# Quasi-Experimental Evidence of School Choice through Residential Sorting *

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**Abstract**

Providing greater school choice is thought to be a viable decentralized avenue for improving scholastic outcomes. Yet very little is understood about the underlying traditional school choice that parents make when deciding where to live. We provide quasi-experimental evidence of such choice by implementing a Regression Discontinuity design, characterizing it according to who exercises it and where it is exercised. Using rich data on North Carolina students, schools and neighborhoods, we exploit the existence of an age cutoff rule for entry into kindergarten to identify residential choices that occur as a result of public schooling. We show that traditional school choice is exercised by at least 20 percent of families with children attending public school and is prevalent both within and across districts, particularly at lower and higher grades. Our evidence indicates that relative to white families, families of other ethnicities tend to exercise more school choice both within and across districts. This implies that minority families would disproportionately benefit from an intra-district or inter-district open enrollment policy. Further analysis suggests that average student achievement in the school, although a relatively important determinant of traditional school choice, still explains little of the TSC observed in the data. We also discuss the role that housing supply frictions may have on school choice. These findings complement the prior literature and provide potentially valuable insight to those interested in school accountability and school choice programs.

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# 1 Introduction

In recent years, policymakers have increasingly focused on education reforms that empower parents with greater school choice as a viable avenue for raising student achievement. The efficacy of such interventions depends on the extent to which an increase in school choice enhances school productivity through increased competition among schools and engenders unintended student segregation across them, each of which in turn hinge on how parents exercise school choice in the absence of overt reforms. Typically referred to as traditional school choice (defined by Hoxby (2003) and hereafter abbreviated as TSC), this baseline is a subset of the broader Tiebout choice and can take one of two forms: households may move purely as a result of public schooling or, conditional on moving for any reason, they may choose a different neighborhood as a result of public schooling. Despite its relevance to the implementation of higher-powered policies, surprisingly little is known about how TSC factors into household decisions.

In this paper, we provide the first quasi-experimental evidence of TSC, determining *who* exercises it and *where* it is exercised. Our approach exploits the ubiquitous practice of school systems restricting entry of prospective students according to a calendar cutoff for a student's date of birth. In particular, we focus on the October 16th cutoff that North Carolina employed,[1] so that a child turning five on or before October 16th would be entitled to begin kindergarten one year earlier than a child born after October 16th of the corresponding year. We hypothesize that such a cutoff should create a discontinuity in the probability of being enrolled in public school in general, and kindergarten in particular, among children who turn five during the school year. This in turn will affect the propensity to exercise TSC in that year. The reasoning is as follows: Households with children born prior to the cutoff may move to access a more desirable school or school district, reaping the benefits at the same time they incur the costs of doing so. On the other hand, while households with children born after the cutoff could move to their preferred neighborhood at the same time, they would be subject to the same immediate costs but would not receive any schooling benefits until the next year. We would therefore expect that some households with a

[1] The age cutoff is defined by North Carolina General Statute 115C-364. It was changed to August 31st when the statute was amended in 2010.

post-cutoff child would delay their schooling decision by one year when compared to those with a pre-cutoff child.

Based on the preceding argument, those born immediately prior to the cutoff face an exogenously different incentive to exercise TSC than those born immediately after. While households with children born just prior to the cutoff are expected to make their schooling choice one year earlier than those with children born just after it, the two types should be similar to each other (on average) along observed and unobserved dimensions. Given this research design, if we detect a discontinuity in a variable such as the moving rate of families, according to the birth date of their child, it must be attributable to incentives arising from school choice.[2]

This identification argument extends to all other ages as well, according to the following logic: In the absence of grade promotion or retention, children born on or before the October 16th cutoff are expected to be enrolled in grade one at age six, grade two at age seven, and so on, with those born after the cutoff being expected to be found in the next lower grade for any given age. Similarly, the older children with respect to the cutoff are expected to be one year away from entering kindergarten at age four, two years away at age three, and so on, with the younger children being an additional year from entering kindergarten in each instance. Based on these differences in treatment, we can analyze the disparity in the rates at which families move on either side of the entry age cutoff date to discover the extent to which they exercise TSC at each stage of a child's development.

To implement our identification strategy, we bring together several sets of data. Provided by the North Carolina Education Research Data Center (NCERDC), the key datasets provide information on the exact birthdate of each student in the North Carolina public school system from 1994 to 2009, the residential address of those students and end-of-grade testing data for grades three through twelve. This last dataset allows us to verify each student's grade, so that we know the grade distribution for any particular age and birthdate, and it also contains individual student characteristics, such as ethnicity, gender, parental education and the school attended. The address

[2]The idea of measuring an effect at the discontinuity point, controlling implicitly for observable and unobservable covariates, was originally proposed by Cook and Campbell (1979). Since then, the so-called Regression Discontinuity design has been used extensively in several domains of empirical work.

data permits us to make an additional methodological contribution to the literature by forming family identifiers that connect siblings to one another, enabling an analysis of student moves before they appear in the grade-verified schooling data and after they leave the school system following graduation. We also augment our rich student-level data by linking it to the 2000 United States Census to explore how our TSC measures correlate with characteristics of the neighborhood where students live.

The evidence of TSC is extensive, with at least 20 percent of families exercising TSC overall. Both types of TSC are prevalent: while some families move purely as a result of public schooling, others, conditional on moving for any reason, choose to live in a different neighborhood as a result of public schooling. Decomposing our results according to the nature of the TSC-related move, we find that families exercise school choice by sorting both across and within school districts. Across districts TSC is more prevalent in families with children around the age of attending elementary school grades, but is also present in families with children in middle school, high school and who benefit less from the public school system as some of their children have graduated from high school. In contrast, the within-district variant is more evenly distributed across ages. Minority families tend to exercise more TSC than white families both within and across districts. This result suggest that an intra-district (or an inter-district) open enrollment policy that allows children to attend any school within their district (or across districts) of residence without their family having to move might disproportionately benefit minority families.[3]

We also study the scholastic determinants of TSC by analyzing whether the school amenities last year affected newly made TSC this year even after controlling for confounding factors. We show that test scores are important determinants of newly made TSC, while peer characteristics such as the share of whites enrolled in the district are found to not be as important.[4] We also find that the presence and number of charter

[3]It is certainly possible that the relative lack of within-district and across-district TSC observed for white families stems from a differential constraint that they face. For instance, white families are more likely to be homeowners rather than renters, hence they may incur in higher costs when moving. If so, a policy of open enrollment could provide a higher benefit to white families as they would be able to avoid incurring moving costs. Further research that disentangles moving costs and preferences when explaining TSC patterns therefore seems warranted, so that the merits of relaxing enrollment constraints can be better assessed.

[4]The share of the student body that is eligible for free lunch was found to not be an important determinant as well.

schools in the district is found to be an important determinant of TSC, perhaps making the district more attractive for parents seeking better education for their children.

Further, we provide suggestive evidence that housing supply frictions play an important role in TSC: families who exercise TSC tend to live in neighborhoods with a tighter housing market, as reflected by fewer housing vacancies. In the presence of housing supply frictions, families who wish to exercise TSC in a particular year may either postpone their decision or choose another neighborhood if their preferred housing type is not available in their preferred neighborhood. A natural consequence of market tightness is that small differences in the timing of residential choices for families facing otherwise similar conditions can result in a permanently divergent set of subsequent neighborhood choices. We find strong evidence in favor of such effects: many families that we observe exercising TSC select entirely different neighborhood choice paths than they would have if their children were born only a few days later.

We show evidence of another housing supply friction: there may not be available neighborhoods with the desirable mix of school quality and other amenities, which would either prevent families from exercising TSC or make them choose a non-optimal level of another amenity in the process of exercising TSC. Given that we measure the extent of TSC for each district, we are able to explore how it is correlated with observable school characteristics and bundled with various neighborhood amenities. Using pairwise correlations, we find that families who exercise TSC tend to select neighborhoods with schools that have higher average standardized test scores and whose peers are more socioeconomically advantaged, as might be expected if parents prefer a better education for their children. The evidence also suggests such families tend to live in neighborhoods with more desirable non-public-school-related amenities, highlighting the potential importance of amenity bundling within North Carolina neighborhoods.[5] In a counterfactual environment without bundling where families are able to pay only for the better school they choose, one would expect our measure of exercised TSC to be positively correlated with school quality measures and the purchase or rental price of housing (which would purely reflect the presence of better schools), but uncorrelated with non-public-school-related amenities. The indication of bundling in our

[5]For instance, these families tend to live in neighborhoods with higher average income levels, which is often viewed as a positive amenity over and above any positive peer effect that may be generated inside the public school.

data suggests that some families who would exercise TSC in the absence of bundling might be impeded from doing so by the prospect of simultaneously paying for more desirable schools and for higher levels of other amenities.[6] Further work on this issue is important, as it would enable researchers to conduct welfare analyses using a refined measure of the willingness to pay for school quality.

Our paper is organized as follows: The next section highlights our contribution relative to the prior literature. Section 3 discusses our identification strategy and Section 4 describes our rich set of data. Section 5 then presents our results and Section 6 concludes.

## 2 Prior Literature

Since Tiebout (1956), there have been several studies on the determinants and consequences of residential sorting in the United States (for example, Epple and Sieg (1999) and Rhode and Strumpf (2003)). People may decide to move to a new neighborhood for several reasons, such as the availability of better neighborhood amenities, a shorter commute time to work and better housing. Among the many amenities that may affect sorting across neighborhoods, none has received greater attention than public education.

The topic of traditional school choice (TSC) has permeated many different strands of literature. Our analysis is complementary to research that shows parents are willing to pay more to live in neighborhoods with better schools (see, Black (1999), Bayer *et al.* (2007) and Caetano (2012)).[7] While this research provides compelling support for the TSC hypothesis, it is notably unable to directly identify the families who move in response to differences in the quality of public education across neighborhoods (rather than differences in any other neighborhood amenity or household characteristic) and where they do so. Without this information, it is difficult to identify the principal beneficiaries of a heightened school choice policy or to design an efficient choice program in the first place (which would require knowledge about whom to target). Moreover,

[6]Note that it is possible families who exercise TSC place a greater value on these other amenities than does the median family. In this case, they would obtain an even higher consumer surplus by exercising TSC within a bundling environment.

[7]Black and Machin (2011) provide a recent review of the literature on this topic.

it is hard to determine exactly where traditional or heightened school choice is more likely to be holding school principals to account. Additionally, without understanding the roles of bundling and search frictions in practice, using measures of the willingness to pay for school quality to conduct welfare analyses is problematic.

Our study is also relevant to a strand of literature that investigates the causes and consequences of TSC using Herfindahl indices of concentration as a proxy variable for the amount of TSC, and hence competition, occurring in a city. For instance, Hoxby (2000a) and Rothstein (2007) use these indices to test the hypothesis that greater competition leads to more productive public schools. Investigating an alternative consequence of TSC, Clotfelter (1999) and Urquiola (2005) analyze its effect on segregation. Clotfelter (1999) compares the degree of segregation across school districts and within them, finding it to be more acute in the former case (where TSC is expected to disproportionately operate), while Urquiola (2005) uses Herfindahl indices to show that more concentrated districts tend to feature greater segregation across schools. In either case, the evidence suggests that TSC engenders greater segregation. With respect to the causes of TSC, Rothstein (2006) presents evidence that parents seem to care more about peer effects than school productivity, which implies that schools would have little incentive to increase efficiency under an environment with heightened competition. While this strand of literature has made important contributions to our understanding of TSC, it relies on indirect measures which may not reflect the amount of competition that public schools actually face. By virtue of our direct revealed-preference-based approach, our measure can provide a foundation for shedding new light on the causes and consequences of TSC.

Beyond the research that has analyzed TSC and its effects, our work complements a much broader set of literature which deals with the fundamental problem of raising student achievement. A key reason for uncovering the extent to which TSC occurs in practice is to relate it to a benchmark where parents can fully exercise TSC without friction. Ostensibly, this would lead to a perfectly competitive environment where schools reach an optimal level of productivity by competing with each other to attract funding through enrollment. The further we are from this ideal benchmark, the more top-down accountability or heightened school choice reforms are needed to get closer to the optimum. For the former type of reform, research has shown that greater accountability can raise achievement (for example, see Carnoy and Loeb (2002), Hanushek and Raymond (2005), and Figlio and Kenny (2007)). However, the scope for accountability to improve outcomes is less clear, as the extent of competition through TSC dictates the efficacy of such reforms. As for heightened school choice reforms, researchers have focused on the effect of private school vouchers (Angrist *et al.* (2002)), charter schools (Hanushek *et al.* (2007) and Angrist *et al.* (2013)) and open enrollment. With respect to this last type of reform, Reback (2008) finds that the choice of parents to be transferred out of the district is more related to school outcomes (for example, test scores) than to school inputs. Additionally, Welsch *et al.* (2010) and Carlson *et al.* (2011) study the characteristics of the destination school where transferring children are more likely to go, and Cullen *et al.* (2005) investigate who is more likely to request to be transferred out of the district. As with accountability reforms, characterizing the degree to which families exercise TSC is needed to provide context for these results. Our approach is well suited to doing so along several key dimensions.

# 3 Identification Strategy

We begin by describing a simple dynamic model of residential choice which we use to interpret our results. We then describe our strategy to disentangle public-school-related residential decisions from the multitude of other factors that influence neighborhood sorting.

## 3.1 A Simple Model of Residential Choice

Consider a family $i$ originally in neighborhood $j_{it-1}$ deciding where to live in period $t$. The family observes a vector of state variables $W_{it}$. Different families may perceive the level of amenities of the same neighborhood differently (e.g., because their child is attending a different grade) or have different preferences for the same level of the amenities, or both. The choice-specific value function can be written (e.g., see Bayer *et al.* (2007b)) as

$$v_j\left(W_{it}\right) = \mathbf{1}_{\{j \neq j_{it-1}\}}.\phi_{it} + u_j\left(W_{it}\right) + \beta_{it} V(W_{it}, j). \tag{1}$$

where $\mathbf{1}_{\{.\}}$ is the indicator function for whether the expression in parenthesis is true, $\phi$ is the moving cost, $u$ is the flow utility, $\beta$ is the intertemporal discount, and $V(W_{it}, j) := E[\max_k v_k(W')|W_{it}, j_{it} = j]$, where $W_{it}$ transitions to $W'$ with probability $F_{ijt}$. Family $i$ will choose a neighborhood in order to maximize its utility, so that

$$j_{it} = j \iff v_j\left(W_{it}\right) > v_k\left(W_{it}\right), \quad \forall k \neq j. \tag{2}$$

where $j_{it} := \operatorname{argmax}_j v_j(W_{it})$.

## 3.2 Identifying Residential Sorting due to TSC

To make our identification strategy more concrete, we introduce some notation. Let the cutoff of October 16th be denoted by $D$. Let $a^T$ denote a child who is of age $a$ and is born just before the cutoff $D$, and $a^C$ denote a child who is of age $a$ and is born just after the cutoff $D$.

For simplicity in the exposition, consider a family with one child.[8] Each family $i$ is systematically characterized by the vector $(a, d, \tau)$, where $d$ refers to the day the child is born and $\tau$ represents the type of the family with respect to that child (which may be unobserved to the researcher). Let $\underline{\mathrm{t}}$ be the year the student is born. In period $t = \underline{\mathrm{t}} + a$ we will observe families with children of age $a$ who were born on day $d$. They will be in different timings $g$ at different rates depending on $(a, d, \tau)$. Even though we tend to observe children $a^T$ at timing $g = a - 5$, and students $a^C$ at timing $g = a - 6$, we also observe them in different timings, so we need to take the entire distribution into account. For expositional simplicity, we focus only on the cohort born $\underline{\mathrm{t}}$ in this section, so we can drop the $t$ subscript.

Let $W(a, d, \tau)$ be the state variable that families of the students of age $a$, of type $\tau$ and born on day $d$ observe just before making their residential decision in that period.

[8] We later argue that this assumption is without loss of generality.

$W(a, d, \tau)$ is related to $W_{it}$ in equation (1) in that the latter is equal to the former plus another idiosyncratic individual term. We decompose $W(a, d, \tau)$ in the following way: $W(a, d, \tau) := (S(a, d, \tau), \xi(a, d, \tau))$, where $S(a, d, \tau)$ includes the component of the state variable related to public schooling and $\xi(a, d, \tau)$ includes the remainder (that is, the component of the state variable that is unrelated to public schooling). For instance, $S(a, d, \tau)$ may include the grade the student is attending or has ever attended, or the amenities of all available schools both in general and for a specific grade. In contrast, $\xi(a, d, \tau)$ may include housing amenities, neighborhood amenities other than public school quality, or constraints in the housing supply that may lead to search frictions. For instance, families of students of age $a$, of type $\tau$ and born on day $d$ may not be able to find a house in the chosen neighborhood that matches their housing preferences during a particular period. $\tau$ represents family characteristics that affect the residential choice irrespective of whether they are observed by the researcher, such as income, education, marital status, number of children in the family, the family's preference for education and the family's preference for housing. To highlight the inclusive aspect of $S$, note that if there is any component of the state variable that was affected by an earlier decision triggered by public schooling, then that component will be included in $S(a, d, \tau)$ rather than in $\xi(a, d, \tau)$. For instance, if $S(a, d, \tau)$ affected the residential decision of students, then, because of moving costs, $S(a + 1, d, \tau)$ will include $S(a, d, \tau)$ (that is, their decision in $t + 1$ will also be a function of the state variable in $t$).

Let $p_j(a, d, \tau)$, the proportion of families who choose to live in $j$, among those whose child is of age $a$, type $\tau$ and is born on day $d$. Then we write:[9]

$$p_j(a, d, \tau) = p_j(S(a, d, \tau), \xi(a, d, \tau)) \tag{3}$$

so that the residential decision is explicitly a function of both state variables.

Aggregating this measure for all potential values of $\tau$, we have

[9] An analogous logic can be made for moving rates, which will be used in the second part of our analysis.

$$p_j(a,d) = \int_\tau p_j(S(a,d,\tau), \xi(a,d,\tau)) f(\tau|a,d) d\tau \tag{4}$$

where $f(\tau|a,d)$ is the conditional probability density function of $\tau$ given $(a,d)$. We make the following assumptions to guarantee identification:

**Assumption 3.1.** *$p_j$ is a continuous function of $S$ and $\xi$.*

**Assumption 3.2.** *(Validity) For any $\tau$:*

1. $\lim_{d\uparrow D} f(\tau|a,d) = \lim_{d\downarrow D} f(\tau|a,d) := f(\tau|a)$ *for any $a$.*

2. $\lim_{d\uparrow D} \xi(a,d,\tau) = \lim_{d\downarrow D} \xi(a,d,\tau) := \xi(a,\tau)$ *for any $a$.*

Assumption 3.1 implies that the number of families choosing neighborhood $j$ does not vary discontinuously with the state variables. As suggested by equation (1) and (2), as long as there is some continuous random component of the moving costs or preferences that generate heterogeneity across families of each type, this assumption is satisfied. Assumption 3.2 represents the explicit assumptions implied by the assumption of validity in the context of our approach. Item 1 of assumption 3.2 means that the distribution of $\tau$ conditional on $a$ does not depend on $d$ when close to the cutoff, and item 2 means that the state variable $\xi$ varies continuously at the cutoff $D$. We provide evidence in favor of assumption 3.2.

**Assumption 3.3.** *(Existence of Treatment) There exists $\tau$ such that* $\lim_{d\downarrow D} S(0,d,\tau) := S^T(0,\tau) \neq S^C(0,\tau) := \lim_{d\uparrow D} S(0,d,\tau)$.

Assumption 3.3 is the standard existence of treatment assumption. It means that the state variable $S$ varies discontinuously at the cutoff $D$ for students of age 0. Although we do not observe students at age 0, we do observe them later in their lives, so we are able to provide evidence of assumption 3.3 because $S$ transitions as a function of the previous level of $S$ as well as $a$, $d$ and $\tau$:

**Assumption 3.4.** *(Transition)* $S(a+1,d,\tau) = g(S(a,d,\tau), a, d, \tau)$, $\forall a, d, \tau$

The assumptions above imply:[10]

$$
\begin{aligned}
\Delta p_j(a) :=& \lim_{d \downarrow D} p_j(a,d) - \lim_{d \uparrow D} p_j(a,d) = \\
&= \int_\tau \left( \lim_{d \downarrow D} p_j(S(a,d,\tau), \xi(a,d,\tau)) f(\tau|a,d) - \lim_{d \uparrow D} p_j(S(a,d,\tau), \xi(a,d,\tau)) f(\tau|a,d) \right) d\tau \\
&= \int_\tau \left( p_j(S^T(a,\tau), \xi(a,\tau)) - p_j(S^C(a,\tau), \xi(a,\tau)) \right) f(\tau|a) d\tau \neq 0 \qquad (5)
\end{aligned}
$$

so that any discontinuity at the cutoff $D$ in the proportion of families located in $j$ among those with a child of age $a$ is due to the state variable $S$ and it cannot be due to $\xi$. In other words, a discontinuity must arise from families exercising traditional school choice (TSC).

### 3.3 Building Intuition

To build further intuition about our identification strategy, consider a simple example with two school districts: one with high and one with low public school quality ($j \in \{H, L\}$). As a starting point, suppose families are only willing to exercise TSC immediately prior to kindergarten. Further, assume that the vector of non-public-school amenities is constant over time ($\xi_a = \xi_{a+1} \ \forall \ a$), so that the distribution of these amenities across neighborhoods is the same for families making their residential decision in any given period. In this case, the proportion of treatment students found in district $H$ at age five would be higher than the analogous proportion of control students, leading to a positive discontinuity in district $H$ ($\Delta p_H(5) = p_H^T(5) - p_H^C(5) > 0$). To balance this out, a negative discontinuity with the same magnitude would occur in district $L$ ($\Delta p_L(5) = -\Delta p_H(5) < 0$). For all other ages, there would be no discontinuity in the proportion ($\Delta p_j(a) = 0 \ \forall \ a \neq 5$). This is visualized in Figure 8a for district $H$. Alternatively, analyzing moves, there would be a positive discontinuity for age five and an offsetting one for age six ($\Delta m(5) = -\Delta m(6) > 0$), as the control students catch up to their treatment counterparts. No disparities in moves would occur for any other

[10] We also make the assumption that $\sup_d f(\tau|a,d)$ is finite. This assumption, together with the fact that $p_j(\cdot)$ is bounded above, guarantees that one can exchange the order of the limit and the integral.

ages ($\Delta m(a) = 0 \; \forall \; a \neq 5, 6$).[11]

The preceding case can be extended by supposing that families are willing to exercise TSC immediately prior to both kindergarten and first grade. Maintaining the assumption of a constant vector of non-public-school amenities over time, the resulting discontinuities in the proportion of students living in district $H$ are illustrated in Figure 8b. Under this scenario, there would be discontinuities for age five ($\Delta p_H(5) = -\Delta p_L(5) > 0$) and six ($\Delta p_H(6) = -\Delta p_L(6) > 0$) that are not necessarily equal to each other, and there would be no discontinuity for any other ages. To generate them, the discontinuity in move rates would be positive for age five, nonzero for age six and negative for age seven, such that $\Delta m(5) + \Delta m(6) + \Delta m(7) = 0$. The disparities for all other ages would be zero.

