Has Mass Education Changed U.S. Politics?: A Look at Voter Turnout in the 50 States[1]

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Abstract

Have rising education levels produced a more politically engaged citizenry? Educational attainment is associated with a higher likelihood of voting among individuals, but scholars remain unsure whether education causes individuals to vote or proxies for relative social class advantages that encourage participation. I turn to an aggregate-level test of the relationship. If education causes individuals to vote, then population-level gains in educational attainment over time should be associated with increases in voter turnout. I analyze data from the 50 states and District of Columbia from 1980 to 2020. I find that voter turnout in presidential and midterms elections increased most in the states where college-educated populations grew most quickly, while turnout held steady in states where educational gains were more modest. Analysis from county-level data yields similar results. The findings are consistent with theories positing education as a cause of voting behavior. They raise important normative questions about educational attainment and political inequality in the U.S.

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Have population-level increases in educational attainment over time produced higher turnout in national elections? The positive association between educational attainment and voting is canonical in the literature on U.S. political behavior (e.g. A. Campbell et al. 1960; Converse 1972; Leighley and Nagler 2014; Lewis-Beck et al. 2008; Wolfinger and Rosenstone 1980). but social scientists have raised serious doubts that education *causes* students to become habitual voters later in life. Educational attainment may instead reflect pre-adult factors that cause individuals both to participate in politics and pursue higher education (Aarøe et al. 2021; Kam and Palmer 2008; Persson, Lindgren, and Oskarsson 2016; Tenn 2007). Alternatively, educational attainment might proxy for social position, since education confers social status and status helps individuals compete successfully in political arenas (Nie, Junn, and Stehlik-Barry 1996; Persson 2011, 2013a; Tenn 2005). While it remains unresolved how much the content of education is responsible for political participation, some micro-level evidence points to the conclusion that education exerts *some* causal effects (Dee 2004; Mayhew et al. 2016; Milligan, Moretti, and Oreopoulos 2004; Sondheimer and Green 2010).

Despite a richness of evidence using individual-level data, evidence for the relationship between education and voting has remained rare at the aggregate level of analysis. The straightforward expectation derived from the education-as-cause explanation—commonly referred to as the "absolute education model"—is that as the average educational attainment of Americans increases over time, turnout in national elections should increase. Where aggregate-level data has been analyzed, the results have contradicted the absolute education model. Brody (1978) first pointed out this puzzle, showing that turnout in presidential elections had declined in the mid-20th Century as educational attainment had risen for decades. Franklin (2004) describes a similar pattern in European democracies—turnout remained flat as education levels rose in those

nations (see also Gallego 2010). In fact, this contradiction between expectations and findings at the aggregate level helped inspire the "relative education" or "sorting" model of education (Nie, Junn, and Stehlik-Barry 1996) and several responses and refinements (D. E. Campbell 2009; Helliwell and Putnam 2007; Persson 2011, 2013a; Tenn 2005).

In this paper, I reexamine the aggregate-level relationship between educational attainment and voter turnout in the U.S. using more recent data. I conduct an analysis of turnout in presidential and midterm elections in the 50 states and the District of Columbia between 1980 and 2020. While aggregate educational attainment rose in all states over that period, both absolute attainment levels and rates of increase varied across states. Using a variety of modeling strategies, I provide evidence that increases in mass educational attainment within states have been associated with over-time increases in both presidential and midterm turnout over the last 40 years. The size of the association is meaningful. On average, a 10-point increase in the percent of state residents holding a college degree is associated with a 9.5-point increase in presidential election turnout in the preferred specification, controlling for potential confounders. I conduct further tests using county-level data. While the results from county data are more mixed, on balance they support the state-level findings.

The findings here call into question a widespread assumption in the education literature that over-time increases in education have not yielded increases in turnout. While that may have been true during the middle of the 20th Century, this analysis suggests instead that the relationship has changed. Future research should seek to explain why. Social scientists have questioned whether the relative education model applies to all forms of participation or whether voting is sufficiently different from other types of participation to merit its own theorizing (D. E. Campbell 2009; Nie, Junn, and Stehlik-Barry 1996; Persson 2011). This study finds evidence

consistent with arguments that the relative education model does not apply to voting behavior in the U.S. The results have important normative implications. While they suggest that efforts to increase educational attainment in the population have promoted citizen engagement, they also invite questions about whether institutions of higher education, to which access is highly unequal, should remain significant venues of political mobilization in the U.S.

Higher Educational Attainment and Voter Turnout

Few would dispute that people with higher levels of education are more engaged in politics. Educational attainment was identified as a key predictor of voting in early survey work (A. Campbell et al. 1960; Wolfinger and Rosenstone 1980) and remains one of the most important explanatory variables in contemporary research (Leighley and Nagler 2014; Lewis-Beck et al. 2008). In addition, the highly educated are more likely to participate in other ways like becoming informed about politics, attending public meetings, and donating to campaigns (Delli Carpini and Keeter 1996; Nie, Junn, and Stehlik-Barry 1996; Schlozman, Brady, and Verba 2018). With regards to political participation, Converse (1972) famously called education "the universal solvent."

