Revisiting the "Puzzle of Participation":
A Dynamic Model of Education and Turnout Growth

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Abstract

One of the enduring questions of political behavior asks why voter turnout in the U.S. declined during a period of substantial growth in educational attainment. Richard Brody (1978) famously termed this paradoxical decline in turnout the "puzzle of participation in America." This paper presents a dynamic model of education and turnout growth in the U.S. from 1948 to 2000 and tests competing theoretical accounts—the resource and sorting models—for how education influences participation. I show that the punctuated growth in education beginning in the 1940s *did* accelerate growth in turnout. In fact, this period of educational growth was substantial enough to result in historically high participation rates. Yet the model shows that education's marginal effect on turnout is much smaller and short-lived than might be expected. The marginal effect has also diminished in size as education levels in the U.S. have increased—evidence that supports the sorting model of educational influence.

To what extent does education influence citizenship in democracies? This question has long been the subject of philosophical and empirical concern. For political philosophers, such as John Locke (1989 [1693]) and John Stuart Mill (1958 [1861]), education promotes both the "moral qualities" and functional knowledge needed for citizenship. In their view, only an educated citizenry can come to respect the rights and liberties of others, while also obtaining the information and civic skills required to control republican government. Empirical scholars have also trumpeted the primacy of education for the health of democracy. Most notably, in reviewing the empirical scholarship on political behavior in the United States, Philip Converse resolves that "[e]ducation is everywhere the universal solvent, and the relationship is always in the same direction. The higher the education, the greater the 'good' values of the variable" (1972, 324). Indeed, increased levels of education have been shown empirically to increase political knowledge (e.g., Delli Carpini and Ketter 1996), political attentiveness (e.g., Zaller 1992), political tolerance (e.g., Stouffer 1955), and voter turnout (e.g, Wolfinger and Rosenstone 1980), all of which are normatively viewed as contributing to the common good. Yet it is the relationship between education with the last of these variables—voter turnout—that has resulted in one of the most enduring questions in the study of political behavior—the "puzzle of political participation" (Brody 1978).

In the decades following World War II, educational attainment levels increased in all segments of American society with secondary and post-secondary graduation rates soaring to unprecedented heights. In theory, America's educational ascent should have contributed to greater levels of voter participation. After all, a more educated citizenry should be endowed with greater information resources and thus be more likely to meet the costs of voting (e.g, Campbell et al. 1960; Wolfinger and Rosenstone 1980). Yet by the end of the 1970s, political scientists began to note a significant *decline* in voter turnout rates in the U.S, a trend that would continue into the 1980s before leveling off.[1] How could these two factors—education and turnout—be trending in opposite directions? Richard Brody (1978) famously termed this paradoxical decline in turnout the "puzzle of participation in America," and, in the decades that have followed, numerous scholars have sought to explain it.[2]

Scholarship investigating the puzzle of participation has focused primarily on establishing an explanation for turnout decline that is unrelated to education growth. It is assumed that the hypothesized positive link between education and turnout is fundamentally correct, and that turnout decline must be caused by downward-trending factors (e.g., efficacy, partisanship, and mobilization) that negate the weight of education's positive influence. This paper revisits the puzzle of political participation and provides a novel interpretation of the relationship between growth in aggregate levels of education and growth in voter turnout. I argue that the "puzzling" nature of this relationship results from both a limited reading of the empirical evidence and a weakly constructed theory linking education and turnout.

Empirically, most studies of the puzzle of participation suffer from at least one of three weaknesses that limit our knowledge of the relationship between education and turnout over time. First, most scholarship examining trends in U.S. voter turnout employs data gathered since the late 1950s or early 1960s—a period coinciding with the advent of the American National Election Study—or later (e.g., Brody 1978; Teixeira 1992). Regrettably, this approach excludes a two decade era of dramatic growth in both education and turnout during the 1940s and 1950s and may bias our understanding of the relationship between the two variables. A second empirical limitation results from the fact that most scholarship does not adequately account for the dynamic relationship between education and turnout. For instance, scholars using individual-level data to model political participation sometimes pool cross-sectional survey observations and test for magnitude shifts in the coefficients linking education and turnout using temporal dummy variables (e.g., Teixeira 1987 and Nie, Junn, and Stehlik-Barry 1996, 131-166). While this approach effectively "de-trends" the individual-level data, it is inadequate for modeling the *dynamic* relationship between education and turnout.[3] Finally, individual-level data is not adequate for testing the puzzle of participation. While such data are necessary for uncovering the structural determinants of individual turnout decisions, such as deciphering whether an individual's years of education affects his/her decision to go to the polls, the puzzle of participation is not such a question.[4] Instead, the puzzle of participation, in its original conception, focuses on *societal changes*. The question is not about individual decisions per se, but rather why aggregate levels of turnout in the U.S. have

declined in the context of a social explosion in education. This sort of question requires aggregate data and is most appropriately modeled dynamically in order to account fully for the short-term and long-term effects of educational growth on the rates of growth in turnout.

This paper not only seeks to resolve these empirical issues, it also hopes to advance our theoretical understanding of the puzzle of participation by viewing education as a sorting mechanism within society. Traditionally, the theoretical mechanism linking education to participation has been resources. In Raymond Wolfinger and Steven Rosenstone's account, for instance, higher education imparts citizens with information about politics, better jobs, increased income, and a higher level of "gratification from political participation" (1980, 35-36). Simply put, education is a resource that can be used to offset the costs of political participation and thus stimulate voting. Work by Norman Nie, Jane Junn, and Kenneth Stehlik-Barry (1996), however, challenges the traditional approach and its conception of education as a resource. Nie, Junn, and Stehlik-Barry argue that higher levels of education impart social status—not resources—on individuals, sorting them into a hierarchy within their social context—an approach known as the *sorting model*. Since individuals at the top of the hierarchy are more likely to be socially engaged and advantaged, educational status is hypothesized to stimulate civic and political participation among social elites. Because social status is measured relative to others, the sorting model forces us to view educational attainment relative to others. Accordingly, we should no longer expect the influence of education to be additive; instead it must be conditioned by an ever-changing social context. As David Campbell (2007, 2) puts it,

> "[A]s average levels of education in the population have risen, each individual has needed ever more education to be positioned at the top of the class hierarchy. The same status conferred by a college degree a generation ago now requires a graduate degree. In other words, education has undergone inflation."

As we shall see, these alterative models, which have been developed and tested only at the individual level of analysis, have direct implications for studying the relationship between education and turnout growth in the aggregate and may alter our understanding of the puzzle of participation.[5]

The paper proceeds by briefly reviewing the existing scholarship on the puzzle of participation. As mentioned, most researchers focus their attention simply on explaining the decline in turnout generally, searching for factors that might negate the positive effect of education. Consequently, most theories explain the decline in turnout in the U.S. primarily as a function of factors that also declined during the post-War II period, particularly weakened partisan ties and lower levels of political efficacy. In fact, some explanations for turnout decline omit positively trending explanations for turnout, such as education, entirely from their models, and none of this scholarship has tested the possibility that education provides diminishing marginal returns on turnout, as suggested by the sorting model. I then review the resource and sorting models in fuller detail and incorporate hypotheses from these theoretical approaches directly into a dynamic model of turnout growth. I test this model of turnout using aggregate data from over 3,000 U.S. counties for 14 U.S. presidential elections (1948-2000). The expansive dataset allows me to test the effect of education growth (in both hypothesized forms) on turnout growth, while controlling for an array of competing social, political, and institutional explanations. Most importantly, with over 40,000 cases, I achieve significant variability in both education and turnout growth rates, providing a strong test of the hypotheses. With a longer time horizon than most studies, I am also able to distinguish between short-term and long-term effects of education growth on turnout.

Education and the Puzzle of Participation

The post-1960 decline in voter turnout in the U.S. has been the subject of substantial scholarly investigation. Yet most explanations for turnout decline are either silent about the influence of the punctuated growth in educational attainment or inadequately model the dynamic relationship between the two variables.

