Fair Weather Voters: Do Canadians stay at home when the weather is bad?

Daniel Stockemer[1] and Michael Wigginton[2]

May 21, 2017

Paper presented at the 2017 meeting of the Canadian Political Science Association
Draft: Please do not cite or circulate without authors' permission

---

ABSTRACT: What is the relationship between precipitation and the temperature on turnout? Using data on the 2004, 2006, 2008, 2011, and 2015 Canadian federal elections, we try to answer this question. Through bivariate and multi-variate statistics, we find that each millimeter of precipitation decreases turnout by more than .1 percentage points. When it comes to the temperature our results indicate that that higher temperatures trigger higher turnout. However, we also find that these relationships only apply to spring, summer and fall elections. In the winter 2006 elections, the association was different. In particular, warmer temperatures in the winter 2006 elections triggered lower turnout, in particular, when there was also high precipitation.

Key words: precipitation, temperature, weather, turnout, Canada

[1] School of Political Studies, University of Ottawa
daniel.stockemer@uottawa.ca
[2] School of Political Studies, University of Ottawa
michael.wigginton@uottawa.ca

Introduction

Does bad weather in the form of rain/snow and low temperatures prevent citizens from voting on Election Day? Utilizing a rational choice perspective, two scenarios are possible: On the one hand, unpleasant weather may dissuade citizens from voting by increasing the costs associated with going to the polls. In rainy, snowy or cold weather it is unpleasant to leave one's home and citizens might try to avoid getting wet or cold while standing in line at or traveling to the polls. On the other hand, particularly pleasant weather could also deter voters by increasing opportunity costs, as voting may interfere with the enjoyment of a nice day either at the beach, in the mountains, or just in one's garden. If either, which of the two perspectives holds? This is the question we want to address in this article. Focusing, on 5 Canadian legislative elections (i.e. the elections in 2004, 2006, 2008, 2011 and 2015), we test the influence of two weather related factors on turnout; namely the effects of the amount of precipitation and the temperature on electoral participation. We hypothesize that in warm and dry weather more citizens will turn out.

Our dependent variable is the percentage of registered voters that cast their ballot measured at the level of the electoral district. Our independent variables are the amount of precipitation during the day measured in millimeters and the temperature measured in Celsius. Controlling for the median age and income per district, the average number of polling stations per district, the population density of the district and the percentage of immigrants per district, we find that both weather related proxies influence turnout. The former of the two measures, rainfall or precipitation decreases turnout, while for the latter, higher temperatures, increase turnout.

This article proceeds as follows. First, we will succinctly summarize the previous literature on weather related factors and turnout, as well as formulate our hypotheses. Second, we will present the data, case, and control variables. In the third, part we will quickly describe the statistical procedures employed in our analysis. Then, we will present and discuss the results of our quantitative study. Finally, we will situate our study within the current literature and provide some avenues for future research.

Weather and turnout

There are two types of studies examining how weather or climate related factors can influence turnout. One array of studies looks at seasonal effects, a second array at the precise weather on Election Day. When it comes to studies looking at seasonal effects, there is some evidence that elections conducted in the winter months trigger much lower turnout than elections conducted in the spring, and moderately lower turnout than elections held in the summer and fall. For example, LeDuc and Pammett (2006, p. 307) highlight that Canadian elections held in the winter had, on average, 6 percentage points lower turnout than elections conducted in the spring (67.7% versus 74.4%). Studlar (2001) confirms this finding; according to his analysis, spring elections consistently had the highest turnout since 1940 in Canadian federal elections (for a similar result for local elections in the United Kingdom, see Rallings et al. 2003).

When it comes to the causal mechanisms behind the finding that spring is season that triggers the highest turnout, there is some evidence that the length in daylight plays a role in voters' decision to turn out. For example, Rallings et al. (2003) posit that the longer the day-length the higher the turnout, as voters may be more reluctant to vote on darker days. Eisinga et al. (2011) contextualize this finding and report that each additional hour of daylight corresponds to approximately one half percent higher turnout. For a different seasonal factor, research has shown that seasonal holidays may put a drain on turnout, as well, because voters might have planned free-time activities such as vacationing or visiting friends out of town during the holiday. To support this conjecture, Dubois and Lakhdar (2007) report that turnout in French Presidential Elections is approximately 1.7 percentage points lower in departments that are experiencing school holidays as compared to departments with no school holidays. [3]

When it comes to studies looking at the influence of the weather on Election Day on political behavior, earlier studies (e.g. Ludlum 1989) have speculated for quite some time that poor weather such as low temperatures and precipitation, deter citizens from going out to vote. This speculation has been echoed by electoral bodies. For example, the Nova Scotia House of Assembly asserted in a 2009 report that poor weather and icy roads deter citizens from voting, though they cited no evidence to support this claim. The academic literature echoes and empirically supports these claims, but only finds a fairly minor drop in turnout triggered by poor weather. For example, Artés (2014) finds in the case of Spanish elections that a one millimeter increase of rainfall results in a turnout decrease of 0.053 percentage points. For the United States 1982 general elections, Merrifeld (1993) reports that per each millimeter of rainfall in a region, turnout decreases by .015 percentage points. Fifteen years later, Gomez et al. (2007) report a slightly higher decrease; in their study on the US, the reported turnout decrease is 0.035 percentage points per millimetre increase in rainfall. Very similarly, and using the Netherlands, as a case, Eisinga et al. (2007) find that per each millimetre of rainfall turnout decreases by 0.041 percentage points in the Dutch parliamentary elections. This finding reproduces itself for the Norwegian municipal elections, where increased rainfall is associated with increases in turnout, as well (Lind, 2014).[4]

Arnold, (forthcoming, p. 22, note 25) reports some more nuanced findings. Focusing on the Bavarian mayoral elections, his first finding is that the absence of rain is associated with a slight decrease in turnout, though substantial rainfalls also have a slight turnout-depressing effect

---

[3] In the Canadian context, a similar negative effect is often assumed during winter elections for 'snowbirds' vacationing outside of Canada for prolonged times. For them, postal voting might be too difficult and costly (Elections Canada, 2006, p. 8; LeDuc & Pammett, 2006)

[4] A slightly different type of analysis, distinguishes between two forms of precipitation, rainfall and snowfall and their influence on turnout. For example, two US studies, by Gomez et al. (2007) and Fraga and Hersh (2010) distinguish between these two forms of precipitation; they both find that rain has a stronger negative effect on voting than snowfall, despite its overall moderate influence

(Arnold, forthcoming, p. 22, note 25). Second, Arnold also reports that the depressing effect of rain on turnout is lessened in more competitive Bavarian mayoral elections. He argues that voters' perception that their vote can potentially have a great impact on the election outcome lessens the importance of costs such as rain. Fraga and Hersh (2010), observe similar results in US presidential elections, where precipitation only has an impact on turnout in uncompetitive elections. One of the few studies which finds no significant effect is Persson et al. (2014), who evaluate the effect of rainfall on turnout using both individual- and aggregate-level data in Swedish parliamentary elections; regardless of the data they use, the authors find no significant and robust effect between the two variables.[5]

There are also some, albeit few, studies, which discuss the type of individuals that might be enticed to stay at home due to rain. For example, Knack (1994) highlights that rain only depresses turnout for citizens with a low sense of civic duty, leading him to conclude that only 'peripheral' voters are deterred. Bassi's (2013) more psychological study suggests that poor weather influences the mood of some voters, and can impact their vote choice. While this laboratory study did not address abstention, some citizens may conceivably experience a similar psychological effect of the weather that entices them to stay home rather than turn out on Election Day.

