Can Internet voting increase political participation?

Remote electronic voting and turnout in the Estonian 2007 parliamentary elections

Daniel Bochsler,

Centre for the Study of Imperfections in Democracies, Central European University[°]

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Abstract

There are far-reaching expectations that electronic democracy will increase political participation, and include previously underrepresented groups in politics. For one aspect of e-democracy – remote electronic voting –, there is little real-world evidence to monitor such trends. In 2007, Estonia became the first country to organise national parliamentary elections in which all voters had a choice of casting their vote at traditional polls, or over the Internet. This study analyses individual data from a special survey of 1000 respondents, as well as aggregated election results from the 234 Estonian municipalities. Instead of attracting new voters, it seems, Internet voting mostly substituted for existing votes at the polls. Furthermore, instead of attracting social groups that usually abstain from elections, Internet voting has for the most part attracted the same politically well-established groups. If it is to have any effect on political participation, Internet voting seems poised to *increase* inequalities, rather than level them, but it could help those voters who live far from the polling stations to participate in elections.

Keywords: Internet and democracy; political participation; turnout; Estonia; aggregate data analysis.

Introduction*

Based on decreasing turnout in elections and referenda in the 1990s (Dalton, 2006: 36-37; Gray & Caul, 2000), scholars and politicians all too often lament people's loss of interest in democratic procedures and their growing alienation from society and democracy.[1] Both scholars and politicians hope that new technology will help citizens to participate in democratic processes, create new forms of citizens' involvement, and thus re-animate participatory democracy (Bimber, 1999; Krueger, 2002; Mossberger, Tolbert, & McNeal, 2007, etc.). Some have focused on the potential of new communications technologies, particularly the Internet.[2]

[°] Central European University, Nador utca 9, H-1051 Budapest, Hungary, E-mail: dbochsler@gmail.com

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[1] In many countries, turnout peaked in the 1950s and 1960s, followed by a general drop in turnout that included large countries such as France, Germany, and the United States.

[2] See Trechsel (2007a) for an overview.

This study investigates the consequences of the first—and so far, only—case of Internet voting[3] in national parliamentary elections, the Estonian Rigikoogu elections in 2007. In particular, my analysis aims to determine whether this new form of voting could increase turnout, and if it might lead to better representation.

Expectations for new communications technologies have been mixed. Some critics complain that the technology has contributed to the individualisation and de-integration of post-modern societies, eroding civic and political engagement, and resulting in a protracted decrease in voter turnout (Putnam, 2000). Others see new communications technologies as providing new democratic arenas and new channels for participation (see Stolle & Hooghe, 2005 for an overview of the discussion). By these means, it is thought that e-democracy could help to rectify the legitimacy problem that has crept up on democracies in times of increasingly weak participation.[4] However, the questions must be asked: do new forms of participation lead to new, increased participation, or do they simply substitute conventional democratic processes? Do they allow social groups that have previously been marginalized to be more closely involved?[5]

Empirical evidence on remote voting over the Internet (along with other novel communications technologies) has mostly been subject to limited experiments or for primaries or university elections, or and for local second-order elections.[6] Parts of this evidence stems from the US, from where turnout dynamics can hardly be generalised, due to the costly voter registration procedures. In 2007, Estonia became the first country to allow remote electronic voting in a national parliament election, giving us the opportunity to do the first analysis of Internet voting on turnout in a national parliamentary election. Several indicators show that the accessibility of the Internet in Estonia was already high in the period of the 2007 elections – so that a positive effect on turnout and political equality might already materialise. Estonia perceives new communication technology very positively; the IT sector is strong there, and Estonians are well-acquainted with computers and the Internet. Estonia had already allowed Internet voting in municipal elections two years before the 2007 national elections. Large parts of the population have Internet access at home, at work, or in public Internet stations, and in 2005, 76-percent of Estonian taxpayers declared their income tax via

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[3] While Internet is the most important way of casting a vote electronically from home, the office, or a public Internet point, there are other technologies that might also enable remote electronic voting. For the sake of simplicity, I speak generally of Internet voting in this study. Remote electronic voting should not be confused with electronic auxiliaries that may be used in physical polling stations for the purpose of casting votes (see Gibson, 2005 for technical aspects on electronic voting).

[4] For instance, Trechsel and Mendez (2005) discuss the introduction of e-voting as a strategy that the European Union might consider, as a reaction to low turnout in European Parliamentary elections.

[5] Liff and Shepherd (2004) argue that, despite the closing gap in numbers between male and female Internet users, the Internet could be shaped over the long term by the interests of early adopters—that is to say, male users—contributing to an enduring gender gap.

[6] Several countries have experimented with Internet voting in selected locations (see Gibson, 2005: 32-33 for an overview). For primary elections, see Gibson (2002), Solop (2002), or Prevost and Schaffner (2008). For experiments in regular elections, see (Auer & Trechsel, 2001).

the Internet (Trechsel, 2007b: 9) – using the same access points as they might have used two years later in the parliamentary elections.

National elections allow valid inferences from within-country variation of turnout – at the individual level and across territorial units. The focus on national parliamentary elections in a PR country allows me to investigate a case with fairly similar electoral competition across the country (while in local elections, turnout might be heavily influenced by local dynamics). In Estonian elections, significant parties are all present across the country, and the conditions are similar in all districts (see section four). Estonia is also well suited for my study of Internet voting's effects on turnout, since the social selectivity of turnout in Estonia is not very different from the European average. Income, education, age, and ethnic affiliation have all been shown to be relevant determinants of a person's probability to turn out at the polls (Gallego, 2007). Furthermore, previous research has scrutinized the social composition of Internet voters in the Estonian 2007 elections, by means of a special survey (Trechsel, 2007b).

From this research, it can be said that Internet voting has mostly addressed established social groups – people who have attained a certain level of education, and who are fluent Estonian speakers. However, such survey-driven research yields limited insight into the question of whether the Internet vote has generated genuinely *new* turnout—or if it has merely attracted voters who would otherwise have cast their vote at the polls. This issue is particularly pressing, since reasonably high and socially equal turnout is typically upheld as fundaments of democratic elections. Indeed, they are thought to constitute important bedrock qualities of a democratic process.

This paper considers Internet voting's effect on voter turnout and on the social selectivity of the voting process in the 2007 Estonian elections—employing various dynamic methodologies to accomplish its goal. After a review of the relevant pre-existing literature, I will address the burgeoning methodological problems of this area of study, and then analyse the available empirical data in three steps: First, I will undertake an analysis of the aggregated data, to see if the increased turnout in the 2007 Estonian elections can be related to the Internet vote; second, I will analyze individual electoral data to deduce trends in social inclusion brought about by in Internet voting.

Theory

The existing literature has vividly discussed the improvements that new communications technology may offer in the way of democratic participation. While pragmatic reasons have been suggested—focusing on the streamlining of the voting process, and the attendant efficiency gains for voters and for the election and referendum administration—these concerns have remained marginal. Indeed, visionary concepts prevail—notions that this new technology might remedy existing problems in representative democracies. Norris (2005: 60) summarises the situation thusly: "If citizens will not come to the polls, [...] why not bring the polls closer to the citizens?".

The early literature presented a "cyber-optimistic" picture, envisioning the Internet as a means to revolutionise the processes of democratic representation by including new groups of voters, and giving new legitimacy to the institutions of democracy (Krueger, 2002; see more in Trechsel, 2007a; Norris, 2001: 96-97). Furthermore, the digital medium was expected to enable a more comprehensive concept of electronically stimulated democratic control. Cheap and easy communication through the Internet was expected to decrease barriers to civic engagement, and such to diminish inequalities in public life. " [...] New technology will allow people to be far more knowledgeable about public policy issues, articulate in expressing their opinions, and active in casting their votes" (Norris, 2001: 235).