One of the first attempts to explain America's declining voter turnout was offered by Paul Abramson and John Aldrich (1982). Using individual-level survey data from the 1952 to 1980 presidential elections, these scholars suggest that the post-1960 decline of electoral participation was driven by two simultaneously decreasing attitudinal trends: a "weakening of party identification and

declining beliefs about government responsiveness" (i.e., external political efficacy) (Abramson and Aldrich 1982, 502).[6] In fact, their evidence suggests that roughly two-thirds of the decline in turnout can be attributed to these two factors alone.[7] One variable that is noticeably absent from the Abramson and Aldrich model, however, is education. As a result, the Abramson and Aldrich model cannot tell us whether growth in education during the period had no effect on turnout or whether its positive effects simply could not offset the negative effects of weakening party identification and political efficacy.

I am not the first to criticize the Abramson-Aldrich model on these grounds. Indeed, Carol Cassel and Robert Luskin (1988) criticize the Abramson-Aldrich model for not including *any* factors that are hypothesized to increase turnout, including education. Inserting education into the Abramson-Aldrich model, Cassel and Luskin (1988, 1325) find that partisanship and efficacy really account for only about 24% of the decline in turnout, not the nearly 66% claimed in the original study. Nevertheless, this finding strongly suggests that the negative effects of declining partisanship and efficacy were sufficient to outweigh the positive effects of education. It should be noted, however, that neither the Abramson-Aldrich nor Cassel-Luskin design actually models the *dynamic* properties of turnout or education growth. Instead, these scholars generate their evidence using simulations of what turnout would have been in the t^{th} election had the joint distribution of partisanship and efficacy (and education in the Cassel-Luskin model) remained at its estimated 1960 level. While this approach provides interesting counterfactuals by which to make comparisons, it does not offer an adequate test of whether changes in voter turnout were actually attributable to changes in education attainment levels.[8]

Other prominent investigations of the decline in voter participation also shy away from explaining the perplexing relationship between education and turnout. Warren Miller (1992), for instance, argues that the decline in aggregate turnout from the late 1950s to the 1980s was primarily attributable to the changing generational composition of the electorate. Miller argues that the "baby-boom generation," which entered the electorate with the 1968 presidential campaign, voted at rates that were significantly lower than those of older generations. Consequently, as more baby-boomers entered the electorate, turnout rates declined. Miller, regrettably, does not explain precisely why this generational

effect exists. Though lower efficacy within the cohort seems to be the main source for Miller's generational effect, he does not consider the fact that the baby-boom generation was also significantly more educated on average than older generations. This factor alone should have increased the propensity for this group to turn out at higher rates. Richard Boyd (1989) provides an alternative explanation for turnout decline, provocatively arguing that elections themselves are the source of lower voter interest. Boyd argues that the proliferation of spring and fall primaries in the post-1960 period made the costs of voting more taxing. Voters have participated at lower rates over time because they have become increasingly overburdened. Yet like Miller's explanation for the puzzle of participation, Boyd's argument is silent on the influence of education growth on the decline in turnout.

Ruy Teixeira (1987; 1992) argues that the post-1960 decline in voter turnout can be explained by declining levels of social and political "connectedness." Similar to the social capital arguments of James S. Coleman (1988) and Robert Putnam (1995), Teixeira contends that Americans' weakening social ties—exemplified by factors such as higher divorce rates and lower church attendance—have diminished individuals' incentives to vote. "The idea is that interpersonal, community, and general social ties provide a substantial proportion of an individual's motivation to vote, because these ties can provide external encouragement to vote, as well as an enhanced sense of an election's meaningfulness" (Teixeira 1992, 36). Teixeira's individual-level study is particularly notable because he attempts to account for temporal effects on turnout and for the over time trend in education. Owing to the limited number of time points (eight) in his study, Teixeira controls for temporal effects by pooling the cross-sectional (ANES) data and inserting temporal dummy variables in his model. Teixeira then assesses the effect of "other theoretically appropriate variables" on the decline of turnout by separately inserting these variables into the model and examining whether their inclusion resulted in the "attenuation or elimination of the time dummies as significant factors" (1992, 196). Using this approach, Teixeira concludes that educational "upgrading actually pushed turnout up" between 1960 and 1988, but these gains were "pushed down" by even bigger declines in social connectedness and external political efficacy. The problem with Teixeira's methodological approach, though arguably the best strategy given his data, is that it does not actually test

for the dynamic relationship between education and turnout. Instead, the temporal dummy variables approach simply "de-trends" the pooled data so as to achieve consistent estimates over the time period. Moreover, the coefficients associated with the temporal dummy variables are highly sensitive to overall model specification (Beck, Katz, and Tucker 1998). This is *not* to say that Teixeira's findings should be treated as erroneous, just that time (i.e., more data points) and method allow us to produce better estimates of the dynamic properties of the relationship between education and turnout.

Perhaps it should not be surprising that education does not play a more prominent role in existing explanations for the decline in turnout. At the time most of this research was conducted, the standard theoretical account argued that education had a direct positive relationship on turnout. Given this assumption and the growth in aggregate levels of educational attainment, it may have been reasonable for scholars to search out factors that would not only counteract the positive effects of education but also outweigh them—thus creating the negative trend in turnout. An alternative, of course, is to supplant the standard theoretical account with one that argues that increases in education have had diminishing marginal returns in the aggregate. This is just the approach taken by Nie, Junn, and Stehlik-Barry.

The Additive and Sorting Models of Educational Influence

In recent years, there has been a broad reexamination of the causal relationship between education and voter turnout. Indeed, the mechanism by which an individual's education affects his/her decision to turn out remains an open question.[9] Most scholars view education as imparting resources with which citizens can more easily absorb the costs of voting. Michael Delli Carpini and Scott Keeter (1996), for instance, argue that education leads directly to increased levels of political knowledge, a resource that reduces much of the information costs associated with political participation. Sidney Verba, Kay Schlozman, and Henry Brady (1995) suggest an alternative mechanism, arguing that education inculcates the civic skills that are necessary and useful for civic voluntarism and political engagement. This view is echoed by D. Sunshine Hillygus (2005), who also views education as a source of civic skills, but adds that the language skills acquired from higher levels of education also result in higher levels of

participation—perhaps owing to increased ability to understand political dialogue. These arguments have their own merits, and, of course, it is conceivable that education contributes to political participation via each of these routes in combination.[10] The point to be made here is not that one alternative is better than the other; rather it is to note the commonality across these explanations. Each of these proposed mechanisms is anchored in the conception of education as a resource, a standard assumption of both SES and rational models of voter participation (e.g., Verba and Nie 1972, Wolfinger and Rosenstone 1980, Aldrich 1993). Moreover, these explanations also make a common assumption that education contributes to political participation in a simple, *additive* fashion: each unit of education adds to the propensity to participate.[11] Yet the resource model (hereafter, the "additive model") has been challenged in recent years.

The sorting model proposed by Nie, Junn, and Stehlik-Barry is an alternative to the additive model. For Nie, Junn, and Stehlik-Barry, education is not viewed as an individually-held commodity. Instead, education serves to sort individuals within their social group, "assigning ranks on the basis of citizen's relative educational attainment" (1996, 6). Assignment by rank is important, according to Nie, Junn, and Stehlik-Barry, because politics entails competition over finite resources. In this competitive setting, rank translates directly into successful acquisition of resources. Simply put, those at the highest rungs of the social ladder are assumed to get a disproportionate share of society's scarce resources. As a result, Nie, Junn, and Stehlik-Barry argue, individuals at higher levels of social rank have a greater incentive to participate in politics because they are most likely to get a return on their investment.

According to the sorting model, the primary criterion by which social rank in America is determined is relative education. Those individuals with the greatest levels of education within a social environment are granted the greatest status. They are looked upon by other members of the group as leaders and are afforded the most influence within the social sphere. It is important to be clear; the sorting model *does not* suggest that higher levels of absolute education alone lead to higher levels of political participation. Rather, educational attainment must be viewed relative to the members of the social group in the aggregate. For instance, in a community where the typical individual holds only a

high school diploma or less, a college graduate within the ranks is likely to be afforded high standing. On the other hand, if this same college graduate were to move to a community replete with individuals holding post-graduate degrees, then he/she would not be afforded the same high standing.