It remains an open question why more educated individuals—and college graduates in particular—vote at higher rates. The leading explanation is that education endows students with certain kinds of human capital that empower them to vote. One form of human capital is political knowledge. A general education does not necessarily produce greater political knowledge (Highton 2009), but civics instruction in particular could give students the kinds of knowledge necessary for voting (Campbell and Niemi 2016; Galston 2004; Niemi and Junn 1998; though

see Manning and Edwards 2014). Enrollment in college-level social sciences courses, in which political knowledge is likely to be transmitted, is associated with higher turnout (Hillygus 2005; Paterson 2009).

Beyond informational content, formal education may help students develop skills applicable to voting. Verbal skills—important for communicating, articulating positions, and learning—acquired through schooling predicts voting later in life (Condon 2015). "Civic skills" acquired through organizing peers, presenting information, and taking responsibility for collective endeavors—for which there are ample opportunities in educational institutions—are further associated with increased participation (Beck and Jennings 1982; Verba, Schlozman, and Brady 1995). Teaching psychosocial skills like grit to young students may also increase their likelihood of participation later in life (Holbein 2017).

A second set of explanations concerns socialization into a culture of participation in educational institutions. High schools, colleges, and universities often function as loci of political mobilization, whether through voter registration drives or student organization by parties and interest groups. Institutions themselves encourage their students to participate through internal communications to students and on-campus initiatives. Students exposed to politics in educational environments can come to internalize the message that they can or should vote and carry that understanding into adulthood. Students who attended high schools with more active civic cultures are more likely to vote and participate later in life (D. E. Campbell 2006). Likewise, college graduates are more likely to have internalized the idea that voting is a civic duty and act accordingly (Hansen and Tyner 2021).

Challenges to the Absolute Education Model

Human capital accumulation and socialization happen in educational institutions, and thus are proposed mechanisms for the "absolute education model"—the idea that education itself can explain the association between attainment and voting. However, some scholars instead suspect the association reflects either pre-adult factors or post-education social position (see Persson 2013b). Pre-adult factors focus on selection effects; individuals who would have been more likely to vote anyway are the same individuals who choose to go to college. Parents who are highly educated and civically engaged may impart those values of participation onto their children independently of schooling (Gidengil, Wass, and Valaste 2016; Verba, Burns, and Schlozman 2003). Individuals with greater cognitive ability or a genetic predisposition to intelligence might select into both participation and education (Aarøe et al. 2021; Denny and Doyle 2008).

The social positioning that occurs after graduation is the subject of the "relative education" or "sorting" model (Nie, Junn, and Stehlik-Barry 1996). The model holds that education and participation correlate not because education confers human capital, but because it confers social status. Higher-status people, relative to the people in their immediate social environment, are more likely to participate in competitive political environments. Because status is relative—only a small proportion of the population can hold markers of status before those markers lose their luster—the model helped to explain why participation in politics declined in the middle of the 20th Century even as educational attainment grew.

. The relative education model provides an important insight into political participation and helps to explain trends in a number of competitive electoral activities. Yet, the evidence is mixed that it can explain voting behavior in the U.S. (D. E. Campbell 2009; Helliwell and

Putnam 2007; Tenn 2005). As Campbell (2009, 774) notes, "there are strong theoretical reasons to expect that voting is not subject to education sorting"—namely, that voting is often motivated by self-expression or a sense of civic duty, and is therefore less likely to reflect a zero-sum competition for social status. Nonetheless, studies conducted in European democracies have found support for the model (Persson 2011, 2013a).

Moving to Aggregate-Level Analysis

Rather than contribute another micro-level study to the question of whether educational attainment causes individuals to vote or proxies for other factors, I return to the aggregate level of analysis. I ask whether Brody's (1978) observation that turnout levels held steady as education levels increased remains valid. There are good reasons to revisit it now. Brody's puzzle helped inspire the influential relative education model (Nie, Junn, and Stehlik-Barry 1996) and continues to influence the literature on education and participation.[2] Yet, more than 40 years have passed since the time of his writing and its main finding relied on less than 30 years of data from the American National Election Studies (ANES). It is possible the direction of the relationship has changed since then. As Franklin (2004) notes, any effects of mass education might take several decades to manifest in aggregate-level data as younger, more-educated generations replace older, less-educated generations. Burden (2009) showed that the size of the individual-level association between educational attainment and voting at the individual level increased after 1980 in the U.S. Revisiting the observation now can help contemporary scholars determine whether to build upon existing scholarship, which has assumed a null relationship over time, or chart new directions in studying the relationship between education and voting.

[2] A search of Google Scholar (conducted 7/30/2021) reveals 398 citations to the work over time, including 57 in the last five years.

