Public Choice (2019) 180:257–283
https://doi.org/10.1007/s11127-018-00635-7

Is civic duty the solution to the paradox of voting?

Abel François[1,3] · **Olivier Gergaud**[2,3]

Received: 30 September 2018 / Accepted: 24 December 2018 / Published online: 21 January 2019

Abstract
Although sense of civic duty is seen by many scholars as the most obvious solution to the paradox of voting, very few empirical studies provide clear evidence on that motive. We use blood donation to build proxies, focusing only on intrinsic motivations, and then introduce such measures into electoral turnout regressions. Our results show that civic duty has a strong influence on voter turnout rates, confirming that the satisfaction voters receive from voting matters regardless of election outcomes. The results are even stronger when we incorporate the number of plasma and platelet donations, which take more time and require stronger commitments from donors.

Keywords Electoral turnout · Paradox of voting · Civic duty · Blood donations · Calculus of voting

1 Introduction

Since the works of Downs (1957), Riker and Ordeshook (1968) and Tullock (1968), the literature addressing economics of voting has been troubled by the well-known paradox of voting, according to which the actual level of voter turnout is inconsistent with theoretical predictions because of rational decision-making on whether or not to vote, which hinges on the vanishingly small probability that any one vote will be decisive. Indeed, the positive and sometimes even massive turnout rates regularly observed at major elections in most

The authors would like to thank David Le Bris, Oliver Hermann as well as seminar participants at University of Nancy 2 (BETA), University of Lille (LEM), as well as participants at the European Public Choice Society meeting 2018 in Rome, and at the Sciences Po Quanti Workshop in Paris, for helpful comments and suggestions. We also thank Eric Toulmonde and Jean-Jacques Lemoine, both from the *Etablissement Français du sang*, for granting us an access to this exceptional database. Last, we are particularly grateful to the editors for their precious help and support. All errors are ours.

✉ Abel François
abel.francois@univ-lille.fr

Olivier Gergaud
olivier.gergaud@kedgebs.com

[1] LEM (UMR 9221), University of Lille, Villeneuve d′Ascq, France

[2] KEDGE Business School, Talence, France

[3] LIEPP, Sciences Po, Paris, France

industrialised democracies is inconsistent with rational reasoning that compares the costs and benefits of voting, thereby predicting low turnout rates. The only apparent solution to the paradox is to take into account the satisfaction of voting per se in the theoretical models in which voting is instrumental. The intuition is that the sense of civic duty would, among other drivers, incite voters to visit polling stations and that such action would increase their personal satisfaction. Civic duty is a utilitarian concept that is not very helpful in explaining variations in turnout rates over time. At least, it has some explanatory power with respect to expected "closeness" of elections (Cancela and Geys 2016). But assessing the impact of the sense of civic duty on electoral turnout is not straightforward because it is hard to define and measure that motive. Available measures based on individual survey data and interviews suffer from unavoidable methodological limitations that prevent them from capturing this complex notion in a convincing way. Most empirical applications based on such data often lead to the overreporting of individual participation at elections. Another problem is that interviewees tend to exaggerate their actual sense of civic duty and scholars often disagree on the types of question that should be asked to capture voting satisfaction and civic duty. As a result, little is known so far about the effect of civic duty on electoral participation and a significant number of scholars cast serious doubt on the explanatory power of this notion as a solution to the paradox of voting.

In this article, we use detailed information about the activity of blood donation in northern France to proxy the sense of civic duty. France is a country that is particularly suited to such empirical testing because donating blood in that country—similar to most industrialised nations—is a voluntary activity[1] and usually does not give rise to any direct or indirect monetary rewards. We innovate in three different ways. First, we use an actual measure of the sense of civic duty and not a self-declared proxy for it. Second, we use information for about six million people living in some 4900 municipalities, and thus we test the civic duty hypothesis at a scale that has never been reached so far. Third, we consider five different election processes—three presidential elections and two less popular European polls—to check whether our results concerning the impact of the sense of civic duty on electoral participation are consistent over time and across space. Moreover, we examine three different types of donations—plasma, platelet and whole blood—as well as various mixed donation indices. Donating whole blood takes less time (about 45 min) than donating plasma (about an hour) or platelets (about 2 h). In a first step, we clean the different donation counts by removing some confounding factors such as the distance to the nearest blood center as well as the holding of one or more blood drives locally. Not doing so would result in biased measures of the sense of civic duty distorted by the inclusion of some undesirable cost and extrinsic components. We claim in this article that intrinsic motivation tied to the activity of blood donation is a good proxy for the sense of civic duty. Overall, our different empirical measures, once corrected, are significant in most regressions we run, regardless of election type (low versus high-intensity).

This article contributes to the economic voting literature in several ways. First, it suggests that the empirical question of the role of civic duty can be tackled using aggregate data on charitable donations (blood donations and others) and that such questions should be included in surveys in future tests of voting motives. Second, the results confirm the important role played by civic duty in the context of elections, regarless of their type, and therefore contribute to solving the economic voting paradox.

[1] At the exception of the United States where donations at private blood banks often are paid (Kessel 1974).

In the next section, we survey briefly the vast theoretical and empirical literatures dealing with the calculus of voting, and discuss in more detail the role of civic duty in the context of those models. In Sect. 3, we summarize the different election settings we analyze. Section 4 contains a careful description of our metrics of the sense of civic duty and the universe of blood donation activities in France. The results are detailed in Sect. 5 and Sect. 6 draws some conclusions.

2 Calculus of voting and civic duty

In this section, we present a brief overview of the literature dealing with the relationship between electoral turnout and civic duty from a theoretical point of view and summarize the various available applications.

2.1 Civic duty as a solution to the paradox of voting

Since the seminal works of Downs (1957) and Tullock (1968), the well-known economic calculus of voting has been defined as follows:

$$R = Bp - C,$$

The decision to vote or abstain depends on the benefit associated with the electoral outcome (B) times the probability of being the decisive voter (p) compared to the cost of voting (C). The paradox of voting results from the difference between the main theoretical prediction of the model and the varied available empirical evidence. Because the cost usually is thought to be higher than the expected benefit (p is very small, indeed close to zero, in mass elections), rational reasoning would predict low turnout rates. But positive and even sometimes massive turnout rates regularly are observed at major elections in most modern democracies.

One of the most popular solution to the paradox has been proposed by Riker and Ordeshook (1968). It consists in adding D to the right-hand side of this equation. D in this context captures the benefit or satisfaction that individual voters receive independently of the electoral outcome. That solution is not universally accepted by scholars (e.g., Schwartz 1987). Indeed, turnout rates are not expected to vary with p, the probability of being the decisive voter, since D exceeds the cost of voting (Cox and Munger 1989). However, Fauvelle-Aymar and Franois (2006), among others, find that turnout rates vary in many contexts with the "closeness" of the election.

Nevertheless, the intuition behind the modified version of the above equation is that the level of satisfaction derived from voting exceeds, in most cases, the cost of voting. For Jones and Hudson (2000), D has two major components: (1) the utility derived when expressing political preferences and (2) the utility received after fulfilling one's electoral or civic duty. The idea within the first component is that voting is (1) a way to elicit our opinions (Hillman 2010; Kamenica and Brad 2014), (2) a way to show our partisan preferences to other people and express our ideological loyalties (Fiorina 1976) and (3) a way to signal preferences to competing parties and candidates (Brennan and Lomasky 1997).

The second component of D rests on the sense of civic duty. The first definition of the notion of civic duty was introduced by Riker and Ordeshook and includes five different dimensions: "the satisfaction from compliance with the ethic of voting", "the satisfaction from affirming allegiance to the political system", "the satisfaction from affirming a

partisan preference", "the satisfaction of deciding, going to the polls, and so on" and "the satisfaction of affirming the political system's efficacy" (Riker and Ordeshook 1968, p. 28). But that definition mixes the two different components of *D* highlithed by Jones and Hudson (2000) and described previously.[2]

However, no consensus exits on the definition and other interpretations are available, such as the one introduced later by Loewen and Dawes (2012, p. 363), who consider that civic duty is the idea that "some citizens feel morally compelled to vote and do so independently of the expected benefits of an election despite the costs of voting". Other authors favor a more pro-social definition of civic duty. "conceive of a sense of duty as the belief that an individual has an obligation to undertake actions that benefit others even when the actions are costly to themselves… A sense of a duty to vote is a pro-social orientation applied to politics".

As a result of the lack of consensus about the definition of civic duty, the notion remains blurred. To cope with that, we have to refine the specification of the utility of voting by introducing the various motivations of voters. The utility gained by voting independently of the election outcome can be explained by intrinsic and extrinsic benefits (Gerber et al. 2008). The notion of intrinsic benefit corresponds to the pleasure experienced by voters from fulfulling their civic duty (Jones and Hudson 2000), whereas that of extrinsic benefit captures the social consequences of voting, especially shame or pride (Gerber et al. 2008) or any other expressive component related to voting. That distinction enables us to adopt a simple definition of civic duty: the intrinsic motivation of casting a ballot independently of the election outcome. That definition is slightly different and more precise than the one proposed by Blais and Galais (2016, p. 61) which states "the civic duty to vote is the belief that a citizen has a moral obligation to vote in election".

