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The impact of the low income housing tax credit program on local schools

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ABSTRACT

The low-income housing tax credit (LIHTC) program has developed over two million rental homes for low-income households since 1986. The perception of deterioration in school quality has been a main reason for community opposition to LIHTC projects in middle- and upper-income areas. In this paper, we examine the impact of LIHTC projects on the nearby school performance using data on all LIHTC projects and elementary schools in Texas from the 2003–04 through 2008–09 academic years. We employ the longitudinal structure of the data to control for school fixed effects and estimate the relationship between the opening of nearby LIHTC on campus-level standardized test scores and performance ratings. We address the potential selection biases by controlling for preexisting trends in school performance prior to the study period. We find no robust evidence that the opening of LIHTC units negatively impacts the performance of nearby elementary schools.

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1. Introduction

In high-cost metropolitan areas, it is challenging for low-income working families to find housing in decent neighborhoods. The conditions they live in are detrimental not only to the occupants, but also to their neighbors and surrounding neighborhood. In response, several public policy instruments have been implemented, including housing choice vouchers, inclusionary zoning, tax breaks for low-income housing developments and local affordable housing mandates or offsets. The low-income housing tax credit (LIHTC) program, our interest, provides incentives for private and public partnership to provide quality multifamily rental units that are available at below-market-rate rents for low-income households.

Previous studies have suggested that LIHTC projects and school performance both affect nearby property values, but very few have considered any direct relationships between subsidized units and school outcomes. Studies show that the developments of LIHTC housing are not likely to cause significant declines in neighboring property values and may even have positive impacts (Ellen et al., 2005; Ezzet-Lofstrom and Murdoch, 2007). Negative impacts exist for some projects under certain circumstances, but they tend to be small and can be reduced if the units are well designed and managed, compatible with the host neighborhood and not concentrated among other subsidized housing (Nguyen, 2005). Deng (2009) looked at eight socioeconomic indicators of neighborhoods hosting LIHTC projects.[1] She found that most of the LIHTC neighborhoods experienced positive changes when compared to the similar neighborhoods without LIHTC projects. Specifically, LIHTC

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[1] The eight indicators include: (1) unemployment rate, (2) poverty rate, (3) percentage of households receiving public assistance, (4) median household income as a percentage of metropolitan median household income, (5) median gross rent as a percentage of metropolitan median gross rent, (6) median housing value as a percentage of metropolitan median housing value, (7) number of units built in the last 10 years, and (8) single-family mortgage approval rate.

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properties invested in high-poverty neighborhoods are most likely to generate positive impacts, while LIHTC invested in middle-class neighborhoods are least likely to do so. The effects are more mixed in "working-class" neighborhoods. Recently, Chellman et al. (2011) found that the completion of subsidized owner occupied housing in New York City was positively associated with an increase in standardized scores at local schools while the completion of subsidized rental housing had little or no association with the school performance.

How LIHTC developments affect neighborhoods and schools may depend on the local conditions and the type of development. If LIHTC projects rehabilitate existing housing, they are likely to improve the existing neighborhood conditions by removing some of the blight in deteriorating areas in addition to improving the living conditions of the project occupants (Santiago et al., 2001).[2] However, rehabilitated properties tend to be in neighborhoods with limited education and job opportunities. In Texas, nearly two thirds of the LIHTC projects produce new units. If new units are located in segregated low-income neighborhoods, even though rents are subsidized, tenants may still suffer from the social problems associated with concentrated poverty. If new units are built in higher-income neighborhoods, existing homeowners may exhibit a "not-in-my-backyard" (NIMBY) attitude, due to their perceptions about the designs and quality of the multifamily properties, potential changes in neighborhood demographics, decline in open space, decreases in public services and safety and impacts on property values (Downs, 1982; Finkel et al., 1996; Nguyen, 2005; Pendall, 1999; Turner et al., 2000). Moreover, parents in the receiving neighborhoods may be concerned that their local public schools will become overcrowded and that low-income students from the LIHTC units will exert negative peer influences. These perceptions can deter the construction of new low-income housing or drive existing residents to "flee" the neighborhoods and local schools, causing a downward spiral in the school quality. But are these perceptions real?

The purpose of this paper is to investigate the link between housing projects built through the LIHTC program and neighborhood public school performance. We compile a panel dataset on approximately 4000 elementary schools in Texas by spatially merging the almost 2000 LIHTC properties to nearby elementary schools from the 2003–04 to 2008–09 academic years. The dataset facilitates estimations of the relationship between changes in school academic performance and changes in the numbers of nearby LIHTC units in various contexts. We discuss how the impacts vary for LIHTC projects located in neighborhoods with different income levels and whether the projects are new construction or rehabilitations. We do not find evidence to suggest overall negative consequences on local elementary schools from LIHTC units.

The rest of the paper is organized as follows. In the next section, we provide an overview of the LIHTC program with a focus on the state of Texas. Then, we discuss the mechanisms through which LIHTC units can potentially affect local schools. In the fourth section, we describe the data and main measures of neighborhood and school quality. The fifth section contains the empirical results followed by discussions and policy implications.

2. Overview of low-income housing tax credit program

The LIHTC program was created under the Tax Reform Act of 1986 to incentivize private developers and non-profit entities to build rental housing for low-income households. The program gives a dollar-for-dollar federal tax credit to developers in return for project equity. Investors, such as financial institutions, purchase the tax credits to lower their federal tax liability over a 10-year period. The typical amount of tax-credit equity raised in a 9% tax-credit transaction is between 45% and 75% of the development costs.[3] With the tax benefits, the private developers and non-profit entities typically need to raise only a fraction of the capital for the projects.

The rents for LIHTC units that are occupied by qualified low-income households are required to be substantially lower than market rates. To be eligible for the tax credits, either 20% of the units must be reserved for households with initial qualifying incomes at or below 50% area median income (AMI), or 40% of units must go to households with initial qualifying incomes at or below 60% AMI. Federal law requires that the rents and incomes remain restricted for 15 years; but some states, such as Texas, apply land-use agreements in order to retain the units in the affordable housing stock for at least 30 years.[4]

The LIHTC is the largest federal rental production subsidy program, producing nearly 2.5 million rental units from 1986 to 2009.[5] To maximize tax credit dollars, most projects designate all of their units to serve residents with income at or below 60% of AMI. LIHTC projects typically have high occupancy rates—95% for larger properties and 97% for smaller ones and relatively low foreclosure rates—average annualized 0.08% through 2006 (Ernst and Young, 2009).[6]

Competition for the tax credits was fierce among developers and states when the economy was growing. The incentives for financial institutions to purchase tax credits reach beyond stable yields and offsetting profits. An investment in a LIHTC state or regional fund can also receive Community Reinvestment Act (CRA) consideration for both a community development loan and community develop-

[2] Rehabilitation projects may produce new units because the properties may be underutilized or unlivable before rehabilitation.

[3] Another type of LIHTC offers tax credit at 4%. It is not as competitive as the 9% credit. Projects financed through tax-exempt private investor bond are eligible for the 4% credit. Many projects financed with a 4% tax credit involve smaller development costs than new constructions, such as rehabilitation and preservation projects.

[4] Owners can exit the program only if they can't find a buyer of the property at the qualified contract price after making a request to the state allocating agency before the expiration of the initial compliance period.

[5] The total drops to nearly two million if bond transactions are not included.

[6] The annualized foreclosure rates elevated during the recession, and were 0.04%, 0.14% and 0.45% for 2007, 2008 and 2009, respectively (Ernst and Young, 2011).

