SOCIAL SCIENCES

Not by turnout alone: Measuring the sources of electoral change, 2012 to 2016

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Changes in partisan outcomes between consecutive elections must come from changes in the composition of the electorate or changes in the vote choices of consistent voters. How much composition versus conversion drives electoral change has critical implications for the policy mandates of election victories and campaigning and governing strategies. Here, we analyze electoral change between the 2012 and 2016 U.S. presidential elections using administrative data. We merge precinct-level election returns, the smallest geography at which vote counts are available, with individual-level turnout records from 37 million registered voters in six key states. We find that both factors were substantively meaningful drivers of electoral change, but the balance varied by state. We estimate that pro-Republican Party (GOP) conversion among two-election voters was particularly important in states including Ohio, Michigan, and Pennsylvania where the pro-GOP swings were largest. Our results suggest conversion remains a crucial component of electoral change.

INTRODUCTION

The peaceful transition of power is a defining feature of democracies. These transitions take place when the party that wins control of government at a first election loses the next. This process of electoral change is at the heart of electoral competition. Despite its centrality to representative democracy, scholarly understanding of the mechanisms driving electoral change is quite limited.

In principle, electoral change is a simple accounting identity—vote margin in election two minus vote margin in election one. Yet changes in vote margins can result from two separate mechanisms. The first is a change in the electorate's composition. Composition produces electoral change when voters who participate in only one of the two elections choose different candidates than do those turning out only in the other. Put differently, compositional changes are caused by differential changes in voter turnout. The second mechanism is conversion. Conversion produces electoral change when the voters who turn out in both elections cast votes for different candidates or political parties across the two elections. Some call voters who switch between parties across elections "swing voters" or "floating voters."

Ex ante, one might expect conversion to be especially influential. A voter who is loyal to one party but only votes in one of two elections influences the vote tally by one vote. A citizen who votes in both elections and switches party preference, in contrast, removes one vote from the first party's tally and adds one to that of the second, shifting two net votes. The overall importance of these effects, however, depends on the number of citizens of each type.

Beliefs about the fraction of citizens of each type are likely to shape politicians' strategies while campaigning and governing (*1*–*3*). Those who believe that electoral change is driven by compositional changes are likely to focus on pleasing core supporters to mobilize them or on demobilizing would-be opponents. Those who believe electoral change stems primarily from conversion often focus instead on persuading likely voters who are ambivalent about the competing candidates.

Much of the existing research on the relative importance of conversion and composition addresses these questions only indirectly. For example, scholarship on stability in partisan preferences across elections generally finds high levels of party loyalty for high-profile offices that may be increasing over time (*3*, *4*). If few consistent voters change their minds, then composition may be more important than conversion (*5*). At the same time, other work focusing on the electoral impact of changing composition generally finds that marginal composition changes only alter candidate performance modestly (*6*, *7*). The relative balance of these factors might also vary with demographics. For example, older voters' turnout might be less variable, while white voters' preferences are sometimes more variable; for different reasons, vote switching may drive electoral change for both groups. Overall, there is considerable uncertainty about the relative impacts of conversion versus composition in explaining electoral change.

Substantial measurement challenges have limited research on this topic. The secret ballot—in which individual ballots are cast privately—prevents the observation of individual vote choices, hampering the observation of conversion. Residential mobility, newly eligible voters, and voters who exit the electorate combine with decentralized election administration to impede the observation of compositional changes.

Electoral change typically involves both composition and conversion. The two factors are likely correlated in any given pair of elections, as the rationale that compels some voters to switch sides might motivate others to turn out or abstain. It is also plausible that the relative weight of compositional shifts is increasing over time, as polarization and nationalization increase the share of voters firmly anchored to one party (*3*, *4*).

Researchers have often turned to survey data to measure individual-level turnout and vote choice. Although surveys circumvent the secret ballot with questions on individual vote choice, few follow individuals across multiple elections. Panel surveys attempt to track individuals over time, but even high-quality panels face recruitment and attrition issues that may produce biased estimates of the share of electoral change stemming from each factor. In particular, panel surveys

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are likely to overrepresent politically engaged citizens who consistently vote and have stable partisan preferences. As a result, they may understate the magnitude of changes from composition or conversion.

We suspect that these survey research challenges are one cause of the limited scientific understanding of electoral change. Here, we use an alternative data source to provide new answers about electoral change. We merge millions of administrative records of individual turnout across elections with precinct-level election returns, the lowest administrative unit at which election results are reported. While our data and strategy do not resolve all potential sources of error, they provide a valuable complement to survey-based estimates.

To measure changes in composition, we collect voter files maintained by election officials in six American states. These comprehensive lists of eligible voters enable us to measure which individuals voted in each of two elections, 2012 and 2016. To estimate conversion, we merge these individual-level turnout records with precinct-level election returns.

The advantage to this approach is that administrative records provide a comprehensive accounting of the inputs to electoral change, turnout, and vote choice. Their use mitigates the problem of selective recruitment and attrition in panel surveys. There are two notable costs to this approach. The first is challenges in merging records over time, while the second is the ecological inference problem—inferring patterns of individual behavior from aggregated records. We document our efforts at record linkage below. We do not claim to have solved the ecological inference problem. However, our use of small geographic units and varied states helps mitigate some biases. Overall, this paper complements other research by leveraging correlations in electoral change across precincts to offer estimates of the role of conversion and composition.