2.2 Empirical literature on civic duty

Overall, the various components of the calculus of voting have been validated by a series of empirical works (Blais 2000; Mueller 2003; Geys 2006). Despite its strategic importance regarding the Downsian paradox, only a handful of studies have attempted to test for the influence of civic duty on electoral participation. All of them point to a positive and significant effect.

The first attempt was by Riker and Ordeshook, who used a series of surveys conducted during the 1952, 1956 and 1960 US presidential election campaigns and the "sense of citizen duty scale" introduced previously by Campbell et al. (1954) to proxy civic duty. That scale is based on the answers (agree or disagree) to a series of four items regarding the importance of voting, such as (1) "It isn't so important to vote when you know your party does not have a chance of winning", (2) "A good many local elections are not important enough to bother with", (3) "So many other people vote in the federal elections that it does not matter whether I vote or not" and (4) "If a person does not care how an election comes out, he should not bother to vote in it". A 'disagree' answer indicates a feeling of political obligation and was found to impact positively voter turnout rates, as expected. Silver (1973) and Ashenfelter and Kelley (1975) use the same measure of civic duty and find a positive impact of that concept on participation. Frohlich et al. (1978) test the Downsian hypothesis assuming that the satisfaction of voting is related to the extent to which

[2] For a fuller discussion of civic duty, see Galais and Blais (2016a).

individuals are attached to the democratic system. That study, also based on survey data, confirms the impact of such moral attachment. In a more recent survey of empirical studies, Blais (2000) observes that the sense of civic duty has a strong effect on electoral participation in all studies he considered. He personally finds that civic duty is the strongest driver of the decision to vote.

One remark at this stage is that all empirical studies carried out to test the civic duty hypothesis are based on self-declared opinions of survey participants. Actual, aggregate data never have been used so far to the best of our knowledge. As a result, the main conclusions derived from such applications are questionable for at least two reasons. First, electoral participation is often clearly over-estimated in surveys, as reported in several studies (see, for example, Presser 1984; Belli et al. 1999). In other words, a significant fraction of interviewees misreport their voting behavior. Using the American National Election Study, Belli et al. (2001) estimates that between 7.8 and 14.2% of all respondents lie about their electoral participation. That problem is a potential source of spurious correlation among our variables of interest (Bernstein et al. 2001; Cassel 2003). Beyond the standard problem of measurement error or memory failure (Stocké and Stark 2007), sociodemographic differences and overreporting at the voter-registration stage (Fullerton et al. 2007), false reporting of voting is "seen to result from the respondent's desire to please the interviewer and to appear to engage in socially desirable behavior." (Silver et al. 1986, p.613). Survey respondents understand that voting is socially desirable and feel social pressure to conform to group norms (Holtgraves 2004). And such a feeling probably is related to the respondent's sense of civic duty. For instance, if civic duty is positively related to the level of education, we know that more educated people are more likely to report having voted, as shown by Bernstein et al. (2001). In other words, we can assume that overreporting of participation partly is correlated with answers to questions about the sense of civic duty, which questions the use of survey data to study the effect of the sense of civic duty on electoral turnout.

Second, overreporting raises some concerns about the way civic duty is measured in surveys. As mentioned previously, a short questionnaire commonly is used in surveys to capture the sense of civic duty of the respondent. For Blais (2000), these questions do not directly measure the sense of duty. Rather, they inform us about the perceived probability of being the decisive voter, the self-interest in voting or the emotional attachment to local elections. The difficulty in measuring civic duty and its likely perverse consequences for analyses of turnout already were pointed out by Riker and Ordeshook (1968, footnote 16, p.36). In his own surveys, Blais (2000) uses other questions and statements to capture the sense of civic duty. In particular, three statements seem to reach greater consensus than the previous set of questions introduced by Campbell et al. (1954).[3] The first question "It is the duty of every citizen to vote" is more a general opinion about the duty related to the values attached to citizenship rather than the respondent's sense of civic duty. The second tries to establish a direct link between abstention and civic duty: "If you did not vote, would you feel that you had neglected your duty as a citizen?". And the third question is related to citizens' feelings of shame and pride from the act of voting: "If you did not vote, would you feel guilty?". If the first question does not deal directly with the respondent's own sense of civic duty, the last two questions introduce confusion between the decision (to vote) and the sentiment (negligence and guilt). As a result, a large fraction of survey

[3] The two others are the first statement of the previous studies and opinions about the relation between the vote and the preservation of democracy (the Downsian hypothesis about the satisfaction of voting).

participants agree or strongly agree with the statement. For instance, 84% of respondents in Quebec agree with the statement concerning negligence and 74% with the sense of guilt. In a more recent survey, Blais and Galais (2016) bases his analysis on a larger set of 13 questions and ends up with two aggregate measures of civic duty. But, that analysis is not free of criticism because the authors observe substantial differences according to the election type (national or European) (Galais and Blais 2016b). Such variations are explained by differences in the perceived impact of governmental action (national or European Union) on the level of well-being. Because "civic duty" here depends on specific context, that is, depends on the election setting, we can conclude that the questions fail to capture the concept's complexity, namely the utility or satisfaction derived from voting independently of the context and nature of the election process. One explanation is that such questions about the sense of civic duty suffer from the respondent's desire to conform to a general norm. Perhaps, the social pressure is greater for those questions than for those about voting per se because they introduce in a more explicit way a normative component.

Given the foregoing problems, serious doubt remains about the validity of empirical tests concerning the impact of civic duty on electoral turnout. In the following sections we show that relying on actual, instead of self-reported, measures of electoral participation and civic duty is a promising way to solve the paradox of voting. At the individual level, it is almost impossible to collect such information and the most promising solution is to rely on aggregate data. We should however keep in mind that conclusions drawn from aggregate data should not be used for inference purposes at the individual level due to potential ecological fallacy.

3 Election data

We study electoral turnout rates for three French presidential elections (2002, 2007 and 2012) for three main reasons. First, the French presidential election is a two-round system and is, by far, the most important electoral event in France held every 5 years. Turnout rates are usually higher at those elections than at any other, international (European), regional or local poll. Indeed, parties and candidates traditionally exert more effort and spend more money to sway voters during the presidential election. In 2002, not less than 16 candidates ran in the first round, 12 candidates in 2007 and 10 candidates in 2012. The likelihood of abstaining from voting owing to alienation or indifference (Brody and Page 1973) was therefore minimal and normally distributed across space. During the second round of the election, two finalists compete, which may reduce expressive-related mobilization more than in the first round's wider range of candidate choice. As a result, we consider only the first round of the presidential elections, which were held on April 22, 2007 ; April 21, 2002 and April 22, 2012, respectively.[4]

Second, all voters consider the same pool of candidates because it is a nationwide election. Turnout levels are therefore not affected by any variations in electoral settings at the local level.

Third, most campaign activities are conducted at the national level, that is, no local aspects of presidential contests are subject to strict French regulations. In other words, it is reasonable to assume that all voters in our sample were affected the same way by the

[4] Political elections always take place on Sundays in France, which lowers the opportunity costs of voting.

Table 1 Turnout rates at the 2002, 2007 and 2012 French presidential elections (first round)

Election	Overall (%)	Our sample				
		Mean (%)	SD	Min (%)	Max (%)	N
2002	73.8	75.5	5.9	43.7	100	4871
2007	85.9	85.2	4.4	61.6	100	4871
2012	83.2	83	4.6	63	100	4871

$\text{Turnout rate} = \frac{\text{valid ballots}}{\text{registered voters}} \times 100$

Overall participation excludes French overseas territories and Corsica

electoral campaigns, meaning that we do not need to control in our regressions for the amounts of money spent by each political party.

As a result, we assume that the probability of becoming the decisive voter and the benefit related to the three election outcomes are identically distributed across space and depend mainly on the regional or area characteristics rather than on campaign activities of the presidential candidates. For instance, the expected benefits of the election results partly is related to the proportion of civil servants living in an area rather than to the actions taken by the candidates in that area. Within the calculus of voting, p is homogenous across all observations, which does not hold for B and C, which are supposed to have an impact on the way people vote at the local level.

We got full access to original data concerning blood, plasma and platelet donations in about 4900 municipalities located in the following administrative *départements* in northern France: Aisne, Ardennes, Marne, Nord, Oise, Pas de Calais and Somme. Our sample covers about 13% of all French municipalities (36,000 such metropolitan areas exist in France) and 10% of the French population, which is estimated to number 63.8 million people, according to the French National Institute for Statistics and Economic Studies (Insee). The reference observation is the municipality, the most disaggregated administrative layer in France. Municipalities in the sample vary quite substantially in size (from seven to 225,789 people) and type (urban, rural).

The turnout rate for a municipality is the number of valid ballots divided by the total number of registered voters. On average, the turnout rate in our sample is not statistically different from the turnout rate observed at the national level (Table 1). It was higher in 2007 than in 2002 and 2012; the outcome of the 2007 election was much more uncertain because no incumbent candidate was on the ballot.

Another observation is that turnout rates are slightly more dispersed in 2002 and 2012 than in 2007 even if the distribution of turnout rates clearly follows a normal distribution for all elections.

4 Measures of civic duty

In this section, we introduce the different measures of civic duty that were used to proxy D in our different regressions. Resources dedicated to blood collection are not distributed uniformally across space and some French regions are covered better than others. That is why some corrections were needed and were carried out to clean up raw donation scores.

