# Early Voting and Late-Election Information

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May 16, 2023

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**Abstract**

Convenience voting (any form of voting that does not take place on Election Day at one's precinct) offers voters a "low-cost" method of voting, but at a price: those choosing to cast a ballot early forfeit their ability to incorporate late-election information into their vote. This information can matter for election outcomes: using a difference-in-differences design and variation in the availability of early voting, I find that voters who were only able to cast their ballot after the release of FBI Director James Comey's letter to Congress on October 28, 2016 were significantly more likely to vote for the Republican candidate. Normative questions arise: from an ex-ante point of view, would society benefit from a wider availability of early voting, or is early voting already too available? To answer these questions, I develop a model in which voters choose whether to vote early, late, or not at all, and where both information and the realized cost of Election Day voting affect whether a particular voter votes or not. I show that early voting is beneficial to society when 1) Election Day voting costs are correlated with ideological preferences and 2) late-election information is not too "big."

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I am grateful for comments and encouragement from Brian Beach, Peter Bils, Patrick Flynn, Mattias Polborn, and Lesley Turner. I also thank seminar participants from Vanderbilt University and the Formal Theory Society virtual workshop. All remaining errors are my own.

# 1 Introduction

Voting is a crucial, yet costly, feedback mechanism between policy-makers and their constituents in the United States. Turnout rates in the U.S. trail behind most of the nation's fellow members in the Organization for Economic Cooperation and Development [Desilver, 2020]. This low turnout is likely not just a product of low interest: among those who reported not voting in November 2018 in the Current Population Survey Voting and Registration Supplement, 26.9% reported they were too busy or had a conflicting schedule, versus the 15.5% who claimed they were not interested [United States Census Bureau, 2019]. Many who *do* turn out pay a high cost to do so: the Brennan Center for Justice estimates that "some 3 million voters waited 30 minutes or more to cast their ballot" in 2018 [Klain et al., 2020]. All of this serves as motivation for election administrators and policy-makers to introduce methods of convenience voting, a blanket term for any form of voting which does not take place in one's voting precinct on Election Day (early in-person voting, absentee voting, and universal vote-by-mail are all methods of convenience voting).

An oft-overlooked consequence of convenience voting is a changed information environment: voters choosing to cast a ballot early give up the ability to incorporate late-election information into their vote. Many elections throughout history have included important late-election events or information. Think of the "October surprise," which refers to a crucial event that can "irreparably damage one candidate's chances and boost the other's. It can come in the form of a calculated political attack – still a "surprise" to the public and the candidate it's brought against – or something unplanned that can critically change the course of an election" [Andrew, 2020].

How might voters' preferences shift in response to information shocks occurring late in an election, and to what extent could early voting constrain the electorate's ability to express these preferences? More broadly, given this tradeoff between the cost of voting and full information, under what conditions is early voting *good* for social welfare? In this paper, I make use of both quantitative and formal theoretical methods to answer these questions.

I focus on the 2016 presidential election and then-FBI Director James Comey's October 28, 2016 letter, sent to Congress just eleven days before Election Day. The letter announced the FBI had discovered more emails which seemed pertinent to the investigation of Democratic presidential candidate Hillary Clinton's use of a private email server during her time as Secretary of State – an investigation Comey had previously testified was complete [Perez and Brown, 2016]. Using a difference-in-differences design and variation in the availability of early voting, I show that voters who had not had the opportunity to vote early by 10/28/16, the day the letter was released, were significantly more likely to vote Republican; estimates of the increase in Republican presidential vote share range between 3.21-3.24 percentage points, larger than the vote margins of eight states in 2016. Of these eight, four did not have early voting ahead of 10/28/16, and three of those four (Florida, Michigan, and Pennsylvania) broke in favor of Republican candidate Donald Trump.

Having shown that late-election information can matter for election outcomes, important normative questions arise. From an ex-ante point of view, would society benefit from a wider availability of early voting, or is early voting already too available? In order to answer these questions, I develop a model in which voters choose whether to vote early, late, or not at all, and where both information and the realized costs of Election Day voting affect whether a particular voter turns out.

The model considers an election with two candidates and many voters. In order to capture endogenous participation, voting is costly, and citizens have the option to abstain on Election Day. Although U.S. turnout is relatively low compared to its OECD peers, it is still much higher than what traditional rational choice models of voting, where voters consider their potential impact on the outcome of the election, would predict. Indeed, in costly voting models where voters are only motivated by the chance that their vote affects the outcome of the election, the predicted equilibrium participation rate converges to zero as the number of citizens becomes large [Riker and Ordeshook, 1968].

In order to build a convincing model of early voting, I need a framework in which there is a positive rate of participation that depends on both voting costs and voters' information status. For this reason, I assume that voters derive utility both from the outcome of the election and the act of voting itself. In fact, a voter does not believe that she is pivotal for the outcome of the election, and therefore, the decision of whether or not (and when) to vote is not influenced by pivotality considerations. Instead, participation depends only on the "expressive" part of the voter's utility. Specifically, this expressive utility depends on the difference between the voter's utility from either candidate, given her current information status – a voter is more likely to vote if she perceives a large utility difference between the Democratic and Republican candidates (see Rivas and Rockey [2021] for recent empirical evidence of desire to "boo" candidates driving turnout).

In this framework, candidates are each endowed with a policy position (for a one-dimensional policy) and valence, some quality which is orthogonal to policy and representative of late-election information, which is known by the time of Election Day. Citizens each have their own ideal policy point and choose whether to vote early or late. When they make that decision, they are aware that new information may arrive between now and Election Day that might affect their voting decision, both whether to vote and for whom. Thus, waiting until Election Day has an option value, in particular for ideologically moderate voters. However, there is also a benefit of voting early, namely that waiting until Election Day may mean that a voter is hit with a high voting cost shock, rendering her unable to vote.

Three "types" of voters arise endogenously from this model, distinguished by how they respond to late-election information. Some voters (labeled "partisans") would *never* vote against their ideological interests, no matter the late-election information at hand. Partisans with sufficiently extreme policy preferences (labeled "strong partisans") will only abstain in the face of extreme voting costs, but would never be driven to abstain by the information itself. Partisans with less extreme policy preferences (labeled "weak partisans") may be driven to abstain as a "protest" in the face of certain late-election information, but they would still never vote for the other candidate. The last type of voter is labeled a "swing voter," as she may respond on the intensive margin previously discussed and vote against her ideological interests in the face of sufficient late-election information. These voters have much more moderate bliss points.

Voters who vote early will be under-informed, as they will not yet know the valence of each candidate. This does not matter for strong partisans whose vote is independent of the information that they may receive – these voters simply benefit from being able to vote early and avoid a high cost shock on Election Day. In contrast, weak partisans and swing voters face a tradeoff between voting cost savings from voting early and the opportunity to respond to late-election information (for swing voters, this means potentially "switching" their vote). While these voters take the option value of waiting into account, their tradeoff is not the socially optimal one because they do not consider their own impact on the outcome of the election. This externality is at the heart of the potential inefficiency of early voting, because these voters only care about their own expressive utility and not about how their choice to vote with incomplete information affects all other voters' outcome utility.

This paper is closest in scope to Meredith and Malhotra [2011], which discussed the notion of convenience voters and Election Day voters facing different information environments. The model developed here formalizes this idea and incorporates insights from an empirical exercise which leverages a singular information shock (the Comey letter) to determine how different kinds of voters respond to such information. To this end, the paper is also related to recent work on the impact of information and media in elections [Wang, 2021, Morton et al., 2015]. My identification strategy is particularly similar to that used in Montalvo [2011], which shows that a terrorist bombing in Spain negatively impacted the performance of the incumbent party in an election that took place three days later. Some work has been done on the impact of the Comey letter, specifically: there is some evidence that the letter had impacts in both polling and electoral prediction markets [Halcoussis et al., 2020, Silver, 2017]. McKee et al. [2019] points out that in each of the seven swing states that Trump won, he lost the sum of the votes cast early in-person or by mail; this paper builds on this by utilizing variation in early voting to determine the causal impact and heterogeneous effects of the Comey letter.

Much of the existing work on early voting focuses on the *individual*: the motivations each individual has to vote early [Shino and Smith, 2022, Gronke and Toffey, 2008] and the satisfaction one holds in their decision to do so [Lago and Blais, 2019]. Another body of work focuses on the effect of convenience voting on political participation and election outcomes [Barber and Holbein, 2020, Kaplan and Yuan, 2020, Thompson et al., 2020]. To my knowledge, this is the first paper to formally model and study the implications of convenience voting for social welfare. Building on models of expressive [Hamlin and Jennings, 2011, Brennan and Hamlin, 1998] and costly [Ledyard, 1984, Palfrey and Rosenthal, 1983] voting to generate individual decision problems for each voter to solve (to vote early or to wait; upon waiting, how to vote on Election Day), the model illuminates how the individual's decision to vote early or not affects social welfare. Consequently, it finds its roots in work which analyzes welfare in the context of costly voting [Krasa and Polborn, 2009, Börgers, 2004]. As pointed out in Gronke and Toffey [2008], institutions are a crucial factor in a voter's decision to vote early or not: a voter cannot vote early if her state does not provide the option to do so. In a time where convenience voting laws are hotly debated in state legislatures, with many states moving to expand early voting access and many others moving to restrict it, understanding the welfare implications of convenience voting is of the upmost importance.

## 2 Reduced-Form Effect of Late-Election Information

How might voters respond to late-election information when it is revealed, if at all? One can imagine that voters may react along both extensive and intensive margins: the information may serve to motivate citizens who were previously going to abstain to turn out and cast a ballot (or discourage citizens who otherwise would have voted into abstaining). It may also lead voters to switch their vote: perhaps they were going to vote for candidate $A$, but now they vote for candidate $B$. Changes along both the extensive and intensive margin can affect election outcomes. In order to demonstrate that information shocks are able to affect election outcomes, I begin by studying the 2016 presidential election and then-FBI Direction James Comey's letter to Congress. The letter, sent on October 28, 2016, announced the discovery of additional emails which pertained to an investigation into Hillary Clinton's use of a private email server – an investigation Comey had previously testified was complete.

It is difficult to determine the causal impact of the Comey letter alone; Clinton was already beginning to slip in the polls prior to October 28th [Silver, 2017] and of course, other campaign activities and news continued throughout the next eleven days until Election Day. Here, I take advantage of variation in convenience voting laws across states and the system of early voting administration in one state in particular (Nevada) to conduct two complementary difference-in-differences analyses in an attempt to study the causal impact of the letter. The central idea behind each of these designs is simple: voters who cast their ballot ahead of October 28th, 2016 did not have knowledge of the Comey letter; voters who cast their ballot after that date did.

Results from both of these designs demonstrate the way voters respond to late-election information. It is important to stress, however, that the Comey letter is just one example of late-election information which helps to fix ideas; the ultimate goal of the paper is to analyze the social welfare implications of early voting, which requires the study of the theoretical model developed in Section 3.

## 2.1 Setting

### 2.1.1 Convenience Voting in the United States

Convenience voting has risen in popularity over the past few decades: traditional Election Day voting dropped from over 90% of ballots cast in 1992 to about 60% in 2016 [MIT Election Data + Science Lab, 2021]. Though its recent rise in popularity may suggest otherwise, the notion of an early voting period is not a new one in the United States: the first presidential election in 1788 lasted over a month. In 1792, Congress allowed each state to choose an election day (or for some, a period of two days) out of a 34-day period before the first Wednesday in December, leading to a "patchwork of election days" across the nation, before formally establishing a national election day in 1845 [Bimes, 2020].

According to Bimes, "the establishment of an explicit early voting period rests on the precedent set during the Civil War," i.e. the ways in which soldiers cast their vote while away on the battlefield. The earliest evidence of formal absentee voting according to the National Conference of State Legislatures is "'a list of eligible persons [who] were permitted to vote before Election Day' when Louisiana established 'in-person absentee voting' in 1921" [Waxman, 2020]. In the late 1900s, states began to move away from requiring excuses (i.e., formal reasons a voter could not cast their ballot in person on Election Day) to no-excuse convenience voting, where no reason was required: in 1978, California allowed no-excuse absentee (by-mail) voting. By the late 1980s, Texas offered early in-person voting (which requires no formal excuse), beginning a period of adoption of convenience voting methods in a number of states between the 1990s and today [Bimes, 2020, Waxman, 2020].

Thirty-five states began convenience voting before October 28$^{\text{th}}$, 2016, the day of the

Comey letter's release. A total of thirty-seven states practiced no-excuse convenience voting at the time: see Figure 1 for statewide variation (note that Florida and Oklahoma had no-excuse convenience voting, but their voting periods did not open until *after* October 28$^{th}$). Of those thirty-five, three states practiced universal vote-by-mail, meaning ballots were mailed to all registered voters.[1] The rest of the thirty-seven had early in-person voting options, where polls were open for citizens to cast their ballot in-person up to more than six weeks ahead of Election Day.[2]

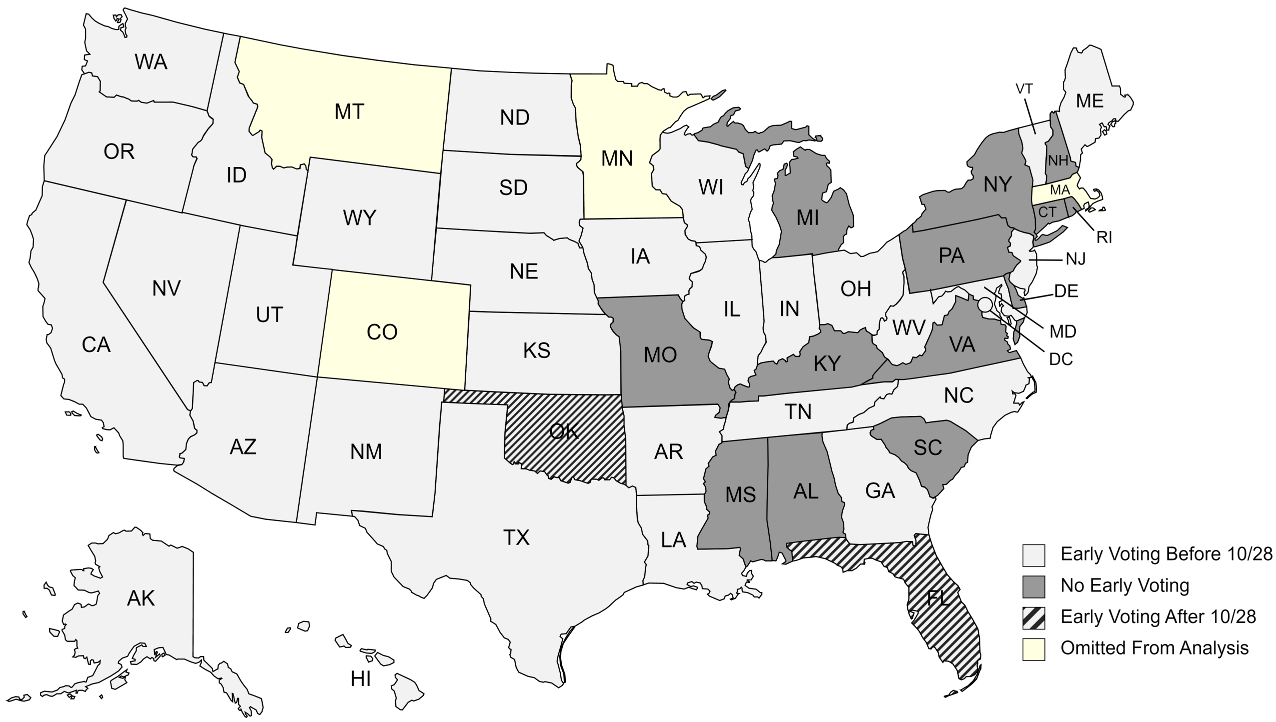
See Table 1 for summary statistics on counties in states with convenience voting and states without convenience voting. All variables, with the exception of the Democrat/Republican U.S. House margin, are taken in 2012, i.e. the "pre-treatment" election of interest. The Democrat/Republican U.S. House margin is an average calculated over elections from 2008, 2010, and 2014. The two groups appear quite similar along most dimensions; the largest difference is in the unemployment rate (there, the groups differ by 0.424 standard deviations).

