

The Mythical Swing Voter*

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Abstract

Cross-sectional surveys conducted during the 2012 U.S. presidential campaign showed large swings in support for the Democratic and Republican candidates, especially before and after the first presidential debate. Using a unique (in terms of scale, frequency, and source) panel survey, we find that daily sample composition varied more in response to campaign events than did vote intentions. Multi-level regression and post-stratification (MRP) is used to correct for selection bias. Demographic post-stratification, similar to that used in most academic and media polls, is inadequate, but the addition of attitudinal variables (party identification, ideological self-placement, and past vote) appear to make selection ignorable in our data. We conclude that vote swings in 2012 were mostly sample artifacts and that real swings were quite small. While this account is at variance with most contemporaneous analyses, it better corresponds with our understanding of partisan polarization in modern American politics.

Keywords: Elections, swing voters, multilevel regression and post-stratification.

*We thank Jake Hofman, Neil Malhotra, and Duncan Watts for comments, and the National Science Foundation for partial support of this research. We also thank the audiences at MPSA, AAPOR, Toulouse Network for Information Technology, Stanford, Microsoft Research, University of Pennsylvania, Duke, and Santa Clara for their feedback during talks on this paper.

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Introduction

In a political environment characterized by close elections, a relatively small number of swing voters can shift control of Congress and the Presidency from one party to the other, or to divided government. Campaigns spend enormous sums—over \$2.6 billion in the 2012 presidential election cycle—trying to target “persuadable voters.” Poll aggregators track day-to-day swings in the proportion of voters supporting each candidate. Political scientists have debated whether swings in the polls are a response to campaign events or are merely reversions to predictable positions as voters become more informed about the candidates (Gelman and King 1993; Hillygus and Jackman 2003; Kaplan, Park and Gelman 2012). This debate, however, has focused on the causes of swings in vote intention, not their existence. Nearly all researchers and campaign participants appear to accept that polls accurately measure vote intentions so that measured swings in public opinion are real (Kaplan, Park and Gelman 2012). Swing voters, it would seem, are key to understanding the changing fortunes of Democrats and Republicans in recent American national elections.

But there is a puzzle: candidates appeal to swing voters in debates, campaigns target advertising toward swing voters, journalists discuss swing voters, and the polls do indeed swing—but it is hard to find people who have actually switched sides. Partly this is because most polls are based on independent cross-sections of voters, so change must be inferred from aggregate shifts in candidate preference, while most election panels are too small to provide reliable data on shifts of a few percent. But aside from scant data about actual swing voters, it is difficult to reconcile substantial vote shifts with the high degree of partisan polarization that now exists in the American electorate (Baldassarri and Gelman 2008; Fiorina and Abrams 2008; Levendusky 2009). It seems implausible that many voters will switch support from one party to the other because of minor campaign events.¹

In this paper, we focus on apparent vote shifts surrounding the presidential debates

¹To be clear, we are discussing *net* change in support for candidates. Panel surveys show much larger amounts of *gross* change in vote intention between waves which are offset by changes in the opposite direction. See, for example, Table 7.1 of Sides and Vavreck (2014)

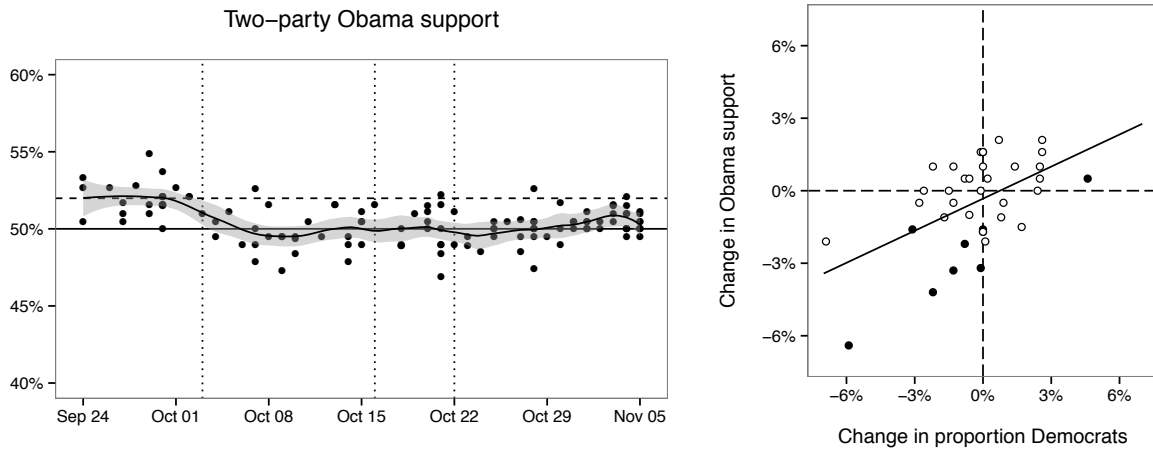


Figure 1: (a) *Two-party support for Obama versus Romney as reported in major media polls. The dashed horizontal line indicates the final vote share, and the dotted vertical lines indicate the three presidential debates.*

(b) *The change in two-party support for Obama versus the change in the fraction of respondents who identify as Democrats. Each point indicates the reported change in consecutive polls conducted by the same polling organization; the solid points correspond to polls conducted immediately before and after the October 3 debate. The solid line is the regression line, and the positive correlation indicates that observed swings in the polls correspond to swings in the proportion of Democrats or Republicans who respond to the polls.*

The figure illustrates how the sharp drop in measured support for Obama around the first debate (Panel A), is strikingly correlated with a drop in the fraction of Democrats responding to major media polls (Panel B).

between Barack Obama and Mitt Romney during the 2012 election campaign. In mid-September, Obama led Romney by an average of 4% in the *Huffington Post* polling average and seemed to be coasting to an easy reelection victory. However, as shown in Figure 1a, following the first presidential debate on October 3, Romney had closed the gap and most of the polls conducted in the week after the first debate showed a Romney lead, with an average of 1%. It was not until after the third debate (on October 22) that Obama regained a small lead in the polling averages, which he maintained until election day. At the time, it was commonly agreed that Obama had performed poorly in the first presidential debate but had recovered in later debates. This account is consistent with the existence of a pool of swing voters who switch back and forth between the candidates.