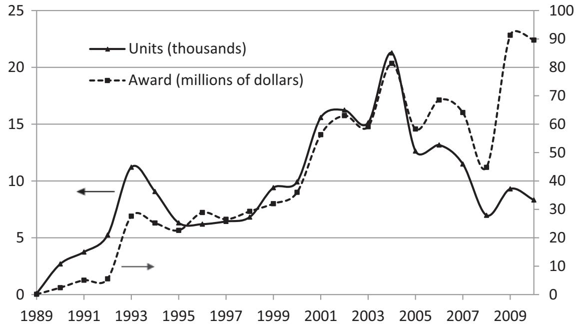

Fig. 1. LIHTC units and program funding in Texas. *SOURCE:* Texas Department of Housing and Community Affairs LIHTC database.

ment investment (Firschein and Chakrabarti, 2009).[7] The LIHTC program faced financing challenges during the recent economic recession. With falling demand for tax credits due to the drop in profits of large investors, getting CRA credit was the primary incentive for banks to invest in LIHTC projects (JCHS, 2009). The U.S. Congress created a series of programs to provide gap-financing and other incentives to stabilize the program.[8]

In Texas, the Department of Housing and Community Affairs (TDHCA) administers the LIHTC program with oversight from the state legislature. As of November 2010, Texas has allocated approximately $930 million in tax credits to developers, leading to an infusion of equity that has contributed to the development of nearly 208,000 affordable housing units.

Fig. 1 shows the dollar value tax credit awards alongside the total number of units created over the 1989–2010 period in Texas. The dashed line (scaled on the right vertical axis) shows a general increase in dollar amount allocation to Texas LIHTC properties since 1989. The substantial rise is mainly due to the increase in state appropriations by the U.S. Congress in 2001. The solid line (scaled on the left vertical axis) illustrates the number of LIHTC units produced in each year. The units produced are not exactly proportional to tax credit allocation because LIHTC units vary in quality, location and size.

The LIHTC program gives extra tax incentives for properties that are located in "qualified census tracts (QCTs)"—essentially tracts in which 50% or more of the households have incomes below 60% of the area median gross income, raising concerns about the potential for further poverty concentration in certain areas. The Texas Legislature addressed this concern by mandating new LIHTC developments to be at least one linear mile from an existing tax credit project or not in a census tract with a large number of existing affordable housing units.[9]

Previous studies suggest that LIHTC properties de-concentrate low-income renters. McClure (2006) notes that 43% of LIHTC projects are located in suburban census tracts nationally, exceeding the percentage of the housing choice voucher program units in suburbs. Rengert (2006) looked at the patterns by state and showed that LIHTC properties in Texas have relatively high penetration in suburban census tracts; however, the number of LIHTC in lower-poverty census tracts remains relatively low. Lopez and Di (2009) examined the distribution of LIHTC properties for Texas counties and found that the LIHTC projects are mostly located in large metropolitan areas. Large central cities have the most developments but have not received the largest awards when considered against their dense population in poverty. While suburban counties do not necessarily have large low-income populations, they are more likely than the central cities to have vacant land available for development. Thus, along with tax incentives, lower project costs and affordable housing demand have attracted LIHTC developers and investors to the suburban counties. Many of these receiving census tracts are not lower-income neighborhoods. For example, in Tarrant County, more than 40% of the LIHTC projects are located in census tracts with median income at or above 80% of MSA median income.[10]

3. Potential effects of the LIHTC program on schools

Our goal is to quantify any effects of LIHTC units on educational performance measures of nearby schools. Nearby LIHTC units could influence the performance of local schools through three pathways that are based on performance differences between students from LIHTC projects and students from the existing schools, changes in neighborhood conditions as a result of moving into LIHTC units, and behavioral changes of school administrators, teachers and parents as a result being near LIHTC units.

The first pathway recognizes that, holding all other factors constant, if there are differences in educational performance between new students from a LIHTC property and the existing students at the receiving schools, then all measures of school performance based on aggregation of student performance must change. For example, if the new LIHTC students were low (high) achievers on standardized assessments, the school-wide average achievement would

[7] The CRA requires federally regulated and insured financial institutions to lend and invest throughout their "assessment areas," where they accept deposits and make a majority of their loans. One of the main principles behind the CRA is that banks and thrifts benefit from the deposits of low- and moderate-income households; in return, they should open access to credit in these communities. The results of the CRA examination are considered when financial institutions apply to open a branch, merge with another institution or become a financial holding company.

[8] Legislations supporting the program include the Housing and Economic Recovery Act of 2008, the American Recovery and Reinvestment Act of 2009, the Job Creation and Tax Cuts Act of 2010, etc.

[9] The 2010 Housing Tax Credit Program Qualified Allocation Plan and Rules can be found at: http://www.tdhca.state.tx.us/multifamily/htc/docs/10-QAP.pdf.

[10] Large metropolitan areas tend to have higher AMI than small rural counties in Texas. Therefore, using MSA AMI instead of county AMI for metro counties may lead to a smaller percentage of LIHTC locating in low poverty tracts.

fall (rise). We consider this a direct pathway that would be evident in the same period as the opening of the LIHTC units.[11]

The second pathway, peer effects, is also based on the performance differentials between LIHTC students and existing students but here we hypothesize an indirect mechanism. Children can be influenced by their new peers so the achievements of both the existing students and the new LIHTC students may change. Peer effects may take longer to manifest. The conventional wisdom suggests that relatively high performers will improve the performance of peers, while relatively poor performers will decrease the performance of peers. Evans et al. (1992) find that peer effects disappear after controlling for simultaneity due to the selection of peers, suggesting that this pathway may fail to exist. Cooley (2006) shows that peer effects mostly take place within reference groups; for example, only peers in the same race and income group would matter, suggesting again that this pathway may not exist in certain situations. Hanushek et al. (2003) find that students throughout the achievement distribution seem to benefit from higher-performing peers.[12] Thus, lower-performing new students could benefit from the higher-performing peers in their new school or higher performing new students could raise the achievement of the existing students. In either case, the school-level measures could change through this pathway.

These first two pathways rely on student-level performance differentials. Unfortunately, we do not know the relative performance of the children—our unit of analysis is the school. Therefore, we need to postulate conditions that may illuminate where such differentials are likely to exist. The obvious case is when new LIHTC units are built in places with relatively high incomes. Because the units are new as opposed to rehabilitation, we can anticipate that the LIHTC students are new to the area and likely to be "different". Additionally, because the areas are relatively high income, we can anticipate that the existing children will tend to be high performers and therefore in higher ranked schools. Assuming that the LIHTC children moved from relatively low-income areas, it is not unreasonable to expect that their academic performance to be lower than that of the existing students. Therefore, we would hypothesize, based on the first pathway, that the new LIHTC units would exert a negative impact on the local school. While less likely, a case can be made for the opposite effects. The LIHTC students are, after all, from households who found a way to move into, presumably, a better housing unit and a better neighborhood. If the parents who move for better schools are relatively more concerned with education, then their children may be relatively high performers and the receiving local school may see an increase in average academic performance.[13]

In the third pathway, we hypothesize behavioral changes at the school level. There are, at least, three different behavioral responses. First, existing parents may change their behaviors. For example, they could increase their efforts at school in order to compensate for any real or perceived negative impacts thereby ameliorating any effects due to new lower-performing students. Alternatively, some of the families may simply move out of the area near the new LIHTC property. If some of the better-performing students leave, then the overall performance of the school will fall. Second, school administrators may allocate additional resources and better teachers to mitigate any potential negative impacts on school accountability ratings (Hanushek and Raymond, 2005). The preexisting input combinations in terms of teachers and support staff may not be optimal after the opening of the LIHTC units. For example, class sizes may be too large when new students are added (Lazear, 2001). This response may or may not be successful. Ouazad (2008), for example, finds that teachers tend to give higher assessments to children of their own race. Thus, if the LIHTC children enter a situation where most of their teachers are different in terms of race and ethnicity, their performance may not improve regardless of the administrative response. Third, teachers that are uncomfortable in the new environment may seek alternative locations (Scafidi et al., 2007). To the extent that these movers were relatively effective teachers, the overall performance of the school may fall. Once again, this pathway is more likely to be revealed by analyzing the LIHTC units in terms of the family incomes in the surrounding area. Higher-income areas will be better equipped to mitigate any negative consequences from nearby LIHTC projects (if there are any) because they generally have more resources for schools and can attract more talented teachers. For schools in lower-income neighborhoods with limited resources, the new students brought in by the LIHTC projects may add stress to the local schools and cause declining academic outcomes even if the new students are similar to the existing students.

