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Articles

Climate and Electoral Turnout in France

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It is commonly stated that the climate has an impact on electoral turnout. This article aims to test this proposition that has not been scientifically proved in the French case yet. Using the last five parliamentary elections' turnout data and the corresponding climatic data on the voting day, our study shows that rain has a depressing effect on turnout, whereas sunshine and high temperatures incite people to vote.
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According to the US Census Bureau, 0.6 per cent of the registered non-voters in the US elections of November 2000 stated that they failed to vote because of the 'bad weather'.[1] As in 2000, the number of the registered non-voters was 18.7 million;[2] this means that, if the survey is unbiased, 112,200 persons failed to vote because of the climatic conditions. Due to the close result of this election, it goes without saying that each vote was crucial. In the same fashion, after the record level of abstention in the French presidential election of 2002, *Le Figaro* reported: 'the weather was fine in the whole of France and that may have distracted voters of their electoral duty'.[3] This kind of argument, which is widespread in the media, suffers, at least in France, from the lack of any strong scientific foundation. Paradoxically, it seems that no study exists on the link between political life and climate, whereas France is often pioneer in political science as well as in earth sciences. The literature in English is more fertile.[4]

A first axis of research focuses on the impact of climatic conditions on the course of particular political events. Some studies show how climatic conditions can disrupt, or even defer, a transfer of power ceremony or an Inauguration Day.[5] This is not unimportant, especially if one considers that the cancellation of an investiture ceremony can, for example, delay the implementation of the newly elected President's policy. Thus, every presidential election year, *Weatherwise* magazine publishes an article whose object is to describe the weather on Inauguration Day (see Ludlum, 1984 and Hughes, 1988, 1996). March 4th, the traditional date of the ceremony, was frequently the theatre of terrific climatic conditions. Thus, half of the investiture ceremonies between 1789 and 1933 took place during bad weather (snow, rain and ice). In 1937 Roosevelt inaugurated a new date of investiture fixed by the Constitution 20th amendment to January 20th of the year following the election. Alas for him, this ceremony was the rainiest of the whole history! The change of date has not therefore been sufficient to break this surprising correlation, the icy temperature of January 20th, 1985 even forcing Ronald Reagan to take the oath of allegiance sheltered beneath the Capitol's dome.[6]

The second axis of research on the interaction between climate and politics[7] tries to verify the existence of an impact of the climate on electoral results. The latter can be measured as the score achieved by political parties or the rate of turnout. It is interesting to note that the first ever study aiming to explain the vote took into account the impact of climatic conditions (Barnhart, 1925). The author showed that bad climatic conditions (drought, rain, etc) reveal deficiencies in infrastructures (transportation, equipment, etc), deficiencies for which political leaders are held responsible. This can even lead to the creation of alternative parties as was the case in Nebraska in 1890's. In the same way, one can suppose that climatic conditions affect economic conditions through an increase of certain prices such as prices of agricultural products. This inflation, seen negatively, would decrease the vote in favor of the incumbent (Pearson and Myers, 1948).[8]

Relative to the turnout issue, climatic conditions can help to influence the decision of some voters to vote or not. For example, rainy weather will simply discourage some voters and divert them from their electoral duty. It has been studied notably by Ludlum (1984), Merrifield (1993) and Knack (1994). Merrifield (1993) shows that rain, defined as the total precipitation in the biggest city of every state the Election Day, played a significantly negative role on the turnout of American voters for the 1982 congressional elections.[9] The gap between the temperature on election day and the 'normal' temperature is also significantly negatively related to the turnout. Therefore, to summarize, the more it rains and the more the temperature departs from the normal, the fewer the people who vote.

Studies by Ludlum (1984) and Knack (1994) go further in claiming that climatic conditions influence the scores obtained by political parties. Thus, American political folklore has it that rain favors Republicans. The relationship goes as follows: rain lowers turnout and abstention helps Republicans since Democrats abstain more frequently. Steve Knack tests this proposition on the 1984, 1986 and 1988 elections. His findings are as follows: bad climatic conditions discourage some voters but this kind of abstention, and even abstention in general, does not favor Republicans. Ludlum (1984), using historical examples, shows that climatic conditions in highly populated states such as California or Florida can affect the American presidential election's national result by influencing the abstention in these states. Thus, in 1960, John F. Kennedy won some states as Illinois or Missouri by a narrow margin, even though these states were more prone to vote for the Republican candidate Richard Nixon. In those two states, the climatic conditions were especially bad on the voting day. Many Republican voters, residing mainly in farming counties, failed to go to the polls in contrast to Democrat voters who lived mostly in the big cities of those states.

Another category of studies aims at examining the impact of climatic conditions on the result of incumbent parties. At the beginning of the 20th century, Marshall (1927)[10] studied the correlation between the precipitation level during the 4 years preceding the presidential election and the incumbent party's electoral results. This paper is noteworthy because the author proposes a theoretical foundation for his argument. According to him, in the agricultural-based states, climatic conditions determine the quality of the harvests that, in turn, determines the voters' level of satisfaction: 'Scant rainfall means poor crops, poor crops mean hard times, and hard times mean discontent' (Marshall, 1988, 265). The electoral mechanism is like a punishment/reward system: voters reward the incumbent party for good harvests and punish it otherwise.[11] Marshall, after having studied the 25 American presidential elections between 1825 and 1924, found that for the 12 elections that led to a change of party in power, 11 took place in years of low precipitation. Of the 13 elections won by the incumbent, 11 took place in years of abundant rain. In other words, the total precipitation during the 4 years of the presidential term allowed him to forecast the future president correctly for nearly 90 per cent of the elections between 1825 and 1924.