The example can also be extended by allowing the vector of non-public-school amenities to vary over time ($\xi_a \neq \xi_{a+1}$).[12] This case is visualized in Figure 8c. The discontinuity in the proportion of students living in each district would follow a similar pattern to the preceding case ($\Delta p_H(5) = -\Delta p_L(5) > 0$ and $\Delta p_H(6) = -\Delta p_L(6) > 0$). However, discontinuities would be likely to persist, as control students never fully close the gap opened by their treatment counterparts ($\Delta p_H(a) = -\Delta p_L(a) \geq 0 \; \forall \; a > 6$). The moving disparities would likewise be positive for age five ($\Delta m(5) > 0$) and nonzero for all higher ages ($\Delta m(a) \neq 0 \; \forall \; a > 5$). Intuitively, the original difference in the proportions due to TSC may continue indefinitely or even increase, as families are exposed to different shocks when it is time for them to choose a new location.

The intuition in the preceding example extends to families exercising TSC immediately prior to any grade, as depicted in Figure 9. In particular, we expect to find a discontinuity in the proportion of students living in each district for all ages, even if $\xi_a = \xi_{a+1} \; \forall \; a$. In the event that the vector of non-public-school amenities does vary over time, any disparity between treatment and control students as a result of valuing public school for a particular grade would be unlikely to close in future periods. While we restrict our example to contain only two districts, it is worth noting that the intu-

[11] For simplicity, we assume that there are no search frictions for housing in this example, so that all moves related to a particular grade of public school occur immediately prior to it. In practice, such frictions may exist, in which case a series of moves may occur from age zero to five that would culminate in the discontinuity in proportions predicted for age five.

[12] This would likely occur in the presence of search frictions. For instance, while a particular house type may be available in one period, it may not be in the following period.

ition developed here extends to an arbitrary number of school districts, which reflects the setting we analyze in practice.

# 4 Data

Our empirical strategy for uncovering direct evidence of TSC depends on the careful integration of several types of data, all of which are available in the case of North Carolina but have not previously been combined. The most important datasets are provided by the NCERDC. Crucially for our approach, the first one contains the exact date of birth for every student in the state who takes a standardized test at least once in their scholastic career.[13] Using this fine-grained information, we are able to identify students who are born close to and on either side of the entry age cutoff date.[14]

The second key set of data consists of encrypted geocoded addresses for a large portion of students in kindergarten through grade twelve across the state. This information is compiled by the NCERDC from busing records which are provided by the North Carolina Transportation Information Management System (NCTIMS) for the years 1994 through 2012.[15] This administrative data serves several purposes. First, it allows us to establish where each student lives at the Census block group level. Second, it enables us to track those students as they move over time through year to year changes in address. Lastly, it permits us to construct a family identifier, which is novel in the literature. In particular, since we observe who resides together over time, we are able to connect siblings to one another for multi-child families. This makes it possible to track where students who are not directly observed in our data live by exploiting the address information of any older or younger siblings who are currently attending public school in our sample.

The third NCERDC-derived dataset of which we make use contains end-of-grade testing data, which exists for all students in grades three through twelve for the years 1994 through 2012. It is useful for two reasons. Most importantly, it allows for grade

[13]In North Carolina, standardized tests are administered yearly for students in grades three through twelve.

[14]It is worth noting that the NCERDC ensures student anonymity by creating encrypted student identifiers in place of actual names, which we use to connect students across datasets.

[15]Addresses are available for all students residing in a school district when the district reports such statistics.

verification. This is essential given that the combination of a student's age and the entry age cutoff rule does not necessarily allow us to infer the grade in which they are enrolled for a given year. This is due to the fact that grade promotion and retention is likely to occur for some students after initial enrollment in kindergarten. The end-of-grade data is also useful because it contains information on individual student characteristics, such as ethnicity, sex, exceptionality status, parental education and the school as well as the school district attended, allowing us to explore whether there is heterogeneity in TSC patterns according to such attributes. In addition, given that the dataset indicates if students attend a charter school, we know how many of these schools serve students in each school district, allowing us to characterize the competitive environment and analyze whether TSC responds to variation in this measure.

To supplement the NCERDC data, we exploit information from the 2000 Decennial United States Census aggregated at the tract level. In particular, the presence of unencrypted block group identifiers (in addition to the encrypted address identifiers) in the busing data enables the linkage of individual students to the average characteristics of their neighbors, such as ethnicity, education, family income and house price. This allows us to explore the extent to which TSC is heterogeneous with respect to these features of the neighborhood.

We address two potentially problematic sample selection issues when constructing the primary dataset used in the analysis. The first one is that busing record coverage across school districts is relatively sparse for earlier years (as many districts do not report busing information in those years), causing us to restrict our analysis to the years 2007 through 2012. The second issue is a censoring one in that the treatment and control groups are non-randomly observed for ages where we cannot directly observe the grade in which each student is enrolled. Given that this problem is exacerbated by grade promotion and retention decisions that occur prior to grade verification being possible in grade three, we focus on students aged ten through sixteen in our core sample. Table 4 presents the grade distribution for students born within one week on either side of the cutoff at each age between ten and sixteen inclusive, where the proportions are designed to sum to one across all grades for each age-side combination. Based on the table, ten is the first age and sixteen the last age for which we are confident that no censoring issue exists based on grade verification. In the former case, while prior retention causes some students to be enrolled in grade three, patterns for age eleven suggest that we would not find any age ten students in grade two if we could verify this grade. An analogous argument holds for age sixteen students.

Based on the prior reasoning, the foundation of our dataset is a balanced panel consisting of student-level observations across seven ages and six years, covering the same 93 school districts over time which together account for 99.8 percent of the population in North Carolina.[16] We then build upon this using our aforementioned family identifier. In particular, upon establishing a familial link between a set of students, we exploit the known address of older siblings in earlier years to establish the address of students who are less than ten years old. In the case of two-child families, the maximum age disparity for which we can simultaneously observe both children (and thus connect them to the same family identifier) is five, owing to the six years contained in our core sample. Thus, given that the eldest sibling must still be contained in our sample to infer her younger sibling's address, five is the earliest age of the younger sibling that we can infer through our identifier for a two-child family. Analogously, twenty-one is the latest age of the older sibling that we can infer for a two-child family using the match between younger students we observe and their older siblings. In principle, families containing three or more children would allow us to expand the age range even further. However, the relatively low frequency of these families (less than 20 percent of observations – see Table 1) coupled with the need for exactly the right disparity among the multiple siblings results in an insufficient number of observations below age five and above age twenty-one.

Our final expanded sample consists of children aged five through twenty-one for the years 2007 through 2012. By construction, it should not suffer from the type of nonrandom selection issue associated with the raw data for non-core ages. This is due to the fact that the probability of being born slightly before or after the October 16th cutoff, conditional on the date of birth being near the cutoff, should be identical and independent across siblings due to random assignment. Therefore, if our sample passes a validity test for ages ten through sixteen, it should also do so for extended ages.

Defining cohorts according to the age of members as of 2007, Table 1 presents the

[16]Using population counts by Census tract for the year 2000, 8,030,477 people live in our included districts out of a total North Carolina population of 8,049,313 (see http://censusviewer.com/state/NC).

number of observations for each of our twelve cohorts. Cohort ten and eleven account for the largest proportion of the sample, given that members are observed in the core data in each of the six years without relying on family linkages for inference. The share of total observations declines for earlier and later cohorts for two reasons. First, the number of years for which students from one-child families appear in the core data declines. At the extreme, cohort five and sixteen students from one-child families only appear in the core data for one year each (2012 and 2007, respectively). Second, based on the prior logic, lower and upper cohorts include a greater number of extended ages for which the match rate using multi-child family identifiers is diminished.

Table 2 presents descriptive statistics for the characteristics of students in our sample and the school districts in which they live. At the student level, the male-female split is identical across one- and multi-child families, while the latter are more likely to contain white or Hispanic students. Overall, white students are the most prevalent in North Carolina, while black students constitute about 27 percent of the sample. In terms of district-level variation, the average school district in our sample contains about 86,000 people with some very large ones in the distribution (as revealed in Figure 1a), including Mecklenburg, Durham and Wake counties. Figures 1e and 1f reveal a highly heterogeneous spatial distribution by race in the state.

Figures 1g and 1h show that the most expensive places to live are around Charlotte-Mecklenburg and the Triangle (Raleigh, Durham and Chapel Hill), while Figures 1j, 1k and 1l reveal income and educated people to be concentrated in these areas. Finally, although students who are classified as gifted are likely to be found in these areas (Figure 1n), this is not always the case for standardized test scores (Figure 1m). We also present a map (Figure 1o) of the districts that have adopted charter schools to provide intuition for our later analysis of TSC in the presence or absence of heightened school choice reforms.

# 5 Results

We divide our results into three subsections. In the first one, we provide evidence of differential treatment, according to whether a student is born before or after the entry age cutoff. We also establish the validity of our identification strategy. In the second subsection, we present evidence of TSC by location, by analyzing the discontinuity in the probability of living within a particular school district according to a student's birthdate with respect to the entry cutoff. Any such discontinuity reflects a family's choice about where to live in all preceding periods spanning back to the birth of the student being considered. In the following subsection, we then discuss the evidence of TSC by changes in location from year to year. This analysis is complementary to the location analysis in two ways: first, we can check whether families are exercising TSC within districts; second, we can measure the pattern of TSC by age without doubly counting the families that exercise TSC.

## 5.1 Evidence of Treatment and Validity

According to the entry age cutoff rule, $5^T$ students are entitled to enroll in kindergarten in the year in which they turn five, whereas $5^C$ students must wait until the following year to enroll in kindergarten. If there is no grade retention or promotion, then $(5+g)^T$ and $(5+g)^C$ students should be enrolled in grade $g$ and $g-1$, respectively, $g$ years after entry into kindergarten ($g=0$). This would represent a sharp discontinuity in the treatment of grade according to a student's date of birth. In practice, retention and promotion does occur, meaning that the probability of finding a student in a particular grade will not be zero or one. Rather, it will be found between these values for the grade predicted by the entry rule and is likely to be non-zero for surrounding grades as well, implying both a fuzzy Regression Discontinuity design and a multi-valued treatment for each age.

To determine these probabilities, we first focus on an age window for which we observe a sufficient number of surrounding grades in the end-of-grade testing data, in order to not face the censoring issue discussed in section 4. Figure 2 reveals the discontinuity at the cutoff in the probability of attending grade six for age eleven students. Each plotted point represents the proportion of students who are born in a one week window and are attending grade six. It is readily apparent that about 50 percent more $11^T$ students are found in grade six than $11^C$. When combined with grade promotion and retention, this is in line with the prediction above. More generally, Table 4 shows that, across ages, the patterns are similar to those for eleven-year-olds, with a slight spreading of the grade distribution as age increases. We interpret these grade distribution results as direct evidence of treatment, as the clear discontinuities in $S$ support assumption 3.3. However, we also see direct evidence of retention and promotion in our sample, which suggests the need to disentangle the intention to treat effect between different kinds of treatment among the treated population if one wants to additionally understand the pattern of TSC across grades. However, it is clear that the majority of the effect is due to the grade implied by no retention and no promotion.[17]

Tables 5 through 12 present the estimated discontinuities for the total number of observations and the proportion of white, black and female students. These tests for validity are shown for each age-year combination, according to whether the child under consideration is the eldest or youngest within her family. Examples of the plots used to calculate such discontinuities are provided in Figures 3a through 3p. For the number of observations, we find no discontinuities at the five percent level and only three at the ten percent level. We also find very few significant discontinuities along race or gender.[18]

## 5.2 Evidence of TSC by Location

Given the preceding evidence in favor of validity and the existence of treatment, we begin our analysis by investigating the extent to which TSC engenders differential choices of where to live by school district. In keeping with our identification strategy, we are specifically interested to know whether the probability of a student living in a district depends on her treatment status. A student's residential location at a particular point in time should be thought of as a stock variable (as opposed to a change in location, which we will analyze next), so that any discontinuity in the probability would arise from differences in location choices for all earlier ages. Despite this ambiguity with respect to the exact timing of TSC, in this subsection we provide primary evidence

[17] We effectively estimate a weighted average of the intention to treat effect through all the potential compliers, weighted by the relative proportion of each set of compliers. For instance, for age eleven our estimate will be about 85 percent of the effect due to the compliers with no retention or promotion, and about 15 percent of the effect due to the compliers with one year of retention. Disentangling the effects of each complier is beyond the scope of this paper, as we focus on showing heterogeneity across ages instead of across grades.

[18] The discontinuities that do exist for the ethnicity variables are concentrated mainly in two cohorts, which we believe reflects an unobserved reclassification of ethnicity by the school system in an earlier year. All results shown in the paper are robust to dropping these cohorts from the sample.

of the existence of TSC and heterogeneity in its pattern.

Figures 4a and 4h show selected discontinuity plots plots aggregated across all LEAs with positive discontinuity for eldest child, youngest child and by race. Tables 13 and 20 present the corresponding results for all age-year combinations. The evidence of TSC is overwhelming for every race, and for both the eldest and the youngest child. The results also suggest that minority families exercise more TSC than white families. While about 20% of white families exercise TSC, the corresponding rate for minority families are around 30%.

Figures 5a through 5f show selected discontinuity plots for a variety of cohorts and districts for the sample of two or more children.[19] The plots show clear discontinuities, providing primary evidence of families exercising TSC. To better understand the extent of TSC across districts, for the sample of families with two or more children we present maps 6a through 6k, which show respectively for each cohort how the discontinuities are geographically distributed according to its sign and significance. One interesting result to notice is that different cohorts tend to exercise TSC in different districts. This is likely due to different neighborhood shocks that they experienced at different timings, which lead them to make permanently different residential choices. Another interesting finding is that the districts with net outflow based on TSC tend to be around districts with net inflow based on TSC, which suggests some substitution across locations within a single labor market area.

## 5.3 Evidence of TSC by Changes in Location

Table 21 reveals the evolution of the discontinuities over time by cohort for selected districts. As can be seen in Panel A, the discontinuities are very stable over time within district, implying that the original difference in choices made by families in $a^T$ and $a^C$ remains the same as the children of the same families grow older. This suggests that as $a^T$ families choose a different location from the $a^C$ families in year $t$, the $a^C$ families in these districts do not fully close the gap in year $t+1$ between themselves and $a^T$ families. There are two reasons why this could happen: either there are new shocks

[19]For all discontinuity plots, we use a local linear polynomial with a bandwidth of 56 days and an Epanechnikov kernel. The scatter plots use bins of 7 days and the confidence intervals are constructed at the 5 percent level of significance. All results presented in the paper are robust to the choice of bandwidth and kernel.

in $t+1$ (e.g., availability of a particular type of housing), which lead $a^C$ families to make an alternative residential choice from what the $a^T$ families chose in $t$, or the $a^T$ families keep moving so that the $a^C$ families do not fully catch up with them. Panel B reveals another interesting pattern in the results. When we focus on a particular school district, Chatham, and we compare the discontinuity results for each cohort by year, we see that the discontinuity found in year 2007 for cohort five is not found for that cohort in subsequent years. This result suggests that the $a^C$ families in Chatham are indeed catching up with the $a^T$ families in the following year. However, this pattern does not repeat for cohorts seven and onward, which suggests that a great deal of TSC (or at least in many of the situations where $a^C$ families catch up with their $a^T$ counterparts next year) occurs at ages up to six. The patterns found in Table 21 suggest the method of estimating discontinuities in the *stock variable* "probability of living in a particular location" is incapable of picking up TSC at a particular age.

Another important drawback of the analysis using the discontinuities in the *stock variable* "probability of living in a particular district" is that we do not see moves within the district. Moreover, an analysis of the heterogeneity of TSC across ages seems warranted. Thus, estimating discontinuities in the *flow variable* "change of locations" is likely to provide a complementary approach to estimating discontinuities for the probability of living in a particular location.

Table 22 presents the results of discontinuities aggregated by age across years for the probability of families having moved last year. We present the analysis for both within and across district moves. Figures 7a through 7f contain plots of a few discontinuities disaggregated at the age-year level that were selected from those used to construct Table 22. Given that we are unable to observe families with one child whose age is less than ten, we opt to show the results for families with two or more children only, so that the results for ages ten through sixteen are comparable with the results for other ages. We find significant magnitudes in moving rates due to TSC on the order of 2.5 percent across several ages for within district TSC, with larger values around 2.5 percent for earlier ages.[20] We also find that the families of black students seem to exercise greater

[20]The standard errors are larger for earlier and later ages because the results are aggregated across fewer years. For instance, the discontinuity for age six represents only the absolute value of the discontinuity for the year 2008, and the discontinuity for age seven represents the average of the absolute value of the discontinuities for the years 2008 and 2009.

TSC within district than the families of white students. This is in contrast with the results from the location analysis, which show that white families tend to exercise more TSC across districts. The across-district results for both moves and residential decisions suggest that families seem to exercise substantially less TSC across districts after age six in comparison to before. One interpretation of these findings is that they are caused by housing market tightness. Indeed, if white families have more stringent preferences for housing than black families, then the former will be less likely to find their preferred house available inside the same district, and will tend to move less frequently than the latter. It should be noted, however, that moving costs may also play an important role in explaining these results, as whites may be incurring higher costs to exercise TSC, since they are more likely to be homeowners.

## 5.4 Interpretation

### 5.4.1 Scholastic Determinants of TSC

We also study the scholastic determinants of TSC by analyzing whether the school amenities last year affected newly made TSC this year even after controlling for confounding factors. We estimate the following regression:

$$|\Delta p_{j,a,t}| = |\Delta p_{j,a-1,t-1}|.\alpha_0 + A_{j,t}.\alpha_c + \gamma_{a,t} + \eta_{j,a,t} \tag{6}$$

where $|\Delta p_{j,a,t}|$ is the absolute value of the TSC measure at the district-age-year level, $|\Delta p_{j,a-1,t-1}|$ is its first lag for the same cohort, $A_{j,t}$ represents the vector of school amenities at the district-year level, $\gamma_{a,t}$ are age-year FEs, and $c$ is defined to categorize ages where the oldest student in the treatment group is typically attending Elementary school (K-5), Middle school (6-8), High school (9-12) or has left high school instead.[21] Notice that $|\Delta p_{j,a-1,t-1}|$ absorbs all the TSC from the past, allowing us to focus only on newly made TSC.

Table **??** provides the results. Test scores are important determinants of newly made TSC, while peer characteristics such as the share of whites enrolled in the dis-

[21]Precisely, $c = 1$ if $a \leq 10$, $c = 2$ if $11 \leq a \leq 13$, $c = 3$ if $14 \leq a \leq 17$, and $c = 4$ if $a \geq 18$.

trict are found to not be as important.[22] We also find that the presence and number of charter schools in the district is found to be an important determinant of TSC, perhaps making the district more attractive for parents seeking better education for their children.

Three interesting results about test scores deserve attention. First, Math test scores have a strongly positive effect on newly made TSC, while Reading test scores have a strongly negative effect on TSC. This could reflect that families prioritize sending their children to schools better at math, as they might believe achievement in math is more related to school inputs than to student and family inputs. Second, these effect vanish right after high school. The fact that test scores are no longer an important determinant of newly made TSC after the eldest child of the family leaves high school may reflect the fact that some families may exercise TSC to a worse district in terms of test scores (since one less children would benefit from the public school quality), while some other families may exercise TSC to a better district in terms of test scores (for instance, if the eldest child leaves home, then the family might be able to afford a smaller house in the better school district). Overall, the fact that the estimates of test score are not important determinants of after high school TSC and are strongly significant within the scholastic period lend additional credibility to our measure of TSC and to our interpretation that higher Math test scores do tend to generate an increase in TSC. Finally, we also found that test scores tend to be more important in elementary school than in middle and in high school. As we found that most of the TSC happens in elementary school and high school, one possible interpretation of these results is that there is some alternative determinant of most of the TSC in high school that is unrelated to average test scores. For instance, it may be that families exercising TSC in high school might be instead more likely to consider the school's sport facilities or the school's track record on sending the best students to good colleges.

#### 5.4.2 Supply Side Frictions

Table 24 shows pairwise correlations between the amount of TSC found in each district and the level of neighborhood amenities at the district level. A one standard deviation

[22]The share of the student body that is eligible for free lunch was found to not be an important determinant as well.

increase in average family income corresponds to an increase of 0.0012 in the magnitude of TSC (or an 11.8 percent increase). We also tend to find more TSC occurring in districts with higher house prices, rents, population, level of education and more children.[23] We interpret these results as suggestive evidence that bundling causes friction which impedes TSC: some families that would be willing to exercise TSC in a counterfactual environment where no bundling exists are not able to do so in practice, as they would also need to pay higher prices for unwanted levels of other amenities. Table 24 also shows that families who exercise TSC tend to live in neighborhoods with tighter housing markets, as measured by the number of vacancies. We interpret these results as suggestive that other supply side frictions may also play an important role in TSC.

# 6 Conclusion

This paper provides a first step toward a better understanding of the kind of school choice that is most traditional in the United States: that which occurs through residential sorting. We found that at least 20 percent of families exercise traditional school choice (TSC) overall. This occurs both within and across districts, and across all ages, but mostly in early and later ages. Moreover, minority families tend to exercise a greater amount of TSC both across and within districts than white families.

We also study the scholastic determinants of TSC and found that test score has an relatively important positive causal effect on TSC, but additional features of the school, particularly related to peer effects, play an important role as well.

By analyzing pairwise correlations of our measure and various neighborhood amenities, we provided suggestive evidence that supply side frictions play an important role in TSC and that families who exercise TSC do so based on a bundle of amenities, in which public school quality is but one included factor. This implies that isolating the effect of public school quality on residential choices is likely to be more complicated than previously thought, highlighting a potentially important agenda for researchers and policymakers going forward.

[23] We also find no correlation between proportion of whites or proportion of blacks and the amount of TSC.

