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Assessing voters' attitudes towards electronic voting in Latin America: Evidence from Colombia's 2007 e-voting pilot

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Abstract. Electronic voting could increase citizens' electoral participation and trust in countries characterized by fragile democratic institutions and public discredit of the political system such as those in Latin America. This paper examines attitudes towards e-voting among participants in a large scale pilot project conducted in Colombia in 2007, focusing on the perceived reliability and usability of different automated voting technologies. Using a multivariate probit model, we determine the effect of socio-demographic, geographic and technical factors on users' evaluations of electronic voting *vis a vis* the traditional paper ballot system. Our results show that users find e-voting not only easier than the current voting system, but also substantially more reliable. While voters' opinions on usability are driven by technical issues, their trust in the new technologies is strongly affected by individual characteristics. We conclude that e-voting entails a promising opportunity to empower voters and increase confidence in elections in Colombia.

Key words: e-voting pilot, Latin America, multivariate probit, reliability, usability, trust in government, voter confidence.

1 Introduction

Most social science research analyzing the interaction between citizens and automated voting systems has focused on the accuracy of different e-voting technologies and, in particular, on the so-called residual vote [2], [3], [4].[3] However, the growing trend towards electronic voting in developing democracies [24] underscores the need to broaden the analysis to encompass core issues such as the potential role of electronic voting in increasing voters' confidence in the electoral process and in strengthening political participation [18], [25]. In the case of Latin America, where e-voting technologies have been increasingly used at

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[3] Residual votes are ballots that cannot be counted in a specific election. There may be multiple reasons for residual votes, such as spoiled or unmarked ballots, ballots in which the voter marked more names than allowed, etc.

national, state and local elections since their introduction in Brazil in the mid 1990s, it has been argued that electronic voting could help increase the efficacy and transparency of electoral processes [5], [6], supporting free and fair elections and enhancing the legitimacy of elected authorities in a context characterized by citizens' low degree of trust in democratic and political institutions [20], [32]. Moreover, given the relatively high levels of (complete and functional) illiteracy and the complexity of the manual voting systems prevalent in the continent, the introduction of e-voting devices with user friendly features could lower the information and cognitive barriers to electoral participation, contributing to the *de facto* enfranchisement of important segments of the electorate that face considerable problems at the moment of exercising their right to vote [21].

For electronic voting to fulfill this fundamental role in developing countries, a prerequisite is that citizens can easily use and trust e-voting technologies. Besides obvious complex technological considerations, a voting system is ultimately 'only as good as the public believes it to be' [23]. In this sense, [5] have distinguished between voters' trust in electronic voting systems and the 'trustworthiness' of the system itself, and [25] have shown that voters' perceptions about the security and usability of e-voting technologies is not only - not even necessarily - related to the actual technical properties of the devices, but also influenced by personal and contextual factors. Moreover, previous research has shown that voters might prefer electronic voting systems over traditional paper-based methods even though the former might not perform better than the latter in terms of efficiency or effectiveness, and could be potentially more vulnerable [14], [19].[4] More generally, the information systems literature has recognized that, in order to be successfully adopted and trusted, technology-based transactions must be perceived as useful, easy to use and secure [11], [13]. Neglecting these issues when considering the introduction of electronic voting systems might result in technology becoming a barrier, rather than a tool for increasing citizens' participation and trust in elections, with potentially undesirable and dangerous implications for the perceived legitimacy of the democratic process [18], [26], [28].

The lack of empirical evidence and systematic analysis of past e-voting experiences in Latin America has prevented so far an in-depth study of voters' assessments of electronic voting technologies along these dimensions.[5] The few academic articles evaluating the use of electronic voting in the region have almost exclusively focused on the case of Brazil, with virtually no research on any

[4] See [14] for a definition of efficiency and effectiveness in the context of evaluating alternative voting technologies.

[5] By now, electronic voting has been used in official elections in Argentina, Brazil, Mexico, Panama, Puerto Rico and Venezuela, while other countries (Colombia, Paraguay, Peru) have conducted pilot tests to determine the feasibility and convenience of its implementation. All of these experiences have been 'supervised e-voting' elections, rather than 'remote' or 'telematic' e-voting.

of the other elections or pilot tests.[6] Even in the case of Brazil, however, most analyses are mainly theoretical or descriptive [5], [27], [28].