However, there are reasons to be skeptical about whether the first presidential debate in 2012 actually swung substantial number of voters toward Romney. Consider, for example, the Pew Research surveys. In the September 12–16 Pew survey, Obama led Romney 51–42 among registered voters, but the two candidates were tied 46–46 in the October 4–7 survey. The 5% swing to Romney sounds impressive until it is compared to how the same respondents recalled voting in 2008. In the September 12–16 sample, 47% recalled voting for Obama in 2008, but this dropped to 42% in the October 4–7 sample. Recalled vote for McCain also rose by 5% in this pair of surveys (from 32% to 37%). The swing toward Romney in the two polls was identical to the increase in recalled voting for McCain.

Similarly, Figure 1b shows that throughout the election cycle and across polling organizations, Obama support is positively correlated with the proportion of survey respondents who are Democrats. Each point in the plot compares the change in two-party Obama support to the change in the proportion of respondents who self-identify as Democrats in consecutive surveys conducted by the same polling organization. Estimated support for Obama rises and falls with the proportion of Democrats in the sample.

At this point, two potential explanations suggest themselves: possibly the debate not only changed people’s vote intentions but also retrospectively changed their memory of their

vote in the previous election, and also their stated party allegiance (Himmelweit, Biberian and Stockdale 1978). Or, alternatively, the surveys taken before and after the debate were capturing different populations.

This discussion illustrates the problem of inferring change from independent cross-sections. Respondents in the September and October Pew samples don't overlap, so we cannot tell whether more of the September respondents would have supported Romney if they had been reinterviewed in October. The October interviews are with a different sample and, while more say they intend to vote for Romney than those in the September sample, we do not know whether these respondents were less supportive of Romney in September, since they were not interviewed in September. We do know, however, that the October sample contains more people who remembered voting for McCain in 2008, suggesting that the October sample was more Republican.

We shall argue that, in this case, apparent swings in vote intention represent mostly changes in sample composition, not actual swings. These are phantom swings arising from sample selection bias in survey participation. Previous studies have tended to assume that campaign events cause changes in vote intentions, while ignoring the possibility that they may cause changes in survey participation. We will show that in 2012, campaign events more strongly correlated with changes in survey participation than vote intentions. As a consequence, aggregate changes involve invalid sample comparisons, similar to uncontrolled differences between treatment groups.

If survey variables such as vote intention are independent of sample selection conditional upon a set of covariates, various methods can be used to obtain consistent estimates of population parameters. Using the method of multilevel regression and post-stratification (MRP), we show that conditioning upon standard demographics (age, race, gender, education) is inadequate to remove the selection bias present in our data. However, the introduction of controls for party ID, ideology, and past vote among the covariates appears to substantially eliminate selection effects. While the use of party ID weighting is controversial in cross-

sectional studies (Allsop and Weisberg 1988; Kaminska and Barnes 2008), most of these problems can be avoided in a panel design.² In panels, post-stratification on baseline attitudes avoids endogeneity problems associated with cross-sectional party ID weighting, even if these attitudes are not stable over the campaign.

Data and methods

Our analysis is based on a unique dataset. During the 2012 U.S. presidential campaign, we conducted 750,148 interviews with 345,858 unique respondents on the Xbox gaming platform during the 45 days preceding the election. Xbox Live subscribers who opted-in provided baseline information about themselves in a registration survey, including demographics, party identification, and ideological self-placement. Each day, a new survey was offered and respondents could choose whether they wished to complete it. The analysis reported here is based upon the 83,283 users who responded at least once prior to the first presidential debate on October 3. In total, these respondents completed 336,805 interviews, or an average of about four interviews per respondent. Over 20,000 panelists completed at least five interviews and over 5,000 answered surveys on 15 or more days. The average number of respondents in our analysis sample each day was about 7,500. The Xbox panel provides abundant data on actual shifts in vote intention by a particular set of voters during the 2012 presidential campaign, and the size of the Xbox panel supports estimation of MRP models which adjust for different types of selection bias.

Our analysis has two steps. We first show that with demographic adjustments, the Xbox data reproduce swings found in media polls during the 2012 campaign. That is, if one adjusts for the variables typically used for weighting phone samples, daily Xbox surveys exhibit the same sort of patterns found in conventional polls. Second, because the Xbox data come from a panel with baseline measurements of party ID and other attitudes, it is feasible to correct for variations in survey participation due to partisanship, ideology, and

²See Reilly, Gelman and Katz (2001) for a potential work-around in cross-sectional studies.

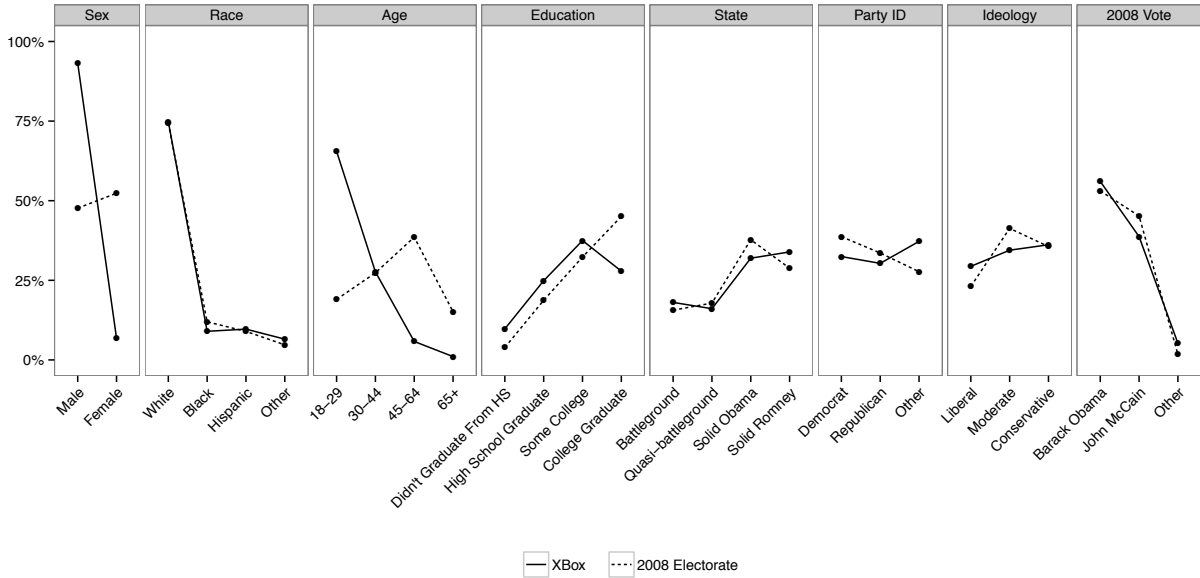


Figure 2: *Demographic and partisan composition of the Xbox panel and the 2008 electorate. There are large differences in the age distribution and gender composition of the Xbox panel and the 2012 exit poll. Without adjustment, Xbox data consistently overstate support for Romney. However, the large size of the Xbox panel permits satisfactory adjustment even for large skews.*