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TABLE 1
Tabulations

| | N | Percent |
|---|---|---|
| No. of Children | | |
| 1 | 2,021,202 | 42.38 |
| 2 | 1,806,836 | 37.88 |
| 3 | 676,020 | 14.17 |
| 4 | 182,073 | 3.82 |
| 5 or More | 83,659 | 1.75 |
| | 4,769,790 | 100.00 |
| Cohort | | |
| 5 | 200,880 | 4.21 |
| 6 | 302,358 | 6.34 |
| 7 | 381,100 | 7.99 |
| 8 | 448,696 | 9.41 |
| 9 | 512,036 | 10.73 |
| 10 | 568,204 | 11.91 |
| 11 | 569,721 | 11.94 |
| 12 | 506,478 | 10.62 |
| 13 | 436,118 | 9.14 |
| 14 | 363,730 | 7.63 |
| 15 | 283,589 | 5.95 |
| 16 | 196,880 | 4.13 |
| | 4,769,790 | 100.00 |

## TABLE 2
### Descriptive Statistics

| Panel A: Student-Level Characteristics | Mean | St. Dev. | Min | Max | N |
|---|---|---|---|---|---|
| ≥ Two Children | | | | | |
| Female | 0.49 | 0.50 | 0 | 1 | 2,748,588 |
| White | 0.57 | 0.49 | 0 | 1 | 2,748,588 |
| Black | 0.24 | 0.43 | 0 | 1 | 2,748,588 |
| Hispanic | 0.11 | 0.31 | 0 | 1 | 2,748,588 |
| Asian | 0.03 | 0.17 | 0 | 1 | 2,748,588 |
| One Child | | | | | |
| Female | 0.49 | 0.50 | 0 | 1 | 2,021,202 |
| White | 0.52 | 0.50 | 0 | 1 | 2,021,202 |
| Black | 0.32 | 0.47 | 0 | 1 | 2,021,202 |
| Hispanic | 0.09 | 0.29 | 0 | 1 | 2,021,202 |
| Asian | 0.02 | 0.14 | 0 | 1 | 2,021,202 |

| Panel B: District-Level Characteristics | Mean | St. Dev. | Min | Max | N |
|---|---|---|---|---|---|
| Census | | | | | |
| Population (in 100000s) | 0.86 | 1.12 | 0.06 | 7.16 | 93 |
| Share Below Poverty | 0.15 | 0.04 | 0.07 | 0.27 | 93 |
| Share White | 0.72 | 0.17 | 0.30 | 0.98 | 93 |
| Share Black | 0.24 | 0.16 | 0.01 | 0.66 | 93 |
| Share Adult | 0.76 | 0.02 | 0.72 | 0.82 | 93 |
| Share Elderly | 0.14 | 0.03 | 0.08 | 0.25 | 93 |
| Share Young Children | 0.06 | 0.01 | 0.04 | 0.08 | 93 |
| Share No HS | 0.27 | 0.06 | 0.06 | 0.40 | 93 |
| Share HS | 0.58 | 0.09 | 0.14 | 0.73 | 93 |
| Share College | 0.16 | 0.09 | 0.08 | 0.71 | 93 |
| Family Income (in 100000s) | 0.51 | 0.08 | 0.39 | 0.89 | 93 |
| Share House Vacancies | 0.12 | 0.06 | 0.05 | 0.36 | 93 |
| Median Rent (in 1000s) | 0.48 | 0.08 | 0.35 | 0.72 | 93 |
| Median House Price (in 100000s) | 0.96 | 0.24 | 0.59 | 2.02 | 93 |
| School District | | | | | |
| Std. Test Score | -0.02 | 0.44 | -1.29 | 1.89 | 558 |
| Share Gifted | 0.14 | 0.08 | 0.00 | 0.48 | 186 |
| Share No Exceptionality Status | 0.65 | 0.20 | 0.00 | 0.89 | 186 |
| Share Learning Impaired | 0.21 | 0.16 | 0.05 | 0.77 | 186 |
| Charter Sch. in District | 0.38 | 0.49 | 0 | 1 | 465 |
| No. of Charters in District | 0.66 | 1.23 | 0 | 11 | 465 |

TABLE 3

Observations by Age and Category

(First Stage)

| Age | $T_{D-7<d\leq D}$ | $C_{D<d\leq D+7}$ | $T_{d\leq D}$ | $C_{d>D}$ | Total |
|---|---|---|---|---|---|
| 10 | 2,208 | 2,175 | 59,922 | 57,004 | 116,926 |
| 11 | 5,984 | 5,874 | 157,755 | 155,002 | 312,757 |
| 12 | 7,512 | 7,363 | 198,890 | 192,807 | 391,697 |
| 13 | 7,531 | 7,449 | 199,929 | 193,429 | 393,358 |
| 14 | 7,571 | 7,504 | 200,754 | 195,075 | 395,829 |
| 15 | 7,834 | 7,566 | 205,439 | 196,696 | 402,135 |
| 16 | 7,714 | 7,630 | 200,832 | 200,498 | 401,330 |

TABLE 4

Grade Distribution Across Ages

(First Stage)

| | G3 | G4 | G5 | G6 | G7 | G8 | G9 | G10 | G11 | G12 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $10^T$ | 0.027 | 0.482 | 0.490 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $10^C$ | 0.070 | 0.859 | 0.070 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $11^T$ | 0.000 | 0.041 | 0.494 | 0.465 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $11^C$ | 0.001 | 0.090 | 0.831 | 0.078 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $12^T$ | 0.000 | 0.001 | 0.046 | 0.491 | 0.461 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $12^C$ | 0.000 | 0.003 | 0.096 | 0.820 | 0.081 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $13^T$ | 0.000 | 0.000 | 0.001 | 0.054 | 0.496 | 0.449 | 0.000 | 0.000 | 0.000 | 0.000 | 1.000 |
| $13^C$ | 0.000 | 0.000 | 0.004 | 0.096 | 0.814 | 0.084 | 0.001 | 0.000 | 0.000 | 0.000 | 1.000 |
| $14^T$ | 0.000 | 0.000 | 0.000 | 0.003 | 0.060 | 0.501 | 0.435 | 0.001 | 0.000 | 0.000 | 1.000 |
| $14^C$ | 0.000 | 0.000 | 0.000 | 0.005 | 0.105 | 0.794 | 0.095 | 0.001 | 0.000 | 0.000 | 1.000 |
| $15^T$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.004 | 0.070 | 0.514 | 0.410 | 0.002 | 0.000 | 1.000 |
| $15^C$ | 0.000 | 0.000 | 0.000 | 0.001 | 0.006 | 0.112 | 0.787 | 0.092 | 0.001 | 0.000 | 1.000 |
| $16^T$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.005 | 0.129 | 0.455 | 0.405 | 0.005 | 1.000 |
| $16^C$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.008 | 0.168 | 0.728 | 0.094 | 0.002 | 1.000 |

TABLE 5

Validity: Number of Observations (Eldest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 2.00 | – | – | – | – | – |
| | (3.53) | | | | | |
| 11 | 1.96 | 1.02 | – | – | – | – |
| | (4.29) | (3.62) | | | | |
| 12 | -1.57 | 2.28 | 2.51 | – | – | – |
| | (3.97) | (4.54) | (4.03) | | | |
| 13 | 5.44 | -1.00 | 0.18 | 2.66 | – | – |
| | (4.65) | (4.29) | (4.34) | (4.24) | | |
| 14 | 7.86* | 5.12 | 0.07 | -0.42 | 2.61 | – |
| | (4.06) | (4.78) | (4.31) | (4.71) | (4.46) | |
| 15 | -1.53 | 4.93 | 3.94 | -1.37 | 1.38 | 3.68 |
| | (4.02) | (4.29) | (4.88) | (4.90) | (5.39) | (4.49) |
| 16 | 3.51 | -1.75 | 6.02 | 5.66 | -2.36 | 0.07 |
| | (5.09) | (4.15) | (3.94) | (4.75) | (5.22) | (4.76) |
| 17 | – | 5.74 | 0.31 | 6.25* | 4.01 | -0.61 |
| | | (4.23) | (3.68) | (3.74) | (4.00) | (4.17) |
| 18 | – | – | 2.58 | -2.22 | 4.72 | 2.78 |
| | | | (3.75) | (3.43) | (3.40) | (4.29) |
| 19 | – | – | – | 1.82 | -3.33 | 2.10 |
| | | | | (2.94) | (2.73) | (2.99) |
| 20 | – | – | – | – | 2.58 | -1.52 |
| | | | | | (2.51) | (2.66) |
| 21 | – | – | – | – | – | 0.85 |
| | | | | | | (2.23) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

*Significant at the 10 percent level.

TABLE 6

VALIDITY: NUMBER OF OBSERVATIONS (YOUNGEST SIBLING)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | 4.27 | – | – | – | – | – |
| | (3.04) | | | | | |
| 6 | 5.78 | 4.34 | – | – | – | – |
| | (3.79) | (4.12) | | | | |
| 7 | 8.68* | 5.66 | 5.89 | – | – | – |
| | (4.57) | (5.03) | (5.03) | | | |
| 8 | 6.18 | 7.68 | 4.30 | 5.91 | – | – |
| | (4.65) | (5.81) | (6.27) | (6.11) | | |
| 9 | -2.80 | 5.05 | 6.85 | 1.63 | 6.89 | – |
| | (5.21) | (5.16) | (6.21) | (6.55) | (6.55) | |
| 10 | 2.16 | -1.87 | 4.09 | 9.58 | 4.27 | 11.00 |
| | (5.42) | (5.86) | (6.08) | (7.61) | (8.51) | (8.88) |
| 11 | -4.78 | 2.30 | -1.78 | 4.26 | 11.61 | 4.61 |
| | (4.99) | (5.58) | (5.84) | (6.39) | (7.77) | (8.23) |
| 12 | – | -3.38 | 2.49 | -2.40 | 3.30 | 10.02 |
| | | (4.77) | (5.31) | (5.80) | (6.49) | (7.38) |
| 13 | – | – | -4.51 | 2.47 | -3.25 | 2.63 |
| | | | (4.57) | (5.06) | (6.15) | (6.29) |
| 14 | – | – | – | -3.29 | 1.36 | -4.02 |
| | | | | (4.70) | (5.13) | (5.64) |
| 15 | – | – | – | – | -2.16 | 1.58 |
| | | | | | (4.62) | (5.10) |
| 16 | – | – | – | – | – | -4.05 |
| | | | | | | (4.34) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

*Significant at the 10 percent level.

TABLE 7
VALIDITY: ETHNICITY – WHITE (ELDEST SIBLING)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 0.04 | – | – | – | – | – |
| | (0.03) | | | | | |
| 11 | -0.04 | 0.05* | – | – | – | – |
| | (0.03) | (0.03) | | | | |
| 12 | 0.02 | -0.02 | 0.06** | – | – | – |
| | (0.02) | (0.03) | (0.03) | | | |
| 13 | 0.01 | 0.01 | -0.02 | 0.05* | – | – |
| | (0.02) | (0.02) | (0.03) | (0.03) | | |
| 14 | 0.00 | 0.03 | 0.01 | -0.03 | 0.04* | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 15 | 0.05** | 0.02 | 0.02 | 0.01 | -0.03 | 0.05** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 16 | 0.01 | 0.04** | 0.02 | 0.02 | 0.00 | -0.02 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 17 | – | 0.02 | 0.04* | 0.01 | -0.02 | -0.01 |
| | | (0.02) | (0.02) | (0.02) | (0.03) | (0.02) |
| 18 | – | – | 0.03 | 0.04 | 0.02 | 0.00 |
| | | | (0.02) | (0.02) | (0.03) | (0.02) |
| 19 | – | – | – | 0.04 | 0.02 | 0.02 |
| | | | | (0.03) | (0.03) | (0.03) |
| 20 | – | – | – | – | 0.03 | 0.03 |
| | | | | | (0.03) | (0.03) |
| 21 | – | – | – | – | – | 0.06* |
| | | | | | | (0.04) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

TABLE 8

VALIDITY: ETHNICITY – WHITE (YOUNGEST SIBLING)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | 0.07* | – | – | – | – | – |
| | (0.04) | | | | | |
| 6 | -0.11** | 0.02 | – | – | – | – |
| | (0.03) | (0.03) | | | | |
| 7 | 0.03 | -0.08** | 0.03 | – | – | – |
| | (0.03) | (0.03) | (0.03) | | | |
| 8 | -0.01 | 0.02 | -0.09** | 0.04 | – | – |
| | (0.03) | (0.02) | (0.02) | (0.02) | | |
| 9 | 0.02 | 0.02 | 0.03 | -0.08** | 0.03 | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 10 | 0.03 | 0.02 | 0.01 | 0.00 | -0.06** | 0.02 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 11 | 0.01 | 0.05** | 0.02 | 0.01 | 0.00 | -0.06** |
| | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 12 | – | 0.01 | 0.05* | 0.01 | 0.02 | 0.00 |
| | | (0.03) | (0.03) | (0.02) | (0.02) | (0.02) |
| 13 | – | – | 0.01 | 0.04 | 0.02 | 0.01 |
| | | | (0.03) | (0.02) | (0.02) | (0.02) |
| 14 | – | – | – | 0.00 | 0.04* | 0.02 |
| | | | | (0.03) | (0.03) | (0.02) |
| 15 | – | – | – | – | -0.01 | 0.04* |
| | | | | | (0.03) | (0.03) |
| 16 | – | – | – | – | – | 0.01 |
| | | | | | | (0.03) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 9

VALIDITY: ETHNICITY – BLACK (ELDEST SIBLING)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | -0.05** | – | – | – | – | – |
| | (0.02) | | | | | |
| 11 | 0.01 | -0.04* | – | – | – | – |
| | (0.02) | (0.02) | | | | |
| 12 | -0.01 | 0.00 | -0.05** | – | – | – |
| | (0.02) | (0.02) | (0.02) | | | |
| 13 | -0.02 | -0.01 | -0.01 | -0.04** | – | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | | |
| 14 | -0.01 | -0.02 | -0.01 | 0.00 | -0.03* | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 15 | -0.02 | -0.01 | -0.02 | -0.01 | 0.01 | -0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 16 | 0.01 | -0.01 | -0.02 | -0.02 | 0.00 | 0.00 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 17 | – | 0.00 | -0.02 | -0.01 | -0.02 | 0.01 |
| | | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 18 | – | – | 0.01 | -0.01 | -0.04 | -0.01 |
| | | | (0.02) | (0.02) | (0.02) | (0.02) |
| 19 | – | – | – | 0.00 | -0.02 | -0.03 |
| | | | | (0.02) | (0.03) | (0.02) |
| 20 | – | – | – | – | 0.01 | -0.01 |
| | | | | | (0.03) | (0.03) |
| 21 | – | – | – | – | – | -0.01 |
| | | | | | | (0.03) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 10

Validity: Ethnicity – Black (Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | -0.05* | – | – | – | – | – |
| | (0.03) | | | | | |
| 6 | 0.09** | 0.00 | – | – | – | – |
| | (0.03) | (0.03) | | | | |
| 7 | 0.00 | 0.06** | -0.02 | – | – | – |
| | (0.02) | (0.02) | (0.02) | | | |
| 8 | 0.01 | 0.00 | 0.06** | -0.02 | – | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | | |
| 9 | -0.02 | 0.01 | -0.01 | 0.06** | -0.02 | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 10 | -0.03 | -0.03 | 0.00 | 0.00 | 0.05** | -0.02 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 11 | 0.01 | -0.05** | -0.03 | 0.00 | 0.01 | 0.05** |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 12 | – | 0.00 | -0.04* | -0.02 | 0.00 | 0.01 |
| | | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 13 | – | – | 0.00 | -0.03 | -0.03 | 0.01 |
| | | | (0.02) | (0.02) | (0.02) | (0.02) |
| 14 | – | – | – | -0.01 | -0.04 | -0.03 |
| | | | | (0.02) | (0.02) | (0.02) |
| 15 | – | – | – | – | -0.01 | -0.03 |
| | | | | | (0.02) | (0.02) |
| 16 | – | – | – | – | – | 0.00 |
| | | | | | | (0.02) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 11

VALIDITY: GENDER – FEMALE (ELDEST SIBLING)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | -0.02 | – | – | – | – | – |
| | (0.03) | | | | | |
| 11 | 0.00 | -0.04 | – | – | – | – |
| | (0.03) | (0.03) | | | | |
| 12 | -0.03 | -0.02 | -0.03 | – | – | – |
| | (0.03) | (0.03) | (0.03) | | | |
| 13 | -0.01 | -0.02 | 0.00 | -0.03 | – | – |
| | (0.02) | (0.02) | (0.03) | (0.03) | | |
| 14 | 0.00 | 0.01 | -0.01 | -0.01 | -0.03 | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 15 | 0.03 | 0.00 | 0.01 | -0.02 | -0.01 | -0.03 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 16 | -0.01 | 0.02 | 0.00 | 0.01 | -0.02 | -0.01 |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 17 | – | 0.01 | 0.02 | -0.01 | 0.01 | -0.03 |
| | | (0.02) | (0.02) | (0.02) | (0.03) | (0.02) |
| 18 | – | – | 0.00 | 0.03 | -0.02 | 0.02 |
| | | | (0.02) | (0.02) | (0.03) | (0.02) |
| 19 | – | – | – | -0.04 | 0.01 | 0.00 |
| | | | | (0.03) | (0.03) | (0.03) |
| 20 | – | – | – | – | -0.02 | 0.02 |
| | | | | | (0.03) | (0.03) |
| 21 | – | – | – | – | – | -0.01 |
| | | | | | | (0.04) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

TABLE 12

Validity: Gender – Female (Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | -0.03 | – | – | – | – | – |
| | (0.04) | | | | | |
| 6 | 0.04 | -0.04 | – | – | – | – |
| | (0.03) | (0.03) | | | | |
| 7 | -0.01 | 0.01 | -0.05** | – | – | – |
| | (0.03) | (0.03) | (0.03) | | | |
| 8 | 0.04 | -0.01 | 0.00 | -0.01 | – | – |
| | (0.03) | (0.02) | (0.02) | (0.02) | | |
| 9 | -0.02 | 0.04 | -0.01 | -0.02 | -0.01 | – |
| | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) | |
| 10 | 0.04* | -0.02 | 0.03 | 0.00 | 0.01 | -0.02 |
| | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) | (0.02) |
| 11 | -0.02 | 0.04* | -0.02 | 0.04* | 0.00 | -0.01 |
| | (0.03) | (0.03) | (0.02) | (0.02) | (0.02) | (0.02) |
| 12 | – | -0.03 | 0.03 | -0.03 | 0.03 | 0.00 |
| | | (0.03) | (0.03) | (0.02) | (0.02) | (0.02) |
| 13 | – | – | -0.04 | 0.05** | -0.01 | 0.04* |
| | | | (0.03) | (0.03) | (0.02) | (0.02) |
| 14 | – | – | – | -0.04 | 0.03 | -0.02 |
| | | | | (0.03) | (0.03) | (0.02) |
| 15 | – | – | – | – | -0.01 | 0.05* |
| | | | | | (0.03) | (0.03) |
| 16 | – | – | – | – | – | -0.01 |
| | | | | | | (0.03) |

*Note:* Estimates from a local linear regression using an Epanechnikov kernel.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

TABLE 13
TSC by Proportion Attending School District
(Eldest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 0.227** | – | – | – | – | – |
| | (0.028) | | | | | |
| 11 | 0.149** | 0.217** | – | – | – | – |
| | (0.027) | (0.027) | | | | |
| 12 | 0.161** | 0.156** | 0.203** | – | – | – |
| | (0.025) | (0.026) | (0.026) | | | |
| 13 | 0.159** | 0.158** | 0.142** | 0.191** | – | – |
| | (0.024) | (0.023) | (0.025) | (0.025) | | |
| 14 | 0.131** | 0.153** | 0.152** | 0.147** | 0.174** | – |
| | (0.022) | (0.023) | (0.024) | (0.023) | (0.024) | |
| 15 | 0.137** | 0.130** | 0.145** | 0.133** | 0.129** | 0.181** |
| | (0.021) | (0.021) | (0.023) | (0.023) | (0.022) | (0.024) |
| 16 | 0.118** | 0.137** | 0.142** | 0.138** | 0.126** | 0.123** |
| | (0.021) | (0.021) | (0.021) | (0.022) | (0.021) | (0.023) |
| 17 | – | 0.124** | 0.160** | 0.153** | 0.166** | 0.127** |
| | | (0.022) | (0.023) | (0.024) | (0.026) | (0.023) |
| 18 | – | – | 0.133** | 0.159** | 0.171** | 0.156** |
| | | | (0.023) | (0.025) | (0.026) | (0.025) |
| 19 | – | – | – | 0.152** | 0.199** | 0.184** |
| | | | | (0.027) | (0.029) | (0.027) |
| 20 | – | – | – | – | 0.211** | 0.218** |
| | | | | | (0.033) | (0.030) |
| 21 | – | – | – | – | – | 0.221** |
| | | | | | | (0.035) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 14
TSC by Proportion Attending School District
(Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | $0.235^{**}$ | – | – | – | – | – |
| | (0.037) | | | | | |
| 6 | $0.213^{**}$ | $0.196^{**}$ | – | – | – | – |
| | (0.029) | (0.031) | | | | |
| 7 | $0.157^{**}$ | $0.197^{**}$ | $0.173^{**}$ | – | – | – |
| | (0.028) | (0.026) | (0.027) | | | |
| 8 | $0.170^{**}$ | $0.149^{**}$ | $0.166^{**}$ | $0.161^{**}$ | – | – |
| | (0.025) | (0.025) | (0.023) | (0.024) | | |
| 9 | $0.156^{**}$ | $0.162^{**}$ | $0.136^{**}$ | $0.162^{**}$ | $0.173^{**}$ | – |
| | (0.025) | (0.024) | (0.024) | (0.023) | (0.023) | |
| 10 | $0.159^{**}$ | $0.147^{**}$ | $0.149^{**}$ | $0.141^{**}$ | $0.134^{**}$ | $0.131^{**}$ |
| | (0.024) | (0.023) | (0.023) | (0.021) | (0.019) | (0.020) |
| 11 | $0.171^{**}$ | $0.166^{**}$ | $0.139^{**}$ | $0.156^{**}$ | $0.141^{**}$ | $0.135^{**}$ |
| | (0.027) | (0.024) | (0.024) | (0.022) | (0.020) | (0.020) |
| 12 | – | $0.160^{**}$ | $0.186^{**}$ | $0.153^{**}$ | $0.142^{**}$ | $0.129^{**}$ |
| | | (0.027) | (0.025) | (0.023) | (0.022) | (0.021) |
| 13 | – | – | $0.175^{**}$ | $0.164^{**}$ | $0.164^{**}$ | $0.149^{**}$ |
| | | | (0.027) | (0.025) | (0.023) | (0.023) |
| 14 | – | – | – | $0.175^{**}$ | $0.165^{**}$ | $0.153^{**}$ |
| | | | | (0.027) | (0.026) | (0.024) |
| 15 | – | – | – | – | $0.160^{**}$ | $0.169^{**}$ |
| | | | | | (0.027) | (0.026) |
| 16 | – | – | – | – | – | $0.171^{**}$ |
| | | | | | | (0.029) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
$^{**}$ Significant at the 5 percent level.

