensions of electoral competition in the constituency besides, or in addition to, money – e.g., the way in which national party platforms are presented, or information about candidate characteristics if these matter to voters despite the Westminster parliamentary system, and that the relative value of a party's incumbency is altered as a result. Figure 2 suggests that the competitiveness of recent past elections can serve as a proxy for organizational quality to the extent that quality and the size of campaign budgets are positively correlated. Controlling for prior competitiveness in a constituency, which weighs heavily in a party's estimate of the degree of competition to be expected in the near future, would also conveniently allow for any effects of the prior degree of electoral competition on the relative success of incumbents and challengers.

3. Measuring closeness or competitiveness at the constituency level

We want to compare regression discontinuity estimates of the incumbency effect using two alternative methods of defining a close or highly competitive election contest: one that is fashioned out of unadjusted vote share margins, and a second - which also has a long history but is less well employed in the empirical literature - based on vote share margins adjusted for vote volatility.

The vote share margin of a candidate at the constituency level often used in RDD studies is defined as:

$$VM_{t,p,c} = v_{t,p,c} - v_{t,o,c} \qquad (1)$$

where $VM_{t,p,c}$ is the vote share margin for party p in constituency c in the election at time t, $v_{t,p,c}$

is the vote share for this party, and $v_{t,o,c}$ is the highest other vote share in the constituency.[8] In an RDD using (1) as a measure of competitiveness, assignment to winning the previous election and becoming the incumbent (or not) is discontinuous at *VM* = 0.

To define an alternative, volatility adjusted, margin of electoral closeness, we first require an index of the volatility of the vote for any candidate - that is, of the extent to which votes for all candidates have been switched among the parties across two adjacent elections. We use the volatility measure suggested by Pedersen (1979, 1983) and others:

$$V_{t,c} = \sum_p | \ v_{t,p,c} - \ v_{t-1,p,c} \ | \ / \ 2 \qquad (2)$$

where $V_{t,c}$ denotes vote volatility in constituency c in election *t*. Division by 2 avoids double counting of vote switches. Following Przeworski and Sprague (1971), the volatility adjusted margin is then defined as

$$VAM_{t,p,c} = \frac{VM_{t,p,c}}{V_{t,c}} \ . \qquad (3)$$

This measure has the advantage of including both the 'distance to go' for a party that is currently not the leader, the numerator in (3), and a measure of how easy it is to bridge the gap, given by the denominator. As (3) indicates, a contest with a small positive vote margin for the leading candidate and low expected volatility might not be very close compared to a situation with a large margin and even higher volatility. Note that while *VM* expressed as a fraction is less than 1 in absolute value, *VAM* the volatility adjusted margin may be greater than 1. One should also note that both indexes have the property that the status of a party as a winner or loser changes abruptly at 0.

There is a large literature on the measurement of volatility beginning with Pederson and including Bartolini and Maier (1990) and Taagepera and Grofman (2003) among others. A number of problems arise in its calculation. Redistricting at the constituency level, which occurs

[8] The vote margin is sometimes calculated as the absolute value of VM.

periodically over Canadian electoral history, poses a challenge for the calculation of volatility by making it difficult to link changes in votes for parties across adjacent elections. Splits, mergers and the emergence of new parties also create difficulties by altering measured volatility even in the absence of vote switching.[9]

To accommodate periodic redistricting while still permitting volatility across adjacent elections to be computed, we compare voting by party across superconstituencies defined for 80 geographical areas in Canada which, by construction, do not change their boundaries over time, following Ferris, Winer and Grofman (2016, Appendix). The number of these superconstituencies used for any given election grows as the country develops. Many of these superconstituencies are urban areas or parts thereof, especially in the post-1950 period.[10] We measure volatility for each superconstituency by computing average vote shares by party within a superconstituency for a given election, computing the absolute value of the changes in these party-specific average vote shares across adjacent elections, summing these changes across the parties and then dividing by two to allow for the fact that votes lost are also gained and vice versa.[11] This index is then used to adjust the vote share margin relevant to each party in a constituency in the corresponding superconstituency.

[9] In Calgary Southeast, the same candidate ran for the Reform Party of Canada in 1997, the Canadian Alliance in 2000 and the Conservative Party of Canada in 2004. In each election, he won by more than 30% of the vote. The usual method of calculating volatility would suggest substantial vote volatility among parties. More generally, say that party *a* becomes party *b* in the following election, that they both receive the same share of vote and that we did not account for the change. The increase of volatility in district *c* from these two parties would be $(v_{t-1,a,c} + v_{t,b,c})/2$ while it would be 0 if both parties are treated as the same. Splits and mergers in parties can also lead to increased volatility. We note that the Reform party and the Canadian Alliance are treated as the same party in our calculations.

[10] Defining a geographically based superconstituency is a problem only in few cases where new regions appear in the country for the first time. This problem arises only in the 19th century in Canada. The additional problem of matching data for constituencies across adjacent elections having to do with the consistency over time of assigned constituency names is addressed in the Appendix.

[11] A 13 party classification is used covering Canadian electoral history. A party must: have at least 4% of the popular vote in at least one election; have contested at least 1% of seats in at least one election: and must have won at least 1 seat in at least two elections. There are 12 such parties in Canadian history. The 13th 'party' is a residual.

To reduce the problem for volatility calculations associated with changes in the definition of parties, we focus on the overall incumbency effect for candidates of the Liberal Party of Canada, and we emphasize results that use post-1950 elections from 1953 to 2019, though results for the pre-1950 period and the entire history of the country are always provided. In contrast to the other major party in Canada, over the post-1950 period the formal name and basic character of the Liberal party remained more or less the same. We also consider how omitting certain post-1950 elections that include significant changes in the nature of other parties contesting them affects the outcome of estimation.