As a research setting, we consider electoral change in the United States from 2012 to 2016. The outcome of the 2016 U.S. presidential election surprised many, as Republican Donald Trump won several states that Democrat Barack Obama had won—often comfortably—4 years earlier. The result ignited debates about the sources of the surprise (*8*). It also highlighted the limited answers that political scientists have generated to date to a central question of electoral democracy: What are the causes of election-to-election shifts in vote totals for competing parties and candidates (*2*, *5*)?

Our collection of precinct-level returns and voter files comes from six states that cover 30,000 precincts and tens of millions of votes cast. We chose the six states—Florida, Georgia, Michigan, Nevada, Ohio, and Pennsylvania—on the basis of multiple criteria. We emphasized states that were closely contested in 2012 and/or 2016, for which we could obtain the necessary voter files and precinct returns, and which provided some indication of party preference in the voter file through party registration or records of party primary participation.

Our empirical analyses begin with descriptive and graphical summaries of the data to evaluate the observable implications of composition- versus conversion-driven processes of electoral change. We identify three key empirical tests. First, if electoral change is driven by compositional changes, then the magnitude of electoral change should be greatest in precincts with the most single-election voters and smallest in precincts with the most two-election voters. At the extreme, if electoral change is observed in precincts with no change in composition—meaning that the population of voters is identical in both elections—then electoral change must have occurred through conversion.

A second compositional mechanism might differentiate among precincts with many single-election voters. It is possible that a precinct can have very different compositions in two elections even though new voters have very similar vote preferences to exiting voters. A precinct on a college campus may be one such example. In these places, residential mobility coupled with partisan sorting in where people move may mean that voters leaving a community are replaced by like-minded voters. If partisan compositional change were driving electoral change, then stability alone would not be strongly associated with electoral change. Instead, we should observe that only precincts that experience larger net partisan changes in turnout among single election voters should, on average, have larger electoral changes.

Last, to the extent that composition drives electoral change, regression models that account for different kinds of compositional changes—both stability and net partisan change—should have more explanatory power in predicting changes in electoral outcomes. A defensible assumption underpinning some analyses is that partisan turnout differentials effectively capture candidates' turnout advantages.

In these six states, Trump's performance improved relative to the 2012 Republican candidate Mitt Romney in all but Georgia. Overall, we find that the balance of composition and conversion varies by state, but with clear indications that conversion more consistently explains pro-republican Party (GOP) electoral change between the two elections. Republicans did better in 2016 than in 2012 in precincts with highly stable compositions and even in many precincts where the balance of party registration among those who turned out shifted toward the Democrats. This implies that, even if the electorate had been held constant across elections, Trump would have done better in these states by meaningful amounts, all else equal.

Compositional change was also important in each state, but it was especially important in explaining electoral change in two of our six states. The average pro-Trump swing for each precinct in Nevada was 26 votes or 4.9 percentage points. In Georgia, the average precinct swung toward the 2016 Democratic candidate Hillary Clinton by 49 votes or 2.7 percentage points. In these two states, we estimate that compositional effects were 3 and 1.4 times larger than conversion effects. In the other four states, we estimate that composition effects were of smaller magnitudes than conversion effects. Conversion was especially relevant in the key battleground states of Michigan, Ohio, and Pennsylvania. In these states, Trump's improved performance over Romney was powered by voters who turned out in both elections but switched to the GOP, while the effect of compositional change is estimated to have benefited the Democrats.

Together, these findings indicate that while both compositional change and conversion were crucial to the unexpected GOP victory in 2016, conversion explains more of the observed electoral change than composition. Conversion is particularly important in the states with the largest swing in party margin between the two elections—Michigan, Ohio, and Pennsylvania.

MATERIALS AND METHODS

To date, work on electoral change has principally relied on opinion surveys to estimate the sources of electoral change. One alternative that addresses several concerns with survey-based inference is to use administrative records. If one can gather records for consecutive elections, then the compilation represents a nearly full accounting of both votes cast and changes in the electorate's composition.

While electorate-level totals provide only limited information because of the ecological inference problem, administrative jurisdictions report results at lower levels of aggregation such as the precinct. In general, election data at lower levels of aggregation reduce ecological inference problems by increasing unit homogeneity. They also provide substantial variation in compositional change, allowing researchers to estimate the average relationship between changing composition and election outcomes and therefore affording leverage to isolate conversion from composition.

Some research on composition and conversion using administrative data finds that conversion accounts for most of electoral change in presidential elections (*9*). Other work ascribes a greater role to changing composition in congressional elections (*2*). However, this work does not analyze as many states or precincts as we do here, raising questions about generalizability across time periods and places.

Generating precinct-level measures of composition is a substantial undertaking, explaining our focus on six states. For each state, we first acquired separate voter files from the periods just after the 2012 and 2016 elections. We then used registrants whose addresses were constant to evaluate any precinct-level boundary changes, and subsequently removed precincts where fewer than 85% of the fixed-address voters had the same precinct in both elections. This filter removes precincts with non-trivial boundary changes between elections. For Michigan, for example, it is 14%, while it is 7% for Nevada and 12% for Ohio. See the Supplementary Materials (SM) for details on dataset construction.