This paper addresses these shortcoming and adds to the existing literature on electronic voting in Latin America, using data from an e-voting pilot conducted in Colombia in October 2007. The data collected during the Colombian pilot allows us to assess voters' opinions towards automated voting in comparison to the current system using paper ballots and to apply formal statistical methods to examine the effect of individual and aggregate factors on voters' evaluations of electronic voting. In addition, since different voting technologies were tested in the pilot, we can examine the sensitivity of respondents' opinions about e-voting to the prototypes used. As noted by several researchers, the characteristics of specific devices can have differential effects on the voting behavior of particular groups of citizens and on their general attitudes towards electronic voting [9], [18], [31]. Taking these differences into account is particularly relevant in Latin America, given the sociodemographic characteristics of the electorate and the relatively large number of parties competing for office, which imposes higher cognitive demands on voters and increases the potential influence of design effects on electoral behavior [8]. Our focus lies on the analysis of voters' opinions about the usability and reliability of electronic voting systems and their potential policy implications, rather than on comparing the actual performance of automated voting *vis a vis* traditional methods. In view of the importance of voting as a central democratic institution and the heated debates surrounding the implementation of e-voting in Latin America [27], [28], our research can provide valuable insights about the convenience and implications of adopting electronic voting systems and their potential to enhance the quality of electoral processes in less developed democracies.

The remainder of the paper is organized as follows. The next section describes the main characteristics of Colombia's 2007 e-voting pilot. Section 3 presents and comments the results from a multivariate statistical model aimed at estimating the effect of different socio-demographic and technological factors on voters' evaluation of electronic voting. Finally, Section 4 summarizes the main empirical findings and discusses their implications in the light of the foreseeable move towards the adoption of new voting technologies in Latin America.

2 The 2007 Colombia e-voting pilot

In 2004, a modification in Colombian electoral law opened the possibility of adopting an automated voting system in the country and regulated its implementation.[7] In order to explore the feasibility of introducing e-voting in official

[6] While [8] analyze the 2005 Buenos Aires e-voting pilot, they do not focus on evaluations of electronic voting systems from the voters' perspective or on comparing automated voting with the traditional manual system.

[7] Law 892 of July 7, 2004.

elections, a large scale voting pilot was conducted in the country in 2007.[8] The explicit purpose of the pilot was to test different voting technologies in order to evaluate their functional features and to analyze users' attitudes towards electronic voting, particularly in relation to the traditional paper ballots. The comparison with the current electoral system in place in Colombia is particularly relevant given our research purpose. Besides examining if Colombian voters perceive electronic voting to be easier to use or more convenient than the manual system in place, as has been the focus of most studies in this area, we are also interested in analyzing whether e-voting can have any effect on voters' trust in the electoral process. As in many countries in the Latin America, public trust in elections and electoral authorities is very low in Colombia: in 2005, an opinion poll by the Universidad de los Andes showed that the National Electoral Authority ranked at the bottom of Colombian institutions in terms of citizens' confidence. Only 53.2% of respondents in the study declared to trust elections, while the level of confidence in the electoral authority was even lower (48.6%) [33].

The pilot was scheduled for October 27, 2007, the day before municipal elections were held throughout the country, in order to capitalize on the nationwide 'political climate' to encourage participation in the experiment. The organization and supervision of the pilot was in charge of Colombia's Electoral Authority and the Center for Software Research and Development from the Universidad Industrial de Santander, and a team of political scientists from the US assisted as academic consultants. The field study was conducted in nine locations across three cities: the country's capital, Bogotá, with a population of almost 7,000,000; Pereira, with more than 400,000 inhabitants; and San Andrés, with a population of 70,000. In order to select the cities for the study, the countries' urban centers were divided in three strata according to their population (large, medium and small) and, within each stratum, the chosen cities were selected taking into account their infrastructure and logistical facilities, as well as the representativeness of their populations.[9] In each city, voting booths were installed in three shopping malls selected due to their their geographical location, guaranteeing a large and diverse pool of potential subjects. The location of the testing sites, as well as the organization of in-site training sessions for those interested in taking part in the pilot, was publicized by the Colombian Electoral Authority in the weeks prior to the field experiment.