New communication technologies might foster participation in elections if they simplify the time-consuming process of voting, and thereby attract additional voters. To assess the potential effect of Internet voting on turnout, we need, however, connect several related aspects: the individual motivation not to vote and to what extent this is related to the costs of the voting process that might be reduced through the Internet vote, the social structure of the non-voters, and the social structure of the Internet users.

The potential effect of internet voting on turnout depends on the exact shape of the function that relates turnout propensities to the vote proportion of social groups (Grofman, Owen, & Collet, 1999: 361). As the Internet usage is a highly socially selective phenomenon, Internet voting can only ease voting for those who are already familiar with the Internet: that is to say, predominantly male, young people, the rich, and the well educated (Norris, 2001: 68-92). From this, it would seem that Internet voting seems poised to facilitate the voting process for those who are *already* well informed about politics and likely to participate in elections. Indeed, high education and high income are two of the three factors that correlate most strongly with political participation in North America, Western Europe, and in new EU member states (cf. Dalton, 2006; Gallego, 2007). With this in mind, I expect that those voters (and voter groups) who are most likely to use the Internet to vote already participate at a high level in government. This suggests that the convenience of online voting might mainly substitute conventional forms of participation (as argued by others, Alvarez & Nagler, 2001; Norris, 2001; Gibson, 2002), and only increase turnout marginally.

H1: Internet voting has the potential to reinforce social inequalities in turnout, particularly inequalities related to education.

H2: Internet voting mainly substitutes previous votes at the polls.

On the other hand, the literature has also shown that variation in turnout can be explained with age cohorts, and young citizens are particularly likely to belong to the group of election abstainers. The very same group, however, is most accustomed to use the Internet, so that the possibility of remote electronic voting might particularly reach this group of voters.

H3: Internet voting has the potential to reduce social inequalities in turnout, if they are related to age cohorts.

If hypothesis 3 were right, one could also expect that Internet voting would increase turnout slowly, having stronger long-term than short-term effects. Given the short period of experience with Internet voting, such hypothesis might be tested in the future.

Finally, we should look closer at the individual motivations why to vote or not to vote. The decision about political participation is determined, on the one hand, by the interest in politics and elections, and on the other hand in practical costs of voting.

While the Internet vote can only to a low extent be a remedy against general disinterest or dissatisfaction with politics, which leads to political abstention, it might have an impact there, where the practical costs of voting are high. According to the resource theory of participation, there are benefits and costs of participation (Krueger, 2002), and Internet might reduce these costs, and so attract more voters. This applies less to high registration costs of voting, as Internet voters need to register for the electoral lists as polling station voters need to, but to the voting process itself. Facilitating the voting process on the election day, by allowing remote voting, can increase participation (Luechinger, Rosinger, & Stutzer, 2007).

H4: Internet voting is particularly used by voters whose costs of voting at the polling station are high.

Previous findings

A substantial literature on Internet and citizen participation has highlighted the opportunities that new communication technologies offer for political debate and for citizens' participation in government processes (among many others, Krueger, 2002; Mossberger et al., 2007). The general picture shows that the Internet offers new chances for participative processes, but (in its early stage) it might be socially biased, especially reproducing educational (Krueger, 2002) and gender inequalities (Bimber, 1999), but it remains unclear whether they might decline in the long run, if the technology gets more spread.

Focusing on Internet voting, the empirical findings of experiments with e-democracy and primary elections provoke little excitement about the possibilities for rising turnout and the inclusion of politically marginalised groups. In the Arizona Democratic primary elections 2000, Internet voting was allowed, along with classical voting at polling stations. In the UK, Internet voting was allowed in local elections in selected municipalities, as an alternative to voting at the polling stations. Studies suggest that on both occasions, Internet voting increased the social selectivity of the voting process, attracting mostly voters with a high formal education (Solop, 2002; Norris,

2005: 84-85; Gibson, 2002).[7] Young citizens are the only ones who tend to have low participation rates in elections at polling stations, but who are slightly better represented among Internet voters (Norris, 2005: 84-85). Analysing the Estonian municipal elections 2005, Breuer and Trechsel argue that the social differences caused by e-voting can be traced back to the social selectivity of computer access and Internet use:

> "we found that e-voting is completely neutral with respect to such crucial variables as gender, income, education and the type of settlement – as soon as we control for our entire set of independent variables [computing knowledge[8]]. These results indicate that e-voting scores quite high on a scale of truly democratic procedures" (Trechsel, 2007b: 57)

And furthermore...

> "Had we found looming discrepancies according to gender or income, for instance, one could have easily criticized the new form of voting over the internet as introducing very un-democratic biases into the electoral process. This is clearly not the case" (Breuer & Trechsel, 2006).

To put it a different way: Internet voting is more popular among certain social groups, and Breuer, Trechsel and their co-authors show that this can be explained by the lower rate of usage of Internet use by persons with a lower socioeconomic status. Some authors have argued that the real effect of Internet voting can only be established, assuming the future possibility of "near-equal access" to the Internet (Krueger, 2002), in the Estonian case, this is close to be fulfilled – so that Internet usage is measuring the inequalities in usage, after near-equal access was established.

The discussion of the Internet vote's social selectivity does not answer the question of whether Internet voting substitutes for votes at the polls, or if it creates genuinely new votes, however. Most studies in this area have employed voter surveys to analyse the social structure of Internet voters (Gibson, 2002; Trechsel, 2007b; Breuer & Trechsel, 2006; Solop, 2002). But one can hardly estimate the substitution effect using surveys alone. Indeed, there might be a bias when estimating the number of new voters, and accordingly, one might analyse the structure of Internet voters without knowing which are genuinely new voters and what voters otherwise would have voted at the polls (Grofman et al., 1999).

Few studies have relied on methods other than surveys to analyse the effect of new forms of voting on turnout – which however would allow to capture possible substitution effects. They have studied the outcomes of elections, where new voting procedures were introduced only in certain

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[7] Prevost and Schaffner (2008) find that in the case of the 2004Michigan Democratic primary, where Internet voting was only accessible to voters who had previously applied for an absentee ballot, Internet voting was not more socially selective than postal voting. This, however, does not put the other results in question, given that the application for an absentee ballot is an additional time-consuming step, which itself is socially selective.

[8] See pages 47, 51-52 of the report.

regions, allowing them to test for effects on turnout through a quasi-experimental cross-sectional design. While postal voting seems to have an overall positive impact on turnout (Luechinger et al., 2007), internet voting had not the same effect, although in an early period (in UK local elections in 2003), when Internet access rates and usage were lower than today (Norris, 2005: 77).

So far, analysts have not employed aggregated data to study the effect of electronic voting on turnout in national elections. In nationwide elections with Internet voting, there is no cross-sectional variance in the voting rules, meaning that panel data are needed to estimate the effects of electronic voting. Variance in the usage of the electronic vote within a country might reveal information about whether e-voting increases the overall turnout. This is the first study that investigates the effects of nationwide e-voting on turnout, using aggregated data.

Data and study design

This study employs both individual and aggregated data to analyse voting behaviour in the 2007 Estonian elections, as compared to previous Estonian national elections. This data allows me to investigate the social selectivity of the Internet vote, and to estimate the magnitude of the substitution effect of the Internet vote, relying on municipal differences in turnout at the polling stations and in Internet turnout. I also control for alternative explanations which might explain changes in turnout. My model includes changes at the supply side of the electoral market, which might lead to changes in political participation, and a series of control variables most commonly investigated in studies of turnout.