4. The data, and a comparison of alternative competitiveness measures

To compute and compare the competitiveness measures, and to estimate the incumbency effect, we begin with the *Data Set on Federal Elections with Superconstituencies, Canada 1867 - 2015, Elections 1 – 42* (Winer and Ferris 2019), updated to include the 43rd general election of 2019. This dataset, in which a constituency which remains geographically the same despite name changes is assigned the same (most recent) name throughout, and in which the eighty superconstituencies referred to earlier are defined, provides voting information for each constituency election using various official sources. Only regular general elections are included here: by-elections are excluded, though the consequences of these elections for the designation of incumbents is still embedded in the data.[12] This avoids complications that arise if voters and parties behave differently in by-elections than in general elections. By-elections seldom earn much attention beyond the constituencies in which they take place and voter turnout is often lower than in general elections. Further discussion and a summary of this and other adjustments applied to the official electoral data set are provided in the Appendix.

[12] We note that the incumbent party won in about 2/3 of all by-elections.

4.1 The election data, and a comparison of measures of electoral closeness

Table 1 provides summary statistics for all constituencies in Canadian general elections from 1867 to 2019 in our competed data set. Elections are divided into pre- and post-1950 subsets. The first period includes elections from 1867 to 1949 (elections 1-21) and the second includes elections from 1953 to 2019 (elections 22-43).[13]

As shown in the table, a Liberal candidate won at time t+1 in 46.3% of all constituency contests. Liberal challengers won 20.4% of the time, while Liberal incumbents won 75.6% of the time, a fact which leads one to recall the problem pointed to by Erikson (1971).

Table 1 records that a general election occurred in 10923 electoral districts. In 9134 of these, a Liberal candidate *VM* can be computed, while a *VAM* can be computed for 8957 constituency elections, a difference of 177. The difference arises because the volatility adjusted margin cannot be estimated for the first election and because of the impossibility of calculating volatility when a superconstituency first appears in the data as the country develops.[14] In estimating the incumbency effect, we begin with the sample of 8957 constituencies for which both indexes can be computed.

The proportion of elections with a Liberal *VAM* is higher in the post-1950 period, with 88.0% of constituency elections covered, compared to 74.0% for the pre-1950 period. The larger number after 1950 is due to less redistricting, and to there being fewer acclamations and two-seat constituencies which are always excluded from the data set. The average Liberal (unadjusted) vote share margin is close to zero at -0.029. The associated average volatility is 0.326; it is lower in the post-1950 period than in the pre-1950 period. The average Liberal volatility adjusted margin is -0.151, and it is also lower post-1950.

[13] The quality of data pre-1950 is not quite as good as after. For further detail, see the database, Winer and Ferris (2019).

[14] In five cases, superconstituencies are newly defined (e.g., Northwest Territories) and so lack a volatility measure for the first election of its existence.

Table 1: Summary statistics for Canadian general (federal) elections by constituency, Canadian general elections 1-43, 1867-2019

VARIABLES	All elections	pre-1950	post-1950
Population	64,147	32,135	83,210
Number of electors	40,152	13,969	58,092
Number of ballots	27,902	10,231	40,084
Number of rejected ballots	382	214	408
Number of candidates	3.86	2.43	4.90
Number of constituencies			
In a general election	10,923	4,607	6,316
With an acclamation	260	257	3
With 2 seats	123	111	12
At t+1 with a Liberal lagged vote margin	9,134	3,573	5,561
At t+1 with a Liberal volatility adjusted margin	8,957	3,408	5,549
Constituencies at t+1 with a Liberal volatility adjusted margin			
Liberal vote margin at t	-0.029	-0.026	-0.031
Volatility at t	0.326	0.359	0.306
Liberal volatility adjusted vote margin at t	-0.151	0.294	-0.424
Proportion of Liberal			
Victory at t+1	0.463	0.529	0.422
Challenger victory at t+1	0.204	0.289	0.160
Incumbent victory at t+1	0.756	0.752	0.759
Losing at t-1	0.504	0.413	0.554
Winning at t-1	0.496	0.587	0.446
Winning at t-1 and t-2	0.331	0.348	0.322

Note: Many values of variables are missing for elections during the pre-1950 period. Elections at t versus t+1 are described to reflect the RDD experiment used to investigate the effect of winning at t on the probability of winning at t+1

To more carefully compare the nature of *VM* and *VAM* as indexes of the closeness of elections, we rank each election using both measures and then examine if elections can be considered close or highly competitive with both. Table 2 records that over the period 1874-2019, there are 332 elections where the unadjusted Liberal vote share margin *VM* was less than 1% in absolute value. Of the 332 closest elections ranked using the volatility adjusted margin *VAM*, 231 of these had a *VM* (in the numerator) lower than 1%. Similar comparisons are provided in the table for *VM* < 5% and VM<10%.[15]

Another useful comparison of the competitiveness measures concerns the way they rank order constituency elections. This is important because in the estimation of the incumbency effect, linear terms that incorporate, and differently weight, observations away from the discontinuity in the indexes at zero are employed. The ranking of observations away from zero also affects the data-driven bandwidth selected in the course of estimation. To compare rankings using *VM* and *VAM*, Table 2 shows Kendall and Spearman rank correlation coefficients for observations in each column of the table that are considered representative of close elections by both measures. The Kendall rank correlation shown provides us with an idea about the proportions of concordant and discordant pairs, while the Spearman rank correlation emphasizes the overall deviation between the two groups of numbers.

Table 2: Comparison between the Liberal vote margin (VM) and the Liberal volatility adjusted margin (VAM), Canadian general elections 3-43, 1874 – 2019

	<1%VM	<5%VM	<10%VM
Number of observations	332	1,676	3,061
Competitive for VM and VAM	231	1,187	2,280
	69.60%	70.80%	74.50%
Correlation			
Kendall rank correlation	0.459	0.486	0.483
Spearman rank correlation	0.636	0.666	0.664

[15] An alternate exercise can be conducted starting with the size of the volatility adjusted index *VAM*. This leads to similar results.

These results show that while both measures of electoral closeness are similar in their expost ranking of constituency elections, they clearly are not the same index. Around 30% of close or highly competitive elections when judged as such using the unadjusted vote margin are not deemed to be highly competitive when the volatility adjusted margin is used. Additionally, the rank order of competitive elections differs even when by both measures, elections are deemed to be close.