It is difficult to identify the impact of LIHTC units on school-level academic performance through each of the three pathways. The observed relationship between the inflow of LIHTC units and school academic outcomes depends on the relative magnitude of influences through all four pathways. However, we expect that when the students from the LIHTC projects are relatively low performers they will have an immediate negative impact, while those who are high performers should have an immediate positive impact. Over time, if the LIHTC projects are located in better neighborhoods, the impacts can either be positive or negative. Some areas may readily absorb the new students and the better environment may allow the motivated LIHTC students to thrive academically, while

[11] There have no specific studies of the academic performance of children who move into LIHTC units. However, some studies of the Moving to Opportunity program found that the academic performance of children from low-income households that moved to less poor neighborhoods was below the average of their new school (Jacob and Ludwig, 2009; Vigdor and Ludwig, 2007). Other studies have found that being a renter rather than a homeowner is likely to negatively affect children's academic performance due to the unstable environment (Hanushek et al., 2004; Mao et al., 1998).

[12] Burke and Sass (2008) also find nonlinear peer effects.

[13] Boston(2005) found that families leaving public housing in Atlanta tend to move to mixed-income housing or conventional public housing project with superior schools, suggesting that one motivation for movers is a desire for better schools.

Table 1
Summary statistics of the LIHTC data.

Variable	Description	Mean	Std. dev.	Min	Max	No. of obs.
UNITS	Number of units	106.70	91.52	1	826	1911
LOW_UNITS	Number of low income units	101.64	88.68	1	826	1911
REHAB	Acquisition/rehabilitation	0.374	0.484	0	1	1911
NEW	New construction	0.626	0.484	0	1	1911
PIS_YEAR	Year placed in service	1997.7	6.79	1985	2008	1911
	PIS_YEAR = 2003					113
	PIS_YEAR = 2004					104
	PIS_YEAR = 2005					142
	PIS_YEAR = 2006					135
	PIS_YEAR = 2007					94
	PIS_YEAR = 2008					78

SOURCE: Texas Department of Housing and Community Affairs LIHTC database.

negative peer effects and reactions from parents and teachers could cause the school-level performance to fall.

If the LIHTC projects are located in areas that are similar to where the participants used to live, the children are less likely to benefit from better schools and neighborhoods. But children can still benefit and improve their school performance because of the financial assistance of the program and through improved living conditions.

4. Data

The data for the empirical analysis come primarily from two sources. The first is the administrative data on LIHTC projects in Texas that is maintained by the Texas Department of Housing and Community Affairs (TDHCA). This dataset contains 2311 LIHTC properties, including fields such as the property address, purpose (for example, general or limited to elderly residents), date placed in service, number of total units and units reserved for low income tenants, limited financing information, and the type of project (new construction or rehabilitation).[14] These data were address-geocoded—in some cases by calling the property contact person to get the precise location—in order to get the latitudes and longitudes for the properties. After deleting the cases with missing values on the number and type of units or on the placed-in-service dates, we ended up with 1911 projects.

Summary statistics of the TDHCA data are presented in Table 1. The average number of low-income units (*LOW_UNITS*) is approximately 95% of the average number of total units (*UNITS*), indicating that the bulk of these projects provide housing exclusively for low-income tenants. Thus, we use *UNITS* in the remainder of the analysis. In Texas, newly constructed units (*NEW*) account for about 63% of total production of LIHTC units. Table 1 also gives the number of LIHTC projects that were placed in service (*PIS_YEAR*) from 2003 to 2008—our study period. As noted in Fig. 1, there were a large number of projects placed in service since the increase in the allocation of the tax credit in 2001. In our data, approximately 35% of the projects were placed in service between 2003 and 2008.

The second primary source of data is the Texas Education Agency (TEA) website, which hosts a multiyear, multi-table database on schools in Texas.[15] Of particular interest, the accountability system of TEA assigns a rating to every campus and district in the Texas public education system each year. The rating generally falls into one of the four categories: exemplary (*RATING* = 4), recognized (*RATING* = 3), academically acceptable (*RATING* = 2) or academically unacceptable (*RATING* = 1). Ratings and other campus-level data, including summary information about the passing rate on standardized exams, are available from the 1997 to the 2009 academic year.[16] We will analyze both the ratings and the passing rates on standardized examinations.

The TDHCA data are for the calendar year, while the TEA data are for the academic year. However, standardized testing is performed during the spring semester, meaning that the students, teachers and administrators in the school during the spring semester are the ones that determine the rating and academic performance on standardized tests. Thus, to correctly align the two data sources, we match placed-in-service year for LIHTC to the spring semester of the following year. For example, the TEA data for the 2008–09 academic year are matched to LIHTC units that are placed in service during 2008. To ease the notation, we call the 2008–09 academic year the 2009 school year and etc.

Due to the transition of TEA to a new rating system and, correspondingly new standardized examinations, there

[14] The U.S. Department of Housing and Urban Development (HUD) also maintains a database on LIHTC, but we used its data only for reconciling some addresses or missing values in the TDHCA data. In particular, a key variable we use, the year that the property is placed in service (*PIS_YEAR*), was constructed with both datasets. Approximately 10% of our projects did not have the placed-in-service dates. Rather than deleting the observations, we approximated the placed-in-service year by adding one year to the approval years for the financing from the HUD data. This algorithm was justified by looking at the relationship between approval dates and placed-in-service dates for the observations with data in both fields.

[15] Campus level data include financial information, teacher information, student characteristics and academic performance. The TEA website also contains a GIS file with the district boundaries and addresses for the campuses within districts. The campus-level data were address-geocoded in order to get the precise latitudes and longitudes for their locations. See http://www.tea.state.tx.us.

[16] Other rating codes appear in the data such as "not rated," but we did not use any of those observations.

Table 2
Variable names, brief descriptions and summary statistics for the data on Texas elementary schools in 2008.

Variable	Description	No. of obs.	Mean	Min	Max
RATING	TEA academic rating	4043	2.9	1	4
ΔRATING	Change in TEA rating from 2007	3946	0.26	−2	2
STRATIO	Ratio of students to teachers	4043	14.7	7	31.5
NSTUDENTS	Number of students	4043	551.8	44	1564
PWHITE	% of students white	4043	35.1	0	98.4
PBLACK	% of students black	4043	13.3	0	100
PHISPANIC	% of students Hispanic	4043	48.4	0	100
PLOWSES	% of students economically disadvantaged	4043	61.6	0	100
PLEP	% of students with limited English proficiency	4043	22.5	0	95.1
TAKSREAD[b]	% Meeting reading standard	3205	84.4	30	99
ΔTAKSREAD	Change in *TAKSREAD*	3017	2.85	−43	43
TAKSMATH[b]	% Meeting mathematics standard	3197	85.3	27	99
ΔTAKMATH	Change in *TAKSMATH*	2956	0.73	−45	47
TAKSSCIENCE[b]	% Meeting science standard	3258	81.2	11	99
ΔTAKSSCIENCE	Change in TAKSSCIENCE	3077	4.01	−50	74
LIHTC	LIHTC project nearby	4043	0.09	0	1
UNITS[a]	Total LIHTC units nearby[a]	374	324.0	1	2761
NEW[a]	Total new LIHTC units nearby[a]	288	253.8	1	2196
REHAB[a]	Total rehabilitated LIHTC units nearby[a]	189	235.2	1	1684
TREND9802	Trend in rating from 1998 to 2002	3232	0.31	−2	2

[a] Summaries only include nonzero observations.
[b] Based on TAKS passing rates for fifth grade.