The additive and sorting models provide the microfoundations for understanding the relationship between education and turnout in the aggregate. Though both theories have been developed and tested as explanations for individual-level political behavior, their aggregate consequences are easily decipherable and lead to alternative predictions about how aggregate education growth should affect growth in turnout rates. Without a notion of relativism, the additive model suggests that aggregate gains in education are directly transformed into aggregate gains in turnout. The assumption is that education levels in the aggregate are related to turnout levels as a positive linear function. Consequently, we can assume that dynamic changes in these levels are also related in a similar linear fashion. This results in the following testable hypothesis:

> *Additive Hypothesis: The marginal effect of the education growth rate on the growth in turnout is positive and constant across different levels of education*.

The sorting model espoused by Nie, Junn, and Stehlik-Barry behaves differently in the aggregate, so that "[a]s the aggregate amount of absolute education in the population changes over time, the relative significance of a given number of actual years of education will vary" (1996, 6). This suggests a diminishing marginal effect of educational growth on turnout growth, where the magnitude of the effect is conditional on the base level of education within the social group in the period before education growth. Thus, the sorting model produces the following conditional hypothesis:

> *Sorting Hypothesis: The conditional marginal effect of the education growth rate on the growth of turnout will diminish in size as the aggregate level of education$_{t-1}$ increases.*

In espousing the sorting model, Nie, Junn, and Stehlik-Barry take a strong position against the additive model. They argue, "[i]f, indeed, education is of *relative* importance to political engagement, then changes in the aggregate *levels* of education over time should have *no effect* on political engagement, all else being equal" (Nie, Junn, and Stehlik-Barry 1996, 111, *emphasis mine*).[12] Again, this rejection of

the additive model outright is a strong position to take, though clearly it is one that on its face seems substantiated by the divergent temporal paths of education and turnout. A less stringent view of the additive and sorting models is that they may work in concert with one another, suggesting that education has both direct and relative effects. Over time, this may lead to a perverse result: education may counteract itself. That is, the resource benefits of education may be ballasted by the diminishing status that education conveys. Since this is an issue that can be adjudicated empirically, I test both the strong and weaker versions of the sorting model.

Level of Aggregation and the Sorting Model

The puzzle of participation is inherently an aggregate question, asking why the turnout rate in the United States has decreased during a period of growth in educational attainment. Yet, in order to test the conditional nature of the sorting model, it is important to ask what the appropriate level of aggregation should be. Because social status may be conveyed locally within social networks, higher levels of aggregation would seem to mask much of the variation inherent in measuring relative educational status. Consequently, I have chosen to utilize the lowest level of aggregation for which there is both turnout and educational data over the historical period—the county level.[13] This unit of analysis has two advantages: 1) it is proximate to voters and their social networks, and 2) it offers substantial variation in educational attainment across county units, allowing for a strong test of the sorting model. Of course, even this level of aggregation may artificially truncate variation to some degree, since some counties may be quite diverse. Cook County, Illinois, for instance, is the second largest county (by population) in the United States and contains the city of Chicago and seventy-seven other communities recognized by the Census Bureau. Aggregation by county treats all counties, including diverse populations such as Cook County, as being homogeneous.

The Growth Rate Model of Voter Turnout

As mentioned previously, most models investigating the over time relationship between education and voter turnout tend to rely on pooled cross-sections of individual-level survey data, utilizing the respondent's reported turnout in the current election as the dependent variable. Researchers then estimate the effect of individuals' reported educational attainment on turnout and test whether this coefficient estimate varies significantly over time as a way of tracking the temporal effects. This is a less than optimal approach for modeling the dynamic relationship between education and turnout. The approach taken here is to utilize aggregate data and measure the variables of interest as growth rates.[14] This decision allows for a more direct test of the puzzle of participation by explicitly examining social changes in education and turnout over time within the framework of a dynamic model.[15]

The ramifications from the decision to convert the data from levels to growth rates can be shown graphically. Figure 1 presents a comparison of the trends in county-level education and turnout in the U.S. from 1944-2000 measuring both variables as yearly rates (levels). The presentation here produces the same divergent trends observed when the puzzle of participation was originally formulated—the difference being that I use average county-level data rather than national data.[16] While there is a fair amount of heterogeneity in the county data, the trends in the average levels tell a similar story to that offered by Brody. After a roughly two decade period of increasing turnout at the county level, voter participation enters into a period of gradual decline beginning roughly in 1960.[17] The decline in turnout can be juxtaposed against the increasing trend in education during this period. The right-hand panel of Figure 1 clearly shows the tremendous increase in educational attainment (measured as the average percentage of high school graduates in U.S. counties) during the post-WWII period. When compared over time, the trends in education and turnout clearly seem to be moving in different directions, just as Brody observed.

[FIGURE 1 HERE]

When the data on levels of education and turnout are converted into growth rates, we obtain a very different picture of the relationship between the two variables. Figure 2 presents the growth rates of turnout and education from 1948-2000 in a side-by-side comparison. Remarkably, the trends in growth

are quite similar. The period of greatest growth in turnout—between 1948 and 1952—corresponds with the most substantial period of growth in education in the country. As the growth rate in education decelerates, so too does the growth rate in turnout. Clearly, the trends in growth rate tell a different story than the trends in levels.

[FIGURE 2 HERE]

To test the linkage between the growth in education and the growth in turnout, a dynamic model is constructed. The model estimated here uses panel data (about which more later) indexed by county *i* and presidential election *t*. For the simple additive model, the equation takes the following functional form:

$$Y_{it} = a_i + \beta_1 X_{1it} + \delta Y_{it-1} + \gamma Z_{it} + e_{it},$$

where Y_{it} is the growth rate in turnout, X_{1it} is the growth rate in education, Y_{it-1} is a lag of the growth rate in turnout, and Z_{it} is a set of exogenous variables. The inclusion of the lagged dependent variable, Y_{it-1}, controls for behavioral persistence in turnout growth rates. The expectation is that periods of high growth in turnout will be followed by slower rates of growth. The lagged dependent variable also attenuates a problem found in dynamic models of growth rates of variables constructed from percentages—the presence of an upper boundary in the dependent variable. As the base level (percentage) grows larger, the maximum growth rate arbitrarily decreases. For instance, once turnout in a county reaches 50%, the growth rate can no longer exceed 100%. Also, the inclusion of this lagged dependent variable allows me to adjudicate between the short-term and long-term effects of growth in education on growth in turnout, a property that is very informative for understanding the over time relationship between the variables. [18] Finally, the model also includes an intercept, a_i, slope estimates, $\beta, \delta, \gamma,$ and an error term, e_{it}. In this functional form, the additive hypothesis simply requires that $\beta_1 > 0$.

To estimate the sorting model, an interaction term is required (along with its constitutive terms), so that

$$Y_{it} = a_i + \beta_1 X_{1it} + \beta_2 X_{2it-1} + \beta_3 X_{1it} X_{2it-1} + \delta Y_{it-1} + \gamma Z_{it} + e_{it},$$

where X_{2it-1} is the base level of education in the county at *t*-1, and $X_{1it} X_{2it-1}$ is an interaction term consisting of the product of the county's growth rate in education times the base level of education in the county at *t*-1. Recall that in an interaction model, β_1 only provides the marginal effect of X_{1it} when $X_{2it-1} = 0$ (Brambor, Clark, and Golder 2005). The marginal effect of the growth rate in education X_{1it} on turnout growth Y_{it} is calculated as $\partial Y_{it} / \partial X_{1it} = \beta_1 + \beta_3 X_{2it-1}$. Under this specification, the additive hypothesis again requires that $\beta_1 > 0$, but it also mandates that the $\beta_3 = 0$ (i.e., the marginal effect of X_1 on Y is independent of the value of X_2). Substantively, this means that the additive model assumes that the gains from education are constant and independent of the base level of education in the county at *t*-1. According to the sorting hypothesis, the conditional marginal effect of the county's growth rate will diminish in size as its base level of education increases. The sorting hypothesis is tested on the basis of the following conditions: $\beta_1 \geq 0$ and $\beta_3 < 0$. Note that the strong version of the sorting hypothesis, which states that the sorting effects of education work to the exclusion of any resource effects of education, requires that $\beta_1 = 0$, whereas the weaker version of the hypothesis, which allows both to work in concert, would require that $\beta_1 > 0$.

