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Distance and Voting: Evidence from Danish Municipalities

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Living far from the assigned polling station possibly renders voting less convenient than if the polls are right around the corner. Using a cross-sectional dataset of about 2.3 million potential voters, including the distances between each household and the assigned polling station, a substantial impact of distance on the propensity to vote is found. An individual living five kilometers from the polling station has a ten percentage-point lower propensity to turnout than an individual living right next to it. The relationship between distance and turnout is found to be approximately logarithmic. Additionally, the impact of distance appears to be conditional on the availability of cars in the household. The policy implications of the results are discussed in the concluding section.

Introduction

Voting is one of the most fundamental ways individuals participate in modern democracies and is therefore one of the most studied subjects in political science. A particularly important question is what motivates individuals to participate or what leads them to abstain (Gimpel & Schuknecht 2003). If we can identify the drivers and barriers behind the vote, we might be able to arrange elections in a manner facilitating increased turnout[1] – especially if administrative decisions have a bearing on the motivating factors. In this study, I use a large cross-sectional dataset to examine possible differences in turnout propensities caused by a seemingly innocuous administrative decision: polling station placement. More specifically, I estimate the effect of the distance from the home to the assigned polling station (Haspel & Knotts 2005, 560).

In a Downsian perspective, individuals decide whether or not to turn out based on their individual costs and benefits of voting (Downs 1957; Riker & Ordeshook 1968). One cost could be the distance between the home and the polling station. The longer an individual must travel to vote, the higher the

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opportunity costs of voting (Dyck & Gimpel 2005, 532). This could potentially lead individuals with long commutes to the polling station to abstain disproportionately. If distance indeed is an obstacle against voting, the variation in individuals' distance to the polls is a strong normative concern from the perspective of equal opportunity of participation. Besides being theoretically and normatively interesting, studying the impact of distance on turnout is particularly important in a practical perspective because it can easily be influenced by administrative decisions (Haspel & Knotts 2005, 560). Though there is extensive evidence in the turnout literature that socioeconomic status influences turnout (e.g., Verba & Nie 1972; Wolfinger & Rosenstone 1980), individual resources or status are difficult to engineer without transforming society fundamentally. Additional polling stations can be established or existing stations can be dropped at relatively low costs. If distance indeed matters, there is reason to reconsider the recent trends towards centralizing voting in fewer locations in countries like Denmark, the Netherlands and United States (e.g., Allers & Kooreman 2009, 162; McNulty et al. 2009; Folketinget 2010).

Despite its potential importance and practical implications, the empirical literature on the influence of distance on voting is relatively new. With the growing interest in political geography and easier access to geographical information system (GIS) applications, a handful of intriguing studies have produced empirical evidence supporting the theoretically compelling relationship between distance and turnout (Gimpel & Schuknecht 2003; Dyck & Gimpel 2005; Brady & McNulty 2011; Haspel & Knotts 2005; McNulty et al. 2009). However, the empirical literature has almost exclusively been conducted in the American context. (The author of this article is unaware of any Scandinavian or even European individual-level studies focusing on the distance between the home and polling station.[2])

In this study, I investigate the distance-turnout relationship in the Scandinavian context; more specifically, in the Danish municipal setting. I pay special attention to the functional form of the relationship and whether it is conditional on access to an automobile in the household. As well as the general need to study the relationships in different contexts, the Danish case is interesting since turnout is higher even in municipal elections than in national elections in the United States. If voter engagement is high, individuals may feel less disincentivized to vote by long commutes (Orford et al. 2009). Conversely, there is very little tradition for using early voting in Denmark, which possibly imposes a greater burden on those living far from the nearest polling station compared to other countries. As for data, Statistics Denmark provides researchers access to household-level information regarding distance, and individual-level administrative data is available for independent variables which provide more reliable controls than is possible in most other contexts. There is also a more practical reason for studying

Denmark. Since 2005, some 300 of the 1,855 polling stations have been closed (Folketinget 2010). Thus, it is important to know whether the distance to polling stations matters in order to evaluate the potential negative impact of polling station consolidation on turnout.

Before I proceed an important caveat should be mentioned. Though in many respects unique, the dataset used in the present investigation is cross-sectional and thereby vulnerable to unobserved unit heterogeneity. This should lead to – which I will return to later – some caution in my conclusions.

The article proceeds as follows. In the next section, I discuss theory and the previous empirical literature on the distance-turnout relationship. Then, the Danish context is presented together with the data used in the study. The empirical analysis is divided into two parts. First, and most importantly, the overall effect of distance on turnout is investigated. The multivariate effect is found to be negative with an approximately logarithmic functional form. Second, I examine the conditional effect of distance, depending on access to a car in the household. A strong interaction effect is found. For individuals with access to cars, distance is less of an impediment than for those who must settle for alternative modes of transportation. In the concluding section, the policy implications of the study are discussed.