TABLE 15
TSC by Proportion – White
(Eldest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 0.245** | – | – | – | – | – |
| | (0.037) | | | | | |
| 11 | 0.205** | 0.229** | – | – | – | – |
| | (0.034) | (0.035) | | | | |
| 12 | 0.204** | 0.190** | 0.213** | – | – | – |
| | (0.032) | (0.034) | (0.034) | | | |
| 13 | 0.204** | 0.208** | 0.188** | 0.197** | – | – |
| | (0.031) | (0.031) | (0.033) | (0.032) | | |
| 14 | 0.175** | 0.196** | 0.200** | 0.194** | 0.188** | – |
| | (0.029) | (0.030) | (0.031) | (0.032) | (0.031) | |
| 15 | 0.167** | 0.172** | 0.193** | 0.171** | 0.165** | 0.204** |
| | (0.027) | (0.029) | (0.030) | (0.029) | (0.029) | (0.032) |
| 16 | 0.169** | 0.165** | 0.187** | 0.188** | 0.161** | 0.169** |
| | (0.027) | (0.027) | (0.029) | (0.029) | (0.028) | (0.031) |
| 17 | – | 0.167** | 0.202** | 0.200** | 0.205** | 0.178** |
| | | (0.029) | (0.029) | (0.032) | (0.034) | (0.031) |
| 18 | – | – | 0.168** | 0.199** | 0.214** | 0.204** |
| | | | (0.030) | (0.031) | (0.034) | (0.032) |
| 19 | – | – | – | 0.197** | 0.232** | 0.232** |
| | | | | (0.034) | (0.037) | (0.035) |
| 20 | – | – | – | – | 0.248** | 0.301** |
| | | | | | (0.042) | (0.040) |
| 21 | – | – | – | – | – | 0.296** |
| | | | | | | (0.045) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 16

TSC by Proportion – Black

(Eldest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 0.356** | – | – | – | – | – |
| | (0.060) | | | | | |
| 11 | 0.318** | 0.371** | – | – | – | – |
| | (0.052) | (0.057) | | | | |
| 12 | 0.330** | 0.315** | 0.366** | – | – | – |
| | (0.049) | (0.051) | (0.056) | | | |
| 13 | 0.278** | 0.325** | 0.281** | 0.354** | – | – |
| | (0.046) | (0.049) | (0.048) | (0.053) | | |
| 14 | 0.238** | 0.280** | 0.346** | 0.289** | 0.332** | – |
| | (0.042) | (0.046) | (0.047) | (0.048) | (0.050) | |
| 15 | 0.264** | 0.225** | 0.267** | 0.332** | 0.252** | 0.347** |
| | (0.039) | (0.040) | (0.045) | (0.043) | (0.044) | (0.051) |
| 16 | 0.242** | 0.261** | 0.236** | 0.245** | 0.291** | 0.262** |
| | (0.039) | (0.039) | (0.039) | (0.043) | (0.041) | (0.044) |
| 17 | – | 0.262** | 0.264** | 0.253** | 0.308** | 0.305** |
| | | (0.041) | (0.042) | (0.043) | (0.051) | (0.042) |
| 18 | – | – | 0.280** | 0.326** | 0.309** | 0.284** |
| | | | (0.047) | (0.045) | (0.050) | (0.049) |
| 19 | – | – | – | 0.319** | 0.376** | 0.288** |
| | | | | (0.052) | (0.055) | (0.050) |
| 20 | – | – | – | – | 0.411** | 0.379** |
| | | | | | (0.062) | (0.058) |
| 21 | – | – | – | – | – | 0.418** |
| | | | | | | (0.065) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 17
TSC by Proportion – Other
(Eldest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 10 | 0.463** | – | – | – | – | – |
| | (0.061) | | | | | |
| 11 | 0.309** | 0.428** | – | – | – | – |
| | (0.058) | (0.059) | | | | |
| 12 | 0.370** | 0.318** | 0.396** | – | – | – |
| | (0.057) | (0.056) | (0.058) | | | |
| 13 | 0.296** | 0.343** | 0.318** | 0.363** | – | – |
| | (0.055) | (0.055) | (0.055) | (0.055) | | |
| 14 | 0.335** | 0.273** | 0.328** | 0.319** | 0.352** | – |
| | (0.053) | (0.052) | (0.055) | (0.052) | (0.053) | |
| 15 | 0.321** | 0.311** | 0.282** | 0.349** | 0.290** | 0.348** |
| | (0.052) | (0.052) | (0.052) | (0.052) | (0.049) | (0.053) |
| 16 | 0.361** | 0.315** | 0.324** | 0.286** | 0.341** | 0.268** |
| | (0.051) | (0.050) | (0.051) | (0.051) | (0.050) | (0.049) |
| 17 | – | 0.363** | 0.345** | 0.352** | 0.349** | 0.397** |
| | | (0.055) | (0.055) | (0.057) | (0.060) | (0.055) |
| 18 | – | – | 0.360** | 0.343** | 0.354** | 0.338** |
| | | | (0.057) | (0.062) | (0.062) | (0.056) |
| 19 | – | – | – | 0.391** | 0.435** | 0.398** |
| | | | | (0.066) | (0.067) | (0.062) |
| 20 | – | – | – | – | 0.417** | 0.463** |
| | | | | | (0.076) | (0.067) |
| 21 | – | – | – | – | – | 0.394** |
| | | | | | | (0.073) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 18
TSC by Proportion – White
(Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | 0.285** | – | – | – | – | – |
| | (0.051) | | | | | |
| 6 | 0.273** | 0.237** | – | – | – | – |
| | (0.041) | (0.043) | | | | |
| 7 | 0.226** | 0.225** | 0.201** | – | – | – |
| | (0.037) | (0.034) | (0.036) | | | |
| 8 | 0.212** | 0.205** | 0.183** | 0.165** | – | – |
| | (0.033) | (0.032) | (0.030) | (0.032) | | |
| 9 | 0.220** | 0.214** | 0.187** | 0.189** | 0.194** | – |
| | (0.032) | (0.031) | (0.030) | (0.030) | (0.031) | |
| 10 | 0.212** | 0.210** | 0.212** | 0.176** | 0.169** | 0.151** |
| | (0.032) | (0.030) | (0.030) | (0.028) | (0.026) | (0.027) |
| 11 | 0.209** | 0.214** | 0.215** | 0.211** | 0.182** | 0.173** |
| | (0.032) | (0.031) | (0.031) | (0.029) | (0.027) | (0.027) |
| 12 | – | 0.199** | 0.220** | 0.214** | 0.192** | 0.176** |
| | | (0.033) | (0.031) | (0.030) | (0.029) | (0.028) |
| 13 | – | – | 0.213** | 0.196** | 0.221** | 0.201** |
| | | | (0.034) | (0.032) | (0.030) | (0.030) |
| 14 | – | – | – | 0.207** | 0.205** | 0.218** |
| | | | | (0.033) | (0.032) | (0.031) |
| 15 | – | – | – | – | 0.206** | 0.218** |
| | | | | | (0.034) | (0.033) |
| 16 | – | – | – | – | – | 0.224** |
| | | | | | | (0.035) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 19

TSC by Proportion – Black

(Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | 0.426** | – | – | – | – | – |
| | (0.070) | | | | | |
| 6 | 0.374** | 0.364** | – | – | – | – |
| | (0.059) | (0.060) | | | | |
| 7 | 0.302** | 0.332** | 0.364** | – | – | – |
| | (0.057) | (0.053) | (0.053) | | | |
| 8 | 0.331** | 0.272** | 0.315** | 0.285** | – | – |
| | (0.053) | (0.052) | (0.047) | (0.046) | | |
| 9 | 0.294** | 0.307** | 0.224** | 0.294** | 0.303** | – |
| | (0.046) | (0.050) | (0.048) | (0.045) | (0.045) | |
| 10 | 0.294** | 0.279** | 0.302** | 0.252** | 0.249** | 0.242** |
| | (0.051) | (0.044) | (0.046) | (0.042) | (0.039) | (0.039) |
| 11 | 0.343** | 0.331** | 0.268** | 0.274** | 0.244** | 0.230** |
| | (0.053) | (0.051) | (0.045) | (0.046) | (0.042) | (0.039) |
| 12 | – | 0.320** | 0.325** | 0.246** | 0.274** | 0.255** |
| | | (0.054) | (0.053) | (0.045) | (0.045) | (0.043) |
| 13 | – | – | 0.289** | 0.360** | 0.272** | 0.290** |
| | | | (0.055) | (0.052) | (0.046) | (0.046) |
| 14 | – | – | – | 0.335** | 0.359** | 0.242** |
| | | | | (0.056) | (0.052) | (0.046) |
| 15 | – | – | – | – | 0.358** | 0.376** |
| | | | | | (0.057) | (0.053) |
| 16 | – | – | – | – | – | 0.371** |
| | | | | | | (0.059) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 20

TSC by Proportion – Other

(Youngest Sibling)

| Age/Year | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|
| 5 | 0.416** | – | – | – | – | – |
| | (0.066) | | | | | |
| 6 | 0.363** | 0.406** | – | – | – | – |
| | (0.065) | (0.061) | | | | |
| 7 | 0.358** | 0.310** | 0.344** | – | – | – |
| | (0.063) | (0.056) | (0.054) | | | |
| 8 | 0.340** | 0.310** | 0.297** | 0.309** | – | – |
| | (0.055) | (0.055) | (0.050) | (0.048) | | |
| 9 | 0.371** | 0.304** | 0.317** | 0.322** | 0.285** | – |
| | (0.056) | (0.053) | (0.052) | (0.047) | (0.047) | |
| 10 | 0.369** | 0.378** | 0.280** | 0.273** | 0.244** | 0.233** |
| | (0.057) | (0.053) | (0.050) | (0.047) | (0.041) | (0.040) |
| 11 | 0.481** | 0.339** | 0.405** | 0.307** | 0.261** | 0.274** |
| | (0.065) | (0.059) | (0.053) | (0.049) | (0.047) | (0.042) |
| 12 | – | 0.446** | 0.368** | 0.381** | 0.286** | 0.289** |
| | | (0.065) | (0.061) | (0.054) | (0.049) | (0.048) |
| 13 | – | – | 0.424** | 0.400** | 0.372** | 0.293** |
| | | | (0.066) | (0.060) | (0.054) | (0.051) |
| 14 | – | – | – | 0.419** | 0.365** | 0.365** |
| | | | | (0.070) | (0.061) | (0.056) |
| 15 | – | – | – | – | 0.409** | 0.355** |
| | | | | | (0.067) | (0.064) |
| 16 | – | – | – | – | – | 0.393** |
| | | | | | | (0.074) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.
** Significant at the 5 percent level.

TABLE 21
Evolution of Discontinuities by Cohort Over Time
(Multiple Siblings)

Panel A: Selected District-Cohort Pairs

| County | Cohort | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Greene | 9 | -0.004 | -0.002 | -0.003 | -0.003 | -0.004 | -0.005 |
| | | (0.003) | (0.002) | (0.003) | (0.002) | (0.002) | (0.003) |
| Pender | 11 | 0.005 | 0.009 | 0.009 | 0.011 | 0.009 | 0.009 |
| | | (0.004) | (0.004) | (0.004) | (0.005) | (0.004) | (0.004) |
| Washington | 12 | -0.004 | -0.004 | -0.003 | -0.003 | -0.003 | -0.008 |
| | | (0.004) | (0.004) | (0.004) | (0.003) | (0.003) | (0.004) |
| McDowell | 13 | 0.007 | 0.007 | 0.004 | 0.003 | 0.000 | 0.003 |
| | | (0.003) | (0.003) | (0.003) | (0.003) | (0.000) | (0.004) |
| Rutherford | 14 | -0.008 | -0.009 | -0.005 | -0.009 | -0.008 | -0.007 |
| | | (0.005) | (0.005) | (0.005) | (0.006) | (0.007) | (0.006) |

Panel B: All Cohorts for Particular District

| County | Cohort | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|
| Chatham | 5 | -0.017 | -0.004 | -0.002 | -0.007 | -0.002 | -0.001 |
| | | (0.009) | (0.007) | (0.006) | (0.005) | (0.004) | (0.004) |
| Chatham | 7 | 0.001 | 0.000 | -0.004 | -0.001 | -0.002 | -0.001 |
| | | (0.006) | (0.005) | (0.005) | (0.003) | (0.004) | (0.003) |
| Chatham | 8 | -0.012 | -0.012 | -0.009 | -0.012 | -0.012 | -0.013 |
| | | (0.005) | (0.005) | (0.004) | (0.004) | (0.004) | (0.004) |
| Chatham | 9 | -0.003 | -0.002 | -0.003 | -0.002 | -0.002 | -0.001 |
| | | (0.004) | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) |
| Chatham | 10 | 0.004 | 0.004 | 0.007 | 0.004 | 0.007 | 0.007 |
| | | (0.005) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Chatham | 11 | 0.007 | 0.007 | 0.006 | 0.006 | 0.005 | 0.004 |
| | | (0.005) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Chatham | 12 | 0.001 | -0.003 | 0.000 | 0.000 | -0.001 | -0.005 |
| | | (0.004) | (0.004) | (0.005) | (0.004) | (0.005) | (0.005) |
| Chatham | 13 | -0.005 | -0.004 | -0.005 | -0.004 | -0.002 | -0.004 |
| | | (0.004) | (0.004) | (0.004) | (0.004) | (0.005) | (0.004) |
| Chatham | 14 | -0.005 | -0.004 | -0.002 | -0.005 | -0.010 | -0.007 |
| | | (0.004) | (0.004) | (0.003) | (0.006) | (0.006) | (0.006) |
| Chatham | 15 | 0.001 | 0.001 | 0.001 | 0.000 | 0.006 | 0.006 |
| | | (0.004) | (0.004) | (0.005) | (0.006) | (0.006) | (0.007) |
| Chatham | 16 | 0.000 | -0.004 | -0.004 | -0.002 | -0.006 | 0.004 |
| | | (0.005) | (0.005) | (0.006) | (0.008) | (0.009) | (0.010) |

TABLE 22
Discontinuities in Moving Rate
(Within vs. Across Districts)

| Age | Within District | | | Across District | | |
|---|---|---|---|---|---|---|
| | All | White | Black | All | White | Black |
| 6 | 0.026 | 0.003 | 0.072 | 0.004 | 0.016 | 0.046** |
| | (0.025) | (0.029) | (0.067) | (0.009) | (0.017) | (0.024) |
| 7 | 0.035 | 0.024 | 0.096 | 0.004 | 0.006 | 0.009 |
| | (0.030) | (0.029) | (0.068) | (0.013) | (0.015) | (0.035) |
| 8 | 0.026* | 0.014 | 0.084** | 0.002 | 0.006 | 0.016 |
| | (0.015) | (0.018) | (0.038) | (0.007) | (0.010) | (0.014) |
| 9 | 0.017* | 0.020* | 0.058** | 0.003 | 0.006 | 0.007 |
| | (0.010) | (0.011) | (0.023) | (0.004) | (0.005) | (0.009) |
| 10 | 0.018** | 0.017 | 0.039* | 0.005 | 0.007 | 0.006 |
| | (0.009) | (0.012) | (0.021) | (0.004) | (0.006) | (0.012) |
| 11 | 0.018** | 0.019* | 0.052** | 0.003 | 0.004 | 0.006 |
| | (0.008) | (0.011) | (0.020) | (0.003) | (0.005) | (0.009) |
| 12 | 0.009 | 0.017** | 0.029 | 0.003 | 0.005 | 0.011 |
| | (0.007) | (0.009) | (0.020) | (0.003) | (0.003) | (0.008) |
| 13 | 0.014** | 0.012 | 0.056** | 0.004 | 0.004 | 0.013* |
| | (0.007) | (0.008) | (0.017) | (0.003) | (0.003) | (0.007) |
| 14 | 0.012 | 0.013 | 0.026 | 0.002 | 0.005 | 0.013** |
| | (0.008) | (0.01) | (0.019) | (0.003) | (0.004) | (0.006) |
| 15 | 0.009 | 0.018** | 0.014 | 0.005* | 0.002 | 0.015** |
| | (0.007) | (0.009) | (0.017) | (0.003) | (0.003) | (0.006) |
| 16 | 0.013** | 0.018** | 0.029* | 0.007** | 0.009** | 0.007 |
| | (0.006) | (0.007) | (0.015) | (0.002) | (0.002) | (0.005) |
| 17 | 0.013* | 0.014 | 0.037** | 0.004 | 0.008** | 0.006 |
| | (0.008) | (0.008) | (0.018) | (0.003) | (0.004) | (0.006) |
| 18 | 0.010 | 0.006 | 0.052** | 0.003 | 0.005 | 0.013 |
| | (0.009) | (0.012) | (0.017) | (0.003) | (0.004) | (0.008) |
| 19 | 0.003 | 0.025* | 0.056** | 0.004 | 0.003 | 0.024** |
| | (0.011) | (0.013) | (0.024) | (0.005) | (0.006) | (0.011) |
| 20 | 0.030* | 0.048* | 0.009 | 0.013** | 0.016** | 0.005 |
| | (0.016) | (0.019) | (0.031) | (0.006) | (0.008) | (0.014) |
| 21 | 0.010 | 0.024 | 0.040 | 0.000 | 0.007 | 0.002 |
| | (0.026) | (0.031) | (0.065) | (0.011) | (0.016) | (0.019) |

*Note:* Estimates come from a local linear regression using an Epanechnikov kernel.

** Significant at the 5 percent level.
* Significant at the 10 percent level.

## TABLE 23
### Scholastic Determinants of TSC

| | | Share Whites | | |
|---|---|---|---|---|
| | | 0-33% | 33-67% | 67-100% |
| Test Score | 0-33% | -0.0168** | -0.0033 | 0.0004 |
| | | (0.0034) | (0.0023) | (0.0012) |
| | 33-67% | -0.0007 | 0.0017 | -0.0012 |
| | | (0.0026) | (0.0034) | (0.0028) |
| | 67-100% | 0.0004 | 0.0110** | 0.0052 |
| | | (0.0026) | (0.0033) | (0.0033) |
| Lagged TSC | | | 0.1694** | |
| | | | (0.0540) | |
| Age-year FEs included? | | | Yes | |
| $R^2$ | | | 0.1767 | |

## TABLE 24
### Δ Associated with One SD Δ in abs(RD)

| Amenity | Δ | % of sd(amenity) |
|---|---|---|
| Average Family Income | $2,813** | 33.5 |
| Average Rent | $28** | 35.4 |
| Average House Price | $7,079** | 28.9 |
| Proportion White | 0.010 | 5.7 |
| Proportion Black | -0.014 | -8.6 |
| Proportion HS | -0.028** | -29.8 |
| Proportion No HS or less | -0.018** | -30.5 |
| Proportion Below Poverty | -0.009** | -20.4 |
| Proportion Adult or less | -0.003* | -14.0 |
| Proportion Old | -0.012** | -39.2 |
| Proportion Children | 0.002** | 25.3 |
| Number of Vacancies | -45** | -17.9 |

** Significant at the 5 percent level.
* Significant at the 10 percent level.

TABLE 25

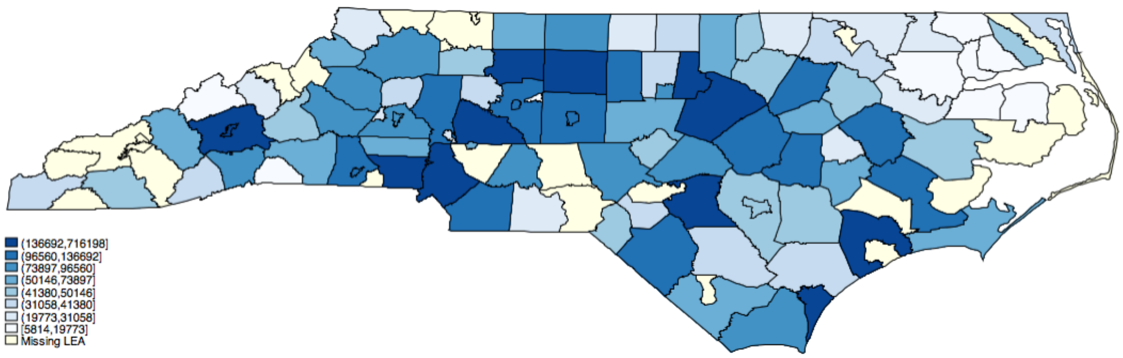
| | 0-20% | 20-40% | 40-60% | 60-80% | 80-100% |
|---|---|---|---|---|---|
| Score | -0.0131** | -0.0078** | 0.0010** | 0.0040 | 0.0124** |
| | (0.0041) | (0.0037) | (0.0040) | (0.0031) | (0.0045) |
| Score Whites | -0.0053 | 0.0037 | -0.0089* | 0.0029 | 0.0056 |
| | (0.0042) | (0.0040) | (0.0046) | (0.0029) | (0.0052) |
| Score Blacks | -0.0198** | -0.0056 | -0.0036 | 0.0035 | 0.0210** |
| | (0.0068) | (0.0060) | (0.0068) | (0.0079) | (0.0077) |
| Score Others | -0.0165** | -0.0083 | -0.0040 | 0.0091 | 0.0181** |
| | (0.0062) | (0.0081) | (0.0074) | (0.0077) | (0.0084) |
| Math Score | -0.0123** | -0.0074** | 0.0007 | 0.0003 | 0.0154** |
| | (0.0037) | (0.0037) | (0.0037) | (0.0034) | (0.0046) |
| Reading Score | -0.0167** | -0.0040 | 0.0020 | 0.0031 | 0.0126** |
| | (0.0042) | (0.0034) | (0.0044) | (0.0035) | (0.0049) |
| Whites | -0.0151** | -0.0031 | 0.0087** | 0.0047 | 0.0010 |
| | (0.0032) | (0.0033) | (0.0031) | (0.029) | (0.0033) |
| Highly Educated Parents | -0.0091** | -0.0091** | -0.0064** | 0.0027 | 0.0069** |
| | (0.0034) | (0.0027) | (0.0029) | (0.0031) | (0.0025) |
| Blacks | 0.0017 | 0.0012 | 0.0053 | -0.0041 | -0.0093** |
| | (0.0039) | (0.0022) | (0.0034) | (0.0033) | (0.0032) |
| Free Lunch Eligible | 0.0061* | 0.0033 | 0.0046 | 0.0019 | -0.0144** |
| | (0.0033) | (0.0033) | (0.0038) | (0.0032) | (0.0040) |