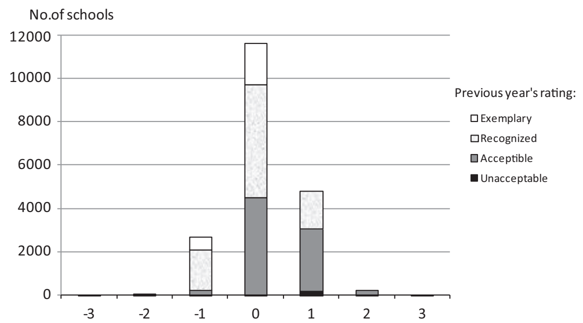

Fig. 2. Distribution of changes in Texas education agency ratings from the previous year (19,433 observations, 2004–2009). *SOURCE:* Texas Education Agency Academic Excellence Indicator System.

were no ratings published for 2003 and starting with 2004 the ratings are based on the new system. To avoid the inconsistency between the two systems, our analyses focus on the panel from the 2004 school year through the 2009 school years.

In the top portion of Table 2, we present summary statistics for the elementary schools for the 2008 school year as an example. Other years produce similar values so we only show one year as an example. For the 2008 school year, the mean of *RATING* is close to 3 (recognized) and we have data on 4043 elementary schools.[17] Only 49 (or 1.2%) schools were rated academically unacceptable, 1057 (or 26.2%) schools were rated acceptable, 2101 (or 51.9%) schools were rated recognized, and 836 (or 20.7%) schools were rated exemplary. The number of observations is lower for the change in *RATING* from the previous year (Δ*RATING*) because there were some new schools in 2008. For 2008, 2342 schools kept the same ratings as the year before, 1206 schools improved one level, and 317 schools dropped one level in rating. Only 75 schools moved two levels up, and six schools dropped two levels, yielding an overall mean for Δ*RATING* of 0.26.

Fig. 2 shows the distribution of Δ*RATING* for the pooled data. With six years of data, we observe five years of changes for each school with 19,433 observations.[18] Similar to the 2008 school year, the ratings remain unchanged over one year periods for most schools. Some of the schools move up or down one level, but very few move two or more levels. Fig. 2 illustrates that most schools that improved one level were initially rated "academically acceptable" and most that fell one level were "recognized". Among schools rated "exemplary", approximately 25% fell one level the next year, while only 2% fell two levels.

For the 2008 school year, the majority of the students were minorities (black or Hispanic), almost 61.6% were economically disadvantaged (*PLOWSES*), and 22.5% had limited English proficiency (*PLEP*). The average elementary school had about 552 students (*NSTUDENTS*) and 38 teachers for an average student–teacher ratio (*STRATIO*) of 14.7:1.

The next set of variables measure the fifth-grade passing rate of the Texas Assessment of Knowledge and Skills (TAKS) examinations. TAKS passing rates are an input to the campus rating system, making them an attractive complementary measure to the rating variable. Specifically, we

[17] We only examine schools with appropriate ratings. Besides deleting cases without ratings, we deleted approximately 300 cases with anomalous data in terms of total number of students, total number of teachers and student-teacher ratios.

[18] The panel is unbalanced because of some new and closed schools over the study period.

consider the percentage of those taking the tests that meet the passing standard in the subjects of reading (*TAKSREAD*), mathematics (*TAKSMATH*) and science (*TAKSSCIENCE*). One reason for focusing on the fifth grade is that the scores actually factor in the decision to promote students to sixth grade. Note that the dimensions of the TAKS panel does not mirror that of the *RATINGS* panel because some of the elementary schools have ratings but do not have a class of fifth graders. Also, some schools that received ratings may have been granted exemptions for some of the TAKS tests. Table 2 displays the summary statistics of the TAKS test passing rates and the improvement of passing rates from the previous year for 2008.[19] The TAKS test passing rates are negatively skewed—the distribution tends to cluster after approximately 70% passing rates. Also, they tend to be leptokurtic (more peaked) when compared to a normal distribution, which is not surprising given that most schools are rated "recognized" or "exemplary". However, the distributions for the first differences of these average passing rates are reasonably symmetric, suggesting that least squares estimators will be appropriate for the differenced data.

The TDHCA data on LIHTC properties and the TEA data were merged with a three-step process. First, each LIHTC property was assigned to its school district using a point-in-polygon operation in Geographic Information System (GIS) software. Next, for each year, each LIHTC that existed in that year was assigned to its nearest campus, based on the straight-line distance within the district.[20] Finally, we determined the total units of LIHTC properties assigned to each school each year. It is important to emphasize that no campuses were assigned a LIHTC property that was outside of its school district even if the property happened to be the closest LIHTC project to the campus. The spatial merge of the data by year facilitates the creation of a school-level panel dataset with six years of data—from the 2004 school year to 2009 school year. The number of schools varies from 3700 to 4043 in each year and the total number of observations in the unbalanced panel is 23,292.

The lower portion of Table 2 shows summary statistics for the LIHTC data spatially merged to the school-level data. By 2008, 374 (or 9%) of the 4043 elementary schools in Texas have at least one LIHTC project assigned to them. Of the 374 projects, 260 and 188 have been classified as either new or rehabilitation project, respectively. For the 374 schools, the average total number of units nearby an elementary school is 324 although the range is from 1 to 2761. The average total number of new and rehabilitation units are 254 and 235, respectively.

5. Empirical analysis

Using the ratings as an indicator of academic success has its limitations because of small sample sizes per grade level in some elementary schools (Kane and Staiger, 2002). However, the state accountability system developed by TEA is by far the most comprehensive measure for school performance in Texas. They are highly visible to school administrators, teachers, parents, local residents and businesses. Schools that receive an exemplary rating generally display a highly visible banner announcing it. The variables used to determine the ratings include "assessment results on the state standardized assessment instruments as well as longitudinal completion rates and annual dropout rates. Generally, campuses and districts earn ratings by having performance meet absolute standards or by demonstrating sufficient improvement toward the standard" (TEA 2009).

5.1. Ordered probit model

We use the ordered probit model to estimate the direction, magnitude and statistical significance of the impact of nearby LIHTC units on the ratings of elementary schools, which are ordered discrete values. Instead of running a fixed-effect ordered probit model on *RATING*, we calculate the first differences in values for all variables and use ordered probit on Δ*RATING*. This expedites the computing process because the school fixed-effects are differenced out of the model. Additionally, the first-differenced model helps avoid the incidental parameter problem in discrete models with fixed effects (Greene, 2004). All models include year fixed effects.

In the ordered probit model, the latent variable is estimated as a linear function of the independent variables and a set of cut points. The probability of observing the changes in the accountability rating from the previous year, Δ*RATING*, corresponds to the probability that the estimated linear function, plus a random error, is within the range of the cut points estimated for the changes in rating:

$$\Pr(\Delta RATING_j = i) = \Pr(CUT_{i-1} < \Delta UNITS_j\beta_1 + \Delta_j\beta_2 + T_j\beta_3 + \mu_j \leqslant CUT_1),$$

where j denotes school, $\Delta UNITS_j$ indicates the changes in LIHTC units from the previous year, ΔX_j are changes in school characteristics or other demographics, T_j is a vector of year dummies, which allow the intercepts to differ for each year, and u_j is the random error that is assumed to be independent and normally distributed. With six academic years, we have five years of differenced data. As shown in Fig. 2 there are seven potential values for $\Delta RATING_j$: −3, −2, −1, 0, 1, 2, and 3.

Table 3 shows the coefficient estimates for several specifications.[21] Model (1) is just Δ*RATING* on Δ*LIHTC*—a dummy variable that indicates the existence of LIHTC units nearby. The coefficient is positive but not significantly different from zero. The "Cuts" in Table 3 denote the estimated cut points for the underlying latent variable, which we think of as "academic improvement". In Model (2), we add Δ*UNITS*. The coefficient on Δ*UNITS* is positive and statistically significant, suggesting that the opening of new LIHTC units is associated with positive changes in the accountability rating of the nearest elementary school. The estimate on the dummy variable Δ*LIHTC* is still insignificant. The coefficients on the year

[19] While the shape of the distributions in 2008 is representative of other years, there is a slight upward trend in average scores over the sample period 2004–09.

[20] For example, LIHTC projects placed in service in 2007 will be considered existing for the 2007–2008 academic year.

[21] To ease the discussion of the results, we drop the j subscript.