In what follows, I focus on retesting the absolute education model at the aggregate level of analysis. Looking here can help provide new evidence resolving the question of whether higher education offers broader benefits to society or particularistic benefits for only the individuals who attend. If higher education has causal effects on turnout over time, then those effects should appear in aggregate-level data. However, if higher education acts as more of a sorting mechanism, conferring degrees only on those individuals most likely to have been active in the political class anyway, then we may expect to see no change in turnout over time (Nie, Junn, and Stehlik-Barry 1996).

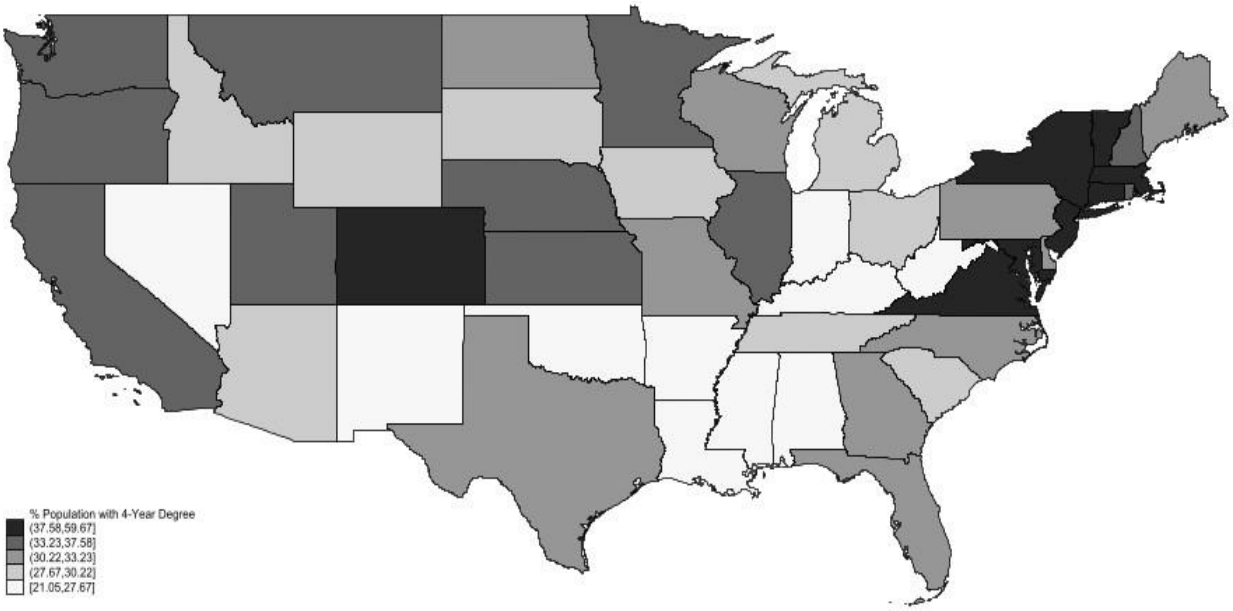
I turn to an over-time comparison of voter turnout in the 50 states and the District of Columbia. If obtaining higher levels of education causes individuals to vote more frequently, we should expect to see that turnout increases within states over time as their populations become more educated on average. This strategy allows me to leverage variation in aggregate-level educational attainment to understand changes in turnout. Though higher educational attainment has risen in all states since the 1940s, it varies at absolute levels across states and has increased more quickly in some states than others. The states have well-defined, stable boundaries, allowing for comparison over time. Moreover, states are involved in funding and administering higher education programs for their residents. As a result, state borders are more than arbitrary lines that divide the country into smaller segments, but rather meaningful divisions that produce disparities in educational outcomes through varying policy choices. Finally, a comparison of the states holds constant potential confounding factors like national political context, election timing, and (in presidential elections) the candidates on the ballot.

Data

I compile state-level data from a wide variety of sources. As the dependent variable, I use turnout rates among the voting eligible population (VEP) in each state provided by the United States Elections Project (McDonald 2021). State-level data are available for presidential and midterm elections between 1980 and 2020. As the main independent variable, I use the percent of each state's residents over age 25 holding at least a four-year college degree, available from the U.S. Census. College graduation stands today as a rite of passage into the middle class, and is associated with a variety of positive economic and social outcomes (Mayhew et al. 2016). It also effectively distinguishes educational attainment across states; the proportion of college graduates varies more widely than the proportion of high school graduates (over 90% in most states). Data are available decennially dating back to the 1940 Census and annually beginning in 2006 from the Census Bureau's American Community Survey. Using the full range of available data, I interpolate missing state-years of educational attainment to make more precise state-year matches with each election.