It should be noted that other articles show a surprising correlation without obvious theoretical foundations. Thus, one learns that in Boston, for the last 40 years, it snowed twice as often when the president was Democrat than when the president was Republican (D'Aleo, 1998)!

As we can see through this short survey of the literature, the French case has not been tackled yet, even briefly. Our study aims to fill this gap. Firstly, we present the theoretical foundations of abstention. After having described the variables, the data and the methodology, we then show the estimations and the results of our study. Some issues are explored before some concluding remarks.

Theoretical Foundations of Turnout

Why do some people vote and others abstain? The decision to turn out or to abstain can be identified as a rational choice problem. Voters make a cost/benefit analysis that can be described by the following relation:[12]

$$R = Bp + D - C$$

where R denotes their expected utility; B is the gain derived from the political program; and p the probability that an individual's vote is decisive in changing the result of the election; D represents the non-contingent gains of turnout with respect to certain ethics or the efficiency of the political system (Riker and Ordeshook, 1968); and C represents the costs of voting. These are essentially opportunity costs including the cost of collecting information about political programs or the time taken going to the polls.[13] The voter decides to vote if the gains are greater than the costs and abstains otherwise.[14]

As in Merrifield (1993) and Knack (1994), the hypothesis advanced in our study is that climatic variables, while modifying the costs, influence the voter's decision to vote or not. However, these studies say nothing about the form that such a modification can take. In order to be more precise, we decompose the costs as follows:

$$C = C_i + C_j$$

where C_i represents the opportunity costs before the electoral day, including, for example, following the campaign or studying the party programs, and C_j represents the opportunity costs on the electoral day itself. The climate is not a cost in itself (i.e. it does not belong to C_i or to C_j), but it modifies the perception of C_j.[15] For instance, two people having the same C_j and facing the same climatic conditions on election day may adopt a different attitude as to whether or not they will vote.

The empirical study may allow us to verify that the climate, while modifying the perception of some costs related to the vote, influences the decision to vote and then has an impact on the electoral turnout. The following development specifies the variables, the data and the methodology used.

The Empirical Model

The dependent variable, noted $\text{TURN}_{i,t}$, is the turnout in the French departments for the first round of the five parliamentary elections since 1986.[16] We have then four choices to justify: the electoral unit, the relevant round, the level of elections and the studied period.

France is subdivided in 'regions', each of which is subdivided into 'departments'. Each department is composed of several electoral districts. In metropolitan France there are 22 regions, 96 departments, and 555 electoral districts. We disregard the district level because too few data were available to define our independent variables.[17] We have chosen the department level because it is a more homogeneous electoral territory than the region. Indeed, most regions show important disparities. For example, in the Aquitaine region, which traditionally votes for the Left, the Pyrénées-Atlantiques department always votes for the Right. Similarly, while the Côtes-d'Armor department votes for the Left, the region to which it belongs, Bretagne, votes for the Right. Similar disparities exist within a department — for example, in the Lozère voters in the north of the department support the Right, whereas those in the south support the Left. All the same, the degree of disparity is generally less. By estimating the same model (same dependent variable, same explanatory variables, same period) at different levels of data (national, regional, departmental), Dubois and Fauvelle-Aymar (2004) have shown the departmental model to be clearly superiority in terms of vote forecasting.

Furthermore, our study only concerns the first ballot. First, this choice means that we can avoid having to do some extremely complicated modeling to take account of triangular contests (Left/Right/Extreme-Right), fratricidal duels (Left/Left or Right/Right), single candidates, or even the cases where there are no second round candidates. Second, at the first round, the electoral supply (i.e., the number of candidates) is larger and so the turnout is likely to be higher.

We have chosen parliamentary elections because, along with the presidential ones, these elections are the most important in the eyes of the public. We have not aggregated these two types of elections because we feel that any such amalgamation would be based on the highly contestable assumption that the determinants of turnout at parliamentary and presidential elections are the same.

We started our study in 1986 to ensure homogeneity of constituencies. Since that year, the number of electoral district has remained unchanged.[18]

We identify six explanatory variables. The first one is a trend variable that captures the political weariness of the French voter for near 25 years as shown in Figure 1.

This weariness finds its origins mainly in the multiplication of scandals involving politicians, the potential failure of representation and in the repetition of electoral contests (28 in 10 years for all types of elections!). The expected sign of the coefficient of this variable, noted TREND, will be therefore negative.

The second variable is a dummy variable that takes into account the special features of the 1986 ballot. For this election, there was a single round. This may have led to a higher turnout. Furthermore, the fact that regional elections were organized on the same day constituted another incentive to go to polls. The variable will be noted DUM1986 and will take 1 in 1986 and 0 otherwise. We

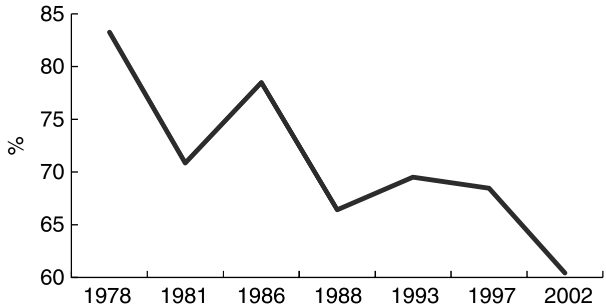

Figure 1 Turnout at French parliamentary elections (1978–2002).

expect a positive sign for the coefficient of this variable. At first glance, Figure 1 is consistent with this hypothesis.