past vote. The correlation of within-panel response rates with party ID, for example, varies over the course of the campaign. Using MRP with an expanded set of covariates enables us to distinguish between actual vote swings and compositional changes in daily samples. With these adjustments, most of the apparent swings in vote intention disappear.

The Xbox panel is not representative of the electorate, with Xbox respondents predominantly young and male. As shown in Figure 2, 66% of Xbox panelists are between 18 and 29 years old, compared to only 18% of respondents in the 2008 exit poll,³ while men make up 93% of Xbox panelists but only 47% of voters in the exit poll. With a typical-sized sample of 1,000 or so, it would be difficult to correct skews this large, but the scale of the Xbox panel compensates for its many sins. For example, despite the small proportion of women among Xbox panelists, there are over 5,000 women in our sample, which is an order of magnitude

³As discussed later, we chose to use the 2008 exit poll data for post-stratification so that the analysis relies only upon information available before the 2012 election. Relying upon 2008 data demonstrates the feasibility of this approach for forecasting. Similar results are obtained by post-stratifying on 2012 exit poll demographics and attitudes.

more than the number of women in an RDD sample of 1,000.

The method of MRP is described in Gelman and Little (1997). Briefly, post-stratification is a standard framework for correcting for known differences between sample and target populations (Little 1993). The idea is to partition the population into cells (defined by the cross-classification of various attributes of respondents), use the sample to estimate the mean of a survey variable within each cell, and finally to aggregate the cell-level estimates by weighting each cell by its proportion in the population. In conventional post-stratification, cell means are estimated using the sample mean within each cell. This estimate is unbiased if selection is ignorable (i.e., if sample selection is independent of survey variables conditional upon the variables defining the post-stratification.) The ignorability assumption is more plausible if more variables are conditioned upon. However, adding more variables to the post-stratification increases the number of cells at an exponential rate. If any cell is empty in the sample (which is guaranteed to occur if the number of cells exceeds the sample size), then the conventional post-stratification estimator is not defined, and nonempty cells can also cause problems because estimates of cell means will be noisy in cells with small sample counts. MRP addresses this problem by using hierarchical Bayesian regression to obtain stable estimates of cell means (Gelman and Hill 2006). This technique has been successfully used in the study of public opinion and voting (Lax and Phillips 2009; Ghitza and Gelman 2013).

We initially apply MRP by partitioning the population into 6,258 cells based upon demographics and state of residence (2 gender \times 4 race \times 4 age \times 4 education \times 50 states plus the District of Columbia).⁴ One cell, for example, corresponds to 30–44-year-old white male college graduates living in California. Using each day’s sample, we then fit separate multilevel logistic regression models that predict respondents’ stated vote intention on that day as a function of their demographic attributes. We assumed that the distribution of voter demographics for each state would be the same as that found in the 2008 exit poll. See the

⁴The survey system used for the Xbox project was limited to four response options per question, except for state of residence, which used a text box for input.

Appendix for additional details on modeling and methods.

To further test our claims, we examine results from the RAND Continuous 2012 Presidential Election Poll (Gutsche, Kapteyn, Meijer and Weerman 2014). Starting in July 2012, RAND polled a fixed panel of 3,666 people each week, asking each participant the likelihood he or she would vote for each presidential candidate (for example, a respondent could specify 60% likelihood to vote for Obama, 35% likelihood for Romney, and 5% likelihood for someone else). Participants were additionally asked how likely they were to vote in the election, and their assessed probability of Obama winning the election. Each day, one-seventh of the panel (approximately 500 people) were prompted to answer these three questions and had seven days to respond—though in practice, most responded immediately. Respondents received \$2 for each completed interview, and the response rate was impressive, with 80% of participants typically responding each week. Given the high response rate, we would not expect the survey to suffer greatly from partisan nonresponse.

Results

Figure 3a shows the estimated daily proportion of voters intending to vote for Obama (excluding minor party voters and non-voters).⁵ After adjustment for demographics by MRP, the daily Xbox estimates of voting intention are quite similar to daily polling averages from media polls shown in Figure 1. In particular, the most striking trend in these polls is the precipitous decline in Obama’s support following the first presidential debate on October 3 (indicated by the left-most dotted vertical line). This swing was widely interpreted as a real and important change in shift in vote intentions. For example, Nate Silver wrote in the *New York Times* on October 6, “Mr. Romney has not only improved his own standing but also taken voters away from Mr. Obama’s column,” and Karl Rove declared in the *Wall Street Journal* the following day, “Mr. Romney’s bounce is significant.”

⁵We smooth the estimates over a four-day moving window, matching the typical duration for which standard telephone polls were in the field in the 2012 election cycle.