It should be noted that this measure does not distinguish how the population came to earn their degrees. The college-educated population in a state could increase either from sending young residents to college or from attracting college-educated workers to emigrate to the state. Therefore, this analysis can only speak to the effect of gaining college-educated residents, rather than the effect of sending more higher numbers of young people to college. However, because

Figure 1: College Degree Attainment by State, 2019



Notes: Data from the U.S. Census and the American Community Survey. Not pictured are Alaska (30.19%) and Hawaii (33.63%).

the share of college-educated residents increased significantly in all states during the period of observation, we can rule out that any association we see is driven exclusively by the displacement of the college-educated across state borders.

Figure 1 shows the cross-sectional variation in educational attainment by state in 2019.[3] College education rates ranged from 21.1% in West Virginia to 59.7% in the District of Columbia, with 32.3% of residents of the median state (North Carolina) holding college degrees. Educational attainment today differs sharply from prior decades. In 1980, college attainment rates ranged from 10% in West Virginia to 28% in the District of Columbia, with 15.8% of

[3] Because detailed state-level data from the 2020 Census has been slow to be released, I use 2019 data for all 2020 observations until more recent data becomes available.

residents of the median state (Idaho) holding college degrees. In terms of growth, the average state has roughly doubled the proportion of its resident holding a four-year degree. Alaska experienced the slowest growth (43% increase) and Pennsylvania the fastest (137% increase).

I test the hypothesis that rising college attainment rates are associated with rising turnout within states over time. For the main models I utilize OLS regression models with state fixed effects, though as I discuss further below, results are largely robust regardless of model choice. State fixed effects (FEs) remove from the equation unobserved, time-invariant confounders that might predict differences in turnout across states (e.g. state culture). However, state FEs do not account for potential time-varying confounders. Therefore, I estimate models with several time-varying controls.

I include indicators for whether a governorship or U.S. Senate seat are on the ballot in a given election year since these elections can command greater attention and drive turnout (*Governor on Ballot* and *Senator on Ballot*). I control for two-party competition because more competitive elections can also promote turnout. *Competitiveness* is measured as the absolute value of the difference in vote share between the Democratic and Republican nominees in the most recent presidential election; smaller values indicate greater competition. I control for the presence of labor unions because unions work to mobilize both members and nonmembers to vote (Leighley and Nagler 2007). *Union Density* is measured as the percent of state residents who belong to a labor union in a given year (Hirsch and Macpherson 2003). I control for each state's *Unemployment Rate* because higher unemployment tends to mobilize voters against incumbents (Burden and Wichowsky 2014). I draw data from the Bureau of Labor Statistics. Despite a closing turnout gap between black and white voters over the last half century, minorities continue to vote at lower rates than whites (Fraga 2018). I control for the percent of

state residents identifying as white, black, and Hispanic using data from the U.S. Census Bureau and American Community Survey.[4] Finally, to correct for autocorrelation in repeated observations of turnout, I control for *Lagged Turnout* in the most recent presidential (midterm) election. Full descriptive statistics for all variables are presented in Table A1 of the appendix.

Results

Table *1* presents results for both bivariate and fully specified models of turnout in presidential and midterm elections. I model the two types of elections separately given wide difference in turnout rates for each. Evidence in support of the main hypothesis would come in the form of a positive coefficient estimate for the measure of educational attainment, *College*.

In line with the hypothesis, the association is positive and statistically significant in all models.[5] Beginning in the first column, the model suggests that bivariate association is large, with a one-point increase in college attainment yield a 0.6-point increase in voter turnout. Adding controls in the second model only serves to enhance the size of the association, with a one-point increase in attainment yield a 0.95-point increase in voter turnout. While small at first glance, such an association amounts to a substantial increase in turnout over time. A one-point increase in college attainment is roughly half the size of the average four-year growth in attainment across states. Recall that the median state moved from a college-attainment rate of

[4] As with the measure of college degree attainment, I use precise state-year estimates when available from the American Community Survey from 2006 to 2019. I interpolate state-year estimates between the decennial Census years for 1980 to 2006.

[5] Data include all years from 1980 to 2020 in models 1 and 3 and all years 1984 to 2020 in models 2 and 4 given the lagged dependent variable. Elections in 2018 and 2020 were notable for their historically high turnout—in both cases, higher than any election in roughly 100 years. Removing these elections from the data does not alter the conclusions.

Table 1: State Educational Attainment and Voter Turnout

	Presidential		*Midterm*	
	(1)	(2)	(3)	(4)
College	0.60*	0.95*	0.27*	0.93*
	(0.06)	(0.13)	(0.07)	(0.18)
Governor on Ballot		3.22		-7.06*
		(2.00)		(0.67)
Senator on Ballot		0.39		2.13*
		(0.31)		(0.47)
Competitiveness		-0.03		0.02
		(0.02)		(0.03)
Union Density		0.04		0.53*
		(0.14)		(0.24)
Unemployment Rate		0.81*		-0.19*
		(0.09)		(0.09)
% White		0.88*		0.46
		(0.27)		(0.24)
% Black		1.08*		1.19*
		(0.32)		(0.30)
% Hispanic		0.76		0.20
		(0.38)		(0.35)
Lagged Turnout		0.23*		0.08
		(0.05)		(0.07)
Constant	44.54*	-66.52*	36.53*	-34.94
	(1.48)	(27.77)	(1.65)	(24.25)
N	561	510	509	458
R-squared (Within)	0.40	0.57	0.06	0.22
Clusters	51	51	51	51
State FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
* p<0.05