As second measure of the Election Day weather, the role of temperature in determining electoral turnout has been far less studied than that of precipitation. We only know of four studies: (1) Artéz's (2014) study of Spanish elections includes temperature data, but finds no significant effect on turnout. (2) Eisinga et al. (2011) do find significant effects from temperature on Dutch election turnout, estimating a modest increase of 0.119 percentage points per degree Celsius of temperature increase. (3) Focusing on French parliamentary elections, Ben Lakhdar and Dubois (2006) examine the effect of temperature on turnout in terms of the difference from the average temperature for the area, finding a one point increase in turnout for a 3°C increase above the average normal temperature. Finally, Matsusaka and Palda, (1999) incorporate temperature data in their study on turnout in the 1980 US federal elections, they conclude that temperature does not affect citizens' likelihood to cast their ballot. [6]

To sum up, the majority of studies looking at the influence of rainfall on turnout finds a small negative influence of precipitation on turnout. However, this finding is not conclusive and possibly conditional to certain conditions on the ground (see Fraga and Hersh 2010; Persson et

---

[5] In addition, several studies have focused on the partisan electoral implications of weather-related turnout decreases. These studies, in the majority, concur that conservative parties benefit from this turnout decline. For example Gomez et al. (2007) report that in US presidential elections, every inch of rain above the election day normal results in a 2.5% increase in the Republican vote share (0.098% per 1mm increase). Gatrell and Bierly confirm these results for the 2012 general election in the State of Kentucky. Finally, Arnold and Freier (2016) highlight that in German local and state elections, rain-related turnout decreases also benefit the success of the conservative CDU, at the expense of the more left-wing SPD (Arnold and Freier, 2016). Finally, Artés (2014) confirms that turnout increases due to try and good weather hurt the vote share of the Spanish conservatives, primarily to the benefit of small left-wing parties.

[6] Matsusaka and Palda also report that rainfall does not influence electoral participation in their study.

al. 2014). Many existing studies also have some inherent methodological weaknesses. They are conducted in relatively small geographic areas and thus capture a limited range of climatic variation. Furthermore, some research examines only a single election, and many studies are conducted in systems with unvarying election dates (e.g. US presidential elections are always in November, Norwegian municipal elections in September, etc.). This focus on one electoral circle or date might mask the possibility that the relationship between precipitation and turnout might be different based on the season. For example, in the winter warmer temperatures might be beneficial for increased participation, while in the summer the reversed might be true. When it is 30 degrees Celsius, voters might either deem it too hot to leave their home or prefer other free time activities such as going to the swimming pool, a lake or the beach. This possible difference in the relationship between weather related factors and turnout becomes the more important, given that the few existing studies, in particular, in the temperature turnout realm provide inconclusive results. In addition, no study has examined if the effect of precipitation and the temperature on turnout is similar in the winter, spring, summer and fall periods. Therefore, it is important to engage in a renewed analysis of the relationship between precipitation and temperature as the right-hand side variables in regression equations and turnout as a left-hand side variable. We do so using district level data for 5 Canadian elections (i.e. the 2004; 2006; 2008; 2011 and 2015 general elections). Three considerations inform this choice: (1) the size of the country, (2) the fact that elections are held at various times and (3) there are a lot of public discussions of the possible relationship between the weather and turnout in Canada.

First, thanks to its size and the various weather patterns in various parts of the country Canada is geographically well-suited for this analysis. It provides enough variation on the independent variables, the temperature and the amount of precipitation. For any election between 2004 and 2015, the amount of precipitation covered fluctuated between 0 and 15 millimeters of rainfall and for some elections between 0 and 30 millimeters. The temperature difference between electoral districts was over 15 degrees for the 2004 elections and over 20 degrees for other elections. We can find the same variation in the dependent variable turnout, which fluctuated by more than 30 percentage points between electoral districts in any of the five election years.

Second, Canada is one of the few countries, which holds elections in irregular intervals. Following the British Westminster model, the Canadian Prime Minister can ask the Governor-General to call an election any day within a five-year framework from the previous election. Contrary to most countries like the US or France, this means that elections can and do happen in different seasons. For example, the five elections we cover in this study took place in all four seasons. In more detail our data cover the winter elections in 2006 (i.e. on January 23, 2006), the spring elections in 2011 (i.e. on May 2nd, 2011), the summer elections in 2004 (i.e. on June 23, 2004) and the two fall elections in 2008 and 2015, respectively (i.e. on October 14, 2008 and on October 19, 2015).

Third, the role of the weather in influencing elections has been a matter of public discussion in Canada over the past decades. In particular, the cold temperatures in the January 2006 federal elections, the first federal elections to be held during winter in over 25 years, became a topic of public discussion. Commentators on the radio and on TV affirmed loud and strong that this election timing would drive turnout even further below the historic low of 60.5% achieved in 2004. However, in reality turnout rose to 64.9%, possibly as a result of increased voter awareness campaigns and the unseasonably pleasant temperatures on Election Day (LeDuc and Pammett, 2006; Elections Canada, 2006, p. 8). Even beyond the 2006 elections, the weather turnout nexus has remained important in the Canadian context. Statistics Canada even included the weather as a possible reason for non-voting in the 2011 Labour Force Survey. Yet, the survey data reveals that there does not appear to be a conscious decision on the part of voters to stay home due to bad weather – when asked about the reasons for their abstention, only 0.1% of non-voters cited poor weather as their main reason for not casting a ballot, with the majority citing a lack of either interest (27.7%) or time (22.9%) (Statistics Canada, 2012).

Is this voters' self-assessment confirmed in district level macro-level data? Does bad weather depress turnout? Building on most previous research we think it does and hypothesize: (1) the higher the amount of precipitation the lower the district level turnout, and (2) the higher the temperature the higher the district level turnout. We are also interested if these relationships hold across spring, summer, fall and winter elections, or if different dynamics at different season are at stake. We test our hypotheses based on data for all electoral districts in Canada for the 2004 to 2015 elections.[7] In the next section we present the variables and data.

Variables and Data

The dependent variable is the official turnout statistic for the electoral districts; it measures the percentage of registered voters that cast their ballot during the respective federal election. The data come from Elections Canada's official turnout results, which are published following each federal general election (Elections Canada, 2017). Our two weather-related proxies or independent variables measure the amount of precipitation in millimeters and the average daily temperature in the respective electoral district. The data for our weather proxies come from Environment Canada's Historical Data service, which provides historical meteorological readings from weather stations across the country (Environment and Climate Change Canada, 2017). In larger electoral districts with multiple available weather stations, the weather station for the riding's largest population centre was used (e.g. for Central Nova which includes multiple municipalities, weather data was taken for the town of New Glasgow). In more concentrated

[7] Before the 2015 election, federal electoral districts underwent regular decennial redistricting that moved some electoral boundaries and created 30 new ridings. To account for this, our pooled models include only those 2015 districts which lost no more than 15% of their territory in the redistricting, and gained no more that 15% new territory, as calculated by the Pundit's Guide to Canadian Elections (Funke, 2017).

urban areas with multiple electoral districts in the same municipality the same weather station was used for multiple ridings (e.g. all downtown Toronto districts shared the same weather data). In total, we used 135 weather stations with slight year-to-year variations as stations became disused or new stations appeared.

Since the weather is likely not the only variable which influences district level turnout, we control for six likely predictors of turnout; the median age and income per district, the population density, the percentage of immigrants per district and the number of polling stations per district. We sourced the first five of these of these predictors from Statistics Canada's Censuses of Population of 2006 and 2011,[8] as well as the National Household Survey of 2011[9]. The last control variable, the number of polling stations per district, is taken from the Elections Canada data (Elections Canada, 2017).

When it comes to our control variables, we first hypothesize that "older" districts should have higher turnout. Research (e.g. Franklin 2004; Melo and Stockemer 2014) has established that voting is more of a habit for older individuals than for younger people. Normally, the older citizens are, the more civic minded they are, the more integrated they are in society, and the more stable political ideologies they have; all of which should contribute to a higher likelihood to vote. In this study, we further assume that what applies to the micro-level should also apply to the macro-level; that is older districts should trigger higher turnout. We operationalize age by the median age in the electoral district.

We use a similar logic for the second control variable, the average income per district; that is on the micro-level it is an established finding that individuals' likelihood to vote increases with their socio-economic status (SES) (Gallego 2010). In other words, individuals in the higher echelon positions in society have the personal and financial resources to get politically engaged, as well as the network connections (Verba et al. 1995). As it is standard in the literature, we measure somebody's SES by their income. Because we have an aggregated analysis, we use the median individual income per district.