Table 3
The impact of LIHTC units on elementary school ratings by neighborhood characteristics. Ordered probit panel regressions. Dependent variable = Δ*RATING*.

Variables	(1)	(2)	(3)	(4)	(5)	(6) Lower Income	(7) Higher Income
Δ*LIHTC*	0.0746	−0.0620	−0.0597	−0.0392	−0.0797	0.144	−0.228
	(0.126)	(0.146)	(0.172)	(0.172)	(0.183)	(0.297)	(0.233)
Δ*UNITS*		0.000767*	0.000926*	0.000905*	0.000932*	0.000294	0.00144**
		(0.000411)	(0.000502)	(0.000503)	(0.000517)	(0.000773)	(0.000698)
$\Delta UNITS_{-1}$			−0.000891**	−0.000856**	−0.000765*	−0.000662	−0.000838
			(0.000384)	(0.000385)	(0.000404)	(0.000631)	(0.000526)
Δ*STRATIO*				−0.0215**	−0.0168*	−0.0273*	−0.0111
				(0.00863)	(0.00929)	(0.0156)	(0.0116)
Δ*NSTUDENTS*				−0.00132***	−0.00141***	−0.00101***	−0.00163***
				(0.000162)	(0.000193)	(0.000330)	(0.000238)
Δ*PLOWSES*				−0.00165	−0.00368	−0.00145	−0.00470
				(0.00224)	(0.00246)	(0.00455)	(0.00294)
Δ*PWHITE*				0.0131	0.0139	0.0612**	0.00476
				(0.00985)	(0.0112)	(0.0267)	(0.0124)
Δ*PBLACK*				−0.00663	−0.00483	0.0191	−0.00663
				(0.0104)	(0.0116)	(0.0259)	(0.0132)
Δ*PHISPANIC*				−0.00161	−0.000547	0.0252	−0.00414
				(0.00976)	(0.0110)	(0.0253)	(0.0123)
Δ*PLEP*				−0.00169	−1.12e−05	0.00173	−0.000702
				(0.00339)	(0.00364)	(0.00581)	(0.00470)
TREND9802					−0.00539	−0.00705	−0.00445
					(0.0121)	(0.0211)	(0.0148)
Cuts	−4.569***	−4.568***	−4.324***	−4.343***	−3.301***	−3.296***	−3.306***
	(0.253)	(0.253)	(0.261)	(0.258)	(0.0649)	(0.118)	(0.0780)
	−3.331***	−3.331***	−3.293***	−3.321***	−1.579***	−1.554***	−1.590***
	(0.0468)	(0.0468)	(0.0602)	(0.0604)	(0.0249)	(0.0444)	(0.0300)
	−1.585***	−1.584***	−1.568***	−1.590***	0.258***	0.268***	0.254***
	(0.0211)	(0.0211)	(0.0220)	(0.0224)	(0.0214)	(0.0386)	(0.0258)
	0.267***	0.268***	0.267***	0.256***	1.954***	2.027***	1.927***
	(0.0184)	(0.0184)	(0.0187)	(0.0191)	(0.0332)	(0.0621)	(0.0395)
	1.944***	1.945***	1.949***	1.950***	3.333***	3.150***	3.515***
	(0.0289)	(0.0289)	(0.0297)	(0.0301)	(0.159)	(0.207)	(0.261)
	3.302***	3.303***	3.295***	3.306***			
	(0.138)	(0.138)	(0.138)	(0.139)			
Observations	19,199	19,199	15,132	15,132	12,838	3975	8863

Standard errors in parenthesis * significant at 10%; ** significant at 5% and *** significant at 1%.
Each specification also includes annual dummies for years 2005, 2006, 2007, 2008 and 2009.

dummies are not listed in Table 3, but need to be included in calculating the predicted value of the latent variable.[22] As suggested in the results of Model (2), a value for the predicted latent variable less than −4.568 will be in the first category of the observed variable (Δ*RATING* = −3), while a value greater than 3.303 will be in the highest category (Δ*RATING* = 3). The ordered probit model also implies a set of marginal effects—the increment to the probability of being in one of the categories from a marginal increase in an independent variable. Once again, using the estimates in Model (2), we find that the increments to the probabilities of being in the six categories from an additional 100 LIHTC units are: −0.0006 percentage points (to drop three levels), −0.045 percentage points (to drop two levels), −1.52 percentage points (to drop one level), −0.83 percentage points (to stay the same), 2.22 percentage points (to improve one level), 0.18 percentage points (to improve two levels), and 0.0029 percentage points (to improve three levels), respectively. In other words, an increase in the number of nearby LIHTC units is associated with an increase of the probability that the nearest school moves upward in its accountability rating or a decrease of the probability that the nearest school moves downward in its accountability rating.[23] The marginal effects of Δ*UNITS* are significant except for the two extreme cases of moving upward or downward by three levels because very few schools improved or dropped three levels over a one-year period as shown in Fig. 2.

In Model (3), we add the lagged change in the number of LIHTC units, $\Delta UNITS_{-1}$, which allows the impact to take longer than one year. For example, if additional units were added in calendar year 2004, the lag term allows for effects on the ratings in school year 2006 because of our assignment protocol. The coefficient estimate on Δ*UNITS* is now larger, but the lingering effect one year after the units were placed in service is of similar magnitude but in the *opposite* direction.[24] The initial positive impact from LIHTC units is largely negated after a year, suggesting no overall effect from the extra units.

[22] For example, in Model (2) the assumed underlying equation is $\hat{y}^* = -0.062 \times \Delta LIHTC + 0.000767 \times \Delta UNITS - 0.999 \times Y2005 - 0.187 \times Y2006 - 0.825 \times Y2007 - 0.179 \times Y2008$, where $\hat{y}^*$ is the predicted value of the latent variable, y^*, the academic improvement.

[23] The pattern of these marginal effects does not vary across specifications as long as the means of the other independent variables are used for calculation. So we do not present all of the marginal effects in the paper.

[24] Multiyear lags are insignificant; therefore, we did not include them in the specification.

The opposite directions of the contemporaneous and the lagged effects imply that additional LIHTC units initially help school performance. From our discussion about hypothesized pathways, this finding is consistent with the students from the additional units being relatively high academic achievers and/or the existing parents and schools responding to the anticipated negative effects of new units. Dissipation of the positive impact suggests "norming" in that the school converges back toward the school norm after one year. There are several plausible reasons for this. First, it may reflect peer effects—the new students are influenced by the exiting students and revert to the school norm. Second, the teachers and parents at the nearby schools may not have the capacity to accommodate the new students and the extra stress reduces the effects of the high performing new students. And, third, some of the families and/or teachers may leave the school over concerns about the impact of the new projects.

In Model (4), we control for the change in student–teacher ratio ($\Delta STRATIO$), the change in number of students ($\Delta STUDENTS$), the change in the percent of students that are economically disadvantaged ($\Delta PLOWSES$), white ($\Delta PWHITE$), black ($\Delta PBLACK$), Hispanic ($\Delta PHISPANIC$), and with limited English proficiency. The coefficients on the changes in student–teacher ratio and in number of students are statistically significant and with the expected signs. The coefficient estimates of the other control variables are insignificant. The coefficient estimates on $\Delta UNITS$ and $\Delta UNITS_{-1}$ are similar to those from model (3), only slightly smaller. This regression means that the LIHTC effect is not absorbed by changes in the demographics of the school.[25] In other words, the effect does not seem to be direct through demographic changes nor the change in the number of students. To provide some perspective on the potential for a LIHTC property to impact the local school demographics, we computed the average of $\Delta NSTUDENTS$ for school-year pairs that have additional LIHTC units for that school-year pair and compared that to the average of $\Delta NSTUDENTS$ for the school-year pairs without additional units. The difference is 3.3 (4.86 – 1.57), indicating a small difference on average. There is wide variation in $\Delta NSTUDENTS$, however. The interquartile range is −19 to 29 for school-year pairs that get additional LIHTC units, and −18 to 25 for those that do not. Thus, there are certainly cases where the new units may have influenced the number of students at the local school.