Electoral participation can, on the one hand, be driven by the degree of electoral competition – relying both on the closeness of the electoral results (which make it more plausible that mobilisation of voters might affect the outcome) and the list of competitors running in elections. As Estonia elects its parliament under proportional representation with similar conditions in all districts,[9] we can expect that the effect of the closeness of the competition is similar across the country, and not affected by the electoral district. However, there are two remarkable changes remarkable changes to the electoral supply between the 2003 and the 2007 elections in Estonia, which might lead to (de)mobilisation effects in the strongholds of two parties. The *Estonian Greens* (Erakond Eestimaa Rohelised, EER) was noticed for the first time as a new competitor in the 2007 national elections in Estonia, and it was the most important newcomer party, winning 7.1% of the votes and 6 out of 101 available seats. Despite roots going back to the late 1980s, the Greens only registered as an official political party in November 2006; they ran with their own list for the first time in March 2007 (Sikk & Holmgaard Andersen, 2009). Therefore, even if they may not be a new political organisation, technically speaking, they certainly were perceived as a new electoral competitor.[10]

[9] In similarly large electoral districts with a national 5% threshold and nation-wide compensation of mandates (so that district size does not matter primarily for the seat allocation), with all major parties running nationwide.

[10] In the case of the Baltic states, the environmental movements of the 1980s promoted the interests of partisans of ethnic nationalism and independence from the Soviet Union— or, as many ethnic Estonians perceive it, promoted

Differently, *Res Publica*, which competed as new party in 2003, stressed its newness in the electoral campaign. As a new party, it may have attracted voters who were disappointed by the established parties, causing them to go to the polls in order to vote for *Res Publica*. Three years later, the party had left many of its voters disappointed, having failed to deliver on many of its promises (Taagepera, 2006; Solvak & Pettai, 2008). Subsequently, it transformed form a newcomer party to one of the pillars of the government, and it merged with an established Estonian party, the Pro Patria Union (Isamaaliit). Because of this, anti-establishment voters, who might have supported the newcomer in 2003 instead of abstaining, may have turned away by 2007.

Further, I control for socio-economic variables, especially typical parameters of social cleavages, which are commonly used in studies of electoral behaviour, and which can explain territorial differences in voting behaviour in Estonia and explain variance in turnout. In the aggregated data model, these are tax revenues per capita (as a proxy for wealth), the ethno-linguistic composition of the municipality, and the economic sectors. In the individual data model, these are gender, education, income, age, and ethno-linguistic identity. A measure of the (perceived) distance to the next polling station allows me to operationalise my fourth hypothesis – the impact of costs to vote at the polling station.

Individual-level data from surveys can characterise the electorate of certain parties, or help to distinguish voters from non-voters. But the availability of survey data is often limited to a few elections, and typically does not allow us to trace voters' behaviours over time. Furthermore, surveys have some difficulty tracking counterfactuals—such as the question of whether a change in some explanatory variables may lead to a change in voting behaviour—since surveys are poorly suited for hypothetical questions (Grofman et al., 1999). This in turn makes it hard to estimate the effect of Internet voting on an electorate's behaviour using surveys—and difficult for us to understand people's voting behaviour in the absence of Internet voting. Even individual panel data cannot inform us as to whether a possible change in voting behaviour was induced by changes in the voting procedures, or other factors.[11] A long-term study of turnout at the individual level might allow us to evaluate whether Internet voters are similar to groups of citizens who had previously abstained from participation in elections. But individual election data on Estonia is quite rare. In addition, respondents to the 2007 survey were not asked about their participation in the 2003 parliamentary elections. Because of this, we lack information about the hypothetical behaviour of Internet voters, and cannot speculate as to how they might behave if there were no Internet vote.

Apart from individual data, I also employ aggregate data taken from 234 Estonian municipalities and city districts. Only one out of thirty entitled voters exercised the option of voting

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independence from the Russian influence sphere. It is to be expected that the EER, given its legacy, will continue to find major support among (pro-independence) Estonian-speakers than among speakers of Slavonic languages.

[11] Furthermore, the introduction of Internet voting might have indirect effects on non-electronic voting, too. For instance, Internet voting should reduce queues at polling stations; this might attract previous abstainers to vote in polling stations, or it might make social control of the voting process impossible, and thereby decrease turnout.

online. Nevertheless, there was substantial variance in electronic turnout between municipalities and social groups.

Aggregated data have often been employed to study electoral behaviour, especially when no accurate individual data has been available (cf. Achen & Shively, 1995; King, 1997; King, Rosen, & Tanner, 2004), and if social groups live in a (partly) territorially segregated fashion. In Estonia, this is the case for ethno-linguistic minorities, who are overwhelming majorities in a few localities, and are not present in others. For the other explanatory variables in play, there are no clear-cut territorial boundaries, and aggregated data analysis could lead to ecological fallacies. In order to minimise such risk, I have complemented my analysis of aggregated data with survey data analyses, for all those aspects that can be studied with the available cross-sectional survey data.

In my analysis, I have chosen to focus on whether remote electronic voting has helped to increase turnout in the Estonian elections in 2007, compared to the previous national elections in 2003. I control for whether the increase might be due to a general trend, independent of e-voting (constant for the whole country), or whether there might be other factors that explain the change in political participation.[12] Among the models used to analyze aggregated voting data, the Goodman regression model allows for the inclusion of a constant (measuring the general trend) as well as control variables—even those that do not occur in the form of a percentage of a population, such as tax revenues per capita in the present example (Achen & Shively, 1995). Goodman regressions are OLS models, adopted for aggregated variables. They allow the inclusion of non-transformed percentage points both as independent and as dependent variable.[13]

Does the e-vote increase turnout? The Estonian 2007 elections

Estonia was the first country in the world to allow its voters to cast their vote over the Internet in countrywide parliamentary elections in 2007 (a process that took place four to six days in advance of the election). Voting was enabled by electronic ID-cards, which are used widely in Estonia, and which allow for a voter to be electronically identified. As an alternative, voters could still vote at

[12] Those ecological inference models that attempt to elucidate individual voters' behaviour from aggregated data (King, 1997) are not very helpful for the purposes of this study. Attempts to explain individual voters' behaviour in this fashion are best used if *only* aggregated data is available. Methods have now been developed to track correlations between the voting behaviour of individuals and of social groups. Models that are aimed at analysing the behaviour of individual voters or social groups, compared to the previous elections, help to describe how certain voters have changed their voting behaviour (such as voting electronically, after having abstained in previous elections), but this does not allow any conclusions to be drawn about the reasons for their changing behaviour. The same problem applies to Thomsen's (1987) logit regression model, which analyses changes in the voting behaviour in two elections. Tests using the Thomsen model (available on request) lead to contradicting results when the baseline category is changed.