Additionally, any baseline differences in these measures need not be too concerning: difference-in-differences specifications allow for differences in *levels*, so long as there are parallel *trends*. Given that I exclude any states which change their convenience voting laws between 2012 and 2016 from my analysis, preexisting cross-state variation in convenience voting laws should not reflect differing trends in political and election outcomes.

[1] These three states were Colorado, Oregon, and Washington; nearly 80% of counties in Utah were also using universal vote-by-mail in 2016 [Thompson et al., 2020].

[2] The earliest early voting start date in 2016 was September 21$^{st}$ in Wisconsin.

Figure 1: Variation in state convenience voting laws in the U.S., 2012-2016




**Notes**: States in light gray had early voting open prior to 10/28/16. States in dark gray did not have no-excuse early voting available. Oklahoma and Florida (striped) did have early voting available, but only after 10/28/16. States in light yellow changed their convenience voting laws between the 2012 and 2016 elections and are thus excluded from my analysis (Colorado, Massachusetts, Minnesota, and Montana). Made using https://mapchart.net.

Table 1: Summary statistics: treatment v. control groups

| | Convenience Voting | No Convenience Voting | Difference (Std. Devs.) |
|---|---|---|---|
| 18+ Population | 78,171.43 | 77,744.84 | 0.002 |
| Unemployment Rate | 7.554 | 8.74 | 0.424 |
| Population Density | 136.341 | 410.587 | 0.184 |
| Median Age | 40.258 | 40.279 | 0.004 |
| # Men Per 100 Women | 100.823 | 98.334 | 0.221 |
| % Non-white | 15.434 | 18.461 | 0.183 |
| Median Income | 45,540.93 | 44,108.41 | 0.122 |
| % with Bach. or Higher | 19.024 | 19.148 | 0.015 |
| Dem/Rep. House Margin* | -0.234 | -0.158 | 0.241 |
| Dem. Vote Share in Pres. Race | 0.368 | 0.417 | 0.331 |
| Turnout | 0.549 | 0.568 | 0.2 |
| Count | 2090 | 801 | |

**Notes**: The means of the convenience voting and no convenience voting groups are reported, along with the difference in terms of the standard deviation of the entire sample, for reference. For example, the difference in 18+ population between the groups is 0.002 of one standard deviation (measured from the entire sample). Variables denoted with an asterisk are averages over three U.S. House election cycles: 2008, 2010, and 2014. All other variables are taken from 2012. Colorado, Massachusetts, Minnesota, and Montana are not included, as they changed convenience voting laws between 2012 and 2016; Alaska is not included, as it does not report election results by county. Population density is calculated by dividing a county's 18+ population by its land area in square miles (as reported by the 2010 Census). The % with Bach. or Higher variable refers to the percent of those aged 25+ with a bachelor's or more advanced degree.

### 2.1.2 The Comey Letter as Late-Election Information

There are many recent examples of late-election information in the United States: in 2020, news of an extramarital affair and a subsequent investigation by the U.S. Army Reserve of Cal Cunningham, a Democrat running for a U.S. Senate seat in North Carolina, occurred less than one month away from Election Day [Robertson, 2020]. In the 2003 California gubernatorial recall election, Republican Arnold Schwarzenegger replaced incumbent Democratic Governor Gray Davis, winning by a margin of 968,491 votes [Ballotpedia, b]. The *Los Angeles Times* reported on the Friday before the election that six women had alleged Schwarzenegger of sexual misconduct [Cohn et al., 2003] after "more than three million of ten million voters had already cast their ballots" [Gronke et al., 2008]. In 2000, news of George

W. Bush's 1976 DUI arrest was reported on by media outlets four days before Election Day [Balz, 2000].

In this section, I focus on a particular example of late-election information: then-FBI Director James Comey's October 28, 2016 letter which announced the FBI had discovered more emails which seemed pertinent to the investigation of Hillary Clinton's use of a private email server during her time as Secretary of State (an investigation Comey had previously testified was complete), sent to Congress just eleven days before Election Day [Perez and Brown, 2016].

The 2016 presidential election featured Republican candidate Donald Trump, a real estate mogul and reality television star, and Democratic candidate Hillary Clinton, a former New York Senator, U.S. Secretary of State, and first lady. The two candidates entered Election Day with "record-high" unfavorability ratings, according to Gallup polling [Saad, 2016]. In the end, Clinton won the popular vote, but Trump won the Electoral College, clinching the presidency.

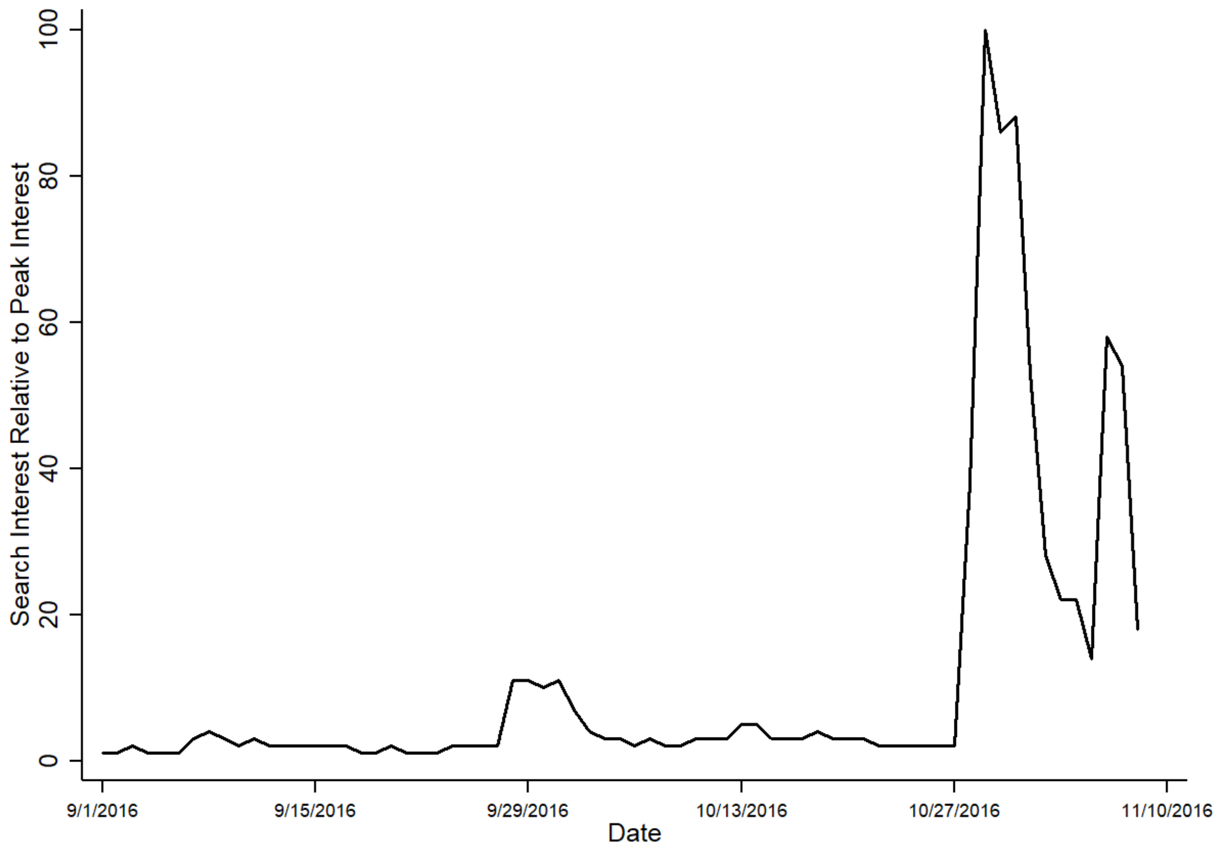
The last month or so of the campaign leading up to Election Day on November 8$^{\text{th}}$ was quite dynamic. On October 7$^{\text{th}}$, *The Washington Post* obtained a video in which "Donald Trump bragged in vulgar terms about kissing, groping and trying to have sex with women during a 2005 conversation caught on a hot microphone" [Fahrenthold, 2016]. This prompted several prominent Republicans to condemn Trump; some even suggested he withdraw his candidacy [Wellford, 2016]. On that same day, the Office of the Director of National Intelligence and the Department of Homeland Security released a statement accusing Russia of interfering with the election, and media organization WikiLeaks began releasing emails of Clinton campaign chairman John Podesta, many of them "embarrassing for Clinton" [Cohen, 2017]. These releases continued on a near-daily basis throughout the rest of the campaign, but none seemed to generate a nation-wide shock in the way that 1) the aforementioned tape, 2) the beginning of the WikiLeaks releases, or 3) the Comey letter did.

I choose to focus on the Comey letter as the late-election information of interest in the election. The events of October 7$^{\text{th}}$ negatively impacted both candidates, prompting muddled behavioral implications for voters. In comparison, the Comey letter (and thus October 28$^{\text{th}}$) clearly represented negative information on Clinton. Additionally, not as many people had yet had the opportunity to vote by October 7$^{\text{th}}$, making for a smaller control group: just ten states began convenience voting before October 10th.[3]

As mentioned above, thirty-five states began convenience voting before October 28$^{\text{th}}$. Although concerns over Clinton's use of the email server had already been raised (in fact, the FBI had already conducted an investigation, which Comey had previously testified was closed), this letter may have "legitimized" some voter's concerns about the candidate and/or raised speculations of a re-opening of the FBI investigation. It certainly represented an information shock of interest to many voters; see Figure 2 for Google Trends data, which shows a large spike in searches for "Comey" on 10/28/16. The election was still eleven days away, yet many had already cast their ballot before they learned of this investigation. Their hands were now tied; would they have voted differently had they waited until Election Day, or perhaps abstained altogether?

[3] In a robustness check, I drop these ten states from my control group to ensure that all counties, both treated and control, had knowledge of the events of October 7$^{\text{th}}$ prior to voting: see Section 5.1.4.

Figure 2: Google Trends: searches for “Comey”




**Notes**: This figure shows Google Trends data for searches for “Comey” in the United States between 9/1/2016-11/8/2016. A value of 100 is peak popularity for the term.

## 2.2 Data

I obtain data on convenience voting laws and timing from the Elections & Voting Information Center for the 2012 election [Hicks, 2012] and Ballotpedia for the 2016 election [Ballotpedia, a] and use it to define treatment in the first difference-in-differences design: states with early voting windows which open before 10/28/16 are control states and those without early voting windows open before 10/28/16 are treatment states (this includes states which did not have early voting at all). Treatment is defined by the availability of no-excuse early voting, where voters need not provide a reason for casting their ballot early.

I collect county-level presidential election returns (vote totals for each candidate) for 2012 and 2016 from Dave Leip's Atlas of Elections [Leip] and counts of 18+ population for each county in 2012 and 2016 from the Survey of Epidemiology and End Results (SEER). I use these counts as voting-age population for calculating turnout rates. For the Nevada design, I collect county-level early voting returns for 2012 and 2016 (turnout rates and turnout rates by party registration, broken out by week) from the Nevada Secretary of State's website.

I obtain county-level controls from the U.S. Census Bureau's American Community Survey 5-year estimates, the U.S. Bureau of Labor Statistics, and the U.S. Census Bureau's Census of Population and Housing.

## 2.3 Methodology

### 2.3.1 State-Level Variation in Convenience Voting

In the first design, I code two types of counties as treated: counties in states without early voting and counties in states where early voting did not open until after October 28$^{\text{th}}$, 2016. The treatment turns on with the Comey letter (only in 2016 and not in 2012). Counties in states with early voting which opened before October 28$^{\text{th}}$, 2016 are controls, as voters in these states would have been least able to respond to the Comey report. Here, the variation of interest comes from the availability of early voting, something set independently by each state. In order to avoid any confounding trends at the state level, I exclude any state which changed its convenience voting laws between 2012 and 2016 from my analysis (these states are Colorado, Massachusetts, Minnesota, and Michigan).

The identifying assumption here is that, absent the Comey letter, treatment and control counties would have trended similarly in the outcomes of interest (turnout and partisan vote shares).[4,5] This design also requires that any late-election information in 2012 did not affect political behavior.[6] I estimate

$$y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}, \tag{1}$$

where $T_c$ takes a value of 1 for counties in states without early voting and states where early voting did not open until after October 28$^{\text{th}}$, 2016 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 otherwise.[7] Outcomes of interest $y_{ct}$ for county $c$ in year $t$ include turnout rate and vote shares for Democratic and Republican presidential candidates. I calculate turnout rate out of the voting-age population (i.e., the 18+ population); vote shares are proportions of total ballots cast for the president. I weight by voting-age population in my preferred specification, since 1) I expect more accurate measurement of rates in counties with larger populations and 2) treatment effects could be correlated with population (insofar as how population might be related to political ideology, etc.).

[4] It may be problematic to compare voters in states with early voting to voters in states without early voting if these two types of states are on different political *trends* – this would mean a violation of the parallel trends assumption. To this end, counties in Florida and Oklahoma may be a superior "treated" group, as both Florida and Oklahoma had no-excuse early voting periods that did not open until *after* 10/28/16, meaning both treated and control voters live in states with early voting (the difference is just in when early voting is offered). See Section 5.1.1 in the appendix for a robustness check; results are robust to a refinement of the design which compares counties in Florida and Oklahoma to counties with early voting open before 10/28/16.

[5] Another method of addressing the trends assumption is a border county design which restricts comparisons to counties on either side of the same state border at which treatment status changes: it may be more plausible that counties along the same border have parallel trends. See Section 5.1.2 in the appendix for this method; results are broadly consistent with those presented here. Ultimately, the design comes at a cost of lost power to make marginal improvements in the underlying similarities of treatment and control counties.

[6] Some may view Hurricane Sandy, which made landfall in the U.S. on October 29$^{\text{th}}$, 2016, as late-election information benefiting President Obama (since his handling of the storm was positively regarded by both parties). See Section 5.1.3 in the appendix for a robustness check; results are robust to leaving out counties in Connecticut, New Jersey, and New York, which had the largest populations in storm surge zones during Hurricane Sandy [Center for International Earth Science Information Network, 2012].

[7] This definition of treatment means that some control counties had early voting available prior to October 7$^{\text{th}}$, another important day in the election cycle. In Section 5.1.4 in the appendix, I show results are robust to the exclusion of all counties which had early voting available prior to 10/7.

### 2.3.2 Nevada

A potential issue with the above design is comparing voters across states – several other statewide races coincide with presidential elections, which could lead to confounding influences on turnout and partisan vote shares. Thus, I focus solely on the state of Nevada, which reports its early vote turnout by party and by week. Nevada has a two-week early voting period which was divided into October 22–28 and October 29–November 4 in 2016. Since the Comey Report was released on October 28$^{\text{th}}$, those who voted in Week 2 were able to incorporate information in their vote which those who voted in Week 1 were not.

The unique timing of early voting and system of reporting early voting turnout in Nevada buys me a few things: I am able to compare within state, ruling out confounding cross-state differences, and I am able to compare early voters to other early voters. Although it comes at the cost of a much smaller sample size, these are valuable improvements over the first design.

Using week-county-year observations, I estimate a difference-in-differences specification and compare Week 2 and Week 1 voters in 2016 and in 2012. The identifying assumption here is that, absent the Comey letter, Week 1 and Week 2 voters would have trended similarly in terms of the outcomes of interest. Again, this design also requires that any late-election information in 2012 did not affect political behavior in Nevada. I estimate

$$y_{wct} = \alpha + \delta T_t + \gamma P_w + \beta(T_t \times P_w) + \epsilon_{wct}, \tag{2}$$

where $w$ indexes week, $c$ indexes county, and $t$ indexes year/election (it may be helpful to think of the 2016 election as treated and 2012 as control, where Week 2 is the post-period and Week 1 is the pre-period). Outcomes of interest include early turnout as a proportion of 18+ population and turnout by party registrants (i.e., voters registered as Democrats, etc.) as a share of total early votes. Unfortunately, I am unable to see the outcomes (i.e., ballots cast for the Democrat, etc.) broken up into weeks. However, turnout by party registration is helpful in determining how different "types" of voters are reacting on the extensive margin, something I am unable to determine by just looking at election outcomes. I weight by voting-age population and report bootstrapped standard errors (clustered at the county level).