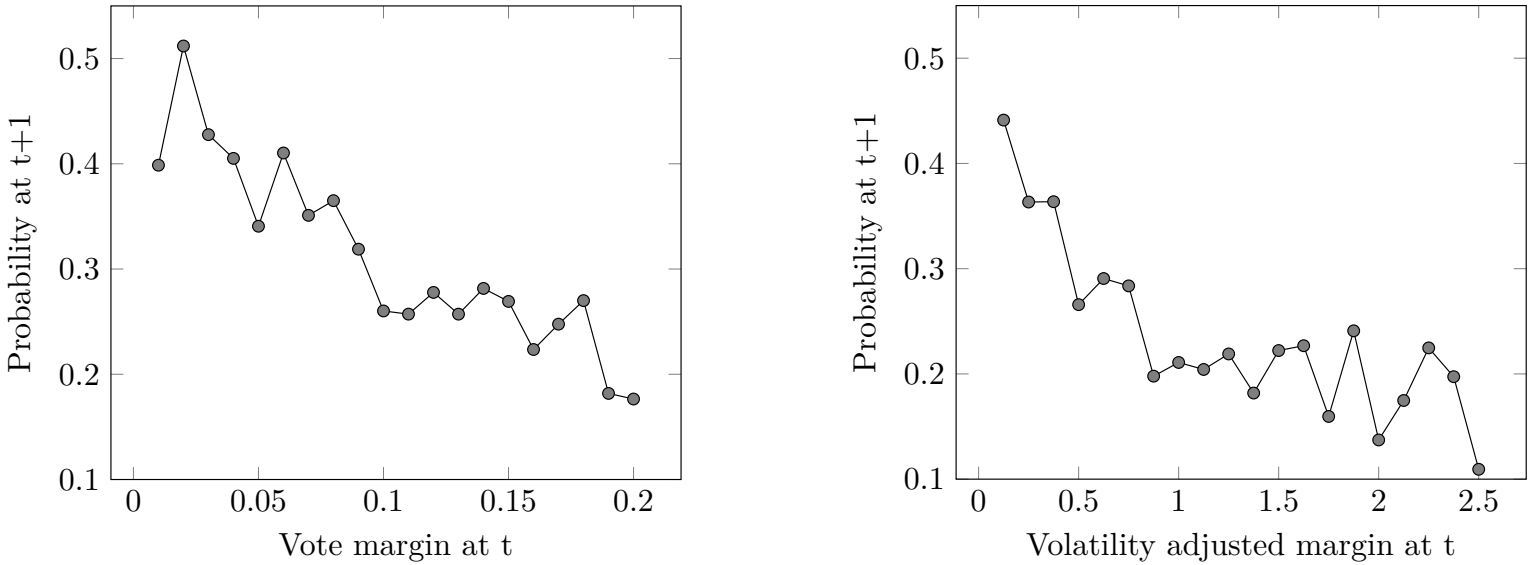
Another way to compare the two measures is to look at graphs of the probability a Liberal party incumbent loses (at t+1) by *VM* and by *VAM* in the previous election (at t). These graphs are shown in Figure 3 for values of *VM* and *VAM* approximately covering the bandwidth used in estimation of the incumbency effect. Both graphs generally decline as the measure of the closeness of the election at t declines - that is, the probability of losing at t+1 declines as the election at t becomes less competitive - as we should expect. But the pattern of the decline differs. It remains to be seen how the differences in the indexes revealed in Table 2 and Figure 3 influence the RDD estimation results.

5. Estimation of the incumbency effect

We now compare RDD estimates of the overall incumbency effect for Liberal party candidates using, alternatively, the simple vote margin and the volatility adjusted margin as the running variable in an RDD study of incumbency. In each case, the model is estimated using local linear regression with a data driven bandwidth estimated from the minimization of the asymptotic approximation of the mean square error. To do so, we follow the methodology of Calonico, Cattaneo and Titiunik (2014b) as implemented in Calonico, Cattaneo and Titiunik (2014a) using robust confidence intervals to deal with data driven bandwidths that may be large.[16]

[16]The estimation is done using the rdrobust procedure in Stata 17. The regression tables present the incumbency coefficients and the standard errors using the conventional method while the significance level is based on the p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point.

Figure 3: The probability a Liberal candidate loses, Canadian general elections 3-43, 1874 – 2019



5. 1 Local linear regression

Estimation is by kernel regression, which involves computing weighted local averages at two boundary points, the difference between which measures the incumbency effect. Since kernel regressions are known to be biased at the boundaries, Hahn, Todd and Van der Klaauw (2001) propose a local linear nonparametric regression, which we use.

The solution to the following minimization problem for both limiting points leads to the semiparametric estimation of the overall incumbency effect by local linear regression. Using *VM,* and alternatively *VAM*, this problem is for the lower bound incumbency effect α_L(alternatively for the upper bound α_U)

$$\min_{\alpha,\beta_1} \frac{1}{n}\sum_{i=1}^{n} K_h(VM_i - \overline{VM}) w_i [y_i - \alpha - \beta_1(VM_i - \overline{VM})]^2 \qquad (4)$$

where $\overline{VM}$ is the vote margin at the discontinuity point 0; K_h is a kernel function defined over the bandwidth *h;* $w_i = 1$ if $\{VM_i < \overline{VM}\}$ when estimating α_L and $w_i = 1$ if $\{VM_i > \overline{VM}\}$ when estimating α_U , $w_i = 0$ otherwise; and $y_i = 1$ if the incumbent wins, $= 0$ otherwise. The parameter of interest is α, and $\beta_1$is a nuisance parameter. This function is estimated twice, once for each interval defined by the measure of competitiveness that is employed. For each index of closeness, the incumbency effect is the difference between the estimated values of α_L and α_U.

We use the triangular kernel function for K_h to reduce the weight of observations away from the discontinuity, and a data driven bandwidth for the local linear nonparametric regression so that *h* is determined from the data. The bandwidth is defined so as to minimize the asymptotic approximation of the mean square error of the treatment effect τ: $h_{optimal} = \min E[(\tau - \hat{\tau})]$.[17]

[17] Rdrobust uses two bandwidths, one to compute the treatment effect and one for the variance.