TABLE 26

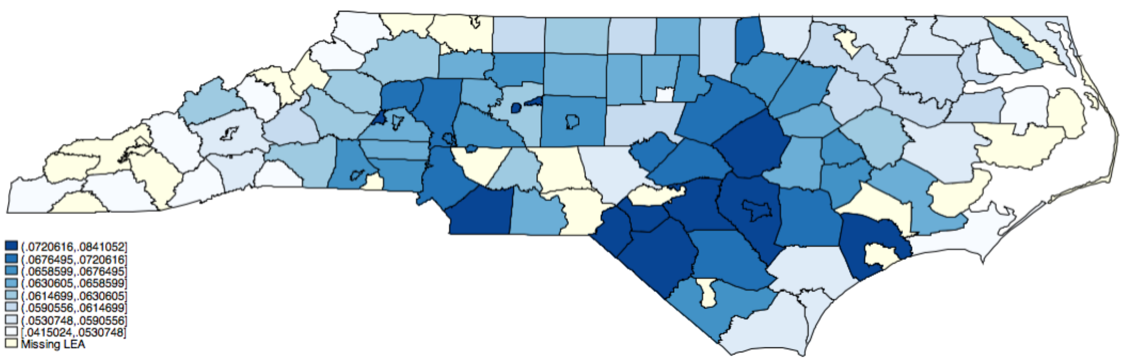
| | 0-20% | 20-40% | 40-60% | 60-80% | 80-100% |
|---|---|---|---|---|---|
| Population | -0.0027 | -0.0044** | 0.0042* | 0.0043 | -0.0016 |
| | (0.0031) | (0.0021) | (0.0024) | (0.0027) | (0.0020) |
| Whites | -0.0081** | 0.0017 | 0.0082** | -0.0059* | 0.0040 |
| | (0.0026) | (0.0032) | (0.0025) | (0.0031) | (0.0027) |
| Blacks | 0.0009 | -0.0010 | 0.0091** | -0.0047 | -0.0046** |
| | (0.0029) | (0.0030) | (0.0022) | (0.0031) | (0.0021) |
| Household Income | -0.0034 | -0.0061 | 0.0058** | -0.0026 | 0.0063 |
| | (0.0029) | (0.0040) | (0.0021) | (0.0025) | (0.0041) |
| Highly Educated Neighbors | 0.0006 | -0.0073** | -0.0034 | 0.0044* | 0.0054 |
| | (0.0027) | (0.0027) | (0.0035) | (0.0026) | (0.0039) |
| Number of Charter Schools | -0.0094** | 0.0022 | 0.0031 | 0.0049 | 0.0019 |
| | (0.0037) | (0.0038) | (0.0036) | (0.0032) | (0.0033) |
| Rent | -0.0026 | 0.0033 | -0.0033 | 0.0050** | -0.0026 |
| | (0.0026) | (0.0033) | (0.0029) | (0.0025) | (0.0031) |
| House Price | -0.0082** | 0.0033 | -0.0069* | -0.0001 | 0.0117** |
| | (0.0021) | (0.0030) | (0.0037) | (0.0025) | (0.0038) |
| Vacancies | -0.0119** | 0.0103** | -0.0013 | 0.0010 | 0.0022 |
| | (0.0030) | (0.0024) | (0.0028) | (0.0026) | (0.023) |

FIGURE 1
School District Characteristics

(a) Population




(b) Proportion Young Children (Age 4 Years or Less)




(c) Proportion Elderly (Age 65 Years or More)

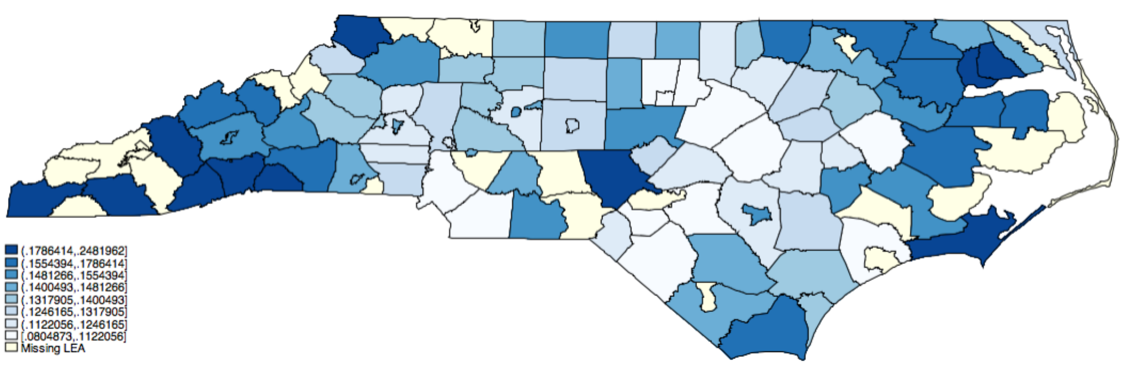
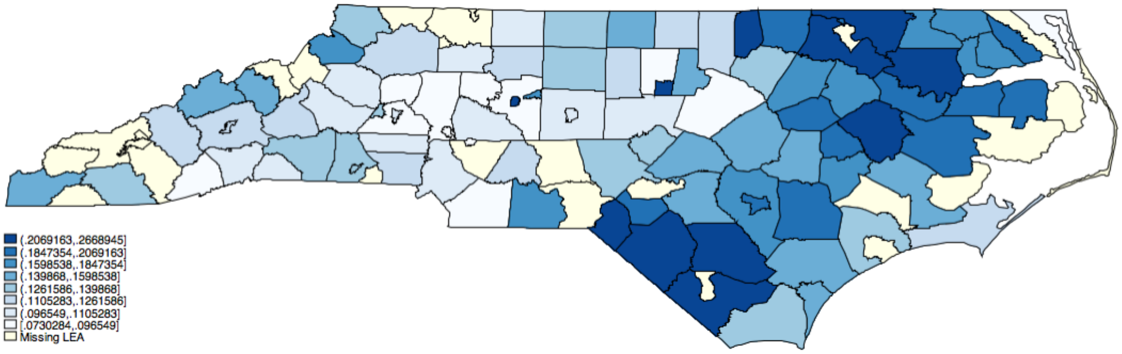
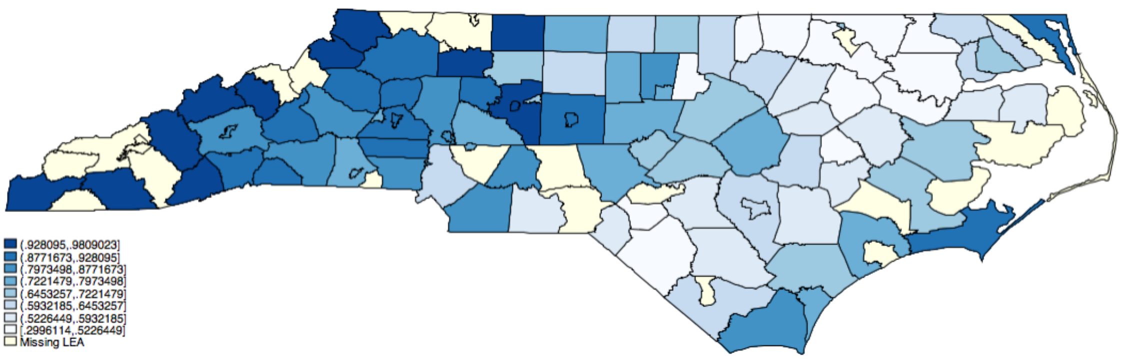


FIGURE 1
School District Characteristics

(d) Proportion Below Poverty Line




(e) Proportion White




(f) Proportion Black

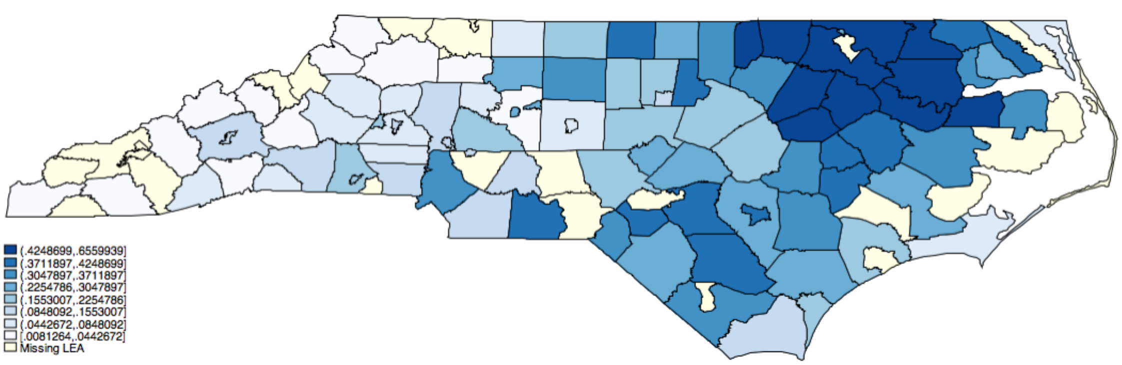
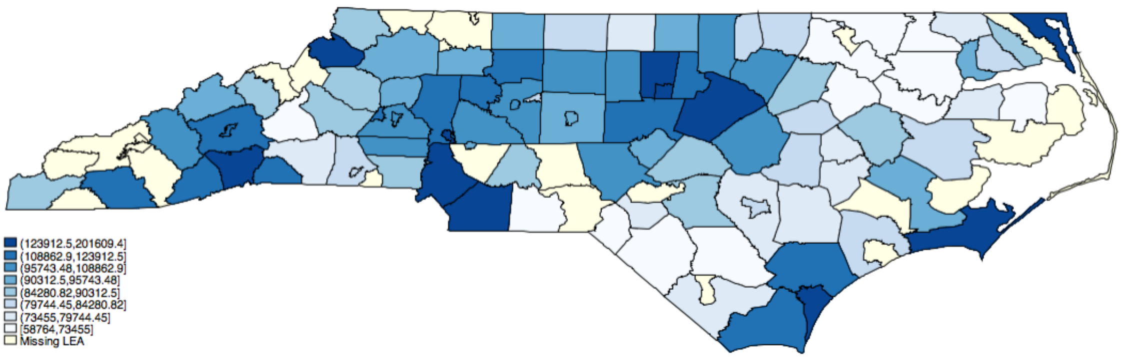


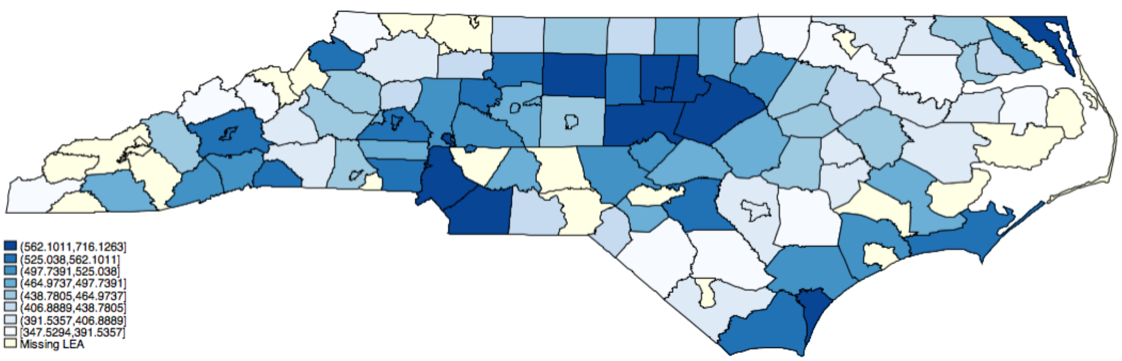
FIGURE 1

School District Characteristics

(g) Median House Price




(h) Median Rent




(i) Proportion House Vacancies

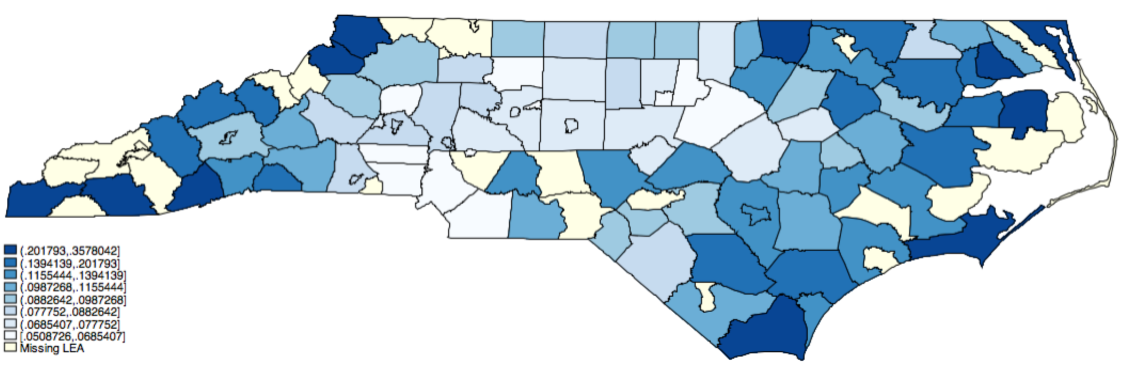
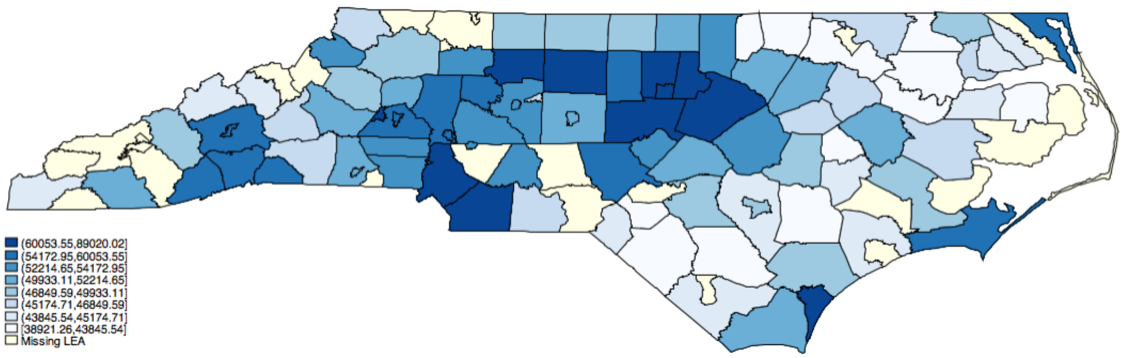


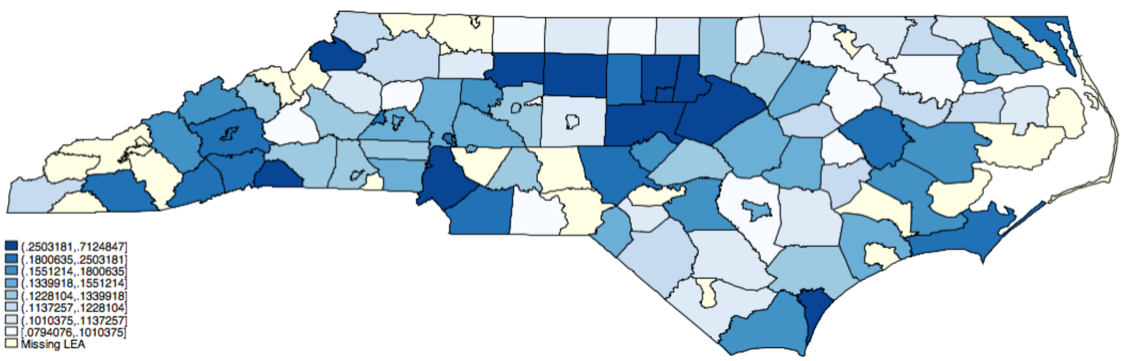
FIGURE 1

School District Characteristics

(j) Family Income




(k) Proportion College Degree Attained




(l) Proportion High School Degree Attained or Less

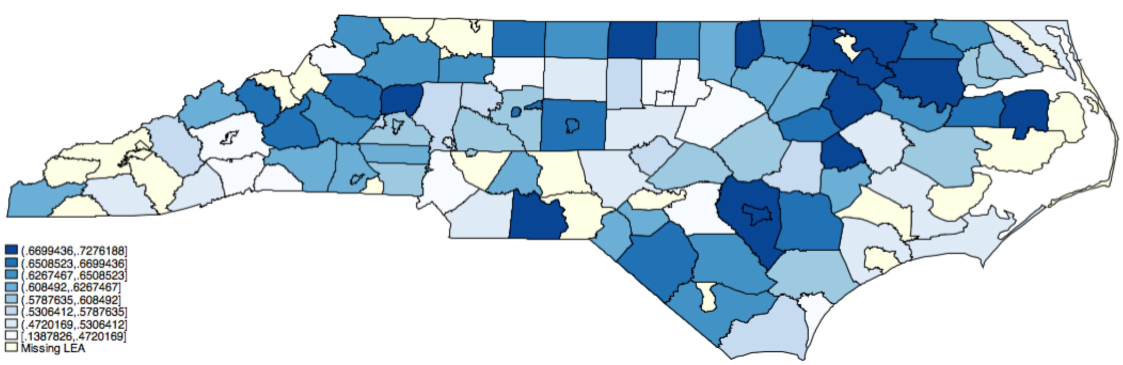
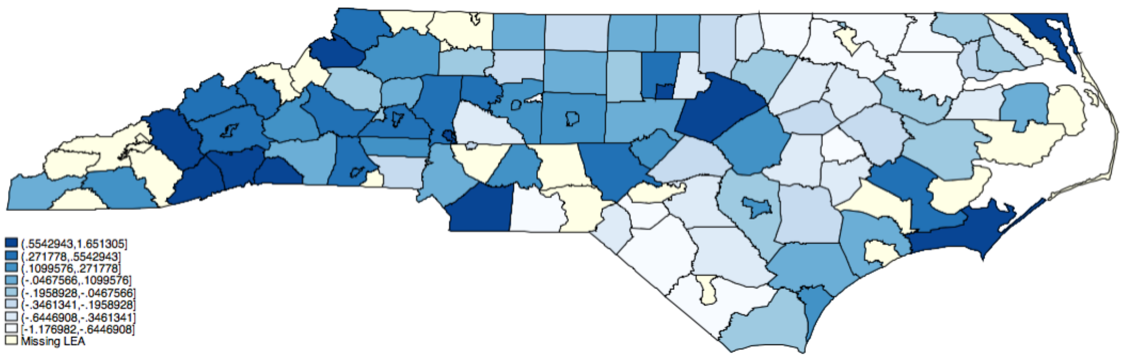
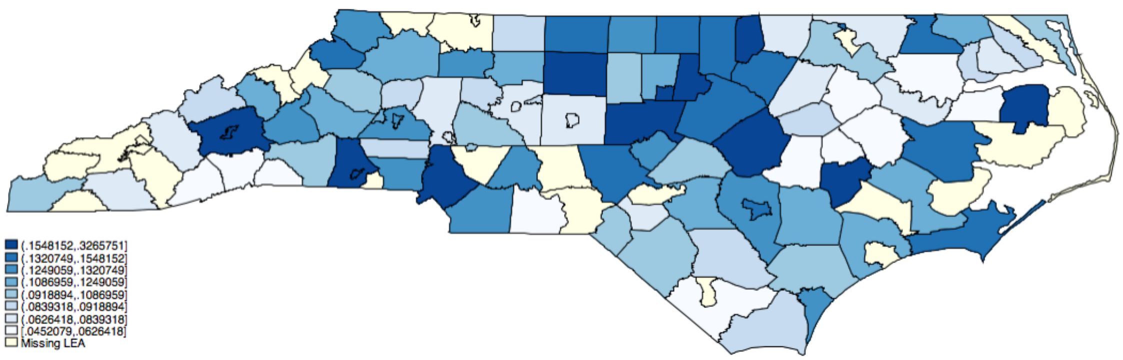


FIGURE 1
School District Characteristics

(m) Average Standardized Test Score




(n) Proportion Gifted




(o) Presence of Charter Schools

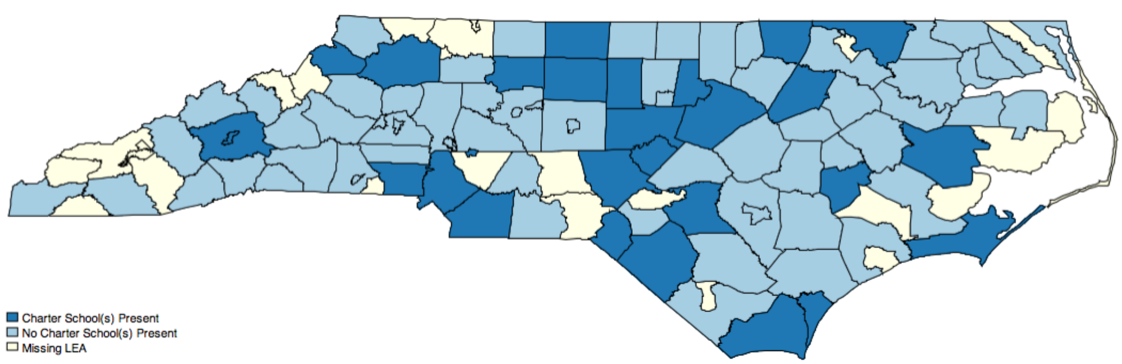


FIGURE 2
Proportion Attending Grade Six at Age 11
(Control versus Treatment)

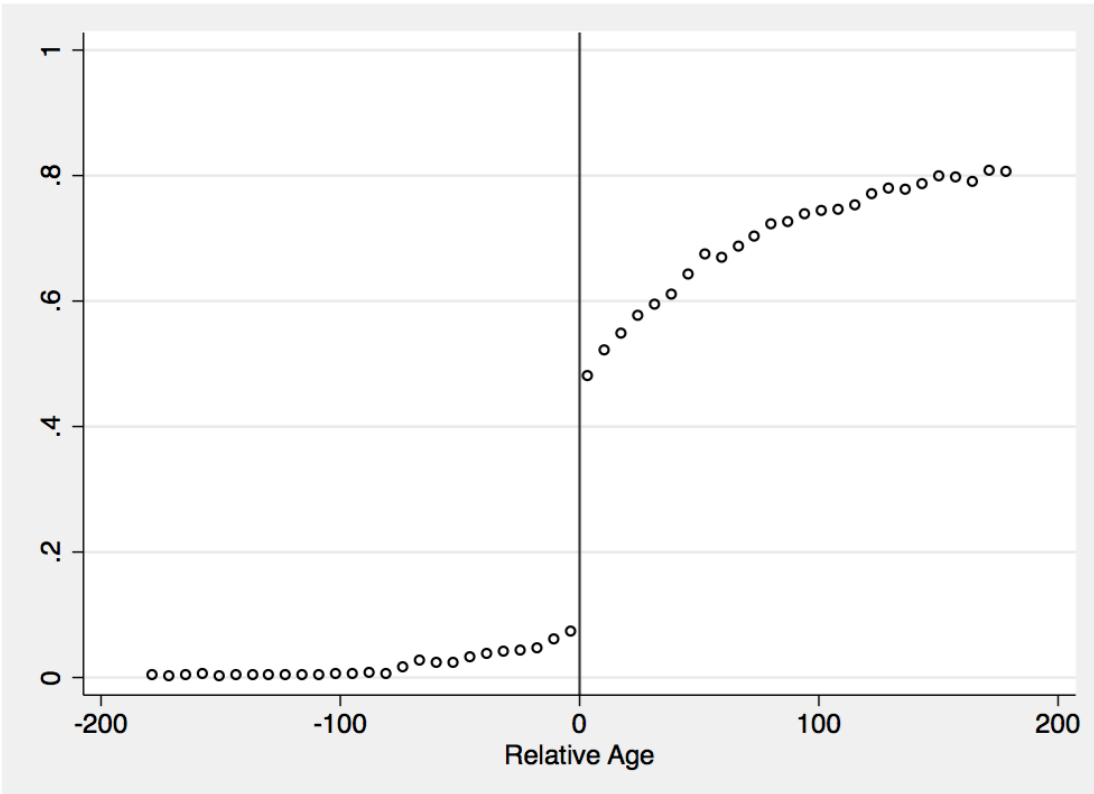
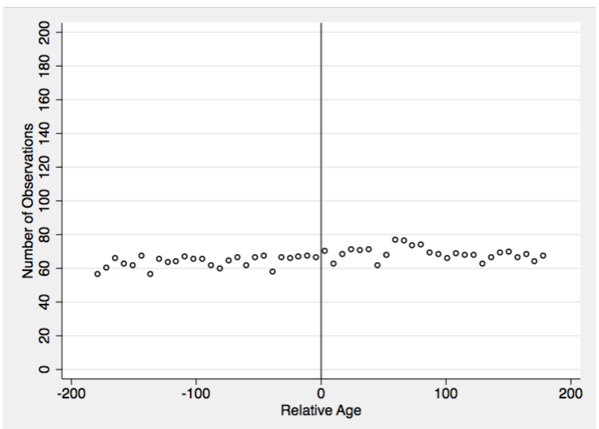
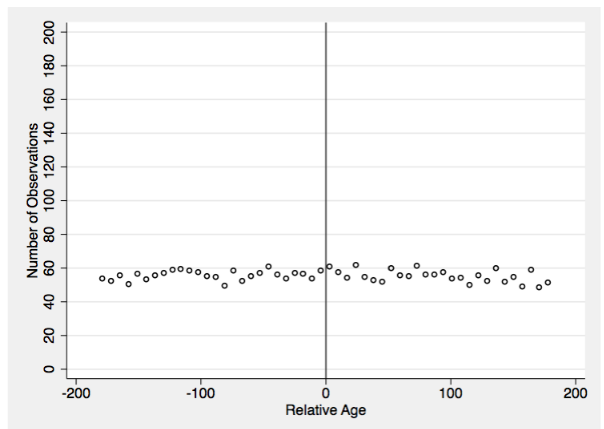