## 2.4 Results

Table 2 shows results from the first design. My preferred specification is column (2), which includes county and year fixed effects and weights by voting-age population (as rates are more accurately measured in more populous counties, and treatment effects may be correlated with population). First, note that there is no change in turnout. Since there is not a significant change on the *extensive* margin, I look for changes on the *intensive* margin by examining the effect of the Comey letter on vote shares (total ballots cast for a candidate, divided by total presidential ballots cast).

The results show an increase in Republican vote share of between 3.21 and 3.24 percentage points, in combination with a decrease in Democrat vote share of between 2.04-2.1 percentage points. The results are robust to the inclusion of time-varying county controls including unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a Bachelor's degree or higher (column (3)). As mentioned above, results are robust to a refinement considering only counties in Florida and Oklahoma (which had early voting, but not before 10/28) as treated units (Section 5.1.1), using a design which restricts comparisons to counties along the same state border (Section 5.1.2), dropping counties in states most affected by Hurricane Sandy in 2012 (Section 5.1.3), and excluding counties in states with early voting open before 10/7 (Section 5.1.4).

Table 2: Cross-state difference-in-differences

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0041 | 0.0086 | 0.0098 |
| | (0.0076) | (0.0064) | (0.0076) |
| Dem. Vote Share | -0.0021 | -0.0204$^{*}$ | -0.021$^{*}$ |
| | (0.0117) | (0.0108) | (0.0125) |
| Rep. Vote Share | 0.0116 | 0.0321$^{***}$ | 0.0324$^{**}$ |
| | (0.0108) | (0.0107) | (0.0122) |
| $N$ | 5782 | 5782 | 5782 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.
$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows results from a county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties *without* early voting open before 10/28/16 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. In column (1), I include county and year fixed effects. In column (2), which is my preferred specification, I weight by 18+ population. In column (3), I include time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a Bachelor's degree or higher). I calculate turnout rate as a proportion of 18+ population; all vote shares are proportions of total presidential votes cast.

Table 3 shows results from the second design. The results show an increase in early turnout rate of 0.4 percentage points: Week 2 voters were more likely to turn out upon learning of the Comey letter. Additionally, there is a decrease of 0.9 percentage points in the share of early ballots cast by registered Democrats. This may serve as informative of *who* is reacting to the Comey letter: it is plausible that the letter mobilized right-leaning and independent voters in Nevada and discouraged left-leaning ones.[8]

[8] One might be concerned that this result does not represent the "true" impact of the Comey letter on registered Democrats in Nevada; for instance, it could be that registered Democrats are discouraged in Week 2, but come around to vote by Election Day. However, this is not the case. Section 5.1.5 shows results from a similar difference-in-differences specification which compares Election Day voters to Week 1 voters; the decrease in registered Democrat vote share actually becomes *stronger*.

Table 3: Nevada difference-in-differences

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Early Turnout Rate | Registered Dem. Early Turnout Share | Registered Rep. Early Turnout Share | Registered Ind. Early Turnout Share |
| Treat×Post | 0.004** | -0.009* | 0.0006 | 0.0087 |
| | (0.0018) | (0.0054) | (0.0078) | (0.0074) |
| $N$ | 68 | 68 | 68 | 68 |
| Mean | 0.1343 | 0.2849 | 0.5307 | 0.1844 |

Bootstrapped standard errors are clustered at the county level and listed in parentheses.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows results from a county-week level difference-in-differences specification, weighted by 18+ population: $y_{wct} = \alpha + \delta T_t + \gamma P_w + \beta(T_t \times P_w) + \epsilon_{wct}$, where $T_t$ takes a value of 1 in 2016 and 0 in 2012, and $P_w$ takes a value of 1 for "Week 2" voters and 0 for "Week 1" voters. The early turnout rate is the number of early ballots cast divided by 18+ population. Registered Democrat early turnout share is the number of registered Democrats who cast a ballot early divided by the number of early ballots cast; outcomes (3) and (4) are defined similarly for registered Republicans and voters not registered as Republicans or Democrats, respectively.

The results from this section cast light upon the ways in which voters may respond to late-election information (and how convenience voting limits their ability to do so). Using state-level variation in the availability of convenience voting, I show that voters who were only able to vote *after* the Comey letter was released were more likely to vote for Trump and less likely to vote for Clinton. Using variation in the timing of early voting in Nevada, I show that early voters exposed to the Comey letter were more likely to turn out overall, but registered Democrats were less likely to do so.

The empirical exercise is useful in showing that late-election information matters for election outcomes; voters may react both on extensive and intensive margins. The demonstrated tradeoff between late-election information and early voting access begs the question: when is early voting good for social welfare? To answer this question, I develop a theoretical model which attempts to capture the behavior of the voters shown above.

# 3 The Model

## 3.1 Model Setup and Discussion

Suppose there exists a continuum of voters and two candidates, $L$ and $R$. Each candidate is endowed with a policy position in one dimension, $x_j$, and some valence, $v_j \in \mathbb{R}$. Let candidates' policy positions be given by $x_L = -1$ and $x_R = 1$.

The electorate consists of many citizens: each have their own bliss point $\theta \in \mathbb{R}$, according to some type distribution where $F_\theta(\cdot)$ is the cumulative distribution function.[9] In order to generate positive turnout predictions, I assume citizens vote "expressively," meaning that no voter expects their vote to be pivotal. In particular, a citizen's expressive utility is given by

$$u(x_j, x_{-j}, v_j, v_{-j}, \theta) = \begin{cases} m + (x_{-j} - \theta)^2 - (x_j - \theta)^2 + (v_j - v_{-j}) - c & \text{if vote for candidate } j \\ 0 & \text{if abstain} \end{cases}$$

Note that citizens' utility consists of two different components: they enjoy the act of voting itself ($m > 0$). However, just a "warm-glow" utility from voting would not allow voters to be motivated by the release of late-election information on *either candidate.* As such, I model voters to derive utility from the difference in payoffs she receives from the candidate she votes for and the candidate she does not. I use this difference so that voters are affected not just by the candidate they are closer to ideologically, but the other candidate as well. This mirrors conventional knowledge of how voters behave in the "real world": consider very left-leaning voters in the United States who voted for Joe Biden in 2020. A model considering only the absolute ideological utility ($-(x_j - \theta)^2$) would not have predicted far-left voters turning out for someone so distant from their ideal point; these voters likely considered the *difference* in payoffs of endorsing Biden's policies over Trump's. This applies not just to ideology, but

[9] I allow $|\theta| > 1$, so that citizens can hold more extreme policy preferences than the candidates' set positions.

valence issues as well: voters' actions are not just driven by the valence of the candidate they prefer. As seen in the previous section, right-leaning voters can be affected by the valence of left-leaning candidates (and vice versa); perhaps a feeling of "moral superiority" comes into play. This notion of voters enjoying "booing" their non-preferred candidates has empirical grounding: see Rivas and Rockey [2021] for recent evidence. Finally, there is a "cost" component of voting (given by $c$): voters must take time out of their lives to gather information, travel to the polls, wait in line, etc.

This expressive utility is needed to generate realistic predictions of political participation. Note that in rational choice models of voting, where voters are motivated by their potential impact on the election outcome, the costly voting literature has shown the predicted turnout rate in equilibrium converges to zero as the number of citizens grows large [Riker and Ordeshook, 1968]. For this reason, I use expressive voting to build a compelling model of early voting. However, voters clearly derive some utility from the outcome of the election, which is important to social welfare. I argue that this "outcome utility" does not matter for a citizen's voting behavior (whether to turn out or not), but it is felt by all citizens, whether they vote or not: consider those who do not vote but are very much impacted by the policies of elected officials. I focus on this outcome utility in Section 3.3, where I analyze welfare.

Before Election Day, there is uncertainty over both 1) the exact cost of voting and 2) the valence of each candidate. The former represents the unexpected troubles voters may face on Election Day: bad traffic, long lines, out-of-order voting machines. At times, such a large cost may occur that citizens abstain altogether. The latter illustrates the role of potential late-election information about candidates: in the weeks leading up to an election, candidates' policy positions are fairly set. However, October surprises (like the Comey letter) can arise just before Election Day and shift perceptions of candidates. On the day of the election, all of these components ($c$, $v_L$, and $v_R$) are known to voters.

Let $v_L$ and $v_R$ each be distributed over some interval $[-v, v]$, for sufficiently large $v$. Assume that $\mathbb{E}[v_L - v_R] = 0$, so that the ex ante assumption of voters is that candidates do not differ in valence. Consider $v$ indicative of the potential "size" of late-election information. A large $v$ means valence shocks could be quite extreme; a small one means valence shocks will be minute and unimportant.[10]

To simplify the cost distribution as much as possible, let $c$ be a discrete random variable distributed according to the cdf $F_C$ such that

$$c = \begin{cases} c_L & \text{with probability } q \\ c_H & \text{with probability } 1 - q, \end{cases}$$

where $0 < c_L < c_H$. Suppose that $c_H > m + 2v + 4\max\{\theta\} > c_L$ where $m + 2v + 4\max\{\theta\}$ is the maximum expressive voting utility, so that no one ever votes on Election Day if the realized voting cost is $c = c_H$.[11]

[10] It is important to note that in this model, information shocks are exogenous. While it is true that politicians have incentives to strategically time the release of private information (see Gratton et al. [2018]), this candidate-supplied information will not be affected much by whether or not early voting is available. With the introduction of early voting, candidates would simply release this information earlier. Instead, my model focuses on information released by media and late-breaking events which might affect election outcomes. The release of this kind of information would not be moved earlier with the introduction of early voting because its release is not strategic.

[11] In order to guarantee that there will be some cases where citizens abstain under $c = c_L$ and some cases where they vote, I assume the following throughout this section: $m < c_L < m + 2v$. The assumption $m < c_L$ means that "warm-glow" alone cannot drive turnout; the assumption $c_L < m + 2v$ means that an individual with a bliss point exactly at 0 (i.e., exactly indifferent between the two candidates ideologically) would turn out to vote for the beneficiary of the best-possible late-election information.

## 3.2 Analysis

### 3.2.1 Election Day

On Election Day, when an individual knows the realizations of candidate valences and Election Day voting cost, she solves the following:

$$\max\{m + (x_R - \theta)^2 - (x_L - \theta)^2 + \Delta v - c, m + (x_L - \theta)^2 - (x_R - \theta)^2 - \Delta v - c, 0\}, \quad (3)$$

where $\Delta v \equiv v_L - v_R$ is $L$'s relative valence. The solution to this problem for a voter with bliss point $\theta$ is described in the proposition below.

Suppose a voter with bliss point $\theta$ draws cost $c = c_L$ on Election Day. Then, she will vote for candidate $R$ if and only if $\Delta v < 4\theta + m - c_L \equiv \Delta v_R$, vote for candidate $L$ if and only if $\Delta v > 4\theta + c_L - m \equiv \Delta v_L$, and abstain otherwise.

The proof can be found in the appendix. Each voter has threshold values for candidates' relative valences: they require a candidate's relative valence to be sufficiently "good" in order to vote for them. These thresholds are easier for candidate $L$ to meet the further left a voter's bliss point is (and similarly for candidate $R$). Three distinct voter "types" arise endogenously from the model's setup. These types are defined by their Election Day behavior – namely, how they incorporate late-election information into their votes. The following corollaries describe each type.

If $\theta > \frac{1}{4}(c_L - m) + \frac{v}{2}$ ($\theta < \frac{1}{4}(m - c_L) - \frac{v}{2}$), then $\Delta v < 4\theta + m - c_L$ ($\Delta v > 4\theta + c_L - m$, resp.) for all realizations of $\Delta v$. Thus, the voter will always vote for candidate $R$ ($L$, resp.) on Election Day (given she draws $c = c_L$) and is called a "strong partisan."

If $\frac{v}{2} < \theta < \frac{1}{4}(c_L - m) + \frac{v}{2}$ ($\frac{1}{4}(m - c_L) - \frac{v}{2} < \theta < -\frac{v}{2}$), then $\Delta v < 4\theta + c_L - m$ ($\Delta v > 4\theta + m - c_L$, resp.) for all realizations of $\Delta v$. Thus, the voter will never vote for candidate $L$ ($R$, resp.)

on Election Day. She will vote for candidate $R$ ($L$, resp.) whenever $\Delta v < 4\theta + m - c_L$ ($\Delta v > 4\theta + c_L - m$, resp.) – given she draws $c = c_L$ – and will abstain otherwise. This voter is called a "weak partisan."

If $0 < \theta < \frac{v}{2}$ ($-\frac{v}{2} < \theta < 0$), then the voter does not always prefer $R$ ($L$, resp.) on Election Day: sometimes the utility from voting for candidate $L$ ($R$, resp.) will be greater than the utility from voting for candidate $R$ ($L$, resp.). This voter is called a "swing voter."

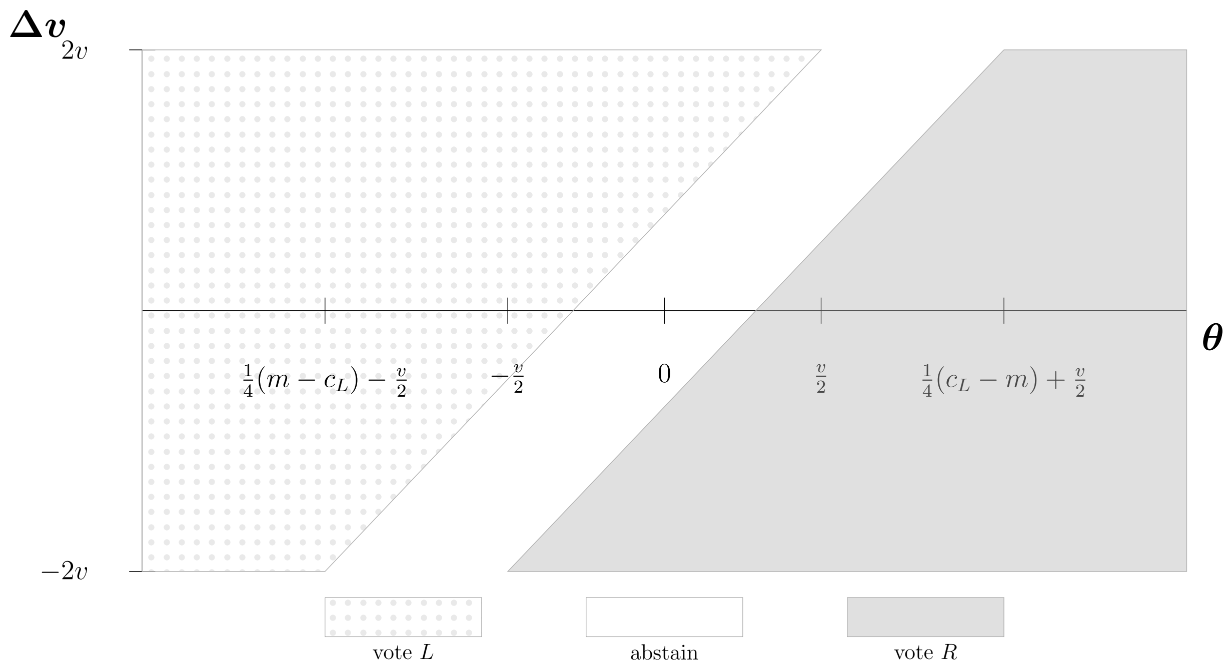
Note that $|\theta_{\text{strong partisan}}| > |\theta_{\text{weak partisan}}| > |\theta_{\text{swing voter}}|$.

The proofs for Corollaries 3.2.1-3.2.1 can be found in the appendix. Strong partisans prefer the candidate they are ideologically closer to – no matter the realization of late-election information – and only abstain when they face Election Day cost $c_H$. Weak partisans always prefer the candidate they are ideologically closer to. However, they can abstain (even when facing cost $c_L$) for some valence realizations, but they will *never* "switch" their vote to the candidate ideologically further from them. Finally, swing voters would vote for the candidate they are ideologically further from for *some* realizations of the valence shocks. The distinction between types comes directly from differing ideal points. Naturally, strong partisans have the most extreme bliss points, and swing voters have the most moderate ones.