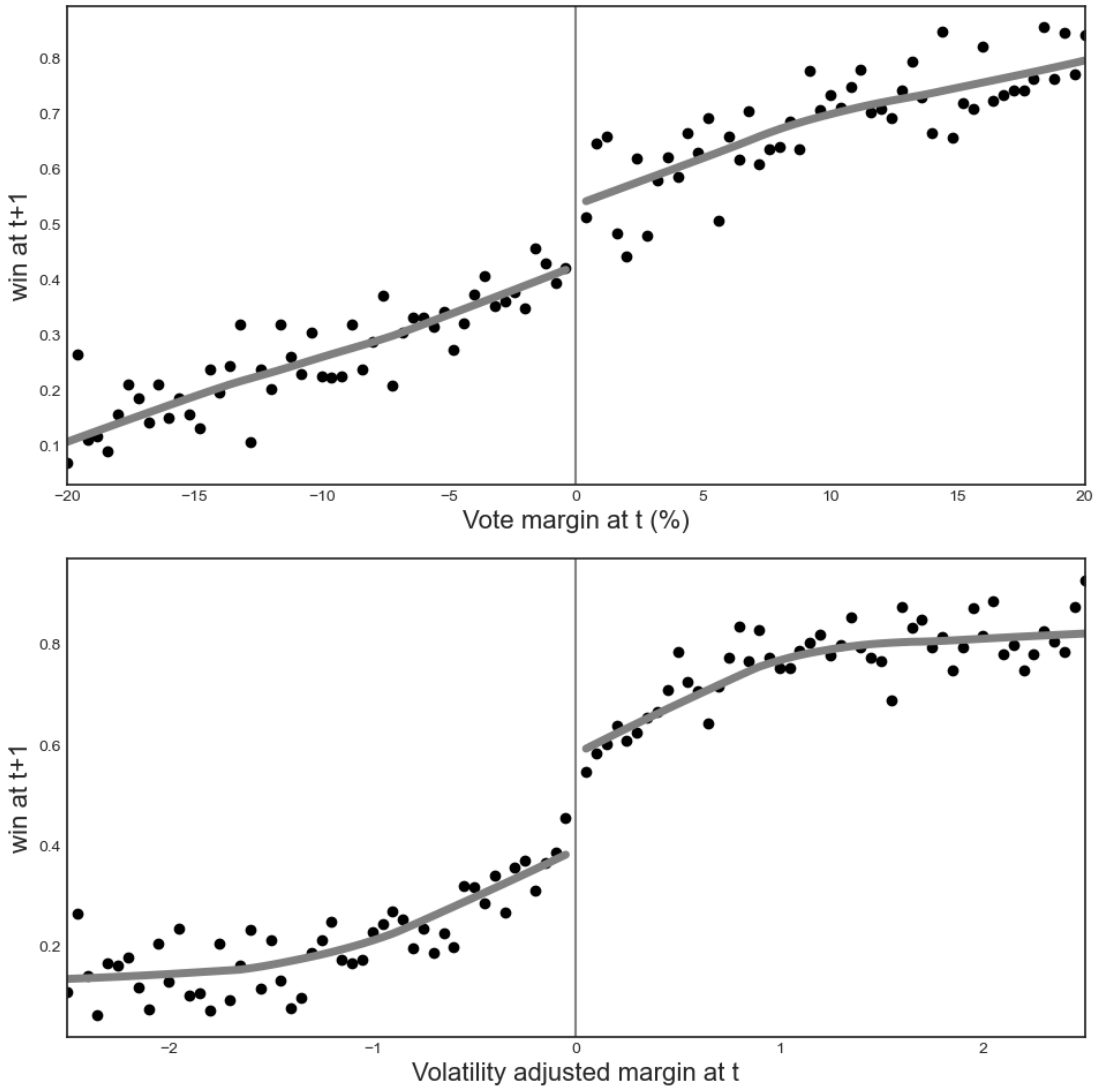
5.2 Results

A visual preview of the results of estimating (4) is presented in Figure 4 for the entire sample period, elections 3 to 43, 1874-2019. The top panel plots the probability of winning at t+1 on the y-axis in relation to the vote margin at t, *VM*. The bottom panel plots the probability of winning at t+1 in relation to the volatility adjusted margin at t, *VAM*. The shifts at zero in the locally weighted regression lines superimposed on the scatterplots are visual indicators of what sort of incumbency effect can be expected to emerge from the nonparametric linear regression in each case. The shift at the threshold appears to be larger when *VAM* rather than *VM* is used as the running variable.

Table 3 presents the point estimates of (4) using both running variables. The numbers of observations used in the data driven bandwidth is similar using either *VM* or *VAM*. Depending on the sample period considered, the estimate of the overall party incumbency effect is 40% to 46% higher when *VAM* is used as the competitiveness index. A Liberal incumbent in a competitive election after 1950 is on average 16.5% more likely to win than a Liberal candidate who is not an incumbent when *VAM* is used as the running variable, compared to 11.3% using *VM*. The comparison for the pre-1950 figures is similar: 17.7% with *VAM* compared to 12.6 % using *VM*. These results indicate that that there is a quantitatively important overall incumbency effect for Liberal candidates in Canadian general elections: our preferred estimate, 16.5%, is the one for the post-1950 period using *VAM.*

To deal with the possibility that party splits and mergers may bias the measure of volatility and hence our calculation of *VAM*, we also estimate (4) after removing elections 36, 38 and 39 when important party splits and mergers occurred. Following the 34th election the Reform Party of Canada and the Bloc Québecois were created. Following the 36th election the Reform Party of Canada was succeeded by the Canadian Alliance. Following the 37th election, the Canadian Alliance and the Progressive Conservative Party of Canada were merged into the current

Figure 4: Probability of winning at t+1 based on VM and VAM, Canadian general elections 3-43, 1874 – 2019



Note: Each point represents an average value. In each figure we use 100 bins divided evenly on both sides of the threshold. Since the scale of the two competitiveness measures is different, the vote margin plot presents 5,484 elections and the volatility adjusted margin plot presents 6,037 elections. Other elections are outside of the bandwidth presented. Note that the minimum volatility adjusted vote margin is -212, and the maximum is 494. Both values are well away the observations presented which vary between 2.5 and -2.5. The lines in gray are locally weighted scatterplot smoothing regression lines (LOWESS) estimated on each side of the discontinuity for both VM and VAM. Varying the number and length of the bins does not significantly affect the visual presentation.