To characterize changes in composition, we match individual registrants from the 2012 to the 2016 voter file in each state. We classify each registrant observed in each precinct into 15 categories by registration presence (registered in the precinct in both elections, in 2012 only, or in 2016 only), political party (Democrat, Republican, or other), and turnout (turned out twice, in 2012 only, or in 2016 only). If a voter is registered in two separate precincts in the two elections, then he or she is counted as two different individuals. This choice likely leads to an overstatement of compositional effects, as consistent voters who move are classified as two separate single-election voters. However, residential stability is reasonably high: According to the American Community Survey, 1-year residential stability for these six states is no lower than 82% and is likely higher among registered voters.

For party affiliation, we use the most recent registration for the three states that register by party. Georgia, Michigan, and Ohio, in contrast, do not register by party, so we instead use the most recent presidential primary in which the voter cast a ballot. Voters who participated in either the 2012 or 2016 presidential primaries were classified as affiliated with the party of their most recent primary ballot, with the remaining registrants classified as not affiliated.

We separately compiled precinct-level election returns from the appropriate state and county-level election authorities for 2012 and 2016. We then merged precinct election returns to the individual voter file counts. We applied filters to remove precincts where there were large deviations between the number of votes recorded in the voter files and those recorded via election returns to minimize measurement error. In total, our dataset includes more than 28 million 2016 voters.

For analysis, we focus on measuring the extent to which differences in composition—measured with electorate stability or net partisan balance—explain precinct-level electoral change. The ecological inference problem prevents us from providing a full accounting of electoral change, so our research design is to identify key observable implications of the two different mechanisms and test for each empirically. We focus on three implications if composition were the primary driver of electoral change:

1) Precincts with little change in composition—i.e., both elections composed mostly of two-election voters—should have more limited electoral change.

2) Changes in the net party composition of single-election voters in each precinct should predict changes in the partisan vote margin in that precinct.

3) Multiple regression models of electoral change should find that changes in composition explain a large portion of electoral change.

Our primary measurement is vote totals and composition in absolute counts rather than proportions. Politically, candidates seek to maximize votes; thus, using counts as the primary measure captures the politically relevant construct and also accounts for differences in precinct size. We present tables and graphics using proportions in the SM.

RESULTS

We first summarize changes in election results and changes in composition. Table 1 reports each party's mean precinct vote total and mean partisan composition in counts by state (we present statistics for vote percentages in the SM). This presentation sets aside differences in turnout by nonpartisan voters. Because primary participation is a more error-prone measure of partisan affiliation, we begin our discussion with the party registration states of Florida, Nevada, and Pennsylvania.

The first column in Table 1 shows that in the average precinct in Florida, the Democrats gained 47 votes and the Republicans gained 84 votes from 2012 to 2016. In other words, Clinton received 47 more votes than Obama and Trump received 84 votes more than Romney in the average Florida precinct. The average Trump margin in 2016 was thus 37 votes greater than the average Romney margin. This represents our measure of electoral change: how much the Republican margin over the Democrat changed from 2012 to 2016. Note the importance of relative changes. While Clinton garnered more votes, on average, than Obama had in 2012, Trump improved by even more relative to Romney, making the Republican the net winner.

The subsequent rows of the table present our measures of change in partisan composition from 2012 to 2016. The average Florida precinct had 43 more registered Democrats and 55 more registered Republicans turn out in 2016 than in 2012. On net, the average precinct increased the relative Republican compositional advantage by 12 voters in Florida. However, the Republicans gained 37 net votes in the vote margin. Under the strong assumption that party of registration perfectly predicted vote choice, change in composition would account for 12 of 37 net votes of electoral change in Florida, or 32%.

Our next party registration state is Nevada, where Trump netted 26 votes in the average precinct in 2016 compared to 2012. Compositional change, by contrast, benefited the Democrats by four voters per precinct on average.

Last, in Pennsylvania, the Republican margin increased by 40 votes in the typical precinct. Change in electorate composition also benefited the Republicans, but with a net increase of just three registered Republicans turning out. Under the assumption of perfect correspondence between registration and vote choice, composition would explain about 8% of electoral change.

Table 1. Average precinct electoral and compositional change by state, 2012 to 2016. Cell entries in counts of votes. Turnout among nonpartisan voters not shown.

	FL	GA	MI	NV	OH	PA
Total precincts	4938	1494	3558	1499	7115	8457
Election results						
Mean Democratic votes 2012	782	654	509	332	305	327
Mean Democratic votes 2016	829	698	468	333	258	319
Difference Democratic votes	47	44	−41	1	−47	−8
Mean Republican votes 2012	773	760	478	290	301	286
Mean Republican votes 2016	858	755	537	317	320	318
Difference Republican votes	84	−5	60	27	20	31
Difference in difference votes	37	−49	101	26	67	40
Composition by party registration/primary participation						
Mean Democratic voters 2012	635	257	183	269	142	307
Mean Democratic voters 2016	678	291	255	280	150	326
Difference Democratic voters	43	34	72	11	9	20
Mean Republican voters 2012	613	521	283	241	232	243
Mean Republican voters 2016	668	522	357	248	244	265
Difference Republican voters	55	1	74	7	12	23
Difference in difference voters	12	−33	2	−4	3	3

Among our three states without party registration, in which we coarsely approximate party identification by primary turnout, the patterns roughly track those of the party registration states but with some additional variability. In Georgia, the Democrats improved on their 2012 margin in 2016 by an average of 49 votes, and the average net increase in their party composition advantage was 33 voters. In Michigan, the Republicans picked up 101 votes in the typical precinct on a net increase of only two voters in party composition. In Ohio, the Republicans gained 67 votes on a three-voter net change in composition.