Distance and Turnout: Theory and Empirical Literature

The most debated perspective on voter turnout is possibly the calculus of voting perspective (Downs 1957; Riker & Ordeshook 1968). The basic logic here is that the individual's choice to vote or not is a rational, calculated decision based on the perceived benefit of the preferred outcome (B), the probability of becoming the pivotal voter (P) and the various costs associated with voting (C). The utility (U) of voting is then given by $U = B \times P - C$ (an additional term, D, for civic duty is often added to the right-hand side). Strictly interpreted, the individual will vote if his or her net utility from doing so is positive, otherwise not. While the calculus of voting perspective has been widely criticized for failing to explain the overall high levels of voting, it has been highly successful in explaining behaviour at the margins (Aldrich 1993; Blais et al. 2000) – in other words, if the components of B, P or C change, turnout is also found to change.

The cost of voting involves gathering information about the political candidates, the time required to vote, the amount spent on traveling to the polling station and so on. The distance to the polling station is interesting as it clearly influences how convenient it is to vote. For most individuals, traveling great distances is simply not very pleasant. Voting takes time and

places an economic burden on the individual in terms of bus fare, gas and so on (Gimpel & Schuknecht 2003, 474; Dyck & Gimpel 2005, 532). This may discourage some individuals with long commutes to the polling station from voting.

While the distance from the voter's home to the polling station influences the costs of voting, there are also reasonable grounds to believe that this has no noteworthy effect on turnout. Niemi (1976) argues that the inconvenience of voting is often overstated in the literature, but also that costs can still influence turnout at the margins (see also Haspel & Knotts 2005, 561). The case could be made that even large distances are simply not enough to discourage even poorly motivated individuals from voting. How much individuals perceive the opportunity costs to be relative to the benefits they receive from voting is essentially an empirical question.

Empirical studies usually find the distance between the home and polling station to matter.[3] Gimpel and Schuknecht (2003) find a curvilinear relationship between the distances from the centre of the precinct to the actual location of the district polling site with an effect of up to half a percentage point per mile. The distance factor seems to be most burdensome for the middle ranges of distance (2–5 miles). In a later study based on individual-level data from Clark County in Nevada, Dyck and Gimpel (2005) arrive at similar conclusions. Distance decreases turnout for commutes up to about ten miles, where the relationship reverses (effects are 1.4 percentage points for a two-mile change from zero distance, whereas they are 3.6 percentage points for a six-mile change). However, as almost all individuals live within ten miles of the voting site, the impact of greater distances is negative for most citizens. Looking at polling station consolidations, McNulty et al. (2009) find a strong negative, linear impact of changes in distances to the polling stations on turnout. Increasing the distance from the home by 3.5 miles roughly corresponds to a 7 percentage point decrease in turnout. In a recent study, Brady and McNulty (2011) find that changes in distance have a limited impact – and only in a small interval (from around a –0.40 mile change to a +0.40 mile change).

The effect of distance on turnout needs not be identical for all types of individuals. Having a car possibly reduces the inconvenience of traveling long distances. Haspel and Knotts (2005) consider this possibly moderating influence by including an interaction between having a vehicle in the household and the distance to the polling station. They find a negative, logarithmic main effect and a positive interaction effect. The propensity of voting decreases about 25 percentage points from 0.01 miles to 0.69 miles distance (the median distance in the study) to the polling station when no car is available. For households owning a car, the corresponding effect is only about 5 percentage points. In other words, the commute to the polling station is substantially less burdensome for automobile owners.

In sum, existing empirical evidence from the American context strongly suggests that the distance to the polling station matters at the margins. The magnitude of the effects differs substantially in the respective studies (Brady & McNulty (2011) in particular find comparatively very low effects), as does the functional form of the relationship to a certain extent (although most of the studies find some decline in the effect as distances become larger). One study examines the influence of cars and finds a strong moderating effect. Somewhat surprisingly, the moderation seems strongest for those with short distances to the polls.

The Danish Municipalities and the Data

The data for this study is from 44 of the 98 municipalities from the 2009 Danish municipal elections (see Elklit et al. (2000) for a similar study).[4] Local elections in Denmark are substantively important. Municipalities play a key role in the Danish government system. The municipal councils have considerable influence on the delivery of core welfare services (Mouritzen 2003). Furthermore, the municipalities can tax their citizens directly, although in practice this is under some restrictions from the national government. While the turnout for municipal elections is less than in connection with national parliamentary elections (roughly 85 percent), they are high saliency elections with a usual turnout rate of about 70 percent. The turnout in the 2009 election was 65.8 percent, which was somewhat lower than usual.

Danish voters are automatically registered and receive their polling cards in the mail. Early voting at municipal elections is possible until two working days prior to the election, typically only at a few locations in each municipality. Early voting, directly translated as postal voting, is not very common (about 5 percent of the ballots cast). The use of postal voting is slightly greater in the capital area than in the rural parts of the country. With the low usage and geographical patterns in mind, it is probably fair to say that unlike in several states in the United States (e.g., Dyck & Gimpel 2005), early voting is rarely used as a substitute for voting on Election Day at the assigned polling station.[5] The individuals in our data (from 44 municipalities) were administratively divided into 726 districts, each with one polling station. The average number of eligible citizens per polling station was 3,189.