Data

The analyses presented here utilize county-level data measured across a series of U.S. presidential elections—a panel dataset. Specifically, the data consist of observations from a maximum of 3,115 counties in the continental United States, for each of the 14 presidential elections occurring within the 1948-2000 sample frame ($T = 14$; $N = 3{,}115$ (max); Total Number of Observations = 40,262). [19]

The measure of the estimated voter turnout in each county is based on the number of votes cast in the presidential election divided by the estimated voting age population.[20] In some cases, the denominator for the turnout measure was altered to reflect state-level differences in voting age requirements.[21] The data for constructing this measure were obtained from various sources. County-

level vote returns were compiled primarily from Congressional Quarterly's *America Votes* series and Congressional Quarterly's Voting and Elections online module. County-level voting age population data were compiled from two sources: data from 1944 to 1968 were entered manually from the U.S. Census Bureau's *City and County Data Book*. Data from the 1972 to 2000 election years were obtained from the Census Bureau website. The county-level turnout measures were then converted to reflect the *Growth in Turnout*.

The main independent variable of interest is the *Growth in Education*. To compute this measure, the percentage of high school graduates in a county was recorded and transformed into a growth rate.[22] To test the simple additive model, the education growth rate is entered directly into the dynamic model. To test the sorting model, an interaction term is required—the growth rate, which measures the percentage change in education from time *t*-1 to *t*, is multiplied by the percentage of high school graduates in a county at time *t*-1 (*Education*), which stands as a base level from which education grew.

The model that I construct also controls for a number of exogenous variables. Because the growth in education may be a proxy for other socio-economic factors at play, I include the *Growth in Income*, based on the real median household income in the county, and *% African American* $_{t-1}$.[23] The expectation is that as *Growth in Income* increases, *Growth in Turnout* will also increase. I expect that counties high on the *% African American* $_{t-1}$ will have lower rates of *Growth in Turnout*.[24]

Several studies demonstrate the negative effect of restrictive registration laws on voter turnout (e.g., Rosenstone and Wolfinger 1978). Highton's (2004) recent study on restrictive registration laws points to a number of variables that affect turnout across space and time, including poll taxes, literacy tests, registration closing dates, and motor voter laws. I enter these restrictive registration requirements into the dynamic model in two ways. First, I measure of *Registration Closing Date* as the number of days between the last day to register to vote in the state and Election Day.[25] This measure is then differenced to denote the change in registration closing date restrictiveness from one time period to the next. It is expected that increases in closing date restrictiveness should decrease the rate of growth in turnout. The second measure of restrictive registration requirements in the county also attempts to track changes in

restrictiveness and is constructed from a series of dichotomous variables denoting the presence or absence of *Poll Tax*, *Literacy Test*, *Property Requirement* and *Motor Voter* laws in the state.[26] Each of these dichotomous variables was recoded so that +1 indicates an adoption of a restrictive law in the state since the last election period, -1 indicates the repeal of such a law since the last election, and 0 indicates no change. (The direction of the coding is reversed for adoption of *Motor Voter* laws, which are believed to ease registration costs.) An additive scale, *Restrictiveness*, is then constructed from these variables. Since restrictive registration laws have been shown to "not dissuade individuals with lower levels of education from voting any more than individuals with higher levels of education" (Nagler 1991, 1393), these variables are entered as independent, additive components of the model. Lastly, I also control for the possibility that important state-wide elections might affect turnout growth from one period to the next by including *Gubernatorial Election* or U.S. *Senate Election* shock variables. These variables are coded so that +1 indicates a shift from no election in the previous period to an election in the current period, -1 indicates a shift from an election in the previous period to no election in the current, and 0 denotes no change across periods.

Methods

Because the data are arranged in a panel design, there are a number of methodological issues to consider. The panel design allows me to predict the county-level *Growth in Turnout* over space and time, respectively. Because the panel is decidedly cross-section dominant ($N \gg T$), linear cross-sectional random effects (CSRE) estimation is the most appropriate model specification. The CSRE specification allows for stochastic variation across counties by providing estimates that are a weighted average of "between" (across counties) and "within" (fixed) effects.[27] In instances where the panel is heavily cross-section dominant, CSRE provides more efficient parameter estimates than the cross-sectional fixed effects (CSFE) model, which would require the estimation of as many as 3,114 cross-sectional (county-level) dummy variables in the model.[28]

To control for unobserved overtime heterogeneity, I also incorporate T - 1 election year dummies in the model (the 1948 presidential election dummy is excluded and its effect is captured by the intercept term). Statistically, the use of time dummies is a standard approach for accounting for temporal heterogeneity in panel models where T is relatively small, since proper stochastic modeling of the dependent variable is difficult in these cases (Arellano 2003, 60-64; Wooldridge 2002, 170). Substantively, these election year dummies also allow me to control for the electoral environment and campaign effects that might be unique to each presidential election.

Results

Table 1 presents different models of county level growth in turnout. The alternative model specifications allow for a robust test of the education-turnout hypotheses in both the additive and sorting forms. (To simplify the presentations, coefficients for the set of election year dummies are not shown.) As made evident by the likelihood ratio tests and the statistical significance of nearly all of the independent variables, the models provide statistically significant fits to the *Growth in Turnout* data.[29]

[INSERT TABLE 1 HERE]

Model 1 provides a straightforward test of the additive hypothesis. In this simple model, the additive hypothesis is supported: as *Growth in Education* increases, *Growth in Turnout* also increases. The results of this model suggest that in the largest period of growth in average county-level education (an average increase of 31.75% between 1948 and 1952), voter turnout grew at an average rate of 4.13%. Though somewhat modest, this effect alone provides some credence to the traditional theoretical account for how education affects turnout. Moreover, even in this simplest of specifications, the conversion of the data into growth rates seems justified—aggregate education and turnout are positively correlated. Of course, an important question is whether the additive hypothesis will be supported when paired against Nie, Junn, and Stehlik-Barry's sorting hypothesis.

Model 2 provides a parsimonious specification of both the additive and sorting hypotheses. In addition to the inclusion of the *Growth in Education* variable, an interaction term, *Growth in Education* ×

Education $_{t-1}$, is also included (along with its constitutive term, *Education* $_{t-1}$). In this specification, both the additive and sorting hypotheses receive support with neither working to the exclusion of the other. As hypothesized by the additive model, the marginal effect of *Growth in Education* (i.e., β_1) on *Growth in Turnout* when *Education* $_{t-1}$ is set to zero is statistically significant and positive.[30] But these positive effects are neither constant in magnitude nor independent of the base level of education in a county. This is made evident by the fact that the conditioning effect associated with the multiplicative term is statistically significant and in the hypothesized negative direction ($\beta_3 < 0$). The negative coefficient associated with β_3 suggests that the conditional marginal effect of *Growth in Education* on *Growth in Turnout* decreases as the base level of *Education* $_{t-1}$ in the county increases. The significance of both of these estimates suggests that the two theorized mechanisms by which education influences turnout—by providing resources to reduce the cost of voting and by sorting individuals into social ranks—seem to work in concert with one another. This dual effect, it will be recalled, stands in contrast to the strong version of the sorting model put forth by Nie, Junn, and Stehlik-Barry, who hypothesized no significant effects for the additive hypothesis.[31]

To be assured of the robustness of these findings, I construct two additional models that include competing explanations for the *Growth in Turnout*. Model 3 includes a set of socioeconomic variables that are hypothesized to affect voter turnout, and Model 4 adds a set of variables tracking the changes in restrictive registration laws as well as electoral shocks to the Model 3 equation. The performance of the socioeconomic variables in both models presents interesting results. First, the *Growth in Income* is not statistically significant in either model. This is a bit surprising given the prominence granted by some authors to the income variable as an explanation for voter turnout (e.g., Leighley and Nagler 1992b). Second, the *% African American*$_{t-1}$ variable is statistically significant, but not in the direction initially hypothesized. Instead of deflating the rate of growth in turnout, *% African American*$_{t-1}$ actually inflates the growth rate. Interestingly, further tests show that this effect is *not* a product of the dramatic shift in African American turnout caused by the 1965 Voting Rights Act, as the effect of *% African American* $_{t-1}$ on *Growth in Turnout* is positive in both the pre- and post-1965 periods.[32] Most importantly, after

controlling for these socioeconomic factors, both the additive and sorting hypotheses continue to be supported. The results are also consistent once the restrictive registration variables and the *Gubernatorial Election* and *Senate Election* variables are included in Model 4. These institutional variables are, in fact, quite strong in the magnitude of their coefficients and do work to minimize *Growth in Turnout* as hypothesized, but the inclusion of these variables does little to diminish the role assigned to education by the additive and sorting hypotheses.