Participation in the pilot was voluntary, and subjects were not given any incentive to participate. Citizens in each of the testing locations were invited to take part in a mock election in which they had to choose one candidate for

[8] Electronic voting machines had been previously used, along with the traditional paper ballots, in a few polling stations during the 1992 national elections, as well as in a dozen local elections throughout the country. None of these e-voting pilots, though, had focused on analyzing voters' attitudes towards electronic voting.

[9] Cities with more than 1,000,000 inhabitants were included in the first category. Urban centers with populations ranging between 200,000 and 1,000,000 were classified as 'medium-sized', and those with less than 200,000 inhabitants were included in the last category.

president and one for the senate. In case of acceptance, they were randomly assigned to one of the available voting machines and received the instructions and a 5-minute training needed to operate it. The only eligibility requirement was to be older than 18 years of age and being able to provide a valid form of identification ('cédula de identidad'); registration and inscription procedures were analogous as those used in official elections. A total of 2,294 participants took part in the test. After casting a vote, participants were asked to provide basic socio-demographic information - age, education, gender - and to complete a survey containing seven questions dealing with usability issues of the devices tested, as well as with their general perceptions about electronic voting compared to the procedure based on paper ballots. Table 1 provides summary data about the socio-demographic characteristics of the participants in the pilot.

Table 1. Characteristics of the participants in Colombia's e-voting pilot

Socio-demographic variables (%)		Bogota	Pereira	San Andres	Total
Age	18-30	37.8	26.4	34.1	32.9
	31-50	45.1	44.9	52.2	46.5
	>50	17.1	28.7	13.7	20.6
Education	Primary or less	2.8	5.6	4.8	4.2
	Secondary	32.4	35.6	54.6	38.1
	University	64.8	58.8	40.5	57.7
Gender	Female	39.5	38.0	51.0	41.3
	Male	60.5	62.0	49.0	58.7
Total number of participants		1,171	843	280	2,294

Four different voting devices supplied by private vendors were tested in the pilot (Figure 1). Two machines for each of the e-voting systems were installed in each of the testing locations, totaling 24 machines in each city and 72 in the pilot. All the prototypes were equipped with headphones and keypads for visually-impaired voters to privately interact with the terminal.

The first three prototypes were touch-screen direct recording electronic (DRE) machines. After inserting a smart card into the reader attached to the terminals, participants were presented with the name, number and logo of seven parties running candidates for office in the presidential and the senate race, as well as with the names of the candidates running for President (4) and for the Senate (58 in total), sorted according to the party number and the candidates' personal code.[10] Voters could scroll and select their candidates - one for each race - by

[10] As in most Latin American countries, each party in Colombia is assigned a different list number when registering the candidates running for a specific election. Can-

tapping onto the screen. Before registering the vote, users were asked to confirm their choices at the end of the process. Only at this review stage could they stop, change or cancel the vote. After the confirmation, the vote could not be changed and the information was digitally stored in the machine. Overvotes - e.g., ballots selecting more than one candidate for the presidential or senate race - were not admitted by any of these prototypes; the voter was notified of the mistake and requested to correct it in order to proceed with the vote. After casting their vote, participants returned the smart cards to the poll workers, who reprogrammed it for the next user. There were two primary differences between these DRE devices. First, unlike *Prototype 1*, both *Prototypes 2* and *3* had voter-verifiable audit trails, the former only on screen, the latter also a paper trail that had to be deposited by the user in a box after the vote. Also, under *Prototype 1*, the participant had to select the order in which she wanted to vote - i.e., in the presidential or senate election - priot to casting a ballot, using an electronic card connected to the voting machine. In contrast, voters using *Prototypes 2* and *3* could move through the screen to switch between the two races.