15.8% in 1980 to 32.3% in 2020, an increase of 16.5 points. The result suggest that growing attainment in the median state would be associated with a 15.7-point increase in presidential election turnout over this period, controlling for other factors in the model. Results for midterm elections tell a similar story. Though the bivariate association between attainment and turnout is smaller (0.27), the size of the association in the fully specified model in column 4 is comparable to that for the fully specified presidential model in column 2.

Though the state FE model specification allows me to compare the relationship within states over time, it could reasonably be modeled in other ways accounting for TSCS nature of the data. In Tables A2 and A3 in the appendix, I present the results from a series of alternative specifications, including pooled OLS regression (with and without a lagged dependent variable), state random effects (RE), and two-way fixed effects (TWFE) for states and year. Across all specifications, the coefficient estimate for the attainment variable is positive and statistically significant, with estimates ranging from 0.36 to 0.86.

Another potential approach to modeling the relationship comes from the logic of difference-in-differences (DiD) designs. A large number of time periods in the data and the use of a continuous independent variable make implausible the modeling assumptions a true DiD design would require. However, changes in turnout could be modeled as a function of changes in educational attainment. Focusing narrowly on short-term changes between election cycles ties turnout trends more closely to education trends and better controls for unobserved confounders.

I present the results of this specification in Table *2*. If anything, the results of this specification suggest a stronger relationship between attainment and turnout than the cross-sectional models in Table *1*. The bivariate model in the first column suggests that a one-point increase in college attainment over four years is associated with a 2.37-point increase in turnout over the previous presidential election. The estimate is similar once a full set of controls is added in the second column. For midterm elections, an even stronger association is suggested in the bivariate model in the third column, though the association diminishes once controls are added in the fourth column. Table A4 in the appendix also presents these results under alternative specifications. While the association remains robust in a pooled OLS regression model, it is not found to be statistically significant in a TWFE model. With a few exceptions, the results are

Table 2: Change in State Educational Attainment and Change in Voter Turnout

	Presidential		*Midterm*	
	(1)	(2)	(3)	(4)
Δ College	2.37*	2.45*	3.54*	2.26*
	(0.43)	(0.51)	(0.76)	(0.91)
Governor on Ballot		-0.16		-1.07*
		(0.38)		(0.53)
Senator on Ballot		0.23		4.08*
		(0.48)		(0.73)
Competitiveness		0.00		0.02
		(0.02)		(0.04)
Union Density		-0.46*		-0.21
		(0.10)		(0.11)
Unemployment Rate		0.56*		-0.58*
		(0.08)		(0.19)
% White		0.46*		0.01
		(0.12)		(0.16)
% Black		0.74*		0.45*
		(0.16)		(0.21)
% Hispanic		0.36*		0.26
		(0.15)		(0.24)
Constant	-2.90*	-46.02*	-5.20*	-7.16
	(0.73)	(11.54)	(1.27)	(15.46)
N	510	510	458	458
R-squared (Within)	0.06	0.12	0.07	0.20
State FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
* p<0.05

consistent with the idea that over-time growth in educational attainment has yielded over time increases in voter turnout.

The elections in 2018 and 2020 saw historic increases in voter turnout, in both cases shattering century-long records. The associations observed in these models are somewhat, but not solely, driven by those outlier elections. Restricting the data from 1980 to 2016, as I do in Table A5 of the appendix, the results continue to show a positive relationship between education and turnout for presidential elections. The size of the association is marginally reduced in the

models with and without controls, but still statistically significant. For midterms, the model without controls shows a null relationship, but the association remains positive and significant when controls are included.

County-Level Analysis

While the evidence above is generally consistent that increasing educational attainment within states is associated with increasing turnout, it is vulnerable to the criticism that the chosen unit of analysis is, at some level, arbitrary. In other geographic aggregations of individuals, we may not observe the same relationship between educational attainment and voter turnout. Therefore, I conduct further analysis using county-level data. If we observe a similar relationship within counties as in states, we can be reasonably more confident that the relationship is robust to the choice of unit of analysis.

I rely upon county-level data on voter turnout between 1976 and 2008 from Burden and Wichowsky (2014), which extended original data from Gomez, Hansford and Krause (2007). I further extend the data set to 2020. I limit the analysis to bivariate relationships between turnout and educational attainment for presidential elections only.[6] Unfortunately, measures of turnout using VEP are not available over all counties for this time period. Instead, I rely on voting age population (VAP) measures.[7] I include county fixed effects and present results both unweighted and weighted by county population. Table A6 in the appendix provides summary statistics.