The models presented here provide support for both the additive and sorting hypotheses. Yet, because of its nonlinear nature, it is necessary to assure that the results supporting the sorting model are statistically significant across the entire range of the constitutive variables. To do this it is necessary to examine both the conditional marginal effect and conditional standard error associated with the interaction effect across all levels of $Education_{t\text{-}1}$ (see Freidrich 1982; Brambor, Clark, and Golder 2005). This is required because the statistical significance of the interaction term only indicates that the slope of the conditioning effect β_3 is not zero. Even with a significant interaction term, it is possible that the conditional marginal effect of *Growth in Education* on *Growth in Turnout* may not be statistically significant across the entire range of $Education_{t\text{-}1}$. Given that the conditional marginal effect of *Growth in Education* on *Growth in Turnout* is positive ($\beta_1 = .164$) when $Education_{t\text{-}1} = 0$, we should expect the marginal effect to be indistinguishable from zero somewhere within the range of $0 > Education_{t\text{-}1} < 100$ before becoming negative. Thus, I computed both the conditional marginal effects and conditional standard errors using the parameter estimates generated by Model 4. Figure 3 plots these effects.

[INSERT FIGURE 3 HERE]

As is visually apparent in Figure 3, the conditional marginal effects work just as the sorting model hypothesizes: educational growth has a declining marginal effect on growth in turnout conditional on the county's base level of education in the previous time period. In fact, the positive gains from education growth (a product of both educational resources and educational status) are restricted to counties with low levels of educational attainment (the lower band of the 95% confidence interval crosses zero when $Education_{t\text{-}1} = 24.25\%$). During the early elections under investigation here, these levels of

educational attainment were not uncommon. In 1948, for instance, the average county had only roughly 7% of its population with a high school diploma; a statistic that is remarkable by today's standards. It should not be surprising therefore that education's greatest positive effects on turnout (modest as they are) occurred during this early period. Just as hypothesized by the sorting model, as educational attainment rises, the marginal effect of educational growth on turnout growth dissipates quickly and indeed becomes negative (when $Education_{t-1} > 31.02\%$). Again, these marginal effects are quite small, but they tell an interesting story about education's effect on turnout in our society—for they suggest that a more educated U.S. population has actually contributed to declines in turnout.

Finally, it is important to distinguish between the short-term and long-term effects of education on turnout. Within the structure of a dynamic model, the coefficient estimates associated with the independent variables reflect only the short-term or immediate effect of that variable on the dependent variable. If the time series is stationary, the long-run effect defines the time in which it takes these short-term effects to dissipate and the dynamic system to return to equilibrium (e.g., Greene 2008, 672-674).[33] In the case presented here, we can only estimate the interactive effects of our variable of interest, *Growth in Education*. Thus we are forced to apply the long-run multiplier to these conditional marginal effects, so that $\varphi = (\beta_1 + \beta_3 X_{2it-1})/1-\delta$ where δ is the estimated coefficient associated with the lagged dependent variable $Growth\ in\ Turnout_{t-1}$. Of course, this estimated long-run effect is also conditional on the value of the variable X_{2it-1}, which is the base level of education in the county at t-1 and varies (in theory if not in practice) from 0 to 100. I calculated the mean value of the long-run effect $\overline{\varphi}$ over this range of X_{2it-1} and found the average conditional long-run effect of *Growth in Education* on *Growth in Turnout* to be -.124 (S.E. = .014, $p < .05$).[34] This effect is very telling, because it suggests that all of the gains (at lower levels of $Education_{t-1}$) or losses (at higher levels of $Education_{t-1}$) made by *Growth in Education's* immediate effects on *Growth in Turnout* evaporate within the first electoral cycle. In fact, the negative sign associated with the long-run effect suggests an oscillation effect. This means that election periods in which *Growth in Education* immediately increases *Growth in Turnout* are likely to be followed by small

declines in *Growth in Turnout* in the next period. Conversely, election periods in which *Growth in Education* immediately decreases *Growth in Turnout* will likely result in small increases in *Growth in Turnout* in the next period.

In sum, the dynamic model of turnout growth developed here provides several insights into the puzzle of participation in the U.S. First, aggregate gains in educational attainment *did* result in aggregate gains in voter turnout. However, these relational gains are restricted primarily to counties that started the period of growth with low levels of education. As the levels of education in U.S. counties grew, educational growth had a declining marginal effect on turnout growth, which actually becomes negative, meaning that over time the dynamic effect of education on turnout largely evaporated. Second, the dynamic model strongly suggests that whatever gains or losses educational growth contributes to turnout growth in a single election cycle, those shocks are short-lived to the system, and the contribution to turnout growth does not persist.

Discussion

Education's role in a democracy has long been heralded. Political philosophers and political scientists alike have argued that an educated public improves democracy. Education is thought to promote civic skills, inculcate democratic norms, and stimulate higher levels of political participation. Yet, exactly how education brings about these "good" returns is still a matter of lively debate. In this paper, I have examined one aspect of education's role in improving democratic citizenship—its promotion of voter participation. In doing so, I have reevaluated and brought new data to bear on the long studied "puzzle of participation," which asks why voter turnout in the United States decreased in recent decades while educational attainment levels skyrocketed? The puzzle continues to perplex, in part, because previous scholars have had insufficient data to examine the dynamic relationship between education and turnout properly. Moreover, many scholars have reduced an inherently social (aggregate) question into an individual-level investigation. While the individual-level relationship between a citizen's education and his/her turnout decision is intrinsically important, this level of analysis unnecessarily

distorts the puzzle of participation. This paper shows that when aggregate levels of education and turnout in the U.S. are transformed into growth rates (one benefit of having longer available time series data), the two variables actually move through time in a similar pattern. Yet, this discovery alone does not "solve" the puzzle; it just restates it. Simply showing that the two growth rates have actually taken a similar temporal path does not explain why this is the case.

To help explain the relationship between the growth in education and the growth in turnout, I have relied on insights from two alternative models—the additive and sorting models. The additive model assumes that education contributes to turnout by providing resources that ease the costs of voting. From this perspective, which has dominated the extant literature, the effect of education on turnout is assumed to be additive in that gains in the former lead to proportional and cumulative gains in the latter. Alternatively, the sorting model contends that educational achievement affords status to those who outperform others in their community, thereby sorting individuals within a social hierarchy. Because those at the top of the social hierarchy tend to reap disproportionate rewards in society, it is argued by proponents of the sorting model that those with high status have a greater incentive to participate in politics. From this perspective, the effect of education on turnout is assumed to be conditional in that the magnitude of this relationship depends on the educational attainment of others in the community. Educational gains in communities that are poorly educated are more likely to confer status and thus have a greater effect on gains in turnout. In communities that are highly-educated, relative status is more difficult to achieve. Consequently, educational gains in these communities are less likely to confer status and thus have a smaller effect on gains in turnout. Over time, as achievement levels increased, this model suggests that the marginal effect of changes in education on changes in turnout should have declined markedly.

The results presented in this paper suggest that the two approaches are far more complementary than previous accounts have suggested. In modeling growth in turnout in the U.S. during the post-WWII period, both the additive *and* sorting mechanisms seem to be at play. The evidence suggests that it is possible for education to provide a citizenry with both resources *and* a social hierarchy. However, the

growth model also shows that education's effect on turnout has diminished greatly during the historical period under investigation owing to remarkably high levels of education attainment through the nation.