The third control variable gauges the degree of urbanization in a district. Among other things, because of higher levels of religiosity and closer links between politicians and parties turnout has traditionally been higher in the countryside as compared to cities and urban hubs in Canada and Western countries (Corvalan and Cox 2013; Smets and van Ham 2013). We have no reason to assume that this relationship should not hold for our study. Hence, we hypothesize that more rural districts should have higher turnout than more urban districts. We measure the degree

[8] Ideally, we would have liked to use the 2016 census for the 2015 election, however not all the necessary data had been released at the time of data collection.

[9] Stephen Harper's Conservative government abolished the mandatory long-form census, replacing it with the optional National Household Survey, which collected the same information. The mandatory short-form census did continue to exist for more basic demographic data, and was used for population and age data in our sample.

of urbanization by the population density per square kilometer, which we derived using the census values for total population and area of the electoral district.

Forth, we want to control for the percentage of citizens who are not born in the country. We expect those individuals, who are born in the country of current citizenship (i.e. those born in Canada) to have a stronger attachment to “their” country than Canadians who came to Canada as immigrants. Native-born Canadians are more familiar with the political institutions and parties in their country; they have become politically socialized in their home country, and they have developed partisan attachments, all of which should contribute to higher turnout (Xu 2005). However, due to data unavailability on the percentage of naturalized citizens, we have to employ a suboptimal proxy variable for the percentage of naturalized citizens, namely the percentage of the population within any district that have not been Canadian citizens from birth. For sure, this includes naturalized citizens in the majority, but also permanent residents and individuals residing in Canada on a visa. Ideally, we would have liked to exclude the two latter categories, as they are ineligible to vote, but with the data we have, this is not possible. We nevertheless assume that our proxy provides a somewhat valid operationalization measuring the influence of the proportion of non-Canadians by birth in a district.

The final control variable is an institutional variable. We control for the average number of polling stations per square kilometer in each district. The idea is that the closer the polling station is to somebody’s home, the quicker and less costly voting should be. In contrast, if voters have to drive several kilometers, or even tens of kilometers to get to their station, voting becomes more costly in terms of both time and money, and thus turnout should be lower (Aldrich 1993; Fedderson 2004). We calculated the average number of polling stations by dividing the absolute number of polling stations per district (provided in the Elections Canada data) by the size of the district measured in terms of square kilometers (as reported in the census data).

Statistical Procedures

Our data captures the population of electoral districts for our 5 elections. We use these data for the following types of analyses. First, we present some bivariate analyses (i.e. scatterplots) between any of our two weather proxies and district level turnout, respectively. Second, we present 3 pooled models. On the left-hand side is the dependent variable, district level turnout. On the right-hand side are the two independent variables; the precipitation per day measured in millimeters, and the daily average temperature, as well as the control variables. Our main model, is a unit fixed effects model. This model is the most conservative model we could choose as it controls for other non-observed district level characteristics (Allison 2009). It gauges if year-to-year weather changes within a district change electoral turnout. As robustness checks, we run the same model as a panel random effects model and a generalised least squares (GLS) model. To account for the fact that overall turnout and district level turnout differed in the 5 elections we cover, we include election dummies for the 2006, 2008, 2011 and 2015 general elections. The 2004 elections serve as the reference category in our three main models.

Results

The bivariate scatterplots mainly confirm our initial hypotheses; that is Figures 1 to 10 generally confirm (1) that the more precipitation there is the lower the turnout and (2) higher temperatures lead to higher turnout.[10] Figures 1 to 5, which gauge the influence between precipitation and turnout all show a slightly negative or negative fitted line, confirming the notion that if it rains, some voters might prefer to stay at home rather than casting their ballot. Substantively, the scatterplots display a 1 to 5 percentage points difference in turnout between districts, where it does not rain and districts where it rains a lot during Election Day (e.g. 15 millimeters of rainfall and more).

When it comes to temperature, our assumption that higher temperatures trigger higher turnout is confirmed in 4 out of the 5 scatterplots. Except for the 2006 winter elections, higher temperatures lead to higher turnout. For the 2008 fall election in particular, this relationship seems strong. As such figure 8 highlights that turnout was approximately 5 percentage points higher in districts with an average temperature between 15 and 20 degrees Celsius, as compared to districts with an average temperature between 0 and 5 degrees. In 2004, 2008, 2011, and 2015, the relationship was a bit less strong, but still in the vicinity of 2 to 3 percentage points between cold districts and warm districts.

Figures 1-10 about here

However, there is one exception to the general pattern; the 2006 winter general election reveals an opposite than expected pattern. In this January election, turnout was significantly higher in “cold” districts, where the average daily temperature was in the vicinity of -10 or -15 Celsius than in less cold districts with a temperature between 0 and 5 degrees Celsius. How can this rather unexpected finding be explained? Wouldn’t it be more logical that voters turn out more if it is rather warm for winter months with temperatures hovering around 0 or 5 degrees than in relatively cold weather with an average temperature of -10 or -15 degrees Celsius? Maybe it has something to do with precipitation in this particular election. In other words, the warmer districts might have been the ones where it has rained or snowed a lot. To examine this possibility, we first run a correlation analysis; the Pearson correlation coefficient is .41 indicating some median strong association between warmer weather and more precipitation. We examine this interaction effect below in more detail, by displaying a separate OLS model for 2006 between our two weather proxies and an interaction between the two (see models 4). Because, the winter elections of 2006 do not fit the general pattern, we also run models 1 to 3 excluding these elections (see models 5 to 7).

[10] Because of the different seasons during which our 5 elections took place, it is impossible to create one graph displaying the influence of temperature or precipitation on turnout.

Our main regression models confirm our bivariate analysis. Models 1 to 3 indicate that precipitation moderately decreases turnout. In more detail, the three equations predict that per every millimeter of rain- or snowfall turnout decreases by .13 points. In other words, 10 millimeters of precipitation decrease electoral participation by 1.3 percentage points. When it comes to temperature, Models 1 to 3 illustrate that for every degree the temperature gets warmer, turnout increases by .05 percentage. In other words, a ten-degree temperature increase triggers approximately .5 percentage points more individuals to turn out. However, if we exclude the 2006 winter elections, the substantive influence of the variable temperature is more than twice as high as in our main equations. In other words, our additional regression models (see models 5 to 7) , which exclude the winter 2006 elections predict that turnout increases by .1 points for every degree Celsius the temperature is warmer.

Tables 1 to 3 about here

The winter elections 2006 reveals a specific pattern. Model 4 highlights that higher temperatures decrease turnout. The same applies to high precipitation. However, in areas with relatively warm winter temperatures and a lot of precipitation turnout is higher. To highlight this counterintuitive relationship, table 4 displays the predicted district level turnout for a hypothetical district based on various temperatures and different amounts of rainfall. For example, the figure highlights that in areas with no precipitation (which includes 180 or more than 61 percent of the electoral districts) turnout decreases with warmer weather. In more detail, the model predicts that in a district with an average daily temperature of -10 degrees Celsius, turnout is approximately 3 percentage points higher than in a district with an average daily temperature of +10. However, once rain or snowfall comes into the picture the relationship is reversed; that is in a district with 10 millimeters of precipitation, the turnout rate is predicted to be 6 points higher in a district where the average temperature is 10 decrees compared to a district where the temperature is -10. For the 20 millimeters of precipitation, the difference is 16 percentage points between a district where the average temperature is -10 as compared to a district with an average temperature of +10.

Table 4 about here

We can only speculate about the rather counterintuitive findings for the winter 2006 elections. The higher turnout could, it may still be explained in terms of opportunity costs. In those areas with no precipitation, the temperature was colder than in areas with precipitation, but still unseasonably warm for the season. These pleasant temperatures in combination with sunshine might have made enjoying outdoor activities like skiing more enticing than voting for some citizens. Conversely, the presence of precipitation may negate the desire to enjoy the warm weather, hence the combination between warm weather and precipitation might have "decreased" the opportunity costs, leading more citizens to turn out. A similar logic is used by Lind (2014) to explain the positive relationship between rain and turnout in Norwegian municipal elections, although with no analysis of the role of temperature.