In Denmark, the voter lists are administered by the municipalities after the elections. All 98 municipalities were offered to participate in the study and half of them accepted. After the election, the voter lists in the participating municipalities were computerized and, via an individual identification number, merged with individual-level administrative data on socio-demographics from Statistics Denmark, the official statistics bureau.[6]

I have access to data for almost all of the potential voters in the municipalities participating in the study, and there was no self-selection involved at the individual level.[7] All the socio-demographic variables are based on government information on each individual. In addition to the socio-demographic data, the dataset includes the distance from each household to the assigned polling station as well as the distance in kilometers between the household and city hall. The latter variable is included as a rough indicator of urbanization (a factor also partly taken into account through the fixed effects). The dataset is cross-sectional, and although panel data clearly would be preferable in order to obtain a strong control for unit heterogeneity, the administrative data provides good quality controls.

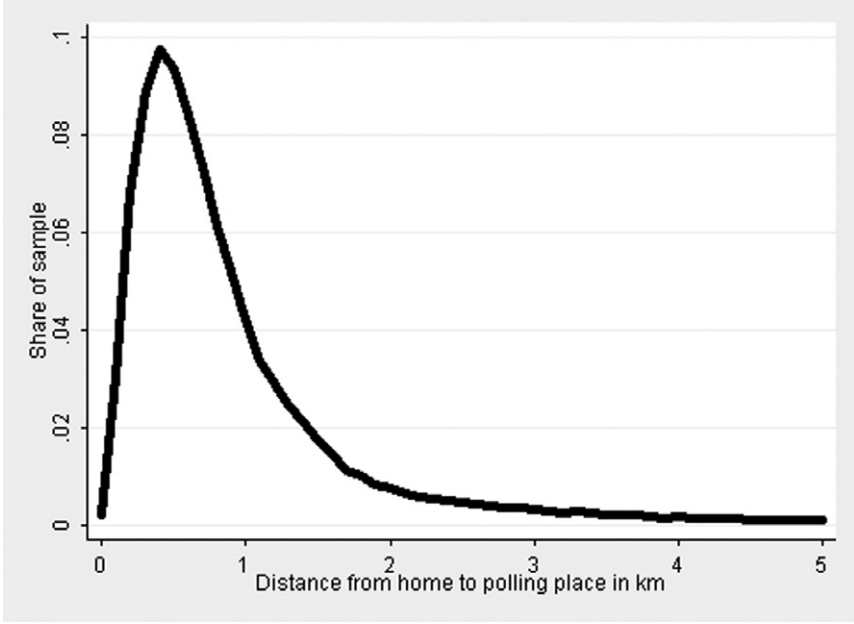
The distances from the homes to the assigned polling stations were calculated prior to merging the various administrative databases since a direct merge of the household geographical location with the administrative data would be problematic in terms of respondent anonymity. The distances were calculated using the longitude and latitude of the individual households and polling stations using straight-line reckoning. The estimates are obtained simply by adding the difference between the longitudes squared and the difference between the latitudes squared and then taking the square root of that sum. The method does not take into account the curvature of the earth, which is defensible over short distances. Additionally, in a previous study, straight-line reckoning has been found to produce almost identical results to measures of road distance (McNulty et al. 2009).

The average distance for individuals from their homes to the polling station is 1.5 km, the minimum is 0.0 km, and the maximum 39.7 km. The distribution is strongly right-skewed, and the median distance is only 0.7 km. Figure 1 presents a more detailed distribution of voters in 0.1 km distance increments. For the sake of presentation, the figure focuses on the 95 percent of the sample with distances of 5 km or less.

Results

In the first part of the analysis, I focus on the relationship between distance and turnout and its functional form. In the second part, I consider the conditional effect of having a car on the distance-turnout relationship. In addition to the main variables of interest, all of the main models include indicators for a range of individual-level controls commonly used in the turnout literature which can be expected to influence both residence (distance) and turnout. More specifically, I control for age and age-squared, gender, education (completed and ongoing), income, whether the individual is employed, civil status, whether the individual lives with someone or in a

Figure 1. Distribution of Distances in 0.1 km Intervals from Household to Polling Station.



Notes: Distances in the figure are rounded to the nearest 0.1 km. Only distances which round down to 5 km or less are included (95 percent of the samples). The 51 observations (encompassing 2,208,923 individuals) in the figure are represented by a straight line.

single person household, the number of children in the household, ethnicity, citizenship and residential stability (for more detailed work on the individual variables, see, e.g., Wolfinger & Rosenstone 1980; Togeby 1999; Highton 2000; Denver 2008; Wolfinger & Wolfinger 2008; Sondheimer & Green 2010).

Ideally, I would like to include an indicator of urbanization since this factor is likely to be strongly correlated with distance to the polling station and could also potentially affect turnout. No direct measure of this factor is available at the household level. However, I include two alternatives. First, in addition to the standard variables, I include an indicator for the distance between the home and city hall. This provides a rough control for urbanization and whether the individual lives in the centre or periphery. Second, I include district fixed effects to take unobserved district-specific characteristics (such as urbanization) into account that could possibly be correlated with turnout and the distance to the polling station. Descriptive statistics can be found in Appendix Table 1.