With more controls, the estimation results of Model (4) again suggest that after two years, an increase in the number of LIHTC units does not affect the academic performance of local schools. One challenge to the unbiasedness of the estimates is the possible endogeneity due to any omitted unobserved factors correlated with the *change* in the number of units. Developers presumably select the locations for the new LIHTC projects based on prediction of potential long-term capital gain, which might be somewhat determined by the trend in the quality of the local schools. Corroborating this notion, Eriksen and Rosenthal (2010) find some evidence that developers of LIHTC seek markets that are ripe for new construction and areas designated as Qualified Census Tracts (QCTs).[26]

We address these endogeneity concerns by differencing the data and removing the school fixed effects in all models. Any time invariant school-level factor will not confound our interpretation. In addition, we control for pre-existing trends in the school ratings, which were observable to developers when they built these projects. These results are presented as Model (5). Note that *TREND9802* is the average change in school rating from 1998 to 2002. The mean of *TREND9802* is 0.31 (Table 2), slightly positive. By controlling for the preexisting trends, we can address unobserved time-varying site-specific factors to certain extent. The coefficient estimate on *TREND9802* turns out to be insignificant but, the positive contemporaneous influence of LIHTC units becomes slightly larger and the negative lingering effect becomes slightly smaller than the estimates in Model (4).

There are also reasons that the selection may not be a severe issue in our study. First, while LIHTC developers could analyze local trends in economic conditions in order to make site selections, it is highly unlikely that they can predict an annual uptick in school performance and use it as one of the major criteria for site selection and time the opening of their project to precisely correspond with the improvement in the school quality. In Texas, because of equal-financing education policy, even if developers can predict tax revenue increases from property appreciation, they won't be able to estimate changes in future school funding and performance given the school districts have good or bad ratings historically.[27]

Moreover, many developers are motivated to locate LIHTC projects in QCTs with larger tax incentives or gentrifying neighborhoods where it is likely to have fast property appreciation (Baum_Snow et al., 2009). However, these areas do not necessarily have good schools and the production of school quality is beyond the developers' control. For example, gentrifying neighborhoods are likely to experience quick turnover of teachers and principals and uncertain school outcomes. Moreover, the bias due to preselection into QCT areas can also be corrected by controlling for the preexisting trends.

As noted in Section 3, the effects of LIHTC units on local schools may vary by the initial neighborhood conditions. In relatively high-income areas, the LIHTC units may bring children that are low performers compared to the existing children. Alternatively, LIHTC families composed of highly motivated parents and potentially higher-performing students may relocate for to the LIHTC units in the wealthier areas in seek of better schools. Although we cannot observe these motivations, we can use neighborhood characteristics from the U.S. Census to identify the LIHTC units

[25] The change in percentage black is the only school demographic variable that is positive and statistically significant correlated with the change of LIHTC units. Horn and O'Regan (2011) examined the LIHTC tenant data from TDHCA and also found that the race composition of LIHTC is quite similar to that of the hosting neighborhood.

[26] The status of these tracts is based on 50% of households in a tract with incomes of less than 60% of the adjusted metropolitan area median gross income. LIHTC projects in QCTs can receive 30% higher tax credit.

[27] Texas legislation mandates redistributing property tax revenue from property-wealth school districts to property-poor district throughout Texas.

that are in relatively higher-income areas and compare the estimates of the impacts of the LIHTC properties on the local schools.

We divided the neighborhoods by median income in census block groups according to the 2000 Census. Lower-(higher) income neighborhoods are block groups with median income smaller than or equal to (greater than) 80% county median income. The elementary schools with LIHTC projects nearby are located in 136 lower-income and 179 higher-income census block groups. The average number of total units is 300 in lower-income census block groups, higher than that in higher-income areas (225).

The last two columns of Table 3 presents the estimates of LIHTC impact on schools for these two types of neighborhoods, controlling for school characteristics, the year dummies and the preexisting trends of school ratings. The estimates of the coefficients on LIHTC dummies remain insignificant in both types of neighborhoods. For neighborhoods with higher income, the contemporaneous impact of the change in LIHTC units is positive and statistically significant. The coefficient is also substantially larger than that for the entire sample in Model (5) and dominates the insignificant lagged effect, indicating an overall positive effect. The impact on lower-income neighborhood is insignificant. This is a puzzling finding. We would expect that in the higher-income areas that the contemporaneous effect would be negative although as noted above, the local schools and parents in places that may "ramp-up" their efforts to make sure that the new students from LIHTC projects do not harm existing ratings. It is also possible that LIHTC projects allow motivated families with higher-performing children to move to better neighborhood that help them advance their opportunities.

5.2. Variation of impacts by project type

Different types of LIHTC projects may bring various neighborhood changes. We now consider how the two types of LIHTC projects—rehabilitation and new construction—affect local school outcomes. The rehabilitations are *in situ*, making them more likely to be in areas with traditionally more low-income housing. The new units are more likely to be in places with capacity for expansion such as suburban neighborhood with better schools. Consequently, the move into a rehabilitated LIHTC unit is less likely to be motivated by a drive to find a better school even though the subsidy can improve tenants' financial condition and this may help children's education. Again, we do not observe the motivation of families who move to LIHTC units, but we can use the distinction between new and rehabilitation LIHTC units to test the difference in school outcomes.

Column two in Table 4 presents the estimates for the influences of adding new and rehabilitated units, with the comparison group to be schools with no addition of LIHTC units. As the results show, the coefficient estimate for additional new units added is not statistically significant, but its confidence interval falls in the positive territory. The new units placed in service the year before has a negative impact on academic ratings. Additional rehabilitated units do not have a significant influence on school ratings.

We estimate how the impact of additional new and rehabilitated LIHTC units in regressions differs for lower- and higher-income neighborhoods. All model specifications in Table 4 continue to control for school demographic characteristics, preexisting trend *TREND9802* and year dummies. The cut point estimates are not presented. The results shown in the third and fourth columns of Table 4 suggest that only additional new LIHTC units in higher-income neighborhoods have a positive influence on local elementary school ratings. But again, the confidence intervals of lagged influence of new units fall into negative territories for both higher- and lower-income neighborhoods, although the coefficients are not statistically significant by conventional standard.

Overall, the coefficient estimates on the dummy variable, $\Delta LIHTC$, are not significant across all specifications, which suggest that the mere existence of LIHTC units nearby does not influence ratings independently from the effects captured by the number of units. Similarly, we do not see rehabilitated LIHTC units generate any significant consequences on school ratings. The relationship between LIHTC units and school ratings appears to be driven by new projects. The contemporaneous influence from the new units is positive (in higher-income neighborhoods), but the influence from the units built a year ago is negative.

Higher-income areas are more likely to host new LIHTC units instead of rehabilitated units and the construction of new rental units may confront some local objections in

Table 4
The impact of LIHTC units on elementary school ratings by type of LIHTC project. Ordered probit panel regressions. Dependent variable = $\Delta RATING$.

VARIABLES	All	Lower income	Higher income
$\Delta LIHTC$	−0.0445	0.153	−0.165
	(0.184)	(0.304)	(0.232)
$\Delta UNITS\_NEW$	0.000907	0.000475	0.00130*
	(0.000565)	(0.000815)	(0.000788)
$\Delta UNITS\_NEW_{-1}$	−0.000919**	−0.000920	−0.000937
	(0.000453)	(0.000715)	(0.000586)
$\Delta UNITS\_REHAB$	0.000475	−0.000194	0.000781
	(0.00100)	(0.00181)	(0.00121)
$\Delta UNITS\_REHAB_{-1}$	0.000136	0.000436	6.37e-05
	(0.000929)	(0.00153)	(0.00117)
$\Delta STRATIO$	−0.0167*	−0.0273*	−0.0109
	(0.00929)	(0.0156)	(0.0116)
$\Delta NSTUDENTS$	−0.00141***	−0.00101***	−0.00163***
	(0.000193)	(0.000330)	(0.000238)
$\Delta PLOWSES$	−0.00364	−0.00138	−0.00466
	(0.00246)	(0.00455)	(0.00294)
$\Delta PWHITE$	0.0139	0.0617**	0.00477
	(0.0112)	(0.0267)	(0.0124)
$\Delta PBLACK$	−0.00480	0.0193	−0.00652
	(0.0116)	(0.0260)	(0.0132)
$\Delta PHISPANIC$	−0.000522	0.0256	−0.00418
	(0.0110)	(0.0253)	(0.0123)
$\Delta PLEP$	1.61e-05	0.00170	−0.000606
	(0.00364)	(0.00581)	(0.00470)
TREND9802	−0.00550	−0.00726	−0.00449
	(0.0121)	(0.0212)	(0.0148)
Observations	12,838	3975	8863

Standard errors in parenthesis.
* significant at 10%; ** significant at 5% and *** significant at 1%.
Each specification also includes annual dummies for years 2005, 2006, 2007, 20008 and 2009.