Further explanatory variables capture the economic situation. For example, when macroeconomic performances are poor, two arguments can be advanced. According to the first one, turnout is higher because some voters that usually abstain will go to polls to sanction the ruling majority. The second argument, the complete opposite of the first, is that voters who support the incumbent prefer to abstain rather to vote against her. We have chosen the unemployment rate as a proxy for the economic situation. More precisely, UNEM1 is the difference in the unemployment rate between the quarter in which the election took place and the previous quarter; UNEM2 is the difference in the unemployment rate between the quarter in which the election took place and the rate four quarters previously; and UNEM3 is the difference in the unemployment rate between the quarter in which the election took place and the rate eight quarters before. The expected sign is indeterminate given the aforementioned arguments. The variable could then have a positive sign (as in Merrifield, 1993) or a negative sign (as in Fauvelle-Aymar *et al.*, 2000). In the case where the two effects are opposed, the variable should be nonsignificant.

The three other independent variables are the climatic variables on the election day: temperature, precipitation and sunshine.

The first problem to deal with is geographical heterogeneity. For example, a temperature of 20°C is not experienced in the same way in a northern department as in a southern department. In order to account for these disparities and to capture the exceptional character of precipitation, temperature or sunshine, we chose to control for the long-term trend of our climatic data. For this, we controlled for the 'climatic standard', that is the monthly average for the period 1951–1980.

We then use the following variables:

$PRE_{i,t}$: the height in millimeters of the precipitation that fell between 0600 and 1800 on the voting day minus the long-term tendency observed on the period 1961–1990.[19]

$TEMP_{i,t}$: the arithmetic mean of the temperature in Celsius measured at 0600 and the temperature in Celsius measured at 1800 on the voting day minus the long-term tendency observed on the period 1961–1990.

$SUN_{i,t}$: the 'sunshine ratio' defined as 'length of sunshine/length of the astronomical day $\times 100$' on the voting day minus the long-term tendency observed on the period 1951–1980.

If, intuitively, the climatic variable that influences the turnout the most should be precipitation, there is here a problem linked to their frequency since a drizzle falling continuously will, presumably, discourage voters more than a big but once-off shower.[20]

The sunshine ratio is a good indicator because, by its construction, it permits us to account for what we might call 'good weather' or a 'bad weather'. For example, a sunshine ratio of 90 per cent for a city means that it was sunny 90 per cent of the day and not that there was a strong sunshine during a small part of the day.

Numerous other variables explaining turnout also exist (see, among others, Blais and Dobrzynska (1998) and the articles quoted above). These variables are essentially socio-demographical factors that affect turnout in the long run: age, level of education, religion, etc.[21] They explain why a department systematically has a higher turnout rate than another. To capture these spatial disparities, we estimate a fixed-effects model.[22] In this kind of model, the intercept term varies from a department from another. This allows us to take into account the long-run specificities of each department (see Dubois and Fauvelle-Aymar, 2004).

The model to estimate will be

$$\begin{aligned} \mathrm{TURN}_{i,t} = & c_i + \beta_1 \mathrm{TREND}_t + \beta_2 \mathrm{DUM1986}_i + \beta_3 \mathrm{UNEMj}_{i,t} \\ & + \beta_4 \mathrm{TEMP}_{i,t} + \beta_5 \mathrm{PRE}_{i,t} + \beta_6 \mathrm{SUN}_{i,t} + \varepsilon_{i,t} \end{aligned}$$

where $j = 1, 2, 3$, for UNEM according to the definition retained. Let us turn to the description of the sample and to the presentation of the estimation results.

Sample and Estimation Results

There are 96 departments in France but our sample is slightly smaller since only 90 departments have a 'reference meteorological station'.[23] Equally, only 43 departments simultaneously offer the three climatic standards.[24] Our final sample then includes these 43 departments for five elections, that is a total of 215 observations.[25]

Table 1 shows some descriptive statistics.[26] The Figure 2–4 plot the turnout against our three climatic variables.[27]

These figures give the expected sign of the climatic variable that is outlined in Table 2. The estimation leads to Table 3.[28]

Immediately, we see in columns 1 and 2 that the unemployment variable is not statistically significant at a 10 per cent level.[29] We have then removed this variable (column 4). But in columns 1–4, all the climatic variables are simultaneously included and this can lead to a multicolinearity problem. For example, it is easy to understand that the higher the sunshine ratio, the higher the temperature or the higher the sunshine ratio, the lower the level of precipitation. To tackle this problem, we have run three regressions with a single climatic variable (columns 5, 6, 7). As we can see, all the climatic variables are significant at a 1 per cent level, their coefficients are broadly the

Table 1 Descriptive statistics

Variable	*Minimum*	*Maximum*	*Mean*	*Median*	*Standard deviation*
TURN	55.50	85.68	69.96	68.82	5.67
TREND	1.00	5.00	3.00	3.00	1.42
TEMP	−8.80	8.20	−0.64	−0.65	3.46
PRE	−3.59	12.17	−0.71	−1.67	2.55
SUN	−60.00	62.00	−6.06	−12.00	34.32
DUM86	0.00	1.00	0.20	0.00	0.40
UNEM1	−1.30	0.80	0.01	0.00	0.30
UNEM2	−1.90	2.00	0.13	0.10	0.70
UNEM3	−3.10	3.60	0.41	0.40	1.21

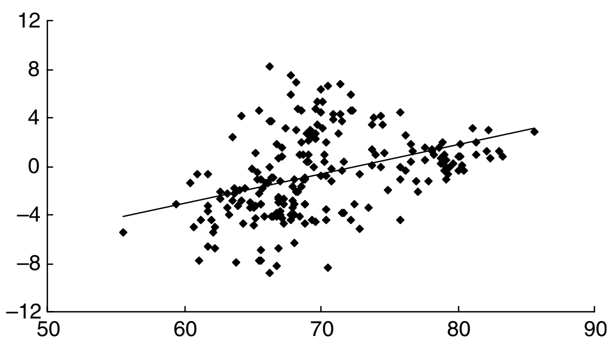

Figure 2 Turnout and temperature (1986–2002).