The Relationship between Distance and Turnout

The bivariate relationship between distance and turnout is positive – for those having less than average distance to the polls (1.5 km) the turnout rate is 63.6 percent compared to 67.6 for those with more than average distance to the polls. This should be no surprise since it is well known that turnout is extraordinarily low in the metropolitan area around Copenhagen (mainly due to its socioeconomic composition), where the distances to the polling stations are also short. What happens when the relationship is analyzed in appropriate specified models? Table 1 presents the results from two regressions with individual-level turnout as the dependent variable and linear distance from the household to the polling station as the main independent variable.

In the first model (model 1) in Table 1 district fixed effects are included. When the average differences between districts are taken into account, the hypothesized negative relationship appears. In model 2 I also include a range of individual-level control variables, as described above. This even further increases the magnitude of the negative impact of distance on turnout. Voting becomes more inconvenient as the distance to the polling station increases, meaning that individuals become less likely to vote. The negative relationship is very robust across specifications. In general, there is a tendency for a slightly weaker relationship if relevant variables are excluded – that is, the greatest effects can be found in the theoretically best specified models.

The effects of the control variables are as expected from the existing literature. Women tend to vote more frequently than men, and the relationship between turnout and age is curvilinear (Fieldhouse et al. 2007, 803). Highly educated individuals vote substantially more than those with shorter educations (Sondheimer & Green 2010). Being employed, married and living with someone also influence voting positively (Wolfinger & Rosenstone 1980), as these variables are indicators for social networks and integration into society. Being an ethnic minority has a negative impact on the propensity of voting (Verba & Nie 1972, 161; Togeby 1999), while having two or more children affects turnout positively, possibly because parents are in frequent contact with municipal services.[8] Finally, residential stability seems to matter. This may be because of the positive influence of community ties (Highton 2000).

An interesting question concerns the functional form of the distance-turnout relationship. In the models in Table 1, a linear (note the models are based on logistic regressions, so 'linear' does not imply a perfect linear relationship between distance and the probability of voting) relationship was assumed, but this is not necessarily the correct form. As discussed in the theory section, most existing studies find some kind of decay of the effect as

Table 1. Logistic Regressions using Distance to Predict Individual-level Turnout

	Model 1		Model 2	
	Logistic coefficient	Change in percentage points	Logistic coefficient	Change in percentage points
Distance between home and polling station (km)	–0.042*** (0.0016)	–1.0	–0.080*** (0.0022)	–1.6
Distance between home and city hall (km)	–	–	–0.0069*** (0.0020)	–0.1
Sex (male)	–	–	–0.072*** (0.0026)	–1.5
Age in 1,000 days	–	–	0.15*** (0.0012)	–
Age in 1,000 days^2	–	–	–0.0037*** (0.000050)	–
Education, completed (base = primary school):				
High school	–	–	0.67*** (0.0068)	12.0
Technical education	–	–	0.33*** (0.0042)	6.6
Higher education (4 years or less)	–	–	0.91*** (0.0053)	16.4
Higher education (5 years or more)	–	–	1.18*** (0.0076)	18.7
Income (100,000 DKK)	–	–	0.0021*** (0.00061)	0.0
Employed	–	–	0.23*** (0.0042)	4.9
Married	–	–	0.34*** (0.0050)	6.9
Living with someone	–	–	0.43*** (0.0047)	9.1
Number of children in household (base = 0):				
1 child	–	–	–0.0063 (0.0057)	–0.1
2 children	–	–	0.068*** (0.0060)	1.4
3 or more children	–	–	0.12*** (0.0089)	2.4
Non-Danish, Western ethnicity	–	–	–0.42*** (0.017)	–9.2
Non-Danish, non-Western ethnicity	–	–	–0.95*** (0.0098)	–22.1
Non-Danish, Western citizen	–	–	–0.69*** (0.019)	–15.9
Non-Danish, non-Western citizen	–	–	–0.30*** (0.013)	–6.5
Residential stability (in 1,000 days at current address)	–	–	0.028*** (0.00054)	0.6
Municipal stability (in 1,000 days in municipality)	–	–	0.015*** (0.00044)	0.3
Constant	0.49*** (0.017)	–	–1.63*** (0.024)	–
N	2,323,508		2,218,074	
McFadden's pseudo-R-squared	0.023		0.116	
Log likelihood	–1,479,180		–1,258,029	
Chi2	68,511		203,842	

Notes: Five dummies for levels of ongoing education are included in model 2, but not in model 1; and 725 district dummies are included in both models. Standard errors in parentheses are clustered by household to take into account the fact that distances are household-specific. The effect sizes in columns 2 and 4 are calculated by SPost for Stata and depict the percentage-point change from a change from the value 0 to value 1 on dummy variables. For continuous variables, the value depicts the corresponding effect from changing the variable in question a half unit below to a half unit above the mean with other variables held at their mean (age^2 is held at the mean of age, squared). The municipal dummies and ongoing education dummies are omitted due to space considerations. *** $p < 0.001$.

distances become greater. Travelling 1 km extra may simply matter more for those who were to otherwise only travel 100 metres as compared to those who were to travel a distance of 10 km (Gimpel & Schuknecht 2003, 477).