Table 5
The impact of LIHTC units on Texas fifth grade TAKS test passing rates.

	Mathematics			Reading			Science		
	All	Lower income	Higher income	All	Lower income	Higher income	All	Lower income	Higher income
ΔLIHTC	−0.0869	0.941	−0.780	1.920	2.636	1.278	−0.883	1.520	−1.851
	(1.772)	(3.098)	(2.160)	(1.587)	(2.974)	(1.839)	(2.058)	(3.781)	(2.427)
ΔUNITS_NEW	0.00519	0.00959	0.00135	0.00270	−0.00131	0.00438	0.0126*	0.0146	0.0104
	(0.00540)	(0.00918)	(0.00670)	(0.00492)	(0.00869)	(0.00594)	(0.00648)	(0.0112)	(0.00794)
$\Delta UNITS\_NEW_{-1}$	−0.00470	−0.00814	−0.00225	−0.00804**	−0.0114	−0.00554	−0.0141***	−0.0244**	−0.00841
	(0.00425)	(0.00780)	(0.00499)	(0.00386)	(0.00746)	(0.00437)	(0.00509)	(0.00952)	(0.00591)
ΔUNITS_REHAB	0.0209**	0.0391**	0.0117	0.0199**	0.0458***	0.00846	0.0143	0.0220	0.00969
	(0.00909)	(0.0186)	(0.0101)	(0.00821)	(0.0175)	(0.00886)	(0.0109)	(0.0227)	(0.0120)
$\Delta UNITS\_REHAB_{-1}$	−0.00304	−0.00538	0.000482	0.00278	−0.00168	0.00655	0.00341	0.00626	0.00423
	(0.00837)	(0.0165)	(0.00946)	(0.00765)	(0.0155)	(0.00845)	(0.0102)	(0.0202)	(0.0116)
Constant	−0.0842	0.297	0.503**	−0.504***	3.473***	2.764***	3.696***	4.353***	3.368***
	(0.206)	(0.407)	(0.233)	(0.187)	(0.380)	(0.206)	(0.248)	(0.495)	(0.278)
Observations	9,564	3,214	6,350	9,821	3,260	6,561	9,921	3,245	6,676
R-squared	0.030	0.037	0.032	0.068	0.076	0.068	0.106	0.102	0.114

Standard errors in parentheses * significant at 10%; ** significant at 5% and *** significant at 1%.
Each specification also includes school demographics, *TREND9802* and annual dummies for years 2005, 2006, 2007, 20008 and 2009.

higher-income areas. However, the results show that the new students from the project do not necessarily have a negative influence on school performance.

The results for rehabilitation projects represent a different pattern. The estimates are insignificant for neighborhoods with different income levels. Given that the rehabilitated units are usually located in neighborhoods with existing multifamily units, the addition of children from lower-income families does not have a discernable benefit or harm to the local school ratings.

5.3. Influence of LIHTC on state standardized test passing rate

The Texas school rating system is complicated and reflects performance on standardized tests as well as completion and dropout rates, creating challenges to understand how specific components of the rating are affected by LIHTC students. One direct influence is through the fifth-grade passing rate of the standardized Texas Assessment of Knowledge and Skills (TAKS) tests—one of the main determinants in the rating scheme.[28]

We estimate the relationship between TAKS test passing rates and LIHTC units using a first-differenced linear model. The dependent variable is the change in passing rates for TAKS tests on reading (*ΔTAKSREA)*, math (*ΔTAKSMATH)* or science (*ΔTAKSSCIENCE)*. The independent variables are *ΔLIHTC, ΔUNITS*, $\Delta UNITS_{-1}$, school demographic characteristics, the pre-existing trends and the annual dummy variables.[29]

The coefficient estimates of the LIHTC variables on TAKS passing rates are presented in Table 5. Again, the mere appearance of LIHTC units nearby in an area without existing LIHTC units does not seem to influence the TAKS test passing rates. With respect to changes in new units, the coefficients in the TAKS regressions present a similar sign pattern as those from the ratings regressions. The contemporaneous estimates are positive in every case except reading in lower-income neighborhoods, while the estimates on the lagged terms are negative in every case. Differences appear when comparing the rehabilitated units on TAKS and ratings. In Table 4, we see no significant effects from changes in the rehabilitated units. Additionally, there is the counterintuitive negative contemporaneous sign in lower-income neighborhoods. In Table 5, we positive and significant contemporaneous effects from additions in rehabilitated units along with very small and insignificant coefficients on the lags.

6. Discussion

The findings from the regressions on TAKS passing rates in the core areas of mathematics and reading in low-income areas are more consistent with *a priori* notions of

[28] Schools can achieve particular ratings in more than one way. The first mechanism is to meet standards based on passing rates on the TAKS examinations, on completing grades, and on dropout rates. For example, part of the standards for achieving exemplary is a 90% passing rate on TAKS. All students and each group of students meeting minimum size (e.g., African American, Hispanic, White, and economically disadvantaged) must meet the standard or required improvement. This means that really high pass rates for one group will not compensate for lower rates in another group. (see http://ritter.tea.state.tx.us/perfreport/account/2009/manual/table7.pdf). A second mechanism is to meet standards through the Texas Projection Measure (TPM). The TPM provides an estimate of whether a student is likely to pass a TAKS test in the future and depends on such factors as race/ethnicity, qualification for free lunch, and previous performance. Campuses that are rated unacceptable, acceptable, or recognized can achieve a higher rating when their passing rates of TPM kids is relatively high; i.e., they are doing a good job on those that are predicted to pass. (see http://ritter.tea.state.tx.us/perfreport/account/2009/manual/ch03.pdf) There are other mechanisms for improving on a rating that are based on changes in other factors such as dropout and completion rates.

[29] Differencing the data solves the skewness issue, but there appear to be some unusually large changes in passing rates—the interquartile range is generally within plus or minus five points of the means, regardless of the year. Thus, one might suspect that schools with large differences may be influential observations. However, we did not find any reasons for discarding any observations. The residuals were analyzed with leverage and dfbeta diagnostics. See Belsley et al. (2004).

how LIHTC children might impact local schools—rehabbing existing units in lower income areas improves living conditions in those areas, which generates positive spillovers to academic performance. Comparing these findings to those from the regressions on the school ratings, we can see that the positive impacts on fifth grade TAKS is not enough to show up in positive changes in the ratings of schools in low-income areas. A likely explanation for this is that with the opening of rehabilitated units, the actual number of kids in these units might be relatively small in comparison to the total number of kids in the school. Calculating the difference between $\Delta STUDENTS$ in areas with and without new rehabilitated units reveals that the rehabilitated units are associated with, on average, 4.8 additional students, indicating that the average of the treatment size is relatively small.[30] Thus, while we are able to detect marginal effects in passing rates in one grade, they are not large enough to actually move the dial on the accountability rating.[31]

The regressions on the TAKS passing rates do not suggest significant effects from LIHTC units, new or rehabilitated, on school performance in high-income areas (Table 5). Yet, the estimates from the ratings models indicate a *positive* impact from new units in higher-income areas (Table 4). A plausible explanation stems from the importance of the ratings in Texas. School administrators, local residents, local politicians and local businesses are highly sensitive to these ratings. They may have anticipated the opening of the new units and compensated for expected low performing students. The compensating behavior actually has generated a bump in the likelihood of a higher rating.