Across the six states, the general pattern weighs strongly against party compositional change as a complete explanation for electoral change. In the typical precinct, change in the partisan composition of the electorate was not large enough to explain the change in the election margin. This suggests either that vote choice is not very well predicted by party registration/primary participation, that changes in turnout by nonpartisan voters are important, or that the other mechanism of electoral change—conversion—is driving much of the electoral change we observe. Results using vote and composition shares in the SM are mostly consistent with the results from counts. Comparisons between the two tables are complicated by the increase in third-party votes in 2016 relative to 2012.

Table 1 presented precinct-average changes by state. We now turn to precinct-level relationships between composition and electoral change.

One implication of composition-driven electoral change is that precincts with no change in composition should exhibit no electoral change. That is, if electoral change were entirely due to different voters turning out in the two elections, then we should observe no electoral change in a precinct with exactly the same voters in both elections. Extending the argument, if there are no two-election voters switching between the parties, then electoral change in the precinct should attenuate toward zero as the share of the electorate composed of these two-election voters increases. We thus evaluate the relationship between precinct-level compositional stability and electoral change.

To measure stability, we first calculate the total electorate size across both elections in each precinct. We then calculate the share of this total electorate composed of voters who voted in both elections. The larger this share, the greater the compositional stability.

A share of one indicates that the exact same set of voters participated in both elections, while zero means that no voter turned out in both elections. For example, if a precinct had 200 voters in 2012 and then 100 voters in 2016, and all 100 2016 voters had voted in that precinct in 2012, then stability is 0.50. This stability measure does not use information about partisan affiliation and therefore makes no assumptions about appearing and disappearing voters' vote choices.

Figure 1 presents the relationship between compositional stability and electoral change. Each point represents one precinct, with point shading corresponding to the density of precincts. The *x* axis measures stability in that precinct from 0 to 1, and the *y* axis is the net change in the precinct's Republican vote margin from 2012 to 2016 [(2016 GOP votes minus 2016 Democratic votes) minus (2012 GOP votes minus 2012 Democratic votes)]. The red line is a loess smoother of the relationship between the two measures.

Across states, average stability varies from 0.38 in Nevada to 0.61 in Ohio. Within states, Fig. 1 illustrates that electoral stability weakly correlates with electoral change—neither the means nor variances of electoral change vary to an important degree with electoral stability. At every value of stability in each state, there are some precincts with large net swings toward Trump and others with large net swings toward Clinton.

The loess smoother summarizes two other patterns that call into question a simple compositional account. First, on average, net GOP performance is generally positive for almost all levels of stability in five of the states, with the exception of Georgia. Second, there is no clear negative relationship between stability and the magnitude of electoral change. In Florida, Georgia, and Pennsylvania, GOP performance appears to increase with electoral stability.

In sum, this analysis suggests that conversion—the changing votes of two-election voters—is a likely component of electoral change. The GOP tended to gain (lose) votes roughly equally in places where the electorate was largely stable and where it changed substantially. We reach similar substantive conclusions when specifying the outcome as vote shares (see the SM).

While the stability analysis above evaluates a strong variant of the no-conversion hypothesis, this measure of stability might be missing important compositional dynamics. The large degree of dispersion in changes in vote outcomes for each fixed level of electoral stability apparent in Fig. 1 invites further explanation. In particular, precincts that are unstable with respect to turnout might still differ with respect to the vote choices of those who turn out only in one of the two elections. For example, imagine two precincts with large turnover in their electorates (i.e., low stability). In one, every 2012 Obama voter who stays home is replaced with a new 2016 Clinton voter. In the other, however, every 2012 Obama voter who stays home is replaced by a 2016 Trump voter. Our overall stability measure would indicate similarly large instability in both precincts, but the first precinct would have no electoral change while the second would have large-magnitude electoral change. In each case, composition would be an important part of the story that the nonpartisan compositional stability measure cannot distinguish.

To evaluate the importance of this partisan mechanism of compositional change, we consider how change in the composition of the electorate from 2012 to 2016 by party of registration (or party of most recent primary participation) explains electoral change in each precinct. To the extent that net partisan compositional changes drive electoral change, we should see a positive slope. If conversion effects were of small importance for electoral change, then the relationship of electoral change to change in composition would be strongly linear with little variability around the line. This analysis does not account for changes in turnout by registrants not coded as partisans; we address these voters in regression analyses below.

