# Performance Information and Retrospective Voting: Evidence from a School Accountability Regime[1]

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**Abstract**

Governments are increasingly publishing information about the performance of the services they provide, in part to help citizens hold their elected representatives accountable for government service outcomes. Yet there is little evidence concerning the influence of information about government service performance on voter behavior. This paper examines the degree to which school performance information affects incumbent support in school board elections. A regression discontinuity analysis indicates that voters reward incumbents when local schools achieve the highest available measure of school performance. Voters do not respond to information differentiating between schools in the middle of the performance distribution, however, or to information from a source that lacks credibility.

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# Performance Information and Retrospective Voting: Evidence from a School Accountability Regime

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A central conjecture of democratic theory is that citizens will hold their elected representatives accountable for the quality of services provided by the government body. Models of democratic accountability posit that through this retrospective behavior citizens can incentivize politicians to deliver high quality services. In recent years, governments have begun to publish information about the performance of the services they provide in numerous domains, in part to strengthen democratic accountability. We currently know little, however, about the degree to which citizens hold their elected representatives accountable for information about government service performance.

A vast literature on retrospective voting has examined how the past performance of incumbent politicians affects their electoral support. Studies of retrospective voting have focused on voters' responses to economic conditions, however, and largely ignored the extent to which voters hold officials accountable for the services they oversee. Scholars exploring how voters acquire and use information in forming retrospective evaluations, meanwhile, have focused on the role of the media, and paid little attention to information provided by governments. There is, consequently, little evidence concerning the influence of information about government service performance on electoral outcomes.

There are strong empirical reasons to examine how information about the performance of government services affects voter behavior. Elected officials are frequently responsible for government services and yield significant influence over their delivery. This is particularly apparent in the case of single-function officials, such as school board members. In addition, information about government service performance is widely available in a range of policy domains. If retrospective voting is to be a general theory of political behavior, therefore, it must explain when voters hold their representatives accountable for information about the services for which they are responsible.

This paper presents the first study to test whether publicly reported information about government service performance has a causal effect on support for incumbent politicians. Specifically, I explore how the letter grades awarded to public elementary schools in Florida under the state's accountability system influence support for incumbent school board members. Florida is a useful case in which to study the impacts of school performance information, as the state's accountability system permits the use of a regression discontinuity design to identify the effects of the grades awarded to schools on electoral outcomes.

I analyze a unique dataset of election returns from five electoral cycles between 2006 and 2014. I find that when a school is assigned an A grade, rather than a B, this increases incumbent support in nearby precincts in three of the five electoral cycles considered. I find no evidence that performance information affects incumbent support at other grade boundaries, however, or in the two electoral cycles in which there was controversy surrounding the calculation of school grades. I propose that the costs of acquiring and analyzing performance information, and the extent to which citizens trust the information's source, explain the observed variation in the effects of performance information.

### Government Services and Retrospective Voting

A vast literature on retrospective voting has explored the extent to which the electorate is "an appraiser of past events, past performance, and past actions" (Key 1966, 61). The positive correlation between an area's economic performance and incumbent support in Congressional and presidential elections is amongst the most robust relationships in political economy (Ansolabehere, Meredith, and Snowberg 2014). In recent years, a "renaissance" in the study of retrospective voting has seen researchers examine the influence of conditions outside of the economic domain and information from different sources on the formation of retrospective evaluations (Ansolabehere, Meredith, and Snowberg 2012; Healy and Malhotra 2013, 18.3).

Studies of retrospective voting, however, have paid little attention to the effects of information about government service performance on electoral outcomes. Scholars investigating the electoral

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impacts of non-economic factors have focused on the influence of conditions that facilitate the identification of causal effects, such as shark attacks and war casualties, rather than government service quality (Achen and Bartels 2004; Gasper and Reeves 2011; Healy and Malhotra 2013; Karol and Miguel 2007). Studies of the role of different sources of information in retrospective voting have focused on what Popkin (1991, 23-28) calls "daily life" and "media" sources, and have largely ignored the third information source highlighted by Popkin: "information about government programs." [3]

Yet there are strong grounds to consider how the performance of government services influences electoral outcomes. The delivery of government services is a central responsibility of many elected officials. In particular, the primary responsibility of whole classes of locally elected officials is the delivery of a single public service, for example, park commissioners and school board members (Berry and Howell 2007; Hooghe and Marks 2003). Further, elected officials can often be expected to yield considerable influence over the performance of government services.[4] If retrospective voting is to be "a general theory of political behavior", therefore, it must identify the conditions under which voters hold incumbents accountable for the performance of the services that they oversee (Berry and Howell 2007, 846).

There are, likewise, good reasons to examine when citizens use information provided by the government in forming retrospective evaluations. Recent reforms have made information about the performance of government services publicly available in numerous policy domains (Fung 2008; Linn, Nagler, and Morales 2010; Stecher 2010; Walker 2014).[5] A central justification for these transparency reforms has been to strengthen democratic accountability (Chingos, Henderson, and West 2012). In addition, the federal government has used the publication of performance

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[3]One exception is a recent working paper by Alt, Lassen, and Marshall (2015), which examines how the credibility of different sources of information about national economic performance affects the influence of information on citizens' attitudes. In addition, a growing body of evidence from developing countries finds that voters respond to publicly reported information about the behavior of politicians (Chong et al. 2015; Olken and Pande 2013).

[4]In contrast, political economists debate the extent to which fiscal policy affects economic outcomes (Healy and Malhotra 2013).

[5]Citizens may also employ government statistics in forming evaluations of the macro-economy (Linn, Nagler, and Morales 2010).

information to align the electoral incentives facing local officials with national policy goals (Kogan, Lavertu, and Peskowitz 2015). Underpinning these rationales for reform is the assumption that voters will use performance information to hold their elected representatives accountable.

## School Performance and Retrospective Voting

Studies of US public schooling have made probably the most progress in exploring the relationship between government service performance and electoral outcomes. Public schooling provides a useful empirical case because democracy plays a central role in school governance. Nearly fourteen thousand local school boards oversee public schools, and around 95 percent of school board members are elected (Hess and Meeks 2010). Information about school performance is also widely available. The No Child Left Behind Act of 2001 requires states to provide annual report cards informing parents of the academic performance of schools and school districts, and there is evidence that this information can influence citizens' evaluations of their local schools (Chingos, Henderson, and West 2012; Clinton and Grissom 2015; Jacbosen, Saultz, and Snyder 2014; Peterson, Henderson, and West 2014; Rhodes 2015; Rockoff and Turner 2008).[6]

Existing analyses of the electoral impacts of school performance information have called into question, however, the extent to which traditional models of retrospective voting and democratic accountability explain citizens' responses to information about government service performance. Berry and Howell (2007) report that moving from the 25th to the 75th percentile of test score improvement in local schools increases the vote share of school board incumbents in nearby precincts by just three percentage points, and in only one of the three electoral cycles that they consider. Kogan, Lavertu, and Peskowitz (2015, 1) find that the provision of school performance information can "distort democratic accountability", with information signaling poor performance depressing support for tax levies to fund local schools.

Studies of the relationship between school performance and electoral outcomes have not, however, examined the effect of publicly reported information about school performance on in-

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[6]Previous studies have also found that school performance information influences citizens' school choices and house purchases (Figlio and Lucas 2004; Hastings and Weinstein 2007; Henderson 2010).

cumbent support. Berry and Howell (2007) study the relationship between school test results and school board election outcomes, but do not distinguish the influence of informational signals from underlying school performance.[7] Yet a weak relationship between underlying school performance and incumbent support may conceal informational effects.[8] Kogan, Lavertu, and Peskowitz (2015) identify the effects of informational signals about school performance; however, they examine the effects of information on outcomes in local referenda, rather than incumbent electoral support.[9]

### Performance Information and School Board Elections

Performance information will influence citizens' perceptions of government service quality when the costs of acquiring, understanding, and recalling the information are low, and when citizens trust the information's source. The extent to which citizens' perceptions, in turn, influence incumbent support will depend on the characteristics of government services and electoral institutions. I consider the conditions under which information about government service performance will influence electoral outcomes in the context of school performance information and school board elections.