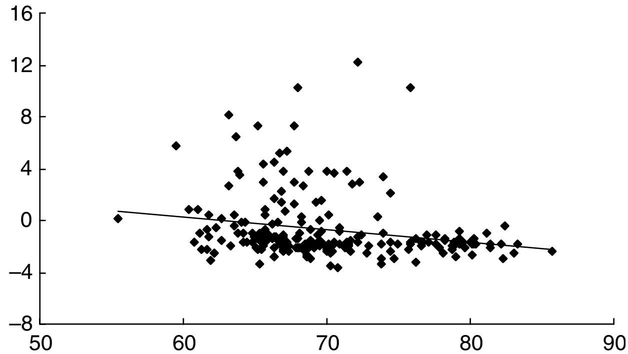

Figure 3 Turnout and precipitation (1986–2002).

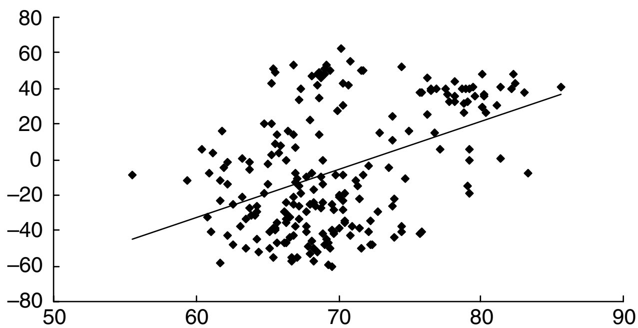

Figure 4 Turnout and sunshine (1986–2002).

Table 2 Expected signs of the climatic variables

TEMP	>0
PRE	<0
SUN	>0

same than in column 4 and they keep the same sign. All of this indicates that the multicolinearity, if it exists, is not a very important issue. Moreover, simple correlations between turnout and weather variables are rather weak: 0.39 for temperature, 0.15 for precipitation and 0.13 for sunshine. To account for this point, we have estimated auxiliary regressions as suggested by Gujarati (2003). The results are shown in Table 4.

Table 3 Estimates

Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
$TREND_t$	−0.24**	−0.29**	−0.15	−0.25**	−0.27**	−0.42***	−0.38***	−0.25**	−1.74***
	(2.14)	(2.36)	(1.37)	(2.24)	(2.32)	(3.00)	(2.74)	(2.27)	(9.84)
$DUM1986_t$	9.64***	9.56***	9.95***	9.62***	10.26***	10.19***	9.77***	9.69***	—
	(24.34)	(24.04)	(26.98)	(25.11)	(31.54)	(23.31)	(21.19)	(25.29)	—
$PRE_{i,t}$	−0.17***	−0.18***	−0.17***	−0.17***	—	−0.17***	—	−0.19***	−0.15*
	(3.25)	(3.37)	(3.26)	(3.27)	—	(2.61)	—	(3.57)	(1.85)
$SUN_{i,t}$	0.01**	0.01***	0.01***	0.01**	—	—	0.02***	0.01***	0.04***
	(2.47)	(2.66)	(2.72)	(2.60)	—	—	(3.84)	(2.78)	(6.53)
$TEMP_{i,t}$	0.37***	0.34***	0.25***	0.36***	0.35***	—	—	0.37***	0.44***
	(8.90)	(7.73)	(4.80)	(13.40)	(14.12)	—	—	(14.12)	(7.31)
$TEMP^2_{i,t}$	—	—	—	—	—	—	—	0.01	—
	—	—	—	—	—	—	—	(1.61)	—
$UNEM1_{i,t}$	−0.21	—	—	—	—	—	—	—	—
	(0.41)	—	—	—	—	—	—	—	—
$UNEM2_{i,t}$	—	0.15	—	—	—	—	—	—	—
	—	(0.72)	—	—	—	—	—	—	—
$UNEM3_{i,t}$	—	—	0.39***	—	—	—	—	—	—
	—	—	(2.64)	—	—	—	—	—	—
R^2	0.94	0.94	0.94	0.94	0.93	0.89	0.89	0.94	0.75
Adj. R^2	0.92	0.92	0.92	0.92	0.91	0.86	0.87	0.92	0.69
N	215	215	215	215	215	215	215	215	215

Student's t are in parentheses.
***Significant at 0.01 level.
**Significant at 0.05 level.
*Significant at 0.10 level.

Table 4 Multicolinearity detection: auxiliary regressions

Dependant variable	R^2	*P-value F statistics*
TREND	0.53	0.00
DUM1986	0.50	0.00
UNEM1	0.58	0.00
UNEM2	0.61	0.00
UNEM3	0.71	0.00
TEMP	0.49	0.00
PRE	0.31	0.00
SUN	0.50	0.00

Partial correlations are all significant but not very high. The rule is that if no R^2 obtained from auxiliary regressions is higher than the overall R^2 (Table 3, column 4), multicolinearity is not a troublesome problem (Gujarati, 2003, 361). This is the case here. We remark in Table 4 that the three highest R^2 are the ones associated with the UNEMs variables. This can explain the nonsignificativity of UNEM1 and UNEM2 and the fact that TREND is no longer significant when included with UNEM3 (that is significant at a 1 per cent level).

We turn to the interpretation of the results. According to the discussion above, we focus on Equation (4). All the variables have the expected sign and are significant at a 1 per cent level except the trend variable, which is significant at a 5 per cent level. For this variable, the coefficient indicates that turnout decreases by 0.25 points from one election to another. For example, this negative trend costs 2.5 points in 2002 (since the value of the trend in 2002 is 5). The fact that there was a single round for the legislative election and two ballots on the same day in 1986 has increased the turnout by about 10 points for this election. Overall, it seems that climate has an important impact on the turnout at French parliamentary elections. $TEMP_{i,t}$ and $SUN_{i,t}$ have a positive impact on the turnout: a hot and/or a sunny day encourage people to vote. More precisely, when compared with a normal day (in a climatic sense), an increase in temperature of 3°C increases turnout by about one point and an increase of 4 h of sunshine[30] increases turnout by a quarter of a point. The variable $PRE_{i,t}$ has the expected negative sign: the more it rains, the fewer people who vote; 6 mm more precipitation than normal leads to a decrease in the turnout of about 1 point.