Table 2 Blood donations and donors scores before each presidential election

	PT		PL		WB	
	Donations	Donors	Donations	Donors	Donations	Donors
2002						
Mean	5.37	1.49	6.84	1.73	80.32	34.11
SD	14.16	3.29	20.45	4.66	65.29	24.88
2007						
Mean	6.18	1.69	9.37	2.62	82.18	32.64
SD	14.79	3.55	22.55	4.91	66.04	23.12
2012						
Mean	2.43	0.81	15.69	3.58	89.57	33.08
SD	9.16	2.32	30.31	5.68	66.92	22.48

PT, PL and WB stand for platelet, plasma and whole blood, respectively. Variables are calculated from 2 years of data before the election date and per 1000 inhabitants

4.1 Blood, plasma and platelet donations

Our different measures of civic duty have been compiled using comprehensive data on actual blood, plasma and platelet donations for 4917 different municipalities in northern France as collected by the *Etablissement Français du Sang* (French Blood Service, or FBS thereafter). The FBS holds a monopoly on the activity of blood collection in France. There, donors are not eligible for any monetary or non-monetary reward except a snack and two bus tickets after each visit to a collection center or participating in a blood drive. In France, donors are not allowed to donate for themselves (e.g., ahead of time for use during surgery) nor for a recipient of their choice (e.g., relatives or friends). Donating platelets takes more time (about 120 min) than donating plasma (about 90 min) and whole blood (45 min). Collecting platelets and plasma requires more sophisticated machines, equipped with a blood cell separator. Such machines are available at blood centers only and on very rare occasions during blood drives. In economic terms, platelet and plasma donations are associated with higher opportunity costs than regular whole blood donations. We will take advantage of that time-cost difference to check whether more intense commitment levels (that is, senses of civic duty) are associated with higher voter turnout rates.

4.2 Donation and donor scores

Each of the 4.5 million observations in the FBS database is tied to a single donor identifier, his or her postal address including a unique zip code (Insee code), the date and the exact location (postal address) of the donation, either at a blood center or a blood drive. Our donation or donor scores were obtained by counting the number of platelet, plasma and whole blood donations (or number of donors) at the municipality level recorded for a period of 2 years before each of our three presidential ballots. For example, we count the number of donations or donors from April 1, 2005 to April 30, 2007 to proxy civic duty for the 2007 presidential election. We proceeded the same way for the two other elections. In total, we computed scores for the 2002, 2007 and 2012 presidential elections as well as the less popular European elections of 2004 and 2009 because the FBS database we accessed

covers only the 2000–2013 period. Using 2 years of data before substantially reduces the frequencies of zeros in the sample of our different scores and also provides a fair picture of the current level of civic duty in those municipalities. Also, adopting a 2-year observation window reduces the risk of having to deal with contemporaneous events that could have occurred in the months or year preceding the election. Table 2 reports some summary statistics on our different alternative measures of actual civic duty.

As expected, whole blood donations (WB thereafter) are more frequent than plasma donations (PL), which are donated more often than platelets (PT). As explained above, each type of donation takes more or less time (opportunity costs are different) and some require dedicated blood-separation equipment (for plasma and platelets). The frequency with which donors are allowed to give blood also varies from one donation type to another and by gender. Men (women) are allowed to donate whole blood six times (four times) per year. Donors (male and female) can donate plasma and platelets more frequently: twice a month for plasma and every 8 weeks for platelets. We observe a steady increase in whole blood and plasma donations (and donors) over the sample period. That pattern also was observed for platelets between 2002 and 2007, but not between 2007 and 2012. We also observe considerable variation in terms of blood donations across space, as illustrated by the large standard deviations obtained, in particular, for platelet and plasma donations (the standard deviations are twice the corresponding means). Quite logically, the number of donations exceeds the number of donors on average because each donor may have one or more records in the FBS database.

5 Linking blood donations and civic duty

The strand of literature dealing with pro-social activities, such as blood donations, both theoretical (Benabou and Tirole 2003, 2006) and empirical (Frey and Jegen 2001; Goette et al. 2010; Kamenica 2012), highlights three main drivers of generosity. First, the cost associated with the activity is inversely related to donations. The higher the cost, the less generous donors tend to be. In our case, the distance to the donation center or the absence of blood drives locally is expected to reduce the numbers of donors and donations at the municipality level. Second, donations depend on the extrinsic utility related to the social rewards people get when donating (e.g., more favorable reputations). In our application, the donor environment is considered to be non-neutral and is expected to play a role in the decision to donate blood. Third, donations rely on the intrinsic motivations of the donor. We therefore conlcude that the raw blood donation counts we have just introduced are not appropriate measures of civic duty and contain some undesirable components, such as the effect of distance to the nearest center, which varies significantly from one donor to the other. To isolate the third component, which corresponds to civic duty, we regress the different raw blood and plasma donation or donor scores against the cost of transportation to the nearest blood center, the number of blood drives conducted locally[5] and a series of proxies for the level of extrinsic motivation. We then argue that the residual values from that equation correspond to a proper measure of civic duty. To capture the opportunity cost of donating blood, we determine for each municipality the distance to the nearest available blood center. All distances were computed using a large pool of 33 blood centers.

[5] Blood drives and blood centers are both managed by the FBS.

Sixteen of them are located in one of the seven *départements* for which we have observations. Another 17 additional centers, located in surrounding *départements,* were included to calculate accurately the distance to the nearest center for all donors living on the outskirts of the observation area. The transportation cost is assumed to be a linear function of the distance traveled to reach the nearest center. That is not a strong assumption for northern France because travel time is proportional to the distance traveled in this region where few landscape irregularities exist (in the Ardennes, mostly). Travel is (in most cases), the second most important component of the cost associated with the activity of blood donation, time spent donating blood being the most important cost. We measure the distance (in kilometers) between the centroid of municipality (i) and the centroid of the municipality of the nearest blood center (bc). It is calculated using the following standard formula:

$$Distance_i = \sqrt{\left(Latitude_i - Latitude_{bc}\right)^2 + \left(Longitude_i - Longitude_{bc}\right)^2}.$$

The mean distance to the nearest blood center is about 26.8 km in our sample, the minimum distance is quite logically equal to zero for all municipalities hosting a blood center and the maximum distance slightly exceeds 75 km. Because donating blood also can be carried out in mobile units commonly, in France, called blood drives, we also include in our model the number of mobile blood-collection vehicles (per inhabitant) hosted by each municipality over the relevant observation period, that is, 2 years before our three presidential elections. Moreover, we enter population size and population density as proxies for external motivation, that is, the level of social pressure and possible reputational rewards within the municipalites in our dataset. Indeed, we postulate that the more populated a municipality is, the lower is the social pressure and, hence, level of external motivation for donating blood. Last, the regression also contains some exogenous controls (including year dummies) that are used thereafter in our voter turnout regressions. The set of year dummies enables us to capture some unobservable heterogeneity specific to each ballot and election cycle. To sum up, our donation model is as follows:

$$\text{Blood}_i^{02,07,12} = \delta_d Distance_i + \delta_{bd} BloodDrive_i + \delta_s Size_i + \delta_w W_i + \delta_y Year + \epsilon_i^{blood},$$

where $Distance_i$ and $BloodDrive_i$ are proxies for the direct costs associated with donating blood in municipality (i); $Size_i$ is a proxy for the level of external motivation; W_i a vector of independent variables such as income level, population age and municipality type (rural, urban) and ϵ_i^{blood} is a well-behaved error term. We assume that ϵ_i^{blood}, the residuals from our model, are strongly correlated with the level of intrinsic motivation. In other words, we assume that ϵ_i^{blood} is a suitable and valid proxy for civic duty. All estimation results—by donation type (whole blood, plasma, platelets)—are reproduced in Tables 3 and 4 for the number of donations and donors, respectively.

All estimated coefficients have the expected signs and are consistent across all specifications of Tables 3 and 4. As expected the distance between the municipality and its nearest blood center negatively affects the frequency with which people donate blood as well as the number of donors of whatever the type (PT, PL or WB). The number of blood drives hosted by the municipality during the 2-year pre-election observation period has a positive effect only on plasma and whole blood donations. The lack of significance of this coefficient in our platelet regressions is simply explained by the fact that such donations are collected only in blood centers. Overall, we detected a strong and significant impact of the cost associated with blood donation activities. City size and population density negatively affect the number of donations and donors. Recall that both measures (population and density) are proxies for external motivations and social

Table 3 Estimation of the number of WB, PL and PT donations (per 1000 inhab.)