Conclusion

This article pushes our understanding of the weather–turnout nexus forward. As the first study that looks at the association between the weather and turnout in all four seasons we make important observations. First, we confirm most prior research that highlights that precipitation decreases turnout, whereas higher temperatures increase turnout. This association seems to hold for spring, summer and fall elections. Substantively, we find that per every millimeter of precipitation turnout decreases by .13 percentage points. The relationship for temperature is of similar magnitude; that is for every degree the temperature increases turnout increases by. 1 degrees. These linkages are large in comparison to most other studies, hinting that rain/snowfall and the daily temperature on Election Day could explain fluctuations in turnout of several percentage points.

Second, our results also indicate that for the winter elections, this general pattern does not hold. In particular, we find that colder temperatures trigger higher turnout; this finding applies, in particular, to regions with no precipitation. In contrast, in districts with high precipitation, the combination between mild winter temperatures and high amounts of precipitation triggers higher turnout. Hence, the winter elections do not confirm the general relationship. The costs and opportunity costs associated with winter voting might be more complex and require further inquiry not only in Canada, but in other countries and regions, as well.

For policy, this study allows for the tentative conclusion that scheduling elections during more pleasant weather could moderately increase turnout. If it then is warm and does not rain on Election Day, more individuals will turn out as compared to a relatively cold and rainy day. In addition to scheduling in warmer seasons, flexible scheduling of elections to allow voting over multiple days could potentially mitigate the effects of weather itself, allowing voters to pick a pleasant day to go to the polls; Nova Scotia has implemented such a measure provincially by allowing voting at any time during the writ-period, and saw a modest 1 percentage point turnout increase in the one election held under the new rules. Nevertheless, addressing the effects of the weather alone will not dramatically change turnout. Rather, to reach turnout figures achieved in the 1950s and 1960s in Canada and elsewhere in Western countries, it is necessary that citizens achieve equally high amounts of political interest and knowledge than citizens had decades ago. On the institutional side, the only measure that would significantly increase turnout would be the implementation of mandatory compulsory voting, which, in turn, could reveal other ethical considerations.

Figures and Tables:

Figure 1 Scatterplot: Precipitation and turnout (June 28, 2004)

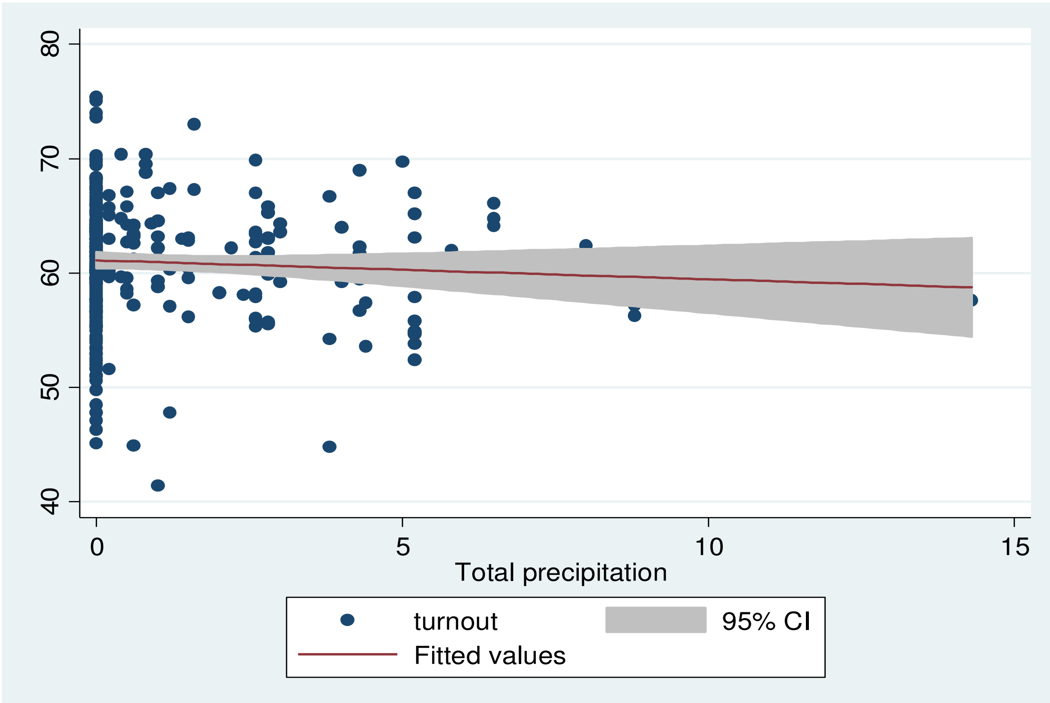

Figure 2 Scatterplot: Precipitation and turnout (January 23, 2006)

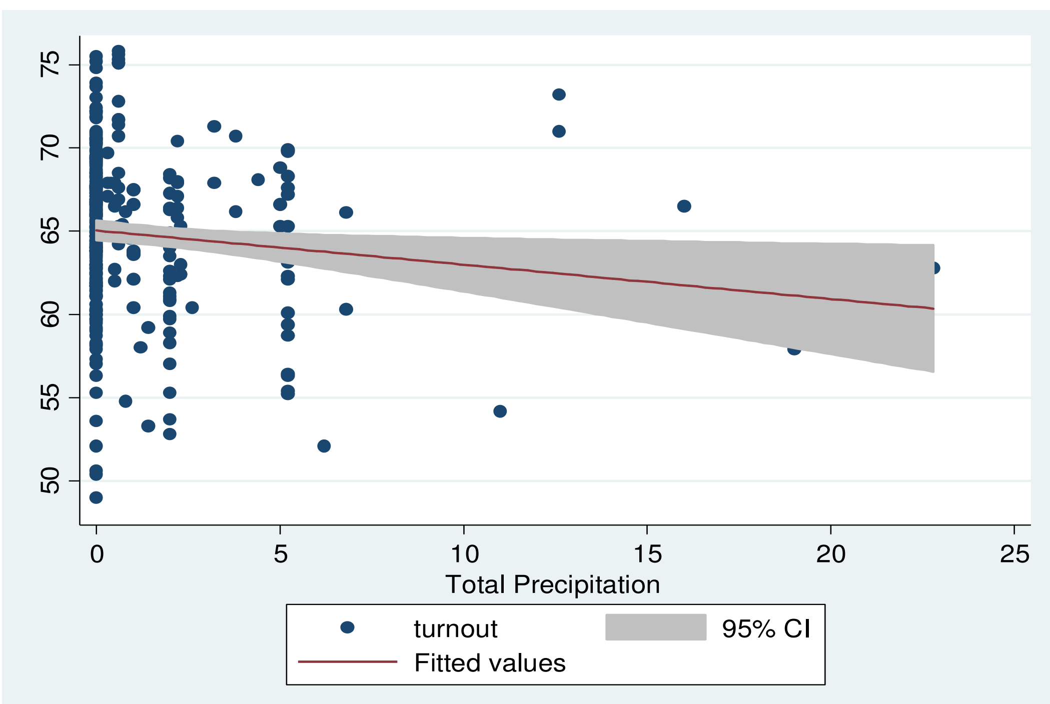

Figure 3 Scatterplot: Precipitation and turnout (October 14, 2008)