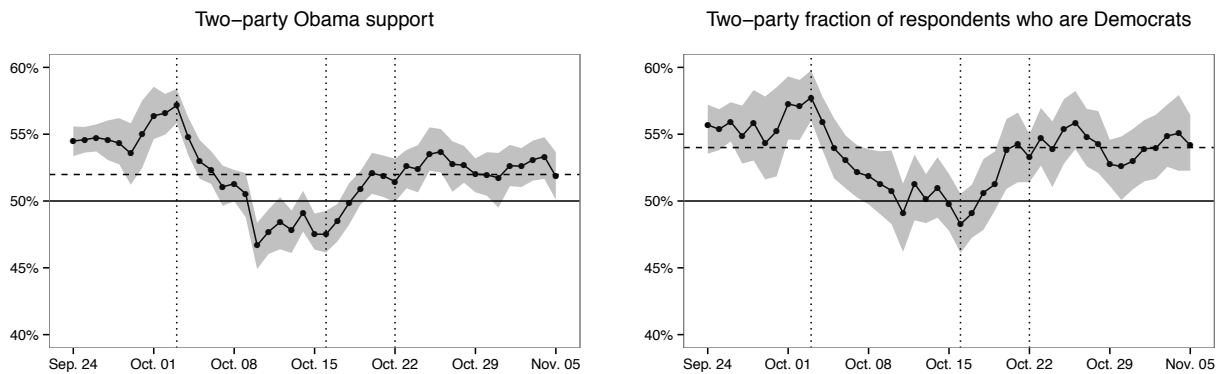


Figure 3: (a) Among respondents who support either Barack Obama or Mitt Romney, estimated support for Obama (with 95% confidence bands), adjusted for demographics. The dashed horizontal line indicates the final vote share, and the dotted vertical lines indicate the three presidential debates. This demographically-adjusted series is a close match to what was obtained by national media polls during this period.

(b) Among respondents who report affiliation with one of the two major parties, the estimated proportion who identify as Democrats (with 95% confidence bands), adjusted for demographics. The dashed horizontal lines indicate the final party identification share, and the dotted vertical lines indicate the three presidential debates.

The pattern in the two figures is strikingly similar, suggesting that most of the apparent changes in public opinion are actually artifacts of differential nonresponse.

But was the swing in Romney support in the polls real? Figure 3b shows the daily proportion of respondents, after adjusting for demographics, who say they are Democrats or Republicans (omitting independents). For the two weeks following the first debate, Democrats were simply much less likely than Republicans to participate in the survey, even after adjustment for demographic differences in the daily samples. For example, among 30–44 year-old white male college graduates living in California, more of the respondents were self-identified Republicans after the debate than in the days leading up to it. Demographic adjustment alone is inadequate to correct selection bias due to partisanship.

An important methodological concern is the potential endogeneity of attitudinal variables, such as party ID, in voting decisions. If some respondents change their party identification and vote intention simultaneously, then using current party ID to weight a cross-sectional survey to a past party ID benchmark is both inaccurate and arbitrary. The approach used here, however, avoids this problem because we are adjusting *past* party ID to a *past* party ID benchmark. We still need a source for the baseline party ID distribution to use for post-stratification. We used the 2008 exit poll for the joint distribution of all variables, but swing estimates are not particularly sensitive to which baseline is used. See the Appendix for further discussion, and comparison of the use of the 2008 and 2012 exit polls for benchmarks.

In Figure 4, we compare MRP adjustments using only demographics (shown in light gray) and both demographic and attitudinal variables (a black line with dark gray confidence bounds). The additional attitudinal variables used for post-stratification were party identification (Democratic, Republican, Independent, and other), ideology (liberal, moderate, and conservative), and 2008 presidential vote (Obama, McCain, other, and did not vote). Again, we applied MRP to adjust the daily samples for selection bias, but now the adjustment allows for selection correlated with both attitudinal and demographic variables.

In Figure 4, the swings shown in Figure 3 largely disappear. The addition of attitudinal variables in the MRP model corrects for differential response rates by party ID and other

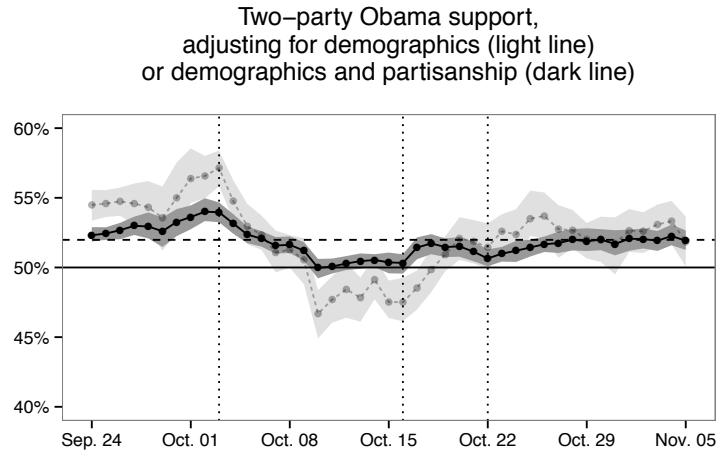


Figure 4: *Obama share of the two-party vote preference (with 95% confidence bands) estimated from the Xbox panel under two different post-stratification models: the dark line shows results after adjusting for both demographics and partisanship, and the light line adjusts only for demographics (identical to Figure 3a). The surveys adjusted for partisanship show less than half the variation of the surveys adjusted for demographics alone, suggesting that most of the apparent changes in support during this period were artifacts of partisan nonresponse.*

attitudinal variables at different points in the campaign. Compared to the demographic-only post-stratification (shown in gray), post-stratification on both demographics and party ID greatly reduces (but does not entirely eliminate) the swings in vote intention after the first presidential debate. Adjusting only for demographics yields a six-point drop in support for Obama in the four days following the first presidential debate; adjusting for both demographics and partisanship reduces the drop in support for Obama to between two and three percent. More generally, adjusting for partisanship reduces swings by more than 50% compared to adjusting for demographics alone. In the demographics-only post-stratification, Romney takes a small lead following the first debate (similar to that observed in contemporaneous media polls). In contrast, the demographics and party ID adjustment leaves Obama with a lead throughout the campaign. Correctly estimated, most of the apparent swings were sample artifacts, not actual change.