Note that (weak) partisans are only influenced by late-election information in its capacity to determine their turnout decision: particularly bad information about their ideologically-preferred candidate may drive some partisans to stay home instead, for example. Strong partisans do not consider late-election information at all. Swing voters, however, are affected along another dimension besides turnout: negative revelations about their ideologically-preferred candidate may lead them to vote for the other candidate, something a partisan would never do. Remember that, since voters derive utility from the difference in candidates' valence, particularly *good* information about the candidate the voter is ideologically *further* from can also lead to partisan abstention or "vote-switching" from the swing voter. One can imagine both types of voters in the 2016 election: consider a left-leaning (weak) partisan who, upon learning of the Comey report, decides she would rather abstain than vote for Clinton (see the decrease in registered Democrats' early turnout share in Nevada in Table 3). Now, consider a left-leaning swing voter who, upon learning that same information, decides to vote for Trump (whose policies she is marginally less aligned with) instead of Clinton.

Each of these types' solution to the problem faced on Election Day (shown in Equation 3) looks different: the same valence realization may lead a swing voter to vote against her ideological interests and a weak partisan to abstain altogether. Election Day behavior for each type is characterized in Corollaries 3.2.1-3.2.1 and displayed in Figure 3.

Figure 3: Election Day behavior: voter types




**Notes**: This figure displays Election Day behavior for each "type" along the policy spectrum, assuming the voter has drawn $c = c_L$. Left-leaning (strong) partisans have bliss points $\theta < \frac{1}{4}(m - c_L) - \frac{v}{2}$, left-leaning (weak) partisans have bliss points $\frac{1}{4}(m - c_L) - \frac{v}{2} < \theta < -\frac{v}{2}$, left-leaning swing voters have bliss points $-\frac{v}{2} < \theta < 0$, and so on. Note that left (right)-leaning voters can have ideal points to the left (right) of $x_L = -1$ ($x_R = 1$, resp.).

First, as mentioned above, strong partisans' Election Day behavior is trivial: they vote for their ideologically-preferred candidate if they face cost $c = c_L$ and abstain if they face cost $c = c_H$. Next, consider the left-leaning weak partisan. Recall that she will *never* vote for candidate $R$: she will vote $L$ or abstain. Note that both *positive* late-election information about $L$ and *negative* late-election information about $R$ make the left-leaning weak partisan more likely to turn out and vote. This is because utility depends on the *difference* in candidates' valence: even late-election information that is solely about $R$, the candidate the left-leaning weak partisan would never vote for, can have an effect on her choice to turn out or abstain.

Then, a left-leaning weak partisan with bliss point $\theta$ abstains with probability $1 - q[1 - \mathbb{P}(\Delta v \leq \Delta v_L)]$.[12] The threshold (and thus the probability of abstaining) is: decreasing in $m$ and increasing in $c_L$; notably, the likelihood of abstention decreases as one's policy preferences become more extreme (i.e., as $|\theta|$ increases). The expected utility of a left-leaning weak partisan on Election Day is simply the probability that she faces cost $c = c_L$ multiplied by the likelihood her utility from voting $L$ would outweigh the cost, $c_L$, times the utility she would receive from doing so (conditional on that utility being large enough that she would do so).

The left-leaning swing voter faces a slightly more complicated problem: depending on the realizations of Election Day cost and relative valence, she may vote for $L$, vote for $R$, or abstain. Like the weak partisan, the valence realizations may render her indifferent enough between the two candidates such that she decides to abstain entirely. However, since she is more ideologically moderate than the weak partisan, sufficiently good information about candidate $R$ (and/or sufficiently *bad* information about candidate $L$) may push her to vote against her ideological interests on Election Day.

[12] This comes from $\mathbb{P}(c = c_L)\mathbb{P}(\Delta v \leq 4\theta + c_L - m) + \mathbb{P}(c = c_H) \cdot 1$, where $\mathbb{P}(c = c_L) = q$ and $4\theta + c_L - m = \Delta v_L$.

Then, a left-leaning swing voter with bliss point $\theta$ abstains with probability $1 - q[1 - \mathbb{P}(\Delta v_R \leq \Delta v \leq \Delta v_L)]$.[13] The probability of abstaining is decreasing in $m$ and increasing in $c_L$; additionally, the likelihood of abstention increases as a citizen's policy preferences become more moderate (i.e., as $|\theta|$ grows closer to 0). The expected utility of a left-leaning swing voter on Election Day is the probability that she votes, multiplied by the utility she would receive from doing so (there are two cases for the swing voter: one where she votes for $R$ and one where she votes for $L$).

I summarize all types' Election Day behavior below in Proposition 3.2.1. The proof can be found in the appendix, but the logic is as follows: suppose some voter votes for $L$ on Election Day. Then, certainly another voter to her left would also vote for $L$ (given she draws the low cost). The late-election information shifts all voters' preferences in the same direction.

Suppose that a voter with $\tilde{\theta}$ votes for $L$ on Election Day. Then, any voter with $\theta < \tilde{\theta}$ who draws $c = c_L$ also votes for $L$ on Election Day. Similarly, suppose that a voter with $\tilde{\theta}$ votes for $R$ on Election Day. Then, any voter with $\theta > \tilde{\theta}$ who draws $c = c_L$ also votes for $R$ on Election Day.

The above characterization of Election Day behavior describes how all types of voters incorporate late-election information into their vote. However, not all ballots are cast on Election Day. How do voters behave if they do not yet know the late-election information? When will they choose to vote early, and when will they choose to wait until Election Day? In the following section, I introduce early voting into the model to answer these questions.

[13]This comes from $\mathbb{P}(c = c_L)(\mathbb{P}(4\theta + m - c_L \leq \Delta v \leq 4\theta + c_L - m)) + \mathbb{P}(c = c_H) \cdot 1$, where $\mathbb{P}(c = c_L) = q$, $4\theta + m - c_L = \Delta v_R$, and $4\theta + c_L - m = \Delta v_L$.

### 3.2.2 Early Voting

In the previous section, citizens only had the option to vote on Election Day, at which point any late-election information is public knowledge. Citizens are fully informed of each candidate's valence and can act to maximize their ex post utility. However, voting may be too costly on Election Day, leaving citizens unable or unwilling to vote. Consider a shock to voting costs: unexpectedly long lines, broken machines, a large storm (represented by $c = c_H$ in the model) which forces voters to abstain. Many citizens might wish to avoid this risk and guarantee themselves a set, lower voting cost – something offered by early voting.

Consider an election with the same setup as above, but with one modification: a period that occurs *before* Election Day. In this first period (called the early voting period), citizens may vote and pay a cost $c' < c_H$. This cost is less than what voters could see on Election Day, offering citizens a way to mitigate risk. However, late-election information (i.e., the realizations of $v_L$ and $v_R$) is not yet known: voters who cast their ballot early are unable to consider relative valence and can only maximize their *ex ante* utility. This is the key tradeoff of early voting: it offers a (potentially) lower cost of voting but leaves voters without full information. How do individuals balance this tradeoff? Who votes early, and who waits until Election Day?

A voter who casts her ballot early will vote for the candidate who maximizes her ex ante utility. Since valence is unknown at this point (and $\mathbb{E}[\Delta v] = 0$ by assumption),[14] she votes for the candidate whose policy she prefers. That is, voters with $\theta < 0$ vote for $L$ and voters with $\theta > 0$ vote for $R$. Recall that voters need not vote early, though: they can choose to wait until Election Day. Therefore, in the first period, citizens have three options: vote early for $L$, vote early for $R$, or wait until Election Day. If they wait until Election Day, they maximize their ex post utility (i.e., they act according to the characterizations from Section

[14] One could consider an extension of the model which relaxes this assumption to allow some initial information on the candidates' valence. In theory, all this initial information would do is shift the populations who vote early for $L$ and $R$ to not necessarily directly correspond to ideological preferences.

3.2.1). As such, in the early voting period, an individual solves

$$\max\{m + 4\theta - c', m - 4\theta - c', \mathbb{E}[u| \text{ wait until Election Day}]\}, \tag{4}$$

where $\mathbb{E}[u|$ wait until Election Day$]$ is the expected utility of a voter if she waits until Election Day, derived in Section 3.2.1. As above, I characterize the behavior of (left-leaning) strong partisans, weak partisans, and swing voters separately.

A left-leaning strong partisan will vote early if and only if the ex ante utility of voting for $L$ outweighs her expected maximized ex post utility. Since she will always vote for $L$ as long as she faces $c = c_L$ on Election Day, there is no benefit to waiting. In particular, she votes early if and only if

$$c' < (1 - q)[m - 4\theta] + qc_L. \tag{5}$$

The first term on the right-hand side is the expected opportunity cost of waiting: if the strong partisan votes early, she forgoes receiving $m - 4\theta$ with certainty and only receives it with the probability she votes on Election Day, $q$. The second term is the expected cost of voting on Election Day: $q$, the probability she faces $c = c_L$, times $c_L$. There is no opportunity cost of voting early (i.e., there is no option value to waiting), since her Election Day behavior does not depend on the realization of the valence shock.

A left-leaning weak partisan will vote early if and only if the ex ante utility of voting for $L$ outweighs her expected maximized ex post utility. Since she would never vote for $R$ no matter what the late-election information is, the only benefit of waiting until Election Day is the option to abstain as a "protest" of sorts: if she learns the relative valence is sufficiently negative for $L$, she might prefer to stay home than vote. In particular, she votes early if and only if

$$c' < [1 - q(1 - F_{\Delta v}(\Delta v_L))][m - 4\theta] + q(1 - F_{\Delta v}(\Delta v_L))c_L - q\int_{\Delta v_L}^{2v} \Delta v f_{\Delta v}(\Delta v)d\Delta v. \tag{6}$$

Note that the first term on the right-hand side is the expected opportunity cost of waiting: if the voter chooses not to vote early, she gives up getting $m - 4\theta$ with certainty and only receives it with the probability she ends up voting on Election Day, $q(1 - F_{\Delta v}(\Delta v_L))$. The second term represents the expected cost of voting on Election Day: the Election Day voting cost, multiplied by the probability the voter will vote. Finally, the expected opportunity cost of voting early is subtracted: rather than receiving $\mathbb{E}[\Delta v|\Delta v > \Delta v_L]$ with the probability that she votes for $L$ on Election Day, the voter gets $\mathbb{E}[\Delta v] = 0$ if she votes early.

A left-leaning swing voter will also vote early if and only if the ex ante utility of voting for $L$ outweighs her expected maximized ex post utility; however, she must consider that she will have *two* more options on Election Day: abstention or switching her vote and voting for $R$. As such, she votes early if and only if

$$\begin{aligned} c' < {} & [1 - q(1 - F_{\Delta v}(\Delta v_L))][m - 4\theta] + qc_L[F_{\Delta v}(\Delta v_R) + 1 - F_{\Delta v}(\Delta v_L)] \\ & - q[\int_{\Delta v_L}^{2v} \Delta v f_{\Delta v}(\Delta v)d\Delta v + \int_{-2v}^{\Delta v_R} -\Delta v f_{\Delta v}(\Delta v)d\Delta v] - qF_{\Delta v}(\Delta v_R)[m + 4\theta]. \end{aligned} \tag{7}$$

Here, the first term on the right-hand side gives the expected opportunity cost of waiting: if the voter chooses not to vote early, she gives up getting $m - 4\theta$ with certainty and only receives it with the probability she ends up voting for $L$ on Election Day, $q(1 - F_{\Delta v}(\Delta v_L))$. The second term represents the expected cost of voting on Election Day: the Election Day voting cost, multiplied by the probability the voter will vote. Finally, we subtract off the expected opportunity cost of voting early: rather than receiving $\mathbb{P}(\text{vote } L) \cdot \mathbb{E}[\Delta v|\Delta v > \Delta v_L] + \mathbb{P}(\text{vote } R) \cdot \mathbb{E}[-\Delta v|\Delta v < \Delta v_R]$ if she voted on Election Day, the voter gets $\mathbb{E}[\Delta v] = 0$ if she votes early. In addition, she gives up receiving $m + 4\theta$ with the probability that she votes for $R$ on Election Day if she chooses to vote early.

Ultimately, the decision to vote early or not boils down to a simple equation for both partisans and swing voters: a voter votes early if and only if the sum of the actual and expected opportunity costs of voting early is less than the sum of the expected actual and opportunity costs of voting on Election Day. Then, a low cost of early voting ($c'$) or low opportunity cost of early voting (the difference in expected relative valence one receives if voting early (0) versus on Election Day) makes voters more likely to cast their ballot before Election Day, i.e. *without* knowledge of the candidates' relative valence. Does one kind of voter have more to gain by waiting and learning this late-election information? Since all voters pay the same voting cost, this difference comes from the *opportunity costs*. In particular, swing voters and weak partisans have an option value of waiting and strong partisans do not.

Suppose that a voter with $\tilde{\theta} > 0$ votes early. Then, any voter with $\theta > \tilde{\theta}$ votes early as well. Likewise, for any voter with $\tilde{\theta} < 0$ that votes early, any voter with $\theta < \tilde{\theta}$ votes early as well. The proof is in the appendix. The above is clear intuitively: strong partisans (who have the most extreme bliss points) have nothing to gain from waiting until Election Day, since late-election information does not impact their actions. Weak partisans have less to gain from waiting until Election Day than swing voters do, as the late-election information would never cause them to "switch" their vote (like it might for swing voters). Notably, this means the cost threshold for early voting is higher for partisans than it is for swing voters: if swing voters vote early, then so do partisans.

The decision of whether (and for whom) to vote is only driven by expressive voting. As discussed above, voters also receive utility from the election outcome. This outcome utility does not impact voters' behavior (they do not believe their vote has any impact on the outcome), but it does matter for social welfare. I focus on social welfare and how it is affected by early voting in the following section.

## 3.3 Welfare

The voters in this model balance a tradeoff between a lower cost of voting and voting with full information: early voting limits a voter's ability to react to late-election information, which (as shown in the reduced-form work) can matter for election outcomes. I now turn to the key question behind this paper: what are the welfare implications of early voting? Would society benefit from increased access to early voting and the expansion of convenience voting laws, or is early voting already too convenient?

So far, I have shown how single-person optimization problems can be used to characterize how individuals behave on Election Day and, when they have the option, during periods of early voting. However, as the ultimate goal of any election is to combine individuals' preferences and decide some *outcome*, it is important to determine whether this outcome is something the individuals are ultimately pleased with. This requires assigning voters some utility derived from the winner of the election (not just from the act of voting for a candidate): let a citizen's "outcome utility" be given by

$$u(x_w, v_w, \theta) = v_w - (x_w - \theta)^2$$

where candidate $w$ is the winner. Citizens receive this utility regardless of which candidate they voted for (or if they voted at all). Since they do not believe their vote to be pivotal (and thus do not expect their ballot to affect the outcome), this utility does not factor into the individual optimization problems shown above. However, it is crucial in analyzing the welfare of citizens with respect to the outcome of the election (and how the presence of early voting, Election Day voting cost shocks, and late-election information contribute to or take away from welfare).

In order to study the welfare implications of early voting, I focus on the outcome utility of the median voter and the *aggregate* voting cost (i.e., the sum of costs paid by all who vote).

If the type distribution $F_\theta(\cdot)$ were symmetric around the median voter, then maximizing the ex ante outcome utility of the median voter would be equivalent to maximizing the utilitarian outcome utility (i.e., the sum of all voters' ex ante outcome utilities). Most of the interesting cases in the early voting dilemma arise when the distribution is *asymmetric*; however, focusing on the utilitarian outcome utility would bring the focus to intensity of preferences, something I wish to abstract away from in the context of this model. That is to say, the main insights of this model should not be driven by the intensity of voters' preferences but rather the tension between full information and lower costs. By focusing on the ex ante utility of the median voter, the question becomes: if the electorate were offered a referendum on whether to allow early voting or not, what would the outcome of this referendum be? This notion of efficiency is related to the notions of majority-efficiency and competition-efficiency in Krasa and Polborn [2010a] and Krasa and Polborn [2010b]; i.e., is it possible to make a majority of voters better off than they are in equilibrium. Studying the aggregate voting cost does not lead to these same "intensity" issues as voting costs are comparable across voters. Focusing on just the cost paid by the median voter would not necessarily be representative of the experience of the entire electorate.