The last prototype, *Prototype 4*, was an optical scan (OS) device. The staff supervising the test provided each participant with a paper ballot including all the relevant information (party name, logo, and number, and the complete list of candidates for each race). Voters marked their preferences for the presidential and senate race with a special pencil on the paper ballot and introduced it into the scanner. The only possibility of changing the vote once the ballot was introduced into the scanner was if the voter had cast an invalid vote or left the ballot blank. In both cases, the voter was notified of the potential mistake, and had the option of correcting it or casting the vote anyway. In the case of a spoiled ballot, correcting the mistake required the user to approach the staff supervising the pilot, request a new ballot and start the process over again. This prototype was not equipped with a smart card reader.

It is worth mentioning that, while the evaluation by the organizers of the field experiment was largely positive, this first large scale experience with electronic voting in Colombia also revealed the importance of organizational and logistic aspects that need to be taken into account for future testing and implementation of e-voting technologies in the country. The process of delivering and installing the voting machines simultaneously in nine voting sites, the organization of help desks and the training of the support staff and the participants in the pilot proved to be difficult tasks, requiring considerable planning and coordination between the private vendors, the academic supervisors and the electoral authority. The voting sessions highlighted the need for more extensive training of both the participants and the election authorities, as well general informative sessions about the characteristics of the system, before it can be used in official elections. Also, although choosing shopping malls as testing locations provided convenient facilities and infrastructure for the field experiment and ensured a large influx of potential subjects, it probably affected the composition of the

didates and parties advertise this number during the campaign, together with the party and candidate's name.

Fig. 1. The figure plots the different voting devices tested in the 2007 Colombia's e-voting pilot: *Prototype 1* (upper left), *Prototype 2*(upper right), *Prototype 3* (lower left) and *Prototype 4* (lower right).

sample. In fact, a large majority of the participants in the test had very high education levels compared to the average Colombian population. This, together with the fact that participation was voluntary, limits the possibility of generalizing the results presented in this paper to the overall voting population and underscores the need to conduct further tests in alternative locations and with a more heterogeneous subject pool. However, given that participants in each experimental site were randomly distributed across prototypes, there was no systematic relationship between voters' personal characteristics in each location and the prototype assignment, and thus these problems do not invalidate the internal (i.e., in-sample) validity of our results.[11] Moreover, our randomized research design mitigates some concerns that have plagued previous studies in this area, such as vote tampering, differential turnout rates, and self-selection into different voting technologies [17], [29].[12]

[11] Balance checks based on [16] indicate no significant differences in the distribution of relevant individual characteristics across prototypes.

[12] Ideally, each voter would have been assigned to each of the four prototypes tested in random order, and then asked to compare the performance of the different voting devices. However, such designs are extremely rare in field experiments due to cost and time constraints. Field experiments, on the other hand, allow for a more realistic and representative environment than laboratory experiments [26].

3 Participants' assessments of electronic voting and their determinants

We used the survey data collected during the pilot to analyze voters' opinions about e-voting and their evaluations of electronic voting *vis a vis* the traditional paper-based system used in Colombia. Participants' responses to the survey questions allow us to examine their level of acceptance and confidence in electronic voting, the influence of their personal characteristics on these assessments, and the sensitivity of their responses to the different technologies tested. In line with the above arguments regarding the main determinants of the perceived trustworthiness of voting systems, we focus on two main aspects: usability of the different voting technologies and confidence in the system. Specifically, we examine participants' response to four questions comparing e-voting with the traditional voting procedure, each of them admitting only a 'yes' or 'no' answer:

- Usability
  1. Is electronic voting easier than the traditional voting procedure?
  2. Is correcting mistakes made easier using the electronic voting machines?
- Reliability
  1. Is e-voting more reliable than the traditional voting procedure?
  2. Am I more confident that my votes will be counted?

The first two questions aimed at measuring 'perceived ease of use', i.e., 'the degree to which a person believes that using a particular system would be free from effort' [12]. Earlier research underscored the role of perceived ease of use as a key factor for the successful adoption of technological innovations [30]. The other two questions concerned users' trust in the system: voters should not only be able to vote, but must be assured that their votes will be counted and attributed correctly [25], [29]. Furthermore, for electronic voting to contribute to increase or restore citizens' confidence in the electoral process in Latin America, it is important that the new technology fares well in this respect compared to the paper-ballot system currently in place.