During the early part of the historical period investigated, when educational attainment levels in U.S. counties were substantially lower than today's standard, growth in educational rates had a positive and statistically significant influence on growth in turnout. In the late-1940s and early-1950s, substantial growth in high school graduation rates *did* accelerate growth in voter participation. In fact, the increases in educational growth were so sizeable that they contributed to historically high levels of turnout during this period. Yet this study shows that these positive gains in turnout are typically much smaller and short-lived than might be expected. First, the dynamic model shows that growth in turnout equilibrates very rapidly. In other words, whatever short-term gains growth in education might have contributed to turnout growth in any one election period quickly evaporate by the next election cycle. Education growth does not have a persistent effect on turnout growth. Second, as America became more educated, the marginal effect of educational growth on turnout growth actually became negative. Though this effect is quite small, it is statistically significant nonetheless. This suggests that as America has become increasingly homogeneous in educational attainment, education no longer affects voter turnout in the ways and to the extent that normative and empirical theorists once hoped it might.

Notes

[1] In the 1960 presidential election, for example, approximately 64% of eligible voters in the U.S. turned out to the polls. By 1980, this number had decreased to roughly 53%. During this same period of time, high school graduation rates in the U.S. increased by roughly fifty percent and college graduation rates nearly doubled.

[2] Brody (1978) notes that the decline in voter participation is made doubly puzzling by the fact that voter registration laws became significantly less burdensome during this period of time. While the models employed in this paper explicitly account for these systemic changes in electoral laws, the theoretical focus of this paper is on the dynamic between education and turnout.

[3] Nie, Junn, and Stehlik-Barry concede this point when they state that their "model is not intended to explain the trend itself" (1996, 135).

[4] In addition to the conceptual differences between individual- and aggregate-level studies of turnout, it is also important to note differences in empirical findings across the levels. At the individual level, education is widely accepted as the "primary [individual-level] determinant of voting" (Leighley and Nagler 1992a). In the aggregate, however, "education is a poor predictor of time-series variation in voter turnout" (Tenn 2005, 271). This, of course, adds to the confounding nature of the puzzle of participation.

[5] In addition to Nie, Junn, and Stehlik-Barry's original work, a number of scholars have demonstrated additional empirical support for the sorting model (e.g., Tenn 2005, 2007; Campbell 2007). These studies all provide individual-level tests of the sorting model, and so it is not necessary to do so here. The aggregate-level implications of the sorting model have not yet been tested. This paper aims to accomplish this task.

[6] Brody's (1978) own explanation for puzzle of participation in America also focuses on decreasing levels of political efficacy within the electorate.

[7] The Abramson-Aldrich explanation is similar to (though not a direct modeling of) that offered by Walter Dean Burnham's (1965) thesis linking the decreases in party competition to secular declines in

turnout. The argument that turnout decline resulted from decreasing partisan attachments is also adopted by Kleppner (1982).

[8] Counterfactual simulations of over-time trends are also used by Steven Rosenstone and John Mark Hansen (1993) in their landmark study of mobilization and political participation. Their over-time comparisons of the probability of voting are based upon simulations where respondents from the 1960, 1964, and 1968 National Election Studies are assigned characteristics—such as elevated levels of education, lower levels of efficacy, weaker partisan attachments, and less frequent contact with mobilizing agents—held by their 1980 counterparts. Rosenstone and Hansen argue that the decline of political participation in America is primarily a function of decreased mobilization efforts by political parties and interest groups and that this factor outweighed any potential gains attributable to increased education attainment. Yet, once again, the simulation method used in this study does not provide a true test of whether changes in voter turnout were attributable to changes in educational attainment.

In fairness, the Abramson-Aldrich, Cassel-Luskin, and Rosenstone-Hansen studies—like all individual-level studies of turnout decline conducted during this period of time—were inherently limited by the small number of over-time data points with which they were dealing. With few time points, standard time series practices could not be implemented; alternative methods, even though inferior, were used to gain as much leverage on temporal issues as was possible.

[9] Not everyone accepts the existence of a causal relationship between education and turnout. Recent work by Milligan, Moretti, and Oreopolous (2003) and Dee (2004) argue that the correlation between education and political participation may be spurious, owing to unobserved correlated factors (see also, Tenn 2007). This position is supported by the recent work of Kam and Palmer (2008), who argue that higher education is simply a proxy for pre-adult socialization and not a direct cause of political participation.

[10] This is meant to be a suggestive rather than exhaustive list of the causal mechanisms that might link education to turnout. Jackson (1995, 279), for example, lists four plausible explanations: "(a) education

instills a sense of civic duty, (b) education increases sense of political efficacy, (c) education makes registration easier, and (d) education enhances political sophistication or awareness." He finds that the latter two factors are especially relevant paths to increased turnout.

[11] In their book, Nie, Junn, and Stehlik-Barry routinely refer to the resource model as "the additive model."

[12] Nie, Junn, and Stehlik-Barry distinguish two dimensions of democratic citizenship: political engagement (found in the quote) and democratic enlightenment. In fairness, the authors actually categorize turnout under the rubric of democratic enlightenment, not political engagement. The quotation used in the text is not meant to confuse turnout with their conceptualization, merely to show the strength with which the authors juxtapose the additive and sorting models. Indeed, the authors apply this "either or" approach to tests of both political engagement and democratic enlightment.

[13] Ideally, neighborhood level data or network level data would provide an even better test of the sorting model, but these data do not exist over the time period of interest.

[14] The growth rate for turnout, for instance, takes the following form $[(\text{turnout}_t - \text{turnout}_{t-1})/\text{turnout}_{t-1}]*100$. Other growth rates used in the analysis are constructed similarly.

[15] One additional benefit of using aggregate data instead of survey data is that I do not have to rely on self reports of turnout, which are potentially troublesome. Survey respondents have long been known to over report their participation in elections to researchers (Silver, Anderson, and Abramson 1986). More importantly, Burden (2000) has shown that over-reporting of voter turnout in the National Election Study (one common source for individual level data) has increased severely over time. This problem could bias any inferences that one might draw about turnout over time.

[16] The bivariate correlation between the average county-level turnout and national turnout from 1944 to 2000 is 0.62 ($p < .01$, one-tailed). Graphical comparison of the two trends suggests that the average county-level turnout and national turnout measures diverge a bit after the 1970 presidential election. This is likely caused by positive skew in the distribution of county-level turnout during this period, bringing up

the average. Nevertheless, as seen in Figure 1, the average county level turnout measure does illustrate a significant decline in turnout post-1960.

[17] It is important to note that most studies of the puzzle of participation do not incorporate data from the period of increasing turnout between 1944 and 1960. This is because reliable survey data, such as the American National Election Studies, do not begin until the mid-1950s.

[18] The inclusion of a lagged dependent variable in our dynamic growth model also ensures that the coefficient estimates associated with the independent variables are conservative (Achen 2000).

[19] The data are restricted to the continental U.S. for two reasons: 1) Alaska and Hawaii did not enter the union until 1959, and 2) Alaska records election data by Elected District rather than county.

[20] Work by McDonald and Popkin (2001) suggests that the voting eligible population (VEP) is a more appropriate denominator for measuring turnout. VEP differs from voting age population (VAP) in that it excludes individuals who are noncitizens or disenfranchised felons, while including citizens temporarily living abroad. Unfortunately, the VEP data are only available at the national level and not at the county level, which precludes me from using them here.

[21] In the period before the passage of the 26th Amendment in 1971, a few states allowed citizens between the ages of 18-21 to vote.

[22] I use growth in high school graduates rather than growth in college graduates on turnout growth because the latter is relatively static over the period investigated here. Of course, college graduation levels in the United States have increased dramatically from a county-level mean of roughly 4% in 1948 to roughly 16.5% in 2000. Yet the rate of growth in college graduation levels is much more static during the period under investigation here (mean rate of growth in county-level college graduation rates = 12.28%, standard deviation = 5.01%), especially when compared to growth in high school graduation rates (mean rate of growth in county-level high school graduation rates = 21.86%, standard deviation = 32.34%). In fact, there is no decipherable temporal trend in the average growth rate in college graduates

across the time period studied here. Consequently, growth in college graduation rates has a much more muted effect on the growth in turnout when compared to the growth in high school graduation rates.