[13] This method has been criticised (see King, 1997: 56-68; Achen & Shively, 1995) because it can yield unrealistic values, violating basic mathematical parameters. For example, it can lead to unreal estimates, suggesting that certain groups vote at more than 100% or at less than 0% for a certain option. This might occur if effects are falsely assumed to be linear, or if the parameters that I test are not constant across observations—something that is a genuine problem of ecological data analysis. While the Goodman model does not capture heteroskedasticity, I am careful to calculate robust standard errors, controlling for heteroskedasticity. Furthermore, I control for whether some of the variables may violate the natural bounds of 0% or 100%. Finally, other ecological inference models do not provide robust results if data varies only over a small portion of its possible range, as in the case of Internet-voting, which is used only by small parts of the registered voters (King, 1997: 73)

the polls on Election Day. The same system had been used two years earlier in the local elections (Breuer & Trechsel, 2006; Madise, Vinkel, & Maater, 2005). The Internet voting procedure has been described as fairly difficult, while the paper ballot at the polls has generally been recognized for its simplicity. (For a technical description of the voting procedure, see Alvarez, Hall, & Trechsel, 2008.)

	mean (weighted)	std dev (weighted)	min	max
Turnout				
Turnout 2003 at polls	57.3%	6.2%	41.9%	94.9%
Turnout 2007 at polls	57.9%	5.0%	42.4%	70.8%
E-vote share 2007	3.4%	1.5%	0.0%	10.1%
Change in turnout at polls, 2003-07	0.6%	0.3%	-24.1%	18.1%
Party votes at the polls				
Green party (EER), 2007	6.9%	2.5%	0.0%	20.0%
Green party (EER) * Turnout 2007	4.0%	1.6%	0.0%	9.8%
Res Publica (RP), 2003	24.7%	6.6%	0.0%	68.2%
Res Publica (RP) * Turnout 2003	14.2%	4.3%	0.0%	42.1%
Socio-economic variables				
Tax revenue per capita, 2006 (log)	8.642	0.307	7.465	9.720
Eastern Slavic languages, %[a]	24.1%	25.1%	0.3%	95.8%
Linguistic heterogeneity[b]	0.120	0.083	0.003	0.250
Primary sector, %[c]	7.7%	10.0%	0.0%	51.9%
Secondary sector, %[c]	30.9%	8.1%	6.8%	67.1%

Table 1: Descriptive statistics (mean of all 234 municipalities, importance weighted by the number of registered voters).

Sources: Sikk & Bochsler (2008) and Estonian Electoral Commission for figures on the e-vote.
Notes: The turnout figures do not include any invalid votes (since they are not available at the municipal level. The political parties' vote share slightly differs from the actual vote share, because only the votes cast at the polls are available at the municipal level (the Green party's actual vote share, including e-votes, was 7.1%).
a. The main linguistic cleavage in Estonia divides speakers of Eastern Slavic languages (Russian, Ukrainian, Belarusian) from other inhabitants. Russian speakers dominate the Eastern Slavic community in numbers, and Ukrainians and Belarusians seem to behave similar to them politically (Sikk & Bochsler, 2008).
b. The variable linguistic heterogeneity measures the intensity of ethnic conflict in the partisan model. It is calculated as the product of the share of speakers of Eastern Slavic languages and speakers of other languages.
c. The primary sector is defined as agriculture and fishing; the secondary sector is defined as mining, industry and construction.

From 2003 to 2007, voter turnout in Estonia rose by 4%. Even if Internet votes (3.4%) are not counted, a tiny increase in turnout remains evident (see table 1; n.b., figures do not include invalid votes). However, a causal link between the introduction of Internet voting and increased voter turnout is not evident. Voters who went to the polling station were not necessarily the same in both elections. Various time-related circumstances, which are not linked to the voting procedure, may explain the increase in turnout. I argue that, if the boost of the turnout was due to the introduction of e-voting, then the municipalities with a high e-turnout should show a particularly strong increase in turnout. Inversely, municipalities with less prevalence of Internet voting should demonstrate lower

rates of turnout increase, after controlling for other explanations of changes in turnout, such as political or socio-economic effects.

I investigate whether *e-turnout* (the vote share cast over the Internet) had a significant effect on the change in turnout at the polls from 2003 to 2007. If higher e-turnout did not affect turnout at the polls this would indicate that Internet votes were genuinely new, and that these Internet votes increased the overall turnout. If higher e-turnout were related to lower turnout at the polls, however, the results would suggest the presence of a substitution effect, with electronic votes replacing conventional voting instead of increasing overall turnout.[14] My two models - a political and a socio-economic one – further control for alternative explanations which might explain the same results.[15]

First, I estimated a voter stream model, to show how groups of voters changed their electoral behaviour between 2003 and 2007, using a Goodman regression model and aggregated results. Figure 1 shows a summary of the results of the analysis (for detailed results, see appendix). The model first shows that (non-)participation was highly stable. Out of six voters who went to the polls in the 2003 elections, almost five did so again four years later, and additional 8% voted online. 80% of the abstainers in 2003 decided not vote either in the 2007 elections. Hence, more previous abstainers decided to go to the polls in 2007 than vice-versa. After controlling for partisan and socio-economic factors, the models suggest that there were hardly any Internet voters who abstained in the previous elections (the models report a value slightly lower than 0%).

[14] Such analysis can make only limited interference about the behaviour of individual voters. An analysis of aggregated data can not measure factors that do not vary or that vary only slightly in the territory (such as gender or age groups). Furthermore, aggregated analyses have difficulty with interactive and non-linear effects when they are not controlled for. However, this problem can certainly occur in research with individual data as well.

[15] I have measured the vote share of *Res Publica* and the vote share of the Green Party as percentages of the overall number of registered voters. These variables possess the advantage of having the same denominator as the dependent variable—turnout—and they allow for a direct estimation of the impact of the Res Publica and the Green Party vote on turnout. However, one must be careful in implementing these variable; if the Green vote share and Res Publica vote were related to turnout (or, would be constant), then the variables employed (*Green Party vote * turnout07*; *RP vote * turnout03*) would be linear transformations of turnout in 2003 and of turnout in 2007, and accordingly, would almost perfectly estimate the dependent variable. This is why I have also calculated the model with a conventional operationalisation, using the number of valid votes as the denominator. The alternative operationalisation leads to almost identical results—a fact that reassures me that the preferred solution is no transformation of turnout.

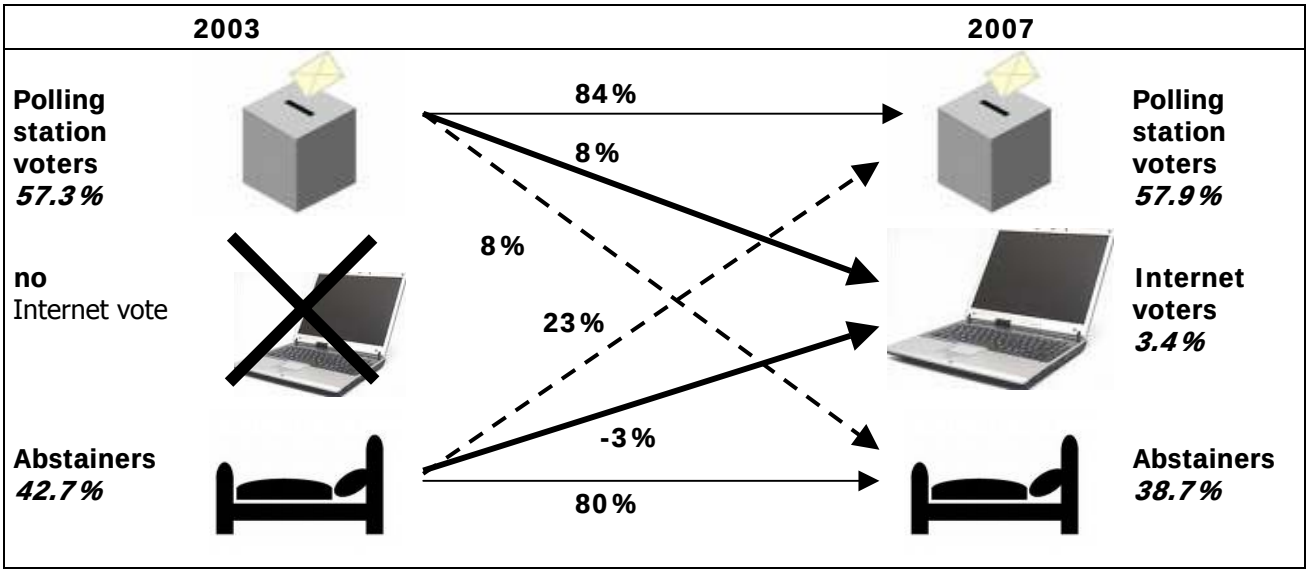

Figure 1: Voter stream between 2003 and 2007, vote at polling station, on the Internet and abstainers. The voter streams are calculated relatively to the 2003 figure.