Table 2 reports the percentage of positive answers to each of these four questions, discriminated by personal (age, education, gender) and geographic (city) variables. A striking result emerging from the table is the high proportion of positive answers for each of the survey questions, which in all cases is over 85 percent for the whole sample. Overall, more than 70% of the participants in the pilot answered positively to the four questions. This is a highly unusual rate of success when compared to other pilot tests in developed democracies, particularly with respect to users' trust in the computer-based voting technologies [7], [18], [34]. Interestingly, while participants could actually compare whether casting a vote was easier using the e-voting devices than with the paper ballots, there was in principle no objective measure that could indicate them whether their votes were more likely to be counted under the new system. In other words, while participants' responses to the usability questions are supported by the performance of the e-voting machines, the high proportion of positive answers to

the two reliability questions cannot be explained by characteristics of the devices tested or of the electronic voting system, but are entirely based on voters' perceptions.

Table 2. Percentage of positive responses to the four survey questions

Individual and geographic variables		E-voting is easier	Correcting mistakes is easier	E-voting is more reliable	Votes will be counted
Age	18-30	92.8	90.9	79.7	82.8
	31-50	95.7	90.5	87.0	89.7
	>50	94.6	89.9	92.9	90.5
Education	Primary or less	93.6	87.2	95.7	94.7
	Secondary	96.2	92.8	90.2	90.1
	University	93.4	89.2	82.1	85.3
Gender	Female	94.7	90.6	86.1	87.5
	Male	94.3	90.5	85.6	87.6
City	Bogota	94.7	89.0	84.7	86.7
	Pereira	94.9	93.2	87.0	89.7
	San Andres	93.4	89.0	85.6	85.7
Whole sample		94.5	90.5	85.8	87.6

Another important result from Table 2 concerns the difference in the response patterns across categories of the socio-demographic and geographic variables. The data on the two usability questions shows little variation across subsamples. The proportion of participants who found casting a vote easier under the new system is very high and similar across individual characteristics and in the three cities in which the study was conducted, and while the percentage of respondents stating that correcting mistakes is easier with the voting machines is slightly lower, the distribution is again quite similar across age, education, gender, and city. While some authors (e.g., [6]) implied that the 'digital divide' could affect the ability of older and less educated voters to use the new voting technologies satisfactorily, we find no significant differences in the responses to the two usability questions by age or education levels. In contrast, age and education do affect users' trust in the security of electronic voting. Younger and more educated users were much less likely to rely on automated voting *versus* the traditional procedure than participants over 50 or those with less than secondary education, and they were also considerably less confident that their votes would be counted under the new system. Differences in the proportion of positive responses to the two reliability questions between lowest and highest categories of age and education range between 7.7 and 13.6 percentage points,

and are all strongly statistically significant.[13] A possible explanation for these differences lies in the correlation between age and education, on the one hand, and familiarity with technology, on the other. Younger and more educated people have probably higher levels of computer skills and experience and thus can be more critical about security issues than people who lack the knowledge to detect potential threats to computer security and verifiability. Even for the more critical users, though, the percentage of positive responses to the two reliability questions is never lower than 79%, a fact probably related to the very low degree of public confidence in elections and in the electoral system in the country [33].

Figure 2 complements the information provided in Table 2, plotting the proportion of positive responses to each of the four questions analyzed, discriminated by prototype. There is a strong consensus among participants using the four devices that e-voting is simpler than the paper-ballot system, and there are also almost no differences in the large proportions of affirmative answers to the two reliability questions across prototypes. The absence or availability of voter verifiable audit trails does not seem to influence voters' confidence in the process or their beliefs about the likelihood that their votes will be counted. The hypothesis of independence between the responses to each of these three questions and the prototype used cannot be rejected at the 0.05 level [1]. However, the figure reveals that respondents found that the optical scan device (*Prototype 4*) presented considerable difficulties at the moment of correcting their vote. While 96.5% of the participants using the three DRE machines (*Prototypes 1-3*) believed that correcting a mistake was easier than using a paper ballot, only 72% of respondents using the OS prototype agreed with this statement. This result is hardly surprising since *Prototype 4* is the one that more closely resembles the paper ballot system in this regard and, as described in Section 2, correcting a mistake is considerably more difficult than under the three DRE devices.