[6] Future iterations of this paper will include controls in the county-level model. All controls in Table 2 are available at the county level except for *Union Density*.

[7] To extend data from 2008 to 2020, I relied upon county-level presidential election returns data from the MIT Election Data and Science Lab (2018) and Census Bureau estimates of the Citizen Voting Age Population (CVAP) by county. I calculate turnout by dividing the number of presidential votes cast in the county by the CVAP estimate.

Table 3: County Educational Attainment and Voter Turnout

	DV: Turnout		*DV: Δ Turnout*	
	Unweighted	Weighted	Unweighted	Weighted
College	0.08*	0.25*		
	(0.02)	(0.03)		
Δ College			0.18*	-0.04
			(0.06)	(0.29)
Constant	57.17*	50.53*	-0.25*	0.53
	(0.24)	(0.60)	(0.07)	(0.48)
Observations	34,099	34,098	31,003	30,998
R-squared	0.00	0.74	0.00	0.05
County FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
* $p<0.05$

Table 3 displays the results. The first two models rely on cross-sectional data tracking the association between college degree attainment and turnout. In both, we see a statistically significant and positive relationship, though the sizes of the associations are notably smaller than in the state-level results. The third and fourth models use the more stringent specification, modeling four-year change in turnout as a function of four-year change in college attainment rates. Here the evidence is mixed. The unweighted model suggests a positive and significant, but modest, association between turnout and attainment. However, the weighted model estimates a negative relationship, though the estimate is not statistically significant.

As before, I present results from alternate model specifications in the appendix. Table A7 shows a consistent positive and significant association between attainment and turnout in the cross-sectional data in pooled (with and without a lagged dependent variable), random effects, and two-way fixed effects models. Table A8 in the appendix shows models in which change in turnout is modeled as a function of change in educational attainment over four years. Using

pooled observations, the relationship is positive and statistically significant. However, when two-way fixed effects are employed, the association is signed positively but not significant.

These county-level findings are more mixed than the state-level findings, though suggest a positive relationship between attainment and turnout on balance. The differences in findings may be explained by the absence of controls or by use of a differing measure of turnout (VAP instead of VEP). Future iterations of this paper will include county-level controls to test further the robustness of the results.

Discussion

As states saw increases in the proportion of their citizens holding college degrees since 1980, turnout in presidential and midterm elections increased. Though educational attainment grew in all states, those states with the quickest gains in education saw the largest increases in turnout. Evidence from counties shows a similar pattern, but the results are more mixed. On the whole, the findings are consistent with the predictions of the absolute education model.

The results raise questions about whether the relative education model accurately characterizes voting behavior in the U.S. If true, we should expect to see no gains in turnout over time as attainment increased, as scholars observed in the middle of the 20th Century. As some authors including Nie, Junn, and Stehlik-Barry (1997) have noted, voting has expressive and symbolic motivations, not competitive motivations alone. This could explain the mixed results supporting the relative education model as applied to voting across subsequent studies (D. E. Campbell 2009; Helliwell and Putnam 2007; Tenn 2005). However, the results here cannot speak to how well the relative education model characterizes forms of political participation besides voting.

This study comes with some notable limitations. The analysis shows an association between education and turnout over time, but it is not causally identified. Fixed effects models offer a more robust research design than cross sectional analysis alone, but cannot ultimately overcome concerns about confounding (see Imai and Kim 2021). Methodological research on identifying the causal effects through two-way fixed effects and difference-in-difference designs are rapidly evolving. Once settled, new methods could be employed to verify the findings in the present analysis. For one example, Callaway et al. (2021) present in an unpublished manuscript a framework for estimating ATT effects for continuous variables in a DiD framework. Imai, Kim, and Wang (2021) present a matching framework using TSCS data with binary treatment variables with plans to generalize the framework to continuous treatment variables in the future.

The results are likely peculiar to the U.S. in the last half century. There are upper bounds on the percent of the population that can participate in an election. As a consequence, the upward trends observed here could not continue indefinitely after universal turnout in elections is reached. However, the rising wave of educational attainment in the last four decades seems to have manifested in increased voting over time, other downward pressures on turnout notwithstanding. The findings should also be considered as limited to the United States. Persson (2011, 2013a) presents evidence that the relative education model explains voting behavior well in European democracies. As Gallego (2010) points out, varying electoral rules and the presence of other kinds of mobilizing institutions likely explain why turnout has not risen with educational attainment in other Western democracies.

That turnout has increased with rising education levels sheds light on the nature of inequality in political participation in the U.S. On the one hand, reformers could interpret the results to suggest that increasing access to higher education for young people will produce

positive, downstream consequences for participation. Activists may champion policies like increased higher education spending or greater subsidy of student tuition using arguments that education encourages more citizen engagement in the political system. On the other hand, the findings highlight the unique intertwining of education and participation in the U.S. One can look beyond U.S. borders (and occasionally within the U.S.) to find examples of political institutions, like unions or party organizations, that successfully mobilize turnout among citizens without college degrees (Gallego 2010). Roughly two thirds of American adults still do not hold a four-year college degree, and college still remains financially out of reach of millions of young Americans. Activists interested in increasing mass political participation and reducing political inequality might instead focus their attention on these alternative institutions to encourage turnout.

