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Waiting to Vote

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ABSTRACT

We review evidence that long lines waiting to vote in the 2012 presidential election were costly and disproportionately appeared in certain regions of the country, in cities, and among minority voters. We argue that the field of queuing theory helps to frame thinking about polling place lines. Because addressing the problem of long lines requires precise data about polling place dynamics, we conclude by suggesting new approaches to research that are necessary to identify the most effective cure for long lines.

Waiting in line to vote[1] is the most visible sign of administrative frictions of managing elections. The visibility of long lines makes them a convenient symbol for those who seek to improve election administration. However, absent comprehensive, reliable information about lines—where they appear, who endures them, and strategies to mitigate them—it is easy to flail at the problem without making much progress. In this article, we lay the groundwork with some evidence about where long lines occur and what is thought to cause them. We emphasize four points:

First, long lines are costly.
Second, long lines are not universal.
Third, the field of queuing theory helps frame thinking about polling place lines.
Fourth, new approaches to empirical research in polling places are needed to identify the most effective cures for long lines.

THE COSTS OF LINES

Long lines present three categories of problems in American elections: they discourage voting, lower voter confidence, and impose economic costs on voters.

First, long lines discourage some from voting. Responses to the 2012 Voting and Registration Supplement (VRS) of the Current Population Survey suggest that over 500,000 eligible voters failed to vote because of a list of polling place problems that include long lines—inconvenient hours or polling place location, or lines too long.

Second, long lines reduce voter confidence in elections. Responses to the Survey of the Performance of America Elections (SPAE) suggest that

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[1]This article makes use of data from the Cooperative Congressional Election Study (CCES) and the Survey of the Performance of American Elections (SPAE). Ansolabehere and Stewart are the principal investigators of the CCES and SPAE, respectively. The SPAE was undertaken with the financial support of the Pew Charitable Trusts, which bears no responsibility for the analysis contained herein. Both the CCES and SPAE are Internet surveys and both ask an identical question concerning the amount of time voters waited at the polls. In 2012, the CCES interviewed 54,535 adults, 39,675 of whom voted; the SPAE interviewed 10,200 registered voters, 9,336 of whom voted. The CCES asks fewer questions about election administration, but has a larger sample size that is distributed across the nation in proportion to population. The SPAE focuses its questions entirely on election administration, with a smaller sample size distributed within states in proportion to population. Depending on the nature of the analysis, one survey will be more appropriate to use than the other. In some cases, specifically estimating waiting times within states, we can combine the two surveys to create more precise estimates.

waiting a long time to vote reduces the confidence voters have that their votes are counted. For instance, among Election Day voters in 2012, 68% of those who waited ten minutes or less to vote stated they were very confident their vote was counted as intended, compared to 47% of voters who waited over an hour.[2] Moreover, voters who themselves experienced long lines were also less likely to believe that votes in their county, their state, and nationwide were counted as intended (Stewart and Ansolabehere 2013, Table 1).

Third, long lines impose monetary costs on voters. A simple way to produce a ballpark estimate of monetary costs is to multiply the total number of hours waiting in line by average hourly earnings in 2012, as reported by the U.S. Bureau of Labor Statistics. Doing so yields an estimated economic cost of $544.4 million in election line-waiting in 2012, which is about one-fifth the budget of local election offices in 2012 (Stewart and Ansolabehere, pp. 4–5).

BASIC FACTS ABOUT LINES

We now turn to the evidence about who waits in line, and how long they wait, using answers to two major academic surveys, the Cooperative Congressional Election Study (CCES) and the SPAE.

Relying on responses to the 2008 and 2012 CCES, Table 1 reports the distribution of responses to the question, "Approximately, how long did you have to wait in line to vote?"

Most voters in the past two general elections did not wait very long to vote. Roughly one-third report not waiting at all, and roughly two-thirds report waiting ten minutes or less.

For those who wait more than one hour, the waits can be quite long. Among those waiting more than an hour in these two presidential elections, the average reported wait time was 109 minutes in 2008 and 110 minutes in 2012.

The factor that is associated with the biggest differences in wait times is the voter's state of residence. According to estimates derived by combining responses to the CCES and SPAE, average wait times in 2012 ranged from 1.5 minutes in Vermont to 39.2 minutes in Florida. The table in Appendix A reports the state estimates, along with 95% margins of error. Regionally, the shortest waiting times tend to occur in the western half of the country and in the northeast, while the longest waits tend to occur in the lower eastern seaboard.