#### *Performance Information and Citizens' Perceptions*

Performance information will have a greater influence on citizens' perceptions of government service quality when the information can be acquired at low cost (Chingos, Henderson, and West 2012; Weil et al. 2006). The costs of obtaining school performance information are generally low, as the No Child Left Behind Act requires all states to make performance data "widely available through public means, such as posting on the Internet, distribution to the media, and distribution

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[7]In addition, the relationship between school performance and incumbent support that Berry and Howell report may be confounded, as they do not employ a strategy to identify the causal effect of school performance beyond including a series of control variables in their model.

[8]Numerous studies in labor economics, for example, have documented nonlinear "sheepskin effects" in returns to education, where the signal of a diploma or other form or certification provides economic returns over and above an individual's years of schooling (Goldberg and Smith 2008; Oreopoulos and Petronijevic 2013).

[9]Several recent working papers also find a relationship between school performance and voter behavior in local elections but, again, do not identify the effect of performance information on incumbent support. Scherer (2012) and Lay (2014) find a positive relationship between school performance and incumbent support in school board and mayoral elections respectively; however, neither study distinguishes the effect of publicly reported information from underlying school performance. Holbein (2014) identifies the effect of school performance information on turnout in school board elections, but does not examine its influence on incumbent support.

through public agencies" (No Child Left Behind [NCLB] 2002). There is variation in the information that different states make available, however, and in the attention paid by the media to school performance data (Berry and Howell 2007; Fox 2004; Fung, Graham, and Weil 2007).

A considerable body of research from the behavioral sciences also indicates that "how information is presented can have as much influence...as the factual content of the data" (Fung, Graham, and Weil 2007, 44).[10] Information will have a greater influence on citizens' perceptions when it is easily comprehensible, as people have limited cognitive capacities to digest complex information (Chetty, Looney, and Kroft 2009; Fung, Graham, and Weil 2007). Information that is "vivid and salient" will, likewise, be more influential than information that is "statistical and abstract", because people have limited attention and capacity to recall information and so form their perceptions using examples that most readily come to mind (Sunstein 2014, 722).

States report school performance information in a variety of formats, and the comprehensibility and salience of these formats varies. Whereas some states summarize school performance using a single letter grade, for example, others report multiple pages of information. Given people's limited cognitive capacities, it is probable that "rows and rows and columns and columns of data...quickly becomes overwhelming" (Fox 2004). Jacobsen, Saultz, and Snyder (2014) report evidence from a survey experiment that school letter grades have a greater influence on citizens' evaluations of local schools than less familiar performance measures, such as index ratings.

Certain informational signals may also be easier to comprehend and recall than others, within a given presentational format. It is clear that A and F grades indicate good and poor performance, for example, whereas the interpretation of B and C grades is less obvious. It may also be easier to reconstruct an A or F grade from the "generic knowledge" of good or poor past performance than to reconstruct a B or C grade from an imperfect recollection, and studies have found that people are better able to recall receiving A and F grades in school (Bahrick, Hall, and Berger 1996; Bahrick, Hall, and Da Costa 2008). Jacobsen, Saultz, and Snyder (2014), likewise, report that letter grades

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[10]For overviews of literatures in cognitive psychology, marketing, and behavioral economics that explore how the how cognitive costs and salience shape the impact of information, see Penzer (1995) and Sunstein (2014).

have a greater influence on citizens' evaluations of schools than other presentational formats in the case of high and low performing schools only.[11]

The influence of performance information on citizens' perceptions of government service quality will also be greater when citizens trust the information's source. Alt, Lassen, and Marshall (2015, 2) propose that a source's credibility depends on "institutional expertise and incentives to deceive." The design and administration of school performance measures is the responsibility of state education agencies, which have technocratic expertise and reputational incentives to provide accurate information (Carpenter and Krause 2012; NCLB 2002). Confidence in school performance measures may have been undermined, however, by public criticism of states relaxing their proficiency requirements in order to limit the number of failing schools, and by scandals concerning errors in the administration of state tests and schools gaming the system or cheating (Berry and Howell 2007; Chakrabarti and Schwartz 2013; Jacob and Levitt 2003; Peterson and Lastra-Anadon 2010; Samuels 2011).

*Performance Information and Retrospective Voting*

The extent to which changes in citizens' perceptions of government services, in turn, influence voter behavior will depend on the characteristics of those services. Hirschman (1970) proposes that the easier it is to exit from a service, the less citizens will exercise voice, for example, through voting. Studies of retrospective voting have traditionally examined voters' responses to conditions from which it is difficult to exit, such as the performance of the national economy.[12] In contrast, citizens dissatisfied with government services can often switch service, for example, by moving to a different school. School performance information can, therefore, be expected to have a greater influence on electoral outcomes when school choice options are limited.

The influence of performance information on incumbent support will also depend on the char-

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[11]Figlio and Lucas (2004), similarly, find that when a school receives an A, rather than a B, this has a larger effect on nearby house prices than when a school receives a B, rather than a C.

[12]Studies have only recently begun to explore the influence on electoral outcomes of conditions at the city, county, and state levels, from which it is feasible to exit (Ansolabehere, Meredith, and Snowden 2014; Arnold and Carnes 2012; Kriner and Reeves 2012; Oliver and Ha 2007).

acteristics of electoral institutions. Citizens must, first, be able to attribute responsibility for the outcome being measured to the appropriate incumbent. The responsibilities of school board members are narrow and well defined, which facilitates the attribution of responsibility (Berry and Howell 2007). On the other hand, however, "citizens are poorly informed about [school board members], and seemingly disinterested in acquiring such information" (Kirst and Wirt 2009, 135). In addition, multiple bureaucratic and political actors share responsibility for school outcomes.

In order for performance information to influence incumbent support, citizens must also choose to evaluate incumbents based on government service performance. The nonpartisan character of most school board elections means that party identification will not rival retrospective evaluations as a basis for voter behavior (Berry and Howell 2007).[13] Personal connections to the candidate, however, have been found to play an important role in voting decisions in local elections (Oliver and Ha 2007). Studies have, likewise, found union and interest group affiliations to be influential in school board elections, particularly when elections are held off-cycle and turnout is low (Anzia 2012; Berry and Gersen 2011; Moe 2011).

The influence of performance information on electoral outcomes will also be weakened where difficulties in attributing responsibility and the influence of alternative considerations systematically benefit incumbents. Incumbents frequently accrue multiple advantages, such connections to the media and their constituents, which they can use to influence attributions of responsibility and the salience of different considerations (Trounstine 2009). Incumbency advantages exist in numerous electoral settings, but are particularly pronounced in school board elections (Hess 2008). Nearly 50 percent of superintendents, for example, report that no school board incumbent has been defeated in the past five years (Hess and Meeks 2010).

While it is therefore possible to predict how the effects of performance information on electoral outcomes will vary with the characteristics of government services and electoral institutions,

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[13]In a recent survey, superintendents reported that no party affiliation was listed on the ballot in 90 percent of school board elections (Hess and Meeks 2010).

the conditions under which performance information will be sufficient to influence electoral outcomes remains an open empirical question.

## Florida

Since 1999, the Florida Department of Education has assigned each public school a letter grade A to F. The grade assigned to each school depends primarily on a continuous points score calculated from the performance of students on the Florida Comprehensive Assessment Test.[14] The grades assigned to schools in Florida "receive considerable media attention" and have been shown to influence citizens' perceptions of school performance, school choices, and house purchases (Chingos, Henderson, and West 2012, 22; Figlio and Lucas 2004; Henderson 2010).

The tests used to calculate school grades are administered during the spring of each year, and school grades are published between June and early August.[15] On two occasions in the period considered, controversies surrounding the calculation of school grades delayed their publication. In 2010, several superintendents publicly raised concerns about anomalies in test results, leading to two independent reviews (Strauss 2010). There was further controversy in 2012, when officials first lowered the passing score for students in response to unexpectedly poor results, and later revised the grades awarded to hundreds of schools after admitting that some grades had been miscalculated (Strauss 2012).