In Table 2, I experiment with a logarithmic functional form along with a more flexible series of dummies. For the sake of presentation, only the main independent variables are shown – the remaining variables are the same as in Table 1, model 2. The first column merely repeats model 2 in order to better be able to compare the models. Model 3 uses a logarithmic functional form. It appears that the logarithmic functional form performs better than the linear form.[9] This makes sense in the light of several of the American studies on the subject, which find some decay in the effect for longer distances. To allow for additional flexibility, model 4 shows the results from a model with 16 distance dummies variables. The dummies give an approximate logarithmic result.

The effect size is substantively large. The maximum effect compared to zero distance is a drop in the probability of 9.8 percentage points which occurs at about a distance of 5 km to the home. The relationship between distance and turnout is clearly strongest for low distances and then declines as the distance becomes greater. About half of the eventual 10 percentage point difference is already in place at 1–1.2 km. In other words, an individual living 1–1.2 km from the polling station has a 4.9 percentage point lower probability of voting than a person living next to it. The relationship is clearly in the longer part of the range compared to previous studies. The effect at 5 km is somewhat similar to the 7 percentage points found by McNulty et al. (2009) for a 3.5 mile change. Haspel and Knotts (2005) also find effects of similar magnitude.

A Heterogeneous Effect: The Interaction between Car and Distance

While the analysis strongly indicates that distance matters substantially for the propensity to turnout, it need not matter equally for all individuals. If the effect is a consequence of the inconvenience (or cost) of travelling long distances an obvious factor to consider is whether there is an automobile avaliable in the household. Cars can reduce the time required to travel a given distance and may be more comfortable and flexible than other modes of transportation. Like Haspel and Knotts (2005), I expect that the mediating effect of cars is particularly strong for longer distances (although they eventually find the opposite tendency). For short distances, it might simply be just as convenient to walk or take a bicycle (a common alternative in Danish cities and towns) due to the hassle of having to find parking and so on.

The dataset contains information from Danish motor vehicle registration. More specifically, it is possible to identify whether each household owns a

Table 2. Logistic Regressions using Various Functional Forms of Distance to Predict Individual-level Turnout

	Model 2	Model 3	Model 4	
	Logistic coefficient	Logistic coefficient	Logistic coefficient	Change in percentage points
Distance between home and polling station (km)	–0.080*** (0.0022)	–	–	–
Log distance between home and polling station (log km)	–	–0.13*** (0.0028)	–	–
Distance between home and polling station (base = 0.0–0.2 km):				
0.2–0.4 km	–	–	–0.079*** (0.0086)	–1.5
0.4–0.6 km	–	–	–0.16*** (0.0087)	–3.1
0.6–0.8 km	–	–	–0.20*** (0.0091)	–3.9
0.8–1.0 km	–	–	–0.23*** (0.0098)	–4.4
1.0–1.2 km	–	–	–0.25*** (0.011)	–4.9
1.2–1.4 km	–	–	–0.28*** (0.012)	–5.5
1.4–1.6 km	–	–	–0.31*** (0.013)	–6.2
1.6–1.8 km	–	–	–0.30*** (0.015)	–6.0
1.8–2.0 km	–	–	–0.32*** (0.017)	–6.5
2.0–2.5 km	–	–	–0.36*** (0.014)	–6.2
2.5–3.0 km	–	–	–0.41*** (0.017)	–8.3
3.0–3.5 km	–	–	–0.41*** (0.019)	–8.3
3.5–4.0 km	–	–	–0.43*** (0.022)	–8.8
4.0–4.5 km	–	–	–0.46*** (0.025)	–9.5
4.5–5.0 km	–	–	–0.47*** (0.028)	–9.8
5.0+ km	–	–	–0.47*** (0.019)	–9.8
N	2,218,074	2,217,796	2,218,074	
McFadden	0.116	0.116	0.116	
Log likelihood	–1,258,029	–1,257,245	–1,257,446	
Chi^2	203,842	204,429	204,415	

Notes: All control variables from model 2 and constants are included. The coefficients in columns 1–3 are unstandardized logistic coefficients. Standard errors in parentheses are clustered by household. The percentage-point change for model 4 is calculated as described in the notes to Table 1.
*** $p < 0.001$.

car (all vehicles other than personal automobiles are excluded). It should be noted that this register is only updated until January 2008. While newer data would be preferable, an automobile is a durable good and the availability of cars should therefore not change dramatically over the course of $1^1/_2$ years. In Table 3, I interact the distance dummies from model 4 with the indicator for car ownership in the household.[10] The left column shows the main effects, the right column shows the corresponding interaction effects (the dummy in question multiplied by access to an automobile). The dummy variable specification is used to allow for flexibility in the mediating effect of cars. In addition to the distance-car interactions, the model includes interactions between distance and indicators of societal integration and