Table 1. Average Waiting Times to Vote, 2008 and 2012

	2008	*2012*
Not at all	36.8%	37.3%
Less than 10 minutes	27.6%	31.8%
10–30 minutes	19.0%	18.4%
31–60 minutes	10.3%	8.6%
More than one hour	6.3%	3.9%
Average (min.)	16.7	13.3
95% margin of error (min.)	0.1	0.1
N	18,836	30,124

Source: Cooperative Congressional Election Study (CCES), 2008 and 2012.

Waiting times also vary within states. In Florida, for instance, average estimated wait times range from 5.7 minutes in Marion County (Ocala) to 136.6 minutes in Lee County (Ft. Myers).[3]

The great variation across states suggests there are state-specific factors, such as laws, regulations, and state norms, which influence how long voters wait to vote.[4] The great variation within states suggests that there is further influence of demographics and local administrative practices in determining line lengths at the polls.

State wait times are also persistent. There is remarkable consistency in wait times at the state level, comparing 2008 and 2012. This is illustrated in Figure 1, where we plot the average wait time by state in 2012 along the *y*-axis, and the 2008 average along the *x*-axis. (The axis scales are logarithmic, which aids in the legibility of the individual data points.) States with long wait times in 2012 generally had long wait times in 2008. With some exceptions, if one wanted to predict which states would have long wait times in 2012, the best place to start would be to identify those states with long wait times in 2008.

State persistence is important for thinking about how to tackle the problem of long lines. In the wake of the long lines in 2012, many commentators and election officials pointed out factors that were unique to the 2012 election as the causes. The

[2]See Sances and Stewart 2014. In a multivariate statistical analysis that adds controls for partisanship and state of residence of the voter, the relationship reported here, between voter confidence and wait times, remains.

[3]The 95% confidence intervals are 1.6 minutes for Marion County and 11.4 minutes for Lee County.

[4]See Stein and Vonnahme (2014).

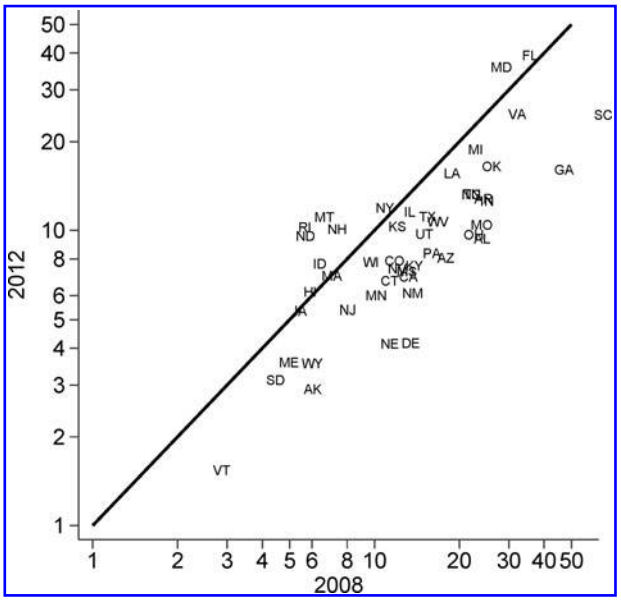

FIG. 1. Average wait time at the state level, 2012 and 2008. *Source:* Cooperative Congressional Election Study (CCES) and the Survey of the Performance of American Elections (SPAE), 2012.

best example is Florida, which saw significant changes in its election law which, in hindsight, seem ripe to have caused longer lines at the polls, such as cutting the early voting period significantly and lengthening the text on the ballot to describe referenda. If these are the explanations for Florida's long lines in 2012, what is the explanation for Florida's long lines in 2008, when they were not factors?

Long lines are also unevenly distributed demographically, as the following statistics, drawn from the CCES, illustrate:[5]

1. *Mode of voting.* Early voters in 2012 waited an average of 18 minutes, compared to 12 minutes for Election Day voters.[6]
2. *Race of voters.* Minority voters waited longer to vote than white voters in 2012. White voters waited an average of 12 minutes to vote, compared to 24 minutes for African American voters and 19 minutes for Hispanic voters.
3. *Population density.* Voters in densely populated neighborhoods wait longer to vote than voters from sparsely populated areas. Respondents to the CCES who lived in the least densely populated ZIP Codes waited an average of 6 minutes to vote, compared to 18 minutes for residents of the most densely populated ZIP Codes.[7]