Type of blood donation	PT Coef. (SE)	PL Coef. (SE)	WB Coef. (SE)
Distance to the nearest center (km)	− 0.20***	− 0.42***	− 0.84***
	(0.0075)	(0.015)	(0.040)
Blood drives per 100 inhab	0.0063	0.071***	0.29***
	(0.0082)	(0.012)	(0.028)
Population (1000 inhab)	0.0018	− 0.040***	− 0.23***
	(0.0095)	(0.014)	(0.038)
Population density	− 0.0015***	− 0.0016***	− 0.0015*
	(0.00020)	(0.00031)	(0.00080)
% of ind. aged 60 to 74	0.053	0.16**	0.067
	(0.040)	(0.072)	(0.17)
% of ind. aged 75 and +	0.11**	0.36***	0.72***
	(0.048)	(0.099)	(0.25)
% of farmers	0.071***	0.037	0.64***
	(0.022)	(0.056)	(0.12)
% of ind. with univ. degrees	0.015	0.11**	0.57***
	(0.024)	(0.049)	(0.10)
% of women	− 0.093*	− 0.063	0.15
	(0.056)	(0.078)	(0.22)
% of civil servants	− 0.0024	− 0.017	− 0.0059
	(0.0067)	(0.014)	(0.030)
Average annual income (€1000)	0.043	− 0.22***	− 0.33***
	(0.029)	(0.059)	(0.12)
Unemployment rate	− 0.42***	− 0.24**	− 0.042
	(0.051)	(0.10)	(0.27)
Municipality types ('part of a large urban area' is the reference):			
Part of medium or small urban area	− 1.37***	2.64***	21.9***
	(0.42)	(0.99)	(2.38)
Part of several areas	− 1.98***	− 1.01*	− 1.18
	(0.28)	(0.60)	(1.48)
Isolated municipality	− 0.76	0.49	4.33*
	(0.55)	(0.86)	(2.51)
Constant	17.3***	20.3***	81.9***
	(2.85)	(4.24)	(11.0)
Year fixed effects	yes	yes	yes
Municipality fixed effects	no	no	no
N	13,976	13,976	13,976
Adjusted R^2	0.07	0.09	0.07

PT, PL and WB stand for platelet, plasma and whole blood, respectively. Standard errors are adjusted using White's (1980) method

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 4 Estimations of the number of WB, PL and PT donors (per 1000 inhab.)

Type of blood donor	PT Coef. (SE)	PL Coef. (SE)	WB Coef. (SE)
Distance to the nearest center (km)	− 0.055***	− 0.099***	− 0.35***
	(0.0017)	(0.0032)	(0.014)
Blood drive per 100 inhab	− 0.00068	0.0091***	0.068***
	(0.0011)	(0.0020)	(0.013)
Population (1000 inhab)	0.0017	− 0.0031	− 0.057***
	(0.0025)	(0.0040)	(0.014)
Population density	− 0.00045***	− 0.00070***	− 0.0010***
	(0.000052)	(0.000079)	(0.00027)
% of ind. aged 60 to 74	0.014	0.036**	− 0.011
	(0.0098)	(0.015)	(0.059)
% of ind. aged 75 and +	0.022**	0.10***	0.14
	(0.011)	(0.022)	(0.092)
% of farmers	0.016***	0.011	0.28***
	(0.0049)	(0.0089)	(0.050)
% of ind. with univ. degrees	0.013**	0.033***	0.24***
	(0.0058)	(0.0087)	(0.039)
% of women	− 0.023*	− 0.035*	0.044
	(0.012)	(0.018)	(0.086)
% of civil servants	− 0.0036**	− 0.0082***	0.0054
	(0.0016)	(0.0027)	(0.010)
Average annual income (€1000)	0.0043	− 0.073***	− 0.029
	(0.0062)	(0.010)	(0.049)
Unemployment rate	− 0.11***	0.034*	− 0.59***
	(0.012)	(0.020)	(0.095)
Municipality types ('part of a large urban area' is the reference):			
Part of medium or small urban area	− 0.34***	0.86***	4.97***
	(0.096)	(0.21)	(0.76)
Part of several areas	− 0.41***	0.053	− 0.43
	(0.067)	(0.13)	(0.51)
Isolated municipality	− 0.19	0.58***	1.01
	(0.12)	(0.20)	(0.84)
Constant	0.47***	0.53***	4.16***
	(0.060)	(0.093)	(0.42)
Year fixed effects	yes	yes	yes
Municipality fixed effects	no	no	no
N	13,893	13,923	14,154
Adjusted R^2	0.09	0.11	0.07

PT, PL and WB stand for platelet, plasma and whole blood donations, respectively. Standard errors are adjusted using White's (1980) method

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

pressures, which are known to be lower in large municipalities. Our results are quite consistent in both tables even if the impact of the number of people living near the donor does not seem to have an impact on plasma and platelet donations. Indeed, the impact of our density measure is negative in all of our specifications, suggesting an overall negative impact of external motivation on donation activity. Last, the other control variables have varied impacts.

The residual values obtained from the just-reported regressions correspond to our corrected indices of blood, plasma and platelet donations as well as the number of donors in each donation category. We use the various adjusted scores in the next section as proxies for the level of intrinsic motivation or civic duty in explaining electoral turnout in three French presidential elections and two European elections.

6 Electoral turnout regressions

In this section, we first set out the econometric strategy and then comment on our main estimation results, focusing on the impact of the alternative measures of civic duty introduced earlier on turnout rates obtained for three French presidential elections. Last, we test the robustness and relevance of these measures in two additional sets of regressions based on two, less popular, European elections.

6.1 Econometric specification

We model the turnout rate of municipality (i) for the 2002, 2007 and 2012 French presidential elections as follows:

$$\text{Turnout}_i^{02,07,12} = \alpha + \alpha_c CD_i + \alpha_w W_i + \alpha_y Year + \epsilon_i^{turnout},$$

where CD_i is the civic duty index proxied by the residual values ϵ_i^{blood} obtained from our ancillary regressions estimated in Sect. 4; W_i is a vector of municipality characteristics similar to those used in Sect. 5 and in earlier studies (see Geys 2006); *Year* is a set of election dummies and $\epsilon_i^{turnout}$ is a vector of independent and identically distributed error terms. The vector of municipality characteristics includes the proportion of individuals with university degrees, the proportion of individuals aged 60 to 74, the proportion of individuals aged 75 and over, the proportion of women, the proportion of farmers, the proportion of civil servants, average annual income, the unemployment rate, population density, the municipality population and its variation over time. All of these characteristics are aggregate measures retrieved from the French National Institute for Statistics and Economic Studies' website (https://www.insee.fr/en/accueil) for each municipality. The exceptions are for average annual income and the unemployment rate, for which we have information on the precise election year; we use census data from 1999 and 2006 as a source for the other variables.[6] In addition to standard sociodemographic factors underlying participation, another set of variables captures the benefits of the election outcomes for some particular groups of citizens (e.g., civil servants, farmers) or the cost of voting.[7] For instance, elections typically

[6] For each election, we match our voter turnout data with this available from the closest census. In particular, we used the 2006 census data for the 2007 and 2012 presidential elections; the previous census of 1999 was used for the 2002 ballot.

[7] For a discussion of the relationships between different aggregate variables and the calculus of voting, see Blais (2000), Geys (2006) and Mueller (2003).

benefit civil servants and farmers more than other groups because substantial shares of their incomes (salaries and subsidies) depend on public-sector decisions. The benefits of voting are positively related to the voter's level of income, although the opportunity cost of casting ballots rises as incomes rise. We use three different variables to control for the influence of municipality size. The first and second variables are municipality populations in levels and its variance, respectively. Those variables are used here to capture the extent of social pressure on the voter at the municipality level, as set out in more detail in the previous section. The third control variable is population density, which is the usual proxy for the average transportation cost of voters to the nearest polling station.[8] Last, year dummies enable us to capture the specific effects of the main time-varying, but unobserved characteristics of each election on participation and, in particular, the role played by campaign activity, inclucing the political context and the personal characteristics of the running candidates. Those different exogenous controls reduce substantially the perverse influences of some unobserved heterogeneity at the election level on the error term and improve the precision of the regression fit.

We use a standard OLS estimation procedure on our regressions because our dependent variables are distributed normally, as mentioned earlier. The advantage of OLS over GLM[9] is in terms of computing marginal effects that are obtained directly from OLS coefficient estimates. One key characteristic is that our set of civic duty measures is quite stable over time. Indeed, it takes considerable effort to increase the numbers of donors and donations in a given place. However, we tried to run a pooled regression with fixed effects at the municipality level, but our civic duty coefficients did not turn out to be significant in most regressions. That finding obviously is explained by a strong link between CD_i and the municipality fixed effects. Municipality fixed effects would therefore be a good way of controlling for the influences of civic duty on electoral turnout rates when information on the former is missing, as it is in most applications. To highlight the impact of CD_i we choose to run a regression for each presidential election. Last, we use robust standard errors that we bootstrap 500 times. That procedure ensures that the variances of our estimates are not affected by any unobserved heterogeneity and takes into account that CD_i, our variable of interest, has been estimated in some ancillary regressions.

6.2 The impact of civic duty on presidential election turnout

Here we present the various estimates obtained in the context of a set of pooled regressions, that is, considering the whole list of presidential elections, using donation scores (Table 5), first, then donor scores (Table 6) for CD_i. Each table reports three different regressions based on the number of platelet (PT), plasma (PL) or whole blood (WB) donations or numbers of donors.

The model has good explanatory power because about 50% of the variation in turnout rates is explained by the vector of independent variables entered. The residual values

[8] Indeed, the number of municipal polling stations depends on the number of local inhabitants. France provides one station for every 1000 eligible voters, on average. Electoral participation commonly is higher in small municipalities.

[9] The general linear model is recommended for estimating proportions when the residuals are not distributed normally.

