The Effects of Low Income Housing Tax Credit Developments on Neighborhoods

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Abstract

This paper evaluates the impacts of new housing developments funded with the Low Income Housing Tax Credit (LIHTC), the largest federal project based housing program in the U.S., on the neighborhoods in which they are built. A discontinuity in the formula determining the magnitude of tax credits as a function of neighborhood characteristics generates pseudo-random assignment in the number of low income housing units built in similar sets of census tracts. Tracts where projects are awarded 30 percent higher tax credits receive approximately six more low income housing units on a base of seven units per tract. These additional new low income developments cause homeowner turnover to rise, raise property values in declining areas and reduce incomes in gentrifying areas in neighborhoods near the 30th percentile of the income distribution. LIHTC units significantly crowd out nearby new rental construction in gentrifying areas but do not displace new construction in stable or declining areas.

1 Introduction

Means tested government programs are an important part of the U.S. housing market and rival in magnitude other public programs for the poor such as food stamps and TANF. In 2002, $26 billion was spent on housing programs for the poor by the Department of Housing and Urban Development through rental subsidies, mortgage interest subsidies, public housing construction, homeless programs, and block grants to states (U.S. House of Representatives, 2004).[1] The Low Income Housing Tax Credit (LIHTC) program, which provides tax subsidies for developers building rental units targeted to low-income households, has become a key component of housing policy. With few new public housing projects expected to be built in the future and a recent expansion in LIHTC funding, the LIHTC is now the primary project based federal housing program.

Table 1 shows trends in the importance of LIHTC subsidized housing construction in the U.S. housing market. The growth in the number of LIHTC units since 1993 is significant. Developers established 479 thousand LIHTC units between 1993 and 1999, making up 2.4 percent of the occupied rental housing stock at the end of the period. By 2003, LIHTC units accounted for 3.6 percent of rental units in the U.S.[2] Meanwhile, the number of occupied public housing units declined from 1.3 million in 1993 to 1.1 million in 2000, representing 3.3 percent of occupied rental housing units nationwide. New LIHTC construction thus more than compensated for the decline in the stock of occupied public housing units over this period.

This paper explores the impacts of low-income housing developments on the neighborhoods in which they are built. Since LIHTC subsidized units are almost entirely populated by households below the 30th percentile of the income distribution, new developments may generate a decline in local amenities because they lead to an influx of lower than average income residents in most neighborhoods. However,

[1] The federal government commits additional indirect financial resources through mechanisms including tax credit commitments to builders and tax exemptions for interest paid on bonds issued by state and local governments to finance public housing and privately owned subsidized projects.

[2] The LIHTC program has grown in importance in more recent years as well. In 2004 and 2005, an additional 207 thousand units were placed in service, 126 thousand of which were new construction.

new LIHTC units may also represent amenity improvements if they replace vacant buildings or unsightly empty lots. As local amenities change, the Tiebout (1956) resorting of the population potentially leads to turnover in neighborhood residents. Furthermore, the new neighborhood characteristics may be capitalized into home prices. Finally, the local aggregate supply of new rental and owner occupied housing may be affected by new subsidized units in the neighborhood.

Two factors complicate this evaluation. First, an LIHTC developer's choice of building location is likely to be influenced by expectations about future rents in the neighborhood. Second, households endogenously sort across neighborhoods based on unobserved attributes. It is therefore difficult to isolate the amenity and new neighbor effects of new low income housing construction from other factors that might drive neighborhood gentrification and decline. To overcome these difficulties, we exploit plausibly exogenous variation in the location of LIHTC projects generated by rules governing the allocation of LIHTC units across space. Projects located in census tracts where at least 50 percent of the households are eligible to rent an LIHTC unit are designated as Qualified Census Tracts (QCT) and receive thirty percent higher tax credits. This tax credit bonus generates more LIHTC projects in census tracts just above the eligibility threshold than those tracts just below.

We find that developers' location choices respond strongly to the tax credit incentives. Census tracts just above the QCT threshold receive on average an additional six LIHTC units on a base of seven units per tract between 1994 and 1999 relative to tracts just below the threshold. The response of LIHTC units to QCT status seems driven by developers' location choices rather than government preferences, as we find that the discontinuity in units at the threshold is driven by the number of applications by developers rather than state housing authorities' acceptance rate of proposed projects. In addition, we provide evidence that developers differentially select gentrifying neighborhoods as locations for their developments, a fact that to our knowledge has not been previously considered in the literature. Failure to account for this selection may lead to faulty conclusions about the impact of these developments on several important outcomes of interest.[3]

[3]For the purposes of this paper, we define neighborhoods in the top tercile of the distribution

Using the resulting exogenous variation in the location of LIHTC units, we find sizable effects on several key neighborhood attributes. We show that owner turnover rates are significantly higher near new LIHTC projects. On average, 100 additional LIHTC units causes a 5.9 percentage point increase in the fraction of owners moving to the neighborhood between 1995 and 2000. We also find that neighborhood income declines as a result of new LIHTC units nearby, and this effect is concentrated in gentrifying areas. In addition, we find a positive effect of LIHTC units on neighborhood home values. Every 100 additional LIHTC units leads to a 14.9 percent increase in the median home value, though this effect is close to zero in gentrifying areas.

Finally, we evaluate the extent to which the construction of LIHTC units crowds out private development. Overall, each new LIHTC unit increases the number of recently built rental units by 0.8 units within one kilometer of the project site, while we find no effect for owner occupied units. However, in gentrifying areas there appears to be significant crowd-out of private construction, as each additional LIHTC unit is only associated with 0.37 newly constructed rental units overall.

The cost of the regression discontinuity approach taken here is that without strong and probably unreasonable assumptions about the homogeneity of treatment effects as a function of neighborhood characteristics, we can only make causal statements about the impacts of low income housing developments on areas that are fairly poor, though not extremely poor. Developers' incentives to build low income versus market rate housing may differ markedly by local economic conditions. Furthermore, as argued in Eriksen and Rosenthal (2007), the magnitude and even the sign of the external effects of LIHTC construction may differ as a function of initial neighborhood composition.

This paper expands and builds on a body of research assessing the impact of subsidized housing on neighborhoods. Schwartz et al. (2006) examine the impact of housing developments in New York City, finding that low income housing developments have large positive effects on local housing values. They suspect this is

of housing value appreciation between 1980 and 1990 in each metropolitan area as "gentrifying", those in the middle tercile as "stable" and those in the bottom tercile as "declining".

due to a positive amenity effect of new construction. Green et al. (2002) present weak evidence that LIHTC projects in Milwaukee decrease property values but show mixed evidence for other areas. Sinai and Waldfogel (2005) study the extent to which publicly supported housing affects total housing supply. Finally, Lee et al. (1999) examine the correlation between the location of various types of federally subsidized housing units and nearby property values. They find that the relationship depends on the type of program, with public housing developments, users of Section 8 vouchers, and LIHTC developments associated with declines in housing values.

More generally, a literature going back to Schelling's (1971) classic model of neighborhood tipping attempts to understand how exogenous changes in neighborhood attributes can shift equilibrium neighborhood composition. A more recent literature studies the impacts of neighborhood attributes on outcomes of individual residents. An essential element required to make convincing empirical progress on both topics is some sort of random variation of people across neighborhoods. One approach used in the series of studies on Moving to Opportunity (most recently Kling et al., 2007) is to actively randomize poor subjects into various groups across which incentives to move to more affluent neighborhoods differ. This paper sheds light on the first topic by making use of the pseudo-random variation across neighborhoods in the number of new residents who are poor generated by the LIHTC tax credit bonus.

This paper proceeds as follows. Section 2 describes the LIHTC program. Section 3 discusses the empirical methodology. Section 4 discusses the data. In Section 5, we demonstrate that the tax credit bonus strongly influences the location of new low income units. Section 6 evaluates the impacts of subsidized rental units on neighborhood outcomes. Finally, Section 7 concludes.