It is worth clarifying a couple of data issues we encountered. First, the TDHCA administrative data on LIHTC include the purpose of the LIHTC projects—either for general or elderly residents. Our analysis was based on the projects for general purpose. As a contra-positive test, we estimated the relationship between the changes in LIHTC units designated for the elderly and changes in school accountability ratings and did not find any significant results, suggesting integrity in the independent variables of interest. Second, we attempted to check the accuracy of our method of assigning LIHTC projects to schools. We found approximately 500 projects with sufficient attendance zone information to allow us to compare the nearest school (our approach) to the zoned school. Approximately 75% of the zoned schools turned out to be the closest school, and many of the rest of the 25% were magnet schools. Hence, using the closest school is a reasonable approach given the lack of information on attendance zones over years.

Considering the relatively small inflow of LIHTC children in elementary schools every year in Texas and the lack of correlations of these projects with school demographic changes, it is surprising to have found any significant relationships at all between LIHTC units and school performance. However, our results are consistent with the previous literature indicating that such projects are not necessarily detrimental to the receiving neighborhoods. In fact, LIHTC projects that rehabilitated housing in low-income areas improve academic performance at the local schools.

7. Disclaimer

The views expressed in the paper are those of the authors and do not necessarily represent the views of the Federal Reserve Bank of Dallas or the Federal Reserve System.

[30] The range is high—from −101 to 212, meaning that there are certainly some schools that get larger treatments of LIHTC kids.

[31] For example, a "recognized" school with an overall passing rate of 80% might improve marginally to 83% from rehabilitated units but that would not be enough to achieve the "exemplary" rating associated with a 90% passing rate.

References

Baum_Snow, N., Marion, J., 2009. The effects of low income housing tax credit developments on neighborhoods. Journal of Public Economics 93 (5–6), 654–666.

Belsley, D., Kuh, E., Welsch, R., 2004. Regression Diagnostics: IdentifyingInfluential Data and Sources of Collinearity. John Wiley and Sons, New York.

Boston, T.D., 2005. The effects of revitalization on public housing residents: a case study of the Atlanta Housing Authority. Journal of the American Planning Association 71, 393–407.

Burke, M.A., Sass, T.R., 2008. Classroom Peer Effects and Student Achievement. Federal Reserve Bank of Boston.

Chellman, C., Ellen, I.G., McCabe, B.J., Schwartz, A.E., Stiefel, A., 2011. Does municipally subsidized, owner-occupied housing improve school quality? Evidence from New York city. Journal of the American Planning Association 77 (2), 127–141.

Cooley, J., 2006. Desegregation and the achievement gap: do diverse peers help?. Unpublished manuscript, Department of Economics, Duke University.

Deng, L., 2009. Assessing Changes in Neighborhoods Hosting the Low-Income Housing Tax Credit Projects, University of Michigan CLOSUP Working Papers Series.

Downs, A., 1982. Creating more affordable housing. Journal of Housing 49, 174–183.

Ellen, I., Schill, M., Schwartz, A., Voicu, I., 2005. Does Federally Subsidized Rental Housing Depress Neighborhood Property Values, New York University Law School Law and Economics Research Paper.

Eriksen, M., Rosenthal, S., 2010. Crowd out effects of place-based subsidized rental housing: new evidence from the LIHTC program. Journal of Public Economics 94 (11–12), 953–966.

Ernst, Young, 2009. Understanding the Dynamics V. Housing Tax Credit Investment Performance Report. <http://www.ncsha.org/resource/ernst-youngs-understanding-dynamics-v-housing-tax-credit-investment-performance-report>.

Ernst, Young, 2011. Low-Income Housing Tax Credit Foreclosure Data, Power Point presentation. <http://housingthink.com/wp-content/uploads/2011/04/Low-income-housing-tax-credit-foreclosure-analysis-through-2009.pdf>.

Evans, W.N., Oates, W.E., Schwab, R.M., 1992. Measuring peer group effects: a study of teenage behavior. The Journal of Political Economy 100, 966–991.

Ezzet-Lofstrom, R., Murdoch, J.C., 2007. The effect of low-income housing tax credit units on residential property values in Dallas County. Williams Review 2, 107–124.

Finkel, M., Climaco, C.G., Elwood, P.R., Feins, J.D., Locke, G., Popkin, S.J., 1996. Learning from each other: new ideas for managing the section 8 certificate and voucher program. U.S. Department of Housing and Urban Development, Washington, DC.

Firschein, J., Chakrabarti, P., 2009. A Primer on the Low Income Housing Tax Credit (LIHTC) and New Market Tax Credit (NMTC) Programs, Federal Reserve BS&R, Federal Reserve System.

Greene, W., 2004. The behavior of the maximum likelihood estimator of limited dependent variable models in the presence of fixed effects. Econometrics Journal 7, 98–119.

Hanushek, E.A., Raymond, M.E., 2005. Does school accountability lead to improved student performance? Journal of Policy Analysis and Management 24, 297–327.

Hanushek, E.A., Kain, J.F., Markman, J.M., Rivkin, S.G., 2003. Does peer ability affect student achievement? Journal of Applied Econometrics 18, 527–544.
Hanushek, E., Kain, J., Rivkin, S., 2004. Disruption versus tiebout improvement: the costs and benefits of switching schools. Journal of Public Economics 88, 1721–1746.
Horn, K.M. and O'Regan, K.M., 2011. The Low Income Housing Tax Credit and Racial Segregation. NYU Wagner Graduate School and Furman Center for Real Estate and Urban Policy Working Paper.
Jacob, B.A., Ludwig, J., 2009. Improving educational outcomes for poor children. In: Cancian, M., Danziger, S. (Eds.), Changing Poverty, Changing Policies. Russel Sage Foundation, New York, pp. 266–300.
JCHS, 2009. The Disruption of the Low-Income Housing Tax Credit Program: Causes, Consequences, Responses, and Proposed Correctives. Joint Center for Housing Studies, Harvard University.
Kane, T.J., Staiger, D.O., 2002. The promise and pitfalls of using imprecise school accountability measures. Journal of Economic Perspectives 16, 91–114.
Lazear, E.P., 2001. Educational production. Quarterly Journal of Economics 116, 777–803.
Lopez, R., Di, W., 2009. Low-income housing tax credits in texas: achievements and challenges. Banking and Community Perspectives 2, 2–7.
Mao, M.X., Whitsett, M.D., Mellor, L.T., 1998. Student Mobility, Academic Performance, and School Accountability. Education Research Service Spectrum 16 (1), 3–15.
McClure, K., 2006. The low-income housing tax credit program goes mainstream and moves to the suburbs. Housing Policy Debate 17, 419–446.
Nguyen, M.T., 2005. Does affordable housing detrimentally affect property values? A review of the literature. Journal of Planning Literature 20, 15–26.
Ouazad, A., 2008. Assessed by a Teacher Like Me: Race, Gender, and Subjective Evaluations, INSEAD Working Paper Series.
Pendall, R., 1999. Opposition to housing: NIMBY and beyond. Urban Affairs Review 35, 112–136.
Rengert, K., 2006. Comment on Kirk McClure's "the low-income housing tax credit program goes mainstream and moves to the suburbs". Housing Policy Debate 17, 473–490.
Santiago, A., Galster, G., Tatian, P., 2001. Assessing the property value impacts of the dispersed housing subsidy program in Denver. Journal of Policy Analysis and Management 20, 65–88.
Scafidi, B., Sjoquist, D.L., Stinebrickner, T.R., 2007. Race, poverty, and teacher mobility. Economics of Education Review 26, 145–159.
Turner, M.A., Popkin, S., Cunningham, M., 2000. Section 8 Mobility and Neighborhood Health. Urban Institute, Washington, DC.
Vigdor, J., Ludwig, J., 2007. Segregation and the Black-White Test Score Gap, NBER Working Paper 12988.