The vast majority of public school students in Florida cannot easily move school in response to information about school performance. School assignment is determined by residence, and changing school therefore requires parents to relocate to a new neighborhood. If a school receives two F grades in a period of four years, however, all pupils at the school are eligible for vouchers to

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[14]Schools are awarded points based on eight components. One point is awarded for each percent of students who receive a satisfactory score in mathematics, reading, writing, and science. Schools are also awarded one point for each percent of students making gains in reading and mathematics, and for each percent of the students in the lowest quartile making gains in reading and mathematics. The eight scores are summed together to calculate a total points score. To achieve a particular grade, schools must also meet minimum requirements with respect to the proportion of eligible students tested, and the proportion of students in the lowest quartile making learning gains in reading and mathematics (Florida Department of Education 2014).

[15]School grades were released on 14 June 2006, 8 July 2008, 6 August 2010, and 11 July 2014. In 2012, school grades were first released on 11 July and corrected grades were released on 20 July.

move school. Consistent with these institutional features, Henderson (2010) finds that the grades assigned to schools in Florida in most cases do not affect school choices. Where parents have a formal choice option, however, students whose school receives an F are more likely to exit the school.

Citizens in Florida may also respond to school performance information through voting in school board elections. Each of the sixty-seven electoral counties in Florida constitutes a school district and is governed by a school board of either five or seven members. School board members serve staggered four-year terms, with elections held in even years. School board primary elections are held in late August or early September, on the same day as all other primary elections.[16] School board elections in Florida include both at-large and single-member elections, and are by law nonpartisan.

There are, therefore, good reasons to expect that performance information will affect incumbent support in Florida school board elections. Performance information is widely publicized, presented in a comprehensible and salient format, and comes from a broadly credible source. In addition, most students cannot easily change school in response to information about school performance, and school board elections are nonpartisan and held on the same day as elections for other offices, minimizing the influence of alternative considerations. There are also grounds to expect, however, that the effects of school performance information may vary across letter grades, and that recent controversies may have undermined public confidence in school grades.

### Data

I collected precinct-level election results for school board primary elections from 2006 to 2014 from the Supervisor of Elections in each of Florida's sixty-seven counties.[17] Electoral precinct boundaries were obtained from the Florida House of Representatives Redistricting Committee. The incumbent in each school board race was identified from a list of school board candidates

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[16]Primary elections were held on 5 September 2006, 26 August 2008, 24 August 2010, 14 August 2012, and 26 August 2014.

[17]Florida does not collect precinct-level data for school board races centrally. 2006 is the earliest year for which precinct-level election data for school board races is widely held by Supervisors of Election.

provided by the Florida School Board Association.[18] The points and grades awarded to each school and school district, as well as data on school characteristics, were obtained from the Florida Department of Education. Further data on school characteristics, including the geographic location of each school, came from the National Center for Education Statistics Common Core of Data.

### School Performance and Incumbent Support

I begin by exploring the relationship between incumbent vote share in a precinct and the performance of the nearest elementary school in the academic year immediately preceding the election. I include in my sample all precinct-incumbent units in which an incumbent ran and was challenged. Each precinct is linked to the nearest non-charter public elementary school.[19] I employ as a measure of school performance the points score from which school letter grades were subsequently calculated.[20] I estimate the following regression for each electoral cycle:

$$Y_{p(sr)} = \theta_{000} + \beta_{010}T_s + \gamma \mathbf{V}_s + c_{0s0} + d_{00r} + e_{p(sr)} \tag{1}$$

where $Y_p(sr)$ is the incumbent vote share in precinct-incumbent unit $p$ with nearest school $s$ in school board race $r$, and $T_s$ is the points score received by school $s$ in the academic year immediately preceding the election. $\mathbf{V}_s$ is a vector of covariates for school $s$, which includes the racial composition of the school, the proportion of students on free or reduced price lunch, the school being in an urban or suburban location, and the points score received by the school in the previous year. The model includes random effects at the school level, $c_{0s0}$, and school board race level, $d_{00r}$, to account for the cross-classified structure of the data.[21]

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[18]Wherever possible, this table was cross-checked against the electoral results obtained from Supervisors of Elections.

[19]Specifically, each electoral precinct is linked to the school that minimizes the Euclidean distance to the precinct centroid. I am unable to link precincts to schools using school attendance zones. The School Attendance Boundary Information System is the richest available source of Florida school boundary data, but only holds data for the 2009-2010 school year and a limited number of schools.

[20]I consider primary election results so as not to exclude precinct-incumbent units in which the general election was not subsequently contested. If a candidate receives more than half of the votes in the primary election, there is no further voting in the general election. In all other cases, the field in the general election is limited to the two leading candidates from the primary election.

[21]Multiple precinct-incumbent units can be linked to a single elementary school, analogous to a cluster randomized

Table 1 reports estimates for each electoral cycle obtained from fitting the model specified in Equation 1 using ordinary least squares regressions. The results indicate that there is little relationship between school performance and incumbent support. In four of the five electoral cycles, the nearest school's points score is not a statistically significant predictor of incumbent vote share, and the largest difference between predicted incumbent vote share at the 90th and the 10th percentiles of school points scores is less than 1.4 percentage points. There is a statistically significant negative relationship between points score and incumbent vote share in 2006; however, the difference between predicted incumbent vote share at the 90th and 10th percentiles of points scores is again just 1.9 percentage points.[22] Nevertheless, a weak linear relationship between school performance and incumbent support may conceal informational effects.

### School Grades and Incumbent Support

To test whether information about school performance has a causal effect on incumbent vote share, I employ a regression discontinuity design that compares precinct-incumbent units on either side of each grade threshold in the points score that determines school grades.[23] To implement this approach, I first estimate expected incumbent vote share for a precinct-incumbent unit assigned the lower grade with a points score precisely at the grade threshold. I obtain this estimate by fitting a linear regression for precinct-incumbent units with a points score less than a bandwidth of $h$ points below the grade threshold. I employ an analogous procedure to estimate expected incumbent vote share at the threshold for a precinct-incumbent unit assigned the higher grade. Combining these two linear functions into one model, and accounting for the cross-classified structure of the data, yields the following specification:

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trial, while each precinct-incumbent unit is also nested within a school board race. The data structure is cross-classified, rather than hierarchical, because a given school can be nested in multiple school board races.

[22]Fitting models excluding controls does not substantively alter these findings (see Appendix 3, Table A1).

[23]My approach broadly follows the strategy employed by Chiang (2009) and set out in Imbens and Lemieux (2008). A more detailed derivation of Equation 2 is provided in Appendix 1. All precinct-incumbent observations for which the points variable does not bind are dropped from the analysis.

$$Y_{p(sr)} = \theta_{000} + \beta_{010}Z_s + \beta_{020}(T_s - t) + \beta_{030}(Z_s \times (T_s - t)) +$$

$$\gamma \mathbf{V}_s + \lambda \mathbf{W}_r + c_{0s0} + d_{00r} + e_{p(sr)} \tag{2}$$

$$\text{s.t.} \ -h < T_s - t < h$$

where $Z_s$ is an indicator for school $s$ receiving the higher grade in the most recent academic year, and $t$ is the points score at the grade threshold. $\mathbf{W}_r$ is a vector of covariates for school board race $r$, and includes the number of candidates in the school board race and an indicator for the school board race being at-large. I employ the same school-level covariates, $\mathbf{V}_s$, as in the model specified in Equation 1.

I select the bandwidths to employ using the cross-validation procedure outlined by Chiang (2009).[24] The idea behind this procedure is that the choice of bandwidth for a grade threshold should minimize the expected squared prediction error for incumbent vote share at the threshold, since the regression discontinuity design relies on predicting incumbent vote share at the threshold. To select a bandwidth, incumbent vote share is estimated for a sample of units on either side of the grade threshold using a series of different bandwidths, and the bandwidth is chosen that minimizes the mean squared error of these predictions. In addition, I fit all models using bandwidths of 10, 15, and 20 points.