2 The LIHTC Program

The LIHTC program was established as part of the Tax Reform Act of 1986 to encourage the development of affordable rental housing for low-income households. Each year, Congress allocates federal tax credits to states based on population, which are then paid out to developers over the subsequent ten years. In 2007, the allocation was $1.95 per state resident per year.[4] Developers apply for tax credits by proposing a specific project to a state, which then selects the projects to fund from these applications. Potential projects must meet one of two criteria to be eligible for the tax credit. Either at least 20 percent of the units must be occupied by tenants earning below 50 percent of the Area Median Gross Income (AMGI) or at least 40 percent of units must be occupied by tenants earning below 60 percent of the AMGI.[5,6] Annual rents on these units cannot exceed 30 percent of the relevant income limit. Since the program's inception, over 95 percent of units in projects supported by the program qualified as low income. The rent requirement binds for 15 years, after which some less restrictive rent restriction is required for an additional 15 years. The cost of constructing or rehabilitating the rent restricted units (excluding land) is known as the "qualified basis".

The base level of the tax credit is intended to have a discounted value of 30 percent of the qualified basis for existing projects without substantial rehabilitation or any projects receiving other federal subsidies and 70 percent for new construction or substantial rehabilitation.[7] In 1989, Congress passed legislation to increase the tax credit by 30 percent for projects developed in "qualified census tracts" (QCTs) or "difficult development areas" (DDAs). A census tract counts as qualified if 50% of its households have incomes below 60% of AMGI, with the restriction that no

[4] Congress allocated $1.25 per state resident all years 1986 to 2001 except 1989 when it allocated $0.93. In 2001, funding was increased to $1.75 per resident, and has been indexed to inflation since 2003. These figures are annual commitments for 10 years. Therefore the total cost is about 10 times greater.

[5] The AMGI is calculated by the Department of Housing and Urban Development for all metropolitan areas and counties using data from the Internal Revenue Service, the American Housing Survey and the decennial Census of Population and Housing. The income limits are adjusted for family size on a base of four family members. The 50 percent figure is adjusted upward by 4 percentage points for each additional family member and downward by five percentage points for each family member short of four. The 60 percent figure is obtained for each family size by multiplying the 50 percent income limit by 1.2.

[6] A household's income may grow over time to exceed the income limit. When this happens in buildings where there exist market-rate units, the next vacancy created by the departure of a market rate tenant must be filled by a low-income tenant. When a building is entirely composed of low-income units, no action is needed.

[7] This amounts to annual tax credits of 4% or 9% of the eligible basis for 10 years.

more than 20% of the population of any metropolitan area may live in a qualified tract. Tracts with the highest fraction eligible get priority for assignment to qualified status. Despite this population restriction, almost all (96 percent) of metropolitan census tracts above the cutoff qualify. Tracts' qualified status is assigned using decennial census data, and is thus only revised every 10 years. The 50 percent threshold is the cutoff that we exploit in this paper to provide exogenous variation in low income housing units across sets of very similar census tracts. Metropolitan areas with the highest ratio of fair market rent to AMGI up to 20 percent of the national urban population qualify as difficult development areas. While we look at changes in outcomes between 1990 and 2000, we focus on exogenous variation in LIHTC developments approved after 1993 and placed in service by 1999 because 1994 was the first full year in which qualified status was assigned using 1990 census tabulations. Further, we only observe the universe of LIHTC projects built after 1994.

States receive far greater tax credit allocation requests than they have federal allotments. According to the State Housing Finance Agencies Factbook, in 2005 only Hawaii received more allotments than they had applications. Most states receive applications for between two and four times their allotment. In addition to indicating profitability of the program for chosen developers, the excess of applications affords states a significant degree of latitude in project selection. Each state is required to have a "Qualified Allocation Plan" (QAP) to determine whether applications for developments merit receiving the tax credit. In most states, the QAP designates the number of points to be allocated for various elements of each project proposal. The points are added up and projects are selected in order until the money runs out. While selection criteria differ by state, they include location, local housing demand conditions, whether funding can be shared with other government programs, resident characteristics, project activities, building characteristics and costs. As of 2001, 29 states gave extra points to projects proposed for tracts with qualified status as one of the location criteria.[8] In addition, a large fraction of states allocated extra points for development proposals that had fewer units than average. Most states give

[8] Gustafson & Walker (2002) provide a summary of state QAPs in 1990 and 2001.

priority to rehabilitation over new construction to the point that almost all proposed rehabilitations get funded.

Table 2 shows trends in LIHTC subsidized new construction and total renter occupied units between 1990 and 2000. In this table, we split the sample of census tracts between those falling above and below the 50 percent eligible household threshold that qualifies the tract as a QCT. There were 433 thousand new and rehabilitated LIHTC units in tracts with less than 50 percent of households eligible in 2000 representing 1.8 percent of the occupied rental stock, compared to less than 0.3 percent in 1990. In tracts with greater than 50 percent eligible households, LIHTC units accounted for 3.5 percent of the 2000 rental stock, up from 0.8 percent in 1990. In the more affluent tracts, 221 thousand newly constructed units were added under the LIHTC program, representing 9 percent of the net growth in units and 7 percent of the rental units less than 10 years old in 2000. Poorer tracts actually experienced a decline in the stock of rental units of 73 thousand during the nineties, while 54 thousand LIHTC units were constructed in these areas. These LIHTC units comprise 15 percent of the units less than 10 years old as of 2000 in poor neighborhoods.

In Table 2, we also examine by tract income level the fraction of census tracts' units renting below LIHTC regulated rent.[9] We show that in the tracts below the 50 percent eligibility threshold, 67 percent of occupied rental apartments rented below LIHTC regulated rents in 2000. This increased substantially from 52 percent in 1990, indicating that rent limits were increasing at a faster rate than market rents during this period. In the areas above the 50 percent cutoff, the market rate was below the regulated rent for 82 percent of apartments rented in 2000, up from 76 percent in 1990. These observations have important implications for understanding the channels through which LIHTC developments affect neighborhoods. It appears that in many cases rent limits are not binding. Furthermore, even in cases where

[9] Since the rent limit is 30 percent of AMGI, it depends on the number of people in the renting household. To estimate the fraction of units renting below the limit, we use the tract-level census data that contains, by number of bedrooms, the number of units with monthly rents in each of six bins. We assume a uniform distribution of rents within each bin. We must also make assumptions regarding the typical household size for each size apartment. We assume one person inhabits a studio apartment, 1.5 people inhabit a one bedroom, three people inhabit a two bedroom unit, and five people live in a three bedroom unit.

a rent limit does bind, this may be due to the LIHTC unit having a higher quality than the surrounding buildings, perhaps due to building age.[10]

3 Empirical Approach

The primary objective of this paper is to estimate the change between 1990 and 2000 in various outcomes y in response to the installation of nearby low-income units x. We first consider how to estimate parameters of interest using tract level data. We then extend our methodology to more systematically account for heterogeneity in the relative locations of LIHTC projects and neighborhoods for which we observe outcomes.

3.1 Basic Empirical Model

We endeavor to estimate the parameter β_1 in the equation

$$\Delta y_i = \beta_0 + \beta_1 x_i + \delta' Z_i + \varepsilon_i \tag{1}$$

where i indexes census tracts and Z_i is a vector of initial characteristics that may influence the outcome. Estimating the specification described by (1) using OLS regression does not generally yield consistent estimates of β_1 since the error term ε_i is unlikely to be orthogonal to the treatment x_i. The probability a project is proposed in a particular tract, and whether this proposal is ultimately accepted, is likely to be related to some unobserved tract characteristics that also influence the change in the outcome Δy_i. When proposing and selecting projects, developers and state housing authorities likely form expectations regarding changes in a host of neighborhood characteristics like rents and demographics that cannot be fully captured in Z. Factors that are unobserved to the econometrician but observed by developers and state housing authorities that may affect changes in neighborhood

[10] Burge (2007) estimates a hedonic model of rents in the Tallahassee housing market. Due to being new, LIHTC developments initially rent for well below their implied market value, though this difference dissipates quickly as the developments age.

outcomes may include gentrification patterns, availability of land for development and infrastructure investment.