Table 5 Presidential turnout regressions: civic duty proxied by the number of PT, PL and WB donations

Type of blood donations	PT Coef. (SE)	PL Coef. (SE)	WB Coef. (SE)
Number of donations per inhab. (adjusted values)	0.10***	0.056***	0.037***
	(0.029)	(0.002)	(0.0058)
Population (1000 inhab.)	− 0.065***	− 0.065***	− 0.065***
	(0.022)	(0.022)	(0.017)
Population density	− 0.0024***	− 0.0024***	− 0.0024***
	(0.00027)	(0.00024)	(0.00022)
% of ind. aged 60 to 74	0.067***	0.067***	0.067***
	(0.012)	(0.013)	(0.013)
% of ind. aged 75 and +	− 0.050***	− 0.050***	− 0.050***
	(0.018)	(0.016)	(0.015)
% of farmers	0.036***	0.036***	0.036***
	(0.0064)	(0.0069)	(0.0068)
% of ind. with univ. degrees	0.100***	0.100***	0.100***
	(0.0063)	(0.0065)	(0.0068)
% of women	− 0.075***	− 0.075***	− 0.075***
	(0.019)	(0.016)	(0.015)
% of civil servants	− 0.0063***	− 0.0063***	− 0.0063***
	(0.0021)	(0.0019)	(0.0020)
Average annual income (€1000)	0.027***	0.027***	0.027***
	(0.0084)	(0.0085)	(0.0087)
Unemployment rate	− 0.10***	− 0.10***	− 0.10***
	(0.019)	(0.021)	(0.021)
Year 2002	*ref*	*ref*	*ref*
Year 2007	9.28***	9.28***	9.28***
	(0.12)	(0.11)	(0.11)
Year 2012	6.60***	6.60***	6.60***
	(0.13)	(0.17)	(0.14)
Constant	78.4***	78.4***	78.4***
	(0.94)	(0.86)	(0.85)
N	13,975	13,975	13,975
Adjusted R^2	0.50	0.50	0.50

PT, PL and WB stand for platelet, plasma and whole blood donations, respectively. Adjusted values of blood donations are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

are identically and independently distributed, as expected. Overall, the results are quite robust and stable to the inclusion of different measures of civic duty. All coefficients but one have the expected signs. In particular, we get positive coefficients for income level, the proportion of farmers and the proportion of educated people. By contrast, population size and density, the proportion of women, the proportion of voters aged 75 and over as well as the unemployment rate negatively affect turnout rates. Last, for unexplained reasons, the percentage of civil servants has a negative impact on electoral turnout, whereas a positive coefficient was expected as explained previously. We also observe, as anticipated,

Table 6 Turnout at the French presidential elections: civic duty proxied by the number of PT, PL and WB donors

Type of blood donors	PT Coef. (SE)	PL Coef. (SE)	WB Coef. (SE)
Number of donors per inhab. (adjusted values)	0.41***	0.24**	0.12***
	(0.15)	(0.091)	(0.022)
Population (1000 inhab.)	− 0.065***	− 0.066***	− 0.066***
	(0.024)	(0.020)	(0.020)
Population density	− 0.0024***	− 0.0024***	− 0.0024***
	(0.00023)	(0.00023)	(0.00023)
% of ind. aged 60 to 74	0.066***	0.065***	0.063***
	(0.012)	(0.015)	(0.012)
% of ind. aged 75 and +	− 0.046***	− 0.046***	− 0.046***
	(0.018)	(0.018)	(0.016)
% of farmers	0.037***	0.037***	0.034***
	(0.0061)	(0.0065)	(0.0091)
% of ind. with univ. degrees	0.10***	0.10***	0.099***
	(0.0066)	(0.0083)	(0.0050)
% of women	− 0.080***	− 0.078***	− 0.072***
	(0.016)	(0.015)	(0.016)
% of civil servants	− 0.0066***	− 0.0064***	− 0.0061***
	(0.0020)	(0.0023)	(0.0020)
Average annual income (€1000)	0.023***	0.023***	0.024***
	(0.0090)	(0.0089)	(0.0068)
Unemployment rate	− 0.10***	− 0.10***	− 0.11***
	(0.018)	(0.019)	(0.024)
Year 2002	*ref*	*ref*	*ref*
Year 2007	9.32***	9.32***	9.34***
	(0.11)	(0.13)	(0.13)
Year 2012	6.65***	6.65***	6.68***
	(0.15)	(0.16)	(0.14)
Constant	78.7***	78.6***	78.4***
	(0.79)	(0.74)	(0.82)
N	13,892	13,922	14,153
Adjusted R^2	0.50	0.50	0.50

PT, PL and WB stand for platelet, plasma and whole blood donations, respectively. Adjusted values of blood donors are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

substantial variation in terms of participation from one election to another, as attested by the strong significance of our different election dummies. The presidential election that mobilised the largest fraction of registered voters was the 2007 election won by Nicolas Sarkozy.

All measures of civic duty have positive and significant impacts on electoral turnout rates. All estimated coefficients but one[10] are significant at the 1% level and have the

[10] It is significant at the 5% level.

expected positive signs. The same results were obtained regardless of the type of adjusted variable we entered; the donation type we considered (PT, PL or WB) or scores based either on the number of donors or the number of donations. Put differently, stonger senses of civic duty levels within a municipality are correlated with higher electoral turnout rates for the French presidential elections studied. According to the type of donation and indicator we use, a one-unit increase in the civic duty index leads to higher voter turnout rates ranging from 0.04 to 0.4 percentage points. The beta coefficients give us better insight into the magnitude of the link. For blood donations, a one standard-deviation change in the average value of PT, PL and WB leads to a 0.020, 0.020 and 0.036 rise in the electoral turnout rate, respectively. As far as blood donors are concerned, a one standard-deviation change in the average value of PT, PL and WB leads to increases of 0.019, 0.017 and 0.041, respectively.

In conclusion, this first set of regressions clearly suggests that civic duty measured by the number of blood donations or donors plays a significant role in electoral turnout observed for major elections in France.

6.3 Raw versus adjusted measures?

In this section, we compare the performances of the adjusted measures and the raw measures of blood donations or donors in our different turnout regressions. We also take advantage of the heterogeneity in our dataset to build two synthetic indicators of civic duty from the adjusted scores of PT, PL and WB donations or donors. Recall that the raw measures contain the three main drivers of the donation activity—donation cost, extrinsic motivation and intrinsic motivation—and the adjusted measures carry only the intrinsic component, which we used previously and in the following as a proxy for civic duty.

The results of the naive model, which relies on the raw blood donation scores, are detailed in Table 7. Overall, those indicators are less significant than their adjusted counterparts in the PT and PL equations, but remain significant in the WB equation. We also note that all coefficients are positive, even though they are less or not statistically significant at all. That result makes sense because PL and PT donations carry higher costs[11] than WB donations. Extracting the cost component and the elements of external motivations contained in the raw measures, as we did, therefore seems particularly relevant for capturing the influence of civic duty on electoral participation.

The lack of significance of the coefficients estimated from the raw measure of blood donations or donors seems to originate from differences in the richness of the information contained in the raw measures compared to the adjusted measures. Removing some unwanted components, such as the distance to the nearest donation center seems necessary to obtain a reliable proxy for civic duty and improves our predictions of the turnout rate.

[11] Cost is measured in terms of the values of opportunities foregone and travel distance to the nearest blood donation center.

Table 7 Turnout at the French presidential elections: estimates using raw civic duty measures

Type of blood donations/donors	PT		PL		WB	
	Donations	Donors	Donations	Donors	Donations	Donors
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Number of donations/donors per inhab. (raw values)	0.063*	0.17	0.047***	0.12	0.038***	0.11***
	(0.035)	(0.14)	(0.018)	(0.090)	(0.0064)	(0.019)
Population (1000 inhab.)	− 0.065***	− 0.066***	− 0.065***	− 0.066***	− 0.064***	− 0.065***
	(0.021)	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)
Population density	− 0.0024***	− 0.0024***	− 0.0024***	− 0.0024***	− 0.0024***	− 0.0024***
	(0.00023)	(0.00022)	(0.00023)	(0.00022)	(0.00023)	(0.00023)
% of ind. aged 60 to 74	0.067***	0.066***	0.067***	0.064***	0.067***	0.063***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
% of ind. aged 75 and +	− 0.050***	− 0.046***	− 0.051***	− 0.047***	− 0.053***	− 0.048***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
% of farmers	0.036***	0.037***	0.036***	0.037***	0.033***	0.031***
	(0.0069)	(0.0068)	(0.0069)	(0.0068)	(0.0069)	(0.0068)
% of ind. with univ. degrees	0.100***	0.10***	0.099***	0.10***	0.097***	0.096***
	(0.0067)	(0.0067)	(0.0067)	(0.0067)	(0.0067)	(0.0067)
% of women	− 0.075***	− 0.080***	− 0.075***	− 0.078***	− 0.076***	− 0.073***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
% of civil servants	− 0.0063***	− 0.0066***	− 0.0062***	− 0.0063***	− 0.0062***	− 0.0061***
	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Average annual income (€1000)	0.026***	0.022***	0.027***	0.023***	0.027***	0.023***
	(0.0084)	(0.0085)	(0.0084)	(0.0084)	(0.0084)	(0.0083)
Unemployment rate	− 0.10***	− 0.10***	− 0.10***	− 0.11***	− 0.10***	− 0.11***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Year 2002	*ref*	*ref*	*ref*	*ref*	*ref*	*ref*

Table 7 (continued)