For the 2012 and 2014 election cycles, I test for discontinuities at only the B/A threshold. A rule was introduced from the 2011-2012 academic year that no school's grade could be more than one letter grade below that assigned in the previous year. This rule creates an imbalance at all but the B/A threshold, as no observation below a threshold could have received a grade in the previous year higher than the grade immediately above the threshold. I also exclude from my analysis the F/D threshold in 2008, and the F/D and D/C thresholds in 2006, because of the small number of units assigned to the respective grades (Table 2).

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[24] A more detailed description of this procedure is provided in Appendix 2.

### Regression Discontinuity Results

I first plot local linear regression estimates, calculated separately on either side of each grade threshold. Figure 1 indicates that there are small jumps in incumbent vote share at the B/A threshold in 2006, 2008, and 2014. Local linear regression estimates, in contrast, are fairly smooth at the B/A threshold in 2010 and 2012. Local linear regression plots also indicate possible jumps in incumbent vote share at the F/D and D/C grade thresholds in 2010, although there are fewer observations near these grade thresholds (see Appendix 3, Figure A1).

Table 3 reports formal estimates of discontinuities at each of the grade thresholds, obtained by fitting the model specified in Equation 2.[25] These estimates confirm that the positive jumps in incumbent vote share at the B/A threshold in 2006, 2008, and 2014 are statistically significant at the 0.05 level, and range from approximately 4.5 to 7.7 percentage points. These estimates are also largely robust to the choice of bandwidth. The models used in Table 3 includes control variables; however, dropping covariates from the models does not substantively change the results (see Appendix 3, Table A3).

There is some evidence of a statistically significant drop in incumbent vote share at the F/D threshold in 2010 (Table 3). A statistically significant estimate is only obtained when employing the narrowest bandwidth, however, and the size of the point estimate is highly sensitive to bandwidth selection. In addition, the narrowest bandwidth employs observations from only five schools assigned an F grade.[26] Looking across all bandwidths, therefore, the results do not provide evidence of a discontinuity in incumbent vote share at the F/D threshold in 2010. There is, likewise, no evidence of a statistically significant discontinuity in incumbent vote share at the D/C or C/B thresholds.

The reported variation in the effects of school letter grades is consistent with the theoretical expectations of this paper. The finding that an A is the only letter grade shown to affect incumbent

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[25]The number of observations employed in each model is reported in Appendix 3, Table A2.

[26]The narrowest bandwidth is also substantially smaller than the bandwidth selected using the cross-validation criterion.

vote share may be explained by an A grade being particularly easy to comprehend and recall. The prediction that an F grade will be similarly influential may also hold; however, there were insufficient observations to test this empirically. The absence of evidence of informational effects in 2010 or 2012, meanwhile, may be explained by the influence of performance information varying with citizens' trust in the information's source. In both of these years, controversies surrounding the calculation of school grades may have undermined public confidence in this performance measure.

It should be noted, however, that while the observed heterogeneity can be explained by the theoretical claims developed in this paper, it was not possible to formally test these propositions. It may be, for example, that we see an effect at the B/A threshold because nearby voters differ from those at other thresholds, and not because the informational signal is more salient. Consistent with this alternative explanation, there is a statistically significant negative relationship between a school's points score and the proportion of students receiving free or reduced price lunch, across all years (see Appendix 3, Table A4). What the results of this paper clearly show, however, is that in some circumstances the publication of school performance information can help voters to hold their representatives accountable.

I next consider potential threats to the validity of the regression discontinuity design.[27] A first concern is that changes in covariate values at the grade thresholds could affect incumbent vote share, and hence explain the statistically significant effects reported above. Testing for discontinuities in covariates at the B/A grade threshold, however, indicates that all covariates are balanced at the threshold.[28] A second concern is that discontinuities in incumbent vote share at the grade thresholds could be examples of jumps found throughout the test score distribution. The local linear regression plots reported in Figure 1 suggest that this is not the case, however, and formal tests

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[27]Imbens and Lemieux (2008) summarize threats to the validity of regression discontinuity designs and outline the tests that I conduct below. Several studies have confirmed the validity of employing a regression discontinuity design to estimate the effects of the grades assigned to schools in Florida (for example, Chakrabarti 2013; Chiang 2009; Chingos, Henderson, and West 2012; Henderson 2010).

[28]Results are reported in Appendix 3, Table A5. Although one estimate is statistically significant at the 0.1 level, with thirty estimates being reported, this is less than the number of significant estimates we would expect as a result of Type I error if there are no discontinuities.

for discontinuities in incumbent vote share at a series of pseudo thresholds confirm the absence of such discontinuities (see Appendix 3, Table A6).

A further threat to the validity of the regression discontinuity design is manipulation of the points score around the grade thresholds. Manipulation could occur, for example, if schools knew the thresholds and took steps to end up to the right of a threshold. It is doubtful that such manipulation is feasible in Florida, as the grades awarded to schools depend on measures of both absolute performance and student gains, and on results from examinations in four different subjects administered to all students. I nonetheless visually inspect histograms of school points scores to check of discontinuities in this variable at the thresholds, which would suggest a violation of the non-manipulation assumption.[29] I also employ a test developed by McCrary (2008) to formally test for discontinuities in the forcing variable. Both of these procedures confirm that there is no evidence of manipulation of the points score variable at any grade threshold.

**Strategic Behavior by Politicians**

The results reported above were obtained from the sample of school board races in which the incumbent ran and was challenged. Incumbents only sought reelection in between 67 and 77 percent of potential races in each of the five electoral cycles, however, and incumbents sought reelection and were challenged in between 37 and 48 percent of potential races.[30] If politicians and candidates anticipate voters' behavior, incumbents in poorly performing districts may be less likely to seek reelection and more likely to face competition when they do run (Berry and Howell 2007). Such strategic behavior could mean that the results reported above do not capture the full impact of the publication of performance information on incumbents' electoral prospects.

School board politicians in Florida observed school test results before making the decision to run in only one of the five electoral cycles considered, specifically, in 2006. [31] Even in the

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[29]Distributions of points scores for elementary schools in each year are reported in Appendix 3, Figure A2.

[30]The proportions of incumbents who ran and were challenged in each electoral cycle are reported in the Appendix 3, Table A7.

[31]School board candidates were required to qualify by 21 July 2006, 20 June 2008, 18 June 2010, 8 June 2012, and 20 June 2014. See fn. 15 for dates of the publication of school grades.

absence of school test results, however, politicians may form evaluations of school performance on the basis of their own experiences, and from listening to the experiences of others (Berry and Howell 2007). These evaluations of school performance could, in turn, affect the decision to run if potential candidates anticipate that voters will respond to either underlying school performance or the publication of performance information.

To test whether school performance is related to an incumbent $i$'s decisions to run, I consider all potential school board races in a given year and estimate the following logistic regression:

$$P(Run_{id}) = \beta_0 + \beta_1 T_d + \beta_2 P_d + c_{0d} + e_{id} \tag{3}$$

where $T_d$ is the district points score and $P_d$ is the district score in the previous year. [32] I also take the subset of school board races in which an incumbent ran, and employ a model including the same predictors as in Equation 3 to estimate the probability of the incumbent being challenged.

Table 4 reports estimates of the relationship between the district score and the previous year's district score, and the probability of an incumbent running. The direction of these estimates is consistent with incumbents behaving strategically. The probability of an incumbent seeking reelection increases with the district score in all years except 2006, controlling for the previous year's score. The probability of seeking reelection, likewise, decreases in the previous year's district score, given the most recent year's score. None of these estimates, however, is statistically significant at conventional levels.

The direction of estimates of the relationship between the district scores and an incumbent being challenged is also consistent with strategic behavior on the part of potential challengers (Table 5). The probability of an incumbent being challenged decreases in the district score and, controlling for this score, increases in the previous year's district score. Again, however, none of these

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[32]District points scores are calculated from the same attainment and learning gains scores used to calculate school points scores, but with the measures aggregated to the district level. I employ district points scores even though some Florida school board races are for single-member elections, in which only voters from part of the school district are eligible to vote, as it is not possible to identify single-member elections in all potential races.

estimates is statistically significant at conventional levels. Therefore, while the directions of the reported estimates are broadly consistent with incumbents in high performing districts being more likely to run and less likely to be challenged, these results do not provide evidence at conventional levels of significance that politicians alter their behavior in anticipation of the publication of school performance information.