Conservative Party of Canada. During the 36th and 39th elections, volatility was more than double compared to the election average in the post-1950 period. However, excluding these elections does not alter the estimated incumbency effects in a substantial manner using either *VM* or *VAM,* and so these results are not reported in the table.

Table 3: RDD estimates of the overall party incumbency effect for the Liberal Party of Canada using alternative running variables: 1874 – 2019 and pre- and post-1950 periods

	Vote margin			Volatility adjusted margin		
	All elections	pre-1950	post-1950	All elections	pre-1950	post-1950
Incumbency effect	0.115***	0.126**	0.113**	0.187***	0.177***	0.165***
	(0.031)	(0.041)	(0.043)	(0.025)	(0.033)	(0.038)
Bandwidth	0.156	0.185	0.152	1.69	2.247	1.28
Number of observations	8957	3408	5549	8957	3408	5549
Number of observations used[1]	4295	2101	2306	5151	2433	2508

1 Number of observations used within the bandwidth.

Note: All elections 3-43, 1874-2019. Pre 1950 elections 3-22, 1874-1949. Post 1950 elections 22-43, 1953-2019. Standard errors in parentheses and the significance level is based on p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01, ** p<0.05, * p<0.1.

In their study of incumbency using post-1950 elections up to 2008, Kendall and Rekkas (2012, p. 1574) estimated the Liberal overall incumbency effect at 10.8% for their linear case with a fixed bandwidth of +/- 15%, and smaller figures when cubic and quartic terms are added. (Their results are listed for convenience in Table A1 in the Appendix). The Appendix reports results of reproducing the Kendall and Rekkas model, which employs *VM* and estimation with a fixed bandwidth, using our refined and extended basic electoral data set. As shown in Table A1, for the post-1950 period up to 2019, their model for the linear case with their 15% bandwidth yields a Liberal overall incumbency effect of 11.6%, which is still substantially below the corresponding result of 16.5% in Table 3. Using our method of estimation instead (still with *VM*) results in a figure of 11.3%. It appears, then, that for the post-1950 period, the difference between our results in Table 3 and those based on the Kendall and Rekkas model in Table A1 are largely due to the choice of the running variable.

5.3 Testing for balance among covariates

A reliable RDD estimate of the incumbency effect requires that all covariates in close elections at t be balanced across the threshold or discontinuity at zero, so that winning in the next election at t+1 cannot be associated with other characteristics of party candidates other than their incumbency status. Eggers et al. (2015) evaluate the balance between covariates around the threshold by looking at the impact of winning the election at t+1 on various covariates at t using t-tests over a small bandwidth. Accordingly, we consider the RDD estimates of the 'effect' of just winning at t+1 on several covariates at t, the reverse of estimation in Table 3. These placebo tests should result in insignificant effects: winning at t+1 should not appear to lead to a jump in the level of a covariate at t at the zero vote margin. If there is such a jump at, or imbalance across, the threshold, this suggests that there could have been some manipulation of electoral outcomes at t+1 via one or another covariate. This will invalidate the RDD as a way of investigating the causal effect of incumbency.

Table 4 presents these tests based on both *VM* and *VAM* using local linear regression with data driven bandwidths. The main conclusion is that covariates at t appear to be balanced for both measures of electoral closeness in the post-1950 period. But there exists significant imbalance in the pre-1950 period and to a lesser degree when pooling all the elections. An imbalance appears particularly for constituency population, electors, ballots and rejected ballots, all of which are correlated and contain missing observations in the pre-1950 period.

The table also shows that the 'effect' of winning in close elections at t+1 on the probability of being a winner at t is negative; that is, there are fewer winners at t that win close elections at t+1 than lose them. However, this effect is only significant at 10% when the entire history of elections is considered regardless of whether *VM* or *VAM* is used as the running variable. There may also exist some imbalance in the pre-1950 period when using the volatility adjusted margin

at t+1 to determine if there are shifts at the threshold in the volatility adjusted margin at t or volatility at t.

Table 4: Placebo tests: the 'effect' of a Liberal party win at t+1 on covariates at t using local polynomial regression with data driven bandwidth when VM and VAM are used as the running variable

	Vote margin at t+1			Volatility adjusted margin at t+1		
	All elections	Pre-1950	Post-1950	All elections	Pre-1950	Post-1950
Winning at t-1	-0.049*	-0.049	-0.05	-0.037*	-0.003	-0.054
Vote margin at t	-0.012	-0.023	-0.003	0.005	0.003	0.015
VAM at t	-0.502	-0.713	-0.108	-0.509*	-1.208**	0.221
Volatility at t	0.001	-0.032	0.026	-0.011	-0.035**	-0.003
Population at t	98	2,989**	888	-5,063***	2,599**	216
Electors at t	1258	-1174	816	-3,313***	-1080*	223
Ballots at t	524	-761	179	-2,424***	-666	-123
Rejected ballots at t	3	-19	-2	11	-14	6
Candidates at t	0.124	-0.074	0.2	-0.150*	-0.034	0.122

Note: Periods defined as in table 3. The significance level is based on p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01, ** p<0.05, * p<0.1.

These results, along with the difficulty of measuring volatility in the pre-1950 period discussed earlier, cast some doubt on RDD estimates using pre-1950 data. In comparing the effect of using alternative running variables on the estimation of the incumbency effect, it seems appropriate to focus on estimation results for the post-1950 period.