QUEUING THEORY AND ELECTION LINES

The scientific discipline that analyzes the general problem of waiting in line is queuing theory, taught at business and engineering schools throughout the country.[8] In its simplest expression, queuing theory can be applied to the problem of long lines at the poll. Unfortunately, only a handful of professional students of queuing, from academia or the business world, have attacked the issue of queuing in the context of elections.[9]

Using a simple set of mathematical tools, knowledge about the design of the system (e.g., how many service stations are in place) and assumptions or knowledge about inputs (e.g., how frequently new customers arrive), it is possible to predict ahead of time quantities such as the average wait in the queue, the average length of the queue, and the number of customers the system can handle in a given unit of time.

Queuing models that assume there is a single bottleneck in voting—either at the check-in table or the voting booth—have motivated the two most direct applications of queuing theory to the issue of polling places—studies by Allen and Bernshteyn and by Edelstein and Edelstein that were cited above. These studies have provided an analysis of waiting times in Franklin County (Columbus), Ohio, in light of the allocation of equipment to precincts (Allen and Bernshteyn) and a

[5]Full multivariate analysis associated with this series of bivariate relationships may be seen at Stewart and Ansolabehere (2013, appendix 2).

[6]This difference remains when we control for the state in which the respondent lives. Also see Stein and Vonnahme (2014).

[7]This analysis was performed, first, by merging population density data to the CCES, using ZIP Code, and then dividing the sample into equally populated quarters, or quartiles. Respondents from the least densely populated areas lived in ZIP Codes with a population density of 75 persons per square mile or less. Residents from the most densely populated areas lived in ZIP Codes with a population density of 2,739 persons per square mile or more. This is related to Kimball and Baybeck's (2013) findings concerning jurisdiction size and election administration.

[8]A (relatively) accessible introduction to queuing theory may be found in Chapter 4 of the online version of Larson and Ondoni (1981), available at <http://web.mit.edu/urban_or_book/www/book/chapter4/contents4.html>.

[9]But see Allen and Bernshteyn (2006); Edelstein and Edelstein (2010); Olabisi and Chukwunoso (2012); Yang et al. (2012); Yang et al. (2009); Belenky and Larson (2006); Samuelson et al. (2007); Yang et al. (2014); Buell (2013).

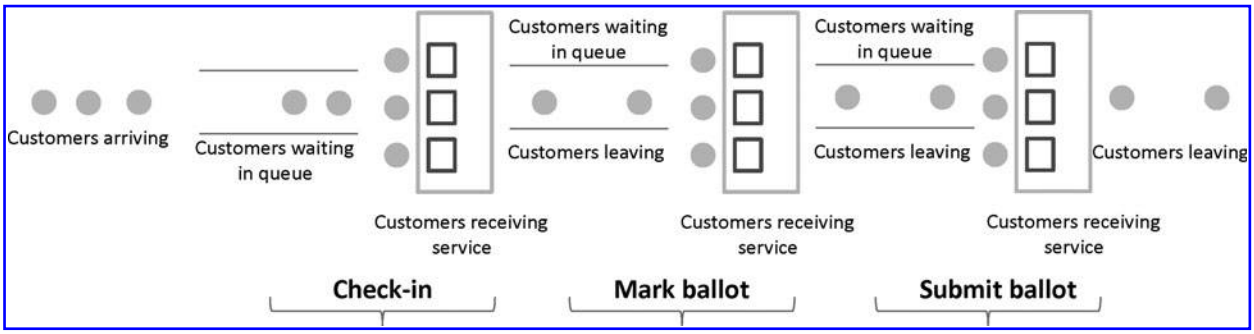

FIG. 2. Queuing in a polling place.

method for allocating voting machines to precincts (Edelstein and Edelstein).

Research papers such as these are a promising start of the application of queuing theory to the field of election administration. Still, the actual complexity of even the simplest polling site is much greater than what has generally been modeled to date. Most importantly, three major services are provided at each polling place, not one: checking in (including verifying one's identity and receiving the proper ballot), marking the ballot, and submitting the ballot for counting. Thus, even at its simplest, the typical in-person voting station (either Election Day or early) should be described using a figure such as the one in Figure 2, in which the issue is not managing one queue, but three related queues, in which departures from one feed the next.