Further results

The first point we want to mention in this section concerns a possible threshold effect for our climatic variables. Even if on the graphs above we have detected a linear relation between each climatic variable and the turnout, it may be possible that the relation is nonlinear. What we have shown is that when the climate is bad, people stay at home and abstain and when the weather is fine, they go to polls. But what happens when climatic conditions are exceptionally good? Is it the case that they prefer to go to the beach instead of spending their time going to vote? For example, in the newspaper *Corse Matin* on the 13 March 1989, it was reported that: ‘Flooded by a more-than-vernal sun, voters stayed at home in large numbers and did not go to the polls’. In this case, statistically speaking, the relation between turnout and climate would not be a straight line but a U-shaped curve. To investigate this possibility, we have estimated a nonlinear functional form for each of our climatic variables. We have considered a degree up to two in order to avoid difficulties in the interpretation:[31]

$$y = \alpha + \beta x + \gamma x^2 + \varepsilon$$

where y is the turnout and x a climatic variable. To test if this nonlinear form is better than the linear one, we have performed an F-test (Greene, 1997, 343–344). This test is adequate because in each case, linear or nonlinear, the model can be estimated by OLS. If it is obvious in the linear case, there is little need to say anything about the nonlinear one. The model above can be written:

$$y = \alpha + \beta x + \gamma z + \varepsilon$$

where observations for z are the squares of the observations of x. As Kennedy (1992, 94) pointed out, the equation is nonlinear in variables but linear in parameters. In this case, it can be estimated by OLS.

Table 5 gives the R^2 for each estimated functional form and the Fisher statistics.

Then we accept a nonlinear form for temperatures only. Here is the graph with the curve (Figure 5).

As expected, we have an inversed-U-shaped curve: low temperatures like high temperatures have a depressing effect on turnout. Why is it specific to this variable? For precipitation, according to the linear relation, the more it rains, the fewer the people who vote. There is no place here for a U-shaped curve: it does not make sense to state that heavy rain increases the likelihood that people will go to polls. For sunshine, however, it is trickier. In particular, how

Table 5 Linear form versus nonlinear form

	Precipitations	*Sunshine ratio*	*Temperatures*
R^2 linear form	0.045	0.200	0.153
R^2 nonlinear form	0.045	0.208	0.193
Fisher statistics	0.000	2.141	10.503**

**Significant at 5%.

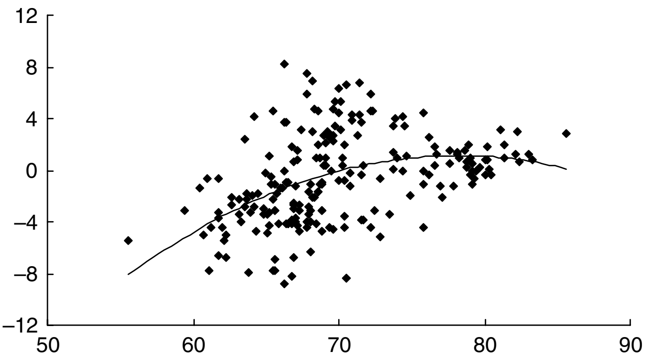

Figure 5 Turnout and temperatures (1986–2002).

do we explain that temperature and sunshine are disconnected? In fact, it is quite straightforward: we can have both cold and sunny weather or both warm and cloudy weather. Thus, sunshine is not a necessary and sufficient condition to go to the beach or to the park; temperature has to be high as well.

The final step with this nonlinear modelling is to estimate the complete model. Table 3 column 8 gives the results.

All the results above are related to estimations on departmental data. We have justified this choice previously by the lack of economic variables at a finer level. Since we removed these variables for multicollinearity problems, we now can estimate our model with district data.

We have identified electoral districts where departmental meteorological stations are located and we have saved the turnout in these electoral districts. In the special case where the departmental meteorological station was in a city composed of several districts, we have summed registered voters on one side and effective voters on another to obtain a global turnout rate.[32] To finish with the description of the dependent variable, just note that the correlation between the turnout at the departmental level and the turnout at the district level is 88 per cent.[33] This high but not perfect correlation can indicate a possible loss of information when we explain the turnout at the departmental level only. It also means that we can expect different results.

Let us turn to the explanatory variables. We keep all our preceding variables except DUM1986 that accounts for specificities of the 1986 ballot. We have already seen two features of this election that may influence the turnout: a single round and two elections on the same day. But this election also gave rise to other institutional changes. First, it was the first time in the Fifth Republic that a legislative election occurred was held under a proportional electoral system and not a majority one. Secondly, and more important for our purpose, voters did not elect one deputy in each district but voted for a departmental list (one list by party). On the basis of the score for each list in each department parties allocated a certain number of seats to the National Assembly. One can consider that for this election, the district was the department as the whole. This last feature led us to remove DUM1986 since this variable made sense at the departmental level only.[34]

The results of the district estimation are shown in Table 3, column 9. At first glance, it is clear that the coefficients' size are comparable to the ones obtained in column 4, except for the trend variable for which the coefficient is much larger in the district estimation than in the department estimation. One can explain this difference by arguing that districts in our sample are mainly localized in big cities (since the meteorological station is the departmental station of reference) and that the negative trend is most dominant in big cities since in rural areas turnout is sticky because of the 'social control'.[35]

All climatic variables are correctly signed and significant at a level of 10 per cent or more. The size of the coefficients indicates that the impact of climatic variable is globally stronger than in the department regression (i.e. coefficients are higher in absolute value for two variables from three). It does not mean that voting behaviour has changed with the level of data but simply that the focus on a smaller territorial unit gives more precise information. It is not surprising since the climate measured in the departmental meteorological station of reference is not necessary the climate in the rest of the department.