6. Heterogeneous treatment effects

The incumbency effects estimated in Table 3 are an average over all those included in the estimation. We suggested in the discussion of the data presented in Figure 2 that the ability of local party organization supporting them, and that organizational quality is likely to be higher than average when the local party organization was involved in a highly competitive contest in the recent past. A high-quality organization can increase campaign funds and attract more qualified or well-known candidates. Candidates might also benefit from a more vigorous local campaign that reinforces the national party's appeal. Such reasoning suggests separating elections in which

the quality of the local organization is high from those in which it is low before estimating an incumbency effect.

Campaign spending data of the sort reported in Figure 2 might serve as basis for separating out high quality from lower quality organizations assuming that quality is correlated with campaign spending relative to allowed limits. Unfortunately, data of the sort used to draw Figure 2 is available only for elections after 1974. Instead, we shall use competitiveness in the recent past (at t-1) as a proxy for organizational quality.[18] The degree of competition in the recent past also allows for the general role the competitiveness of a constituency election may have in altering the importance of other dimensions of the electoral contest besides the incumbency of a party or its candidate.

Table 5a presents estimates of the incumbency effect for both running variables *VM* and *VAM* after restricting the sample used to those elections which followed one that, at t-1, was highly competitive according to the range of values of *VM* or, alternatively, of *VAM,* indicated on the left side of the Table. We focus on the post-1950 period. We see that when samples used are restricted to those which involve a highly competitive election at t-1, re-estimation of (4) now indicates that the incumbency effect in the post-1950 period is statistically insignificant for both running variables, in contrast to the results in Table 3. We also see that the size of the coefficients in the post-1950 period are uniformly smaller compared to Table 3 for any definition of competitiveness when *VAM* – our preferred measure - is used as the running variable.[19]

One should note that the restrictions involved here in choice of the sample reduces the number of elections used compared to Table 3. Still, there are over 800 observations in the sample with an absolute value of VAM less than one. Thus, even though Table 5a does not reveal exactly

[18] Jacobson (1978) and McAdams and Johannes (1987) suggest that the lagged vote margin is a good indicator of a candidate's quality, with smaller margins signalling higher quality. The assumption here is stronger, extending to the quality of the organization supporting candidates.

[19] We note that the results for the pre-1950 period are uniformly larger than corresponding entries in Table 3.

Table 5: RDD estimates of the Liberal party (overall) incumbency effect when the sample is restricted (a) to those elections that are highly competitve at t-1 based on VM and VAM and (b) to elections that are not highly competitive at t-1.

table 5a

	Vote margin			Volatility adjusted margin		
	All elections	pre-1950	post-1950	All elections	pre-1950	post-1950
Incumbency effect:						
abs(VM)<.05	0.198***	0.259***	0.084	0.218***	0.237***	0.105
	(0.054)	(0.079)	(0.110)	(0.054)	(0.064)	(0.110)
abs(VM)<.1	0.141**	0.165**	0.114	0.179***	0.188***	0.088
	(0.047)	(0.057)	(0.080)	(0.040)	(0.048)	(0.084)
abs(VAM)<.5	0.171***	0.235***	0.053	0.198***	0.229***	0.076
	(0.053)	(0.071)	(0.094)	(0.048)	(0.060)	(0.097)
abs(VAM)<1	0.171***	0.212***	0.124	0.181***	0.214***	0.099
	(0.038)	(0.059)	(0.069)	(0.043)	(0.052)	(0.074)
Number of observations						
abs(VM)<.05	1,461	736	725	1,461	736	725
abs(VM)<.1	2,669	1,261	1,408	2,669	1,261	1,408
abs(VAM)<.5	1,958	929	1,029	1,958	929	1,029
abs(VAM)<1	3,234	1,401	1,833	3,234	1,401	1,833
Number of observations used [1]						
abs(VM)<.05	1,152	520	365	1,078	590	395
abs(VM)<.1	1,686	989	701	2,069	1,071	681
abs(VAM)<.5	1,325	676	510	1,408	730	490
abs(VAM)<1	2,443	1,013	951	2,012	1,012	817

[1] Number of observations used within the bandwidth.
Note: Periods defined as in table 3. Standard errors in parentheses and the significance level is based on p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01, ** p<0.05, * p<0.1.

table 5b

	Vote margin			Volatility adjusted margin		
	All elections	pre-1950	post-1950	All elections	pre-1950	post-1950
Incumbency effect:						
abs(VM)>.05	0.082	0.064	0.110	0.176***	0.167***	0.172***
	(0.040)	(0.056)	(0.052)	(0.030)	(0.041)	(0.045)
abs(VM)>.1	0.100	0.103	0.097	0.217***	0.208***	0.194***
	(0.046)	(0.063)	(0.059)	(0.032)	(0.044)	(0.049)
abs(VAM)>.5	0.079	0.030	0.130*	0.191***	0.158***	0.182***
	(0.042)	(0.061)	(0.054)	(0.031)	(0.044)	(0.046)
abs(VAM)>1	0.044	-0.010	0.108	0.217***	0.164***	0.215***
	(0.050)	(0.071)	(0.064)	(0.033)	(0.049)	(0.051)
Number of observations						
abs(VM)>.05	6,332	2,275	4,057	6,332	2,275	4,057
abs(VM)>.1	5,124	1,750	3,374	5,124	1,750	3,374
abs(VAM)>.5	5,702	1,960	3,742	5,702	1,960	3,742
abs(VAM)>1	4,423	1,485	2,938	4,423	1,485	2,938
Number of observations used [1]						
abs(VM)>.05	2,624	1,269	1,555	3,681	1,698	1,823
abs(VM)>.1	2,048	988	1,163	3,064	1,340	1,484
abs(VAM)>.5	2,384	1,069	1,449	3,390	1,440	1,686
abs(VAM)>1	1,679	767	1,027	2,743	1,139	1,391

[1] Number of observations used within the bandwidth.
Note: Periods defined as in table 3. Standard errors in parentheses and the significance level is based on p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01, ** p<0.05, * p<0.1.

what aspects of competition are responsible, there is evidence here that the incumbency effect observed in Table 3 is conditional on the prior state of electoral competition in the constituency.