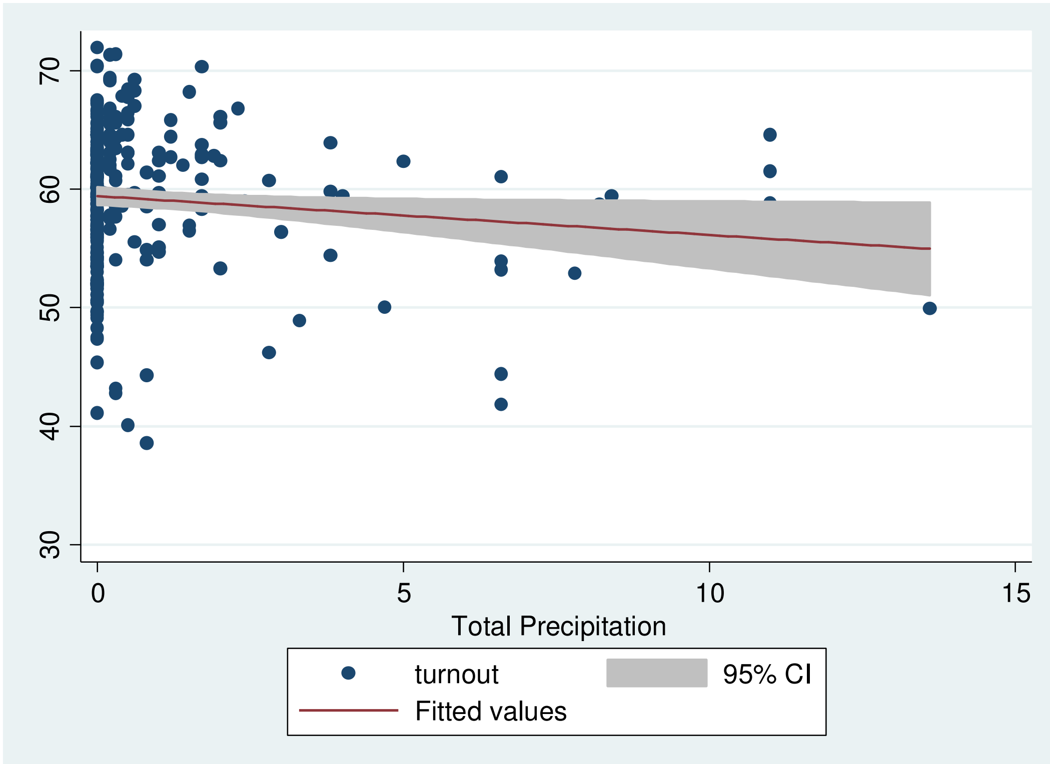

Figure 4 Scatterplot: Precipitation and turnout (May 2, 2011)

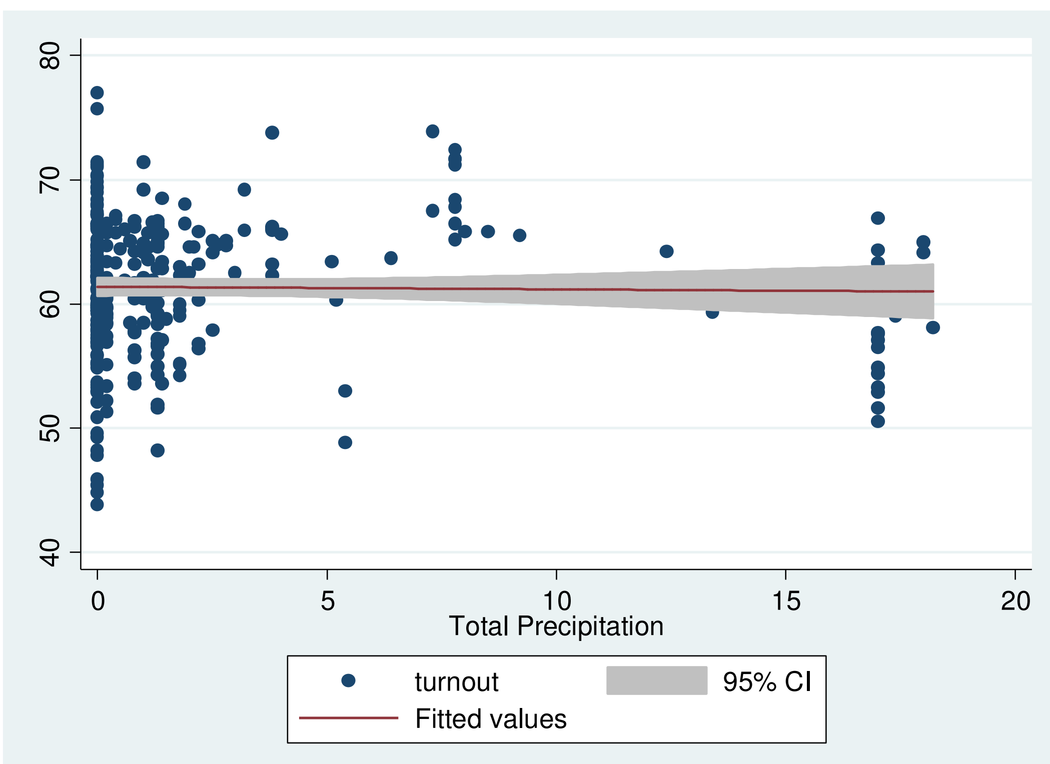

Figure 5 Scatterplot: Precipitation and turnout (October 19, 2015)

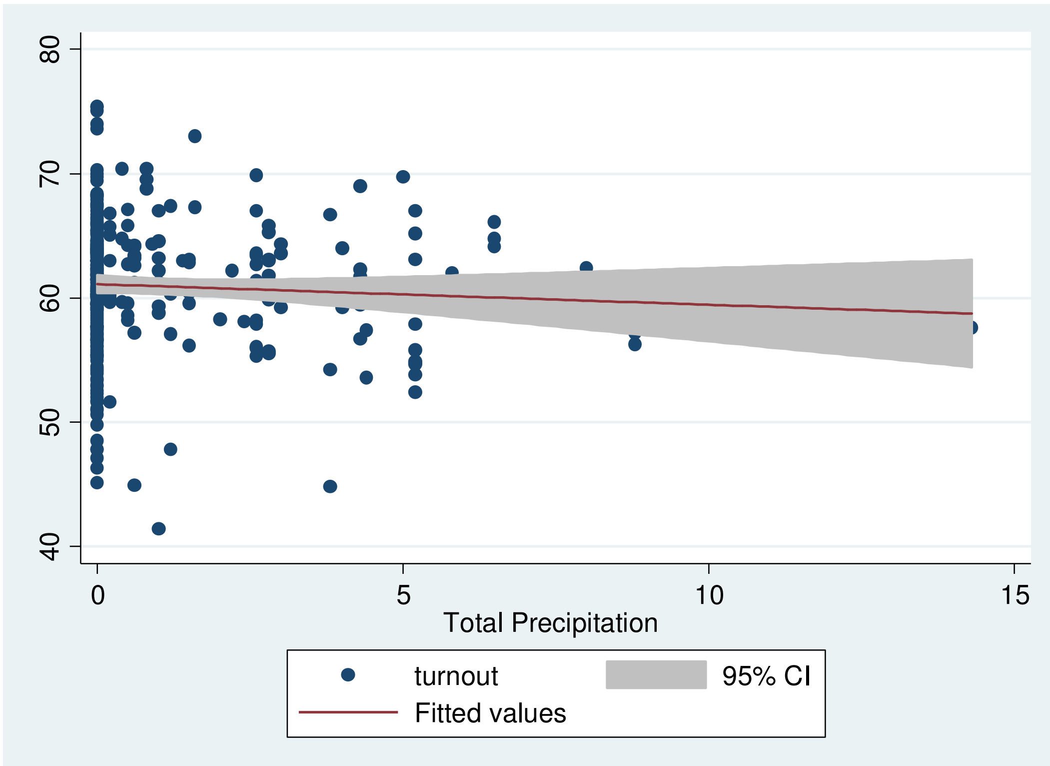

Figure 6 Scatterplot: Mean Temperature on turnout (June 28, 2004)