In order to jointly determine the effect of the different prototypes tested and of the socio-demographic and geographic variables on participants' responses, we fit a multivariate probit model *via* Simulated Maximum Likelihood [10]. The multivariate probit specification generalizes the binary probit model to estimate several correlated binary outcomes, accounting for the fact that unobservable individual characteristics beyond those included in the model might induce correlations across the responses to the different survey questions. The independent variables of interest are linearly combined into underlying latent variables that are related to the observable binary ('yes', 'no') responses through a threshold specification, with a correlated Gaussian distribution assumed for the latent variables [12]. This allows for flexible modeling of the correlation structure and direct interpretation of the regression coefficients, and enables us to 'smooth' the binary responses, determining the effect of the regressors on the probability

[13] The p-values of the tests for equal probabilities [1] between between young/old and more educated/less educated participants in each of the two reliability questions are all smaller than 0.02.

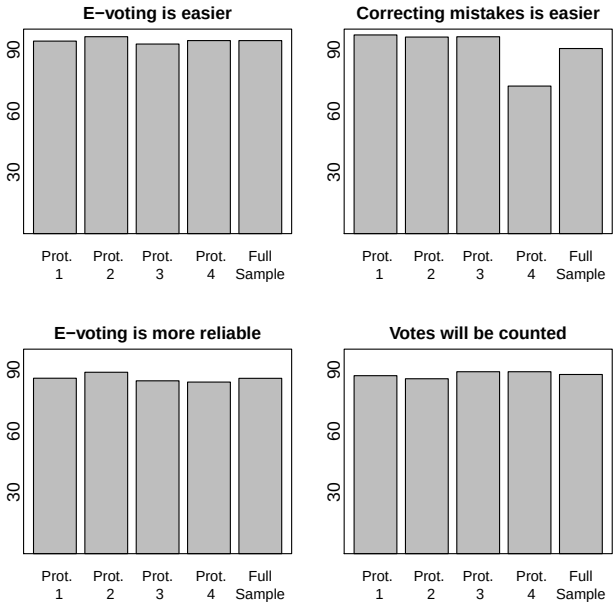

Fig. 2. Percentage of positive answers to each of the four survey questions across prototype vendors.

of providing positive answers to each or all of the survey questions analyzed.[14] In our application, we include the following regressors: Age, coded as two dichotomous variables, *31-50* and *>50*; a dummy variable for those with *primary education or less*; an indicator for *Female*; two indicator variables for geographical location, *Pereira* and *San Andres*; and prototypes tested, with *Prototype 1* used as baseline.[15]

The parameter estimates from the multivariate probit model are reported in Table 3. The upper part of the table reports the estimates for the coefficients of the regressors, while the estimated correlation coefficients between the four survey questions are presented at the bottom. The p-value of the Wald-statistic for the test of joint significance ($312.48 \sim \chi^2_{35}$) is indistinguishable from 0, indicating that we can reject the hypothesis that the variables included in the model have no joint explanatory power on participants' responses. Also, a Wald test for the hypothesis of independence between the responses to the different survey questions can be rejected at the usual confidence levels ($Pr(\chi^2_6 > 321.73) \approx 0$).

[14] A detailed review of the multivariate probit model and of different approaches to estimation can be found in [10] and [12], among others.

[15] We also implemented several alternative specifications, yielding essentially identical results as those reported below.