Calculation based on seemingly unrelated regression models, with partisan control variables. (For the figure, partisan control variables are set at their mean.)

Effect on turnout, model with political party control

The voter stream models highlight specific *patterns*, of how certain groups of voters changed their behaviour from one election to the other. The second model estimates the overall effect of e-voting on turnout. This would be the case if overall turnout rose more in municipalities where more voters used the Internet vote, than in municipalities demonstrating relatively less incidence of Internet voting. I assume that turnout at the polls in 2007 was closely related to turnout in 2003, and that differences in turnout can be explained by either the introduction of the Internet vote (substitution effect), by a general effect (which is constant across the whole country), by other, exogenous factors (socio-economical or political explanations), or randomly. The assumption that 2007's turnout is closely related to 2003's is realistic; both correlate with a Pearson coefficient of 0.87 (municipalities weighted by the number of their inhabitants). I will estimate the results of the following model, in order to explain my dependent variable $diff_{polls03\_07}$.

$$\text{diff}_{\text{polls03\_07}} = \text{turnout}_{\text{polls07}} - \text{turnout}_{\text{polls03}}$$

$$\text{diff}_{\text{polls03\_07}} = \alpha + \beta_1 \cdot \text{e-turnout07} + \beta_x \cdot \text{control variables} + \varepsilon$$

	Political model (1)		Socio-economic model (2)	
	β -Coef.	Robust Std. Err.	β - Coef.	Robust Std. Err.
α	0.015	0.010	-0.465	0.140
e-turnout 2007	-0.799**	0.263	-0.986**	0.360
voteRP 2003 * turnout 2003	-0.118(*)	0.061		
voteEER 2007 * turnout 2007	0.841**	0.212		
Tax revenue per capita (log)			0.055**	0.017
slavic%	0.002	0.020	-0.021	0.019
ethnic heterogeneity				
primary sector			0.069(*)	0.036
secondary sector			0.087*	0.041
N	234		234	
R^2	0.150		0.200	

Table 2: The party model (model 1) and the socio-economic model (model 2) to explain the differences in turnout at the polls, 2003-2007.

Non-standardised regression coefficients and standard errors. OLS regression with robust standard errors; cases weighted by the total number of registered voters in 2007.

The estimations (table 2) suggest that e-voting was linked to a strong substitution effect: in municipalities where Internet voting was used at a higher rate, turnout at the polls increased much less than in municipalities where only few voted online. The political model (1) estimates that for every 100 Internet votes cast online in a municipality, 80 less voters were frequenting the polls, meaning that only few Internet votes seem to be genuinely new. Turnout seems to have increased for two reasons. First, there was a general increase in turnout (approximately 1.5%, which is constant in the model) linked to the Internet voting. It does not vary to the extent that Internet voting was used in different municipalities. Second, the emergence of the Green party coincides with a substantial increase in turnout in Green strongholds. For every 100 votes cast for the Green party in a municipality, the turnout at the polls increased by approximately 84 votes, which could signify that the Green party was reviving electoral competition. On the other hand, the merger of Res Publica seems to have had only a small effect on turnout. For every 100 votes that it received in a municipality in 2003, only 12 voters abstained in 2003. Either, Res Publica did not attract many new voters in 2003, or these new voters could not be convinced to remain politically active on a long-term basis. (This data does not imply that the new voters were identical to the voters for the new party, or that Res Publica's 2003 voters and the 2007 abstainers are identical.)

The success of the Green party was most pronounced in areas with affluent populations – areas where turnout has generally increased more than elsewhere – and the party gained few votes in areas with strong concentrations of Eastern Slavic minorities (Russians, Ukrainians, Belarusians),

and in ethnically heterogeneous areas. Internet voting also saw its greatest use in affluent municipalities, and less use in agricultural and industrial areas, as the second model shows.

In the second model, I test for whether socio-economic variables might explain the boost in turnout in 2007.[16] The results show an even clearer picture than the partisan model: the model suggests that the Internet turnout almost completely substituted previous turnout at the polls. For every additional 100 votes cast on the Internet, the votes at the polls declined by some 99 votes. The increase in turnout, however, seems to be driven by more affluent areas and, to a lesser extent, by areas with a weak tertiary sector. The change in turnout correlates positively with the average personal income tax revenue per capita (data from 2006, logarithmised), with the share of employees in the agricultural sector (numbers incl. fishing), and with the share of employees in the industrial sector (incl. mining, construction). (nb: The constant can not be interpreted directly, because the variable measuring taxes is not bound between 0 and 1.) While there was a lower degree of use of the Internet voting in areas with strong concentrations of Slavic speakers (see below), language did not affect change in turnout at the polls between 2003 and 2007. Slavic speakers vote less frequently than Estonian speakers, but no statistically significant increase in the gap is apparent.

In sum: once the emergence of the Green party or the social structure of the municipalities is controlled for, Internet voting can not explain the increase in turnout.

Models with individual data

While the previous models provided insight into the overall, aggregated effect of e-voting on turnout—and are best-suited for investigating counterfactual questions about plausible turnout levels in the absence of e-voting—individual voter behaviour can only be investigated with survey data. Individual data analyses on electoral turnout in Estonia remain rare so far.[17] This study employs a special survey of the 2007 parliamentary elections, including 987 respondents. The survey was designed on purpose to capture the small group of Internet voters, they were over-sampled, and count 367 respondents. Over-sampling was possible, as the authors of the survey could draw them randomly from the list of voters who voted online (Trechsel, 2007b).

The decision of whether to vote at the polls, online, or to abstain from voting is a decision with three unordered possible outcomes—a situation that can best be analysed with a multi-nominal logistic regression model. I have weighted the single cases in the sample in order to get a distribution of voters across the three outcome groups that conforms to reality.

While most electoral surveys ask only indirect questions about the costs of voting, respondents to the survey at hand were asked about the distance they travelled to their polling station (figure 2). The vast majority of polling station voters were able to reach their polling station in half an hour or

[16] Sikk & Bochsler (2008), Sikk & Holmgaard Andersen (2009).
[17] One of the few exceptions, Gallego (2007), is discussed in the introduction.

less. Among Internet voters, however, there were many fewer voters who lived very close to a polling station. The overwhelming proportion of the Internet voters cast their vote in 10 minutes or less, and only a few thought they could have voted at the polls as quickly (figure 3).