FIGURE 3
Selected Validity Plots
(Control versus Treatment)

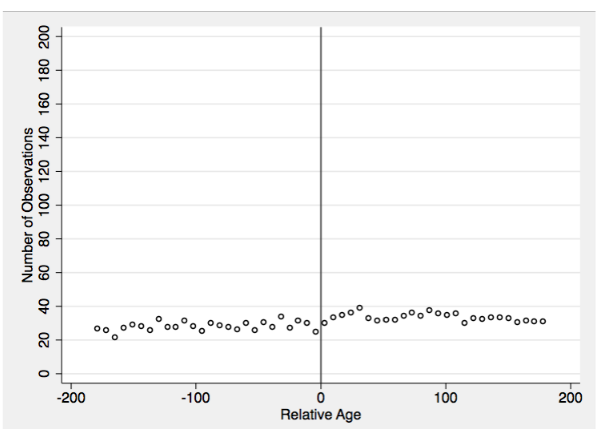
(a) N: Age 13 - 2008 (Eldest Sibling)




(b) N: Age 18 - 2011 (Eldest Sibling)




(c) N: Age 5 - 2007 (Youngest Sibling)




(d) N: Age 8 - 2009 (Youngest Sibling)

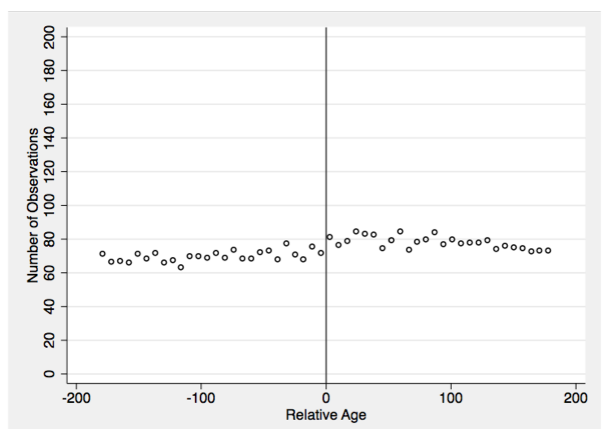
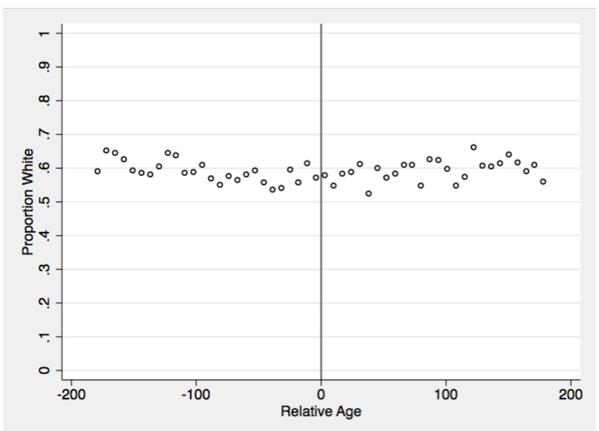


FIGURE 3

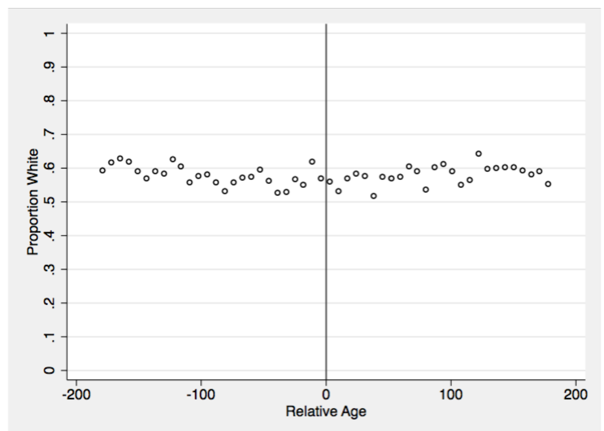
Selected Validity Plots

(Control versus Treatment)

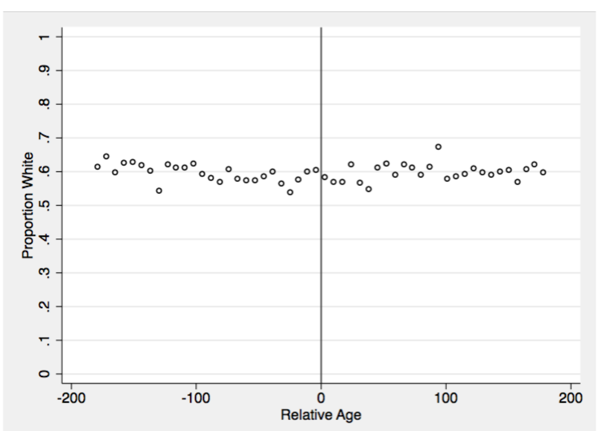
(e) White: Age 12 - 2008 (Eldest Sibling)



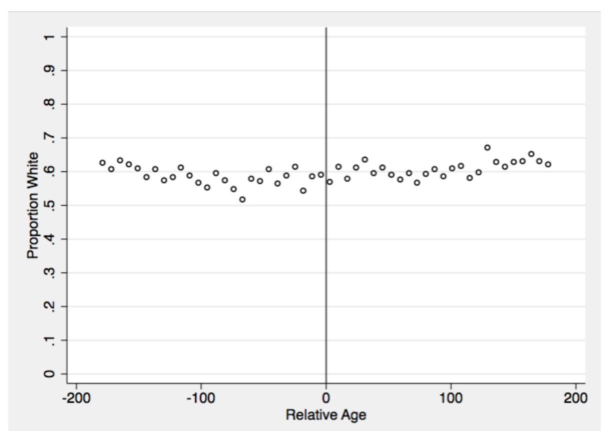

(f) White: Age 15 - 2011 (Eldest Sibling)




(g) White: Age 8 - 2007 (Youngest Sibling)

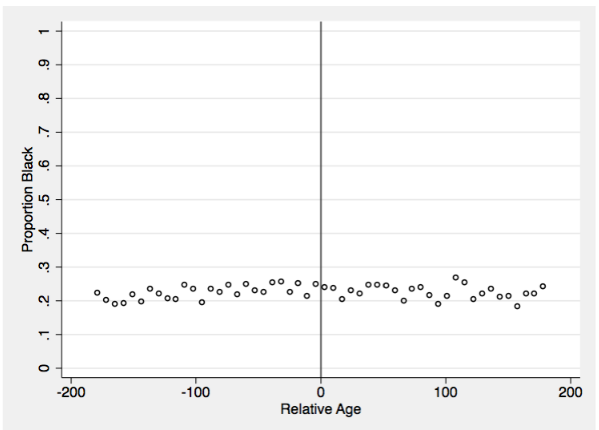



(h) White: Age 12 - 2010 (Youngest Sibling)

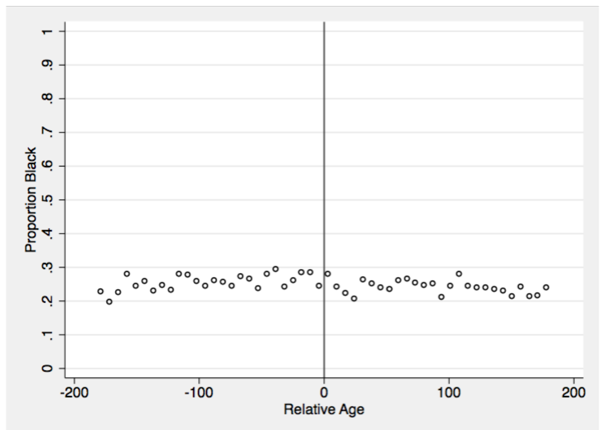


# FIGURE 3
Selected Validity Plots
(Control versus Treatment)

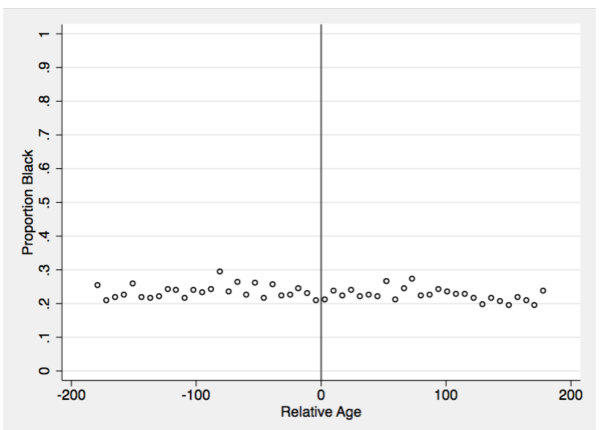
(i) Black: Age 13 - 2009 (Eldest Sibling)




(j) Black: Age 17 - 2010 (Eldest Sibling)




(k) Black: Age 8 - 2008 (Youngest Sibling)




(l) Black: Age 11 - 2012 (Youngest Sibling)

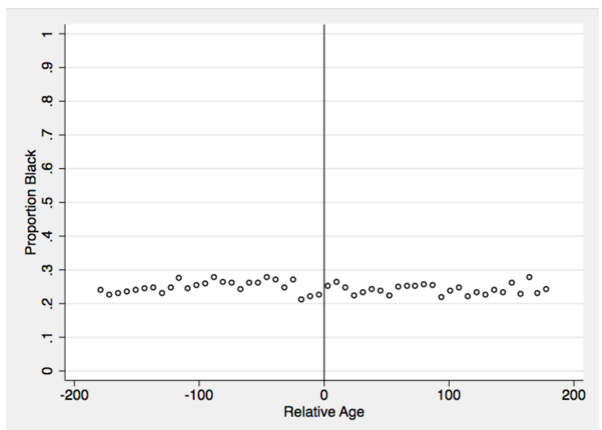
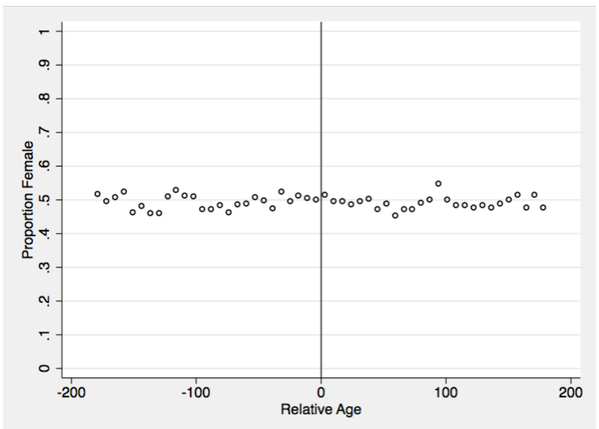
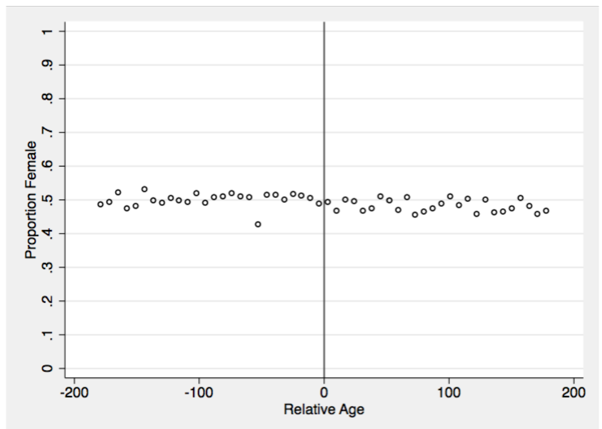


FIGURE 3
Selected Validity Plots
(Control versus Treatment)

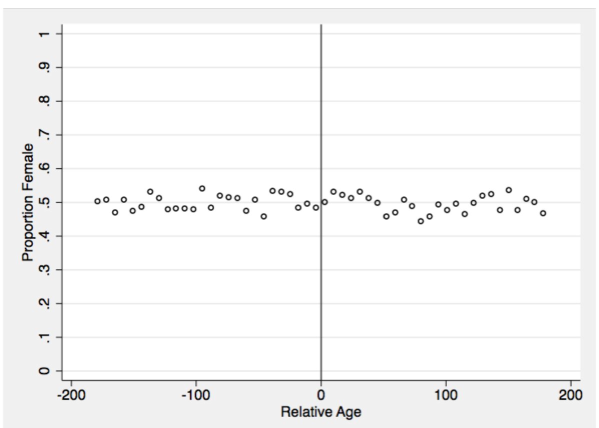
(m) Female: Age 14 - 2007 (Eldest Sibling)




(n) Female: Age 16 - 2012 (Eldest Sibling)




(o) Female: Age 10 - 2009 (Youngest Sibling)




(p) Female: Age 12 - 2011 (Youngest Sibling)

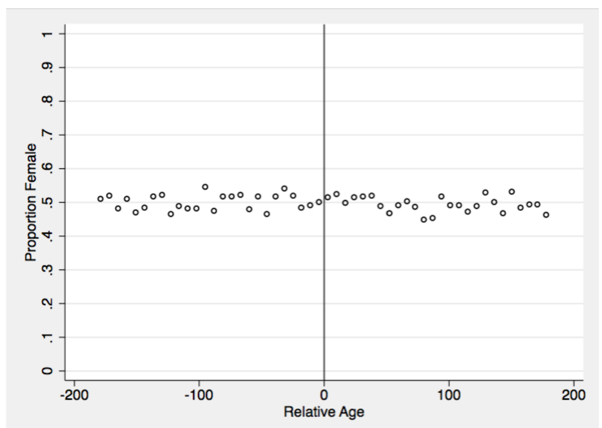
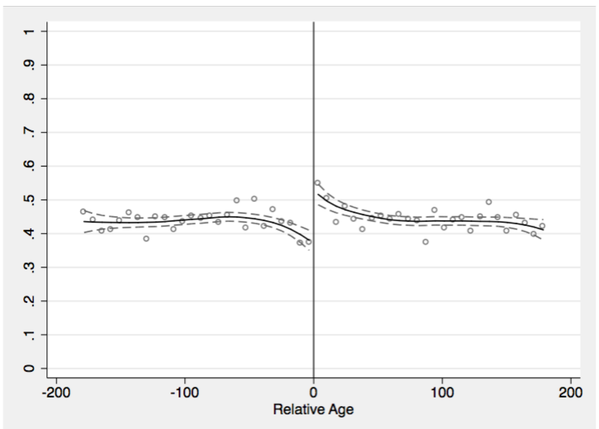
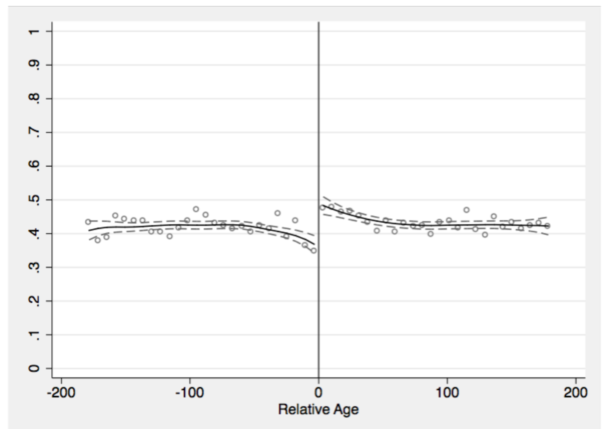


FIGURE 4
TSC by Proportion Attending School District
(Control versus Treatment)

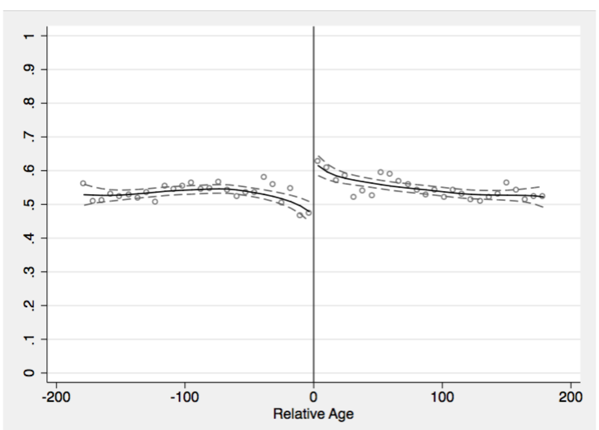
(a) All: Age 12 - 2007 (Eldest Sibling)




(b) All: Age 15 - 2008 (Eldest Sibling)




(c) All: Age 18 - 2010 (Eldest Sibling)




(d) All: Age 19 - 2012 (Eldest Sibling)

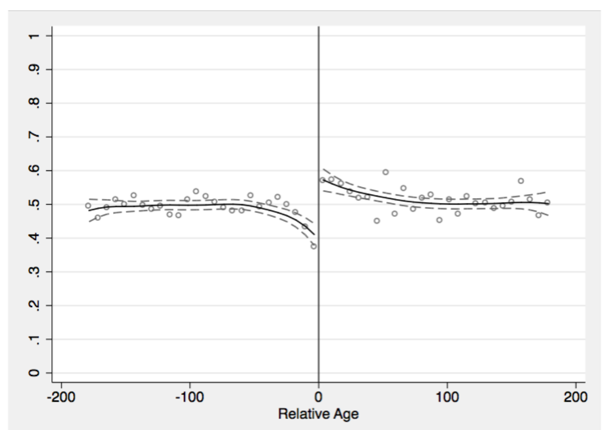
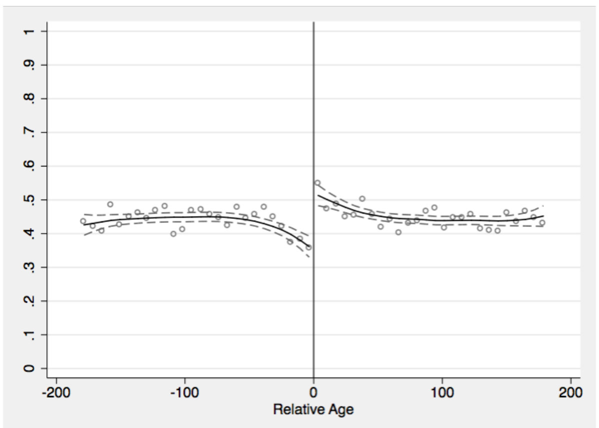
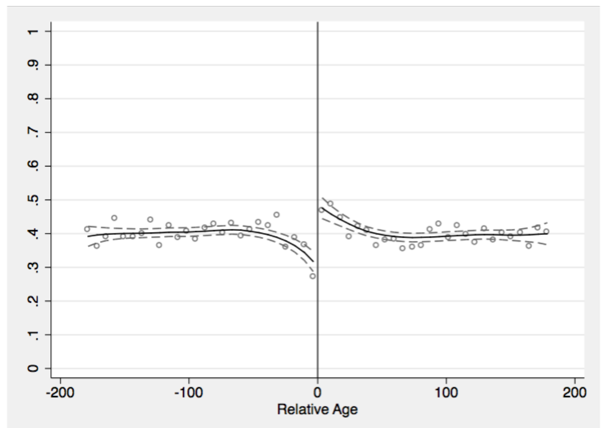


FIGURE 4
TSC by Proportion Attending School District
(Control versus Treatment)

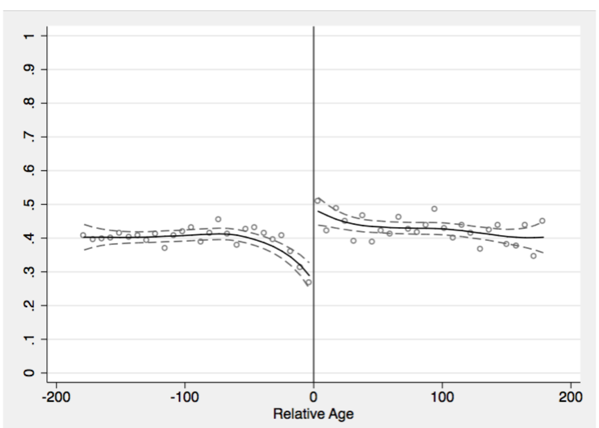
(e) All: Age 8 - 2007 (Youngest Sibling)




(f) All: Age 12 - 2009 (Youngest Sibling)




(g) All: Age 16 - 2010 (Youngest Sibling)




(h) All: Age 10 - 2011 (Youngest Sibling)