## Conclusion

This paper reports, to my knowledge, the first evidence that the publication of information about government service performance affects electoral support for officials responsible for government service delivery. Specifically, I find that the effect of the nearest elementary school to an electoral precinct receiving an A grade under Florida's accountability system, rather than a B, is to increase incumbent vote share in that precinct, in three of the five electoral cycles considered. I also find, however, that performance information did not affect incumbent support at grade boundaries in the middle of the performance distribution, or in years when there was controversy surrounding the calculation of school grades.

These findings can be explained by the characteristics of school performance information, the school system, and electoral institutions in Florida. It is not surprising that school performance information influences electoral outcomes, as the information is widely publicized and provided by a broadly credible source, most parents have limited options to change school, and nonpartisan, on-cycle elections limit the influence of alternative considerations. The observed variation in the effects of information across grade boundaries and electoral cycles can, likewise, be explained by the fact that an A grade is particularly easy to understand and recall, while citizens' confidence in school grades was undermined in years when their was controversy surrounding their calculation.

The findings reported in this paper raise important questions about the conditions under which performance information influences voters' decisions. We need, first, to better understand why the effects of school performance information vary across informational signals and electoral cycles. Although the theoretical claims put forward in this paper are consistent with the observed hetero-

geneity, it was not possible to formally test these propositions. It will also be important to examine the extent to which this paper's findings transfer to other policy domains and electoral settings. Public schools and school boards are in many respects distinct from other government services and elected bodies, and it is unclear that this paper's findings will generalize to the multiple domains in which performance information is published.

The need for further research notwithstanding, the results reported in this paper have significant implications for policy. These findings show that publishing information about the performance of government services can help citizens to hold their elected representatives accountable for service outcomes. This electoral accountability can, in turn, be expected to incentivize politicians to improve government services. This paper's results also suggest that details of the design of systems of information provision may have significant consequences. In light of the evidence reported in this paper, and a substantial body of research from the behavioral sciences, it is remarkable that the presentational formats employed by states in reporting school performance information continue to have little basis in empirical evidence.

The results reported in this paper also have implications for democratic theory. Previous studies have questioned the value of models of retrospective voting in explaining responses to government service performance, and argued that performance information can even undermine democratic accountability. The results of this paper, in contrast, suggest that when provided with relevant information citizens do, at least in some circumstances, hold their local representatives accountable for government service performance.

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## Appendix 1: Regression Discontinuity Specification

To implement a regression discontinuity design, I follow the approach employed by Chiang (2009) and set out by Imbens and Lemieux (2008). To estimate the effect of receiving an A rather than a B grade, for example, I first estimate the expected incumbent vote share for a precinct-incumbent unit for which the nearest school is assigned a B and has a points score precisely at the B/A threshold. I obtain this estimate using precinct-incumbent units for which the nearest school has a points score less than a bandwidth of $h$ points below the B/A threshold, giving the model:

$$Y_{ps} = \alpha_B + \beta_B(T_s - t) + e_{ps} \quad \text{s.t.} \ -h < T_s - t < 0$$

where $Y_{ps}$ is the incumbent vote share in precinct-incumbent unit $p$ with nearest school $s$, $T_s$ is the points score received by school $s$ in the academic year immediately preceding the election, and $t$ is the points score that defines the B/A grade threshold.

I likewise estimate the expected incumbent vote share for a precinct-incumbent unit for which the nearest school is assigned an A and has a points score precisely at the B/A threshold, using precinct-incumbent units for which the nearest school has a points score less than h points above the threshold:

$$Y_{ps} = \alpha_A + \beta_A(T_s - t) + e_{ps} \quad \text{s.t.} \ 0 < T_s - t < h$$

The estimated difference at the threshold, $\hat{\alpha}_A - \hat{\alpha}_B$, is the effect of the A grade. Combining the estimation of the B-sided and A-sided local linear functions into one model yields the equation:

$$Y_{ps} = \beta_0 + \beta_1 Z_s + \beta_2(T_s - t) + \beta_3(Z_s \times (T_s - t)) + \delta \mathbf{X}_{ps} + e_{ps}$$
$$\text{s.t.} \ -h < T_s - t < h$$

where $Z_s$ is an indicator for whether school $s$ received an A in the most recent year, and $\mathbf{X}_{ps}$ is a vector of covariates. The estimated coefficient $\hat{\beta}_1$ is the effect of the A grade.

To account for the cross-classified structure of the data, I specify the following mixed-effects model:

$$Y_{p(sr)} = \theta_{000} + \beta_{010}Z_s + \beta_{020}(T_s - t) + \beta_{030}(Z_s \times (T_s - t)) +$$
$$\gamma \mathbf{V}_s + \lambda \mathbf{W}_r + c_{0s0} + d_{00r} + e_{p(sr)}$$
$$\text{s.t. } -h < T_s - t < h$$

where $Y_{p(sr)}$ is the incumbent vote share in precinct-incumbent unit $p$ with nearest school is $s$ in school board race $r$, $\mathbf{V}_s$ is a vector of explanatory variables for school $s$, and $\mathbf{W}_r$ is a vector of explanatory variables for school board race $r$. The model includes several variance terms: $c_{0s0}$ represents the variability between schools, $d_{00r}$ the variability between school board races, and $e_{p(sr)}$ is the remaining variability between precinct-incumbent units, within school-school board race cells.

## Appendix 2: Cross-Validation Procedure to Select Bandwidths

I select the bandwidths to employ using the cross-validation procedure outlined by Chiang (2009).[33] The idea behind this procedure is that since the regression discontinuity design above relies on predicting incumbent vote share at the grade threshold, the choice of bandwidth should minimize the expected squared prediction error at this threshold. I first select the 50 percent of precinct-incumbent observations, $G_l$, in the grade below a given threshold with points scores nearest to that threshold. For each of these precinct-incumbent observations, I run a regression of incumbent vote share, $Y_{ps}$, on school points scores, $T_s$, using only observations with points scores below the observation by less than a bandwidth of $h$ points:

$$Y_{ps} = \beta_0 + \beta_1 T_s + e_{ps} \text{ s.t. } T_{ks} - h < T_s < T_{ks}$$

where $T_{ks}$ is the points score for the nearest school to precinct-incumbent unit $k$.[34] I then use the estimates from this regression to predict incumbent vote share, $\hat{Y}_{ks}$, for precinct-incumbent unit $k$. The lower cross-validation criterion, for a given bandwidth, is the mean squared prediction error:

$$CV_l(h) = \frac{1}{N_{G_l}} \sum_{k \in G_l} (Y_{ks} - \hat{Y}_{ks})$$

where $N_{G_l}$ is the number of precinct-incumbent observations in $G_l$ . I conduct an analogous procedure for precinct-incumbent observations above the grade threshold, to obtain the higher cross-validation criterion, $CV_h$. For each grade threshold, I find the cross-validation criteria for bandwidths that employ only observations from the two grades being compared, and select the smallest bandwidth at which both cross-validation criteria are near their minima.

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[33] See also Ludwig and Miller (2005) and Imbens and Lemieux (2008).

[34] I do not include random effects in this model because I want to obtain predictions for all observations within the specified bandwidth, rather than for particular school or school board race, and am not concerned about the uncertainty of the point estimates obtained.

# Appendix 3: Tables and Figures

**Table A1:** Relationship between incumbent vote share in a precinct and points score of the nearest elementary school, fitting models without control variables.

|  | 2014 | 2012 | 2010 | 2008 | 2006 |
|---|---|---|---|---|---|
| Total Score | 0.001 | 0.026 | -0.017 | -0.003 | -0.013** |
|  | (0.004) | (0.004) | (0.003) | (0.004) | (0.005) |
| Observations | 2968 | 2416 | 5129 | 4548 | 5142 |
| Pred(inc % vote\|90th %ile)-Pred(inc % vote\|10th %ile) | 0.118 | 1.389 | 0.231 | 0.080 | -1.880 |

Standard errors in parentheses. $\cdot$ $p < 0.1$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. The bottom row reports the difference between predicted incumbent vote share at the 90th and 10th percentiles of the scores awarded to schools, with all other variables held at their mean values.