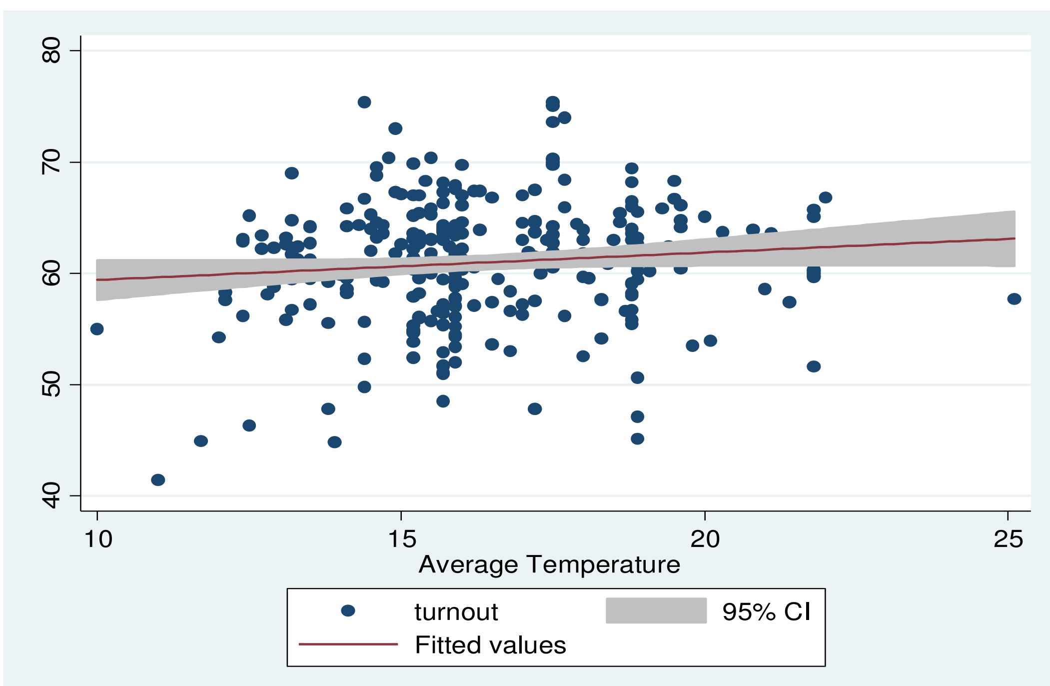

Figure 7 Scatterplot mean temperature on turnout (January 23, 2006)

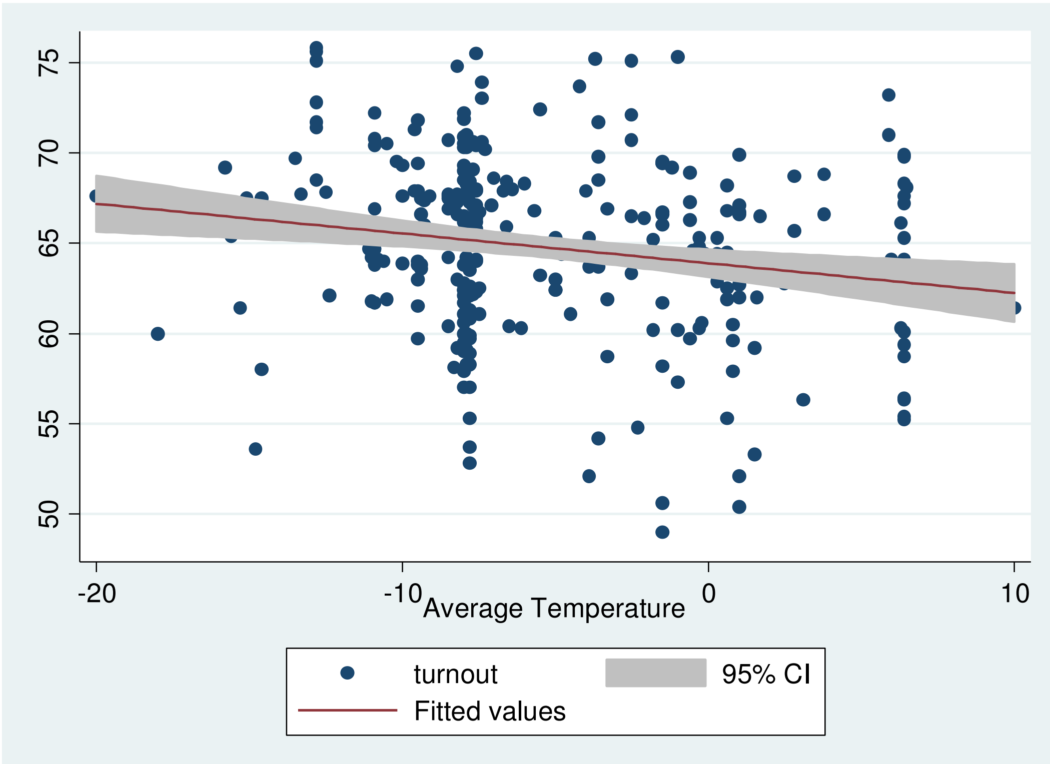

Figure 8: Scatterplot mean temperature on turnout (October 14, 2008)

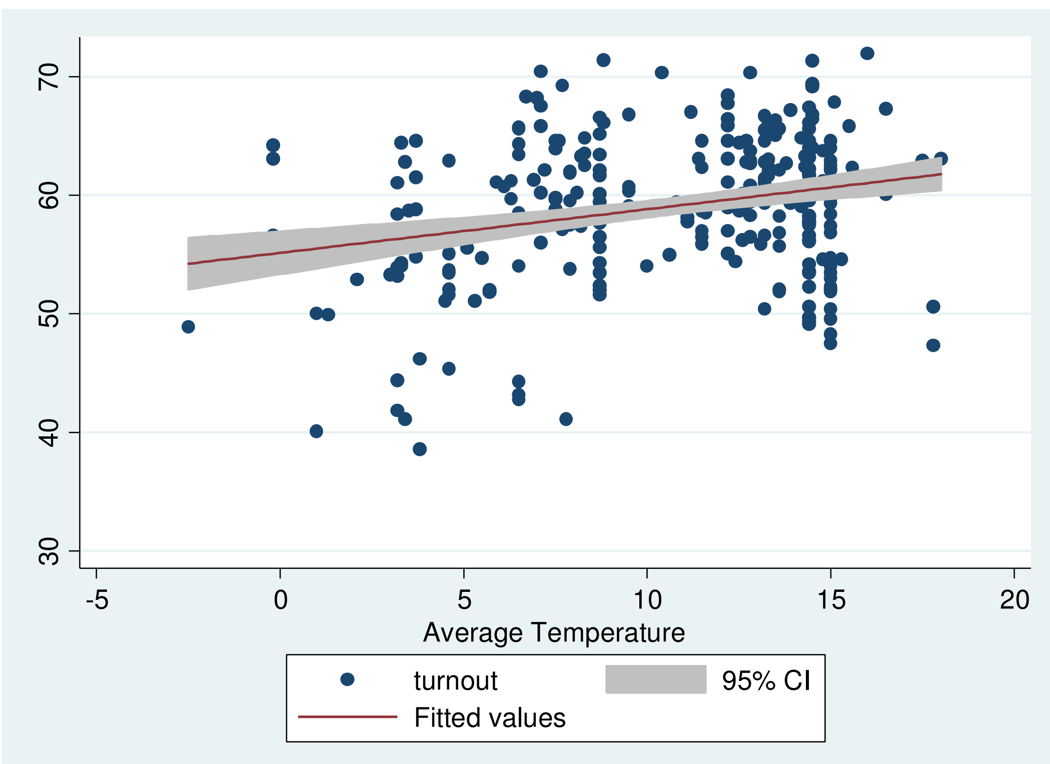

Figure 9: Scatterplot mean temperature on turnout (May 2, 2011)