After defining the welfare objectives, I detail three potential reasons for "bad" election outcomes in this context. The first two serve as reasons that early voting may be detrimental to social welfare: first, if the election outcome is decided by early voting, then the outcome will not reflect any late-election information. Second, even if the election is decided on Election Day, the median voter may not be the decisive voter due to differential "banking" of early votes by one candidate, meaning the outcome may not align with the median voter's preferences. The third reason highlights why early voting may be beneficial to social welfare: suppose that Election Day voting costs are correlated with ideological preferences.[15] Then, even if the election is decided on Election Day, it may be decided by an unrepresentative

[15] This assumption has empirical grounding: Chen et al. [2020] and Quealy and Parlapiano [2021] show that voters in poorer, less white neighborhoods face significantly larger voting wait times.

electorate. Here, early voting is beneficial to social welfare because it offers high-cost voters an opportunity to turn out, making the electorate more representative.

Taking the three cases together, the theory seems to point to a mix of early voting and Election Day voting as the welfare-maximizing scenario. In particular, early voting is *good* for social welfare when there is a sufficient difference in ideological groups' Election Day voting cost distributions, to the extent that early voting raises the turnout of the majority relative to the minority; it is *bad* for social welfare when late-election information is sufficiently large since weak partisans and swing voters who vote early do not incorporate this late-election information into their vote. A cost of early voting which is low enough to incentivize strong partisans (who do not utilize late-election information) to vote early but not so low to convince weak partisans and swing voters to do the same *may* be best for social welfare, depending on the difference in Election Day cost distributions and the size or relevance of late-election information.

### 3.3.1 Welfare Objective #1: The Median Voter

One of the social welfare objectives I focus on is the outcome utility of the median voter. This allows me to abstract away from the intensity of voters' preferences when studying the impact of early voting on welfare (something that may drive results if I were to focus on the sum of all individuals' outcome utilities instead). Define the median voter as an individual with bliss point $\theta_M$ such that $F_\theta(\theta_M) = \frac{1}{2}$; that is, her bliss point is the median of the type distribution. Then, the outcome utility of the median voter (called Welfare Objective #1) is

$$W_1(\theta_M) = v_w - (x_w - \theta_M)^2.$$

Note that, for any election, there exist cutoffs $\theta_1 < 0$, $\theta_2 > 0$ such that any voter with

$\theta \leq \theta_1$ or $\theta \geq \theta_2$ votes early (see Proposition 3.2.2). If the median voter has a bliss point more extreme than these cutoffs (i.e. $\theta_M < \theta_1$ or $\theta_M > \theta_2$), she votes early; consequently, whichever candidate she votes for will win (Suppose $\theta_M < \theta_1$. Then, the median voter votes early for $L$ since $\theta_M < 0$. All voters to the left of the median voter also vote early for $L$ by Proposition 3.2.2. Thus, $L$ wins.).

If the median voter waits until Election Day, i.e. $\theta_1 < \theta_M < \theta_2$, then she is still the median voter after preferences are adjusted for late-election information (this is because the valence shock moves all voters' preferences in the same direction). The median voter now acts to maximize her ex post expressive utility: after observing the late-election information and Election Day voting costs, she can vote for $L$, vote for $R$, or abstain. If she does vote on Election Day, then whoever she casts her ballot for wins (Suppose the median voter votes for $L$ on Election Day. Then all voters to the left of her vote for $L$ too – those with $\theta < \theta_1$ voted early for $L$ by Proposition 3.2.2 and those with $\theta_1 < \theta < \theta_M$ vote for $L$ on Election Day by Proposition 3.2.1. Then, $L$ wins).

If instead the median voter abstains on Election Day, denote the median bliss point of those who *do* vote (including those who voted early) as $\theta'_M$. If $\theta'_M < \theta_M$, then $L$ wins; if $\theta'_M > \theta_M$, then $R$ wins (Suppose $\theta'_M < \theta_M$. Then, it must be that the voter with $\theta'_M$ votes for $L$ – if she voted for $R$, then type $\theta_M$ would also vote for $R$ by Proposition 3.2.1. All voters with $\theta < \theta'_M$ vote for $L$ too – those with $\theta < \theta_1$ by Proposition 3.2.2 and those with $\theta_1 < \theta < \theta'_M$ by Proposition 3.2.2. Then, $L$ wins.).[16]

[16]Note that this case is concerned with abstentions due to the late-election information and not when the median voter is faced with Election Day cost $c_H$. If type $\theta_M$ draws voting cost $c_H$ but would have voted had she drawn $c_L$, there is an identical voter with bliss point $\theta_M$ that draws $c_L$ (since there is a continuum of voters) and so the outcome would be identical to the case where type $\theta_M$ draws $c_L$.

### 3.3.2 Welfare Objective #2: Aggregate Voting Cost

The second welfare objective is minimizing the aggregate voting cost of voters. Addressing "costly voting" is a primary motivator for policy-makers to offer early voting and certainly an objective that matters for social welfare. However, unlike with the first objective, I cannot focus on the experience of the median voter alone. One voter's cost of voting is not necessarily representative of the experience of the entire electorate; policy-makers cannot credibly claim to have "solved costly voting" by ensuring a singular voter faces a low cost. Therefore, I move to consider the aggregate voting cost, i.e. the sum of all costs paid by those who choose to vote. Here, I also include the sum of expressive utilities from all voters. Although I do not wish for my welfare results to be driven by intensity of preferences, simply aiming to minimize the aggregate voting cost would imply that fewer voters is "better" from a welfare perspective. This is, of course, not the goal of convenience voting policies – a welfare function that assumes that the welfare-best outcome is one where very few citizens vote is not appropriate here. Therefore, the second welfare objective in an electorate of $N$ voters is given by:

$$W_2(k_1, k_2, \hat{r}, \hat{\ell}) = m(k_1 + k_2) + \sum_{i=\hat{r}}^{N} 4\theta - \sum_{i=1}^{\hat{\ell}} 4\theta + \Delta v(\hat{\ell} - (N + 1 - \hat{r})) - k_1 \cdot c' - k_2 \cdot c_L,$$

where $k_1$ citizens vote early, $k_2$ citizens vote on Election Day, and $\hat{r}$ ($\hat{\ell}$) gives the index of the left (right)-most voter who votes for $R$ ($L$) in either period (early or on Election Day). All who cast a ballot (given by $k_1 + k_2$) receive $m$, all who vote early ($k_1$) pay cost $c'$, and all who vote on Election Day ($k_2$) pay cost $c_L$.[17] Everyone who votes for $L$ receives $\Delta v \equiv v_L - v_R$: this number is given by $\hat{\ell}$, the index of the right-most voter who votes for $L$. Similarly,

[17] The index $\hat{r}$ can be found as follows: denote as $\hat{r}_1$ the index of the cutoff for early voting for those with $\theta > 0$, i.e., all types with $\theta > \theta_{\hat{r}_1}$ vote early for $R$. Denote as $\hat{r}_2$ the index of the cutoff for those who vote for $R$ on Election Day: i.e., all types with $\theta > \theta_{\hat{r}_2}$ vote for $R$ on Election Day. Denote $\hat{\ell}_1$ and $\hat{\ell}_2$ similarly. Then, the left-most voter who votes for $R$ in any period is $\hat{r} \equiv \min\{\hat{r}_1, \max\{\hat{r}_2, \hat{\ell}_1\}\}$. Similarly, the right-most voter who votes for $L$ in any period is $\hat{\ell} \equiv \max\{\hat{\ell}_1, \min\{\hat{\ell}_2, \hat{r}_1\}\}$.

everyone who votes for $R$ ($N+1-\hat{r}$ voters) receives $-\Delta v$. Finally, recall that the ideological expressive utility is $4\theta$ for those who vote for $R$ and $-4\theta$ for those who vote for $L$; the welfare function above aggregates these over all who vote for $R$ and $L$, respectively.

Recall that the main consideration of this welfare function is to minimize the sum of the voting costs, $k_1 \cdot c' + k_2 \cdot c_L$; however, the expressive utility is included so that the welfare objective does not assume it is optimal for almost no one to vote. Taken together with Welfare Objective #1, the two goals here are to: 1) maximize the outcome utility of the median voter and 2) minimize the aggregate voting cost. In the following sections I provide three potential reasons for "bad" election outcomes (in terms of these welfare objectives); ultimately, the "welfare-best" method of voting depends on the 1) size of late-election information and 2) difference in Election Day cost distributions for ideological groups.

### 3.3.3 Election Decided by Early Voting

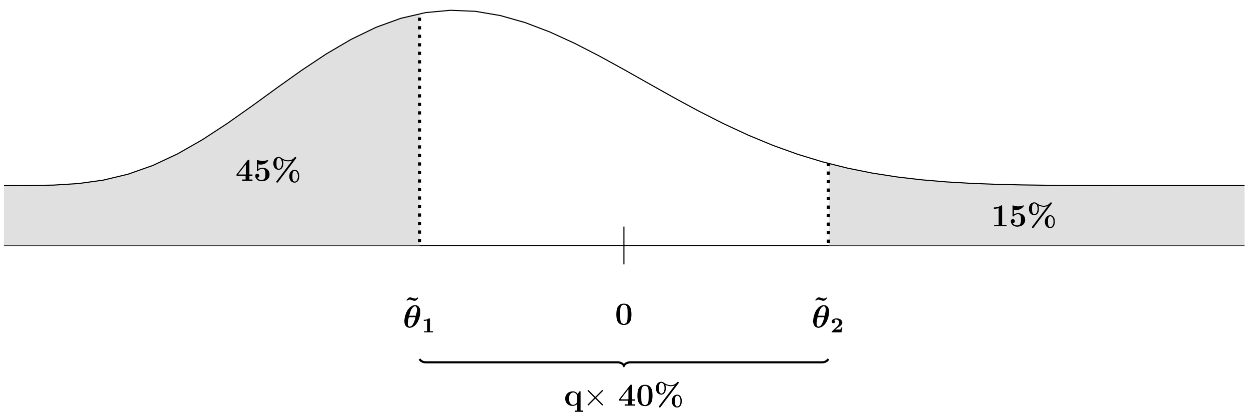
One potential issue with early voting arises if the election is decided by early votes. This occurs if the difference in early votes garnered by the two candidates is larger than the maximum number of (expected) votes remaining on Election Day (i.e., the number of voters who waited times $q$, the probability that a voter receives the low cost). If this is true, then late-election information is not at all influential to the outcome of the election, and the winner may not maximize the median voter's outcome utility.

Figure 4 shows an example: if 45% of the electorate votes early for $L$ and 15% votes early for $R$, then $L$ leads $R$ by 30% of the electorate. This means $R$ needs the votes of at least 30% of the 40% who waited. However, recall that not everyone who waits will be able to vote on Election Day: some voters will draw $c_H$ and have to abstain. For any $q < 0.75$, $R$ will be unable to make up for the initial lead won by $L$: the election is decided by early voting. More generally, an election is decided by early voting whenever

$$q < \frac{|F_\theta(\tilde{\theta}_1) - (1 - F_\theta(\tilde{\theta}_2))|}{F_\theta(\tilde{\theta}_2) - F_\theta(\tilde{\theta}_1)}, \tag{8}$$

where $|F_\theta(\tilde{\theta}_1) - (1 - F_\theta(\tilde{\theta}_2))|$ is the early voting lead and $F_\theta(\tilde{\theta}_2) - F_\theta(\tilde{\theta}_1)$ is the number of citizens who wait until Election Day.

Figure 4: Election decided before Election Day




**Notes**: Suppose the distribution of types $F_\theta(\cdot)$ is given according to this graph and that $\tilde{\theta}_1$ and $\tilde{\theta}_2$ are such that 45% of the electorate votes early for $L$ and 15% of the electorate votes early for $R$. Then, the maximum amount of votes a candidate can earn on Election Day is $q \times 40\%$ of the electorate's votes. It is therefore impossible for $R$ to win (meaning the election is decided by early voting) whenever $q < \frac{30}{40} = 0.75$.

### 3.3.4 Median Voter is Not Decisive

Even if the election is decided on Election Day, the outcome may not align with the median voter's preferences. This occurs if the median voter is not the decisive voter (i.e., the voter whose vote is pivotal to the election outcome). Consider a simple case where $c_L = m$, so that anyone who receives $c_L$ will turn out on Election Day. The median voter is not necessarily decisive here: if candidate $L$ earned many more early votes than candidate $R$ did, then the decisive voter will lie to the left of the median voter, as $L$ already has a large number of votes "locked in." Formally, the decisive voter, with bliss point $\theta_D$, is defined as follows:[18]

$$F_\theta(\theta_D) = \frac{1}{2} + \frac{1-q}{2q}[1 - F_\theta(\tilde{\theta}_2) - F_\theta(\tilde{\theta}_1)]. \tag{9}$$

Note that if $R$ gains more early votes than $L$, then $1-F_\theta(\tilde{\theta}_2) > F_\theta(\tilde{\theta}_1)$, meaning $F_\theta(\theta_D) > \frac{1}{2}$, i.e. the decisive voter lies to the right of the median voter. Then, candidate $R$ will win the election with a higher likelihood than the median voter would prefer – conflicting with Welfare Objective #1. Formally, consider the following proposition:

Suppose that the election is not decided on Election Day and that $c_L = m$. Suppose that candidate $R$ ($L$) receives more early votes than candidate $L$ ($R$, resp.). Then, the decisive voter is shifted to the right (left, resp.) of the median voter, and candidate $R$ ($L$, resp.) wins the election with a higher probability than the median voter prefers.

The proof is in the appendix. In this section, I have shown that early voting can negatively impact social welfare even in cases where the election is not yet decided before Election Day. If one candidate differentially "banks" early votes, then she is able to win the election with a higher likelihood than the median voter would like. However, the introduction of early voting can be welfare-improving, as I will show in the following section.

### 3.3.5 None Vote Early: Correlated Costs and Preferences

Given the above sections, it may be tempting to think that an electorate with *no* early voting is welfare-maximizing – all citizens wait until Election Day and are fully informed of candidates' valence before casting their ballots. This relies on the idea that the group of voters which turns out to vote on Election Day is representative of the electorate's ex post

[18] This comes from rearranging $\frac{F_\theta(\tilde{\theta}_1)+q[F_\theta(\theta_D)-F_\theta(\tilde{\theta}_1)]}{1-(1-q)[F_\theta(\tilde{\theta}_2)-F_\theta(\tilde{\theta}_1)]} = \frac{1}{2}$, where $F_\theta(\tilde{\theta}_1) + q[F_\theta(\theta_D) - F_\theta(\tilde{\theta}_1)]$ gives the total number of votes $L$ receives and $1-(1-q)[F_\theta(\tilde{\theta}_2) - F_\theta(\tilde{\theta}_1)]$ gives the total number of votes cast.

preferences on Election Day. What if those who turned out to vote on Election Day were not representative of the electorate's preferences as a whole?

Voting in the U.S. is not mandatory, and many of those who choose to abstain cite the difficulty of casting a ballot as their reason: 58.8% of those who reported not voting in November 2018 in the CPS Voting and Registration supplement cited reasons pertaining to difficulty of voting [United States Census Bureau, 2019][19]. Clearly, Election Day voting costs serve as a barrier to voting for some citizens, no matter how excited they are about a candidate. Thus far, I have assumed that all voters face the same voting cost distribution on Election Day, which may not be true in the real world. In fact, it might be reasonable to assume that voting costs are correlated with ideological preferences: Chen et al. [2020] use evidence from smartphone data to show that in 2016, "relative to entirely-white neighborhoods, residents of entirely-black neighborhoods waited 29% longer to vote and were 74% more likely to spend more than 30 minutes at their polling place." An analysis from Cuebiq and The New York Times found that in 2020, "casting a vote typically took longer in poorer, less white neighborhoods than it did in whiter and more affluent ones" [Quealy and Parlapiano, 2021].