Table 3. Logistic Regressions using Distance – including Interactions – to Predict Individual-level Turnout

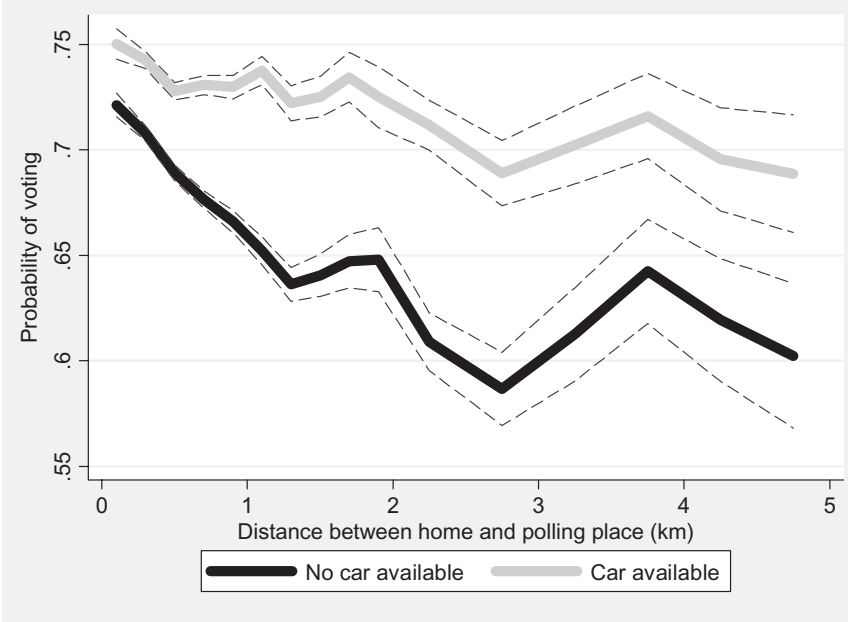
	Model 5	
	Main effect	Interaction effect
Distance between home and polling station (base = 0.0–0.2 km):		
0.2–0.4 km (*car)	–0.066*** (0.016)	0.026 (0.019)
0.4–0.6 km (*car)	–0.16*** (0.016)	0.040* (0.019)
0.6–0.8 km (*car)	–0.21*** (0.017)	0.11*** (0.020)
0.8–1.0 km (*car)	–0.26*** (0.018)	0.15*** (0.021)
1.0–1.2 km (*car)	–0.32*** (0.020)	0.26*** (0.024)
1.2–1.4 km (*car)	–0.39*** (0.022)	0.25*** (0.026)
1.4–1.6 km (*car)	–0.37*** (0.026)	0.24*** (0.030)
1.6–1.8 km (*car)	–0.34*** (0.032)	0.26*** (0.035)
1.8–2.0 km (*car)	–0.34*** (0.037)	0.21*** (0.040)
2.0–2.5 km (*car)	–0.51*** (0.033)	0.31*** (0.034)
2.5–3.0 km (*car)	–0.60*** (0.039)	0.30*** (0.041)
3.0–3.5 km (*car)	–0.49*** (0.050)	0.25*** (0.048)
3.5–4.0 km (*car)	–0.37*** (0.057)	0.19*** (0.056)
4.0–4.5 km (*car)	–0.46*** (0.065)	0.19** (0.067)
4.5–5.0 km (*car)	–0.54*** (0.075)	0.23** (0.075)
5.0– km (*car)	–0.53*** (0.030)	0.26*** (0.028)
Car	0.15*** (0.017)	–
N	2,218,074	
McFadden	0.118	
Log likelihood	1,254,400	
Chi^2	200,277	

Notes: All control variables from model 2 are included; as are 64 interactions between the distance dummies and the variables Employed, Living with Someone, Married and Income. The coefficients are unstandardized logistic coefficients. Standard errors in parentheses are clustered by household. The interactions not shown between Distance and Employed are all negative and significant at the 0.05 level. The interactions between Distance and Living with Someone and Income are close to zero. The interactions between Distance and Married have a positive tendency. The main trend of the results is similar if the 64 interactions are excluded from the model. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

socioeconomic status (not shown) to take into account the possibility that the effect of distance is conditional on these factors which at the same time could be strongly related to owning a car. More specifically, interactions are included between distance and being employed, living with someone, being married and income.

The main effects in model 5 are negative and the interaction is positive – but smaller than the main effects – just as expected. This would seem to indicate a negative relationship between distance and turnout for all individuals, but the effect is somewhat weaker for individuals with access to a car. However, one must be slightly careful about interpreting interaction terms in logit models directly from the coefficients. Figure 2 illustrates the relationship graphically. The top line shows the distance-turnout relationship for automobile owners, while the lower line depicts the same relationship for all other individuals (in both cases, all other variables are held constant at their means).

Figure 2. Predicted Probability of Voting (with Confidence Intervals) by Availability of Cars.