A fundamental observation that emerges from Figure 2 is the potential cascading of problems "downstream." For instance, a delay in scanning ballots, which is part of submitting ballots at the end of the process, can produce a long line of people with marked ballots who wish to leave the polling place, but can't. This, in turn, can lead managers of the polling station to restrict access to check-in, to preserve order at the voting booths and the checkout tables. Lines accumulate at the door, even though the bottleneck is at the end of the process.

One useful tool for exploring the interactive effect of the multiple bottlenecks at the polling place is a simulation program developed by Mark Pelczarski, originally for use by the 2012 Obama campaign, an updated version which was posted on the website of the Caltech/MIT Voting Technology Project in the hopes that tools such as this could help local officials allocate their election resources more effectively.[10] Such tools take as inputs data that election officials usually have at their fingertips, such as the number of check-in stations and voting booths at each precinct, and information they can easily estimate, such as how long it takes to check-in or cast a ballot, and estimate average wait times at precincts, given the input parameters.

MITIGATING LONG LINES

All of the strategies to mitigate long lines can be thought of in terms of the simple queuing theory schematic sketched in Figure 2. Leaving aside the issues of ensuring that the capacities within the specific polling place service points are properly balanced, and applying the *ceteris paribus* proviso, lines will be lowered if (1) the number of voters coming to a polling place is reduced, (2) the number of service points is increased, or (3) average transaction times are reduced. The following categorize various policy proposals that have been put forward as means to improve the problem of line lengths under these topics.[11]

Reduce the number of voters coming to the polling place

- Increase opportunities to vote by mail, thus reducing the total number of people using all forms of in-person voting.
- Increase opportunities to vote early in-person, removing pressure from traditional precincts.

[10] <http://web.mit.edu/vtp>. More pared down tools, developed by Stephen Graves and Aaron Strauss, are also hosted on the site.

[11] These proposals draw heavily on Levitt (2013). See the Levitt article for a longer list of proposals than the one presented here.

- Make Election Day a holiday, allowing for arrival times to be smoothed out during the day at traditional polling places.

Increase the number of service points

- Increase the number of precincts.
- Increase the number of poll workers.
- Increase the number of machines.
- Favor paper balloting over electronic voting machines.

Reduce average transaction times

- Increase information to voters.
- Increase the functionality of electronic poll books.
- Decrease the length of ballots.

Space is another constraint that is rarely highlighted, but in the context of trying to streamline operations, it could be critical. Nearly all physical polling places are located in repurposed space. According to the 2012 SPAE, 32% of Election Day voters voted in school buildings, 22% in churches, and 16% in community centers, with the remaining 30% of voters using a hodgepodge of police/fire stations, libraries, stores, and private residences; for early voting, 44% voted in government buildings such as court houses and city halls, 16% in libraries, and 14% in community centers. The important thing to note is that these are not standardized spaces, and it may not be possible to configure many of them optimally to reduce service times.

Returning to the list of proposed solutions to reduce the length of lines, it is important to reiterate that very little empirical evidence has been produced in the scholarly literature to demonstrate that implementing them in the field will actually reduce lines. The fact that there is only a tiny number of empirical studies that examine correlations between the capacity of individual polling places, on the one hand, and voter experience, on the other, suggests the difficulty in knowing precisely what it would take, in terms of the expenditure of dollars for additional equipment or the redistribution of existing equipment, to mitigate the problems that do exist.

To help overcome the problem caused by a dearth of policy-relevant empirical research aimed at fixing the long-line problem, we identify two barriers that must be overcome by researchers in this field.

First, there must be greater attention to detailed analysis of polling place dynamics. Queueing theory identifies the source of line-causing problems in the transactions that occur at individual check-in tables, voting machines, and ballot scanners. Thus, the analysis must be at the point-of-service; even analysis at the precinct-level may not be granular enough to diagnose and solve problems that lead to long lines.

Second, there must be greater attention to actual experimentation, in order to tell what works. The observational data that are currently available—for instance, the number of polling places deployed across a county—are produced by very complicated, interrelated decisions made by local election officials. This means that the tools that might traditionally be used to study the "causes" of long lines will be blunt instruments without very good measures of confounding effects measured at a highly disaggregated level.

CONCLUSIONS

The previous section reviews a list of the most common recommendations that have been proffered as solutions to the problem of long lines. Unlike post-2000, where research using existing data established a clear pattern that relate the use of antiquated voting machines to increased "lost votes," there is no single, high-impact solution to long lines that emerges from existing research—and certainly nothing that seems to apply everywhere.