To overcome the problems in identifying β_1 presented by the potentially endogenous relationship between changes in neighborhood characteristics and LIHTC projects, we employ a regression discontinuity design that exploits rules governing the assignment of tax credits to projects. As described above, projects located in qualified tracts are eligible for extra tax credits and in some states are given preferential status in scoring LIHTC applications. Qualified status is based on the fraction of households in a tract with incomes of less than 60 percent of the adjusted metropolitan area median gross income. If greater than 50 percent of households meet this criterion, then a tract is considered qualified.[11]

This eligibility cutoff generates a discontinuity in the likelihood that projects located in a tract receive additional tax credits. We begin by using the resulting discontinuity in a first-stage specification of the number of LIHTC units. The first stage equation implied by the regression discontinuity design at the census tract level is

$$x_i = \gamma_0 + \gamma_1 D_i + f(e_i) + G'Z_i + u_i \tag{2}$$

where the running variable e_i represents the fraction of households meeting the income requirement and i indexes census tracts. The treatment indicator takes on a value of $D_i = 1$ if $e_i \geq 0.5$ and 0 otherwise. We specify the control function, $f(e_i)$, of the running variable relative to the cutoff variable as a cubic polynomial where the polynomial coefficients are allowed to differ below and above the cutoff.[12] The

[11] This rule only creates a fuzzy discontinuity since at most 20 percent of metro area population can reside in qualified tracts. As a result, 96 percent of tracts that meet the eligibility criteria are in fact qualified.

[12] Mathematically, the control function is $f(e_i) = \sum_{p=1}^{3} [d_{1p}(e_i - .5)^p + d_{2p} D_i (e_i - .5)^p]$. The form of the control function has little affect on the results. In appendix Figure A1, we compare the fit of the cubic control function with that of linear and quadratic forms in a specification of project location. For both the specification of the number of units and projects, there is virtually no difference at the threshold. Only in the specification of LIHTC units normalized by the number of 1990 rental units is there a noticeable difference, though the linear and quadratic forms still exhibit a clear discontinuity at the QCT threshold.

expected value of the covariates captured in the vector Z should be equal in QCT and non-QCT tracts near the threshold if this identification strategy is valid. They are included as a robustness check and to improve precision.

The reduced form relationship between the change in the tract-level outcome Δy_i and the eligibility for extra tax credits is given by

$$\Delta y_i = \alpha_0 + \alpha_1 D_i + \beta_1 f(e_i) + A' Z_i + \eta_i. \tag{3}$$

Together with the estimate of γ_1, the estimate of α_1 can be used to obtain an Indirect Least Squares estimate of the parameter of interest, $\hat{\beta}_1 = \hat{\alpha}_1/\hat{\gamma}_1$. The estimated coefficient $\hat{\beta}_1$ is consistent provided the error term ε_i does not change discontinuously across the threshold $e_i = 0.5$. This estimator also purges any bias arising from selection due to missing project level data from the estimate of β_1.

3.2 Identification

The basic identifying assumption is that there are no unobservables that influence an outcome of interest and are correlated with QCT status, conditional on controls including the interacted polynomial $f(e)$. This assumption would be violated if there were sorting on unobservables across the yet to be announced qualified threshold in the initial period 1990. It is hard to imagine how such sorting could occur. QCT status was updated in 1993 using tabulations of the 1990 census. Therefore, when the 1990 census was taken it was impossible to know which tracts would end up qualified and which tracts would not within a few percentage points of the 50 percent cutoff. Furthermore, even if some individuals or developers knew perfectly the composition of the relevant census tracts, the fact that the census only samples 15 percent of households for the long form introduces considerable sampling variation. Summary statistics measured in 1990 are reported in the next section and indicate little evidence of sorting on observables near the qualified threshold. Given this evidence and the fact that such sorting appears implausible, we believe it is reasonable to take a tract's qualified status as exogenous conditional on $f(e_i)$.

It is important to recognize that sorting on unobservables is likely to remain within groups of tracts on either side of the QCT threshold. In particular, whether locating in a qualified tract or not, developers will still find it to their advantage to locate in gentrifying areas. For econometric identification, we need that such sorting on unobservables happens using exactly the same process on each side of the threshold. If this is true, the omitted variables on which the sorting occurs get differenced out by the regression discontinuity estimator.

3.3 Generalizing The Geography

Evaluating the effects of LIHTC developments at the census tract level presents some difficulties. If the process that generates the response of y to x operates as a function of distance, tract level regressions may provide inconsistent estimates of the response because not all census tracts are the same size. The wide variation in tract sizes generates variation in the distances to projects within tracts akin to a measurement error problem. Incorporating information from surrounding tracts may also improve efficiency by making use of more potential identifying information. Since tracts are often too large to assess treatment effects that may decay quickly with distance, we examine the effect of geographically close LIHTC units on outcomes at the census block group level.

The objective of the empirical approach described in this subsection is to estimate the effects on block group outcomes of LIHTC units built within 1 kilometer of block group centroids. We again exploit QCT status to obtain exogenous variation in the number of LIHTC units. We instrument for the number of LIHTC units using the fraction of the 1 km ring comprised of blocks in qualified census tracts.

Using geocoded locations of LIHTC projects, we allocate LIHTC projects to rings 1 km in radius centered at block group centroids. This implies the following ring-level estimation equation analogous to (1).

$$\Delta y_g = \beta_0 + \beta_1 x_g + \delta' Z_g + \varepsilon_g \tag{4}$$

where g indexes block group and x_g gives the number of units within 1 km of the centroid of block group g. As with (1), equation (4) may be misspecified due to unobserved variables correlated with x_g that influence Δy_g.

To obtain exogenous variation in x_g, we model the process generating LIHTC developments as happening at the census block level. We choose blocks because they provide approximately the same number of potential LIHTC development sites regardless of spatial location and they are small enough to be precisely aggregated into rings. The first stage equation for this specification can be obtained by summing a census block level version of (2) across tracts i lying at least partially within the 1 km ring:

$$x_g = \sum_{i(g)} B_{ig}(\gamma_0 + \gamma_1 D_i + f(e_i) + G' Z_i + u_i) \tag{5}$$

where B_{ig} is the number of census blocks in the 1 km ring around block group g that are in tract i. Separating the terms within the summation on the right-hand side of (5), we see that the term $\sum_{i(g)} B_{ig} D_i$ represents the number of blocks within a ring located in a QCT. This term serves as our instrument for x_g. Substituting for x_g in (1), this suggests a block group level reduced form specification for Δy_g that is analogous to (3):

$$\Delta y_g = \psi_0 + \psi_1 \sum_{i(g)} B_{ig} D_i + \sum_{i(g)} [B_{ig}(\delta_0 + \beta_1 f(e_i) + Q' Z_i)] \ + \widetilde{\delta}' Z_g + \widetilde{\varepsilon}_g. \tag{6}$$

Assuming the empirical model in (2) captures the data generating process for x at the census block level, inclusion of the aggregated polynomial control function terms ensures that the instrument is orthogonal to the error term $\widetilde{\varepsilon}_g$.[13] In our results,

[13] As in the tract level specification, the control function is modeled here as a cubic polynomial, but one difference is worth mentioning. When estimating the tract level first-stage, we drop tracts far from the eligibility threshold, those with a value of e_i of less than 0.2 or greater than 0.8. In estimating the ring specification discussed in this subsection, however, we wish to include entire rings in all cases, which involves including blocks located in tracts far from the threshold. The parametric specification of the control function becomes weaker when trying to fit these extreme values. We therefore control for extreme values nonparametrically by additionally controlling for the number of census blocks in one percentage point wide bins of eligibility fraction within the 1 km ring when it is greater than 0.8 or less than 0.2. As such, in the ring level regressions we specify the control function as $f(e_i) = \sum_{m=0}^{19} c_m 1(\frac{m}{100} \leq e_i < \frac{m+1}{100})$

we present OLS and IV estimates of β_1.[14] This strategy identifies the parameters of interest by exploiting variation in the fraction of blocks in rings around each block group qualifying for the higher tax credit. By holding geography constant and measuring outcomes at the block group level rather than the tract level, this strategy makes more efficient use of available information.