To incorporate this into the model, suppose that left and right-leaning voters draw their Election Day voting costs from two different distributions, $F_{C_\ell}$ and $F_{C_r}$, where

$$c = \begin{cases} c_L & \text{with probability } q_p \\ c_H & \text{with probability } 1 - q_p \end{cases}$$

for $p \in \{\ell, r\}$, where $q_\ell \neq q_r$. For example, if $q_\ell < q_r$, then left-leaning voters' Election Day voting cost distribution is right-shifted from right-leaning voters' distribution, disadvantaging $L$. If left and right-leaning citizens face different costs of voting on Election Day, then the

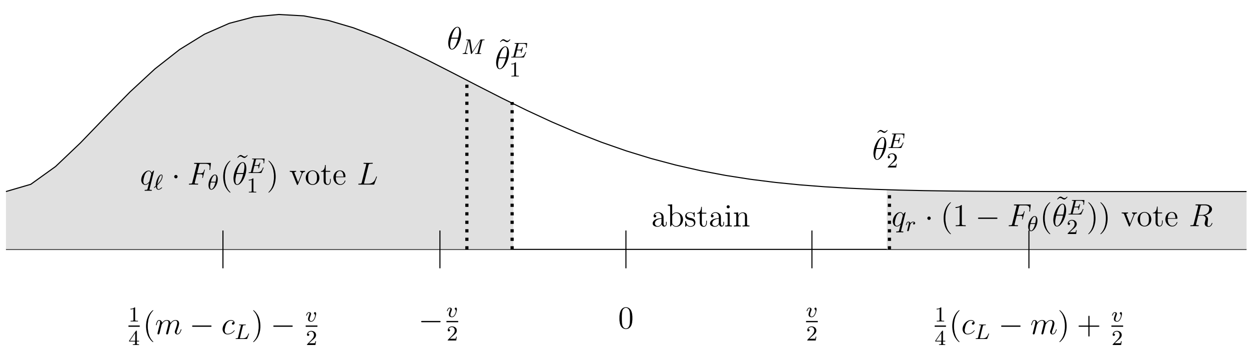
[19]These reasons are: Illness or disability, Out of town, Too busy/conflicting schedule, Transportation problems, Registration problems, Bad weather conditions, and Inconvenient polling place.

median voter may be *worse off* under Election Day voting than under early voting.

For example, suppose the electorate does not have the option to vote early and must wait until Election Day. Let $\theta_M < 0$ so that the distribution of voter types is skewed left. Consider a revelation of $\Delta v$ such that types with $\theta < \tilde{\theta}_1^E$ vote for $L$ if they receive $c_L$ and types with $\theta > \tilde{\theta}_2^E$ vote for $R$ if they receive $c_L$, and assume $\Delta v$ is such that $\theta_M < \tilde{\theta_1}^E$, i.e. the median voter will vote for $L$ upon receiving $c_L$.

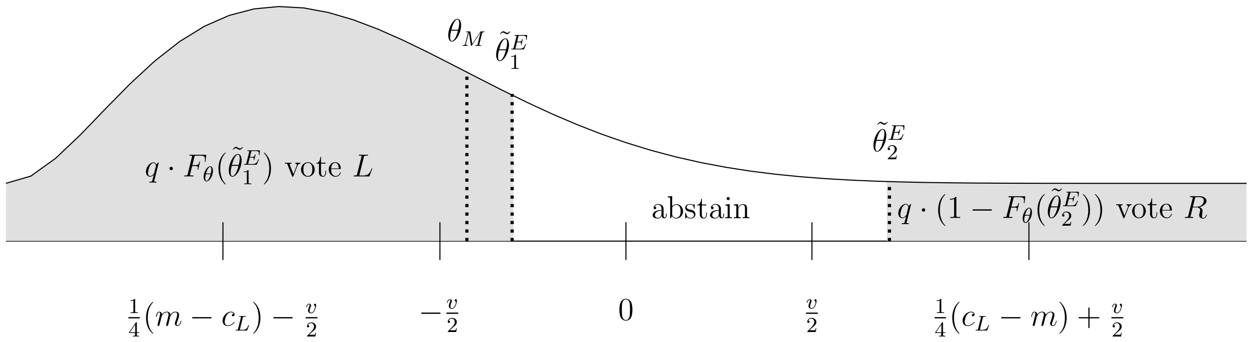
Now, suppose that $0 < q_r < 1$ and $q_\ell < \frac{1-F_\theta(\tilde{\theta}_2^E)}{F_\theta(\tilde{\theta}_1^E)} \cdot q_r$. Then, we have that $F_\theta(\tilde{\theta}_1^E) \cdot q_\ell < (1 - F_\theta(\tilde{\theta}_2^E)) \cdot q_r$, i.e., $L$ receives fewer votes on Election Day than $R$ does, even though more people would have voted for $L$ had they received $c_L$. This can be seen in Figure 5: all types $\theta < \tilde{\theta}_1^E$ abstain with probability $1 - q_\ell$, which is sufficiently greater than all types $\theta > \tilde{\theta}_2^E$ abstention probability, $1 - q_r$, such that $R$ wins. Had all types faced an identical cost distribution, then $L$ would have won instead (see Figure 6).

Figure 5: Correlated costs and preferences




**Notes**: Suppose the distribution of types $F_\theta(\cdot)$ is given according to this graph and that $v_L - v_R \equiv \Delta v = \frac{v}{2}$; the median voter's bliss point, $\theta_M$, is then to the left of the cutoff to vote for $L$, $\tilde{\theta}_1^E$. Consider cost distributions where types $\theta > 0$ draw $c_L$ with $0 < q_r < 1$ but types $\theta < 0$ draw $c_L$ with probability $q_\ell < \frac{1-F_\theta(\tilde{\theta}_2^E)}{F_\theta(\tilde{\theta}_1^E)} \cdot q_r$. All types to the right of $\tilde{\theta}_2^E = \frac{1}{4}(c_L - m) + \frac{v}{8}$ vote $R$ with probability $q_r$ and all types to the left of type $\tilde{\theta}_1^E = \frac{1}{4}(m - c_L) + \frac{v}{8}$ vote $L$ with probability $q_\ell$. Since the cost differential (and thus, the probability of voting) is so large, $R$ wins, even though more voters prefer $L$.

Figure 6: No correlation of costs and preferences




**Notes**: Suppose the distribution of types $F_\theta(\cdot)$ is given according to this graph and that $v_L - v_R \equiv \Delta v = \frac{v}{2}$. Here, suppose all voters face the same cost distribution and draw $c_L$ with probability $q$. The median voter's bliss point, $\theta_M$, is displayed. Then, all to the left of type $\tilde{\theta}_1^E = \frac{1}{4}(m - c_L) + \frac{v}{8}$ vote $L$ with probability $q$ (this includes the median voter) and all to the right of type $\tilde{\theta}_2^E = \frac{1}{4}(c_L - m) + \frac{v}{8}$ vote $R$. Then, $L$ wins under this realization of $\Delta v$ when all voters face the same Election Day voting cost distribution.

The outcome of the election thus differs in Figures 5 and 6, even though the valence realization is the same in each case. This notion is formalized in the proposition below (proof in appendix). If the ideological majority faces a worse cost distribution than the minority, the median voter may be better off in a scenario where all vote early (so that voting costs are equalized): in the context of Welfare Objective #1, an improvement can be made by offering early voting. Additionally, an improvement can be made in terms of Welfare Objective #2 here too: if early voting is offered, then more left-leaning voters can now turn out to vote and obtain some expressive utility for a relatively low cost, and right-leaning strong partisans can choose a lower-cost method of voting as well.

Suppose that early voting is not offered (all citizens must wait until Election Day) and left (right)-leaning voters draw voting costs from $F_{C_\ell}$ ($F_{C_r}$). Consider $\tilde{\theta}_1^E < 0 < \tilde{\theta}_2^E$ and suppose that $\tilde{\theta}_1^E > \theta_M$. Then, $L$ wins the election if and only if $q_\ell > \frac{1-F_\theta(\tilde{\theta}_2^E)}{F_\theta(\tilde{\theta}_1^E)} \cdot q_r$.

According to the above proposition, even if more voters in the electorate prefer $L$ to $R$, if right-leaning voters have a sufficiently higher probability of drawing the low cost, $R$ will win the election. The proposition can be written analogously for a median voter who would vote for $R$ if she received $c_L$ ($\theta_M > \tilde{\theta}_2^E$).[20] Waiting until Election Day offers voters the option to incorporate late-election information into their vote; however, a world without early voting is not necessarily a welfare-maximizing one if Election Day voting costs are correlated with ideological preferences, which may well be the case. There are certainly scenarios where early voting offers potential welfare improvements: to the extent that any cost reduction is likely larger for the high-cost group, and therefore is likely to increase the turnout of the high-cost group relative to the turnout of the low-cost group, convenience voting is beneficial from a welfare perspective. However, it is clearly not a Pareto improvement and is likely to be opposed by the party supported by more low-cost voters – offering an explanation for Republicans' opposition to convenience voting in the United States.[21]

## 3.4 Empirical Predictions

The above model and consequential analysis are useful in providing a *framework* in which to think about the benefits and costs of early voting. I develop a structured way to think about individuals' choices over: when to vote, whether to vote, and who to vote for. I demonstrate that early voting can be both *bad* for social welfare (see Sections 3.3.3 and 3.3.4) and *good* for social welfare (see Section 3.3.5). Whether early voting is helpful or harmful to social welfare depends upon what the state of the world looks like (How large are Election Day voting costs? Are these costs correlated with ideological preferences? How much of the

[20] Here, I focus on cases where the median voter feels strongly enough to vote. If she did not, then it is not a priori clear that equalizing voting costs across ideological preferences would lead to a different outcome. Additionally, the proposition can be generalized such that $\tilde{\theta}_1^E$ and $\tilde{\theta}_2^E$ need not be on either side of 0, but this would require imposing structure on the type distribution such that there are not so many swing voters voting against their ideological preferences that the differing cost distributions lose relevance.

[21] In 2021, fourteen states passed laws to restrict convenience voting access [Brennan Center for Justice at New York University School of Law, 2021]; thirteen of these fourteen states had Republican-controlled legislatures [The National Conference of State Legislatures]. According to surveys done by Pew Research Center, the share of Republicans who support "no-excuse" early or absentee voting has fallen 19 percentage points in less than three years, from 57% in Oct. 2018 to 38% in Apr. 2021. In contrast, the share of Democrats who support no-excuse early or absentee voting was 83% in Oct. 2018 and 84% in Apr. 2021 [Pew Research Center, 2021].

electorate are swing voters vs. partisans? What is the potential amount of late-election information?). Here, I remain agnostic as to what the state of the world is (and therefore do not conclude whether early voting is definitively a social "good" or "bad"). Instead, the contribution of my model is to develop a novel structure on the choices surrounding early and Election Day voting and late-election information in order to clearly identify the different "goods" and "bads" that can arise.

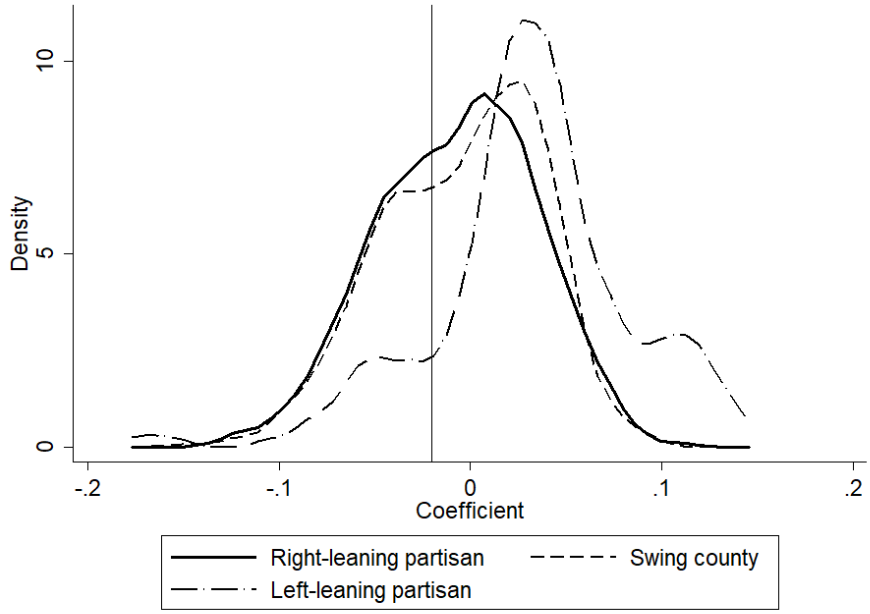
Some empirical predictions come out of this model which help test whether this framework is a reasonable one. In particular, I focus again on the 2016 election and the Comey letter: the model yields predictions for how this relatively negative late-election information on the Democratic candidate ($v_D - v_R \equiv \Delta v < 0$) should have affected each "group" (left/right-leaning partisan/swing voters) along both the intensive margin. In particular, within the framework of the model, the Comey letter should have led to: an increase in the likelihood of voting for the Republican candidate for swing voters (both left and right-leaning).

In order to test these predictions, I return to the difference-in-differences specification which compared counties which did not have early voting open prior to 10/28/16 to counties that did. I disaggregate the average coefficients presented in Table 2 and construct kernel distributions of these coefficients for three separate "types" of counties: left-leaning partisan counties, right-leaning partisan counties, and swing counties. To classify the counties into each type, I use data from Dave Leip's Atlas of Elections Leip on U.S. House election returns in 2008, 2010, and 2014. If a county elected a Democrat (Republican) in each of those elections, the county is classified as a left (right)-leaning partisan county. Otherwise, the county is labeled as a swing county. I calculate the difference-in-differences coefficient for each treated county (any county that did not have early voting open prior to 10/28/16), then construct kernel distributions for each of the three types. I do this for the Democratic vote share and turnout outcomes.

Figure 7 displays the kernel densities of Democratic vote share coefficients. With the use of Kolmogorov-Smirnov tests (non-parametric methods of testing if two distributions differ from one another), I conclude that swing and right-leaning partisan counties' kernel distributions are each shifted to the left of left-leaning partisan counties' distribution. These findings are broadly consistent with the predictions from the model discussed above: $\Delta v < 0$ should lead to a decrease in the likelihood of voting for the Democrat for swing counties and an increase in the likelihood of voting for the Republican in right-leaning partisan counties (mechanically leading to a decrease in the Democrat vote share).

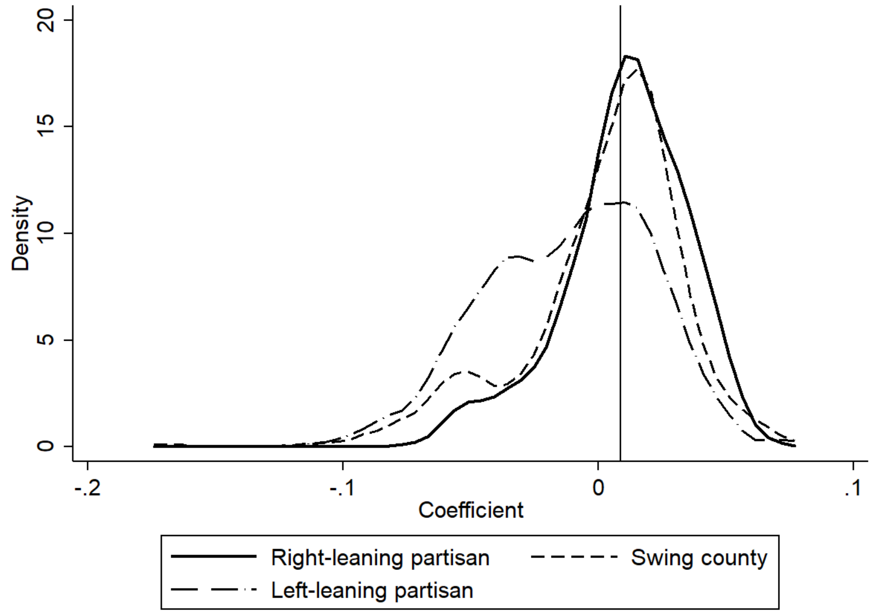
Figure 8 displays the kernel densities of turnout coefficients. Using Kolmogorov-Smirnov tests, I find that left-leaning partisan counties' kernel distribution is shifted left from swing and right-leaning partisan counties' distributions. Again, these findings are consistent with positive predictions from the model in this paper: $\Delta v < 0$ should lead to a decrease in turnout for left-leaning partisan counties.

Figure 7: Right-leaning and swing counties drove the decrease in Democrat vote share




**Notes**: This figure graphs the kernel densities of the coefficients from specification (1) on Democrat vote share (votes for Democratic candidate/total votes) for three groups: left-leaning partisan counties, right-leaning partisan counties, and swing counties. Using three US House races (2008, 2010, and 2014), I categorize counties as left (right)-leaning partisans if a Democrat (Republican) won all three races and categorize them as swing counties otherwise. Kolmogorov-Smirnov tests show that swing and right-leaning partisan counties' kernel distributions are shifted left from left-leaning partisan counties' distribution of coefficients. The vertical line represents the summary coefficient from specification (1), -0.0204.