**Table A2:** Number of observations in each regression model used to estimate the effect of receiving a higher grade on incumbent vote share

| Cutoff | Year | $h^*$ | $h^*$ | 10 | 15 | 20 |
|--------|------|-------|-------|-----|------|------|
| | | | | | Bandwidth | |
| B/A | 2014 | 14 | 449 | 316 | 477 | 608 |
| | 2012 | 4 | 86 | 255 | 438 | 562 |
| | 2010 | 7 | 316 | 508 | 756 | 1102 |
| | 2008 | 13 | 753 | 542 | 840 | 1173 |
| | 2006 | 12 | 923 | 732 | 1205 | 1664 |
| C/B | 2010 | 30 | 1564 | 254 | 733 | 1063 |
| | 2008 | 5 | 175 | 365 | 616 | 829 |
| | 2006 | 11 | 571 | 469 | 771 | 1002 |
| D/C | 2010 | 16 | 191 | 113 | 191 | 240 |
| | 2008 | 7 | 55 | 72 | 143 | 216 |
| F/D | 2010 | 30 | 193 | 40 | 71 | 87 |

Each cell reports number of observations used in model to estimate effect reported in corresponding cell in Table 3.

**Table A3:** Estimates of the effect of receiving a higher grade on incumbent vote share, fitting models without control variables

| Cutoff | Year | $h^*$ | Bandwidth | | | |
|---|---|---|---|---|---|---|
| | | | $h^*$ | 10 | 15 | 20 |
| B/A | 2014 | 14 | 6.66** | 4.67* | 6.42** | 4.9* |
| | | | (2.853) | (2.499) | (2.750) | (2.855) |
| | 2012 | 5 | -2.6 | -2.27 | -5.21* | -3.25 |
| | | | (8.720) | (3.646) | (2.752) | (2.247) |
| | 2010 | 7 | 3.4 | 0.63 | 0.89 | 1.23 |
| | | | (3.722) | (2.812) | (2.108) | (1.820) |
| | 2008 | 13 | 3.91* | 3.1 | 3.28 | 4** |
| | | | (2.085) | (2.391) | (2.153) | (1.776) |
| | 2006 | 12 | 4.72** | 4.77* | 3.31** | 1.92 |
| | | | (2.023) | (2.564) | (1.643) | (1.341) |
| C/B | 2010 | 30 | 1.05 | 0.41 | 0.76 | 0.81 |
| | | | (1.481) | (2.682) | (2.046) | (1.830) |
| | 2008 | 5 | -7.98 | -2.9 | -3.37 | -1.23 |
| | | | (7.206) | (3.031) | (2.287) | (2.013) |
| | 2006 | 11 | -1.13 | 1.09 | -1.83 | -2.28 |
| | | | (2.521) | (2.779) | (2.213) | (1.791) |
| D/C | 2010 | 16 | -5.41 | -9.39 | -5.41 | -4.3 |
| | | | (5.530) | (6.043) | (5.530) | (4.156) |
| | 2008 | 10 | 3.05 | 3.05 | -0.7 | 1.32 |
| | | | (9.643) | (9.643) | (5.241) | (4.847) |
| F/D | 2010 | 30 | -7.75 | -16.8* | 2.38 | 5.01 |
| | | | (5.023) | (9.723) | (9.333) | (6.911) |

Standard errors in parentheses. $\cdot$ $p < 0.1$, $^*$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. Each cell is taken from a separate regression and is the coefficient on the indicator for the nearest school receiving the higher of the two grades. $h^*$ is the smallest bandwidth at which both cross-validation criteria are near their minima.

**Table A4:** Estimates of the relationship between school points score and school characteristics

|  | 2014 | 2012 | 2010 | 2008 | 2006 |
|---|---|---|---|---|---|
| % Black | -42.91*** | -27.04*** | -48.74*** | -30.97*** | 4.89* |
|  | (5.10) | (3.61) | (2.74) | (2.83) | (2.11) |
| % Free/Reduced | -0.841*** | -1.15*** | -1.55*** | -1.73*** | -1.91*** |
| Price Lunch | (0.16) | (0.14) | (0.107) | (0.11) | (0.09) |
| Urban | 1.77 | -2.875 | 2.44 | 11.24*** | 2.47* |
|  | (2.82) | (2.19) | (1.54) | (1.58) | (1.22) |
| Suburban | -1.92 | -1.40 | 5.36*** | 11.13*** | 0.09 |
|  | (2.62) | (1.99) | (1.41) | (1.49) | (1.05) |
| Total Points | 0.761*** | 0.694*** | 0.68*** | 0.58*** | 0.62*** |
| Previous Year | (0.013) | (0.013) | (0.01) | (0.01) | (0.01) |
| At Large | -12.89*** | -6.67** | -2.50* | -4.53*** | -2.34* |
|  | (1.952) | (2.05) | (1.19) | (1.24) | (0.94) |
| Observations | 2950 | 2413 | 5112 | 4489 | 5052 |

Standard errors in parentheses. $p < 0.1$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.

**Table A5:** Estimates of discontinuities in pseudo outcomes at the B/A threshold

|  | 2014 | 2008 | 2006 |
|---|---|---|---|
| Total points previous year | 2.97 (12.317) | -5.83 (7.870) | -2.25 (5.789) |
| % Free/Reduced Price Lunch | 0.71 (2.623) | 0.83 (1.976) | 2.28 (1.873) |
| % Black | 0.07 (0.077) | -0.04 (0.050) | 0.07 (0.129) |
| % Hispanic | 0.02 (0.037) | -0.09 (0.063) | 0.03 (0.034) |
| % White | 0.18 (0.194) | 0.06 (0.059) | 0.03 (0.034) |
| Urban | -1.3 (0.903) | -0.19 (0.538) | -0.82 (2.704) |
| Suburban | 0.85 (0.988) | -0.1 (0.503) | 3.66* (2.072) |
| 2 Candidates | 0.02 (5.848) | 0.15 (4.519) | -1.83 (5.210) |
| 3 Candidates | -0.16 (4.540) | -1.61 (6.065) | 0.96 (5.028) |
| At Large | 0.47 (4.293) | 0.34 (4.276) | 0.33 (4.331) |

Standard errors in parentheses. $\cdot$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Each cell is taken from a separate regression and is the coefficient on the indicator for the nearest school receiving a grade A. Models are fitted using the smallest bandwidth at which both cross-validation criteria are near their minima.

**Table A6:** Estimates of discontinuities in incumbent vote share at pseudo thresholds

| Distance (points) from A/B cutoff | 2014 | 2008 | 2006 |
|---|---|---|---|
| +20 | 0.36 | 1.6 | 0.84 |
|  | (1.708) | (1.029) | (0.852) |
| +15 | -4.19 | 0.84 | 0.33 |
|  | (4.126) | (1.104) | (0.844) |
| +10 | 1.99 | -0.06 | -0.44 |
|  | (1.593) | (3.388) | (0.934) |
| +5 | 1.73 | -2.7 | 0.68 |
|  | (1.684) | (2.541) | (0.986) |
| −5 | 6.2 | 1.46 | 1.4 |
|  | (5.233) | (1.929) | (3.91) |
| −10 | 5.7 | -2 | -2.89 |
|  | (7.109) | (2.066) | (2.417) |
| −15 | -3.19 | -3.16 | 1.01 |
|  | (2.246) | (2.908) | (2.087) |
| −20 | 3.15 | 5.62 | 6.81*** |
|  | (4.594) | (3.546) | (2.095) |

Standard errors in parentheses. $\cdot\ p < 0.1$, $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$. Each cell is taken from a separate regression and is the coefficient on the indicator for the nearest school receiving a points total at or above the pseudo threshold. All models included controls for the racial composition of the nearest school, the proportion of students receiving free or reduced price lunch, the school being in an urban or suburban location, the total points the school received in the previous year, the school board race being at large, and the number of competitors in the school board race. Models are fitted using the smallest bandwidth at which both cross-validation criteria are near their minima.

