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SHORT COMMUNICATION

Weather conditions and voter turnout in Dutch national parliament elections, 1971–2010

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Abstract While conventional wisdom assumes that inclement weather on election day reduces voter turnout, there is remarkably little evidence available to support truth to such belief. This paper examines the effects of temperature, sunshine duration and rainfall on voter turnout in 13 Dutch national parliament elections held from 1971 to 2010. It merges the election results from over 400 municipalities with election-day weather data drawn from the nearest weather station. We find that the weather parameters indeed affect voter turnout. Election-day rainfall of roughly 25 mm (1 inch) reduces turnout by a rate of one percent, whereas a 10-degree-Celsius increase in temperature correlates with an increase of almost one percent in overall turnout. One hundred percent sunshine corresponds to a one and a half percent greater voter turnout compared to zero sunshine.

Keywords Weather conditions · Voter turnout

Introduction

Inclement weather on election day is commonly believed to reduce voter turnout rates (see Knack 1994; Gomez et al. 2007; and references therein). There are generally two reasons given for this popular claim. One is that voters would be less willing to venture to the polling places if they have to deal with rain, cold outside temperature and other uncomfortable weather conditions. Bad weather puts off older people from going out to vote, people who have to bring small children to the polling station, and those reliant on transportation susceptible to weather, such as walking and public transport. Another argument is that there is less political campaigning when the weather is poor and campaigners are unable to reach out to voters and to get by doors.

This supposition of a weather-turnout linkage has received little research attention, however, and the handful of studies that have been conducted produced rather mixed results. While some studies found that rainfall decreases election turnout (Merrifield 1993; Shachar and Nalebuff 1999; Gatrell and Bierly 2002), Knack (1994) suggested that it had no discernable effect. In the most exhaustive test to date, Gomez et al. (2007) studied 14 U.S. presidential elections and concluded that rain reduced voter turnout by about one percent per inch (i.e., 25.4 mm) and snow by almost one half percent (see also Hansford and Gomez 2010). They even argued that had it not been a sunny day in many battleground states on November 8, 1960, Nixon would likely have defeated Kennedy to become the 35th President of the United States.

The present paper continues this work and hypothesizes that inclement election-day weather conditions are associated with depressed voter turnout. To test this conjecture we employ municipality turnout data in all national parliament elections held in the Netherlands following the abolishment of compulsory voting in 1970 and merged them with election day estimates of temperature, sunshine duration and rainfall.

Data and method

The turnout figures for all Dutch municipalities in 13 national parliament elections held from 1971 to 2010 were

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obtained from the Dutch Electoral Council. The municipalities were classified according to the 2010 codes issued by Statistics Netherlands. During the period in question the number of municipalities increased from 412 to 425 as a result of land reclamation. Municipality turnout, defined as the percentage of eligible voters in a municipality who actually voted in the election, varied from 56.5 to 100%, with a mean of 83.3% (SD 5.8).

The weather statistics of 17 to 35 meteorological stations and 222 to 235 precipitation stations were obtained from the Royal Dutch Meteorological Institute, with the number of stations trending up over time by the expansion of weather recording. The measurements include election-day mean temperature in degrees Celsius, fraction of maximum possible sunshine duration in percentages, and rainfall amount in millimeters. The temperature and sunshine data were obtained from the nearest meteorological station. The station closest to the municipality was determined with the Haversine formula, rendering the distance between municipality and station from their longitudes and latitudes. The mean distance was 17.7 km (SD 9.8). A comparison of recorded data at neighboring stations indicated that a greater density of weather stations adds little to the accuracy of the local temperature and sunshine data. The daily mean outside temperature ranged from 1.7 to 19.9°C, with a mean of 12.0°C (SD 4.4). The fraction of maximum possible sunshine duration ranged from 0 to 93%, with a mean of 42.3% (SD 29.3). As local variability is more of an issue with precipitation, the amount of rainfall was obtained from the nearest precipitation station. The mean Haversine distance between municipality and precipitation station was 4.4 km (SD 2.3). Local rainfall on election day ranged from 0 to 43.9 mm (mean 2.6, SD 4.0).

Municipality turnout rates exhibit both continuity across elections and uniqueness. Turnout rates for successive elections are strongly related as a result of routing voting and voter abstention. To account for this temporal continuity the model includes the municipality turnout rates in the two preceding elections. The turnout rates for the elections prior to 1971 were additionally coded to obtain complete data for the first two elections. Because contemporary issues are unique to each election, election dummy variables were entered that allow the election intercepts to vary. Also, the national parliament elections held from 1971 to 2010 comprise eight regularly scheduled elections and five early elections. The actual election dates are listed in Table 1.

If the Dutch government remains in office for the complete term, elections for national parliament are held once in every four years and they are typically scheduled in May, when the weather is at its most pleasant. However, voters have also been called to the poll for an early election in late summer, autumn and winter, following the untimely fall of the government. To examine if the weather effects on turnout vary by season, interaction terms of the weather variables and the seasonal photoperiod were included in the model. Photoperiod was obtained as the time from sunrise to sunset in minutes, using the geographical centre of the Netherlands as reference point. Election-day day length ranged from 611 to 1,117 min (mean 938, SD 181). The variable included in the analysis is photoperiod divided by 60.