Our results indicate that in the absence of selection effects, the measured drop in support for Obama after the first presidential debate would be relatively small. Presumably, similar

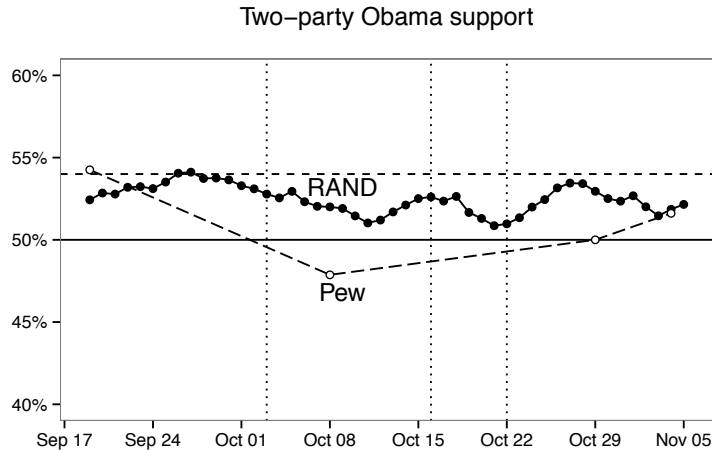


Figure 5: Support for Obama (among respondents who expressed support for one of the two major-party candidates) as reported by the RAND (solid line) and Pew Research (dashed line) surveys. The dashed horizontal line indicates the final vote share, and the dotted vertical lines indicate the three presidential debates. As with most traditional surveys (see Figure 1), the Pew poll indicates a substantial drop in support for Obama after the first debate. However, the high-response rate RAND panel, which should not be susceptible to partisan nonresponse, shows much smaller swings.

swings in widely reported poll aggregates would also be greatly reduced if similar data were available to make corrections for selection bias.

Figure 5 reproduces the results of the RAND survey as reported by Gutsche et al. (2014), where each point represents a seven-day rolling average.⁶ Given the high response rate of the survey (80%), we would expect it to be largely immune to partisan nonresponse. For comparison, we also include the results of the four surveys of likely voters conducted by the Pew Research Center during that time period. Consistent with our results, the RAND survey shows that support for Obama does indeed drop after the first debate, but not nearly as much as suggested by Pew and other traditional surveys that are more susceptible to partisan nonresponse. Specifically, in the days after the debate, RAND shows a low of 51% Obama support, inline with the low of 50% indicated by the Xbox survey; Pew, however, reports support for Obama dropping to 47%.

⁶Whereas Gutsche et al. (2014) separately plot support for Obama and Romney, we combine these two into a single line indicating two-party Obama support; we otherwise make no adjustments to their reported numbers.

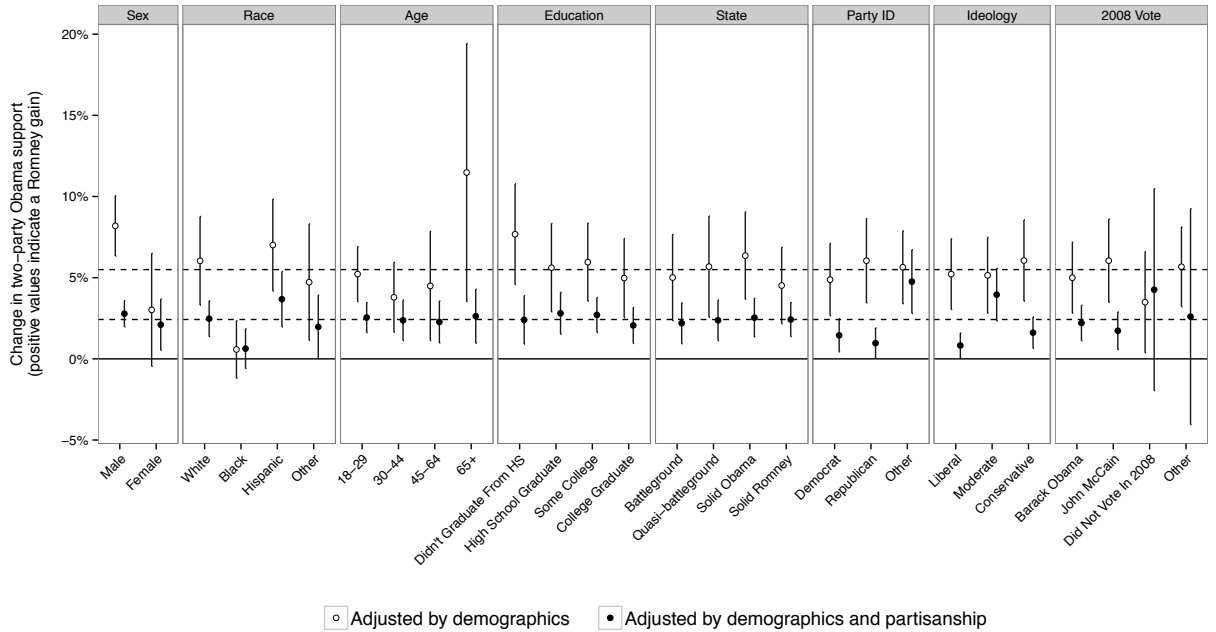


Figure 6: *Estimated swings in two-party Obama support between the day before and four days after the first presidential debate under two different post-stratification models, separated by subpopulation. The vertical lines represent the overall average movement under the each model. The horizontal lines correspond to 95% confidence intervals.*

Next, in Figure 6, we consider estimated swings around the debate broken down by demographics and partisanship. Not surprisingly, the small net change that does occur is concentrated among independents, moderates, and those who did not vote in 2008. Of the relatively few supporters gained by Romney, the majority were previously undecided.

We have thus far investigated population-level swings in opinion, finding that after correcting for partisan nonresponse, the candidates garnered support from relatively stable fractions of the electorate throughout the campaign. This result is in theory consistent with two competing hypotheses. One possibility is that relatively large numbers of supporters for both candidates may have switched their vote intention, resulting in little net movement; the other is that only a relatively small number of individuals may have changed their allegiance. We conclude our analysis by addressing this question, examining individual-level changes of opinion around the first presidential debate.