4 Data

We use data from the Department of Housing and Urban Development on LIHTC projects placed in service from 1987 through 2005. These data provide information regarding specific project location including the geocoded project street address, census tract, and metropolitan statistical area. These data include information on the number of units reserved for individuals qualifying for reduced rent, the type of construction and whether the project qualified for extra tax credits through an increase in the eligible basis.

In all, the data set provides information on 24,504 projects. Unfortunately, missing data is somewhat of a concern. Most important for our analysis, information on project location is missing for 9.5 percent of projects and the number of units is missing for 4.9 percent of observations. Assuming that missing information on location does not differ across the 50 percent eligibility cutoff, missing data does not adversely affect our identification strategy, though it does add noise to the error term.

Because the first year in which 1990 census information was used to determine QCT status was 1993, we focus only on projects allocated in 1994 or later to allow for lead time in project planning. Since the outcome variables we examine include

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$$+\sum_{p=1}^{3}[d_{1p}(e_i-.5)^p+d_{2p}D_i(e_i-.5)^p]$$
$$+\sum_{m=80}^{99}c_m 1(\frac{m}{100}\leq e_i<\frac{m+1}{100})$$
where the parameters d_{1p}, d_{2p} and c_m are estimated.

[14]Because this model is just identified, IV and Indirect Least Squares estimates of β_1 are identical.

information from the 2000 census, we further restrict our sample to projects placed in service in 1999 or earlier. Finally, because of different rules for the allocation of tax credits in rural areas, we only consider projects placed in metropolitan areas.

We combine the data on the locations and attributes of LIHTC projects with census tract and block group level data from 1980, 1990 and 2000. These data provide information on demographic characteristics, housing values, and characteristics of the housing stock. The 1980 tract-level data allow us to establish pre-existing trends that we use to evaluate how estimated treatment effects differ by neighborhood growth and decline.[15] The sample used for tract-level regressions only includes areas in census tracts with between 20 and 80 percent eligibility. This restriction leads us to drop 29 percent of the 45,305 metropolitan area census tracts for which we have data.

One drawback to the LIHTC data is that it only contains information on projects placed in service. An observed project is one that was both proposed *and* selected by a state housing authority. To disentangle the supply decisions of firms from the preferences of state housing authorities, it is worthwhile to know about projects that were rejected. To this end, we collected data for all 690 applications made in California, Texas, and New Jersey in 2004 and 2005. These jurisdictions host a large number of LIHTC projects, make applications data readily available, and include states both with and without preferences to place LIHTC projects in QCTs. The applications information contains location by census tract, the number of units, the Qualified Action Plan score resulting from the project evaluation, and whether the application was accepted or rejected.

Figure 1 illustrates the nature of the data used for the analysis. It shows a map of the North and West sides of Chicago. Figure 1 shows census tracts shaded by eligible household fraction, block group centroids and LIHTC projects. The

[15] Because census geography changes over time, we must normalize year 2000 census block groups and 1980 census tracts to conform to 1990 census block group geographic definitions. The 1990-2000 census block relationship file allows us to precisely calculate the fraction of the population in each 2000 definition block group that resided in each 1990 definition block group. We apply these results to calculate counts or population weighted averages of relevant 2000 census variables in 1990 block group geography. We employ census bureau reports of tract level allocation factors to map 1980 tract variables to 1990 block group geography.

poorer region in the lower left side of the map, which is west of the Loop, received considerably more LIHTC projects than other areas. The map also shows two other distinct pockets of poor tracts. A cluster of LIHTC projects are located in the tracts containing the Cabrini Green housing project, and another cluster of LIHTC developments are located in the Uptown neighborhood in the upper part of the map. These neighborhoods share a common feature in that the are all largely comprised of Qualified Census tracts (shaded in blue). Indeed, very few developments shown on the map are located in the wealthier, non-QCT areas of Chicago. Figure 1 also indicates the extent to which the use of block groups rather than census tracts improves the spatial density of the data.

4.1 Summary statistics

Table 3 presents tract-level summary statistics by the fraction of households that are eligible to rent LIHTC units. The top portion of the table describes the average number of low-income LIHTC units, projects, and units per project for developments in our sample. It is evident that poorer tracts receive more LIHTC developments, with a sizable portion of the income-development gradient explained by QCT status. The 0-40% eligible tracts received an average of 0.07 projects per tract, compared to 0.11 in 40-45% eligible tracts and 0.12 in 45-50% eligible tracts. The average number of projects jumps noticeably to 0.19 in 50-55 percent eligible tracts, and 0.23 in the poorest tracts. Similar profiles are observed for the likelihood a tract has a project, and for the average number of total and low-income units per tract. The final column presents the estimated discontinuity at the QCT eligibility threshold, conditional on the interacted cubic control function and county fixed effects. The discontinuity for units and projects is significant, supporting the claim that the jump between the 45-50 and 50-55 percent eligible bins is due to QCT status. However, there is no discernible trend in the size of projects. The average tract with fewer than 40 percent eligible households has 84.9 units per project, while the average tract in the rest of the income distribution has between 60 and 70 units per project.

In order for the regression discontinuity strategy to yield consistent parameter estimates, unobserved tract characteristics that influence outcomes of interest must not vary discontinuously across the policy threshold. The lower two sections of Table 3 show demographics and housing characteristics in 1990 as functions of the fraction of tracts' households that are eligible to rent LIHTC units. Casual inspection of the raw data and RD coefficients reveals that most demographic and housing characteristics do not vary significantly across the QCT threshold. Of the many variables examined, only population, total housing units, and the fraction of owner occupied housing units that were detached differ significantly across the qualified threshold and magnitudes of these differences are small. Importantly, there are not discontinuities in housing values, pre-existing trends of housing values, or median household incomes. In order to maintain continuity of baseline variables across the tax credit discontinuity, we always control for county fixed effects in the empirical analysis to follow. We demonstrate below that controlling for a host of observables has little effect on the estimated parameters of interest.

Summary statistics in Table 3 show that neighborhoods near the QCT eligibility threshold are somewhat though not extremely poor. These neighborhoods have an average poverty rate of approximately 25 percent, are about 30 percent black and have about 60 percent high school graduates. It is this type of neighborhood for which the exogenous variation in LIHTC developments allows us to estimate causal relationships between low income housing and outcomes of interest.

5 Development Location Results

5.1 Tract Level Estimates

Table 4 presents a variety of tract-level "first stage" estimates of the impacts of the 30 percent additional tax credit on various measures of how LIHTC housing is allocated across space. Each element of Table 4 is an estimate of γ_1 under different specifications of (2). Panel A shows estimated impacts of QCT eligibility on the number of LIHTC units, units per 1990 stock of rentals, number of projects and units per project using data from both rehabilitation and new construction projects.

Specification 1 includes only elements of the cubic control function as explanatory variables. We estimate that tracts just above the QCT threshold receive 6.0 more units per tract relative to tracts below the threshold.[16,17] This response of LIHTC units comes in part because qualified tracts received 0.06 more projects conditional on the control function and in part because projects in qualified tracts had 19 additional units on average. Each estimate except that for units per project is precise. Figure 2 plots predicted values of the cubic control functions and average values of outcome variables within percentage point bins against the fraction of eligible households. Graphs in Figure 2 exhibit noticeable discontinuities at the QCT eligibility threshold.