**Table A7:** Potential school board races in which an incumbent ran and was challenged

| Year | Potential races | Incumbent ran (as % potential races) | Incumbent challenged (as % potential races) |
|------|-----------------|--------------------------------------|---------------------------------------------|
| 2014 | 191 | 76 | 48 |
| 2012 | 139 | 67 | 37 |
| 2010 | 181 | 74 | 44 |
| 2008 | 135 | 74 | 39 |
| 2006 | 189 | 77 | 43 |

**Figure A1:** Local linear regression estimates of incumbent vote share at F/D, D/C, and C/B grade thresholds
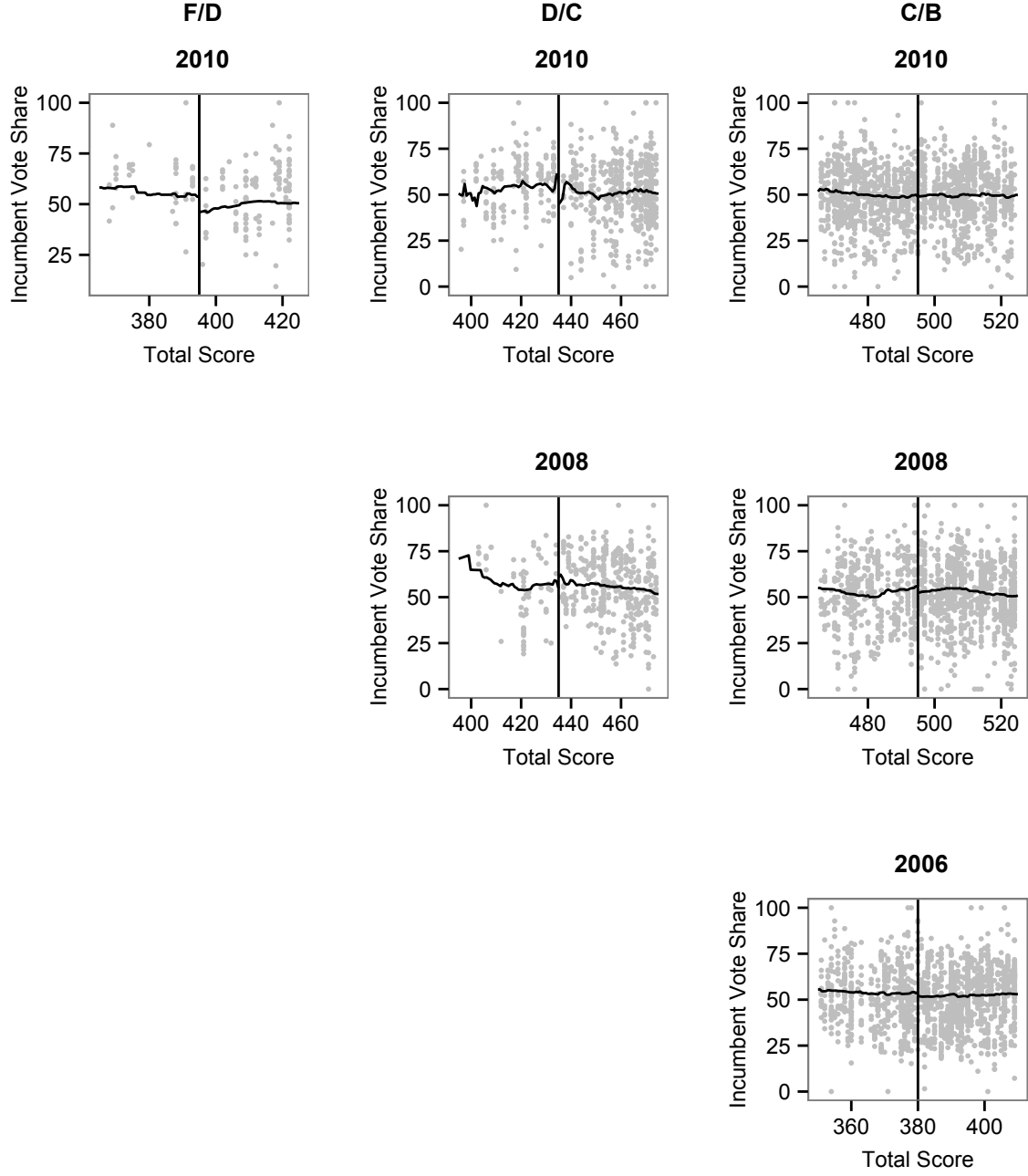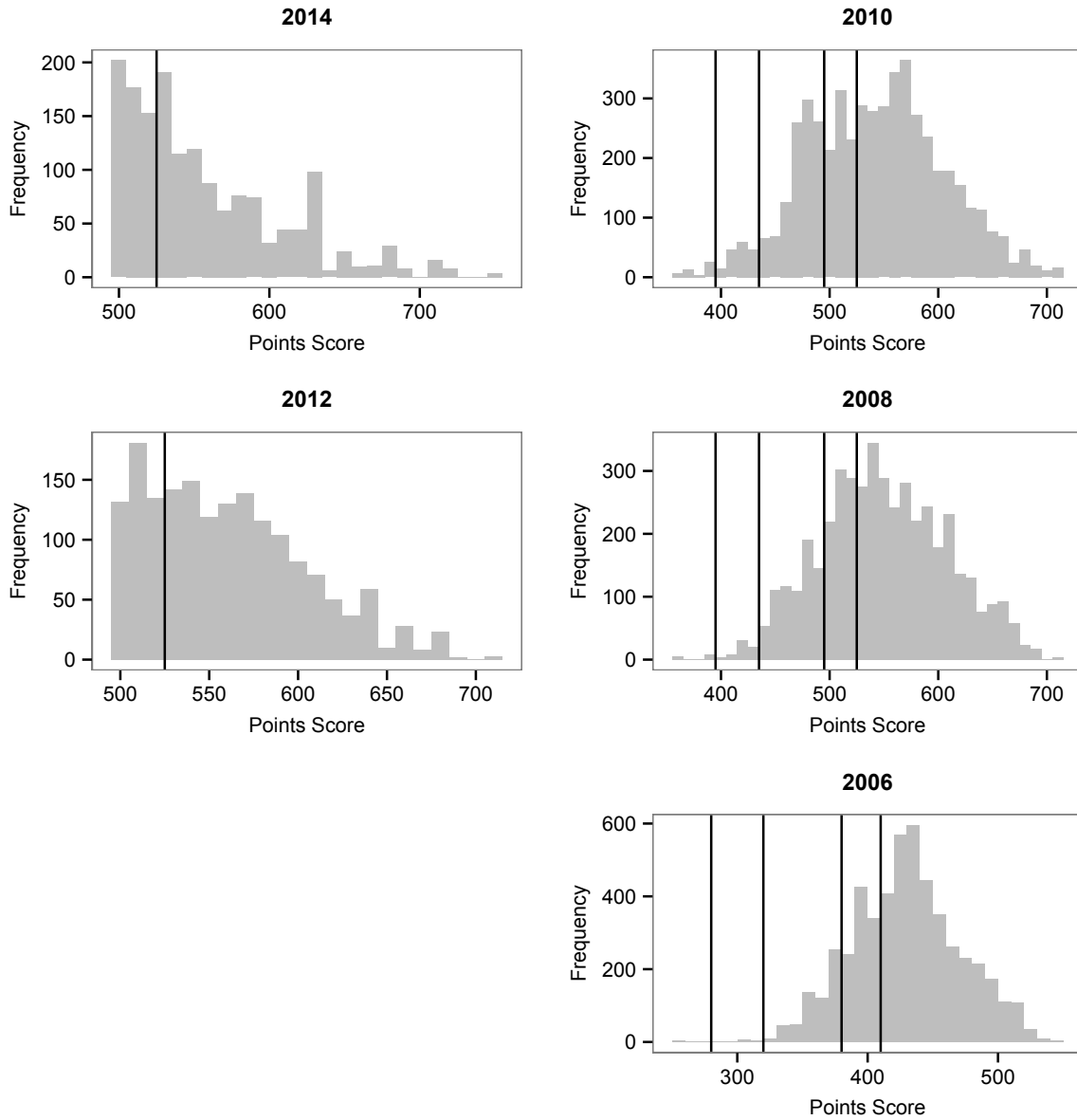
**Figure A2:** Distribution of points awarded to elementary schools in Florida



Vertical lines show school grade thresholds.