Figure 8: The Comey letter decreased turnout in left-leaning counties




**Notes**: This figure graphs the kernel densities of the coefficients from specification (1) on turnout rate (total votes/voting-age population) for three groups: left-leaning partisan counties, right-leaning partisan counties, and swing counties. Using three US House races (2008, 2010, and 2014), I categorize counties as left (right)-leaning partisans if a Democrat (Republican) won all three races and categorize them as swing counties otherwise. Kolmogorov-Smirnov tests show that swing and right-leaning partisan counties' kernel distributions are shifted right from left-leaning partisan counties' distribution of coefficients. The vertical line represents the summary coefficient from specification (1), 0.0086.

# 4 Discussion and Conclusion

Early voting poses a tradeoff between easier access to the ballot and full information. Given this tension, one might wonder when early voting is welfare-improving. The model of voter behavior in this paper attempts to shed light on this question. Expressive voters are faced with the choice of voting early and paying a (potentially) smaller cost or waiting until Election Day and learning late-election information on the two candidates. Results from an empirical exercise determining the causal impact of the Comey letter influence how voters' reactions to late-election information appears in the model: the results show evidence of responses on both the extensive (voter turnout) and intensive (vote-switching) margins.

The model considers three "types" of voters: strong partisans (who will always vote for their ideologically-preferred candidate if they draw a feasible voting cost and are therefore not influenced by late-election information), weak partisans (who would never vote for the other candidate but might abstain in "protest," and therefore can only be influenced on the extensive margin) and swing voters (who may "switch" their vote upon learning certain late-election information, and therefore can be influenced on both the extensive and intensive margins). Then, weak partisans and swing voters create an externality when they vote early, as they do not consider their own impact on the outcome of the election: social welfare as determined by the *outcome* of the election would be improved if these voters waited and incorporated the late-election information into their vote. However, early voting can be welfare-improving: in particular, early voting is beneficial to society when 1) Election Day voting costs are correlated with ideological preferences and 2) late-election information is not too prevalent.

One potential "solution" to the tradeoff of lower costs and full information is universal vote-by-mail, where all registered voters are automatically mailed a ballot each election. This system of voting does not require voters to cast their ballot too far in advance of Election Day (oftentimes, the ballot must be postmarked by Election Day itself), but it does lower voting costs – circumventing the tension created by early voting.

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# 5 Appendix

## 5.1 Robustness Checks

In the following sections, I detail robustness checks for the empirical work done in Section 2. Sections 5.1.1, 5.1.3, 5.1.4, and 5.1.2 present robustness checks for the first research design, introduced in Section 2.3.1. Section 5.1.5 presents a robustness check for the second research design, introduced in Section 2.3.2.

### 5.1.1 Florida and Oklahoma

In equation (1), I leverage cross-state variation in preexisting convenience voting laws at the time of the Comey letter. Counties in states with early voting open prior to 10/28 are controls, and counties in states 1) with early voting open only *after* 10/28 and 2) with no early voting at all are treated. The identifying assumption is the canonical parallel trends assumption: absent the Comey letter, treatment and control counties should have trended similarly in the outcomes of interest. However, one might be concerned that states with and without early voting might be on different political trends, violating this assumption. I exclude any state which changes its convenience voting laws between 2012 and 2016 to help alleviate this concern. In this section, I make a refinement to the design to further address it: I limit treatment counties to those in group (1): with early voting open only *after* 10/28 (all counties in Florida and Oklahoma). Then, I re-estimate (1) with the refined treatment group and same control group (all counties in states with early voting open prior to 10/28).

Results are in Table 4. My preferred specification is in column (2), which weights by voting-age population. Here, there *is* a change on the extensive margin: voters in Florida and Oklahoma, who were more able to respond to the Comey letter, saw an increase in turnout rate of between 1.04-1.45 percentage points. This is a bit puzzling: if the control group already has a number of voters "locked in" and the rest (who did not vote early) are free to respond, then an increase in turnout does not make much sense. This finding persists when limiting the control group to counties in neighboring states (Arkansas, Georgia, Kansas, New Mexico, and Texas; see Table 5). However, looking at disaggregated turnout of a subset of these neighbors in Table 6, I show that the Comey letter did not lead to a significant change in early turnout rate or Election Day turnout rate. This result appears noisy and is perhaps due to measurement error in the denominator. If 18+ population were growing more quickly in Florida than documented by the SEER measures, this could lead to a false finding of increased turnout rate. To investigate further, I plan to obtain data on registration and test the impact on turnout as a proportion of registered voters instead.

Returning to Table 4, the results show an increase in Republican vote share of 1.68 percentage points in my preferred specification. This result holds (and strengthens) when comparing Florida and Oklahoma only to their neighboring states (see Table 5). Broadly, the results remain consistent with those found in my main specification and reported in Table 2.

Table 4: Difference-in-differences: Florida and Oklahoma v. control states

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0164*** | 0.015*** | 0.009 |
| | (0.0045) | (0.0038) | (0.0064) |
| Dem. Vote Share | 0.0074 | -0.0063 | -0.0095 |
| | (0.0129) | (0.0096) | (0.0154) |
| Rep. Vote Share | -0.0062 | 0.0168* | 0.0192 |
| | (0.0082) | (0.0097) | (0.0132) |
| $N$ | 4180 | 4180 | 4180 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties in Florida and Oklahoma, whose early voting periods were *not* open before 10/28/16 and 0 in counties whose early voting periods *were* open before 10/28/16, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. In column (1), I include county and year fixed effects. In column (2), I weight by 18+ population. In column (3), I show that column (2) is robust to the inclusion of time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a bachelor's degree or higher). All rates are taken as a proportion of 18+ population.

Table 5: Difference-in-differences: Florida and Oklahoma v. neighboring control states

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0162** | 0.0116** | 0.0089 |
| | (0.0069) | (0.005) | (0.0094) |
| Dem. Vote Share | -0.0225* | -0.0298* | -0.0122 |
| | (0.0132) | (0.0169) | (0.0369) |
| Rep. Vote Share | 0.0114** | 0.0309*** | 0.0136 |
| | (0.0055) | (0.0117) | (0.0285) |
| $N$ | 1540 | 1540 | 1540 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties in Florida and Oklahoma, whose early voting periods were *not* open before 10/28/16 and 0 in counties whose early voting periods *were* open before 10/28/16, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Here, I restrict the control group to counties in states which neighbor either Florida or Oklahoma: Arkansas, Georgia, Kansas, New Mexico, and Texas. In column (1), I include county and year fixed effects. In column (2), I weight by 18+ population. In column (3), I show that column (2) is robust to the inclusion of time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a bachelor's degree or higher). All rates are taken as a proportion of 18+ population.

Table 6: Florida and Oklahoma v. neighboring control states: disaggregated by voting method

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0216** | 0.0166*** | 0.0174** |
| | (0.0084) | (0.0058) | (0.0086) |
| Early Turnout Rate | -0.017 | 0.0147 | 0.017 |
| | (0.0208) | (0.0267) | (0.0303) |
| Election Day Turnout Rate | 0.0257 | -0.0075 | -0.0101 |
| | (0.0217) | (0.027) | (0.0379) |
| $N$ | 822 | 822 | 822 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties in Florida and Oklahoma, whose early voting periods were *not* open before 10/28/16 and 0 in counties whose early voting periods *were* open before 10/28/16, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Here, I restrict the control group to counties in states which neighbor either Florida or Oklahoma: Arkansas, Georgia, and New Mexico. Kansas and Texas do not provide disaggregated turnout data by method of voting, so I exclude them from the anlaysis. In column (1), I include county and year fixed effects. In column (2), I weight by 18+ population. In column (3), I show that column (2) is robust to the inclusion of time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a bachelor's degree or higher). All rates are taken as a proportion of 18+ population.

### 5.1.2 Border Counties Refinement

The cross-state empirical design used in equation (1) leverages state-level variation in the availability of early voting. A potential concern with this design is that states with and without convenience voting may have been on fundamentally different political trends – something else besides the exposure to Comey letter could be driving the results summarized in Table 2. A refinement that might lessen this concern is a "border counties" design, where comparisons are limited to counties on either side of the same state border at which early voting availability changes (i.e., early voting was open prior to 10/28 on one side of the state border but not the other).

The intuition here is that political trends are more likely to have been similar along the same border segment; this assumption is fundamentally untestable, but observing county-level characteristics in 2012 can signal the underlying similarities. Table 7 presents differences in summary statistics (in terms of standard deviations measured from the entire sample) between counties with and without convenience voting in (1) the border counties sample and (2) the entire sample (from the first empirical design). Differences in column 1 are taken between convenience and non-convenience counties along the same border segment and averaged together. I note that the underlying differences between counties are smaller along most dimensions in the border sample; however, the original differences were not too large to begin with. As such, this design is buying us a small improvement at the cost of empirical power: the sample size is cut by over half.

I use county-border-year observations to estimate

$$y_{cbt} = \alpha + \eta_{bt} + \gamma T_c + \beta(T_c \times P_t) + \epsilon_{cbt}, \tag{10}$$

where $\eta_{bt}$ are border segment-year fixed effects, $T_c$ takes a value of 1 in counties *without* early voting open before 10/28/16 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Border segment-year fixed effects restrict comparisons in this design to counties on either side of the same state border, where the availability of early voting prior to 10/28 switches at the border. Counties are in the dataset as many times as different borders they appear on (that is, a county which lies on two border segments appears in the data twice).[22]

Results are presented in Table 8. As in Section 5.1.1 where I limited the treatment group to counties in Florida and Oklahoma, a positive impact on turnout appears (and is puzzling). Again, there is no reason to expect a turnout effect: the control counties have many voters already "locked in" and the remainder are left to react to the Comey letter on Election Day; as such, we should expect differences on the *intensive* margin but not on the extensive one. I

[22] Thank you to my classmate Tucker Smith for coding the border matches via GIS.

plan to obtain data on registration and examine turnout as a proportion of registered voters to be sure this is not a spurious effect driven by imprecisely-measured voting-age population. Otherwise, the results are broadly consistent with those from Table 2: there is a significant increase in Republican vote share.

Table 7: Differences in summary statistics: border counties sample vs. full sample

| | Difference (Border Counties) | Difference (Entire Sample) |
|---|---|---|
| 18+ Population | 0.023 | 0.002 |
| Unemployment Rate | 0.142 | 0.424 |
| Population Density | 0.005 | 0.184 |
| Median Age | 0.045 | 0.004 |
| # Men Per 100 Women | 0.101 | 0.221 |
| % Non-white | 0.039 | 0.183 |
| Median Income | 0.095 | 0.122 |
| % with Bach. Degree or Higher | 0.085 | 0.015 |
| Dem/Rep. House Margin* | 0.222 | 0.241 |
| Dem. Vote Share in Pres. Race | 0.157 | 0.331 |
| Turnout | 0.129 | 0.2 |
| Count | 1,122 | 2,891 |

**Notes**: This table displays differences in summary statistics of interest in terms of standard deviations (measured from the entire sample); the differences are taken between control counties along a border segment and their respective comparison counties (along the same border segment). Differences between convenience voting counties and non-convenience voting counties from the entire sample are presented for reference. Variables denoted with an asterisk are averages over three U.S. House election cycles: 2008, 2010, and 2014. Notably, the underlying differences between the counties are smaller along most dimensions when restricting to the border segment comparison.

Table 8: Border counties sample difference-in-differences

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.021*** | 0.0149** | 0.0131*** |
| | (0.0057) | (0.0062) | (0.0044) |
| Dem. Vote Share | 0.0003 | -0.0144 | -0.0049 |
| | (0.0085) | (0.0085) | (0.0068) |
| Rep. Vote Share | 0.0062 | 0.0193** | 0.0097 |
| | (0.0091) | (0.0094) | (0.0071) |
| $N$ | 2244 | 2244 | 2244 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.
$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows results from a county-level two-way fixed effects specification: $y_{cbt} = \alpha + \eta_{bt} + \eta_c + \beta(T_c \times P_t) + \epsilon_{cbt}$, where $\eta_{bt}$ are border segment-year fixed effects, $\eta_c$ are county fixed effects, $T_c$ takes a value of 1 in counties *without* early voting open before 10/28/16 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. In column (1), I include county and border segment-year fixed effects. In column (2), I weight by 18+ population. In column (3), I include time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a Bachelor's degree or higher). I calculate turnout rate as a proportion of 18+ population; vote shares are proportions of total presidential votes cast.

### 5.1.3 Hurricane Sandy

The first empirical design, summarized in equation (1), takes 2012 as a base year for the difference-in-differences specification. In doing so, I assume that any late-election information in 2012 did not matter for election outcomes. One potential violation of this assumption comes from Hurricane Sandy, a tropical cyclone which made landfall in the United States around October 29, 2012. Many at the time posited the storm would benefit incumbent Democrat President Obama, who was widely praised for his response. However, as found in Hart [2014], "the effect of Hurricane Sandy on the election were variable and small in magnitude. If there was any proximate effect on voters for whom Sandy was salient as they went to the polls, it seems likely to have been negative for President Obama, despite a popular storyline to the contrary."

To account for any possible impact of Hurricane Sandy, I re-estimate equation (1) after omitting counties in Connecticut, New Jersey, and New York. These three states, along with Massachusetts, which is already excluded from my analysis, had the largest populations in storm surge zones during Hurricane Sandy [Center for International Earth Science Information Network, 2012]; as such, it is probable that any effect Hurricane Sandy had on political outcomes was largest there. Results are robust to this omission; see Table 9.

Table 9: Cross-state difference-in-differences: omitting Connecticut, New Jersey, and New York

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0027 | 0.0052 | 0.005 |
| | (0.008) | (0.0069) | (0.0077) |
| Dem. Vote Share | -0.0006 | -0.0204* | -0.0212 |
| | (0.0122) | (0.0119) | (0.0137) |
| Rep. Vote Share | 0.0112 | 0.0316*** | 0.0316** |
| | (0.0112) | (0.0114) | (0.0132) |
| $N$ | 5600 | 5600 | 5600 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.
$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows results from a county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties *without* early voting open before 10/28/16 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Counties in Connecticut, New Jersey, and New York are dropped, as they had the largest populations in storm surge zones during Hurricane Sandy, along with Massachusetts, which is already excluded from the analysis [Center for International Earth Science Information Network, 2012]. In column (1), I include county and year fixed effects. In column (2), which is my preferred specification, I weight by 18+ population. In column (3), I include time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a bachelor's degree or higher). I calculate turnout rate as a proportion of 18+ population; vote shares are proportions of total presidential votes cast.

### 5.1.4 October 7$^{\text{th}}$

As described in Section 2.1.2, October 7$^{\text{th}}$ was an important day in the 2016 presidential election. Three major events unfolded: *The Washington Post* reported on the 2005 "Access

Hollywood" tape, the U.S. government accused Russia of meddling in the election, and WikiLeaks began releasing emails of John Podesta. By 10/7, ten states had already begun early voting: Idaho, Iowa, Maine, Nebraska, New Jersey, Ohio, South Dakota, Vermont, Virginia, and Wyoming. In order to ensure the results from (1) are not driven by comparing pre-10/7 voters to post-10/7 voters, I omit these ten states from my analysis below. Results are robust to this omission; see Table 10.

Table 10: Cross-state difference-in-differences: omitting states with early voting open before October 7$^{\text{th}}$, 2016

| | (1) | (2) | (3) |
|---|---|---|---|
| Turnout Rate | 0.0045 | 0.0087 | 0.009 |
| | (0.0082) | (0.0061) | (0.0083) |
| Dem. Vote Share | -0.0153 | -0.0307*** | -0.033** |
| | (0.0122) | (0.0115) | (0.0141) |
| Rep. Vote Share | 0.0226** | 0.0435*** | 0.0454*** |
| | (0.0103) | (0.0092) | (0.0138) |
| $N$ | 4588 | 4588 | 4588 |
| Weighted by 18+ Population | | ✓ | ✓ |
| Controls | | | ✓ |

Standard errors are clustered at the state level and listed in parentheses.