Specifications shown in columns 2-4 of Table 4 show estimates of γ_1 when more controls are included in the regression. If the control function adequately accounts for the association between LIHTC developments and the running variable, adding further controls should have little impact on the estimated discontinuity in local LIHTC supply at the QCT threshold. Indeed, adding county fixed effects in column 3, tract demographic controls in column 4, and tract housing characteristics in column 5 generates little change in the estimated units and projects discontinuities. Only the coefficient on units per project changes markedly. The impact of the additional tax credit on this outcome is consistently estimated less precisely than the others at least in part because only the 9.6 percent of tracts that received projects are in the estimation sample for this outcome.

To evaluate the robustness of the RD estimates, we undertake a placebo exercise in which we estimate the model at false QCT eligibility thresholds. We consider placebo thresholds of 0.3, 0.4, 0.6, 0.7, and for comparison purposes the true value of 0.5. In Appendix Table A1, we display the estimated RD coefficients, where each

[16] This does not imply that the greater tax credit afforded projects in QCTs lead to more projects constructed overall, as states have a fixed allocation of tax credit dollars. In fact, if all projects received the non-QCT tax credit amount, the state could afford to fund more projects, provided construction costs are the same in QCTs and non-QCTs. Therefore, these estimates should not be interpreted as the elasticity of LIHTC housing units to the tax credit, as they are likely to significantly overstate this figure.

[17] We bootstrap the standard errors clustering at the MSA level. The identifying assumption for consistent estimation of standard errors is thus independence of observations between but not within MSAs.

column contains the results assuming a different fictional cutoff for QCT eligibility. The estimated discontinuity at the placebo cutoffs should be indistinguishable from zero. With only two exceptions, the estimated discontinuities at the placebo thresholds are statistically insignificant, and in most cases they are closer to zero than the estimates using the true eligibility threshold.

Table 4 Panels B and C display results of regressions analogous to those in Panel A except that LIHTC projects are separated into new construction and rehabilitations separately. While it is impossible to achieve independent exogenous variation in the two variables using the qualified status discontinuity, we show first stage results for these two types of projects in order to better understand the type of project that primarily drives the neighborhood level results presented in the next section.

Panel B reports the results for new construction projects. In the full specification, we estimate that 4 additional new units are built in QCTs just above the threshold, representing the majority of the 6 additional units of all types received by these tracts. The other measures of supply tell a similar story. The discontinuity in LIHTC units as a fraction of the 1990 rental housing stock is estimated to be 0.01 and the estimated discontinuity in new projects is 0.05. As with the results for all projects, the estimated discontinuity in new LIHTC developments is not sensitive to the inclusion of controls for county fixed effects, demographics and housing characteristics. The discontinuity in units per project is slightly larger for new construction, though it remains statistically insignificant.

In Panel C, we report analogous estimates for rehabilitation projects. As implied by results in Panels A and B, estimated discontinuities at the QCT threshold are small and statistically insignificant for each measure of the local supply of rehab housing. These smaller estimated effects are consistent with the fact that the tax credit bonus is smaller for rehabilitations than it is for new construction.

5.2 Evidence from Applications Data

The additional projects and units observed in QCTs can either be due to developers proposing more projects in these areas or to states accepting QCT projects with a higher probability. In this subsection, we investigate the potential importance of these two mechanisms by estimating the effects of QCT designation on proposed and accepted LIHTC projects using data on applications to the LIHTC program. If all profitable projects are proposed, then the response of proposed units to the QCT designation yields the supply response of LIHTC units to higher anticipated tax credits.

The econometric specification employed for Table 4 does not fully capture the data generating process of LIHTC project proposals in 2004 and 2005. In 2003 the QCT criterion was expanded also to allow tracts with a poverty rate exceeding 25 percent to qualify as QCTs. We use the additional variation in QCT status provided by the poverty rate threshold as an additional instrument for whether a tract is a QCT. We report IV coefficients that summarize the effect of QCT status on application decisions that are estimated conditional on cubic control functions in both the eligible household fraction and the poverty rate, both interacted with being above their respective thresholds.

Table 5 Panel A displays the IV estimates of the response of applications to QCT status in California, Texas and New Jersey in 2004 and 2005. As with the number of installed units, we observe a significant response to the QCT designation. QCT tracts receive proposals for an extra 17 units on average, controlling for only the cubic control functions. Adding additional tract controls from the 2000 census changes the coefficient only slightly to 18. We also find a significant effect for the number of proposed LIHTC units as a fraction of 2000 tract rental units. Much of the higher estimated number of units is due to more proposed projects, as QCT tracts receive 0.15 more applications. Units per proposed project also seem to be higher in the tracts qualifying for higher tax credits, however this is imprecisely estimated.

Table 5 Panel B shows estimated effects of QCT status on the number of accepted projects using the same applications data. We estimate that tracts designated as QCTs see an additional 4 accepted units. This coefficient is similar in magnitude to that estimated in Table 4 Panel A, though in this case it is not statistically significant. We also estimate positive but statistically insignificant effects of QCT status on the number of normalized accepted units and number of accepted projects.

These results, combined with those in Panel A, suggest that the discontinuity in local supply we documented in Table 4 is at least in part due to a greater willingness by developers to locate projects in qualified tracts.

5.3 Ring Level First Stage Results

While tract-level analysis most closely matches the QCT policy, an empirical strategy that considers a finer geographic area and that utilizes information from neighboring tracts will likely make more efficient use of the data when estimating the effects of LIHTC units on neighborhood outcomes. We now turn to the ring-level analysis described in Section 3.3. The ultimate objective is to estimate the effect of projects located within 1 km of a block group centroid on outcomes in the block group, instrumenting for the number of projects using information on QCT status within the ring. In this subsection, we present the first stage of this estimation, where we regress the number of units built in the 1 km ring on the number of blocks within the ring located in qualified tracts.

Table 6 presents first stage estimates of γ_1 from Equation (5). Each entry is from a separate regression and can be interpreted as the additional number of LIHTC units built for each qualified census block within a 1 km ring. All reported standard errors are clustered at the county level. Since this level of clustering allows for a very general covariance structure, standard errors are likely to be overstated. Even these generous standard errors imply a strong first stage in most cases.

In column (1) of Table 6, we display the estimated coefficient on the number of blocks in qualified tracts within 1 km of block group centroids for the full sample of block groups. In the first row, we present a specification controlling only for the aggregated eligible household control function, county fixed effects, and the number of census blocks in the ring interacted with county fixed effects. Each qualified block is associated with 0.30 additional units. In the second row, we include the full array of controls, and obtain an estimated coefficient of 0.28.

As argued above, we may expect developers to have a larger incentive to locate in gentrifying neighborhoods given that these neighborhoods have higher expected housing values after the LIHTC commitment is complete. As such, we also separately estimate separate first stages for the samples of tracts in declining, stable and gentrifying neighborhoods. We define these groups as terciles of the distribution of housing value growth between 1980 and 1990 in each metropolitan area separately. Gentrifying areas received more units as a result of the extra tax credit than did declining and stable areas. Including the full set of controls, gentrifying areas show a first stage coefficient of 0.27 while declining neighborhoods show a first stage coefficient of 0.22. These results suggest that the availability of the additional tax credit interacts with expectations about future housing values to generate higher expected profits for developers. The results reported in Table 6 form the first stage for the neighborhood outcome results discussed in the next section.

6 LIHTC Projects and Neighborhood Outcomes

In this section, we evaluate the extent to which LIHTC projects influence neighborhood outcomes. We find that LIHTC developments significantly increase turnover of owner-occupied households within 1 km. In addition, we find that low income units in the neighborhood raise housing values, though this effect is concentrated in stable and declining neighborhoods. Based on evidence that the quantity of owner occupied units changed little in response to LIHTC units nearby, we interpret our estimates as capturing shifts in the demand for living in neighborhoods with LIHTC developments. Declining median area incomes points to negative peer effects or stigma of living near LIHTC projects as potential explanations for these demand shifts.