Notes: The figure is based on the regression from model 5. Points are defined as the middle of the dummy intervals (0.0–0.2 is given the value '0.1', 0.2–0.4 km is given the value '0.3' and so on). Points are connected by straight lines. Distances of more than 5 km are omitted for the sake of presentation. The thick lines are the predicted probabilities when all other variables are held at their means (age^2 held at age-squared). 95 percent confidence intervals are shown as dashed lines.

The figure shows an expected pattern. The relationship between distance and turnout is substantially steeper for individuals not living in a household with access to a car. This is a strong indication that cars reduce the inconvenience associated with travelling to the polling station. The average slope of the lower line is almost twice as steep as the slope of the top line. A somewhat surprising pattern is that cars even appear to matter when distances are very small. I had expected the lines to be relatively parallel within the first half-kilometre or so since there may be some 'fixed costs' of travelling by car (e.g., finding parking). However, this pattern is similar to Haspel and Knotts' (2005) findings. One interpretation could be that automobile ownership simply picks up something that conditions the effect of distance on turnout. The model in this article includes interactions related to societal integration and socioeconomic status but one cannot preclude that other things could condition the relationship between distance and voting. Another interpretation could be that when individuals go to the polls, they are not necessarily starting from their homes. They may do so on the way home from work, shopping and so on, and cars may therefore still offer more flexibility for those living close to the polling station.

Conclusion

The present study examined the relationship between the distance to the polling station and turnout in the Scandinavian context – more specifically in the 2009 Danish municipal elections. I found a strong negative relationship between the distance to the polling station and turnout with a clear decay for longer distances. The effect size was in the longer end of what previous studies find. It was also found that the magnitude of the relationship is conditional on whether a car is available in the household. For those with access to a car, distance seems less important than for others. This is in accordance with the theoretical expectations since the inconvenience of commuting is probably greater when less flexible and more time-consuming modes of transportation must be used. However, the effect of the interaction for small distances was somewhat surprising.

The results inform the administrative debate about the possible closing of polling stations in Scandinavia in general and Denmark in particular. The number (and placement) of polling stations involves several trade-offs. Additional polling stations mean an economic burden on the municipalities, and many municipalities experience problems finding staff and volunteers for operating them. Especially in times of financial hardship, it is understandably very tempting to harvest the economies of scale by closing some polling stations and carrying out the election in a more centralized and

(economically) efficient manner. As the present study indicates, however, the price of such cost-cutting may be measured in terms of lower participation. As individual travel costs increase, the probability of abstaining increases. Of special relevance is the finding of a particularly strong relationship between distance and turnout in the first couple of hundred metres to the polls. This implies that in a metropolitan area, for instance, where the distances are generally small, even small changes can have dramatic consequences for turnout. In other words, caution must be exercised even when closing polling stations where the alternative will only mean moderate increases in distance. The strong relationship between distance and voting also has normative implications because it implies that citizens have unequal opportunities to participate in elections based on their distance to the polling stations.

It should be emphasized that this study (like many others, but not all previous studies) is based on cross-sectional data. While the Danish administrative databases allow for much better than average controls – and although it is slightly comforting that the effects are larger in the presumably best-specified models – regression approaches based on cross-sectional data are more vulnerable to omitted variables bias than regression discontinuity designs, panel studies or natural experiments.

One avenue for improving causal inference with a cross-sectional framework could be to match neighbours living in different districts and therefore having different distances to the polls.[11] This attractive alternative was not possible in the present study as it is not feasible to identify neighbours reliably in the dataset. Another attractive avenue would be to collect panel data. Future studies in the Danish context, for instance, could aim at obtaining comparable data from the 2013 or later municipal elections. This would allow one to examine individuals who in fact change distances to the polls (either because the individuals move or because the polling stations move) and thereby make it possible to eliminate the influence of unobserved, time invariant unit heterogeneity. Regardless of the limitations, the present results are indicators that distance matters in Denmark as in the United States, which should inform concerns about the participatory consequences of the dramatic polling station consolidation that has swept Denmark in recent years.