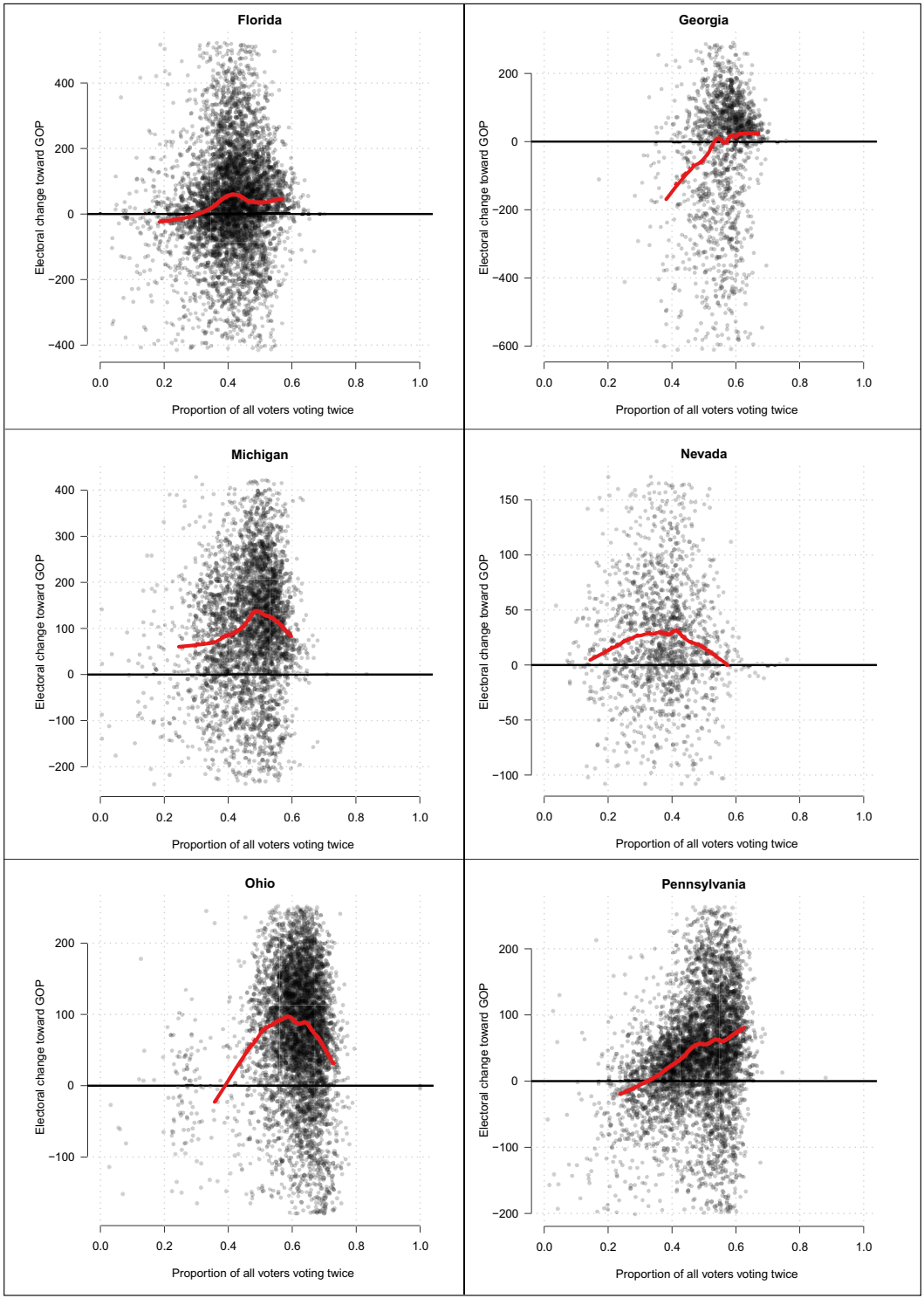
We plot this relationship in Fig. 2. For each state, the *y* axis measures the net change in the GOP vote margin from 2012 to 2016, just as in Fig. 1. The *x* axis measures precincts' net partisan composition change in turnout—[(2016 GOP registered voters minus 2016 Democratic registered voters) minus (2012 GOP registered voters minus 2012 Democratic registered voters)]. The higher this count, the more precinct-level composition shifted to the GOP's advantage in 2016. As before, points are shaded by precinct density, and we include a loess smoother to summarize the relationship. In the SM, we present a similar plot using shares instead of counts.

We find the expected positive relationship in each state, but with a great deal of variability around the slope and important differences in average electoral change. These average differences are easiest to observe by examining the slope and *y* intercept of the plotted smoother. For example, in Florida, the larger the net gain in turnout for the Republicans (higher values on the *x* axis), the greater the average increase in the Republican vote margin in the precinct. However, even in precincts where the net partisan composition is unchanged, Trump's vote margin improved relative to Romney's. In addition, the spread of precincts about the linear trend is large, implying that net partisan compositional change is not a complete explanation. Many precincts with net compositional change advantaging the Democrats still had net electoral change benefiting Trump, and many precincts with net compositional change advantaging the Republicans had net electoral change benefiting Clinton (the upper-left and bottom-right quadrants).

There is important cross-state variation in both average and spread. Florida provides the most linear and lowest-variability relationship, with a somewhat noisier pattern in Ohio, Nevada, and Pennsylvania. Georgia and Michigan exhibit more variable relationships between compositional and electoral change. In all six states, the typical precinct swings toward Trump. The loess trend shows that when net partisan compositional change is zero, Trump picks up votes, on average.