**Table 1:** Relationship between incumbent vote share in a precinct and points score of the nearest elementary school

| | 2014 | 2012 | 2010 | 2008 | 2006 |
|---|---|---|---|---|---|
| Total Score | 0.007 | 0.008 | 0.001 | 0.001 | -0.017* |
| | (0.006) | (0.007) | (0.006) | (0.006) | (0.008) |
| % Black | 3.717** | -6.610*** | 13.373*** | 5.680*** | 7.390*** |
| | (1.893) | (1.609) | (1.395) | (1.432) | (1.375) |
| % Free/Reduced Price Lunch | -0.018 | 0.020 | -0.030 | -0.035 | 0.041 |
| | (0.053) | (0.051) | (0.045) | (0.048) | (0.054) |
| Total Points Previous Year | -0.003 | 0.010 | 0.007 | 0.006 | 0.028*** |
| | (0.006) | (0.007) | (0.006) | (0.006) | (0.007) |
| Urban | 0.709 | 2.656*** | 0.228 | 0.269 | 1.281* |
| | (0.989) | (0.867) | (0.661) | (0.747) | (0.720) |
| Suburban | 1.073 | 0.377 | 0.748 | 0.284 | 0.570 |
| | (0.885) | (0.785) | (0.614) | (0.700) | (0.626) |
| At Large | 2.448 | -5.357 | -0.449 | -4.243 | 0.820 |
| | (3.549) | (3.849) | (2.858) | (4.116) | (3.094) |
| Observations | 2951 | 2414 | 5103 | 4490 | 5046 |
| Pred(inc % vote\|90th %ile)-Pred(inc % vote\|10th %ile) | 1.348 | 1.389 | 0.231 | 0.080 | -1.880 |

Standard errors in parentheses. $\cdot$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. The bottom row reports the difference between predicted incumbent vote share at the 90th and 10th percentiles of the scores awarded to schools, with all other variables held at their mean values.

**Table 2:** Number of precinct-incumbent units and schools by grade and year

| Year | Grade | Precinct-incumbent units | Schools |
|------|-------|--------------------------|---------|
| 2014 | A | 1059 | 281 |
|      | B | 530  | 124 |
| 2012 | A | 1272 | 354 |
|      | B | 448  | 112 |
| 2010 | A | 3077 | 564 |
|      | B | 758  | 144 |
|      | C | 1078 | 194 |
|      | D | 167  | 30  |
|      | F | 49   | 13  |
| 2008 | A | 2993 | 582 |
|      | B | 811  | 169 |
|      | C | 727  | 177 |
|      | D | 64   | 21  |
|      | F | 13   | 4   |
| 2006 | A | 3512 | 535 |
|      | B | 1044 | 167 |
|      | C | 614  | 119 |
|      | D | 13   | 6   |
|      | F | 6    | 3   |

**Table 3:** Estimates of the effect of receiving a higher grade on incumbent vote share

|  |  |  | Bandwidth | | | |
|---|---|---|---|---|---|---|
| Cutoff | Year | $h^*$ | $h^*$ | 10 | 15 | 20 |
| B/A | 2014 | 14 | 7.61*** | 5.55** | 7.1*** | 5.61* |
|  |  |  | (2.847) | (2.519) | (2.720) | (2.864) |
|  | 2012 | 5 | -1.86 | -0.27 | -3.83 | -2.67 |
|  |  |  | (11.387) | (3.729) | (2.814) | (2.276) |
|  | 2010 | 7 | 3.91 | 0.44 | 0.3 | 0.93 |
|  |  |  | (3.424) | (2.732) | (2.032) | (1.720) |
|  | 2008 | 13 | 4.55** | 1.88 | 3.53* | 3.91** |
|  |  |  | (2.082) | (2.335) | (2.071) | (1.731) |
|  | 2006 | 12 | 4.59** | 4.42* | 3.73** | 2.23* |
|  |  |  | (1.995) | (2.462) | (1.609) | (1.335) |
| C/B | 2010 | 30 | 1.1 | 0.01 | 1.24 | 0.81 |
|  |  |  | (1.359) | (2.462) | (1.832) | (1.655) |
|  | 2008 | 5 | 0.08 | -1.79 | -3.15 | -0.82 |
|  |  |  | (6.292) | (2.955) | (2.326) | (2.040) |
|  | 2006 | 11 | -0.33 | 2.48 | -1.19 | -2.04 |
|  |  |  | (2.546) | (2.656) | (2.169) | (1.789) |
| D/C | 2010 | 16 | 3.69 | -1.4 | 3.69 | -3.88 |
|  |  |  | (7.364) | (14.520) | (7.364) | (3.883) |
|  | 2008 | 10 | 0.72 | 0.72 | 2.68 | 1.23 |
|  |  |  | (6.139) | (6.139) | (4.292) | (4.196) |
| F/D | 2010 | 30 | -6.57 | -21* | -0.08 | 2.2 |
|  |  |  | (4.022) | (11.000) | (9.722) | (7.305) |

Standard errors in parentheses.  $\cdot$ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Each cell is taken from a separate regression and is the coefficient on the indicator for the nearest school receiving the higher of the two grades. All models included controls for the racial composition of the nearest school, the proportion of students receiving free or reduced price lunch, the school being in an urban or suburban location, the total points the school received in the previous year, the school board race being at large, and the number of competitors in the school board race. $h^*$ is the smallest bandwidth at which both cross-validation criteria are near their minima.

**Table 4:** Relationship between incumbent running for re-election and district score in current and previous year

|  | 2014 | 2012 | 2010 | 2008 | 2006 |
|---|---|---|---|---|---|
| District score | 0.013 | 0.006 | 0.004 | 0.008 | -0.020 |
|  | (0.012) | (0.005) | (0.004) | (0.014) | (0.017) |
| District score | -0.014 | -0.007 | -0.001 | -0.008 | -0.001 |
| previous year | (0.012) | (0.006) | (0.004) | (0.014) | (0.015) |
| Observations | 191 | 139 | 181 | 135 | 189 |
| P(ran\|90th %ile)-P(ran\|10th %ile) | 0.250 | 0.134 | 0.069 | 0.126 | -0.220 |

Standard errors in parentheses. $\cdot$ $p < 0.1$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. The bottom row reports the difference between the predicted probability that the incumbent ran for the district at the 90th percentile of all districts that year, and the corresponding probability for the district at the 10th percentile.

**Table 5:** Relationship between incumbent being challenged and district score in current and previous year, for subset of races where an incumbent ran

|  | 2014 | 2012 | 2010 | 2008 | 2006 |
|---|---|---|---|---|---|
| District score | -0.003 | -0.002 | -0.009 | -0.001 | -0.015 |
|  | (0.013) | (0.020) | (0.006) | (0.012) | (0.025) |
| District score | 0.010 | 0.015 | 0.013 | -0.002 | 0.021 |
| previous year | (0.014) | (0.024) | (0.007) | (0.012) | (0.022) |
| Observations | 145 | 93 | 134 | 100 | 146 |
| P(challenged\|90th %ile)-P(challenged\|10th %ile) | -0.068 | -0.058 | -0.201 | -0.028 | -0.240 |

Standard errors in parentheses. $\cdot$ $p < 0.1$, $^*$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$. The bottom row reports the difference between the predicted probability that the incumbent ran and was challenged, given that the incumbent ran, for the district at the 90th percentile of all districts that year, and the corresponding probability for the district at the 10th percentile.

**Figure 1:** Local linear regression estimates of incumbent vote share at B/A grade thresholds