The coefficient interpretation is close to what we have done above. Relative to a normal day, a temperature of 5 degrees more than normal increases the turnout by about two points, 4 h more sun[36] increases the turnout by one point, and 7 mm more precipitation leads to a decrease in turnout of about 1 point.

The last point deals with the possible effect of the climate on electoral results via an impact on turnout. In others words, does the climate help one party in France as the rain helps Republicans in the US? This supposes two relations: a relation between climate and turnout that we have now demonstrated and a relation between turnout and vote.

According to Fauvelle-Aymar *et al.* (2000), in France, abstention penalizes left-wing parties.[37] The explanation may lie in the likeness of abstainers and left-wing voters. Indeed, these two groups have several features in common: they are relatively young, they have a weak attachment to Catholicism, their have a relatively low level of edication and so on (see Mossuz-Lavau, 1997). If this link were correct, while having a depressive effect on the abstention, good weather would favour the Left. However, Dubois (2005) tells another story. His data give no support for a link between turnout and the left-wing vote but find a positive relation between turnout and incumbent vote.[38] The theoretical arguments have been presented earlier in this paper. Basically, vote is higher in the case of good macroeconomic performances because some voters that usually abstain go to polls to reward the ruling majority and vote is lower in the case of poor macroeconomic performances because some voters that usually support the incumbent prefer to abstain instead of voting against her.

Table 6 gives the correlations between the turnout and different measures of the vote in our sample.[39]

Turnout seems to help both the Left and the ruling majority (when the moderate right is the incumbent) but, as the column 3 reveals, the correlation between the turnout and the ruling majority vote is spurious. Most of this correlation is due to the correlation between the turnout and the Left's vote. It is worth noting that in our sample the Left is the incumbent in three elections of five (1986, 1993, and 2002).

Table 6 Correlations between turnout and vote

Turnout and left vote	*Turnout and whole right vote*	*Turnout and moderate right vote*	*Turnout and incumbent vote 1*	*Turnout and incumbent vote 2*
0.18***	−0.15**	0.09	0.05	0.31***

***, **, * significant at 1, 5, 10%.
Incumbent vote 1: with whole right vote when right is incumbent.
Incumbent vote 2: with moderate right vote when right is incumbent.

As good meteorological conditions enhance turnout and as turnout and the Left's vote are positively correlated, then one can say that good weather helps the Left.[40]

Conclusion

In the media, it is commonly stated that the climate influences the electoral turnout. In this paper, this proposition has been tested for the last five French parliamentary elections. Data provide support to the hypothesis that climatic conditions influence turnout. Indisputably, rain decreases turnout whereas sunshine and high temperatures encourage it.

As peripheral results, we bring to light some specificities of the 1986 ballot and the trend in turnout is well established.

The main econometric issues have been tackled. Equally, we have tested for heteroskedasticity and multicolinearity making the model reliable.

Moreover, the results seem robust since they hold whatever the level of data, department or district. A threshold effect has been found in temperature: low temperatures like high temperatures enhance abstention. A hot day does not lead to a rush to the polls.

Here, we come across an agenda-setting problem: what is the optimal election date to maximize the turnout? The obvious answer would be to hold an election on a nice day, but this would be the wrong answer. Our climatic variables are defined in relation to the normal standard. In other words, even if the temperature is -2°, then turnout will be higher as long as the normal temperature is -5°. This means it is impossible to set an electoral calendar to maximise turnout unless it is possible to forecast the climate several months in advance.

We have also shown that there exists a positive link between turnout and Left's vote. The main implication is that fine weather favours left-wing parties. In this case, the Right (or Left), when incumbent, would have to choose the election date so that it falls on a worse-than-usual (or better-than-usual) day.

Finally, while there is positive evidence of a link between climate and turnout, there are no normative prescriptions. To make any such recommendations, we would need to be able to control the climate. However, even if we have seen that Nature influences politics, politics does not influence Nature yet.

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Notes

1 *Report on Voting and Registration in the Election of November 2000*, p 10 (*Source*: www.census.gov).
2 *Ibid.*, p 4.
3 *Le Figaro*, 06/17/2002, p 2.
4 This is hardly surprising with people as Benjamin Franklin, inventor of the lightning conductor and writer of the American Declaration of Independence.
5 The Inauguration Day is the day of the President of the United States' investiture.
6 Senator Howard Baker even proposed to organize the next investiture ceremonies on Independence Day (July 4).
7 We do not deal with the case where extreme climatic conditions led to the cancellation of the ballot as it was the case for example in Madagascar for the 1991 general elections.
8 In the light of this relation, it is therefore possible to find a causal foundation to the correlation between precipitation and inflation that Hendry (1980) judges spurious. In this famous paper, the author takes these two variables as examples to show that correlation is not causality.
9 The aim of Merrifield (1993) is not to demonstrate the sole impact of the climate but to explain in detail the turnout. In order to do so, he uses 17 other explanatory variables including institutional variables, socio-demographic variables, etc.
10 This article, originally published in 1927 in *Weatherwise*, is reprinted in the same review in 1988.
11 This has been theorized by Key (1966).
12 Borrowed from Struthers and Young (1989).
13 For a more detailed survey on the costs and benefits of voting, see Aldrich (1993), and more specifically on the cost of going to polls, see Gimpel and Schuknecht (2003).
14 Some authors advanced the idea that the costs are always superior to the benefits, mainly because of the weakness of p (Tullock, 1968). Since, in spite of that, people go still to the polls, there is a paradox known as the 'paradox of voting'.
15 According to Rallings *et al.* (2003), the perception of the cost of voting can be modified by natural factors such as the length of the day. In particular, going to the polls at dusk would have a supplementary psychological cost linked to the fear of the crime. The authors show then that abstention is larger in Winter than in Summer since the night falls earlier.
16 March 16, 1986, June 5, 1988, March 21, 1993, May 25, 1997, and June 9, 2002.
17 This problem of data availability explains why a pooled-data model by district does not yet existed in the French case (for the vote as for the turnout).
18 There were 474 electoral districts before 1986 and 555 after.