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NOTES

1. Though a high turnout is often considered important – for instance, as a foundation of the political system's legitimacy or to ensure equal participation (Tingsten 1937; Lijphart 1997) – there are also scholars who are less concerned with low turnout rates (e.g., Rosema 2007). As I will return to below, however, even if one is not interested in overall turnout, studying the influence of the administrative placement of polling stations is important from the perspective of equal opportunity to participate.
2. See Orford et al. (2009) for a particularly interesting district-level study in the British context.
3. Here, I focus only on studies concerned with turnout (as opposed to registration and other related issues) as the dependent variable.
4. Regional elections were held together with the municipal elections. The turnout for the two election types is almost identical.
5. Dyck and Gimpel (2005) find that early voting is commonly used by those who live far from the polling station as a substitute of Election Day voting. Those living in the capital area in Denmark (where postal voting is highest) generally have shorter trips to the polling place (0.5 km on average) than the average person in the dataset (1.5 km).
6. To ensure anonymity, Statistics Denmark constructed identification numbers that could not be linked by researchers to the individuals' social security numbers.
7. In 39 municipalities, there were no missing districts or voters at all. In Rudersdal Municipality, one district was missing; in Copenhagen, one voter table (voters are assigned randomly to tables) within one district; and six districts were missing in Aarhus. In each of these cases, the municipalities had lost the ballots. Esbjerg participated only with the districts with electronic voting. In all four municipalities, there was no self-selection involved, and the missing districts/tables should therefore pose no problem for the analysis. In one municipality – Odense – the electronic registration in District 4 broke down for a couple of hours. This resulted in 1,160 voters being erroneously coded as non-voters. Excluding District 4 in Odense does not change the main conclusions of this study.
8. This would of course also apply for parents with only one child and therefore it is surprising that there is no effect of this variable.
9. If we re-run model 2 excluding those 278 that drop out in when the logarithmic functional form is applied, the BIC' values indicate that model 3 (BIC' = –319,804) performs better than model 2 (BIC' = –318,555). Furthermore, the Pseudo R^2 was 0.1163 for model 3 compared to 0.1158 for model 2.
10. One might think that there is no variation in car ownership outside metropolitan areas which could be a potential problem. However, even though there is a clear correlation between distance and car ownership, about 22 percent of the households living more than five kilometers from the polling stations do not own a car (the corresponding percentage is 41 for those living less than one kilometer from the polling station).
11. I thank one of the anonymous reviewers for making this point.

Appendix Table 1. Descriptive Statistics for the Variables included in the Analysis

	Mean	SD	Minimum	Maximum	N
Voted	0.64	0.48	0.00	1.00	2,336,772
Distance between home and polling station (km)	1.53	3.27	0.00	39.7	2,323,508
Log distance between home and polling station (log km)	–0.27	1.01	–4.96	3.68	2,323,187
Distance between home and polling station (base = 0.0–0.2 km):					
0.2–0.4 km	0.18	0.38	0.00	1.00	2,323,508
0.4–0.6 km	0.18	0.39	0.00	1.00	2,323,508
0.6–0.8 km	0.15	0.35	0.00	1.00	2,323,508
0.8–1.0 km	0.10	0.30	0.00	1.00	2,323,508
1.0–1.2 km	0.07	0.25	0.00	1.00	2,323,508
1.2–1.4 km	0.05	0.22	0.00	1.00	2,323,508
1.4–1.6 km	0.03	0.18	0.00	1.00	2,323,508
1.6–1.8 km	0.02	0.15	0.00	1.00	2,323,508
1.8–2.0 km	0.02	0.13	0.00	1.00	2,323,508
2.0–2.5 km	0.03	0.17	0.00	1.00	2,323,508
2.5–3.0 km	0.02	0.14	0.00	1.00	2,323,508
3.0–3.5 km	0.01	0.11	0.00	1.00	2,323,508
3.5–4.0 km	0.01	0.10	0.00	1.00	2,323,508
4.0–4.5 km	0.01	0.08	0.00	1.00	2,323,508
4.5–5.0 km	0.01	0.07	0.00	1.00	2,323,508
5.0+ km	0.05	0.22	0.00	1.00	2,323,508
Car	0.65	0.48	0.00	1.00	2,336,772
Distance between home and city hall (km)	5.79	6.08	0.01	42.4	2,323,508
Sex (male)	0.49	0.50	0.00	1.00	2,336,772
Age in 1,000 days (1,000 days older than 18 years)	10.9	6.68	0.00	33.2	2,336,772
Completed education (base = school):					
High school	0.10	0.30	0.00	1.00	2,229,966
Technical education	0.32	0.47	0.00	1.00	2,229,966
Higher education (4 years or less)	0.21	0.41	0.00	1.00	2,229,966
Higher education (5 years or more)	0.08	0.28	0.00	1.00	2,229,966
Income (100,000 DKK)	2.85	7.74	–372	10,331	2,316,414
Employed	0.64	0.48	0.00	1.00	2,315,345
Married	0.47	0.50	0.00	1.00	2,315,345
Living with someone	0.72	0.45	0.00	1.00	2,336,772
Number of children in household (base = none):					
1 child	0.14	0.35	0.00	1.00	2,315,345
2 children	0.15	0.36	0.00	1.00	2,315,345
3 or more children	0.06	0.24	0.00	1.00	2,315,345
Non-Danish, Western ethnicity	0.03	0.16	0.00	1.00	2,315,345
Non-Danish, non-Western ethnicity	0.07	0.26	0.00	1.00	2,315,345
Non-Danish, Western citizen	0.02	0.15	0.00	1.00	2,315,345
Non-Danish, non-Western citizen	0.04	0.19	0.00	1.00	2,315,345
Residential stability (in 1,000 days at current address)	4.47	5.53	0.00	38.67	2,316,623
Municipal stability (in 1,000 days in municipality)	7.47	6.33	0.00	38.84	2,316,623

Notes: The 43 municipal dummies and five ongoing education dummies are excluded due to space considerations. Variables include the register date of 1 January 2009. Exceptions are education (register date: 1 January 2010 to ensure the correct school year is utilized), residency (register date: 17 November 2009), work (register date: 1 November 2008), income (register date: 1 January 2008) and cars (register date: 1 January 2008).

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