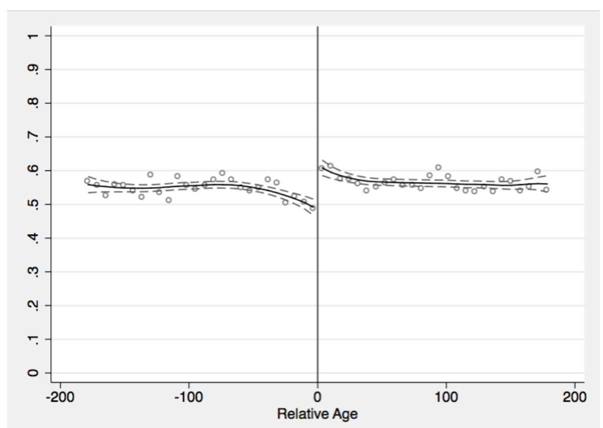
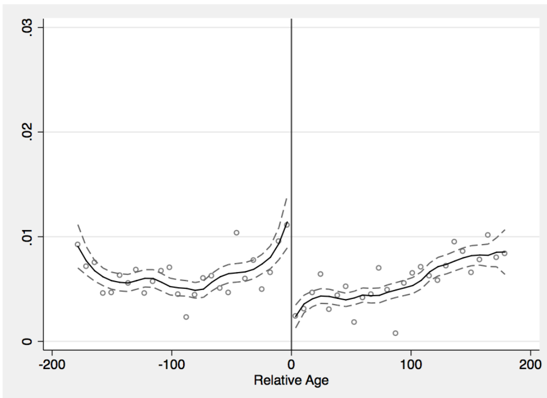


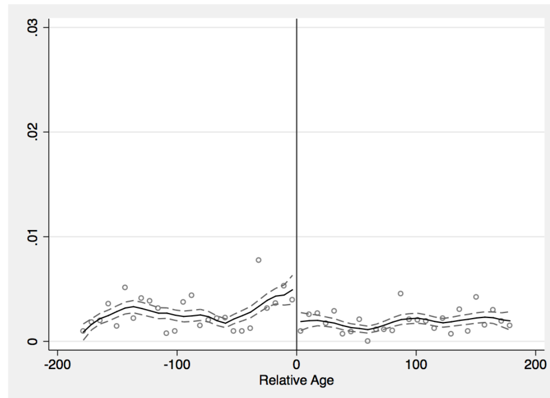
FIGURE 5

Selected Discontinuities in Proportion Attending School District (Multiple Siblings)

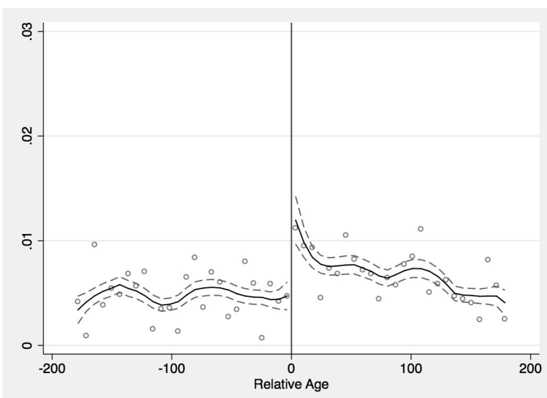
(a) Cohort Eight: Chatham County



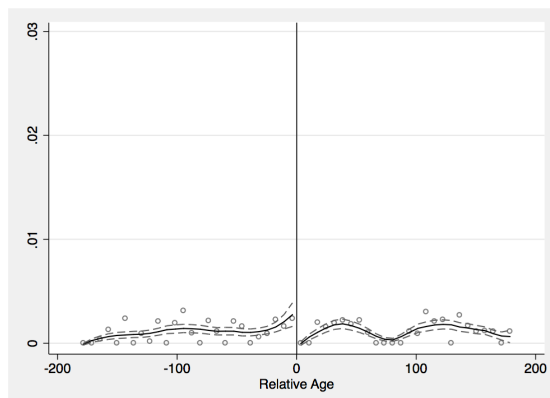

(b) Cohort Nine: Greene County



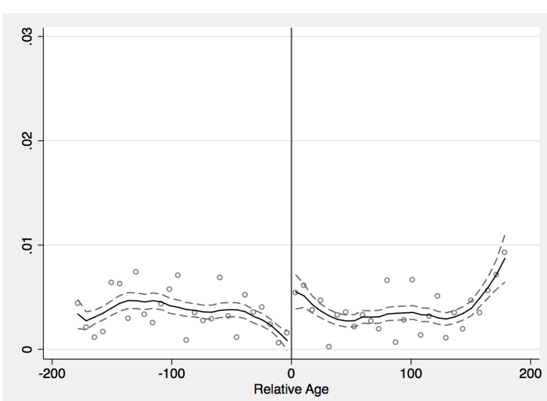

(c) Cohort Eleven: Pender County




(d) Cohort Twelve: Washington County




(e) Cohort Thirteen: McDowell County




(f) Cohort Fourteen: Rutherford County

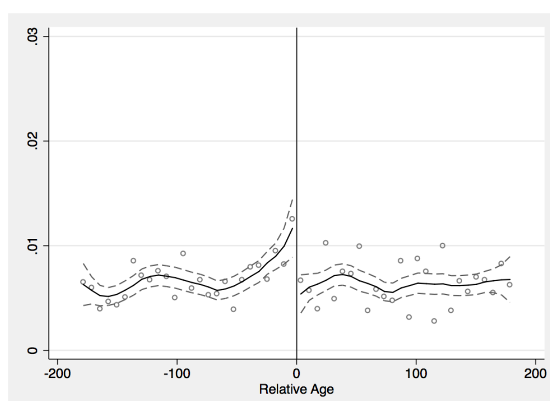
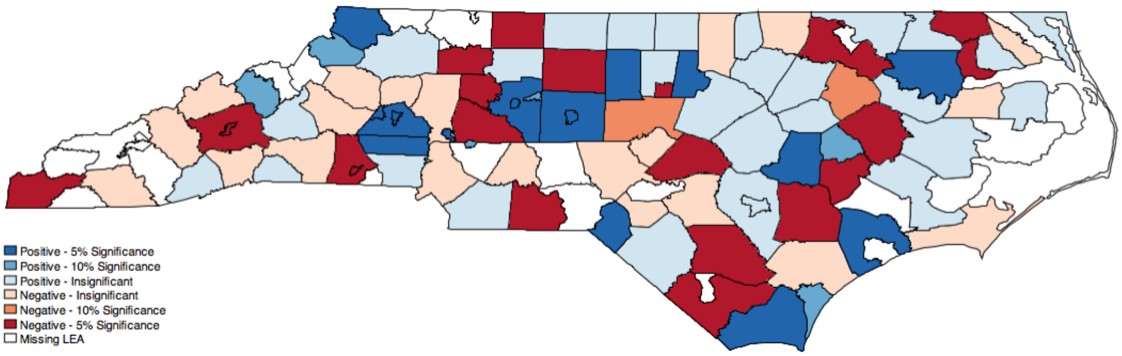
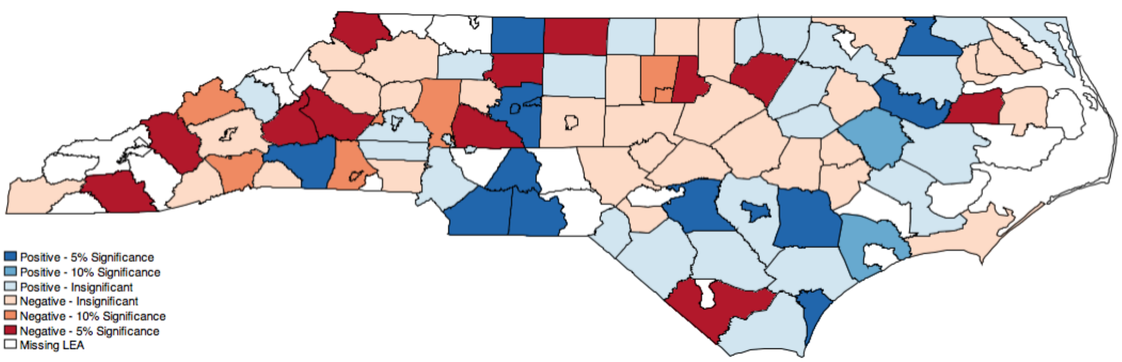


FIGURE 6
Discontinuities in Proportion Attending School District
(Multiple Siblings)

(a) Cohort - Age Five in 2007




(b) Cohort - Age Seven in 2007




(c) Cohort - Age Eight in 2007

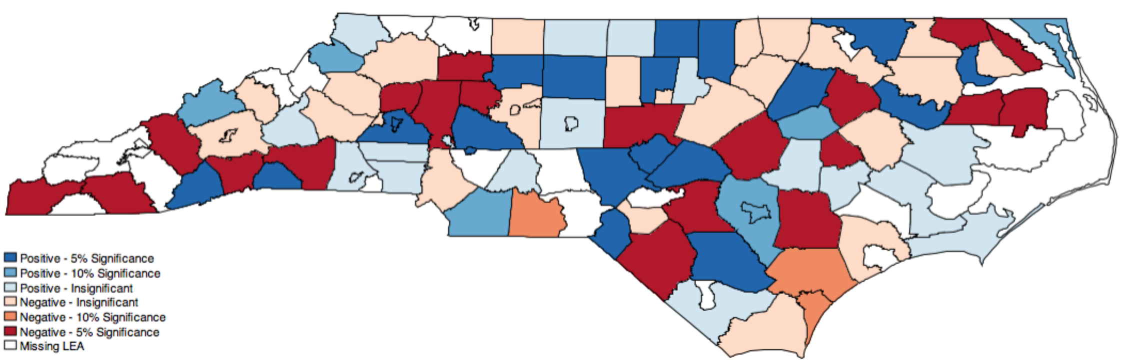
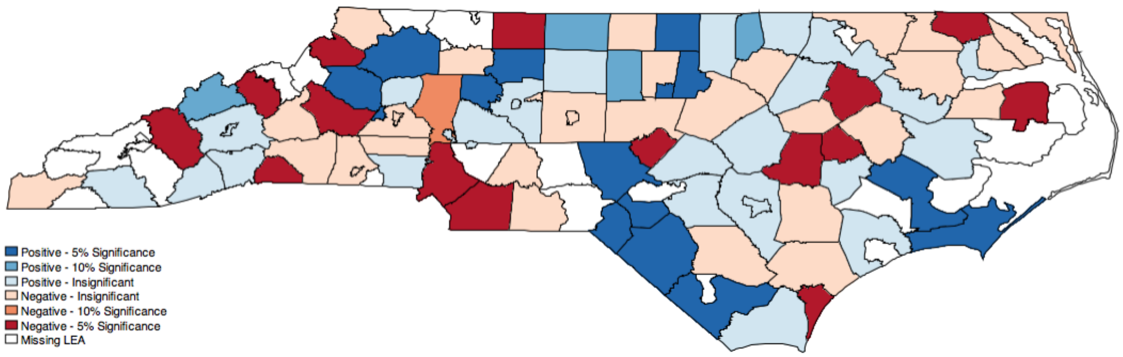


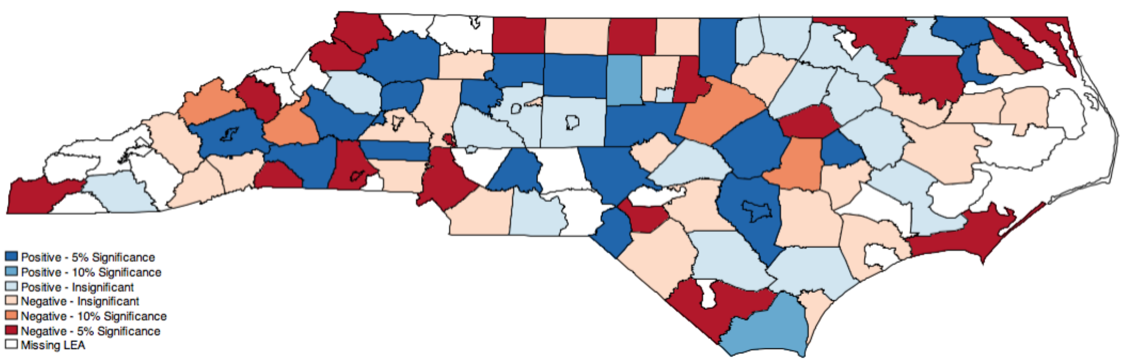
FIGURE 6

Discontinuities in Proportion Attending School District
(Multiple Siblings)

(d) Cohort - Age Nine in 2007




(e) Cohort - Age Ten in 2007




(f) Cohort - Age Eleven in 2007

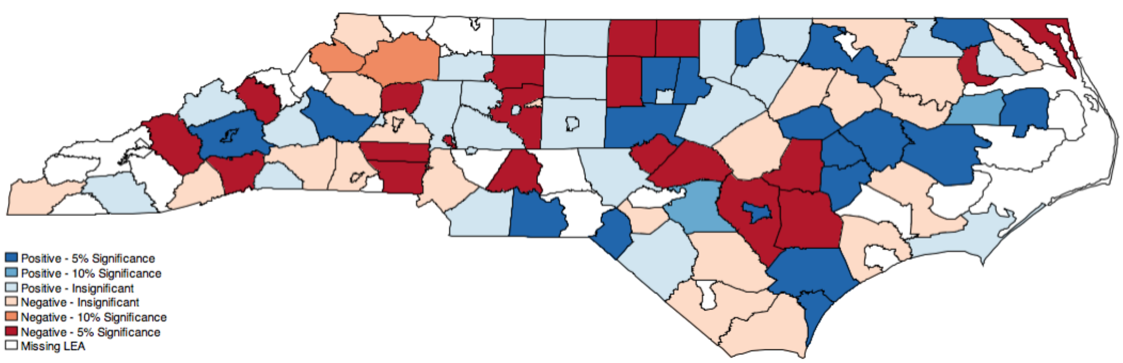
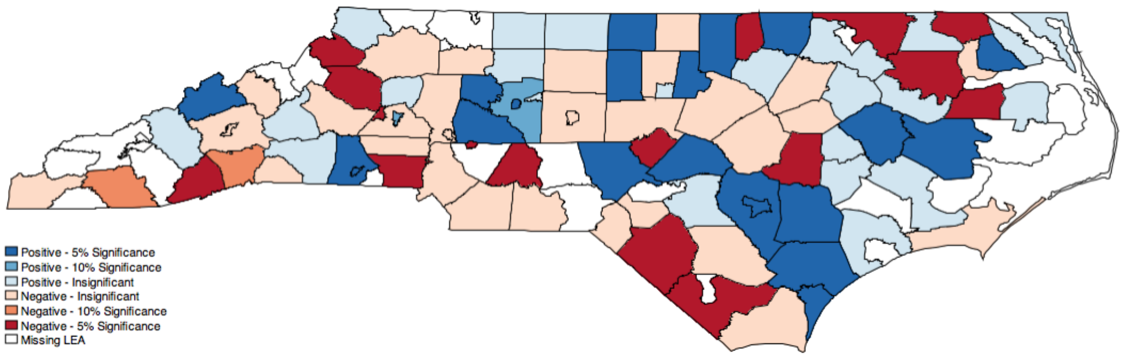


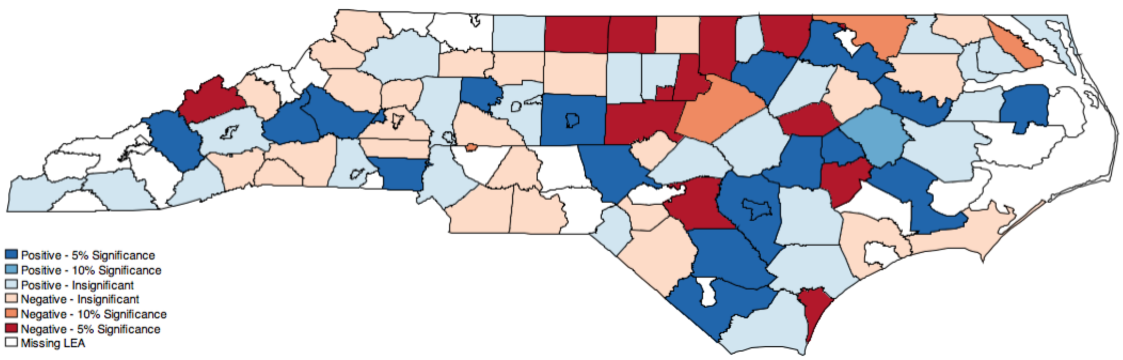
FIGURE 6

Discontinuities in Proportion Attending School District
(Multiple Siblings)

(g) Cohort - Age Twelve in 2007




(h) Cohort - Age Thirteen in 2007




(i) Cohort - Age Fourteen in 2007

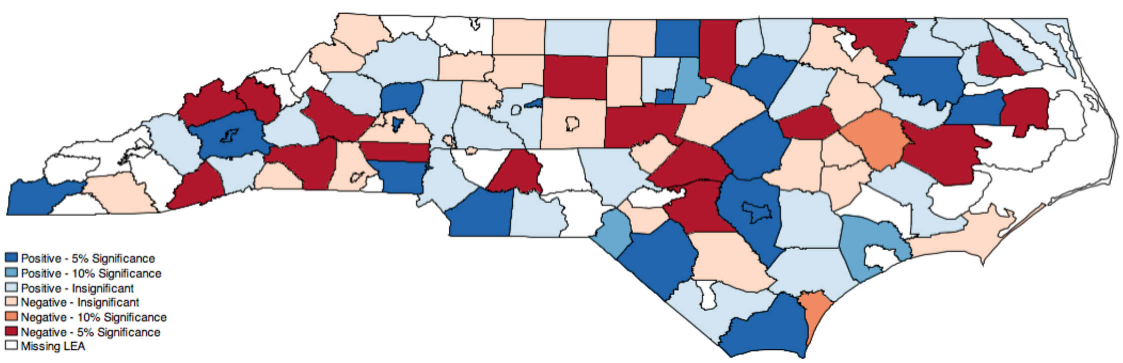
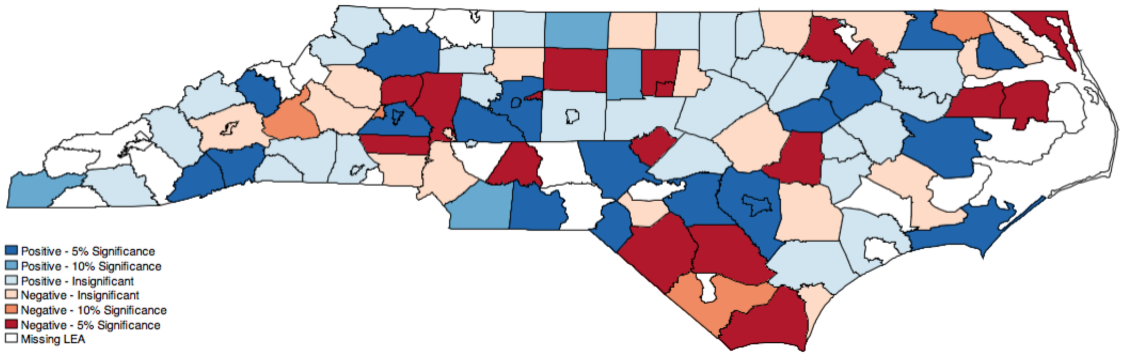


FIGURE 6
Discontinuities in Proportion Attending School District
(Multiple Siblings)

(j) Cohort - Age Fifteen in 2007




(k) Cohort - Age Sixteen in 2007

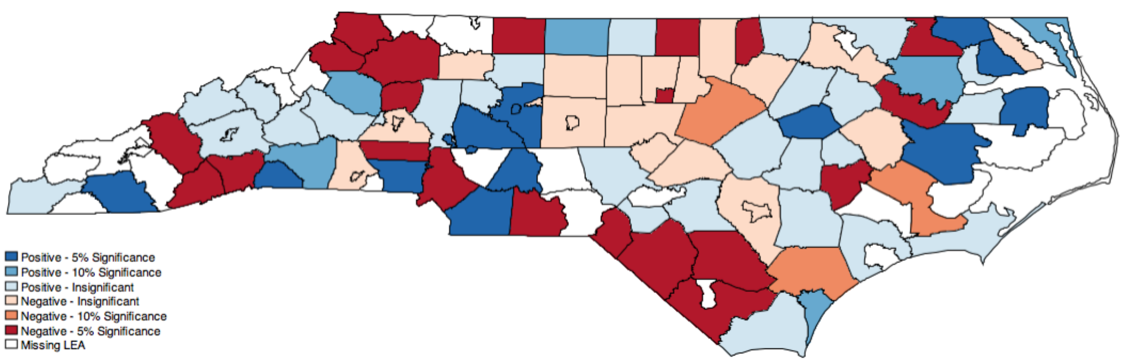
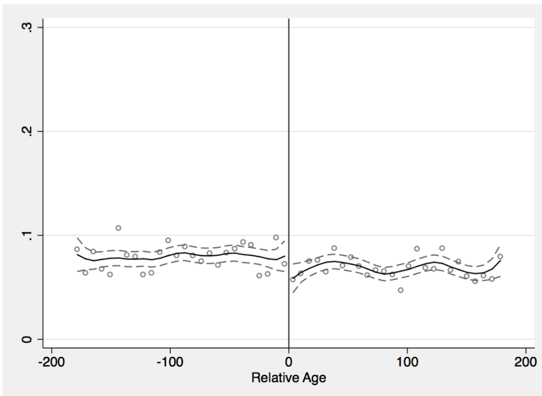


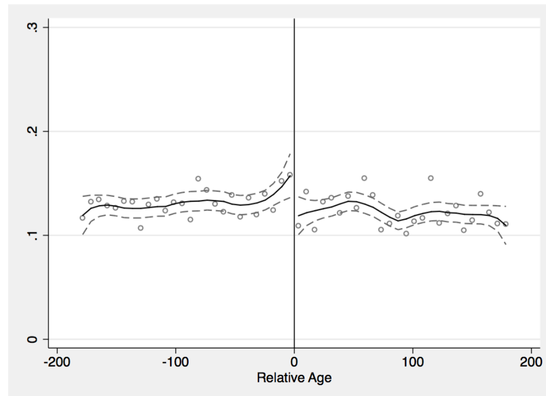
FIGURE 7

Selected Discontinuities in Move Rates (Multiple Siblings)