The municipality longitudes and latitudes (in degrees, decimal degrees) were included to account for regional variations across the country in factors that may affect turnout, such as political apathy, religious affiliation and other correlates of political participation. Finally, the municipality voting-age population density was used as demographic control. The variable included in the analysis is the natural logarithm of the number of eligible voters per municipality square kilometer.

The data were analyzed using three-level hierarchical models—both linear and logistic—with voters at level one, nested within municipality-by-election at level two and municipality at level three. As the parameter estimates of the two models obtained identical effect signs and near equivalent *p*-values, we opted for the presentation of the results of the linear model as they are easier to interpret.

Results

The strong effects reported in Table 2 for previous turnout reveal that for many Dutch citizens voting is a routine activity relatively unaffected by temporary political issues.

More important to our study is the finding that the three weather parameters each affect turnout in a significant manner. The coefficients imply that for a 10-degree-Celsius

Table 1 Dates (*dd-mm-yy*) of regularly scheduled and early elections for Dutch national parliament, 1971–2010

Type of election	Dates of election
Regular	28-04-71, 25-05-77, 26-05-81, 21-05-86, 03-05-94, 06-05-98, 15-05-02, 09-06-10
Early	29-11-72, 08-09-82, 06-09-89, 22-01-03, 22-11-06

Table 2 Maximum likelihood hierarchical linear model of municipality-level voter turnout in Dutch national parliament elections, 1971–2010

Independent variables (iv)	Estimate	Standard error
Fixed effects		
Intercept (iv mean centered)	76.046	0.539***
Election-day local weather conditions		
Temperature (°C)	0.119	0.021***
Sunshine duration (%)	0.015	0.002***
Rainfall (mm)	−0.041	0.011***
Election-day weather by season		
Photoperiod (hrs)	0.628	0.279*
Photoperiod × temperature	0.061	0.011***
Photoperiod × sunshine duration	−0.000	0.001
Photoperiod × rainfall	0.005	0.004
Routine voting		
Turnout previous election	0.422	0.013***
Turnout two elections ago	0.104	0.013***
Geographic and demographic controls		
Municipality latitude	1.512	0.148***
Municipality longitude	−0.490	0.117***
Log voting-age population density	−0.679	0.078***
Random effects		
Fitted model:		
Municipality × election	2.773	0.060***
Municipality	2.651	0.252***
Null model:		
Municipality × election	18.987	0.379***
Municipality	15.007	1.132***
Proportional reduction in error		0.840
Level 2 observations	5,507	
Level 3 observations	425	

Note: The number of observations at level 3 equals the (maximum) number of municipalities and the number of observations at level 2 equals the number of municipalities times the number of elections. The proportional reduction in prediction error is obtained as the ratio of explained variation ([18.987+15.007]–[2.773+2.651]) to total variation (18.987+15.007) and may be interpreted as indicating the proportion of variation explained. Fixed effects of the election dummy variables are not reported. The estimates can be obtained from the authors

$^*p< 0.05$, $^{***}p<0.001$

increase in temperature the overall turnout increases by more than one percent (1.19%). The results also reveal a positive effect of sunshine. If the maximum potential sunshine duration shifts from 0 to 100 percent, turnout increases by one and a half percent (1.5%). The figures for precipitation point out that rainfall depresses municipality turnout by a rate of almost one half percent per centimeter (0.41%). This result replicates the finding of the continental U.S. presidential election study by Gomez et al. (2007), which revealed that rain reduces turnout by about one percent per 2.54 cm (1 inch).

Table 2 also reveals that the longer the photoperiod (day length), the higher the turnout rate. One extra hour of daylight corresponds to about one half percent greater turnout (0.628%). There is, moreover, a positive interaction between photoperiod and temperature implying that the longer the day length the stronger the effect of temperature on turnout. The effects of the other weather parameters, however, fail to vary by season. This implies that there is no significant difference in the effect of sunshine duration and rainfall on turnout for regular scheduled elections, typically held in May, and early elections, held in late summer, autumn and winter.

Finally, as indicated by the geographical coordinates, municipalities in the northern part of the country have higher turnout rates than municipalities in the south, as do those located in the west as opposed to the east. Also, voter turnout is negatively associated with a high population density.

Discussion

This study indicates that weather plays a role in Dutch politics in that inclement weather conditions on election day lower Dutch voter turnout rates. This weather-induced depression in turnout is not restricted by season, but generally occurs year-around. It is important to note, however, that the effects of the weather parameters are rather modest in size, with a maximum downturn of approximately 1.5 percent. An explanation for the modest effect sizes may be that the Netherlands has a maritime climate, with cool summers and mild winters, and that we consequently achieve relatively little variability in meteorological measures. Moreover, it may be that the weather effects are larger in less-at-stake elections for city-councils or provincial states, for example, than in more-at-stake national parliament elections. In national parliament elections the amount and quality of campaigning and partisan efforts, television time give to political parties, and media coverage are all typically greater than in the less-at-stake so-called second-order elections. In the former, there is much more attention given by the public (media as well as voters), because the country's entire political establishment is focused on this event. This attention not only drives up voter turnout but it may also suppress the effect of election-day weather.

However this may be, our study suggests that voting innovations that mitigate the impact of weather, such as providing polling stations at work, postal voting and remote voting via the Internet, may be effective means of increasing voter turnout, albeit only by a few percentage points.

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