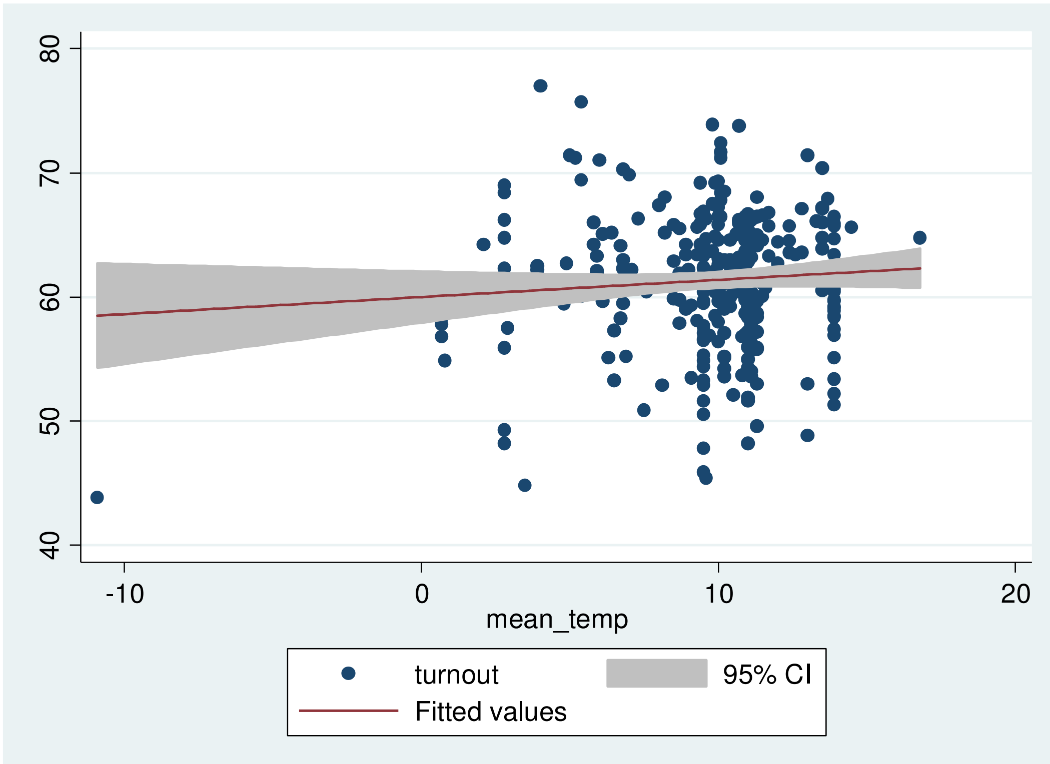

Figure 10: Scatterplot mean temperature on turnout (October 19, 2015)

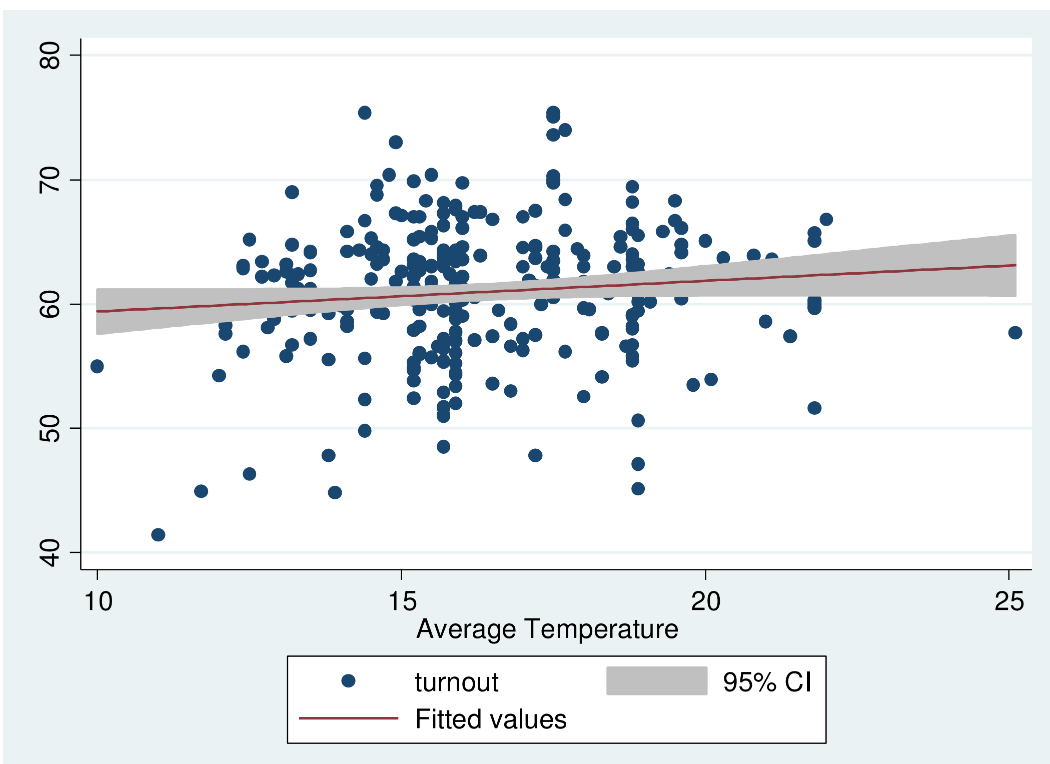

Table 1: Multiple regression models measuring the influence of precipitation and the temperature on turnout

	Model 1: Fixed effects model	Model 2: Random effects model	Model 3: GLS model
Average Temperature	.045*** (.015)	.049*** (.016)	.070** (.029)
Total Precipitation	-.133*** (.019)	-.128*** (.019)	-.127*** (.036)
Median district level age	.017 (.037)	.177*** (.034)	.668*** (.034)
Median district level income	.430*** (.058)	.536*** (.040)	.702*** (.028)
Population density	-.001* (.0007)	-.0007 (.0006)	.0002 (.0006)
Average number of voting stations per square kilometer	.274 .306	.491 (.281)	.320 (.285)
Percent immigrants per district	-.200*** (.058)	-.085*** (.017)	-.059*** (.010)
2006	4.81*** (.364)	4.88*** (.373)	5.35*** (.719)
2008	-1.66*** (.183)	-1.64*** (.271)	-1.46 (.383)
2011	-.801** (.332)	-1.60*** (.271)	-2.92*** (.427)
2015	.000 (.159)	.000 .164)	.000 (.343)
Constant	53.18*** (2.81)	40.76 (1.93)	15.77*** (1.83)
Rsquared	.23	.41	
Log Likelihood			-4147.45
Number of Observations	1459	1459	1459
Number of Groups	294	294	294

Notes: Standard errors in parentheses. Significance: * p < .1; ** p < .05; *** p < .01 (two-tailed).

Table 2: The 2006 interactive model (OLS model with Huber White standard errors)

Average Temperature	-.143*** (.042)
Total Precipitation	-.109 (.075)
Interaction precipitation-turnout	.047** (.018)
Median district level age	.632*** (.070)
Median district level income	.747*** (.057)
Population density	-.001 (.001)
Average number of voting stations per square kilometer	-.468 .558
Percent immigrants per district	-.057*** (.018)
Constant	20.39*** (3.69)
Rsquared	.49
Log Likelihood	
Number of Observations	294

Notes: Standard errors in parentheses. Significance: * p < .1; ** p < .05; *** p < .01 (two-tailed).

Table 3: Multiple regression models measuring the influence of precipitation and the temperature on turnout excluding the year 2006

	Model 5: Fixed effects model	Model 6: Random effects model	Model 7: GLS model
Average Temperature	.108*** (.022)	.122*** (.022)	.199*** (.042)
Total Precipitation	-.125*** (.022)	-.113*** (.022)	-.82* (.042)
Median district level age	.003 (.037)	.166*** (.034)	.646*** (.039)
Median district level income	.430*** (.037)	.519*** (.041)	.672*** (.032)
Population density	-.002** (.001)	-.001 (.0006)	.0005 (.0006)
Average number of voting stations per square kilometer	.366 (.320)	.592** (.295)	.320 (.285)
Percent immigrants per district	-.233*** (.059)	-.095*** (.018)	-.068*** (.012)
2008	-1.32*** (.200)	-1.24*** (.207)	-.735*** (.427)
2011	-.309** (.332)	-1.07*** (.292)	-2.00*** (.489)
2015	.000 (.154)	.000 .161)	.000 (.351)
Constant	53.83*** (2.85)	40.55 (1.99)	15.46*** (2.03)
Rsquared	.17	.36	
Log Likelihood			-3338.09
Number of Observations	1165	1165	1165
Number of Groups	295	295	295

Notes: Standard errors in parentheses. Significance: * p < .1; ** p < .05; *** p < .01 (two-tailed).