A standard strategy for evaluating the marginal willingness to pay for a local amenity is to estimate the response of housing values to exogenous shocks in the amenity (Rosen, 1974 and Ekeland et al. 2004). In a similar paper, Chay and Greenstone (2005) apply this methodology along with a regression discontinuity design to examine how homeowners value improvements in air pollution. They exploit discontinuities in regulatory intensity across counties to identify the valuation of a change in clean air through changes in housing values. Our strategy is analogous with the addition of the ring level aggregation developed above.

6.1 Impacts on Block Group Outcomes

We begin by showing OLS estimates of the relationship between LIHTC units and block group outcomes in Panel A of Table 7. In column 2 of this table, we display estimates using the full sample of block groups and with the full set of controls. Additional units are associated with greater owner turnover. Each additional 100 LIHTC units is associated with an increase of the share of owners that moved into their homes between 1995 and 2000 of 0.9 percentage points. We choose turnover during this period because it closely overlaps with the period during which we have exogenous variation in the location of LIHTC developments. We also find greater turnover among renters, as the fraction of renters entering the area is 0.8 percentage points higher for each 100 additional low-income units. Interestingly, each 100 additional LIHTC units are associated with both a decline in median income of 0.8 percent and with an increase in home prices of 1.1 percent.

In columns 3 and 4, we report estimates for stable neighborhoods, with and without controls. For newly entering owners and renters, and for the change in log median household income and log median housing values, the effects of LIHTC units in stable neighborhoods are estimated to be similar to the full sample. In columns 5 and 6, we report analogous estimates for gentrifying areas. The results are largely comparable with the sample of stable block groups, though two differences are worth noting. First, the effect of LIHTC on the fraction of renters that entered within the past 5 years is estimated to be 0.011 in the stable sample, though only 0.005 in the gentrifying sample. Second, LIHTC units are estimated to be associated with lower incomes in the stable group compared with the gentrifying group. A block group with 100 additional nearby LIHTC units has 1.2 percent slower growth in income in stable areas and 0.7 percent slower growth in gentrifying areas. We do not present separate results for the declining neighborhood sample because of its marginally significant first stage.

Table 7 Panel B reports IV estimates of the effects of 100 LIHTC units on outcomes of interest. As discussed in Section 3.3, these are estimates of $\frac{\psi_1}{\gamma_1}$ from Equations (5) and (6) in which we instrument for LIHTC units within 1 km of block group centroids with the number of blocks in qualified tracts in the ring. In addition, we control for the aggregated eligible fraction polynomial and the number of blocks in 1 percentage point wide bins for 0 to 20 and 80 to 100 percent eligible tracts in the ring. The first set of standard errors are robust to heteroscedasticity. For outcomes with statistically significant estimates, we also report spatially corrected standard errors using the GMM estimator described in Conley (2008).[18]

We estimate that an additional 100 units leads to a 5.9 percentage point increase in the fraction of owners entering a block group between 1995 and 2000, considerably larger than the OLS estimate of 0.9 percentage points. The average fraction of owners moving between 1995 and 2000 in census tracts with between 40 and 60 percent eligible households is 0.27, which suggests that the estimated effect of LIHTC units on owner turnover is large. This marked increased churn rate due to low income units is consistent with LIHTC projects inducing a downward shift in neighborhood desirability that is not fully reflected from the OLS results because developers select into gentrifying neighborhoods.[19]

While we find significantly positive effects of LIHTC on entry of new renters in the OLS results, the IV results yield negative and statistically insignificant effects of LIHTC units. Median household income is again found to be lower as a result of LIHTC units, and the effect is significantly stronger in the IV results. We find that every additional 100 units is estimated to reduce median income by 9.3 percent. Finally, median home values increase by 14.9 percent in response to each 100 units placed in service. It is important to realize that this shift in the composition of neighborhood population does not appear to be due in large part to the tenants in LIHTC projects. With the average project including about 60 units and the average 1 km ring with 3,200 units, tenant incomes would have to be drastically lower than

[18] We calculate that 8 km is the furthest distance over which the error term is dependent. As such, the spatially corrected standard errors allow for arbitrary spatial dependence up to 8 km using a triangular distance kernel.

[19] We find similar effects on the fraction of owners moving into the neighborhood between 1990 and 2000.

neighborhood incomes to generate the estimated declines in neighborhood income.[20] The IV results for the full sample are in general of similar sign though larger in magnitude than the analogous OLS estimates. This either suggests that sorting biases OLS estimates towards zero, or that we are obtaining local estimates at the QCT threshold that do not generalize to the broader sample.

One explanation for the seemingly contradictory results that LIHTC units increase housing values but cause incomes to decline is that the positive effect on housing values comes from declining or low value areas whereas the income declines come from gentrifying or high value areas. That is, for areas near the qualifying threshold, the treatment effect of LIHTC units may be a function of neighborhood trajectory.

We consider such potentially heterogenous treatment effects by examining separate estimates for stable and gentrifying areas, measured as the second and third terciles of the distribution of housing value appreciation between 1980 and 1990 within metropolitan areas. This exercise reveals two important differences in the results for gentrifying areas relative to stable areas. First, the adverse effects of LIHTC units on median block group income seem concentrated in gentrifying block groups. We estimate that each additional 100 LIHTC units within 1 km of a block group centroid reduces median income by 21.5 percent in gentrifying areas. Consistent with this finding, the positive effects of LIHTC units on housing values are concentrated in declining areas. Overall, we find that an additional 100 LIHTC units raises the growth in median house values by 14.9 percent, though the estimated effect is 10.6 percent in stable areas and 5.6 percent in gentrifying areas. This indicates that the amenity affect of LIHTC units may be stronger in less desirable neighborhoods. The slight positive impact of LIHTC units on housing values even in gentrifying neighborhoods may reflect capitalization of the expected future amenity value of the LIHTC developments once they become market rate housing. Splitting the sample instead on terciles of the 1990 housing value distributions within MSAs produces

[20] Block groups have on average just under 500 housing units. Therefore, in most cases LIHTC developments within 1 km of block group centroids are not actually located inside the block groups for which we measure outcomes.

qualitatively similar results, though coefficients are measured with less precision.[21]

6.2 Impacts on Local Construction

In this subsection, we report the effects of LIHTC units on new construction of rental and owner-occupied housing within 1 km of block group centroids. LIHTC subsidized housing may crowd out private housing through its effects on new construction and withdrawals of units from the housing stock. Due to data limitations, we focus on LIHTC's effects on new construction.[22] It is important to recognize that because our exogenous variation in LIHTC units includes both new construction and rehabilitations, our estimates are likely to overstate crowd-out. The fact that about 70 percent of exogenous LIHTC units are new construction indicates that the true crowd out effects on rental units could be up to 30 percentage points smaller than those implied by our reported estimates. On the other hand, the fact that we use LIHTC units built 1994-1999 yet the outcome is for 1995-1999 would cause us to understate crowd-out by up to 17 percentage points.[23]

In Table 8, we present estimates of the effect of LIHTC units on the number of newly built rental and owner occupied housing units. The regressions we present are at the block group level, where the dependent variable is the total number of units that were five years old or newer as of the 2000 census and were built within a 1 km ring around block group centroids. The number of units includes both privately built and LIHTC units. We regress this measure on the number of LIHTC units

[21] We also tried running a specification in which we interact the change in housing values between 1980 and 1990 or 1990 housing values with the number of LIHTC units constructed 1994-1999. Consistent with the evidence in Table 7, using change in log median housing value between 1990 and 2000 as the outcome produces negative and significant coefficients on interactions with either baseline variable. Interaction coefficients for other outcomes are not significant.