Figure 7 shows, as one may have expected, that only a small percentage of individuals

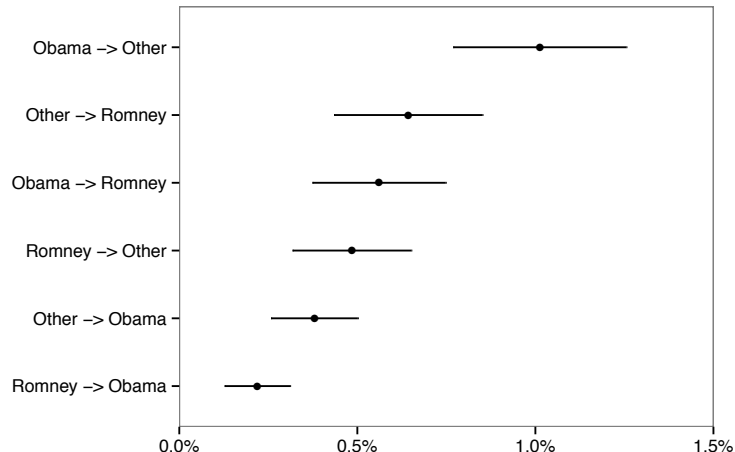


Figure 7: *Estimated proportion of the electorate that switched their support from one candidate to another during the one week immediately before and after the first presidential debate, with 95% confidence intervals. We find that only 0.5% of individuals switched their support from Obama to Romney.*

(3%) switched their support from one candidate to another. Notably, the largest fraction of switches results from individuals who supported Obama prior to the first debate and then switched their support to “other.” In all likelihood, many of these individuals eventually switched back to Obama by election day, further illustrating the stability of candidate support. We estimate that in fact only 0.5% of individuals switched from Obama of Romney in the weeks around the first debate, with 0.2% switching from Romney to Obama. Thus, counter to most accounts of the 2012 campaign, properly correcting for partisan nonresponse shows there was little change in candidate support.

Discussion

The analyses reported here are based upon opt-in samples, but the phenomenon is more pervasive. The magnitude of the selection effects in the Xbox sample are of similar magnitude to those found in other types of surveys. For example, the two-party fraction of Democrats in Pew’s pre- and post-debate polls was 7% (from 55% to 48% of major party identifiers). Any sample with a low response rate—and that includes nearly all election polls—are opt-in

samples. The ability to contact respondents and their willingness to cooperate, not random selection, are the primary determinants of sample inclusion in most election polls today.

Because of their cross-sectional design, it is difficult to correct for attitudinal selection bias in these surveys without assuming that attitudinal variables do not fluctuate over time. Though the proportion of Democrats and Republicans in presidential election exit polls is quite stable, there is also evidence that party ID does fluctuate somewhat between elections. This makes cross-sectional party ID corrections controversial, but the failure to adjust sample composition for anything other than demographics should be equally controversial. Methods exist for such adjustment, making use of the assumption that the post-stratifying variable (in this case, party identification) evolves slowly (Reilly, Gelman and Katz 2001).

Overall, however, panel designs appear to provide the best method for controlling for selection bias on attitudinal variables. Large opt-in panels are likely to have large skews, but MRP methods provide a promising approach for adjusting for selection bias in these situations. Demographic post-stratification yielded estimates similar to most media polls in the 2012 campaign. The availability of baseline attitudinal measurements in a large panel, however, make it feasible to remove types of selection bias that would be difficult in conventional cross-sectional designs.

The temptation to over-interpret bumps in election polls can be difficult to resist, so our findings provide a cautionary tale. The existence of a pivotal set of voters, attentively listening to the presidential debates and switching sides is a much more satisfying narrative, both to pollsters and survey researchers, than a small, but persistent, set of sample selection biases. Conversely, correcting for these biases gives us a picture of public opinion and voting that corresponds better with our understanding of the intense partisan polarization in modern American politics.

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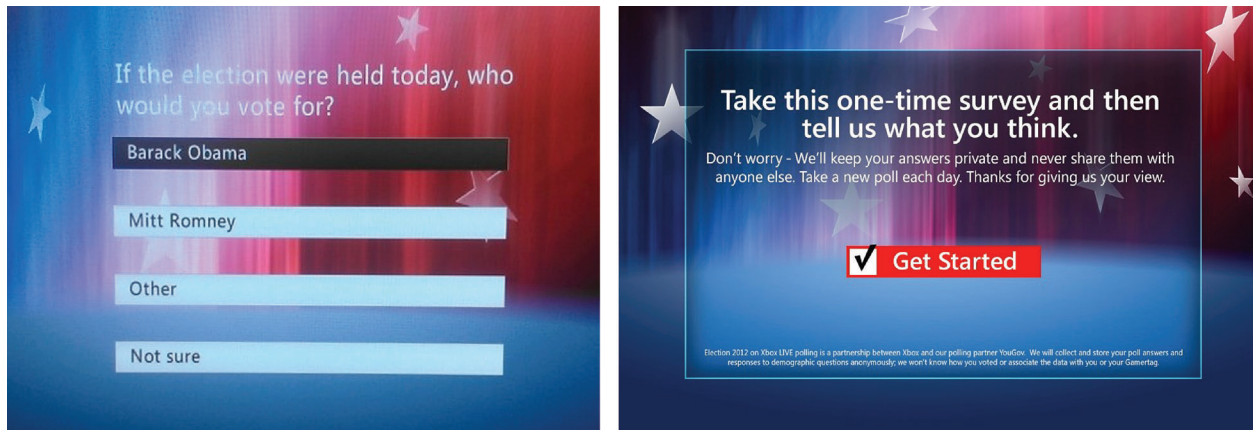


Figure A.1: *The left panel shows the vote intention question, and the right panel shows what respondents were presented with during their first visit to the poll.*

A Methods & Materials

Xbox survey. The only way to answer the polling questions was via the Xbox Live gaming platform. There was no invitation or permanent link to the poll, and so respondents had to locate it daily on the Xbox Live's home page and click into it. The first time a respondent opted-into the poll, they were directed to answer the nine demographics questions listed below. On all subsequent times, respondents were immediately directed to answer between three and five daily survey questions, one of which was always the vote intention question.

Intention Question: If the election were held today, who would you vote for?