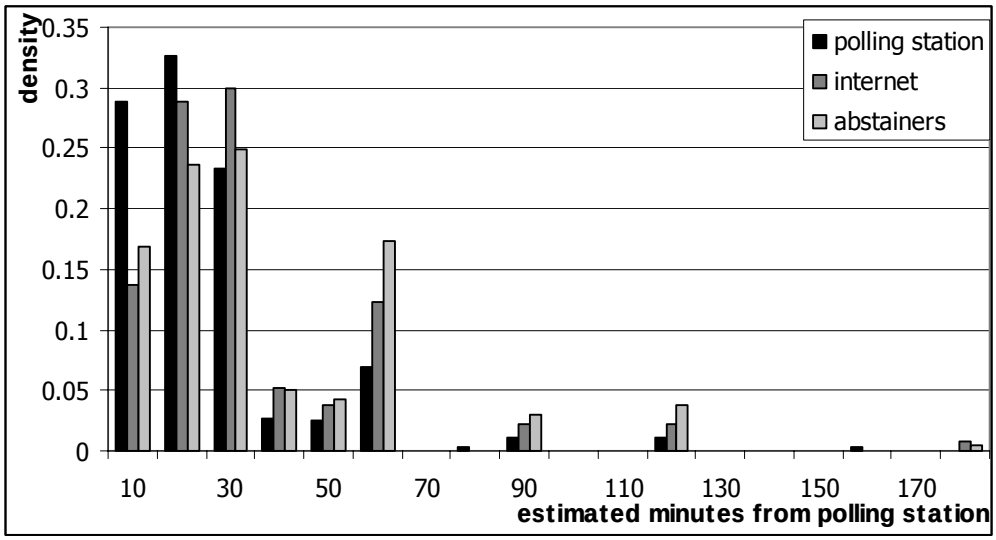

Figure 2: Estimated distance to polling station in minutes; polling-station voters, Internet voters, and abstainers. (N=974; 13 missing cases excluded.)

Original question: "How long did or do you think it would have taken you to go from your home to your polling place, cast your vote and get back?"

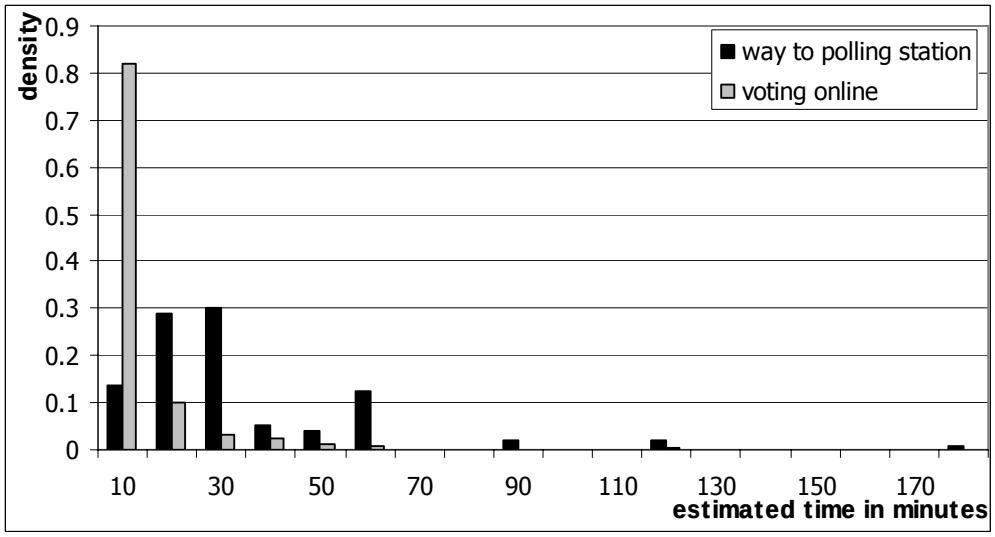

Figure 3: Comparison of the estimated time to cast the vote at the polling station or to vote online, only Internet voters. (N=362; N=364; 3 respectively 5 missing cases excluded.)

Original question 1: "How long did or do you think it would have taken you to go from your home to your polling place, cast your vote and get back?"
Original question 2: "How long did it take you to vote over the Internet?"[18]

For the multivariate analysis, I used the logarithm of the distance, since the effect of a marginal change might decrease for long distances. The results bore this out, showing that turnout and voting method depended heavily on this variable. Voters who lived close to their polling station were

[18] This variable can not be included in any analytical model of voting behaviour, because a large part of no€n-Internet voters could not answer it. Its inclusion would exclude many respondents, and probably also lead to a selection bias.

likely to vote at the polls, and hardly any of these voters chose to use Internet voting. As distance from the polls increased, however, voters more frequently abstained from voting or used the Internet (figure 4). The 360 sampled voters who voted over the Internet and answered both questions indicated that they saved an average of 25 minutes;[19] furthermore, 81% indicated that it would have taken them at least twice as long to go to the polls as to vote over the Internet. No single Internet voter indicated that electronic voting was more time-consuming than going to the polls.

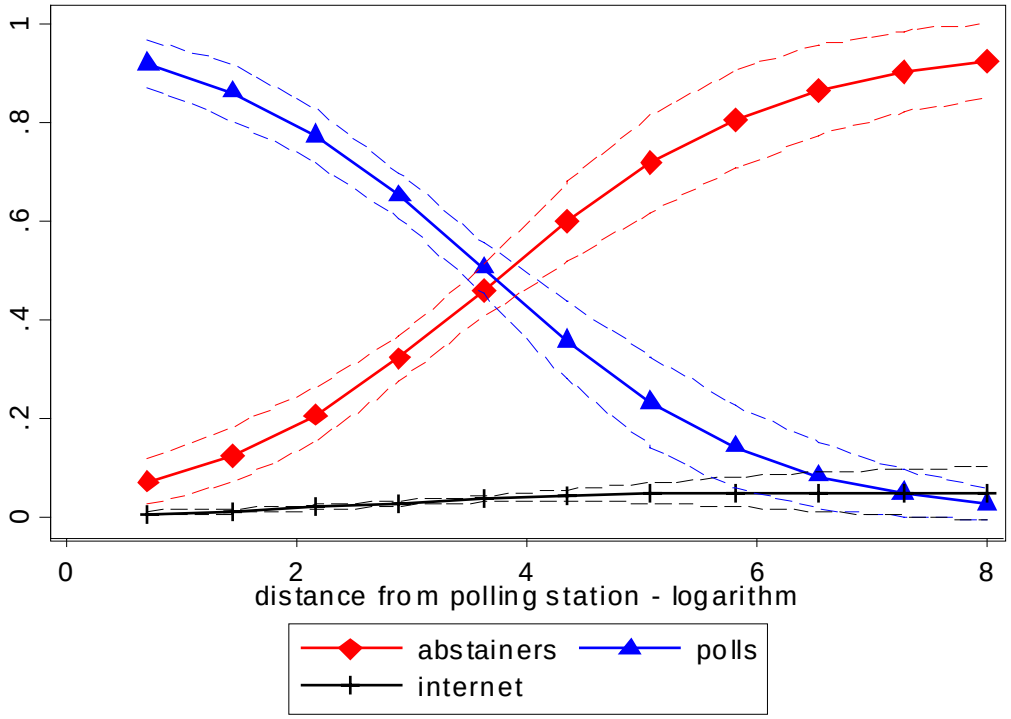

Figure 4: Distance from the polling station (log) and estimated probability of voting, abstaining, or voting through the Internet (all other variables at their mean).

Here, an explanatory model for voting behaviour can best be estimated using a *multinominal logit* model. There are three possible choices for voters: not turning out, going to the polls, or casting their vote online. I weight each case, to help control for possible biases that could result from over-sampling of the Internet voters. This allows me to estimate the probability of each of the three outcomes.[20]

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[19] After dropping one outlier that would have travelled 60 hours to the polls.