[22] We can calculate the change in renter occupied, owner occupied and vacant housing units between 1990 and 2000, a period which does not overlap closely with the period during which we have exogenous variation in new LIHTC units. Attempts to estimate the effects of new LIHTC units on the change in these housing stock measures generate estimates that are very sensitive to specification, possibly because of this lack of overlap.

[23] We cannot only use LIHTC units built 1995-1999 for our new construction crowdout estimates because they are correlated with new LIHTC units built in 1994 which differs across the qualified status discontinuity.

built between 1994 and 1999 in that same ring.

In Panel A, we report OLS estimates of the effect of LIHTC units on the construction of rental and owner occupied housing. As in section 6, we report results for all block groups and then subsequently for stable and gentrifying block groups separately. Each additional LIHTC unit within a 1 km ring is associated with 0.53 new rental units in that same ring. Interestingly, each additional LIHTC unit is also associated with 0.09 additional owner-occupied units. This is consistent with LIHTC developers favoring growing areas.

When the sample is split between stable and gentrifying block groups, we see modestly weaker effects of LIHTC units on new construction. Stable areas receive 0.31 additional newly constructed renter occupied units for each LIHTC unit built, and we obtain an estimate of 0.47 for gentrifying areas. Conversely, the relationship between LIHTC units and new owner occupied units does not seem to depend on preexisting trends in housing values. If developers select into gentrifying neighborhoods, OLS estimates should overstate crowd-out, or be biased downwards, as these are areas where LIHTC subsidies may allow LIHTC developers to outbid private developers for the right to build on limited available land.

Results in Table 8 Panel B confirm this intuition. We again instrument for the number of LIHTC units in a ring around block group centroids using the degree to which that ring is comprised of qualified tracts. We find that each additional LIHTC unit constructed between 1994 and 1999 increases the total number of rental units built during this time by 0.80, which is greater than the OLS estimate of 0.53. We find that the IV estimate for the effect on newly built owner occupied units to be -0.036, which is both statistically insignificant and smaller than the OLS estimate of 0.09. Therefore, we find at least 20 percent crowd out of LIHTC units within 1 km in radius, and this crowd out effect is overstated using OLS estimates.

We next split the sample into stable and gentrifying block groups. In stable block groups, we find very little crowd-out of new rental unit construction, as we obtain an IV coefficient LIHTC units in the full specification of 0.99. In the gentrifying areas, we see evidence of substantial crowd-out. Each LIHTC unit in these areas only increases newly constructed housing by 0.37 units. These results indicate that while LIHTC units increase total new rental construction at a little less than one for one in low demand areas, the private market would have created more than 60 percent of the LIHTC new construction in gentrifying areas if the program did not exist.

7 Conclusions

This paper provides two sets of results relevant for evaluation of the Low Income Housing Tax Credit program, the largest federal project based program for the construction of rental units for low-income households. First, we study the response of developers to the size of the tax credit. We exploit a discontinuity in the size of the tax credit received by developers as a function of location and find that a thirty percent increase in the tax credit leads to six additional LIHTC units constructed on a base of seven units per census tract. We find that this effect is stronger in areas with the fastest growth in housing values during the eighties, suggesting that developers differentially select into gentrifying areas.

We utilize this pseudo-random assignment of units to tracts to investigate the effects of low-income housing developments on neighborhood characteristics and new housing construction. We find that LIHTC developments depress local median household income and increase turnover in owner occupied housing units within 1 km of these projects. Further, new LIHTC units impart a positive amenity effect as they lead to higher housing values in declining and stable neighborhoods. In gentrifying areas, however, there is little or no effect of LIHTC units on housing values. Finally, we show that LIHTC units modestly crowd out rental construction, as each LIHTC unit leads to 0.8 more new rental units nearby. Local crowd out is stronger in gentrifying areas, as each LIHTC unit only increases new rental construction by an estimated 0.37 units in these areas.

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Table 1: Components of the United States Housing Stock 1993-2003 (thousands)

	1993	1995	1997	1999	2001	2003
LIHTC: All Units	338	475	634	817	1,000	1,205
LIHTC: New Construction Only	149	221	317	433	543	670
Occupied Public Housing Units	1,295	1,129[a]	1,127	1,109[b]	1,078[c]	NA
Total Occupied Subsidized Units	NA	4,500[a]	4,571	4,531[b]	4,033[c]	NA
Renter Occupied Housing	33,472	34,150	34,000	34,007	33,996	33,604
Owner Occupied Housing	61,252	63,544	65,487	68,796	72,265	72,238
Total Occupied Units	94,724	97,694	99,487	102,803	106,261	105,842
Fraction of Rentals LIHTC	0.010	0.014	0.019	0.024	0.029	0.036
Fraction of Rentals Public Housing	0.039	0.033	0.033	0.033	0.032	NA

Notes: LIHTC stands for Low Income Housing Tax Credit. LIHTC data is calculated by the authors using the LIHTC data set available from the department of Housing and Urban Development (HUD). The LIHTC numbers assume no projects were taken out of service prior to the listed year. Information on public housing and other subsidized units is calculated from "A Picture of Subsidized Households". Remaining housing stock numbers are from the American Housing Survey. All housing stock numbers are for the 50 US states and the District of Columbia only. [a]Numbers are for 1996. [b]Numbers are for 1998. [c]Numbers are for 2000.

Table 2: LIHTC Units in the Housing Stock 1990-2000
(all housing numbers in thousands)

	Percent of Households Eligible for LIHTC	
	0%-50%	**50%-100%**
2000		
Stock of New Construction LIHTC Units	246	59
Stock of Total LIHTC Units	433	191
Renter Occupied Housing Units	24,539	5,431
Fraction Renting Below Regulated Level	0.67	0.82
Rental Units < 10 Years Old	3,220	361
Owner Occuped Housing Units	51,333	2,621
1990		
Stock of New Construction LIHTC Units	25	5
Stock of Total LIHTC Units	64	42
Renter Occupied Housing Units	22,158	5,502
Fraction Renting Below Regulated Level	0.52	0.76
Owner Occuped Housing Units	42,727	2,620
Difference		
1990-2000 Δ New Construction LIHTC Units	221	54
1990-2000 Δ Renter Occupied Housing Units	2,381	-72
Fraction of Rental Growth LIHTC	0.09	-0.75
Fraction of rental stock <10 years old LIHTC	0.07	0.15
Count of 1990 Census Tracts	38,293	7,012

Notes: The sample includes housing units in the 330 1990-definition metropolitan areas in the continental US. Numbers are based on authors' calculations using census tract data from 1990 and 2000 and the LIHTC data set available from HUD. The percent of households in census tracts eligible to rent LIHTC units is taken from internal data provided by HUD, and reflects the fraction of all tract households with income below the AMGI adjusted for household size. Nearly all tracts in the right-hand column, and none in the left-hand column, are Qualified Census Tracts. The stock of LIHTC units is calculated as the cumulative sum of all LIHTC units placed in service as of the stated year. The variable fraction renting below regulated level indicates the fraction of tract rental units that we estimate rent below the LIHTC rent limit, which depends on family size. We use the census data that contains, by number of bedrooms, the number of units with monthly rents in each of six bins. We assume a uniform distribution of rents within each bin. We assume one person inhabits a studio apartment, 1.5 people inhabit a one bedroom, three people inhabit a two bedroom unit, and five people live in a three bedroom unit.