It seems undoubtedly true that, *ceteris paribus,* if a state or locality were to reduce the number of voters coming to polling places, increase the number of service points, and decrease transaction times, lines would be shortened. However, the cost of these proposals is unknown, and more to the point, the effect of these proposals measured on a per-minute-reduced basis has yet to be quantified.

Therefore, while there may be some consensus solutions to local and state problems with long lines, much work still needs to be done to establish a basis for making changes that may seem less obvious, or for understanding trade-offs across competing values. We conclude this article by making some observations about how the required fact base might be established, building off the evidence that already exists.

1. The "line problem" consists of two parts, *chronic* long lines and long lines due to *one-off events.*

2. Chronic long lines appear to beset only a handful of states and counties. Research that compares

states that are similar demographically, but which have significantly different average wait times, would advance our understanding of how laws and practices facilitate expeditious service at polling places. (A wide-ranging comparison of California and Florida—states with similar demographics and ballot lengths but dramatically different average wait times—would seem the logical place to start.) Even in states with short average waiting periods, urban areas can still have long lines. Understanding the chronic challenges of urban areas appears to be a distinct area where more research is needed.

3. All jurisdictions can be prone to emergencies that cause specific precincts to have long lines, and all jurisdictions could be helped by gaining access to better information about service times, to aid in a process of continued improvement. The Election Assistance Commission (EAC) and professional associations are well positioned to facilitate the sharing of best practices among election officials, as they cope with the inevitable service crises on Election Day.

4. The EAC can provide a helpful role in supporting the research on voters' experiences and the extent and causes of line problems. It is within the EAC's mandate to report on the progress of state and local election officials in improving the customer service provided to voters in polling places, and to develop resources on the management of lines that can assist counties that have chronic line problems.

ACKNOWLEDGMENTS

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(*Appendix follows* →)

APPENDIX A

TABLE A. AVERAGE WAIT TIMES BY STATE, 2008 AND 2012

	2008		2012			2008		2012	
State	Wait	95% m.o.e.[a]	Wait	95% m.o.e.[a]		Wait	95% m.o.e.[a]	Wait	95% m.o.e.[a]
Alabama	21	5.5	10	2.4	Montana	6	2.1	12	5.2
Alaska	5	1.7	3	1.2	Nebraska	10	3.2	4	1.1
Arizona	15	4.5	8	2.9	Nevada	10	2.4	8	1.3
Arkansas	21	4.7	13	2.4	New Hampshire	6	1.7	11	2.2
California	11	2.6	7	0.8	New Jersey	7	1.5	5	0.7
Colorado	10	4.1	8	2.7	New Mexico	12	2.9	6	1.4
Connecticut	10	23.	7	1.6	New York	9	1.3	12	1.5
Delaware	12	3.2	4	1	North Carolina	19	2.9	13	1.4
D.C.	28	9.8	37	7.5	North Dakota	5	1.9	10	7.5
Florida	31	3.5	39	4	Ohio	19	2.7	10	1.3
Georgia	40	5.8	16	2	Oklahoma	22	4.9	17	2.7
Hawaii	5	1.6	7	2	Oregon	na	na	na	na
Idaho	6	1.8	8	1.9	Pennsylvania	14	1.7	8	1
Illinois	12	1.8	12	2.2	Rhode Island	5	2	11	2.2
Indiana	22	3.6	13	2.3	South Carolina	56	7.7	25	3.8
Iowa	5	1.5	6	1.8	South Dakota	4	1.7	3	1.2
Kansas	10	2.3	11	2	Tennessee	19	3.6	13	1.7
Kentucky	12	2.6	8	1.5	Texas	13	1.4	11	1.1
Louisiana	16	3.5	16	3	Utah	13	3.3	10	2
Maine	4	1.3	4	1.1	Vermont	2	1.2	2	0.7
Maryland	24	4.3	36	4	Virginia	28	4.6	25	2.5
Massachusetts	6	1.2	7	1.2	Washington	na	na	na	na
Michigan	20	3.5	19	2.3	West Virginia	14	3.4	11	2
Minnesota	9	2	6	1	Wisconsin	8	1.6	8	1.4
Mississippi	11	2.9	7	1.4	Wyoming	5	2	4	1.2
Missouri	20	3.7	11	1.8					

Oregon and Washington are excluded because they are vote-by-mail states.
Source: Cooperative Congressional Election Study (CCES) and the Survey of the Performance of American Elections (SPAE), 2008 and 2012.
[a]Margin of error.