$^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$

**Notes**: This table shows results from a county-level difference-in-differences specification: $y_{ct} = \alpha + \delta T_c + \gamma P_t + \beta(T_c \times P_t) + \epsilon_{ct}$, where $T_c$ takes a value of 1 in counties *without* early voting open before 10/28/16 and 0 otherwise, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Counties in the ten states with early voting open before 10/7/16 are excluded from the analysis: these states are Idaho, Iowa, Maine, Nebraska, New Jersey, Ohio, South Dakota, Vermont, Virginia, and Wyoming. In column (1), I include county and year fixed effects. In column (2), which is my preferred specification, I weight by 18+ population. In column (3), I include time-varying controls (unemployment rate, population density, median age, number of men per 100 women, percent non-white, median income, and percent of those 25 and up with a bachelor's degree or higher). I calculate turnout rate as a proportion of 18+ population; vote shares are proportions of total presidential votes cast.

#### 5.1.5 Nevada: Comparing Week 1 early voters to Election Day voters

In the second empirical design, summarized in equation (2), I compare "Week 2" early voters to "Week 1" early voters in Nevada, where week 2 occurred post-10/28 and week

1 occurred pre-10/28. The results, displayed in Table 3, show a significant decrease in registered Democrat early turnout share (the number of early ballots cast by registered Democrats as a proportion of total early ballots cast). This seems to imply that the Comey letter discouraged registered Democrats in Nevada. However, one might wonder if that discouragement was only temporary: did Democrats come around by Election Day and turn out?

To answer this question, I compare "week 1" early voters to Election Day voters in Nevada, using the same difference-in-differences framework as in equation (2). The idea behind the design remains the same: those voting in week 1 did so pre-Comey letter; those voting on Election Day did so post-Comey letter. The result from Table 3 persists and even strengthens: the Comey letter led to a decrease in registered Democrat turnout share of 1.43 percentage points.

Table 11: Nevada difference-in-differences: using Election Day voters as the control group

| | (1) | (2) | (3) |
|---|---|---|---|
| | Registered Dem. Turnout Share | Registered Rep. Turnout Share | Registered Ind. Turnout Share |
| Treat×Post | -0.0143*** | 0.0043 | 0.0100* |
| | (0.0044) | (0.0079) | (0.0059) |
| $N$ | 68 | 68 | 68 |

Bootstrapped standard errors are clustered at the county level and listed in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

**Notes**: This table shows results from a county-week level difference-in-differences specification, weighted by 18+ population: $y_{wct} = \alpha + \delta T_w + \gamma P_t + \beta(T_w \times P_t) + \epsilon_{wct}$, where $T_w$ takes a value of 1 for Election Day ("week 3") voters and 0 for "Week 1" voters, and $P_t$ takes a value of 1 in 2016 and 0 in 2012. Registered Democrat turnout share is the number of registered Democrats who cast a ballot in that week, divided by the number of ballots cast that week; outcomes (3) and (4) are defined similarly for registered Republicans and voters not registered as Republicans or Democrats, respectively.

## 5.2 Proofs

**Proposition 3.2.1**. *Suppose a voter with bliss point $\theta$ draws cost $c = c_L$ on Election Day. Then, she will vote for candidate $R$ if and only if $\Delta v < 4\theta + m - c_L \equiv \Delta v_R$, vote for candidate $L$ if and only if $\Delta v > 4\theta + c_L - m \equiv \Delta v_L$, and abstain otherwise.*

*Proof.* Suppose that a voter with bliss point $\theta$ draws cost $c = c_L$ on Election Day. Note that her utility from voting for candidate $R$ is $u_R \equiv m + 4\theta - \Delta v - c_L$, her utility from voting for candidate $L$ is $u_L \equiv m + \Delta v - 4\theta - c_L$, and her utility from abstaining is $u_A \equiv 0$. First, note that it cannot be true that both $u_R$ and $u_L$ are positive: that is, if $u_R > 0$, then $u_L \leq 0$. To see this, suppose that $u_R > 0$. For the sake of contradiction, suppose that $u_L > 0$. Then, $\Delta < 4\theta + m - c_L$ by the first assumption, and $\Delta v > 4\theta + c_L - m$ by the second assumption. Thus, $4\theta + m - c_L > 4\theta + c_L - m \iff m > c_L$. However, $m < c_L$ by the assumption discussed in Footnote 11 – a contradiction.

Now, suppose that $\Delta v < 4\theta + m - c_L$. Then, $u_R = m + 4\theta - \Delta v - c_L > m + 4\theta - (4\theta + m - c_L) - c_L = 0$. Given that $u_R > 0$, $u_L \leq 0$ by the argument made above. Thus, $u_R$ is greater than $u_L (\leq 0)$ and $u_A (= 0)$, so the voter votes for candidate $R$. For the opposite direction, suppose that the voter votes for candidate $R$. Then it must be that $u_R > 0 = u_A$ (i.e., voting for $R$ is better than abstaining). That is, $u_R = m + 4\theta - \Delta v - c_L > 0 \iff \Delta v < 4\theta + m - c_L$. Symmetric arguments can be made for the case where the voter votes for $L$. □

**Corollary 3.2.1**. *If $\theta > \frac{1}{4}(c_L - m) + \frac{v}{2}$ ($\theta < \frac{1}{4}(m - c_L) - \frac{v}{2}$), then $\Delta v < 4\theta + m - c_L$ ($\Delta v > 4\theta + c_L - m$, resp.) for all realizations of $\Delta v$. Thus, the voter will always vote for candidate $R$ ($L$, resp.) on Election Day (given she draws $c = c_L$) and is called a "strong partisan."*

*Proof.* Suppose $\theta > \frac{1}{4}(c_L - m) + \frac{v}{2}$ and $c = c_L$. Then, $4\theta + m - c_L > 4(\frac{1}{4}(c_L - m) + \frac{v}{2}) + m - c_L =$

$2v \geq \Delta v$ for all realizations of $\Delta v$, since $2v \geq \Delta v$ by definition. If $\Delta v < 4\theta + m - c_L$, then the voter votes for candidate $R$ by Proposition 3.2.1. $\square$

**Corollary 3.2.1**. *If* $\frac{v}{2} < \theta < \frac{1}{4}(c_L - m) + \frac{v}{2}$ *(*$\frac{1}{4}(m - c_L) - \frac{v}{2} < \theta < -\frac{v}{2}$*), then* $\Delta v < 4\theta + c_L - m$ *(*$\Delta v > 4\theta + m - c_L$*, resp.) for all realizations of* $\Delta v$*. Thus, the voter will never vote for candidate L (R, resp.) on Election Day. She will vote for candidate R (L, resp.) whenever* $\Delta v < 4\theta + m - c_L$ *(*$\Delta v > 4\theta + c_L - m$*, resp.) – given she draws* $c = c_L$ *– and will abstain otherwise. This voter is called a "weak partisan."*

*Proof.* Suppose $\frac{v}{2} < \theta < \frac{1}{4}(c_L - m) + \frac{v}{2}$ and $c = c_L$. Then, $4\theta + c_L - m > 4(\frac{v}{2}) + c_L - m = 2v + c_L - m > 2v \geq \Delta v$ for all realizations of $\Delta v$, since $c_L > m$ by the assumption discussed in Footnote 11 and $2v \geq \Delta v$ by definition. Thus, $\Delta v < 4\theta + c_L - m \equiv \Delta v_L$ for all $\Delta v$ – i.e., the voter will never vote for candidate $L$ according to Proposition 1. $\square$

**Corollary 3.2.1**. *If* $0 < \theta < \frac{v}{2}$ *(*$-\frac{v}{2} < \theta < 0$*), then the voter does not always prefer R (L, resp.) on Election Day: sometimes the utility from voting for candidate L (R, resp.) will be greater than the utility from voting for candidate R (L, resp.). This voter is called a "swing voter."*

*Proof.* Suppose $0 < \theta < \frac{v}{2}$ and $c = c_L$. For the sake of contradiction, suppose that $u_L < u_R$ for all $\Delta v$. Then, $m + \Delta v - 4\theta - c_L < m + 4\theta - \Delta v - c_L \iff \Delta v < 4\theta$ for all $\Delta v$. Consider $\theta = \frac{v}{2} - \epsilon$ and $\Delta v = 2v - \epsilon$ for some small $\epsilon > 0$. Then, $\Delta v < 4\theta \iff 2v - \epsilon < 4(\frac{v}{2} - \epsilon) = 2v - 4\epsilon$ – a contradiction. There are some values of $\theta$ and some realizations of $\Delta v$ for which $u_L > u_R$. $\square$

**Corollary 3.2.1**. *Note that* $|\theta_{strong\ partisan}| > |\theta_{weak\ partisan}| > |\theta_{swing\ voter}|$.

*Proof.* Clearly, $\frac{1}{4}(c_L - m) + \frac{v}{2} > \frac{v}{2} > 0$. Note that $|\theta_{\text{strong partisan}}| > \frac{1}{4}(c_L - m) + \frac{v}{2} > |\theta_{\text{weak partisan}}| > \frac{v}{2} > |\theta_{\text{swing voter}}| > 0$. □

**Proposition 3.2.1**. *Suppose that a voter with $\tilde{\theta}$ votes for $L$ on Election Day. Then, any voter with $\theta < \tilde{\theta}$ who draws $c = c_L$ also votes for $L$ on Election Day. Similarly, suppose that a voter with $\tilde{\theta}$ votes for $R$ on Election Day. Then, any voter with $\theta > \tilde{\theta}$ who draws $c = c_L$ also votes for $R$ on Election Day.*

*Proof.* Suppose that a voter with $\tilde{\theta}$ votes for $R$ on Election Day. Then, by Proposition 3.2.1, $\Delta v < 4\tilde{\theta} + m - c_L$. Consider a voter with $\theta > \tilde{\theta}$ who draws $c = c_L$ on Election Day. Then, $4\theta + m - c_L > 4\tilde{\theta} + m - c_L > \Delta v$, so this voter also votes for $R$ on Election Day by Proposition 3.2.1. Suppose a voter with $\tilde{\theta}$ votes for $L$ on Election Day. Then, by Proposition 3.2.1, $\Delta v > 4\tilde{\theta} + c_L - m$. Consider a voter with $\theta < \tilde{\theta}$ who draws $c = c_L$ on Election Day. Then, $4\theta + c_L - m < 4\tilde{\theta} + c_L - m < \Delta v$, so this voter also votes for $L$ on Election Day by Proposition 3.2.1. □

**Proposition 3.2.2**. *Suppose that a voter with $\tilde{\theta} > 0$ votes early. Then, any voter with $\theta > \tilde{\theta}$ votes early as well. Likewise, for any voter with $\tilde{\theta} < 0$ that votes early, any voter with $\theta < \tilde{\theta}$ votes early as well.*

*Proof.* Consider two voters, 1 and 2, with $\theta_1 > \theta_2 > 0$. Suppose that voter 2 votes early. Note that a voter with $\theta > 0$ votes early if and only if the expected utility of voting early (for $R$) is greater than the expected utility of waiting until Election Day. That is, $m + 4\theta - \mathbb{E}[\Delta v] - c' > \mathbb{P}(c = c_L)[\mathbb{P}(\text{vote } R)\mathbb{E}[u|\text{ vote } R] + \mathbb{P}(\text{ vote } L)\mathbb{E}[u|\text{ vote } L]]$. Note that $\mathbb{E}[\Delta v] = 0$ by assumption. Then, we can rewrite this condition as:

$$c' < m(1-q) + qc_L + (1+q)4\theta - q(m - c_L)[F_{\Delta v}(\Delta v_R) - F_{\Delta v}(\Delta v_L)] - 4\theta \cdot q[F_{\Delta v}(\Delta v_R) + F_{\Delta v}(\Delta v_L)]$$
$$+ q[\int_{-2v}^{4\theta+m-c_L} \Delta v f_{\Delta v}(\Delta v) d\Delta v - \int_{4\theta+c_L-m}^{2v} \Delta v f_{\Delta v}(\Delta v) d\Delta v] \equiv \hat{c}.$$

This cost threshold, $\hat{c}$, is a function of $\theta$. In particular, it is increasing in $\theta$:

$$\frac{\partial \hat{c}}{\partial \theta} = 4 + 4q[1 - (F_{\Delta v}(\Delta v_R) + F_{\Delta v}(\Delta v_L))] + \cancel{4q(c_L - m)[f_{\Delta v}(\Delta v_R) - f_{\Delta v}(\Delta v_L)]}$$

$$- 4\theta \cdot q[f_{\Delta v}(\Delta v_R) + f_{\Delta v}(\Delta v_L)] + 16\theta \cdot q[f_{\Delta v}(\Delta v_R) + f_{\Delta v}(\Delta v_L)] - \cancel{4q(c_L - m)[f_{\Delta v}(\Delta v_R) - f_{\Delta v}(\Delta v_L)]}$$

$$= 4 + 4q[1 - (F_{\Delta v}(\Delta v_R) + F_{\Delta v}(\Delta v_L))] + 12\theta \cdot q[f_{\Delta v}(\Delta v_R) + f_{\Delta v}(\Delta v_L)] > 0.$$

Since voter 2 votes early, it must be that $c' < \hat{c}_2$, the threshold for her bliss point, $\theta_2$. Since the threshold is increasing in $\theta$, we have $\hat{c}_2 < \hat{c}_1$. Therefore, $c' < \hat{c}_2 < \hat{c}_1$, so voter 1 also votes early. Symmetric arguments can be made for the case where a voter with $\theta < 0$ votes early. □

**Proposition 3.3.4**. *Suppose that the election is not decided on Election Day and that $c_L = m$. Suppose that candidate $R$ ($L$) receives more early votes than candidate $L$ ($R$, resp.). Then, the decisive voter is shifted to the right (left, resp.) of the median voter, and candidate $R$ ($L$, resp.) wins the election with a higher probability than the median voter prefers.*

*Proof.* Suppose that the election is not decided on Election Day and that $c_L = m$. Suppose that candidate $R$ receives more early votes than candidate $L$: $1 - F_\theta(\tilde{\theta}_2) > F_\theta(\tilde{\theta}_1)$. Then, $F_\theta(\theta_D) = \frac{1}{2} + \frac{1-q}{2q}[1 - F_\theta(\tilde{\theta}_2) - F_\theta(\tilde{\theta}_1)] > \frac{1}{2} = F_\theta(\theta_M)$, so that $\theta_D > \theta_M$. Note that $R$ wins with probability $\mathbb{P}(u_R(\theta_D) > u_L(\theta_D)) = F_{\Delta v}(4\theta_D)$. The median voter wants candidate $R$ to win with probability $\mathbb{P}(u_R(\theta_M) > u_L(\theta_M)) = F_{\Delta v}(4\theta_M)$. Since $\theta_D > \theta_M$, we have $F_{\Delta v}(4\theta_D) > F_{\Delta v}(4\theta_M)$. That is, $R$ wins more often than the median voter would like. A similar argument can be made for the case where $L$ earns more early votes than $R$. □

**Proposition 3.3.5**. *Suppose that early voting is not offered (all citizens must wait until Election Day) and left (right)-leaning voters draw voting costs from $F_{C_\ell}$ ($F_{C_r}$). Consider*

*$\tilde{\theta}_1^E < 0 < \tilde{\theta}_2^E$ and suppose that $\tilde{\theta}_1^E > \theta_M$. Then, $L$ wins the election if and only if $q_\ell > \frac{1-F_\theta(\tilde{\theta}_2^E)}{F_\theta(\tilde{\theta}_1^E)} \cdot q_r$.*

*Proof.* Suppose that early voting is not offered (all citizens must wait until Election Day) and left (right)-leaning voters draw voting costs from $F_{C_\ell}$ ($F_{C_r}$). Consider $\tilde{\theta}_1^E < 0 < \tilde{\theta}_2^E$ and suppose that $\tilde{\theta}_1^E > \theta_M$. Then, $L$ obtains $q_\ell \cdot F_\theta(\tilde{\theta}_1^E)$ votes and $R$ obtains $q_r \cdot (1 - F_\theta(\tilde{\theta}_2))$ votes. Therefore, $L$ wins if and only if $q_\ell \cdot F_\theta(\tilde{\theta}_1^E) > q_r \cdot (1 - F_\theta(\tilde{\theta}_2))$. Rearranging, the condition is $q_\ell > \frac{1-F_\theta(\tilde{\theta}_2)}{F_\theta(\tilde{\theta}_1^E)} \cdot q_r$. □