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APPENDIX

Table A1: Summary Statistics for State-Level Data

	(1) N	(2) Mean	(3) SD	(4) Min	(5) Max
Turnout	1,070	51.39	11.28	20	79.60
College	1,071	24.22	7.022	10.40	60.41
Governor on Ballot	1,071	0.458	0.498	0	1
Union Density	1,071	13.37	6.594	1.600	38.30
Senator on Ballot	1,071	0.652	0.477	0	1
Competitiveness	1,071	15.65	13.58	0	86.80
Unemployment Rate	1,071	5.948	2.101	2.100	15.50
% White	1,071	75.16	16.46	21.54	98.52
% Black	1,071	10.66	11.47	0.220	69.74
% Hispanic	1,071	7.923	9.078	0.450	49.26
Δ Turnout	968	0.959	5.888	-21	21
Δ College	1,071	1.728	0.655	-0.340	5.430

Table A2: Alternative Specifications of Presidential Election Turnout

	(1) Pooled	(2) Pooled w/ Lagged DV	(3) RE	(4) TWFE
College	0.82*	0.46*	0.86*	0.61*
	(0.03)	(0.04)	(0.09)	(0.20)
Governor on Ballot	-1.79*	-0.97*	0.59	4.19*
	(0.54)	(0.47)	(1.43)	(1.80)
Senator on Ballot	0.42	0.42	0.39	0.29
	(0.44)	(0.38)	(0.29)	(0.18)
Competitiveness	-0.11*	-0.06*	-0.06*	-0.05*
	(0.02)	(0.01)	(0.03)	(0.02)
Union Density	-0.01	-0.05	0.07	0.17
	(0.04)	(0.03)	(0.07)	(0.13)
Unemployment Rate	0.91*	0.65*	1.00*	0.69*
	(0.12)	(0.10)	(0.11)	(0.14)
% White	0.25*	0.11*	0.28*	0.17
	(0.03)	(0.02)	(0.05)	(0.25)
% Black	-0.09*	-0.04	-0.01	0.09
	(0.03)	(0.03)	(0.06)	(0.31)
% Hispanic	-0.05	-0.04	0.07	0.21
	(0.04)	(0.03)	(0.07)	(0.35)
Lagged Turnout		0.55*		
		(0.03)		
Constant	18.31*	6.41*	10.96	21.46
	(2.90)	(2.58)	(6.08)	(24.92)
Observations	561	510	561	561
R-squared	0.58	0.72	0.55	0.71
State RE	No	No	Yes	No
State FE	No	No	No	Yes
Year FE	No	No	No	Yes

Standard errors in parentheses

* p<0.05. Robust standard errors for models 3 and 4.

Table A3: Alternative Specifications of Midterm Election Turnout

	(1) Pooled	(2) Pooled w/ Lagged DV	(3) RE	(4) TWFE
College	0.47*	0.36*	0.56*	0.68*
	(0.05)	(0.05)	(0.10)	(0.23)
Governor on Ballot	3.18*	1.38*	1.99	-5.79*
	(0.68)	(0.64)	(1.86)	(0.70)
Senator on Ballot	1.95*	3.14*	2.11*	2.06*
	(0.61)	(0.57)	(0.51)	(0.35)
Competitiveness	-0.00	-0.02	-0.01	0.00
	(0.02)	(0.02)	(0.03)	(0.03)
Union Density	0.08	-0.02	0.30*	0.19
	(0.05)	(0.05)	(0.10)	(0.20)
Unemployment Rate	0.13	-0.35*	0.09	0.57*
	(0.15)	(0.15)	(0.09)	(0.14)
% White	0.04	0.03	0.09	0.21
	(0.04)	(0.03)	(0.06)	(0.28)
% Black	-0.31*	-0.10*	-0.19*	0.65*
	(0.04)	(0.04)	(0.07)	(0.30)
% Hispanic	-0.24*	-0.08	-0.13	0.11
	(0.06)	(0.05)	(0.10)	(0.36)
Lagged Turnout		0.52*		
		(0.04)		
Constant	28.34*	11.21*	18.58*	1.57
	(4.10)	(4.03)	(7.44)	(26.96)
Observations	509	458	509	509
R-squared	0.39	0.55	0.35	0.42
State RE	No	No	No	No
State FE	No	No	Yes	Yes
Year FE	No	No	No	Yes

Standard errors in parentheses

* $p<0.05$. Robust standard errors for models 3 and 4.