[20] Other researchers have focused solely on the voters—analysing their decisions to cast their vote at the polls or online (Trechsel, 2007b; Breuer & Trechsel, 2006). By contrast, I consider the abstainers, too. The possibility of casting one's vote online might make a difference for citizens when they decide whether they should vote or not.
Methodological differences lead to a drop in the R^2 of my model, compared to others. Being interested in the sociologic and political inclusion effect of Internet voting, I do not include any variables related to voters' use of computers, or voters' trust in the electronic voting procedure. Such control variables might absorb possible sociological or political effects. I am interested in finding out how the digital divide affects the political behaviour of different social groups, rather than looking at whether computer abilities make it more likely for voters to vote online. Due to the weighting of the cases, R^2 drops from 14.7% to 9.4%, and to 7.3% with the application of a multi-nominal logit model.

Dependent variable (voting behaviour)	abstainers	voters at polling station	Internet voters
weighted distribution	243 (25.0%)	364 (37.4%)	366 (37.6%)
distribution after weighting	38.8%	57.8%	3.4%

Explanatory variables	coding scheme	mean (weighted)	std dev (weighted)	min	max
language	1 = Estonian, 2 = Russian[a]	1.180	0.385	1	2
education degree	1 = elementary/basic; 2 = secondary ed./gymnasium; 3=vocational secondary ed.; 4=higher	2.726	0.976	1	4
age	years	47.383	17.969	18	92
income	monthly, 1 = ≤ 1500 EEK; 2 = 1501-3000 EEK; 3 = 3001-5000 EEK; 4 = 5001-7000 EEK; 5=7001-10000 EEK; 6 = > 10000 EEK (16 EEK ≈ 1 Euro)	3.392	1.185	1	6
gender	1 = male; 2 = female	1.590	0.492	1	2
away (ln)	distance in minutes from polling station (ln)	3.102	0.764	0.693	8.189

Table 3: Descriptive statistics of variables employed in the multi-nominal logit model, N=978. (Importance weighted in order to establish the real distribution of the dependent variable.)

[a] There was no question directly identifying respondents' native language or ethnicity; however, interviews were conducted in either Estonian or Russian. Estonian speakers and Russian speakers are the two largest linguistic groups in Estonia, counting some 97% among Estonian citizens in 2000 (source: Estonian Statistical Office). It is not possible, however, to identify members of other ethnic groups.

Figure 5 displays the main results of the multinominal logit analysis graphically. It shows voters' likelihoods for voting at the polls, online, or to abstain, based on their level of education and for the two main languages used in Estonia. Estonian-speakers are much more likely to vote than Russian-speakers, both at the polls or online, even after controlling for several other factors, such as education, income, age, and gender. Among Russian-speakers, the chances of voting on the Internet are between 0% and 0.5%. Both Estonian- and Russian-speakers who have higher formal education levels demonstrate a considerably higher propensity to vote; among highly educated citizens, the differences in voting between both language groups are smaller than among Russian-speakers with less formal education. The share of Estonian-speakers with a higher educational degree who votes online is about 6%, compared to 2% for those who hold only an elementary school diploma (after controlling for other variables). This figure shows that Internet voting does not complement turnout at the polling station through addressing politically underrepresented groups of voters. Indeed, it seems that Internet voting instead attracts groups of voters who frequently already go to the polls.

The differences in turnout between the language groups might be related to the specific nature of Internet voting in Estonia in the 2007 national election. Casting a vote electronically required a few more steps than voting at the polls, and explanations were available only in Estonian (they were not provided in Russian or in any of the other Slavic languages frequently spoken in Estonia). It is worth noting, however, that in order to get Estonian citizenship and participate in elections, most

Slavic speakers in Estonia must prove their fluency in Estonian as part of a test, and so a large percentage of them would likely be able to follow the explanations for Internet voting.[21]

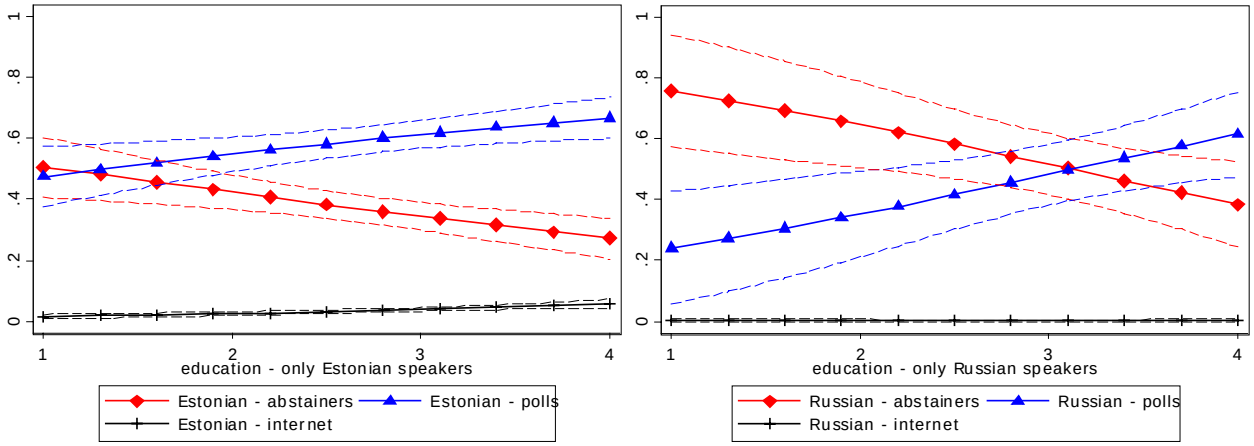

Figure 5: Voting behaviour by linguistic group and by degree of education (1 = minimum, 4 = maximum). Based on two separate multinominal logit models for Estonian speakers and for Russian speakers (table 4).

Further, we spend attention to the age structure of voters – one of the key determinants of turnout (Franklin, 2004; Blais, Gidengil, Nevitte, & Nadeau, 2004). We find that Internet voting is particularly popular with middle-aged citizens, in the group of 40-50 years old, where above 4% of the citizens voted online, compared to 2% among the 18 or 20 years old and among older voters (our operationalisation captures the curvilinear pattern of age differences with a quadratic function). Age is also an important explanation of voting in Estonia, where older citizens are more likely to vote than younger ones (see also Gallego, 2007: 6). This leads to a mixed conclusion. Internet voting could potentially reduce the age gap in voting, in attracting more middle-age citizens (who are currently underrepresented in the voting population, compared elderly voters), but so far, it still does not attract young voters in sufficient numbers to reduce their under-representation in the voting population.

Internet voting proved unable to include groups who have been less politically active in the voting process (table 4). Indeed, it would seem that the Internet vote attracted citizens belonging to social groups that were already more likely to vote than others. Most factors that explain the Internet voting of individual voters are also negatively related to abstaining, (compared to the reference category, voting at the polling station). In general, Internet voting is popular among better educated people with higher incomes, and among native speakers of the Estonian language. The same analysis also shows that voters who fulfil two out of the three criteria—education and language—are over-represented among the voters turn out at the polls. The apparently positive (but not statistically significant) effect of income on abstaining disappears when education is not included in

[21] The same problem arose in the local elections two years earlier (Breuer & Trechsel, 2006).

the model, and seems to be caused by the collinearity of both variables.[22] Furthermore, my study is in line with earlier findings (Trechsel, 2007a: 117), showing no clear gender gap in electoral participation in Estonia. The results remain stable when the distance to the next polling station is accounted for (model 2), as in the model that includes only socio-economic variables (model 1).