The results from the multivariate model tend to confirm the main substantive findings from our descriptive analysis. Regarding the usability questions, the most evident result is the strong negative effect of *Prototype 4* on the probability of stating that correcting mistakes is easier than with the paper ballots. There are no significant differences between the three DRE devices in this regard, although participants using *Prototype 2* find e-voting relatively easier than those using *Prototype 1* after controlling for the socio-demographic and geographic factors. As mentioned in Section 2, while the voting process under *Prototype 2* could be entirely completed by navigating through the screen, *Prototype 1* required the use of an additional control panel located outside the voting booth. Among the individual variables, only *31-50* has a significant effect on the perceived ease of use of the e-voting devices. Personal characteristics - age and education - are however key determinants of voters' trust in the e-voting technologies. Older voters express a higher degree of confidence in electronic voting compared to the paper-based procedure, and are more likely to believe that their votes will be counted than participants under 30. In particular, users' over 50 have a strong trust in e-voting. Also, less educated participants are more likely to answer affirmatively to the two reliability questions than those with higher education, after controlling for the remaining variables. There are no statistically significant differences in users' opinions about the probability that their votes will be counted across prototypes, although participants using *Prototype 2* are relatively more confident in e-voting compared to the traditional manual procedure than those using *Prototype 1*. This could be related to the fact that *Prototype 2* prints a voter-verifiable audit trail on screen, allowing users to check that their vote actually reflects their intent. However, while *Prototype 3* also issues a voter-verified paper ballot, there are no significant differences in voters' opinions about the reliability of prototypes *1* and *3*.

The estimated correlation coefficients shown at the bottom of Table 3 indicate a positive and statistically significant relationship between responses to the different questions. As expected, the correlations are stronger within groups of questions than between them. In particular, voters who believe that e-voting is more reliable than the manual procedure are also very likely to be more confident that their votes will be counted under the new system. However, the estimates also indicate that participants who saw electronic voting as a convenient way to cast their votes were also more likely to trust in e-voting *vis a vis* the paper-based system. This suggests that implementing an e-voting system that is perceived by voters to be both reliable and easy to use could have a strong positive effect on public confidence in the electoral process in Colombia.

Based on the estimates reported in Table 3, Figure 3 plots the effect of a change in each of the relevant variables on the average probability of providing a positive answer to each and to all of the four questions analyzed, while holding all the remaining variables at their actual sample values.[16] This allows us to isolate the impact of each predictor on respondents' opinions on usability and

[16] Since the estimates for the coefficients of *Female* are never significant, we do not examine the effect of gender in this analysis.

Table 3. Multivariate Probit Estimates

Variable	E-voting is easier	Correcting mistakes is easier	E-voting is more reliable	Votes will be counted
Age: 31-50	0.27***	-0.14	0.29***	0.31***
	(0.10)	(0.10)	(0.07)	(0.08)
Age: >50	0.16	-0.19	0.62***	0.31***
	(0.13)	(0.12)	(0.11)	(0.20)
Education: primary or less	-0.10	-0.25	0.52**	0.40*
	(0.22)	(0.18)	(0.24)	(0.22)
Female	0.07	-0.01	0.04	0.04
	(0.09)	(0.09)	(0.07)	(0.07)
Pereira	-0.01	0.32***	0.07	0.12
	(0.10)	(0.10)	(0.08)	(0.08)
San Andres	-0.14	0.06	0.06	-0.08
	(0.12)	(0.11)	(0.09)	(0.09)
Prototype 2	0.23*	-0.14	0.16*	-0.06
	(0.13)	(0.15)	(0.10)	(0.10)
Prototype 3	-0.08	-0.13	-0.08	0.09
	(0.12)	(0.15)	(0.09)	(0.10)
Prototype 4	0.08	-1.30***	-0.08	0.10
	(0.13)	(0.12)	(0.09)	(0.10)

Correlations	E-voting is easier	Correcting mistakes is easier	E-voting is more reliable	Votes will be counted
E-voting is easier				
Correcting mistakes is easier	0.32***			
	(0.06)			
E-voting is more reliable	0.15***	0.22***		
	(0.05)	(0.05)		
Votes will be counted	0.18***	0.19***	0.65***	
	(0.05)	(0.05)	(0.03)	

Standard errors in parenthesis. Significance levels: *** 0.01, ** 0.05, * 0.1.

reliability. The two plots in the upper panel of the figure compare the probabilities of positive responses for the two extreme categories of participants in terms of age and education, clearly illustrating that individual characteristics have a strong effect on the perceived reliability of electronic voting. Other things equal, the probability that participants aged 50 or older believe that e-voting is more reliable than the paper-based system is on average 12.6 percentage points higher than for those under 30, and they are also 7 percentage points more likely to trust that their votes will be counted than younger respondents. In the same direction, the expected probability of providing a positive answer to these two reliability questions among participants with less than secondary education is 0.94. For those with University education, the average likelihoods are 0.86 and 0.87, respectively. In contrast, the average differences between older/younger and less educated/more educated respondents regarding their views on usability issues are all lower than 4 percentage points. Again, as seen in the lower panel of Figure 3, differences in this respect are mainly due to technical factors: *ceteris paribus*, the expected proportion of 'yes' answers to the second usability question is more than 20 percentage points lower for the optical scan device (*Prototype 4*) than for each of the three digital recording electronic (DRE) designs.