To further explore the role of prior competitiveness, it is interesting to investigate what happens when only *uncompetitive* elections in the recent past are used to estimate the incumbency effect. These results are provided in Table 5b using the complementary samples corresponding to each row in Table 5a. The samples used here are larger than those used in Table 5a and candidates with both large losses at t-1 and large wins at t-1 are now included. The latter may be supported by higher quality organizations that spend at the limit, as is suggested by Figure 2, so the association of high organizational quality with a high level of competition relied upon in interpreting Table 5a is not maintained. All of the contests at t-1 are, however, less competitive than in the corresponding row in Table 5a. We see that uniformly for *VAM,* all the incumbency effects for the post-1950 period in Table 5b are statistically significant, larger in size than the corresponding entry in Table 5a, and that one result for *VM* in the post-1950 period is also now significant. The results in Table 5b reinforce those in Table 5a by indicating again that the overall incumbency effect for Liberal party candidates is contingent on the competitiveness of election contests in the recent past over the post-1950 period.

Another possible source of heterogeneity concerns the historical experience of party candidates as winners or losers. Table 6 separates the data into two parts according to whether candidates at t lost or won at t-1, regardless of by how much. The sub-samples here are larger than in Tables 5a and 5b and are more evenly balanced. Using *VAM*, for the post-1950 period we see that for the sample of constituencies with Liberal losers at t-1, the incumbency effect at t+1 for just winners at t is 18.1%, a size comparable to the effect in Table 3. But the incumbency effect is essentially zero for those who are Liberal winners for a second time, that is, for those who also won at t-1 (sometimes by a large margin). Similarly, for those who won at both t-1 and t-2. Thus,

Table 6: RDD estimates of the incumbency effect for winners and losers at t-1

	Vote margin			Volatility adjusted margin		
	All elections	pre-1950	post-1950	All elections	pre-1950	post-1950
Incumbency effect:						
Losing at t-1	0.143**	0.191**	0.114	0.224***	0.190**	0.181*
	(0.050)	(0.073)	(0.083)	(0.041)	(0.064)	(0.071)
Winning at t-1	0.114**	0.127	0.104	0.105	0.143**	-0.001
	(0.047)	(0.073)	(0.067)	(0.048)	(0.057)	(0.087)
Winning at t-1 and t-2	0.060	0.068	0.065	0.084	0.087	0.034
	(0.065)	(0.092)	(0.088)	(0.056)	(0.072)	(0.093)
Number of observations						
Losing at t-1	3,720	1,077	2,643	3,720	1,077	2,643
Winning at t-1	3,663	1,534	2,129	3,663	1,534	2,129
Winning at t-1 and t-2	2,445	909	1,536	2,445	909	1,536
Number of observations used[1]						
Losing at t-1	1,620	697	707	2,076	801	806
Winning at t-1	1,898	810	957	1,695	959	660
Winning at t-1 and t-2	1,051	440	554	1,147	587	521

[1] Number of observations used within the bandwidth.
Note: Periods defined as in table 3. Standard errors in parentheses and the significance level is based on p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01, ** p<0.05, * p<0.1.

it appears that the substantial incumbency effect recorded in Table 3 wears off fairly quickly for serial winners who ran in a close contest at t.

7. Conclusion

In this paper we discuss two methodological issues underlying the use of a regression discontinuity design to estimate the overall incumbency effect for Liberal party candidates in Canadian general elections: the implementation of quasi-random assignment, and the presence of heterogeneous treatment effects or interactions. Emphasis is placed on the post-1950 period for which our preferred measure of electoral competitiveness, the volatility adjusted vote margin, is more easily measured, and for which placebo tests for the validity of an RDD are more assuredly passed. By the overall incumbency effect is meant the combined or average effect of incumbency of the party's candidate coupled with the effect of the incumbency of a particular individual.

The choice of running variable measuring electoral competitiveness matters because elections away from those with a zero vote share margin must be employed in an RDD investigation of incumbency. Using the unadjusted vote share margin, *VM*, as the running variable, the one used by Kendall and Rekkas (2012) and others, leads to results that are similar to those in the Kendall and Rekkas paper for the cases we consider, even though we employ an estimation method with a data driven bandwidth rather than a fixed one, a refined electoral data set and a longer series of elections. However, when a preferred measure of electoral competitiveness is used as a running variable – the volatility adjusted vote margin, *VAM* – the incumbency effect in the post-1950 period is substantially larger than when *VM* is the running variable. Using *VAM,* our estimate of the Liberal party overall incumbency effect for the post-1950 period up to 2019 is a substantial 16.5%, compared to 11.3% with *VM.* This overall incumbency effect turns out to be conditional on the degree of competitiveness of elections in the recent past.

These results do not by themselves allow us to identify what specific features of historically highly competitive elections are responsible for attenuating the incumbency effect, or

what lies behind the fading of the incumbency effect for serial winners. We have suggested that organizational quality fostered by strong competition may play a role, but we have not presented direct evidence on this matter. In addition to investigating the role of alternative measures of competitiveness, developing an understanding of what lies behind the dependence of the incumbency effect on the historical competitiveness of elections and the sequencing of wins and loses may be of interest in future work.

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Appendix

Reproducing the Kendall and Rekkas (2012) approach to estimation of the overall incumbency effect for the Liberal party

In this appendix we reproduce the Kendall and Rekkas (2012) model of the overall incumbency effect for Liberal party candidates. To do so, we combine our refined and extended electoral data with their (volatility unadjusted) index of electoral closeness and different estimation methodology.