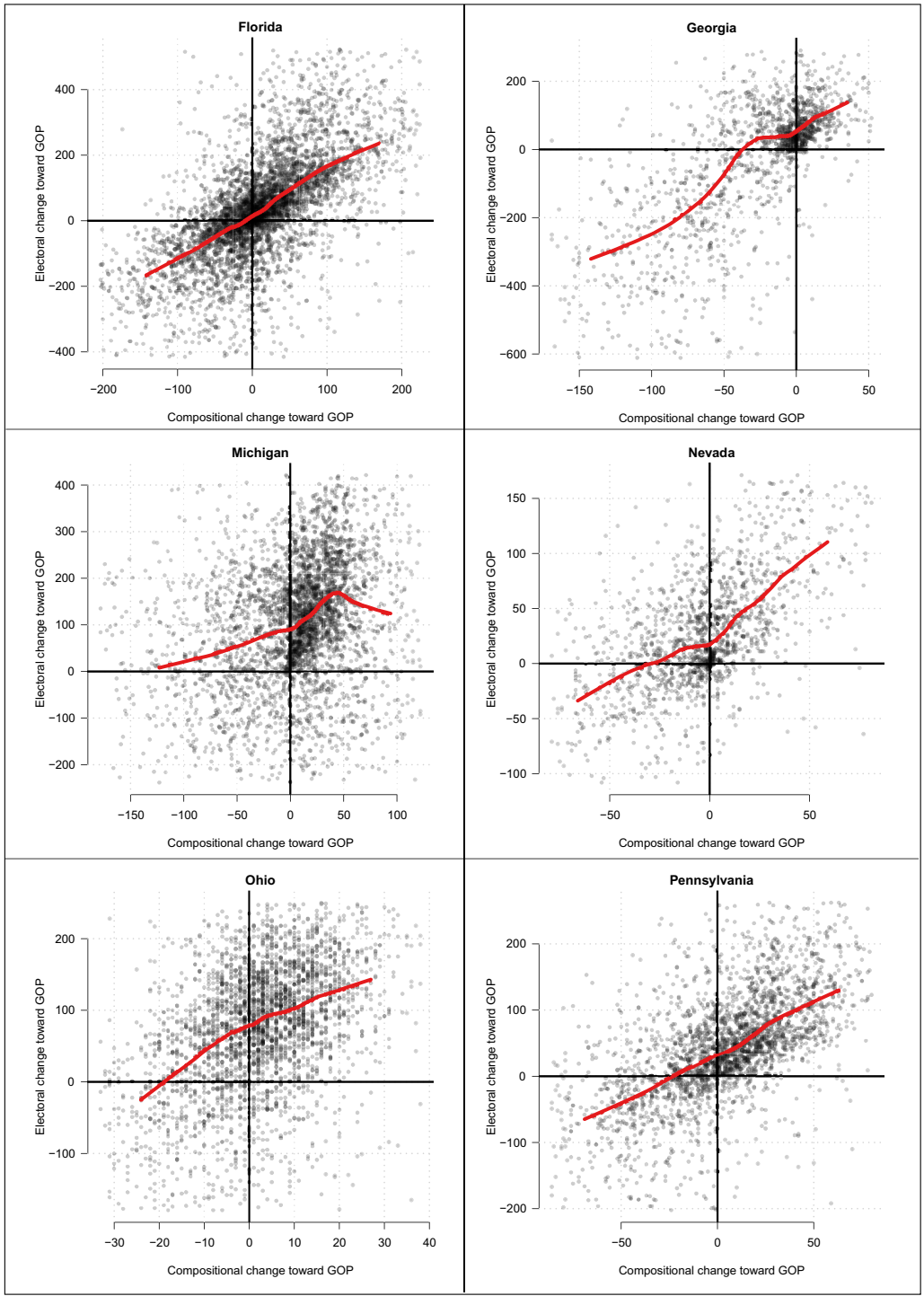
Across states, these patterns suggest that compositional change is not the sole driver of electoral change. Overall, our graphical analyses show that neither total compositional stability nor net party compositional change explains the observed variation in electoral change across precincts. These patterns imply that electoral change toward the GOP from 2012 to 2016 was unlikely to have been driven exclusively by changes in composition even though change in partisan composition played a role in each state. Next, we attempt a quantitative decomposition of the balance of composition and conversion.

We use regression analysis to estimate the relative importance of conversion and composition in explaining state-by-state electoral change. In broad strokes, these analyses exploit our measures of composition as predictors of precinct-level electoral change. Substantively, the key assumption underpinning these analyses is that our turnout measures capture the compositional element of electoral change and that any remaining shifts in vote totals can be attributed to conversion. The presence of states with partisan registration provides some leverage on this assumption, as those are states in which the turnout measures are likely to better capture partisan differentials.



Note: Limited to interior 95 percent of change in vote margin and 4,500 randomly selected points per plot. Line is loess smooth through interior 95 percent.

Fig. 1. Electoral change by stability in composition between 2012 and 2016. Limited to interior 95% of change in vote margin and 4500 randomly selected points per plot. Line is loess smooth through interior 95%.



Note: Limited to interior 95 percent of data and 4,500 randomly selected points per plot. Line is loess smooth through interior 95 percent.

Fig. 2. Electoral change by net change in partisan composition from 2012 to 2016. Limited to interior 95% of data and 4500 randomly selected points per plot. Line is loess smooth through interior 95%.

Such analysis provides all-else-equal comparisons accounting for a variety of net partisan composition measures as well as sampling uncertainty. These analyses assume that there are no omitted variables correlated with changes in composition and changes in election outcomes that operate through mechanisms other than turnout. As with all observational and ecological analysis, they also assume average homogeneity in the effects of changing composition. If there is heterogeneity in the compositional effects across precincts in offsetting directions, then our analysis that assumes homogeneity in these effects will tend to understate the cumulative effect of changing composition because average compositional effects will be biased toward zero.