Type of blood donations/donors	PT		PL		WB	
	Donations	Donors	Donations	Donors	Donations	Donors
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Year 2007	9.29***	9.33***	9.28***	9.31***	9.29***	9.37***
	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)	(0.12)
Year 2012	6.64***	6.67***	6.57***	6.63***	6.61***	6.74***
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Constant	78.4***	78.7***	78.4***	78.6***	78.2***	78.1***
	(0.79)	(0.79)	(0.79)	(0.79)	(0.79)	(0.79)
N	13,975	13,892	13,975	13,922	13,975	14,153
Adjusted R^2	0.50	0.50	0.50	0.50	0.50	0.50

PT, PL and WB stand for platelet, plasma and whole blood donations, respectively. Raw values are calculated per 1000 inhab. Bootstrapped standard errors (500 replications)
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 8 Turnout at the French presidential elections: estimates using adjusted mixed measures of civic duty

	Donations indices		Donors indices	
	Index 1	Index 2	Index 1	Index 2
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Indices of adjusted donations/donors per inhab.	0.032***	0.15***	0.010***	0.049***
	(0.0053)	(0.026)	(0.0018)	(0.0082)
Population (1000 inhab.)	− 0.065***	− 0.065***	− 0.065***	− 0.065**
	(0.022)	(0.019)	(0.019)	(0.027)
Population density	− 0.0024***	− 0.0024***	− 0.0024***	− 0.0024***
	(0.00022)	(0.00023)	(0.00018)	(0.00022)
% of ind. aged 60 to 74	0.067***	0.067***	0.067***	0.066***
	(0.010)	(0.012)	(0.012)	(0.012)
% of ind. aged 75 and +	− 0.050***	− 0.050***	− 0.050***	− 0.046***
	(0.014)	(0.015)	(0.015)	(0.018)
% of farmers	0.036***	0.036***	0.036***	0.037***
	(0.0063)	(0.0055)	(0.0076)	(0.0066)
% of ind. with univ. degrees	0.100***	0.100***	0.100***	0.100***
	(0.0064)	(0.0062)	(0.0063)	(0.0075)
% of women	− 0.075***	− 0.075***	− 0.075***	− 0.080***
	(0.019)	(0.014)	(0.018)	(0.014)
% of civil servants	− 0.0063***	− 0.0063**	− 0.0063***	− 0.0066***
	(0.0017)	(0.0025)	(0.0023)	(0.0020)
Average annual income (€1000)	0.027***	0.027***	0.027***	0.023***
	(0.0078)	(0.0083)	(0.0088)	(0.0081)
Unemployment rate	− 0.10***	− 0.10***	− 0.10***	− 0.10***
	(0.020)	(0.019)	(0.024)	(0.019)
Year 2002	*ref*	*ref*	*ref*	*ref*
Year 2007	9.28***	9.28***	9.28***	9.32***
	(0.12)	(0.13)	(0.11)	(0.11)
Year 2012	6.60***	6.60***	6.60***	6.65***
	(0.15)	(0.15)	(0.15)	(0.14)
Constant	78.4***	78.4***	78.4***	78.7***
	(0.83)	(0.78)	(0.77)	(0.81)
N	13,975	13,975	13,975	13,892
Adjusted R^2	0.50	0.50	0.50	0.50

Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67)PL + (1/5.67)WB. Adjusted values of blood donations and donors indices are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

6.4 Blood donation indices

To investigate further the influence of civic duty on electoral participation, we employ hereafter two alternative, mixed measures of blood donation that we build using the activity of PL, PT and WB donations as well as the number of PL, PT and WB donors. The first index simply is the raw sums of those three indices at the municipality level. The second

Table 9 Adjusted civic duty measure and indices: examples

	Donations/donors			Index 1	Index 2
	PT	PL	WB	Total	Weighted sum
City A	0	0	10	10	1.8
City B	2	1	8	11	2.6
City C	2	4	6	12	3.4
Total	4	5	24	33	

PT, PL and WB stand for platelet, plasma and whole blood, respectively. Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67) PL + (1/5.67)WB

index is a weighted sum of the same indices. The weight of each donation type is based on the time needed to donate: 45 min for WB, 90 min for PL and 120 min for PT. In particular, we assign reference weights of 0.176 (1/5.67) to WB, 0.353 (2/5.67) to PL and 0.471 (2.67/5.67) to PT donations or donors. Our empirical methodology remains the same; we just add a new stage. First, we calculate the two indices for all municipalities in our sample. Second, we estimate the indices using our donation model set out in Tables 3 and 4. The residuals are the new proxies for civic duty, which are entered later in our electoral turnout regressions. The final results with the new synthetic indices are reported in Table 8.

All regression results remain stable and robust to the inclusion of the mixed or weighted indices. Both indices, in terms of either donations or donors, perform well and, indeed, better than the adjusted measures considered separately. Interestingly, the weighted index (Index 2) outperforms the mixed index (Index 1). That result suggests that weighting donations or donors using the opportunity cost of each donation type yields a good proxy for civic duty. Such indices contain more information than their different components considered separately because the weights are informative about how much time donors are willing to invest in the donation activity. Ignoring those weights could distort significantly the influences of civic duty.

In the example given in Table 9, we consider three different equally populated cities. That being said, City A is more civic-minded than City B or City C if we consider the number of WB donations or donors only (column 4) and ignore the number of PL and PT donations or donors (column 2 and 3 respectively). But the ranking changes if we consider instead the other two types of donations, which give a clear advantage to City C over Cities B and A. Indeed, Cities B and C have induced fewer WB donations or donors over the period, but more PL and PT donations or donors as reflected by our indices. Here, both synthetic indices take into account the three types of donations, whereas our single measures do not. Such synthetic measures thus provide a broader and more consistent picture of the sense of civic duty in any city than any of its three components taken in isolation.

Although both indices (last two columns) yield the same ordinal ranking of cities (namely, $C > B > A$) the cardinal difference in terms of civic duty across cities is larger and better captured by Index 2 (column 6) than by Index 1 (column 5). Index 2 thus appears to be the index that best reflects differences in commitment among the three types of donations in a single measure. As a result, it is likely that the clear differences we get in our estimates reflect the richness of the information contained within the indices.

Table 10 Turnout rates at each presidential elections: estimates using adjusted donation indices

Elections	2002		2007		2012	
	Index 1	Index 2	Index 1	Index 2	Index 1	Index 2
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Indices of adjusted donations per inhab.	0.0030*** (0.0011)	0.021*** (0.0050)	0.0019** (0.0083)	0.0084** (0.0037)	0.0027*** (0.0083)	0.014*** (0.0043)
Population (1000 inhab.)	− 0.090** (0.039)	− 0.090** (0.036)	− 0.045 (0.036)	− 0.045 (0.037)	− 0.063 (0.042)	− 0.063 (0.057)
Population Density	− 0.0024*** (0.00046)	− 0.0024*** (0.00041)	− 0.0022*** (0.00037)	− 0.0022*** (0.00034)	− 0.0025*** (0.00032)	− 0.0025*** (0.00045)
% of ind. aged 60 to 74	0.070*** (0.026)	0.070*** (0.023)	0.074*** (0.021)	0.075*** (0.019)	0.034* (0.020)	0.034* (0.019)
% of ind. aged 75 and +	− 0.052 (0.033)	− 0.053 (0.033)	− 0.096*** (0.025)	− 0.096*** (0.025)	− 0.017 (0.017)	− 0.017 (0.027)
% of farmers	0.16*** (0.023)	0.16*** (0.022)	0.077*** (0.022)	0.077*** (0.021)	0.012 (0.0077)	0.011 (0.0071)
% of ind. with Univ. degrees	0.13*** (0.016)	0.13*** (0.013)	0.069*** (0.0088)	0.068*** (0.0098)	0.13*** (0.011)	0.13*** (0.011)
% of women	− 0.046** (0.018)	− 0.046** (0.018)	− 0.086*** (0.026)	− 0.086*** (0.025)	− 0.16*** (0.033)	− 0.16*** (0.038)
% of civil Servants	− 0.014 (0.0085)	− 0.014 (0.0094)	− 0.0076** (0.0038)	− 0.0076** (0.0035)	− 0.0016 (0.0034)	− 0.0016 (0.0031)
Average annual Income (€1000)	0.052** (0.024)	0.053** (0.021)	0.0092 (0.012)	0.0093 (0.012)	0.020 (0.014)	0.020 (0.014)
Unemployment Rate	− 0.072 (0.046)	− 0.070* (0.040)	− 0.10*** (0.032)	− 0.099*** (0.032)	− 0.10*** (0.029)	− 0.10*** (0.029)
Constant	75.6*** (1.20)	75.6*** (1.20)	89.2*** (1.46)	89.2*** (1.51)	89.3*** (1.76)	89.3*** (1.86)
Year fixed effects	No		No		No	
N	4687		4674		4614	
Adjusted R^2	0.14	0.14	0.14	0.14	0.19	0.19

Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67)PL + (1/5.67)WB. Adjusted values of blood donations indices are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