Barack Obama\Mitt Romney\Other\Not Sure

Demographics Questions:

1. Who did you vote for in the 2008 Presidential election?

Barack Obama\John McCain\Other candidate\Did not vote in 2008

2. Thinking about politics these days, how would you describe your own political viewpoint? Liberal\Moderate\Conservative\Not sure

3. Generally speaking, do you think of yourself as a ...?

Democrat\Republican\Independent\Other

4. Are you currently registered to vote?

Yes\No\Not sure

5. Are you male or female?

Male\Female

6. What is the highest level of education that you have completed?

Did not graduate from high school\High school graduate\Some college or 2-year college degree\4-year college degree or Postgraduate degree

7. What state do you live in?

Dropdown menu with states – listed alphabetically; including District of Columbia and “None of the above”

8. In what year were you born?

1947 or earlier\1948–1967\1968–1982\1983–1994

9. What is your race or ethnic group?

White\Black\Hispanic\Other

Demographic post-stratification. We used multilevel regression and post-stratification (MRP) to produce daily estimates of candidate support. For each date d between September 24, 2012 and November 5, 2012, define the set of responses R_d to be those submitted on date d or on any of the three prior days. Daily estimates—which were smoothed over a four day moving window—are generated by repeating the following MRP procedure separately on each subset of responses R_d . In the first step (multilevel regression), we fit two multilevel logistic regression models to predict panelists’ vote intentions (Obama, Romney, or “other”) as a function of their age, sex, race, education, and state. Each of these predictors is categorical: age (18–29, 30–44, 45–64, or 65 and older), sex (male or female), race (white, black, Hispanic

or other), education (no high school diploma, high school graduate, some college, or college graduate), and residence (one of the 50 U.S. states or the District of Columbia).

We fit two binary logistic regressions sequentially. The first model predicts whether a respondent intends to vote for one of the major-party candidates (Obama or Romney), and the second model predicts whether they support Obama or Romney, conditional upon intending to vote for one of these two. Specifically, the first model is given by

$$\begin{aligned} & \Pr(Y_i \in \{\text{Obama, Romney}\}) \\ &= \text{logit}^{-1} \left(\alpha_0 + a_{j[i]}^{\text{age}} + a_{j[i]}^{\text{sex}} + a_{j[i]}^{\text{race}} + a_{j[i]}^{\text{edu}} + a_{j[i]}^{\text{state}} \right) \end{aligned} \quad (1)$$

where Y_i is the i th response (Obama, Romney, or other) in R_d , α_0 is the overall intercept, and $a_{j[i]}^{\text{age}}$, $a_{j[i]}^{\text{sex}}$, $a_{j[i]}^{\text{race}}$, $a_{j[i]}^{\text{edu}}$, and $a_{j[i]}^{\text{state}}$ are random effects for the i -th respondent. Here we follow the notation of Gelman and Hill (2006) to indicate, for example, that $a_{j[i]}^{\text{age}} \in \{a_{18-29}^{\text{age}}, a_{30-44}^{\text{age}}, a_{45-64}^{\text{age}}, a_{65+}^{\text{age}}\}$ depending on the age of the i -th respondent, with $a_{j[i]}^{\text{age}} \sim N(0, \sigma_{\text{age}}^2)$, where σ_{age}^2 is a parameter to be estimated from the data. In this manner, the multilevel model partially pools data across the four age categories—as opposed to fitting each of the four coefficients separately—boosting statistical power. The benefit of this multilevel approach is most apparent for categories with large numbers of levels (for example, geographic location), but for consistency and simplicity we use a fully hierarchical model.

The second of the nested models predicts whether one supports Obama given one supports a major-party candidate, and is fit on the subset $M_d \subseteq R_d$ for which respondents declared support for one of the major-party candidates. For this subset, we again predict the i -th response as a function of age, sex, race, education, and geographic location. Namely, we fit the model

$$\begin{aligned} & \Pr(Y_i = \text{Obama} \mid Y_i \in \{\text{Obama, Romney}\}) \\ &= \text{logit}^{-1} \left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} \right). \end{aligned} \quad (2)$$

Once these two models are fit, we can estimate the likelihood any respondent will report support for Obama, Romney, or “other” as a function of his or her demographic attributes. For example, to estimate a respondent’s likelihood of supporting Obama, we simply multiply the estimates obtained under each of the two models.

By the above, for each of the 6,528 combinations of age, sex, race, education, and geographic location, we can estimate the likelihood that a hypothetical individual with those demographic attributes will support each candidate. In the second step of MRP (post-stratification), we weight these 6,528 estimates by the assumed fraction of such individuals in the electorate. For simplicity, transparency, and repeatability in future elections, in our primary analysis we assume the 2012 electorate mirrors the 2008 electorate, as estimated by exit polls. In particular, we use the full, individual-level data from the exit polls (not the summary cross-tabulations) to estimate the proportion of the electorate in each demographic cell. Our decision to hold fixed the demographic composition of likely voters obviates the need for a likely voter screen, allows us to separate support from enthusiasm or probability of voting, and generates estimates that are largely in line with those produced by leading polling organizations.

The final step in computing the demographic post-stratification estimates is to account for the *house effect*: the disproportionate number of Obama supporters even after adjusting for demographics. For example, older voters who participate in the Xbox survey are more likely to support Obama than their demographic counterparts in the general electorate. To compute this overall bias of our sample, we first fit models (1) and (2) on the entire 45 days of Xbox polling data, and then post-stratify to the 2008 electorate as before. This yields (demographically-adjusted) estimates for the overall proportion of supporters for Obama, Romney and “other”. We next compute the analogous estimates via models (3) and (4) that additionally include respondents’ partisanship, as measured by 2008 vote, ideology, and party identification. (These latter models are described in more detail in the partisan post-stratification section below.) As expected, the overall proportion of Obama supporters

is smaller under the partisanship models than under the purely demographic models, and the difference of one percentage point between the two estimates is the house effect for Obama. Thus, our final, daily, demographically post-stratified estimates of Obama support are obtained by subtracting the Obama house effect from the MRP estimates. A similar house correction is used to estimate support for Romney and “other”.