[23] Income is inflation-adjusted (CPI set to 1984-84 = 100).

[24] The percentage of African Americans in a county is measured as the lagged base level primarily because of the growth in African American population by county lacked significant variation.

[25] The voter registration law data comes from Bernard (1950), Knack (1995), Rosenstone and Wolfinger (1978), Smith (1960), and several volumes of *The Book of States*. There are some missing data for the *Registration Closing Date* variable in the 1960s. To impute these missing values, I averaged the state's *Registration Closing Date* from the preceding and subsequent election years.

[26] The *Motor Voter* variable accounts for the fact that a number of states implemented these programs before the federal passage of the National Voter Registration Act of 1993.

[27] The intercept in the CSRE model is a "group-specific [county-specific] random element entering the regression identically for each period" (Greene 2008, 183). The single constant term is the mean of the unobserved heterogeneity.

[28] An additional benefit of the CSRE model over the CSFE model in this instance is the ability to distinguish county-level variation across multiple variables. Because the model of *Growth in Turnout* contains several county-level control variables, including *Growth in Education*, the inclusion of county-level fixed effects would unnecessarily mute these explanatory factors.

[29] The coefficient estimate for σ_μ reflects the squared root of the residual variance associated with the unobservable county-specific effects. The estimate of ρ denotes the variance ratio of the unobservable county-specific effect component of the residuals to the total residuals (Hsiao 2003, 38)

[30] Setting $Education_{t-1}$ to zero may seem nonsensical until one recognizes the extremely low high school graduation rates during the early period of study here. In this dataset, there are thirty cases where the percent high school graduates in the county is less than 1.5%.

[31] While the modeling approach taken here allows us to discern whether the additive and sorting hypotheses work independently from one another or not, it does not allow us to distinguish the precise contribution to turnout growth made by each factor. The interactive nature of the model requires us to compute marginal effects for these variables jointly.

[32] These results are available from the author upon request.

[33] In a nonstationary process, the long-run effects may be "explosive," meaning that the there is no long-run mean to which the series returns (Enders 1995, 212-212)

[34] Because the long-run effect is a nonlinear combination of estimators, I used the delta method in order to generate approximate standard errors for $\hat{\varphi}$ at one unit increments across the range of X_{2it-1}. The delta method expands a function of a random variable around its mean and then derives its variance using a one-step Taylor approximation (see Greene 2008, 68-70). The delta method can be applied in STATA Version 10 using the `nlcom` command. As was the case with the conditional marginal effects illustrated in Figure 3, the conditional long-run effects are significant and positive (though less than .141) for values of $X_{2it-1} < 24\%$ and significant and negative (never less than -.390) for values of $X_{2it-1} > 30\%$.

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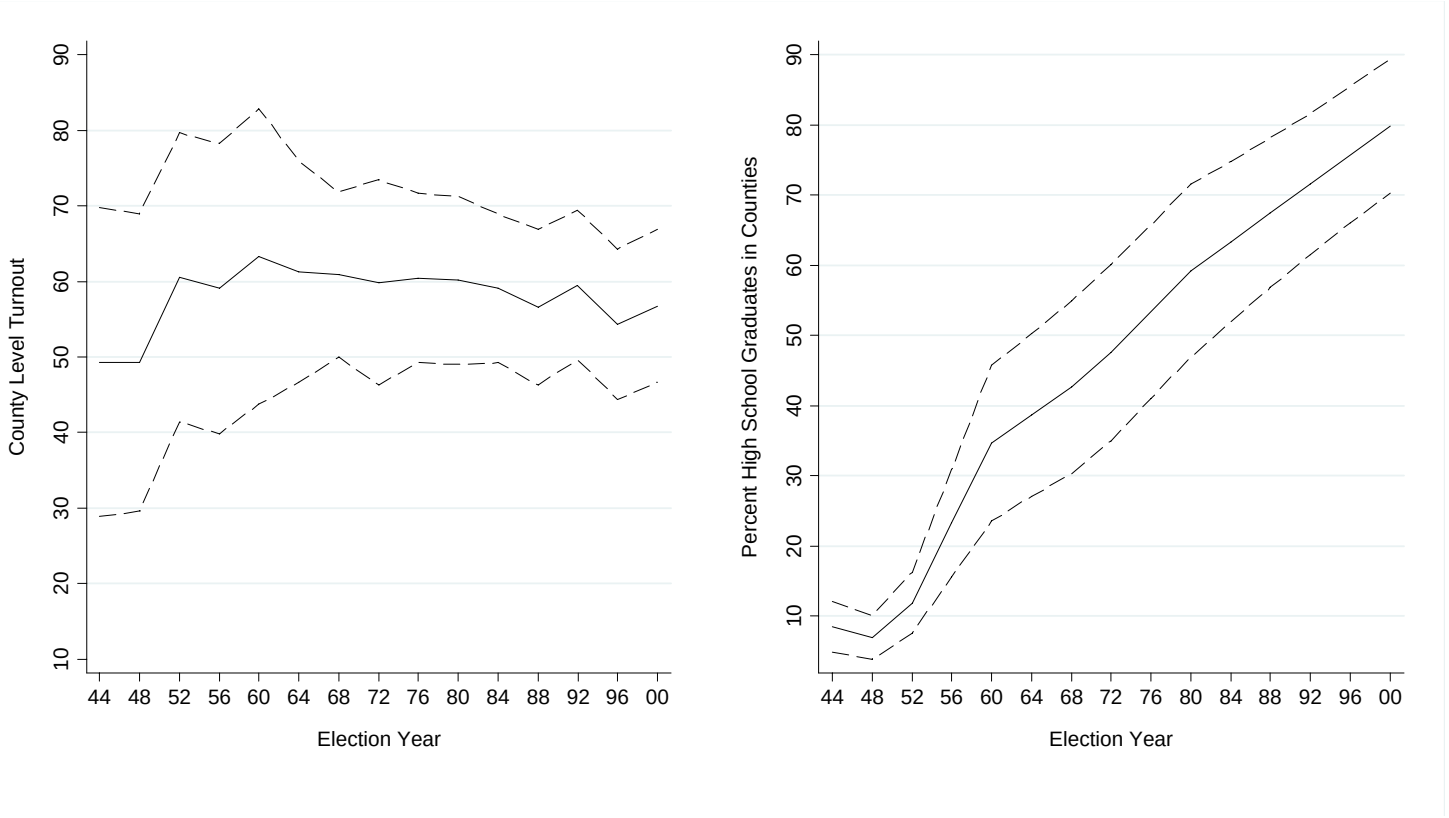
TABLE 1. Models of Growth in County Level Turnout in U.S. Presidential Elections, 1948-2000.

Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Growth in Turnout $_{t-1}$	-.130*	-.146*	-.162*	-.170*
	(.005)	(.005)	(.005)	(.005)
Growth in Education	.130*	.153*	.121*	.164*
	(.005)	(.005)	(.005)	(.006)
Education $_{t-1}$		-.067*	.050*	.063*
		(.008)	(.007)	(.007)
Growth in Education ×		-.009*	-.007*	-.006*
Education $_{t-1}$		(.000)	(.000)	(.000)
Growth in Income			.001	.001
			(.001)	(.001)
% African American $_{t-1}$			.284*	.252*
			(.005)	(.005)
Δ Closing Date				-.251*
				(.006)
Δ Restrictiveness				-3.841*
				(.220)
Gubernatorial Election				-1.997*
				(.332)
Senate Election				-.297
				(.083)
Constant	-11.174*	-1.987*	-4.156*	-1.918*
	(.566)	(.661)	(.726)	(.635)
σ_μ	3.459*	3.219*	.656*	.974*
	(.106)	(.107)	(.289)	(.202)
ρ	.061*	.054*	.003	.005*
	(.004)	(.003)	(.002)	(.002)
Number of Observations	40,262	40,262	40,261	40,256
Log Likelihood	-163,111	-162,748	-161,537	-160,542
LR Test (χ^2 d.f)	16,062 (14)*	16,789 (16)*	19,204 (18)*	21,145 (22)*

Cell entries are linear cross-sectional random effects (CSRE) estimates with standard errors in parentheses. Models also include fixed effects for election year; coefficient estimates for these variables can be obtained from the author.