Table 4: Predicted turnout values for various temperature and precipitation values.

	Temperature (-10)	Temperature (-5)	Temperature (0)	Temperature (5)	Temperature (10)
Precipitation (0)	65.09	64.37	63.65	62.94	62.22
Precipitation (10)	59.23	60.89	62.56	64.22	65.88
Precipitation (20)	53.38	57.42	61.46	65.5	69.54

References:

Aldrich, J. H. (1993). Rational choice and turnout. *American Journal of political science*, 246-278.

Allison, P. D. (2009). Fixed effects regression models. SAGE publications.

Arnold, F. (Forthcoming). Turnout and Closeness: Evidence from 60 Years of Bavarian Mayoral Elections. *The Scandinavian Journal of Economics*. https://doi.org/10.1111/sjoe.12241

Arnold, F., & Freier, R. (2016). Only conservatives are voting in the rain: Evidence from German local and state elections. *Electoral Studies*, *41*, 216–221. https://doi.org/10.1016/j.electstud.2015.11.005

Artés, J. (2014). The rain in Spain: Turnout and partisan voting in Spanish elections. *European Journal of Political Economy*, *34*, 126–141. https://doi.org/10.1016/j.ejpoleco.2014.01.005

Bassi, A. (2013). *Weather, Mood, and Voting: An Experimental Analysis of the Effect of Weather Beyond Turnout* (SSRN Scholarly Paper No. ID 2273189). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=2273189

Ben Lakhdar, C., & Dubois, E. (2006). Climate and Electoral Turnout in France. *French Politics*, *4*(2), 137–157. https://doi.org/http://dx.doi.org/10.1057/palgrave.fp.8200100

Corvalan, A. and P. Cox 2013. “Class-Biased Electoral Participation: The Youth Vote in Chile.” *Latin American Politics and Society* 55(3): 47-68.

Dubois, E., & Lakhdar, C. B. (2007). More on the Seasonal Determinants of Turnout: Holidays and French Presidential Elections. *French Politics; Basingstoke*, *5*(2), 144–159. https://doi.org/10.1057/palgrave.fp.8200123

Eisinga, R., Grotenhuis, M. T., & Pelzer, B. (2011). Weather conditions and voter turnout in Dutch national parliament elections, 1971–2010. *International Journal of Biometeorology*, *56*(4), 783–786. https://doi.org/10.1007/s00484-011-0477-7

Elections Canada. (2006). *Report of the Chief Electoral Officer of Canada on the 39th General Election of January 23, 2006*. Retrieved from http://www.elections.ca/content.aspx?section=res&dir=rep/off/sta_2006&document=index&lang=e

Elections Canada. (2017). Elections Canada’s Official Reports — Official Voting Results. Retrieved from http://www.elections.ca/content.aspx?section=res&dir=rep/off&document=index&lang=e#officialvoting

Environment and Climate Change Canada. (2017, April 3). Historical Climate Data. Retrieved from http://climate.weather.gc.ca/

Feddersen, T. J. (2004). Rational choice theory and the paradox of not voting. *The Journal of Economic Perspectives*, *18*(1), 99-112.

Fraga, B. L., & Hersh, E. (2010). *Voting Costs and Voter Turnout in Competitive Elections* (SSRN Scholarly Paper No. ID 1643019). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=1643019

Franklin, M. N. (2004). Voter turnout and the dynamics of electoral competition in established

democracies since 1945. New York: Cambridge University Press.
Funke, A. (2017). Pundits' Guide to Canadian Elections. Retrieved from https://www.punditsguide.ca/
Gallego, A. (2010). "Understanding Unequal Turnout: Education and Voting in Comparative Perspective." *Electoral Studies* 29(2): 239-247.
Gatrell, J. D., & Bierly, G. D. (2013). Weather and Voter Turnout: Kentucky Primary and General Elections, 1990-2000. *Southeastern Geographer*, *42*(1), 114–134. https://doi.org/10.1353/sgo.2002.0007
Gomez, B. T., Hansford, T. G., & Krause, G. A. (2007). The Republicans Should Pray for Rain: Weather, Turnout, and Voting in U.S. Presidential Elections. *The Journal of Politics*, *69*(3), 649–663. https://doi.org/10.1111/j.1468-2508.2007.00565.x
Knack, S. (1994). Does rain help the Republicans? Theory and evidence on turnout and the vote. *Public Choice*, *79*(1–2), 187–209. https://doi.org/10.1007/BF01047926
LeDuc, L., & Pammett, J. H. (2006). Voter Turnout in 2006: More Than Just the Weather. In J. H. Pammett & C. Dornan (Eds.), *The Canadian federal election of 2006* (pp. 305–326). Toronto ON: Dundurn Press.
Lind, J. T. (2014). *Rainy Day Politics -- An Instrumental Variables Approach to the Effect of Parties on Political Outcomes* (SSRN Scholarly Paper No. ID 2482986). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=2482986
Ludlum, D. (1989). *The Weather Factor*. Boston: American Meteorological Society.
Matsusaka, J. G., & Palda, F. (1999). Voter turnout: How much can we explain? *Public Choice*, *98*(3–4), 431–446. https://doi.org/10.1023/A:1018328621580.
Melo, D. and D. Stockemer (2014). Age and political participation in Germany, France and the UK: A comparative analysis. Comparative European Politics, 12(1): 33-53.
Merrifield, J. (1993). The institutional and political factors that influence voter turnout. *Public Choice*, *77*(3), 657–667. https://doi.org/10.1007/BF01047865
Nova Scotia House of Assembly. (2009). *Report of the Select Committee on Participation in the Democratic Process, 2009* (Draft ed.). Halifax, N.S.: Nova Scotia Legislative Assembly.
Persson, M., Sundell, A., & Öhrvall, R. (2014). Does Election Day weather affect voter turnout? Evidence from Swedish elections. *Electoral Studies*, *33*, 335–342. https://doi.org/10.1016/j.electstud.2013.07.021
Rallings, C., Thrasher, M., & Borisyuk, G. (2003). Seasonal factors, voter fatigue and the costs of voting. *Electoral Studies*, *22*(1), 65–79. https://doi.org/10.1016/S0261-3794(01)00047-6
Smet K. and C. van Ham 2013. "The embarrassment of riches? A meta-analysis of individual-level research on voter turnout." Electoral Studies 32(2): 344-359.
Statistics Canada. (2012). Reasons for not voting. Retrieved from http://www.statcan.gc.ca/pub/11-402-x/2012000/chap/sc/sc01-eng.htm

Statistics Canada. (2008). *Federal Electoral District (FED) Profile, 2006 Census* (Catalogue no. 92–595–XWE). Ottawa. Retrieved from http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/prof/92-595/p2c.cfm?TPL=INDX&LANG=E

Statistics Canada. (2013a). *2011 Census Profile* (Catalogue no. 99–004–XWE). Ottawa. Retrieved from http://www12.statcan.gc.ca/fed-cef/index.cfm?Lang=E&SID=2

Statistics Canada. (2013b). *2011 National Household Survey* (Catalogue no. 99–004–XWE). Ottawa. Retrieved from http://www12.statcan.gc.ca/nhs-enm/2011/dp-pd/prof/index.cfm?Lang=E

Studlar, D. T. (2001). Canadian Exceptionalism: Explaining Differences over Time in Provincial and Federal Voter Turnout. *Canadian Journal of Politiqua Science / Revue Canadienne de Science Politique*, *34*(2), 299–319.

Verba, Sidney, Schlozman, K. L. and Brady H. E. (1995). *Voice and equality: Civic voluntarism in American politics*. Boston: Harvard University Press.

Xu, J. (2005). Why do minorities participate less? The effects of immigration, education, and electoral process on Asian American voter registration and turnout. *Social Science Research*, 34(4): 682-702.