6.5 Robustness checks using other election types

In this section, as a robustness check exercise, we use our mixed indices on different election datasets. First, we successively run a series of three regressions for the 2002, 2007 and 2012 French presidential elections, which were analyzed before using pooled data. Then, we test whether our indices still perform well in the context of elections that usually fail to mobilize a majority of eligible voters, such as the European Union's elections. If blood donations are a important source of information about senses of civic duty at the local level then our various indices should perform the same way regardless of the type of elections we consider. Indeed, by definition, the sense of civic duty is not related to the electoral context and should explain voter participation rates whatever the election setting happens

Table 11 Turnout rates at various European elections: estimates using adjusted donation indices

Elections	All		2004		2009	
	Index 1	Index 2	Index 1	Index 2	Index 1	Index 2
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Indices of adjusted donations per inhab.	0.0054*** (0.0011)	0.022*** (0.0051)	0.0030** (0.0015)	0.014 (0.0078)	0.0056*** (0.0014)	0.020*** (0.0064)
Population (1000 inhab.)	− 0.063** (0.031)	− 0.063** (0.030)	− 0.067 (0.043)	− 0.067 (0.062)	− 0.061 (0.047)	− 0.061 (0.059)
Population Density	− 0.0023*** (0.00030)	− 0.0023*** (0.00028)	− 0.0021*** (0.00044)	− 0.0021*** (0.00049)	− 0.0024*** (0.00048)	− 0.0024*** (0.00043)
% of ind. aged 60 to 74	0.32*** (0.031)	0.32*** (0.026)	0.32*** (0.035)	0.32*** (0.041)	0.32*** (0.041)	0.32*** (0.037)
% of ind. aged 75 and +	0.30*** (0.041)	0.30*** (0.034)	0.26*** (0.051)	0.26*** (0.041)	0.29*** (0.044)	0.29*** (0.043)
% of farmers	0.14*** (0.015)	0.14*** (0.012)	0.38*** (0.040)	0.38*** (0.038)	0.13*** (0.013)	0.13*** (0.012)
% of ind. with Univ. degrees	0.28*** (0.012)	0.28*** (0.014)	0.20*** (0.017)	0.20*** (0.018)	0.50*** (0.028)	0.50*** (0.028)
% of women	− 0.28*** (0.035)	− 0.28*** (0.041)	− 0.25*** (0.053)	− 0.25*** (0.065)	− 0.31*** (0.049)	− 0.31*** (0.052)
% of civil Servants	− 0.026*** (0.0045)	− 0.026*** (0.0048)	− 0.020*** (0.0061)	− 0.020*** (0.0067)	− 0.024*** (0.0062)	− 0.024*** (0.0061)
Average annual Income (€1000)	− 0.044*** (0.017)	− 0.044** (0.019)	− 0.097*** (0.029)	− 0.096*** (0.033)	− 0.13*** (0.032)	− 0.13*** (0.034)
Unemployment Rate	− 0.23*** (0.036)	− 0.23*** (0.042)	− 0.20*** (0.055)	− 0.20*** (0.049)	− 0.24*** (0.061)	− 0.24*** (0.065)
Constant	52.7*** (2.16)	52.7*** (2.16)	52.2*** (3.03)	52.2*** (3.27)	49.0*** (2.59)	49.0*** (2.72)
Year fixed effects	Yes		No		No	
N	9277		4624		4653	
Adjusted R^2	0.21	0.20	0.17	0.17	0.23	0.23

Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67)PL + (1/5.67)WB. Adjusted values of blood donations indices are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

to be. We choose for testing that implication the particularly low-intensity European elections of 2004 and 2009, for which we observe turnout rates of 42.8% and 40.5%, respectively. Those numbers are much lower than the turnout rates typically observed for French presidential elections, which are nearly 40 percentage points higher. Regression results using donations indices are displayed in Tables 10 and 11 and those based on donors indices are provided in Tables 12 and 13.

The first remark is that the precision of the fit drops dramatically. The main reason for that result is that election-specific regressions do not contain any election dummies, which are quite significant in the different pooled regressions we estimated previously.

The second observation is that the set of control variables does not have the same effects in each election. For example, the effect of the income variable is positive and significant

Table 12 Turnout rates at each presidential elections: estimates using adjusted donor indices

Elections	2002		2007		2012	
	Index 1	Index 2	Index 1	Index 2	Index 1	Index 2
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Indices of adjusted donors per inhab.	0.011*** (0.0031)	0.073*** (0.014)	0.0053** (0.0026)	0.020 (0.014)	0.0074** (0.0036)	0.031** (0.017)
Population (1000 inhab.)	− 0.090** (0.043)	− 0.090** (0.039)	− 0.045 (0.047)	− 0.045 (0.037)	− 0.063* (0.038)	− 0.063 (0.042)
Population Density	− 0.0023*** (0.00048)	− 0.0023*** (0.00041)	− 0.0022*** (0.00038)	− 0.0021*** (0.00035)	− 0.0025*** (0.00033)	− 0.0025*** (0.00029)
% of ind. aged 60 to 74	0.071*** (0.026)	0.071*** (0.025)	0.074*** (0.020)	0.069*** (0.019)	0.034* (0.019)	0.037* (0.021)
% of ind. aged 75 and +	− 0.050 (0.032)	− 0.048 (0.038)	− 0.096*** (0.027)	− 0.096*** (0.032)	− 0.018 (0.024)	− 0.0051 (0.027)
% of farmers	0.16*** (0.025)	0.16*** (0.024)	0.077*** (0.017)	0.080*** (0.021)	0.012 (0.0073)	0.013* (0.0074)
% of ind. with Univ. degrees	0.13*** (0.016)	0.13*** (0.015)	0.069*** (0.0096)	0.067*** (0.0097)	0.13*** (0.013)	0.14*** (0.012)
% of women	− 0.047** (0.021)	− 0.048** (0.020)	− 0.086*** (0.030)	− 0.096*** (0.036)	− 0.16*** (0.033)	− 0.18*** (0.033)
% of civil Servants	− 0.014* (0.0083)	− 0.015** (0.0069)	− 0.0076** (0.0036)	− 0.0075** (0.0033)	− 0.0016 (0.0031)	− 0.0021 (0.0028)
Average annual Income (1000 €)	0.053** (0.024)	0.053** (0.022)	0.0088 (0.013)	0.010 (0.011)	0.020 (0.014)	0.0097 (0.012)
Unemployment Rate	− 0.068 (0.042)	− 0.066 (0.040)	− 0.100*** (0.033)	− 0.11*** (0.027)	− 0.10*** (0.031)	− 0.11*** (0.032)
Constant	75.6*** (1.16)	75.6*** (1.16)	89.2*** (1.49)	89.8*** (1.53)	89.3*** (1.70)	90.1*** (1.80)
Year fixed effects	No		No		No	
N	4687		4674		4614	
Adjusted R^2	0.14	0.14	0.14	0.14	0.19	0.19

Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67)PL + (1/5.67)WB. Adjusted values of blood donors indices are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

only in the equation for the 2002 European presidential election. Quite remarkably, the only variables that return consistent coefficient estimates across all regressions are the civic duty indices. Indeed, out of 12 estimated coefficients corresponding to various civic duty metrics and elections only one is not statistically significant.

All other estimates are significant and always in positive sign. Overall, we observe that (1) the effect of civic duty is time-invariant and does not vary across elections; (2) some multicollinearity exists in our pooled regressions between the civic duty indices and the fixed effects, as suggested previously; and (3) we observe more precision with the measures of civic duty after cleaning them from the influence of confounding factors, such as extrinsic motivation and distance to the nearest donation center, which clearly are contained in raw blood donation or donor scores.

Table 13 Turnout rates at various European elections: estimates using adjusted donor indices

Elections	All		2004		2009	
	Index 1	Index 2	Index 1	Index 2	Index 1	Index 2
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Indices of adjusted donors per inhab.	0.017*** (0.0051)	0.078*** (0.021)	0.011** (0.0051)	0.055*** (0.024)	0.013** (0.0053)	0.061** (0.024)
Population (1000 inhab.)	− 0.063 (0.040)	− 0.064* (0.037)	− 0.067 (0.077)	− 0.068* (0.041)	− 0.061 (0.055)	− 0.061 (0.051)
Population Density	− 0.0023*** (0.00035)	− 0.0023*** (0.00034)	− 0.0021*** (0.00068)	− 0.0021*** (0.00052)	− 0.0024*** (0.00042)	− 0.0023*** (0.00046)
% of ind. aged 60 to 74	0.32*** (0.021)	0.31*** (0.031)	0.32*** (0.044)	0.30*** (0.036)	0.32*** (0.042)	0.33*** (0.034)
% of ind. aged 75 and +	0.30*** (0.034)	0.31*** (0.032)	0.26*** (0.044)	0.27*** (0.047)	0.29*** (0.047)	0.31*** (0.051)
% of farmers	0.14*** (0.014)	0.14*** (0.012)	0.38*** (0.033)	0.39*** (0.034)	0.13*** (0.012)	0.13*** (0.013)
% of ind. with Univ. degrees	0.28*** (0.013)	0.28*** (0.016)	0.20*** (0.017)	0.21*** (0.013)	0.50*** (0.029)	0.51*** (0.023)
% of women	− 0.28*** (0.047)	− 0.28*** (0.043)	− 0.25*** (0.045)	− 0.23*** (0.061)	− 0.31*** (0.049)	− 0.33*** (0.058)
% of civil Servants	− 0.026*** (0.0041)	− 0.025*** (0.0049)	− 0.020*** (0.0076)	− 0.016*** (0.0060)	− 0.024*** (0.0054)	− 0.024*** (0.0062)
Average annual Income (1000 €)	− 0.044** (0.019)	− 0.052*** (0.019)	− 0.096*** (0.032)	− 0.11*** (0.035)	− 0.13*** (0.029)	− 0.14*** (0.024)
Unemployment Rate	− 0.23*** (0.043)	− 0.23*** (0.038)	− 0.20*** (0.052)	− 0.21*** (0.046)	− 0.24*** (0.056)	− 0.24*** (0.050)
Constant	52.7*** (2.12)	52.4*** (1.90)	52.1*** (3.18)	51.5*** (3.14)	49.1*** (2.81)	49.8*** (2.68)
Year fixed effects	Yes		No		No	
N	9277		4624		4653	
Adjusted R^2	0.21	0.21	0.17	0.18	0.23	0.24