Table A4: Alternative Specifications of Change in Voter Turnout

	Presidential		*Midterm*	
	(1)	(2)	(3)	(4)
	Pooled	TWFE	Pooled	TWFE
Δ College	1.88*	0.56	2.18*	-0.15
	(0.33)	(0.33)	(0.52)	(0.73)
Governor on Ballot	-0.07	0.74	-0.36	2.17*
	(0.53)	(0.60)	(0.70)	(0.59)
Senator on Ballot	0.31	0.25	4.15*	4.16*
	(0.43)	(0.28)	(0.63)	(0.67)
Competitiveness	-0.01	-0.00	-0.02	0.03
	(0.02)	(0.01)	(0.02)	(0.03)
Union Density	-0.11*	-0.09	-0.11	-0.06
	(0.04)	(0.08)	(0.06)	(0.16)
Unemployment Rate	0.49*	0.38*	-0.39*	-0.09
	(0.12)	(0.13)	(0.18)	(0.26)
% White	-0.03	0.14	-0.03	0.05
	(0.02)	(0.09)	(0.04)	(0.16)
% Black	-0.04	0.31*	0.01	0.22
	(0.03)	(0.10)	(0.05)	(0.22)
% Hispanic	-0.05	0.12	0.03	0.13
	(0.04)	(0.11)	(0.06)	(0.21)
Constant	-0.25	-17.00	0.01	-13.12
	(2.58)	(8.72)	(3.87)	(17.00)
Observations	510	510	458	458
R-squared	0.09	0.78	0.17	0.50
State RE	No	No	No	No
State FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes

Standard errors in parentheses

* $p<0.05$

*****Note: Modeling this variable, pooled results are equivalent to random effects models . Robust standard errors for models 2 and 4.

Table A5: State Education Attainment and Voter Turnout, excluding 2018 and 2020

	(1) Presidential	(2) Presidential	(3) Midterm	(4) Midterm
College	0.47*	0.87*	-0.07	0.42*
	(0.07)	(0.15)	(0.08)	(0.18)
Governor on Ballot		2.49		-4.18*
		(1.38)		(0.76)
Senator on Ballot		0.42		2.29*
		(0.33)		(0.46)
Competitiveness		-0.05		-0.04
		(0.03)		(0.03)
Union Density		-0.07		0.14
		(0.16)		(0.19)
Unemployment Rate		0.61*		0.54*
		(0.10)		(0.10)
% White		1.01*		0.29
		(0.26)		(0.24)
% Black		1.11*		0.86*
		(0.31)		(0.30)
% Hispanic		0.82*		-0.18
		(0.39)		(0.34)
Lagged Turnout		0.25*		0.10
		(0.05)		(0.06)
Constant	47.23*	-73.58*	43.64*	-5.09
	(1.66)	(26.95)	(1.80)	(25.38)
Observations	510	459	458	407
R-squared	0.26	0.45	0.00	0.17
Number of FIPS	51	51	51	51
State FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
* $p<0.05$

Table A6: Summary Statistics for County-Level Data

	(1) N	(2) mean	(3) sd	(4) min	(5) max
Turnout	34,106	58.36	10.16	5.589	135.1
Lagged Turnout	34,106	58.33	10.84	0	110.3
Δ Turnout	31,005	-0.0361	5.650	-56.23	97.30
College	34,099	15.52	8.191	0	78.54
Δ College	31,003	1.174	1.289	-20.93	18.89
Number of county_fips	3,113	3,113	3,113	3,113	3,113

Note: Turnout is calculated dividing observed county turnout from state election boards by Census estimates of the voting age population in that county (VAP). Due to small samples in sparsely populated counties from the Census estimates, calculated values of turnout exceed 100% in a small number of cases.

Table A7: Alternative Specifications of County-Level Presidential Turnout

	(1) Pooled	(2) Pooled w/Lagged DV	(3) RE	(4) TWFE
College	0.24*	0.08*	0.10*	0.55*
	(0.01)	(0.00)	(0.01)	(0.03)
Lagged Turnout		0.79*		
		(0.00)		
Constant	54.62*	11.12*	56.84*	55.12*
	(0.12)	(0.16)	(0.29)	(0.29)
Observations	34,099	34,099	34,099	34,099
R-squared	0.04	0.73	0.04	0.16
County RE	No	No	Yes	No
County FE	No	No	No	Yes
Year FE	No	No	No	Yes
Number of county_fips			3,112	3,112

Standard errors in parentheses

* $p<0.05$

Unweighted. Robust standard errors for models 3 and 4.

Table A8: Alternative Specifications of Change in County-Level Presidential Turnout

	(1) Pooled	(2) TWFE
Δ College	0.25*	0.09
	(0.02)	(0.06)
Constant	-0.33*	-0.40*
	(0.04)	(0.15)
Observations	31,003	31,003
R-squared	0.00	0.19
County FE	No	Yes
Year FE	No	Yes
Number of county_fips		3,113

Standard errors in parentheses

* p<0.05

Unweighted estimates. Random effects are equivalent to pooled