We test the robustness of this homogeneity assumption by examining differences across subsets of more homogeneous precincts within states. Our belief is that the most likely threat to inference is differences in the behavior of groups of registrants across baseline differences in local partisanship, perhaps because of differences in shocks affecting voter preferences in different types of places. However, our robustness analysis suggests that the conclusions do not differ markedly across subsets of precincts defined by partisanship, a reassuring finding. Nonetheless, because we rely on naturalistic variation in both conversion and composition, we suggest caution in assuming that there are no sources of bias in our estimates.

Our primary specifications are models of vote margins measured in counts. We regress changes in the precinct-level Republican vote margin from 2012 to 2016 on variables that measure the changing composition of the precinct's electorate. We use nine variables that each count the number of changing voters in each distinct party–turnout registration category. The party categories are Democrat, Republican, and other. The turnout registration counts are the (i) change in turnout among those registered in both elections, counts of the (ii) 2012-only registrants who voted in 2012, and the (iii) 2016-only registrants who voted in 2016. These measures exhaust the categories that contribute to compositional change across the two elections by excluding registrants who never turn out and registrants who turn out twice.

This nine-variable specification allows greater flexibility in estimating the relationship between compositional change and electoral change than the net composition measure used in the graphics above. We also include a control for precinct size.

Our regression specification is

$$y_i = \alpha + \beta' x_i + \gamma z_i + \varepsilon_i \quad (1)$$

where i indexes precincts, y is the net change in Republican vote margin from 2012 to 2016, x_i is a vector of the nine composition counts, z_i is a scalar counting turnout in the precinct in 2012, and ε_i is an independent and identically distributed error. We estimate the model separately for each state.

We next use the parameter estimates of α, β, and γ to estimate the average influence of composition and conversion on electoral change. We calculate the effect of composition using the observed composition counts and the β estimates. For each measure of composition in x_i, we use the associated regression coefficient and the observed value of that measure in the precinct to calculate the estimated effect of that change in composition.

For example, if the estimated coefficient is −0.50 for the effect of each new Democratic registrant who voted in 2016, then that implies that three out of four new Democratic registrants voted for Clinton rather than Trump on average. If there were 100 new Democratic voters in a precinct, then we would estimate the effect of composition for this group on electoral change as $100 \times -0.50 = -50$. We sum this measure across all compositional categories in each precinct to calculate a net effect of compositional change and then calculate the average across all precincts statewide.

By contrast, to estimate the effect of conversion, we assume that all compositional change variables are zero, which means that we set all elements of x_i to zero (no change in composition between the two elections). We then use the parameter estimates of α and γ, along with the count of 2012 turnout z_i, to predict electoral change (conversion $\equiv \alpha + \gamma z_i$).

Table 2 presents our estimates of conversion and composition by state—for full results, see the SM. The first row is the observed average precinct-level electoral change toward the GOP. The second row presents the average estimate of the compositional effect using our ordinary least squares (OLS) estimator. It should be interpreted as the average number of votes picked up by Trump due to net changes in who turned out to vote. The third row is the estimated conversion effect. It should be interpreted as the average number of votes picked up by Trump due to changes in vote choice among people who voted in both elections (i.e., fixing changes in turnout at zero).

Last, the fourth row is the ratio of the estimated compositional effect to the estimated conversion effect. The ratio measures the relative magnitude (and direction) of the composition and conversion effects.

Table 2. Decomposition of precinct-level electoral change toward Republican candidate, 2012 to 2016. Sample mean is average change in vote margin for GOP, 2016 minus 2012; Composition effect is difference in predicted electoral change with composition variables as observed versus set to zero. Conversion is average electoral change less estimated composition.

	FL	GA	MI	NV	OH	PA
Average electoral change (sample mean)	37	−49	101	26	67	40
Estimated average composition effect	12	−160	−102	20	−29	−10
Estimated average conversion effect	26	111	203	6	96	50
Ratio of composition to conversion	0.5	−1.4	−0.5	3.0	−0.3	−0.2

To test the robustness of these results, in the SM, we present additional specifications for each state. We include a quantile regression estimating the conditional median to reduce the influence of outliers. We also estimate results dividing precincts into thirds by 2012 Republican vote share to account for possible heterogeneity in vote choice by precinct partisanship. This latter robustness check reduces concerns that omitted factors correlated with underlying precinct-level partisanship may also be correlated with differences in the vote choices of the different compositional groups that we include in our estimation model.

The first thing to note in Table 2 is that the estimated conversion effect is positive across all states. It ranges from a 6-vote net Republican gain in Nevada to a 203-vote gain in Michigan. That is, in all states, Trump is estimated to have improved on Romney's net performance above and beyond any effect of measured compositional change. The magnitude of this effect is smaller in Florida, Georgia, and Nevada—three highly diverse states in racial/ethnic terms—than in the three formerly industrial Rust Belt states. Conversion effects are similar in the quantile regression estimates in the SM, varying from an average 12 votes in Nevada to 195 votes in Michigan.