Partisan post-stratification. To simultaneously correct for both demographic and partisan skew, we mimic the MRP procedure described above, but we now include partisanship attributes in the predictive models. Specifically, we include a panelist’s 2008 vote (Obama, McCain, or “other”), party identification (Democrat, Republican, or “other”) and ideology (liberal, moderate, or conservative). As noted in the main text, all three of these covariates are collected the first time that a panelist participates in a survey, which is necessarily before the first presidential debate. The multilevel logistic regression models we use are identical in structure to those in (1) and (2) but now include the added predictors. Namely, we have

$$\begin{aligned} \Pr(Y_i \in \{\text{Obama, Romney}\}) & \\ &= \text{logit}^{-1} \left(\alpha_0 + a_{j[i]}^{\text{age}} + a_{j[i]}^{\text{sex}} + a_{j[i]}^{\text{race}} + a_{j[i]}^{\text{edu}} + a_{j[i]}^{\text{state}} \right. \\ &\quad \left. + a_{j[i]}^{2008 \text{ vote}} + a_{j[i]}^{\text{party ID}} + a_{j[i]}^{\text{ideology}} \right) \end{aligned} \quad (3)$$

and

$$\begin{aligned} \Pr(Y_i = \text{Obama} \mid Y_i \in \{\text{Obama, Romney}\}) & \\ &= \text{logit}^{-1} \left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} \right. \\ &\quad \left. + b_{j[i]}^{2008 \text{ vote}} + b_{j[i]}^{\text{party ID}} + b_{j[i]}^{\text{ideology}} \right). \end{aligned} \quad (4)$$

As before, we post-stratify to the 2008 electorate, where in this case there are a total of 176,256 cells, corresponding to all possible combinations of age, sex, race, education, geographic location, 2008 vote, party identification, and ideology. Since here we explicitly

incorporate partisanship, we do not adjust for the house effect as we did with the purely demographic adjustment.

Change in support by group. Figure 6 shows swings in support around the first presidential debate broken down by various subgroups (for example, support among political moderates), under both partisan and demographic estimation models. To generate these estimates, we start with the same fitted multilevel models as above, but instead of post-stratifying to the entire 2008 electorate, we post-stratify to the 2008 electorate within the subgroup of interest. Thus, in the case of political moderates, younger voters have less weight than in the national estimates since they make up a relatively smaller fraction of the target subgroup of interest.

Partisan nonresponse. To compute the demographically-adjusted daily partisan composition of the Xbox sample (shown in Figure 3), we mimic the demographic MRP approach described above. In this case, however, instead of vote intention, our models predict party identification. Specifically, we use nested models of the following form:

$$\begin{aligned} & \Pr(Y_i \in \{\text{Democrat, Republican}\}) \\ &= \text{logit}^{-1} \left(\alpha_0 + a_{j[i]}^{\text{age}} + a_{j[i]}^{\text{sex}} + a_{j[i]}^{\text{race}} + a_{j[i]}^{\text{edu}} + a_{j[i]}^{\text{state}} \right) \end{aligned} \quad (5)$$

and

$$\begin{aligned} & \Pr(Y_i = \text{Democrat} \mid Y_i \in \{\text{Democrat, Republican}\}) \\ &= \text{logit}^{-1} \left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} \right). \end{aligned} \quad (6)$$

As before, smoothed, daily estimates are computed by separately fitting Eqs. (5) and (6) on the set of responses R_d collected in a moving four-day window. Final partisan composition is based on post-stratifying to the 2008 exit polls.

Individual-level opinion change. To estimate rates of opinion change (shown in Figure 7), we take advantage of the ad hoc panel design of our survey, where 12,425 individuals responded both during the seven days before and during the seven days after the first debate. Specifically, for each of these panelists, we denote their last pre-debate response by y_i^{pre} and their first post-debate response by y_i^{post} . As before, we need to account for the demographic and partisan skew of our panel to make accurate estimates, for which we again use MRP. In this case we use four nested models. Mimicking Eqs. (3) and (4), the first two models, given by Eqs. (7) and (8), estimate panelists’ pre-debate vote intention by decomposing their opinions into support for a major-party candidate, and then support for Obama conditional on supporting a major-party candidate. The third model, in Eq. (9), estimates the probability that an individual switches their support (that $y_i^{\text{pre}} \neq y_i^{\text{post}}$). It has the same demographic and partisanship predictors as both (3) and (7), but additionally includes a coefficient for the panelist’s pre-debate response (shown in bold). The fourth and final of the nested models, in Eq. (10), estimates the likelihood that, conditional on switching, a panelist switches to the more Republican of the alternatives (an Obama supporter switching to Romney, or a Romney supporter switching to “other”). This model is likewise based on demographics, partisanship, and pre-debate response.

$$\begin{aligned} & \Pr(y_i^{\text{pre}} \in \{\text{Obama}, \text{Romney}\}) \\ &= \text{logit}^{-1}\left(\alpha_0 + a_{j[i]}^{\text{age}} + a_{j[i]}^{\text{sex}} + a_{j[i]}^{\text{race}} + a_{j[i]}^{\text{edu}} + a_{j[i]}^{\text{state}} + a_{j[i]}^{\text{2008 vote}} + a_{j[i]}^{\text{party ID}} + a_{j[i]}^{\text{ideology}}\right), \quad (7) \end{aligned}$$

$$\begin{aligned} & \Pr(y_i^{\text{pre}} = \text{Obama} \mid y_i \in \{\text{Obama}, \text{Romney}\}) \\ &= \text{logit}^{-1}\left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} + b_{j[i]}^{\text{2008 vote}} + b_{j[i]}^{\text{party ID}} + b_{j[i]}^{\text{ideology}}\right), \quad (8) \end{aligned}$$

$$\begin{aligned}
& \Pr(\mathbf{y}_i^{\text{pre}} \neq \mathbf{y}_i^{\text{post}}) \\
&= \text{logit}^{-1} \left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} + b_{j[i]}^{\text{2008 vote}} + b_{j[i]}^{\text{party ID}} + b_{j[i]}^{\text{ideology}} + \mathbf{b}_{j[i]}^{\text{pre}} \right),
\end{aligned} \tag{9}$$

and

$$\begin{aligned}
& \Pr(\mathbf{y}_i^{\text{post}} = \text{more Republican alternative} \mid \mathbf{y}_i^{\text{pre}} \neq \mathbf{y}_i^{\text{post}}) \\
&= \text{logit}^{-1} \left(\beta_0 + b_{j[i]}^{\text{age}} + b_{j[i]}^{\text{sex}} + b_{j[i]}^{\text{race}} + b_{j[i]}^{\text{edu}} + b_{j[i]}^{\text{state}} + b_{j[i]}^{\text{2008 vote}} + b_{j[i]}^{\text{party ID}} + b_{j[i]}^{\text{ideology}} + \mathbf{b}_{j[i]}^{\text{pre}} \right).
\end{aligned} \tag{10}$$

After fitting these four nested models, we post-stratify to the 2008 electorate as before.