Index 1 = PT + PL + WB; Index 2 = (2.67/5.67)PT + (2/5.67)PL + (1/5.67)WB. Adjusted values of blood donors indices are multiplied by 10,000. Bootstrapped standard errors (500 replications)

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

7 Conclusion

In this article, we develop a new strategy for testing the influence of senses of civic duty on electoral turnout rates. Instead of using survey data, which suffer from well-known limitations, we provide, for the first time, a test based on aggregate data that overcome those limitations. Working with blood donations in about 4900 municipalities located in northern France, we extract information concerning the intrinsic motivation associated with that charitable activity. We then show that donation or donor scores are convincing proxies for senses of civic duty at the municipality level. The various definitions for our variable of interest, according to the type of donations (platelet, plasma and whole blood), the distinction based on either donation type or numbers of donors, and the construction

of two aggregate indices are then introduced as control variables in some electoral turnout regressions for major and minor elections in France (presidential and European). All estimates converge toward indicating a significant influence of civic duty on voter turnout rates. Moreover, the conclusion seems to be robust to several checks, especially when we analyze elections less popular than for the presidency of France, such as French participation in European elections. That additional set of results reinforces the idea that our proxies for the sense of civic duty perform well in the context of turnout regressions regardless of the electoral context.

The findings presented herein support our initial claim that blood donation data can fruitfully be used to proxy civic duty and to explain electoral participation. Finally, we show empirically that the sense of civic duty—that is, the satisfaction from voting independently of an election's outcome and context—is a good predictor of electoral participation and, thus, a very good candidate for solving the paradox of voting.

Further research could extend this study by replicating it using individual data. Such an extension would require collecting micro observations on electoral participation on the one hand and blood donations on the other. The challenge here, similar to that encountered in previous studies based on post-election surveys, would be to get precise, unbiased data on the ways people vote and donate. That would be particularly difficult because of the well-documented social desirability bias associated with those types of survey questionnaires. The research results discussed herein suggest, however, that some questions, such as "Do you donate whole blood/plasma/platelets?" "If yes, how many times a year do you donate whole blood/plasma/platelets?", could be introduced into surveys to gauge individuals' senses of their civic duty.

References

Ashenfelter, O., & Kelley, S. J. (1975). Determinants of participation in presidential elections. *Journal of Law & Economics*, *18*, 695.

Belli, R. F., Traugott, M. W., & Beckmann, M. N. (2001). What leads to voting overreports? Contrasts of overreporters to validated voters and admitted nonvoters in the american national election studies. *Journal of Official Statistics*, *17*(4), 479–498.

Belli, R. F., Traugott, M. W., Young, M., & McGonagle, K. A. (1999). Reducing vote overreporting in surveys: Social desirability, memory failure, and source monitoring. *Public Opinion Quarterly*, *63*, 90–108.

Benabou, R., & Tirole, J. (2003). Intrinsic and extrinsic motivation. *The Review of Economic Studies*, *70*(3), 489–520.

Benabou, R., & Tirole, J. (2006). Incentives and prosocial behavior. *The American Economic Review*, *96*(5), 1652–1678.

Bernstein, R., Chadha, A., & Montjoy, R. (2001). Overreporting voting: Why it happens and why it matters. *Public Opinion Quarterly*, *65*(1), 22–44.

Blais, A. (2000). *To vote or not to vote? The merits and limits of rational choice theory*. Pittsburgh: University of Pittsburgh Press.

Blais, A., & Galais, C. (2016). Measuring the civic duty to vote: A proposal. *Electoral Studies*, *41*(1), 60–69.

Brennan, G., & Lomasky, L. E. (1997). *Democracy and decision: The pure theory of electoral preference*. Cambridge, MA: Cambridge University Press.

Brody, R. A., & Page, B. I. (1973). Indifference, alientation and rational decisions. *Public Choice*, *15*(1), 1–17.

Campbell, A., Gurin, G., & Miller, W. E. (1954). *The voter decides*. Evanston: Row, Pererson & Co.

Cancela, J., & Geys, B. (2016). Explaining voter turnout: A meta-analysis of national and subnational elections. *Electoral Studies*, *42*(2), 264–275.

Cassel, C. A. (2003). Overreporting and electoral participation research. *American Politics Research*, *31*(1), 81–92.

Cox, G. W., & Munger, M. C. (1989). Closeness, expenditures, and turnout in the 1982 us house elections. *The American Political Science Review*, *83*, 217–231.
Downs, A. (1957). *An economic theory of democracy*. New York: Harper.
Fauvelle-Aymar, C., & François, A. (2006). The impact of closeness on turnout: An unambiguous empirical relation based on a study of a two-round ballot. *Public Choice*, *127*(3–4), 461–484.
Fiorina, M. P. (1976). The voting decision: Instrumental and expressive aspects. *Journal of Politics*, *38*(2), 390–413.
Frey, B. S., & Jegen, R. (2001). Motivation crowding theory. *Journal of Economic Surveys*, *15*(5), 589–611.
Frohlich, N., Oppenheimer, J. A., Smith, J., & Young, O. R. (1978). A test of downsian voter rationality: 1964 presidential voting. *The American Political Science Review*, *72*, 178–197.
Fullerton, A. S., Dixon, J. C., & Borch, C. (2007). Bringing registration into models of vote overreporting. *Public Opinion Quarterly*, *71*(4), 649–660.
Galais, C., & Blais, A. (2016a). Beyond rationalization: Voting out of duty or expressing duty after voting? *International Political Science Review*, *37*(2), 213–29.
Galais, C., & Blais, A. (2016b). Do people feel more of a duty to vote in some elections? *West European Politics*, *39*(4), 755–777.
Gerber, A. S., Green, D. P., & Larimer, C. W. (2008). Social pressure and voter turnout: Evidence from a large-scale field experiment. *American Political Science Review*, *102*(01), 33–48.
Geys, B. (2006). Explaining voter turnout: A review of aggregate-level research. *Electoral Studies*, *25*(4), 637–663.
Goette, L., Stutzer, A., & Frey, B. M. (2010). Prosocial motivation and blood donations: A survey of the empirical literature. *Transfusion Medicine and Hemotherapy*, *37*(3), 149–154.
Hillman, A. L. (2010). Expressive behavior in economics and politics. *European Journal of Political Economy*, *26*(4), 403–418.
Holtgraves, T. (2004). Social desirability and self-reports: Testing models of socially desirable responding. *Personality and Social Psychology Bulletin*, *30*(2), 161–172.
Jones, P., & Hudson, J. (2000). Civic duty and expressive voting: Is virtue its own reward? *Kyklos*, *53*(1), 3–16.
Kamenica, E. (2012). Behavioral economics and psychology of incentives. *Annual Review of Economics*, *4*(1), 427–452.
Kamenica, E., & Brad, L. E. (2014). Voters, dictators, and peons: Expressive voting and pivotality. *Public Choice*, *159*(1–2), 159–176.
Kessel, R. (1974). Transfused blood, serum hepatitis, and the coase theorem. *Journal of Law and Economics*, *17*(2), 265–289.
Loewen, P. J., & Dawes, C. T. (2012). The heritability of duty and voter turnout. *Political Psychology*, *33*(3), 363–373.
Mueller, D. C. (2003). *Public choice III*. Cambridge, MA: CUP.
Presser, S. (1984). Is inaccuracy on factual survey items item-specific or respondent-specific? *Public Opinion Quarterly*, *48*(1B), 344–355.
Riker, W. H., & Ordeshook, P. C. (1968). A theory of the calculus of voting. *American Political Science Review*, *62*(01), 25–42.
Schwartz, T. (1987). Your vote counts on account of the way it is counted: An institutional solution to the paradox of not voting. *Public Choice*, *54*(2), 101–121.
Silver, B. D., Anderson, B. A., & Abramson, P. R. (1986). Who overreports voting? *The American Political Science Review*, *80*(2), 613–624.
Silver, M. (1973). A demand analysis of voting costs and voting participation. *Social Science Research*, *2*(2), 111–124.
Stocké, V., & Stark, T. (2007). Political involvement and memory failure as interdependent determinants of vote overreporting. *Applied Cognitive Psychology*, *21*(2), 239–257.
Tullock, G. (1968). *Toward a mathematics of politics*. Ann Arbor: University of Michigan Press.
White, H. (1980). A heteroskedasticity-consistent covariance matrix estimator and a direct test for heteroskedasticity. *Econometrica: Journal of the Econometric Society*, *48*, 817–838.