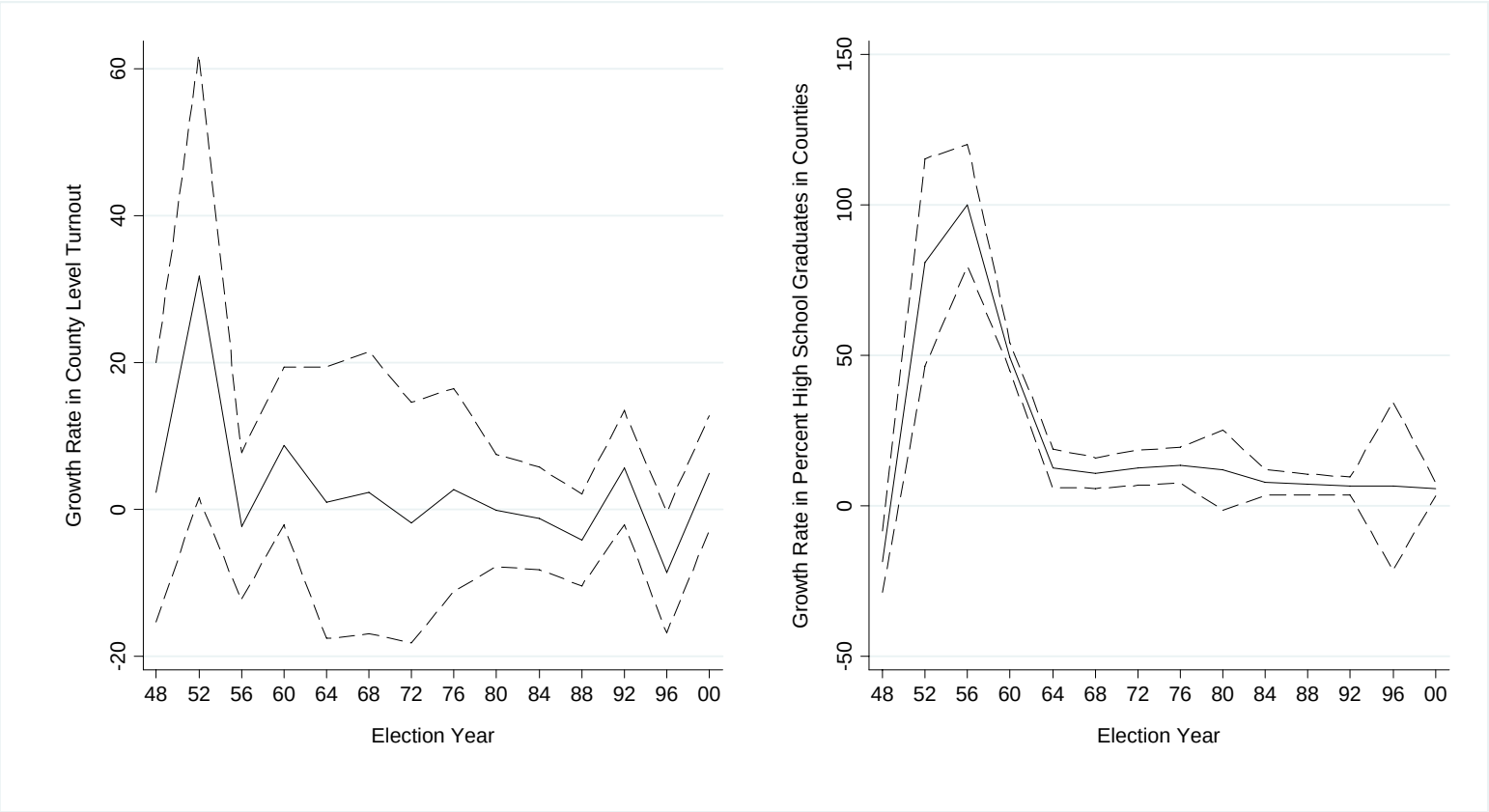
* $p \leq .05$ (two-tailed test).

FIGURE 1. County Level Turnout and Education in the United States, 1944-2000.



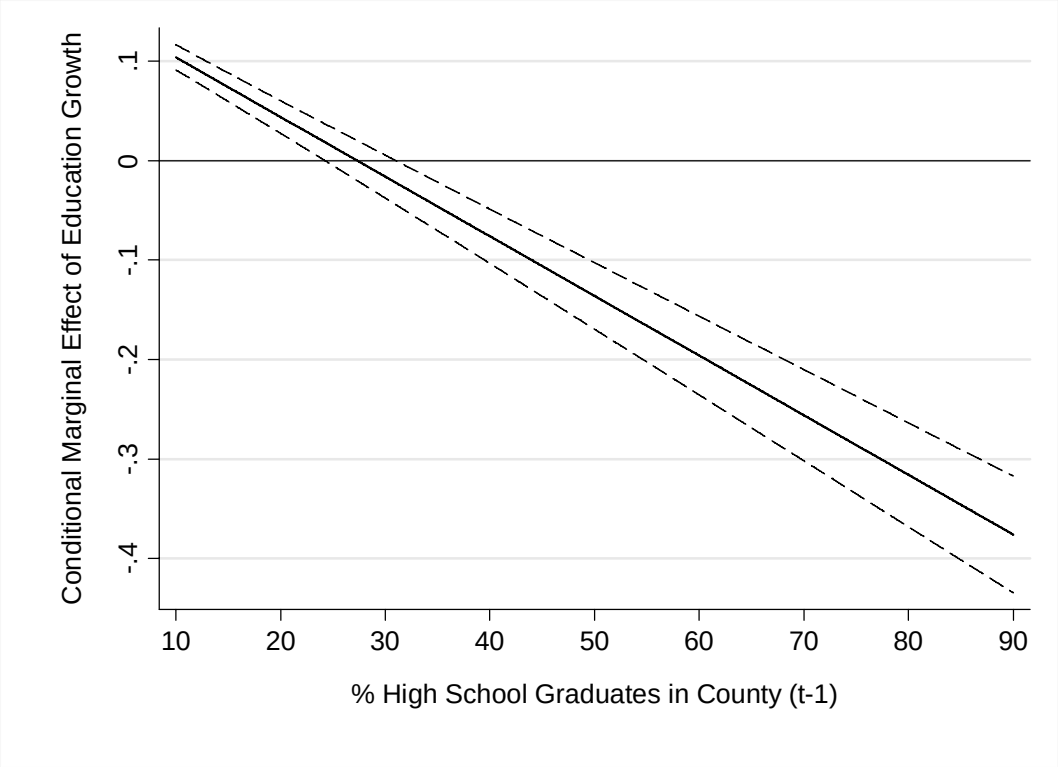
Note: Solid Lines represent the average turnout level and average percent high school graduates, respectively, in U.S. Counties for each of the presidential election years, 1944-2000. Dotted Lines indicate one standard deviation above and below the county-level averages for each election year.

FIGURE 2. Growth Rate in County Level Turnout and Education in the United States, 1948-2000.



Note: Solid Lines represent the average growth turnout level and average growth in percent high school graduates, respectively, in U.S. Counties for each of the presidential election years, 1948-2000. Dotted Lines indicate one standard deviation above and below the county-level averages for each election year.

FIGURE 3. The Conditional Marginal Effect of Growth in Education on Growth in Turnout Given the Level of Education in the County.



Note: The conditional marginal effect represents the change in the slope of turnout growth on education growth associated with a one-unit change in % high school graduates in the county (see Freidrich 1982). A 95% confidence interval was computed based on the conditional standard error of the estimate but was not used in the graph because the interval is so small that it virtually overlaps the estimate.