Second, there is a great deal of variability in the estimated direction and relative magnitude of the compositional effect. In Florida and Nevada, composition benefits the Republicans just as does conversion, on average. In the remaining four states, Democrats benefit from compositional change. In three of these four, conversion outweighs composition leading to electoral change toward Trump, but in Georgia, composition generates a net electoral change toward Clinton. Composition effects are again similar in the quantile regression estimates. Florida has a sign shift from 12 votes benefiting Trump under OLS to 1 vote benefiting Clinton with quantile regression, suggesting the OLS estimate is sensitive to outlying values.

Turning to relative magnitudes, in Florida, the compositional effect is 12 votes to the GOP, while the conversion effect is 26 votes. Conversion thus explains 68% (26 votes) of the observed average 37 vote-per-precinct Republican shift in electoral change. The relative magnitude of conversion and composition, however, is somewhat sensitive to model specification for Florida. With quantile regression, conversion explains 79% of electoral change.

The pattern in Florida is most similar to that in Nevada, where Trump did modestly better than Romney, at 26 net votes per precinct. Accounting for composition explains three times more electoral change than conversion, although the compositional effect is smaller when using quantile regression. In addition, conversion explains the entire average electoral change in the least Republican and more evenly balanced precincts.

In Georgia, the estimated negative composition effect entirely explains the GOP's reduced performance and is about 150% of the effect of conversion (the conversion effect is positive, while the observed average vote change is negative). This is true in all specifications and across all subsamples used in robustness tests.

By contrast, in the states of Michigan, Ohio, and Pennsylvania, compositional differences do less to explain electoral change, both because compositional differences are estimated to help the Democrats and because their absolute magnitudes are smaller. In Michigan, Trump nets 101 votes in the average precinct, but composition is estimated to have increased support for the Democrats by 102 votes so the estimated pro-GOP conversion effect is 203 votes. The absolute size of the composition effect is 50% of the conversion effect, a pattern true across robustness specifications in the SM.

A similar pattern is evident in Ohio. Accounting for composition does not explain Trump's 67 average net vote gain. The estimated pro-GOP conversion effect is larger than the average electoral change, implying both that observed composition differences on balance benefitted Clinton and that conversion was of huge net benefit to the GOP. In absolute magnitude, the composition effect is 30% of the conversion effect. Pennsylvania looks similar to Michigan with an even smaller role for composition, an important observation given that it registers voters by party. In the overall sample, the composition effect is only 20% of the size of the conversion effect.

Cumulatively, these estimates confirm the earlier graphical presentation that conversion is an important source of electoral change in these six states. They additionally provide a more precise understanding of magnitudes. Compared to conversion, the importance of net compositional change in explaining electoral change in five of these six states varies. Only in Nevada are compositional effects estimated to be larger than conversion effects. In Florida, the average effect of composition is less than half of the average conversion effect. However, in the other three states where electoral change benefitted Trump—Michigan, Ohio, and Pennsylvania—we estimate large-magnitude conversion to have been offset by smaller net Democratic shifts due to composition. It is noteworthy, too, that the effects of both conversion and composition dwarf the estimates of effects from specific campaign interventions such as persuasive canvassing or television advertising (*10*, *11*).

DISCUSSION

While partitioning voters into "base" and "swing" is undoubtedly an oversimplification, politicians, journalists, and scholars commonly use these heuristics when trying to understand electoral change. There is evidence that as a fraction of the American electorate, swing voters have declined in recent decades. But have swing voters gone extinct, or are they still capable of delivering changes in party control?

We suggested that difficulty in answering this question follows from difficulties in measurement. To complement existing approaches, we collected new measures of electoral change using administrative data on election results and turnout from six states. We used these records, covering tens of millions of voters, to evaluate the sources of electoral change in American presidential voting between 2012 and 2016. Across statistical models and graphical presentations, our results indicate that, while both compositional change and conversion were crucial to the unexpected GOP victory in 2016, conversion explains more electoral change than composition. The impact of conversion was sizable in the states of Michigan, Ohio, and Pennsylvania that saw especially large vote shifts toward the GOP. Even at a highly polarized time, conversion remains a central engine of electoral change.

Although our main result is evidence that both conversion and compositional change drive electoral change, we also uncovered important variability in the relative balance of these factors across states. In two of the six states—the ethnically and racially diverse states of Georgia and Nevada—we estimate compositional changes to have been of larger magnitude than conversion. In the remaining four states, conversion was of larger magnitude than composition. We also find that in four of the six states, composition and conversion favor different candidates. Conversion effects, however, are more often in the same direction as electoral change.

We take these results as important for two facets of our understanding of electoral politics. First, conversion seems to persist as an important source of electoral change. Converting one voter adds one vote to the candidate's tally while subtracting one vote from the opponent's, netting two votes to the margin. Mobilizing one voter adds only one vote to the margin. Our estimates suggest that despite the role of partisanship in explaining vote choices, a sizable number of voters do change who they vote for across elections.

Second, although electoral change at the presidential level often approximates uniform swing, the diversity of the country reflects a diversity in voting behavior. The magnitudes and directions of conversion and composition depend on the context of voters and candidates. Between 2012 and 2016, conversion was especially notable in states with larger white populations without a college degree, while composition was more notable in growing Sun Belt states.

SUPPLEMENTARY MATERIALS

Supplementary material for this article is available at http://advances.sciencemag.org/cgi/content/full/7/17/eabe3272/DC1

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