	(1) Whole survey		(2) Whole survey		(3) Only Estonian-speakers		(4) Only Russian-speakers	
vote	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.	Coef.	Robust Std.Err.
- abstainers (reference category: polling station voters)								
language	0.667 **	0.221	0.798 **	0.234				
education	-0.347 **	0.097	-0.395 **	0.105	-0.318 **	0.108	-0.537 *	0.231
age	-0.0004	0.034	0.010	0.035	-0.004	0.039	0.047	0.072
age^2	-0.0003	0.0004	-0.0005	0.0004	0.0003	0.0004	-0.001	0.001
income	0.039	0.077	0.112	0.079	0.055	0.085	-0.040	0.186
gender	-0.151	0.181	-0.137	0.188	-0.056	0.197	-0.766	0.501
away (log)			0.837 **	0.136				
constant	0.645	0.851	-2.459	0.939	1.079	0.928	3.008	1.840
- Internet voters (reference category: polling station voters)								
language	-2.408 **	0.449	-2.305 **	0.456				
education	0.264 **	0.097	0.230 **	0.102	0.280 **	0.100	-0.411	0.642
age	0.099 **	0.032	0.108 **	0.034	0.104 **	0.034	-0.029	0.104
age^2	-0.001 **	0.0003	-0.001 **	0.0004	-0.001 **	0.0004	0.0009	0.001
income	0.355 **	0.073	0.420 **	0.079	0.362 **	0.075	0.349	0.337
gender	-0.149	0.172	-0.135	0.180	-0.088	0.177	-1.857 *	0.938
away (log)			0.736 **	0.121				
constant	-3.691	0.928	-6.414	1.058	-6.368	0.885	-1.286	4.132
N	973		960		854		119	
R^2	0.076		0.123		0.059		0.102	

Table 4: Multinominal logit regression for voting participation (abstainers, polling station voters, Internet voters); cases weighted to correct for over-representation of Internet-voters in the sample.
Note: To check for a possible violation of the assumption of independence of irrelevant alternatives (IIA), repeated Small-Hsiao tests were conducted, indicating that the null-hypothesis cannot be rejected.
The second model includes fewer cases due to missing values for the distance variable.

Conclusion

In recent elections, Internet voting has attracted wide interest, spurring hopes that communications technologies may lead to increased voter turnout, and lead to the inclusion of voting groups that had typically abstained from elections. Estonia was the first country in the world to allowed Internet voting in national parliamentary elections, and it therefore serves as an important locus for studying the state of—and prospects for—e-democracy.

Different datasets and methodologies have led us to the same conclusion: that the Internet vote in the 2007 Estonian elections was socially unbalanced, and drew a disproportionate share of voters

[22] The Hausman test is satisfactory at the 95% level.

with a high formal education, and who resided in affluent, Estonian-speaking areas. Hence, the digital divide is reproduced in a political divide. This adds to existing inequalities in political participation, as the Internet tends to exclude social groups that have previously been underrepresented in the politically active part of the population (Gallego, 2007; Dalton, 2006), and reinforce educational, income inequalities and ethnic inequalities (Russian-speaking minorities). All these groups are even more underrepresented among Internet voters in Estonia than they already were. In the Estonian case, this might also lead to a potential partisan bias, as certain parties – particularly the ones belonging to the new governing coalition and the newly competing Green party – have proven particularly successful with Internet voters. The oppositional Centre Party, which attracts a higher proportion of ethnic minorities in Estonia, along with a few smaller minority parties, won hardly any of the votes cast on the Internet.[23]

Whether this effect pertains in the long-run can only be subject to (informed) speculations, and depends particularly on the question whether the current digital divide vanishes – not only with regards to expected increase in internet access, which is already very high in the Estonian case – but most importantly with regards to familiarity with Internet usage.

Based on these facts, Internet voting seems poised to accentuate the pre-existing exclusivity of political participation, instead of diminishing it. However, the Internet vote is particularly attractive to those voters who spend considerable time to reach the polling station – about half of the Internet voters indicated that they would have spent half an hour or more to reach the polling station. Many of these voters might not live in their official residence, either living in another place within Estonia, or abroad. The Internet is an important way to assure their participation in elections, but the number of persons concerned is not very high: the distance to the polling station was considerable at maximum for 1-2% of the electorate (considering that only 3.4% voted online).

These results do not suggest that the addition of Internet voting could increase voter turnout. Instead, it seems that—with a few possible exceptions—votes cast online mainly substituted for votes that would have been cast in polling stations, had the option of web voting been absent. Certainly, turnout in the 2007 Estonian elections increased by some 4% when compared to the 2003 elections. However, as I have noted, this can be explained by other factors. On the one hand, there was a genuine increase in turnout of about 1.5% across most municipalities—regardless of whether the Internet vote was used or not. Further increases of turnout can be explained through the entry of the Green party in the 2007 elections, which attracted voters in affluent, Estonian speaking areas, and in ethnically heterogeneous ones. After controlling for either political or socio-economic variables that might explain changes in turnout, it appears that Internet voting had no additional effect. Instead, the overwhelming part of Internet votes seems to have substituted turnout at the

[23] Analysis available from the author on request.

polling stations. Against the background of the social selectivity of the Internet voting, this is reassuring. While the Internet vote attracted a socially and politically specific part of the electorate to a great extent—particularly among politically well-established groups—there is little reason to believe that the same votes would not have been cast at the polls otherwise. However, should the Internet vote in other circumstances manage to attract new voters, the Estonian experience teaches us that it might increase social inequalities in political representation.

Certainly, this does not yet inform us about the long-term effects of Internet voting, and rightly, some parts of the literature would argue that turnout is determined by long-term habits (Franklin, 2004) – and that Internet voting can only have a socially equal effect, if large parts of the population have access (Krueger, 2002). It is worth to note, though, that citizens in Estonia have very wide Internet access – 76 percent used the Internet to fill in their personal tax declaration in 2005 (Trechsel, 2007b: 9) – and even if the tradition of Internet voting is still young, the investigated national elections were the second in a row, after Internet voting was first introduced for the local elections in 2005.

However, this does not mean that Internet voting has had no effect in the 2007 elections. However, the effect shown in the Estonian case is different from the widely anticipated one. Indeed, Internet voting facilitated access to the polls for those citizens who live in remote areas, far away from the closest polling station. On average, 360 Internet voters stated that they saved 25 minutes by voting on the Internet instead of voting at the polls in a special post-election survey. Bearing in mind the fact that Internet voters might have over-estimated the time they may have saved, an optimistic estimation for 30,000 total Internet voters results in a figure of 12,000 hours saved in total, by the nation of Estonia. Even if such a figure is merely a product of Internet voters' imaginations, at least they will be satisfied with their own perceptions, of having saved such a valuable amount of time.

Appendix: Voter stream models

	Seemingly unrelated regression 1 political model				Seemingly unrelated regression 2 socio-economic model			
Dependent variable	Turnout at polling stations in 2007		E-turnout in 2007		Turnout at polling stations in 2007		E-turnout in 2007	
	β -Coef.	Robust Std. Err.	β - Coef.	Robust Std. Err.	β -Coef.	Robust Std. Err.	β - Coef.	Robust Std. Err.
constant	0.196	0.014	-0.054	0.005				
turnout 2003	0.611**	0.029	0.113**	0.011	0.555**	0.027	0.097**	0.010
voteRP 2003 * turnout 2003	0.016	0.046	0.086**	0.018				
voteEER 2007 * turnout 2007	0.755**	0.117	0.278**	0.044				
Tax revenue per capita (log)					0.048**	0.005	0.028**	0.002
slavic%					-0.031**	0.006	-0.006**	0.002
N	234		234		234		234	
R^2	0.794		0.678		0.819		0.743	
chi2	903.94		491.83		1060.74		677.92	

Table A1: Voter stream models (seemingly unrelated regressions), explaining turnout at the polls and Internet turnout, in 2007, party model (model 1) and socio-economic model (model 2).

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