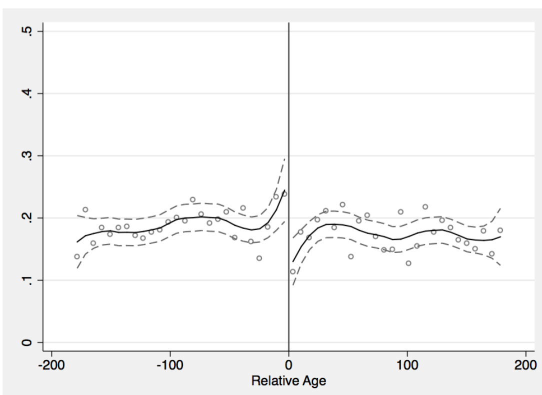
(a) All Students: Age 15 – Year 2011



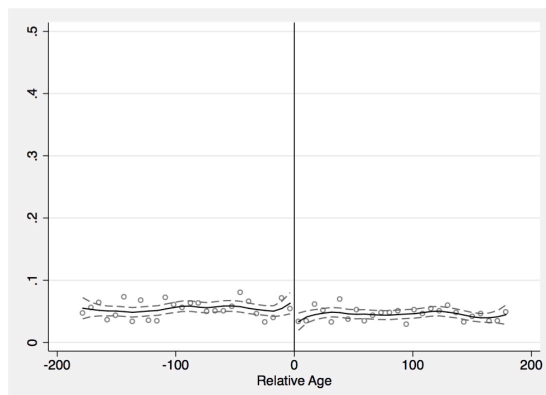

(b) All Students: Age 13 – Year 2012



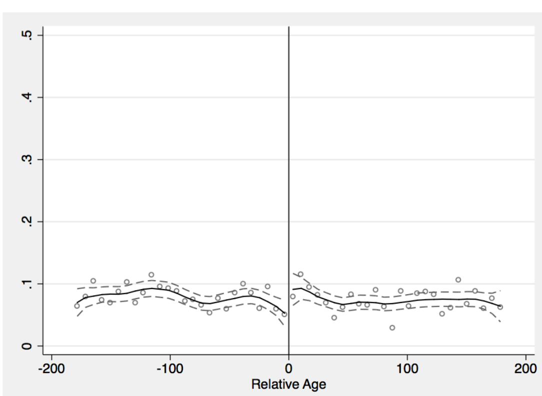

(c) Black Students: Age 13 – Year 2012




(d) White Students: Age 15 – Year 2011




(e) Male Students: Age 10 – Year 2008




(f) Male Students: Age 13 – Year 2012

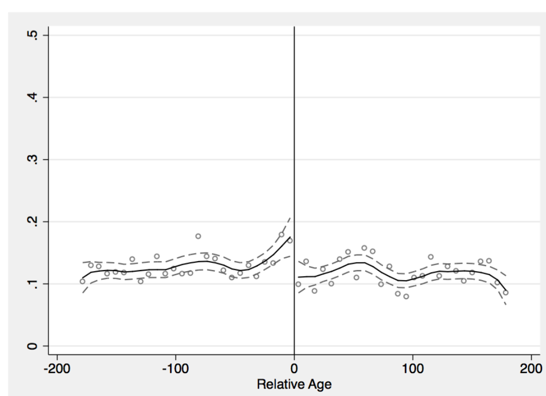
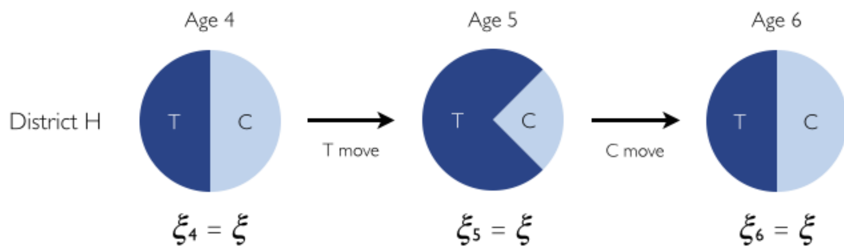
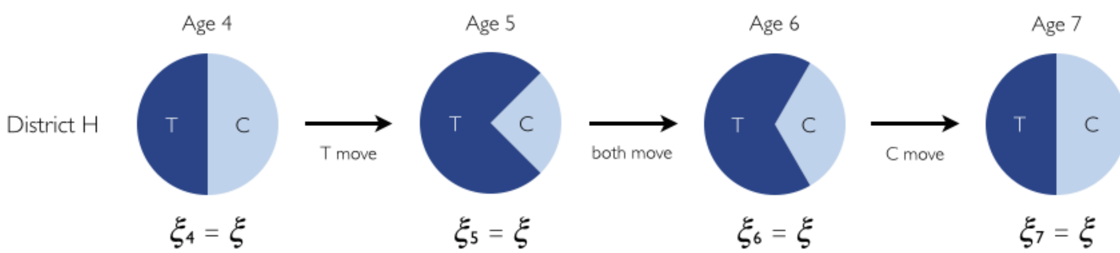


FIGURE 8
Intuition for the Identification Strategy

(a) Case 1: Families Only Willing to Exercise TSC immediately Prior to Kindergarten (No Time Shocks ($\xi_a = \xi_{a+1} \ \forall \ a$)




(b) Case 2: Families Only Willing to Exercise TSC immediately Prior to Kindergarten and First Grade (No Time Shocks ($\xi_a = \xi_{a+1} \ \forall \ a$)




(c) Case 3: Families Only Willing to Exercise TSC immediately Prior to Kindergarten and First Grade (With Time Shocks ($\xi_a \neq \xi_{a+1} \ \forall \ a$)

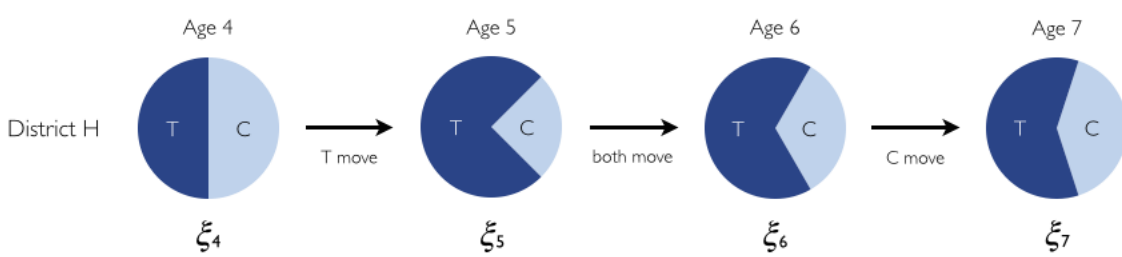


FIGURE 9
Extending the Intuition to All Ages

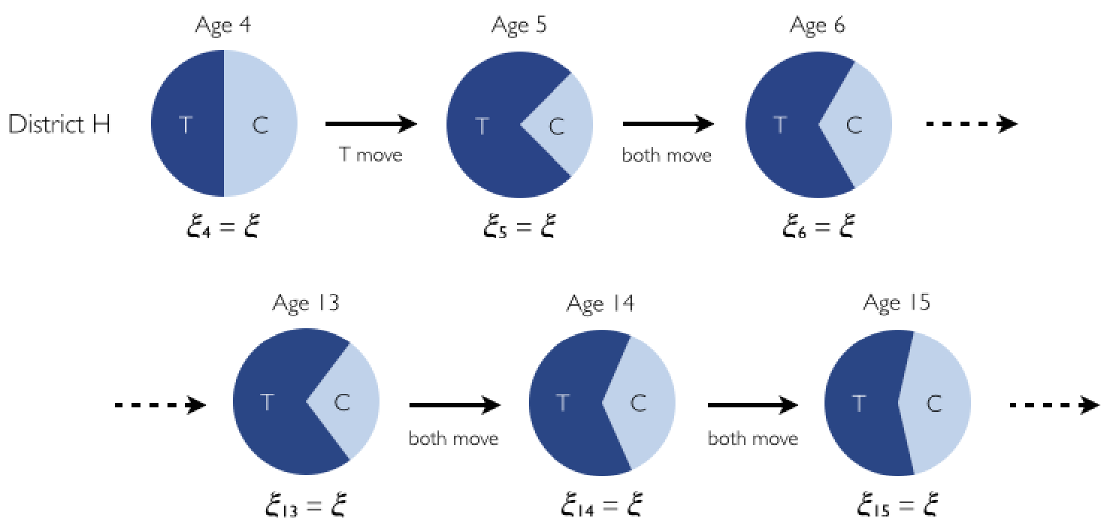


FIGURE 10
EXPLAINING THE LACK OF CATCHUP – PART A

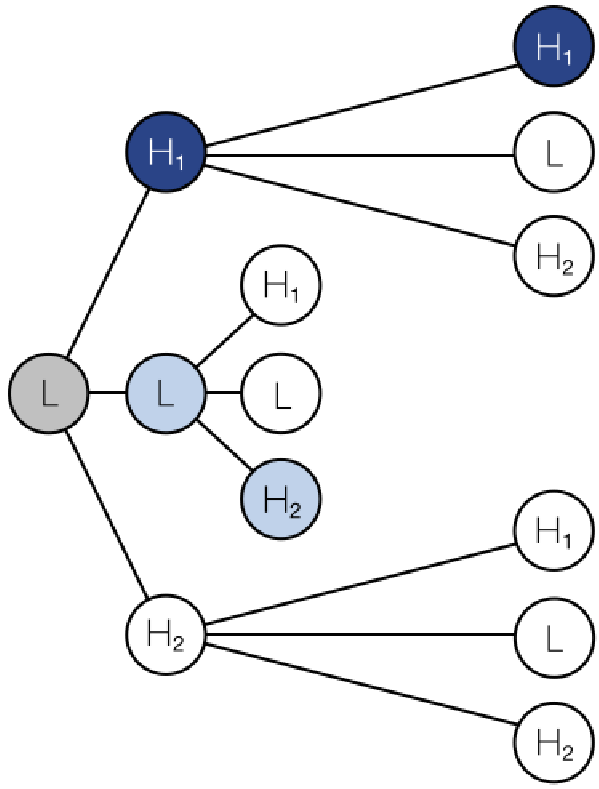


FIGURE 11

Explaining the Lack of Catchup – Part B

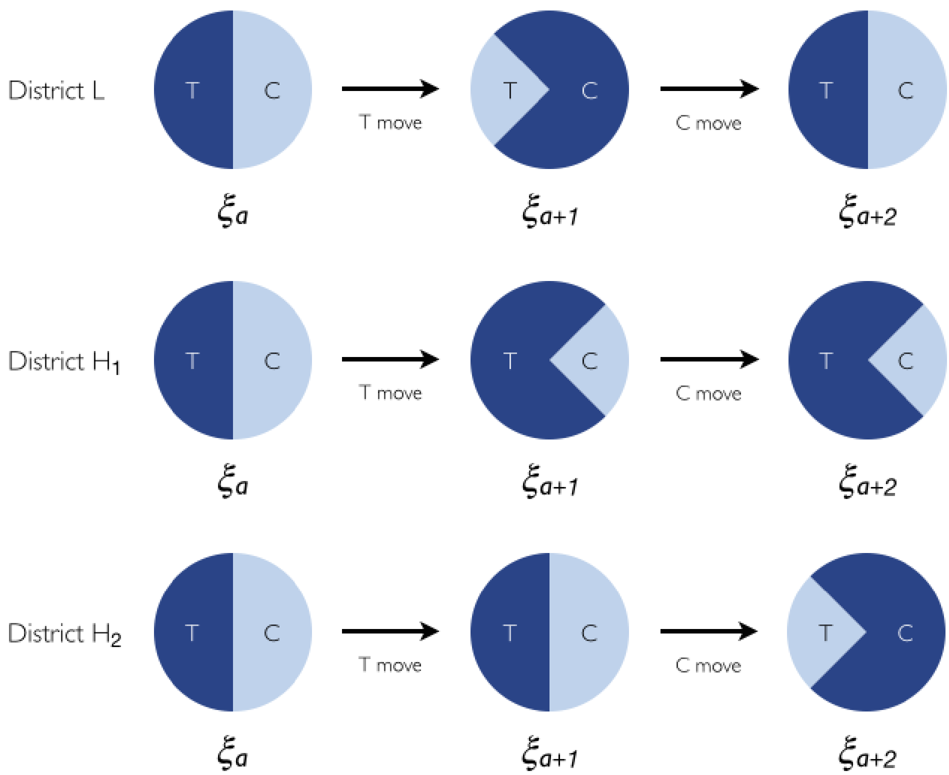
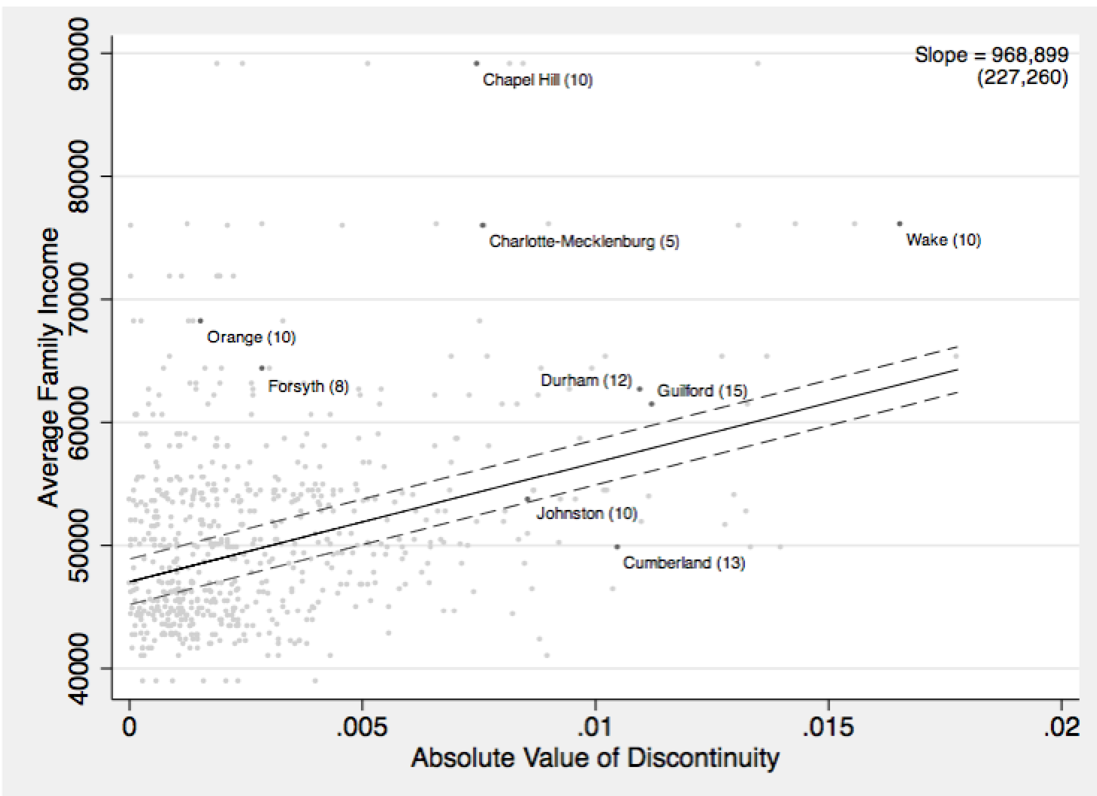


FIGURE 12

Relationship between TSC and Amenities



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Relationship between TSC and Amenities

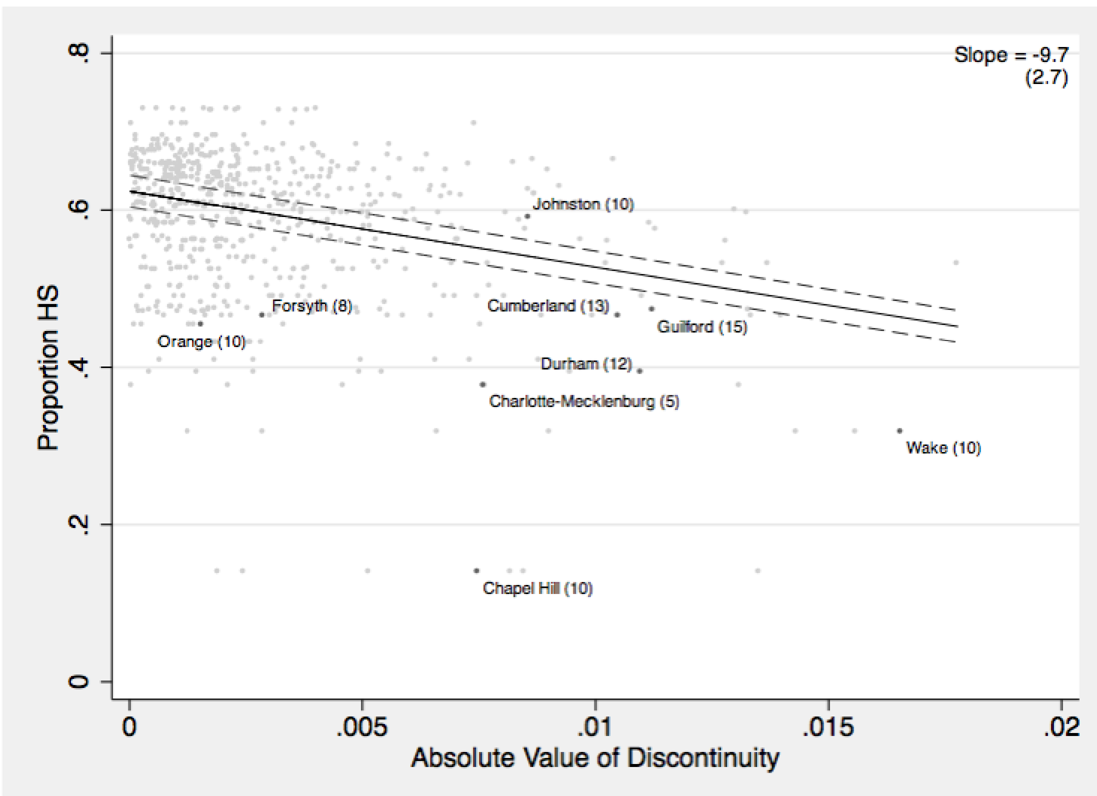

FIGURE 12
Relationship between TSC and Amenities

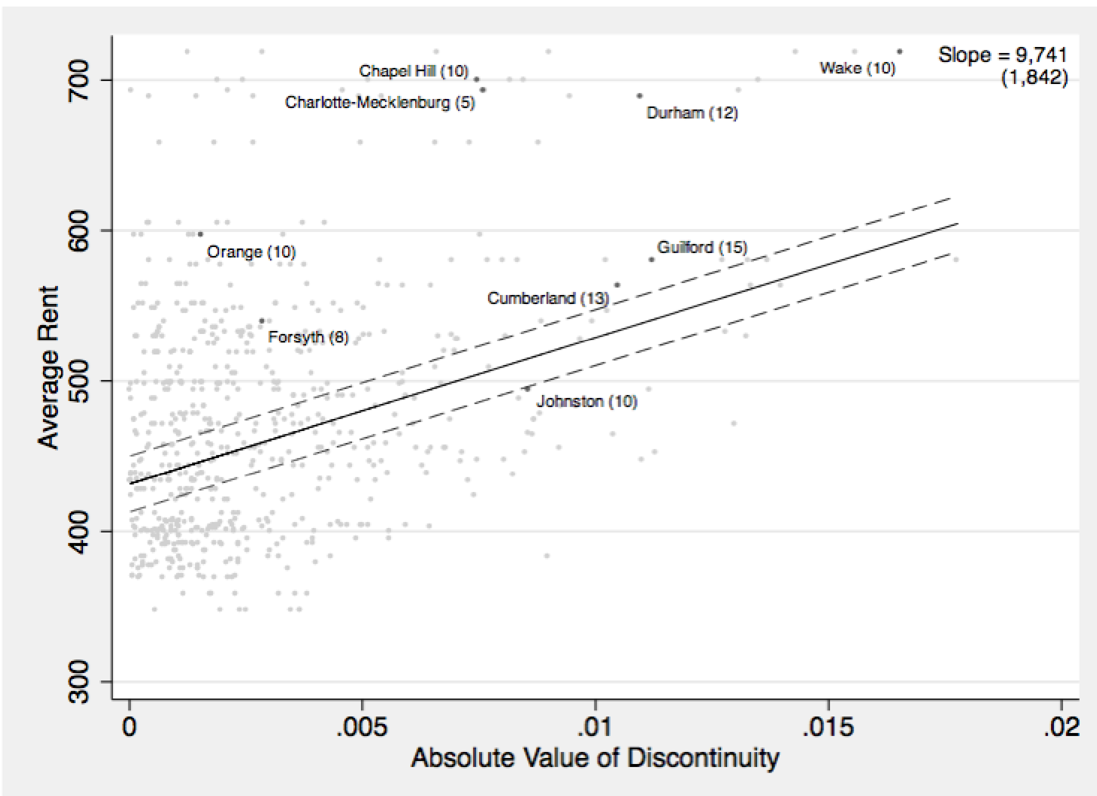

FIGURE 12
Relationship between TSC and Amenities

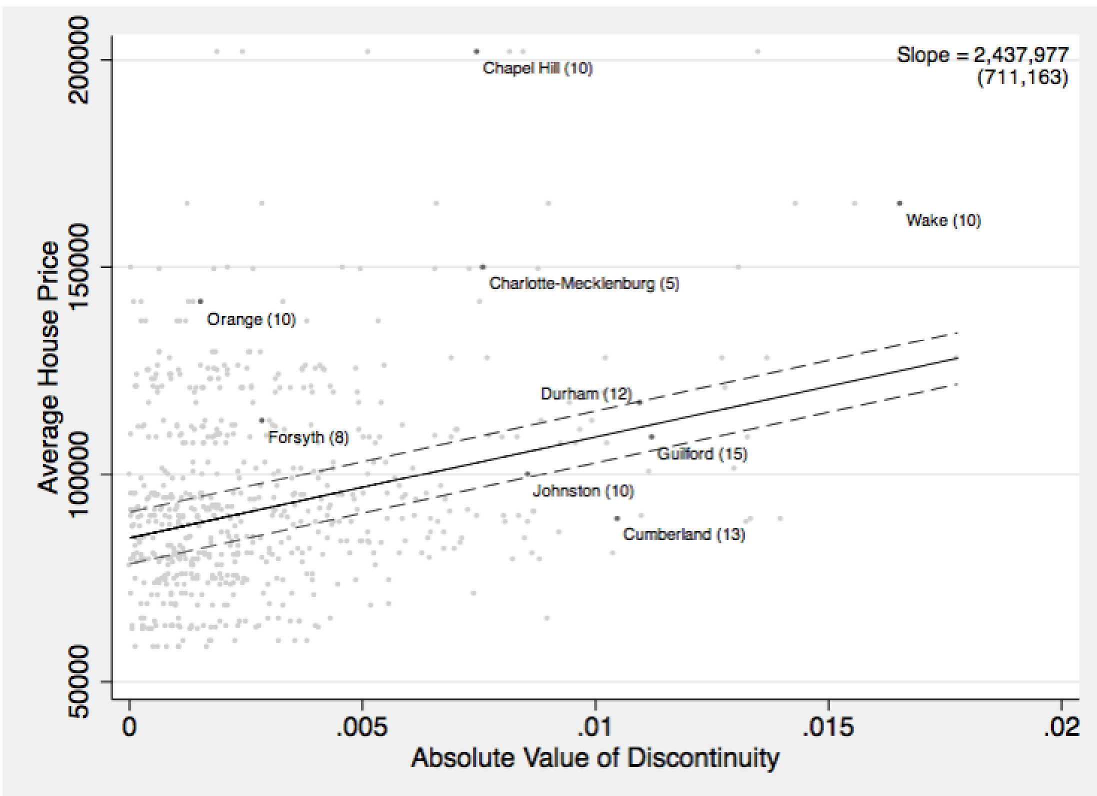

FIGURE 12

Relationship between TSC and Amenities