The results of Kendall and Rekkas (2012, Table 1, p 1574)) concerning the overall party incumbency effect on the probability of winning are based on estimation using a linear regression for a small, exogenously chosen bandwidth around the volatility unadjusted vote share margin discontinuity at zero. Their estimating equation, with their election timing of t-1 and t (instead of our t and t+1) is the following:

$$W_{it} = \alpha_i + \beta_i D_{i,t-1} + \gamma_i VM_{i,t-1} + \delta_i D_{i,t-1} VM_{i,t-1} + \varepsilon_{it} . \quad \text{(A1)}$$

Since we consider only Liberal candidates in our estimation (Kendall and Rekkas also consider Conservatives) the party subscript that would otherwise be present in A1 is dropped. Here *W* is a binary variable that is 1 if the Liberal candidate in constituency *i* during election t won the election. *D* is a binary variable that is 1 if the constituency was won by a Liberal candidate during the previous election. *VM* is the (unadjusted) vote share margin defined in the main text, and ε is a stochastic error term. Time and province fixed effects, not shown, are included in the estimation. The standard errors allow for clustering on constituencies. The estimate of β is the Liberal party overall incumbency effect.

Additional parameters in the vote share margin and corresponding interaction terms are added in the cubic and quartic specifications used by Kendall and Rekkas. Fixed bandwidths, namely +-10% and +-15% for the linear regression, and +-70% in the cubic and quartic cases, are employed in their estimation.

Before turning to our reproduction of (A1), we note that there are differences as well as similarities between the basic electoral data set used by Kendall and Rekkas and by us. First, our sample includes the 1867-2008 period (elections 1 to 40) they used as well as the elections 41-43 of 2011, 2015 and 2019. In our reproduction of Kendall and Rekkas model for the Liberal party, we use elections up to 2008 and also the extended data set.

Second, like Kendall and Rekkas we do not use data from by-elections, but still accept their effect on the subsequent classification of candidates as incumbents or challengers. We note that there were about 200 by-elections during our post-1950 sample period. It can be argued that by-elections are sufficiently different so that they would bias the estimation of the incumbency effect in general elections.

Third, and unlike Kendall and Rekkas, we do not include the 123 elections for constituencies with two seats.

Fourth, instead of using the name of constituencies as given in official election data as a basis for matching districts over time, we modified constituency names to take into account the fact that a name can be changed outside of a redistricting period and without a change in boundaries. For example, St. John's East became St. John's North in 2004 and was then changed back to St. John's East in 2006. These changes are recorded in the *List of ridings represented in the House of Commons from 1867 to today*. We therefore assigned the name St. John's East in each of the three periods referred to, increasing the number of constituency observations with a matched lagged vote margin by two (2004 and 2006). Accents and wording are also problematic and need to be dealt with. For example, *Quebec East* was changed to *Québec Est* in 1967 and to *Québec East* in 1997 in official sources, and each of these may be (mistakenly) recognized as a distinct constituency by statistical software. We implemented about 200 modifications of official electoral data of these types for the post-1950 period, for example, making it difficult to specify exactly the differences between our dataset and the one used by Kendall and Rekkas. Overall, our

modifications resulted in an increase in observations, compared to the unmodified data set, by between 5% to 10% depending on the sample period considered.

Table A1 shows our re-estimation of equation (A1) using our dataset for the same period - up to 2008 - used by Kendall and Rekkas, and when adding the 2011, 2015 and 2019 elections used in the estimation reported in the main text. In all cases, the unadjusted vote share margin *VM* is used to measure competitiveness. As indicated in the table, the point estimates that we obtain are less than half of a standard error away from the Kendall and Rekkas estimates in their Table 1 (p. 1574). The significance level is also similar, though ours are slightly higher for the quartic regression. We can see that the number of elections in our sample is always higher no matter the bandwidth employed, and is almost 300 larger when the +-70% bandwidth is employed. Nonetheless, the results in Table A1 remain consistent with those of Kendall and Rekkas in each case. Adding the 2011, 2015 and 2019 elections does not substantially affect the comparisons, even when estimation employs a data driven bandwidth.

We conclude that our refined and extended electoral data set applied to estimate the main equation used by Kendall and Rekkas yields similar results to those in their 2012 paper for Liberal party incumbents. These results provide additional support for their conclusions, for the cases we consider, provided that one accepts their modeling choices with regard to the running variable and treatment of interactions.

Table A1: Reproduction of Kendall and Rekkas (2012, Table 1, p1574) overall incumbency effect for the Liberal party, pre-1950 elections and post-1950 elections, using the unadjusted vote margin VM as the running variable and the Kendall/ Rekkas estimation method

	y=probability of winning the election				
	Kendall and Rekkas[1]		Reproduction		
	Pre-1950	Post-1950	Pre-1950	Post-1950	Post-1950[2]
Linear (+/- 15%)	0.136***	0.108***	0.130***	0.107***	0.116***
	(0.044)	(0.037)	(0.038)	(0.035)	(0.031)
Linear (+/- 10%)	0.112**	0.070	0.105**	0.070*	0.079**
	(0.051)	(0.044)	(0.045)	(0.042)	(0.038)
Cubic (+/- 70%)	0.110**	0.087**	0.070*	0.070*	0.084**
	(0.048)	(0.038)	(0.039)	(0.036)	(0.033)
Quartic (+/- 70%)	0.130**	0.086*	0.131***	0.072*	0.086**
	(0.057)	(0.046)	(0.046)	(0.043)	(0.039)
Polynomial regression with data-driven bandwidth			0.133***	0.120**	0.113**
			(0.041)	(0.045)	(0.043)
N (linear +/- 15%)	1,627	1,886	1,951	1,988	2,290
N (linear +/- 10%)	1,242	1,337	1,481	1,408	1,629
N (cubic & quartic +/- 70%)	2,425	4,406	3,477	4,706	5,532
N (Data-driven bandwidth)[3]			2,198	2,102	2,318

[1] Pre 1950: elections 2-22, 1872-1949. Post 1950: elections 22-40, 1953-2008.
[2] Including elections 41, 42 and 43, 2011-2019.
[3] Number of observations used within the bandwidth.
Note: Clustered standard errors by ridings in parentheses for the parametric regressions. The significance level for the data-driven bandwidth estimations is based on the p-value of the robust CIs constructed using bias-corrected RD treatment-effect estimators as a starting point following Calonico, S., M. D. Cattaneo and R. Titiunik (2014b). *** p<0.01; ** p<0.05; * p<0.1.