19 Since the climatic standard for precipitation is the total precipitation that falls during the month, we have divided this total by the number of days in the month (31 if the elections hold in March, etc).

20 This problem can be solved by studying the intraday data and not daily data. But, if such data may exist for the climate, they are not available for the turnout.

21 For an econometric study that assesses the impact of these variables on turnout in the French case, see Fauvelle-Aymar and François (2005). Unfortunately, socio-demographic variables are not available on a yearly basis. Since data exist only for census years (that is, in our sample, 1990 and 1999), we have not taken these variables into account. One may also think of other short-term variables such as holidays for example. When the ballot takes place during holidays, the turnout may be lower since a lot of voters are not at home. We cannot test this proposition here since the election dates are always outside standard holiday time in our sample.

22 Using the fixed effect model is equivalent to introducing one dummy variable for each department. This departmental dummy is defined as 1 in a particular department for all the elections and 0 otherwise.

23 The following departments do not have a reference meteorological station: 50, 53, 55, 92, 93, 94. For practical reasons, here and hereafter, we indicate only the number of departments. The full list is displayed in Appendix A (Table A1).

24 The three climatic standards are not available for the following departments: 07, 08, 10, 15, 19, 22, 23, 24, 27, 32, 39, 41, 43, 48, 49, 50, 53, 74, 79, 81, 82, 85, 88 (no temperatures and/or precipitations) and 04, 09, 11, 14, 16, 17, 2B, 28, 37, 38, 42, 52, 56, 58, 62, 64, 65, 68, 70, 73, 75, 77, 84, 90, 91, 95 (no sunshine ratio).

25 See Table A2 in the Appendix A for the list of these 43 departments.

26 We just note that climatic variables are expressed in relation to the climatic standard. The source for the climatic standards is ministère des Transports, Direction de la météorologie (1983). The sources for the other variables are: ministère de l'Intérieur for the turnout, INSEE for the unemployment rates, and the website http://climatheque.meteo.fr for the climatic variables.

27 The straight line represents the equation that regresses the climatic variable on turnout.

28 Intercepts values (fixed effects) are shown in the Appendix A (Table A2). We have systematically applied the White correction to make all our estimations robust to heteroskedasticity.

29 The case with UNEM3 will be developed later.

30 On a 16 h day. This is equal to 25 points more in the sunshine ratio.

31 Indeed, if a U-shaped curve (that is an order 2 polynomial function) makes sense, what about polynomials of degree 3, 4…?

32 The departmental meteorological stations of the following departments are concerned: 6, 25, 34, 45, 63, 66, 72, and 83.

33 The descriptive data for our new dependent variable are as follow: minimum = 53.24; maximum = 85.28; mean = 69.26; median = 68.39; standard deviation = 6.35.

34 It is noteworthy that turnout figures were available at the departmental level only and data were then worked on again to obtain figures at the district level. This is why we have these data at the district level despite the fact that the election was at the departmental one. Instead, by using these data, we should have removed the 1986 election from our sample. We have preferred to take an explanatory variable off rather than observations to keep a high number of degrees of freedom.

35 In rural areas, social monitoring is quite strict due to the relative value of each vote and forces people to vote.

36 Note 30 applies.

37 Fauvelle-Aymar et al. (2000) estimate a pooled-data model with a sample of 15 elections in the period 1981–1998. They use regional data and the dependent variable is the Left vote at the cantonal, regional, legislative, and presidential elections.
38 The dependent variable is the vote at the national level for the 12 legislative elections of the Fifth Republic.
39 The source of data for the vote is the ministère de l'Intérieur. Results by party have been aggregated by the authors to obtain left, moderate right, and whole right vote. Note that left and whole right scores do not sum to 100 per cent because of miscellaneous parties that do not belong to the left nor to the right (regionalists…). Turnout figures are district ones. The same results are found with departmental data (available upon request).
40 Here, we have just correlations and not a complete model that explains the legislative vote (for such a model, see Auberger and Dubois, 2005). So, we cannot assess precisely the impact of turnout on vote.

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Appendix A

The full list of 96 metropolitan French departments is displayed in Table A1. Intercept values (fixed effects) are shown in Table A2.