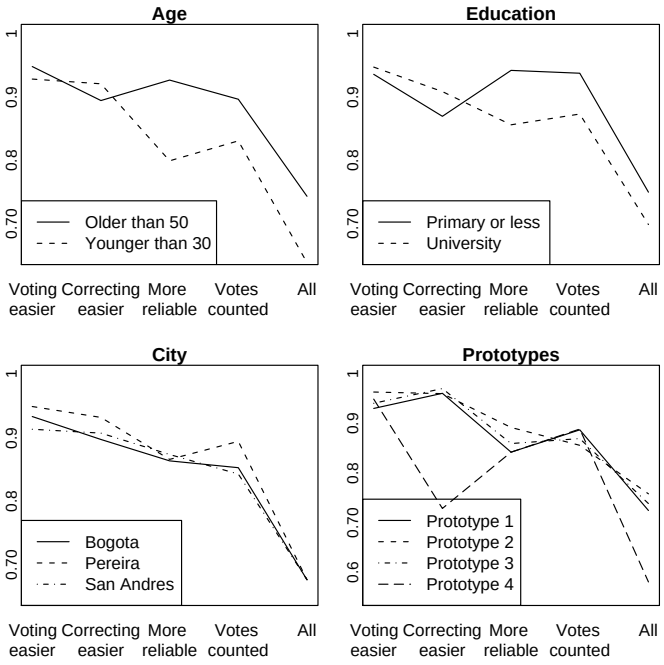

Fig. 3. Effect of the independent variables on the probability of a positive response to each and to all of the four survey questions analyzed.

4 Concluding Remarks

As noted by [25], electronic voting is likely to lead to changes in how citizens maintain confidence in the integrity of elections. In countries where there is widespread disbelief in the freeness and fairness of elections and where the complexity of voting procedures can actually prevent important segments of the electorate from exercising their right to vote, the introduction of e-voting systems poses both a difficult challenge and an interesting opportunity [19]. While the final result of this equation will largely depend on technical developments, as well as on factors such as citizens' familiarity with information technologies in general, the reputation and legitimacy of the electoral authorities and the quality of election administration [5], [29], a fundamental prerequisite for the successful implementation of computer-based voting is that citizens are able to use the systems with ease and trust the overall process [18].

The analysis of the data from the e-voting pilot conducted in Colombia in October 2007 shows an almost unanimous perception that electronic voting is not only simpler than the paper-based procedure currently in force, but also considerably more reliable. The proportion of respondents who declare to trust electronic voting is unusually high when compared to other international experiences, and is probably related to the comparatively low degree of public confidence in elections in many countries in Latin America. While users' opinions about the usability of e-voting devices is strongly related to technical and operative features of the machines and is sensitive to the different prototypes tested, their perceptions about the verifiability of the process are heavily influenced by personal characteristics such as age or education. Our results in this respect are in line with [25], in the sense that people will likely use black box technologies if they believe they are secure, and indicate that improving the usability and the perceived security of e-voting technologies could have a positive impact on public confidence in the electoral process in Colombia.

More generally, contrary to arguments characterizing the introduction of e-voting in Latin America as a purely supply-driven process, our results for Colombia indicate that there seems to be a demand for alternatives to traditional electoral procedures among the citizens, especially from older and less educated voters. Despite the limitations of the analysis noted above, the evidence presented in this paper suggests that, rather than being conceived as an 'expensive toy' [28], the adoption of automated voting systems could provide an opportunity to address some of the genuine electoral needs and interests of the citizenry in less developed democracies.

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