Table A1 The 96 metropolitan French departments and their number

No.	*Department*	*No.*	*Department*	*No.*	*Department*
1	Ain	32	Gers	64	Pyrénées-Atlantiques
2	Aisne	33	Gironde	65	Hautes-Pyrénées
3	Allier	34	Hérault	66	Pyrénées-Orientales
4	Alpes-de-Haute-Provence	35	Ille-et-Vilaine	67	Bas-Rhin
5	Hautes-Alpes	36	Indre	68	Haut-Rhin
6	Alpes-Maritimes	37	Indre-et-Loire	69	Rhône
7	Ardèche	38	Isère	70	Haute-Saône
8	Ardennes	39	Jura	71	Saône-et-Loire
9	Ariège	40	Landes	72	Sarthe
10	Aube	41	Loir-et-Cher	73	Savoie
11	Aude	42	Loire	74	Haute-Savoie
12	Aveyron	43	Haute-Loire	75	Paris
13	Bouches-du-Rhône	44	Loire-Atlantique	76	Seine-Maritime
14	Calvados	45	Loiret	77	Seine-et-Marne
15	Cantal	46	Lot	78	Yvelines
16	Charente	47	Lot-et-Garonne	79	Deux-Sèvres
17	Charente-Maritime	48	Lozère	80	Somme
18	Cher	49	Maine-et-Loire	81	Tarn
19	Corrèze	50	Manche	82	Tarn-et-Garonne
2A	Corse-du-Sud	51	Marne	83	Var
2B	Haute-Corse	52	Haute-Marne	84	Vaucluse

Table A1 Continued

No.	*Department*	*No.*	*Department*	*No.*	*Department*
21	Côte-d'or	53	Mayenne	85	Vendée
22	Côtes-d'Armor	54	Meurthe-et-Moselle	86	Vienne
23	Creuse	55	Meuse	87	Haute-Vienne
24	Dordogne	56	Morbihan	88	Vosges
25	Doubs	57	Moselle	89	Yonne
26	Drôme	58	Nièvre	90	Territoire de Belfort
27	Eure	59	Nord	91	Essonne
28	Eure-et-Loir	60	Oise	92	Hauts-de-Seine
29	Finistère	61	Orne	93	Seine-Saint-Denis
30	Gard	62	Pas-de-Calais	94	Val-de-Marne
31	Haute-Garonne	63	Puy-de-Dôme	95	Val-d'Oise

Table A2 Intercept values for estimations Table 3

Department	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
1	64.74	64.76	64.85	64.26	65.06	65.30	65.73	64.47	71.22
2	69.92	69.92	69.99	69.24	70.03	70.17	70.16	69.81	77.67
3	69.37	69.41	69.58	69.00	69.46	69.92	70.10	69.23	74.36
5	70.11	70.10	70.22	69.53	69.76	70.19	70.60	70.02	75.72
6	66.47	66.49	66.58	65.94	66.10	65.84	66.20	66.34	69.83
12	74.09	74.13	74.26	73.82	74.12	74.25	74.95	73.93	83.26
13	66.78	66.78	66.82	65.91	66.87	66.22	66.42	66.60	76.03
18	68.61	68.61	68.67	67.88	68.68	68.52	68.64	68.52	75.60
2A	65.03	65.12	65.26	64.66	65.17	64.87	65.06	64.97	70.96
21	67.37	67.43	67.54	66.91	67.37	67.63	67.9	67.28	72.47
25	69.44	69.46	69.48	68.82	69.55	69.91	70.10	69.28	75.84
26	68.66	68.68	68.76	67.89	68.66	68.27	69.08	68.45	77.34
29	70.27	70.31	70.45	69.87	70.11	70.57	70.42	70.18	77.62
30	69.45	69.48	69.59	68.85	69.36	69.21	69.68	69.26	73.52
31	70.78	70.82	70.91	70.23	70.72	70.78	71.24	70.67	80.02
33	69.28	69.31	69.43	68.83	69.35	69.57	69.98	69.17	76.81
34	69.31	69.32	69.43	68.75	69.22	69.26	69.76	69.18	76.29
35	68.89	68.90	68.96	68.34	68.99	68.92	69.12	68.70	69.81
36	70.27	70.30	70.41	69.8	70.30	70.88	71.06	70.14	75.63
40	74.45	74.44	74.49	73.66	74.37	74.06	74.32	74.25	80.12
44	68.74	68.76	68.81	67.99	68.70	68.42	68.48	68.52	75.07
45	69.67	69.69	69.78	69.15	69.85	70.11	70.22	69.50	75.80
46	75.84	75.87	75.97	75.39	75.55	76.14	76.39	75.74	81.69
47	72.44	72.50	72.63	71.97	72.12	72.63	72.73	72.41	78.73
51	65.03	65.06	65.11	64.44	65.28	65.32	65.23	64.94	69.76
54	64.58	64.58	64.60	63.88	64.83	64.40	64.67	64.39	75.01
57	63.72	63.73	63.76	62.97	63.95	63.66	63.72	63.57	69.97
59	67.88	67.87	67.92	67.20	68.29	68.57	68.29	67.70	74.04

Table A2 Continued

Department	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
60	69.70	69.69	69.76	69.02	69.55	69.92	69.71	69.58	79.84
61	69.68	69.70	69.83	69.09	69.84	69.93	69.99	69.61	75.27
63	69.68	69.73	69.86	69.31	69.73	70.27	70.53	69.54	75.60
66	68.76	68.78	68.89	68.14	68.46	68.41	68.74	68.60	75.41
67	65.57	65.61	65.68	64.95	65.50	65.63	65.52	65.47	70.88
69	66.12	66.16	66.25	65.59	66.17	66.58	66.97	65.96	68.49
71	67.26	67.25	67.34	66.65	67.06	67.45	67.54	67.11	71.94
72	68.07	68.12	68.24	67.68	68.18	68.41	68.73	67.99	74.52
76	68.71	68.73	68.84	68.16	68.39	69.12	68.81	68.63	74.85
78	68.15	68.15	68.20	67.58	68.16	68.67	68.57	68.02	70.98
80	72.76	72.76	72.86	72.11	72.72	73.20	72.87	72.68	80.00
83	67.58	67.60	67.65	66.83	67.63	66.85	67.11	67.44	71.40
86	69.97	70.00	70.13	69.54	70.08	70.00	70.42	69.88	76.71
87	73.10	73.14	73.27	72.63	73.27	73.44	73.81	72.98	82.33
89	67.61	67.63	67.73	67.22	67.74	68.34	68.29	67.44	73.06