Table 3: Average Characteristics of Areas by Eligibility Status

	Percent of Households Eligible for LIHTC						
	0%-40%	**40%-45%**	**45%-50%**	**50%-55%**	**55%-60%**	**60%-100%**	**RD Coeff**
LIHTC Projects Proposed & Built 1994 to 1999							
Low Income Units	5.5	7.6	7.3	12.4	14.0	13.1	5.6*
Projects	0.07	0.11	0.12	0.19	0.22	0.23	0.06*
Units Per Project	84.9	67.7	67.1	68.7	69.7	61.1	12.20
1990 Census Demographics							
Population	4608	4107	3928	3757	3760	3044	-252*
Housing Units	1868	1716	1603	1491	1479	1176	-116*
Percent Black	0.08	0.19	0.26	0.32	0.40	0.53	0.01
Percent High School Graduate	0.81	0.66	0.63	0.59	0.56	0.50	-0.01
Poverty Rate	0.08	0.19	0.23	0.27	0.32	0.45	0.00
Median Household Income	38,695	23,594	21,169	18,890	16,936	12,015	57
Renter Tenure < 10 Years	0.89	0.86	0.86	0.85	0.84	0.81	-0.01
Owner Tenure < 10 Years	0.50	0.43	0.41	0.39	0.38	0.36	0.00
1990 Census Housing Characteristics							
Average Age, Owner Occupied	27.8	35.9	37.6	38.9	39.9	41.4	0.31
Average Age, Renter Occupied	26.2	31.5	32.4	33.0	33.7	33.4	-0.35
Avg. # of Units, Owner Occ.	2.2	2.5	2.4	2.5	2.8	3.2	0.09
Avg. # of Units, Renter Occ.	8.4	9.1	9.2	9.6	9.8	13.1	0.60
Fraction Detached, Owner Occ.	0.80	0.69	0.67	0.66	0.64	0.60	0.02*
Fraction Detached, Renter Occ.	0.35	0.28	0.27	0.26	0.25	0.18	-0.00
Median Housing Value	124,749	82,921	75,960	72,058	67,746	59,546	-137
Median Gross Rent	545	419	403	390	381	323	-3
ΔLog Med. Housing Value 80-90	0.10	0.09	0.10	0.09	0.09	0.09	-0.01
Count of 1990 Census Tracts	33,203	2,921	2,169	1,697	1,421	3,894	

Notes: Census tracts are divided into bins based on the percent of households eligible for LIHTC, as defined in table 2. Each element in the table is the mean of the variable listed at left over the tracts in the stated income group. The "RD Coeff" column reports the estimated discontinuity of the variable listed at left at the QCT threshold, conditional on county fixed effects and a cubic in eligible fraction interacted with the 0.5 cutoff indicator. Only tracts with between 20 and 80 percent eligible households are used to calculate numbers in the final column. * indicates significance at the 10 percent level. See the notes to Table 2 for sample and data sources.

Table 4: Coefficients on Eligible > .5 for Various Primary Outcomes

	1	2	3	4
Panel A: All Project Types				
Number of LIHTC Low	5.954	5.721	5.844	5.562
Income Units	(2.563)*	(2.522)*	(2.451)*	(2.496)*
Number of LIHTC Low	0.020	0.020	0.012	0.011
Income Units/1990 Rentals	(0.009)*	(0.009)*	(0.004)**	(0.004)*
Number of LIHTC Low	0.064	0.059	0.062	0.061
Income Projects	(0.030)*	(0.029)*	(0.028)*	(0.028)*
Units Per Project	18.773	10.497	9.913	6.014
	(12.494)	(12.001)	(11.044)	(10.982)
Panel B: New Construction Projects				
Number of LIHTC Low	4.291	3.969	4.073	3.975
Income Units	(1.433)**	(1.335)**	(1.408)**	(1.510)**
Number of LIHTC Low	0.008	0.009	0.009	0.008
Income Units/1990 Rentals	(0.003)**	(0.003)**	(0.003)**	(0.003)**
Number of LIHTC Low	0.050	0.047	0.048	0.049
Income Projects	(0.021)*	(0.018)*	(0.020)*	(0.019)*
Units Per Project	20.210	13.698	10.113	11.396
	(13.330)	(14.083)	(14.801)	(14.849)
Panel C: Rehabilitation Projects				
Number of LIHTC Low	1.663	1.752	1.771	1.587
Income Units	(2.161)	(2.055)	(2.056)	(2.075)
Number of LIHTC Low	0.012	0.011	0.004	0.003
Income Units/1990 Rentals	(0.009)	(0.009)	(0.002)	(0.003)
Number of LIHTC Low	0.014	0.012	0.013	0.013
Income Projects	(0.020)	(0.019)	(0.020)	(0.020)
Units Per Project	21.345	12.691	15.642	7.718
	(17.910)	(22.491)	(21.443)	(23.381)
Included Controls:				
Cubic Polynomial	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	Yes
Housing Controls	No	No	No	Yes
County Fixed Effects	No	Yes	Yes	Yes

Notes: Each cell reports the estimated discontinuity at the QCT threshold of the stated dependent variable from a separate regression. Standard errors are calculated from 500 block bootstrap samples drawn using MSA level clusters. The sample includes all census tracts in metropolitan areas excluding Washington, DC. Each specification controls for the QCT criterion variable, the fraction of households eligible for reduced rent, using a cubic polynomial that varies above and below the QCT threshold. Demographic controls are minority population share, share of individuals greater than 25 years old with less than high school, with a high school degree, log median family income, population density, and the poverty rate from 1990. Housing controls and neighborhood characteristics are vacancy rate, the fraction of housing units that are rentals, log units, average owner-occupied age, average renter-occupied age, fraction owner-occupied more than 50 years old, fraction renter occupied more than 50 years old, average size, fraction over 50 units, distance to MSA central business district, and fraction of units comprised of detached houses and attached units for renters and owners.

Table 5: Qualified Census Tract Status and LIHTC Applications

	1	2	3	4
Panel A: Proposed projects				
Number of Proposed LIHTC Low Income Units	16.611	16.819	18.023	18.368
	(6.457)**	(6.476)***	(6.865)***	(6.876)***
Number of Proposed LIHTC Low Income Units/2000 Rentals	0.043	0.044	0.046	0.047
	(0.021)**	(0.021)**	(0.023)**	(0.023)**
Number of Proposed LIHTC Projects	0.143	0.140	0.146	0.148
	(0.073)*	(0.073)*	(0.077)*	(0.077)*
Proposed Units Per Project	56.884	40.347	77.391	78.378
	(56.745)	(56.888)	(56.225)	(62.081)
Panel B: Accepted projects				
Number of Accepted LIHTC Low Income Units	3.478	3.726	4.052	4.166
	(3.060)	(3.059)	(3.207)	(3.197)
Number of Accepted LIHTC Low Income Units/2000 Rentals	0.003	0.004	0.003	0.003
	(0.005)	(0.004)	(0.005)	(0.005)
Number of Accepted LIHTC Projects	0.037	0.039	0.038	0.037
	(0.038)	(0.038)	(0.039)	(0.039)
Accepted Units Per Project	9.473	-59.874	-34.794	-42.007
	(135.159)	(86.589)	(66.333)	(75.870)
Included Controls:				
Cubic Polynomials	Yes	Yes	Yes	Yes
Demographic Controls	No	No	Yes	Yes
Housing Controls	No	No	No	Yes
County Fixed Effects	No	Yes	Yes	Yes

Notes: The sample includes all metropolitan census tracts in Texas, California and New Jersey. Proposal data is from 2004 and 2005. The rules governing qualified status in these years are the same as for the 1990s with the additional requirement that qualified status be granted to tracts with poverty rates of over 25 percent. Controls include cubic polynomial control functions for the two criterion variables, the poverty rate and the fraction of households eligible, interacted with being above the qualified thresholds. Additional control variables are the 2000 versions of those used in Table 4. The reported coefficients are IV estimates of the effect of QCT status using dummies for whether the tract qualifies based on eligible fraction and the poverty rate thresholds as separate instruments. Standard errors are calculated using 500 block bootstrap samples with clustering at the MSA level.

Table 6: First Stage Results for 0 to 1 km Ring

	Number LIHTC Units			
	All	Declining	Stable	Gentrifying
	1	2	3	4
No Controls	0.30	0.24	0.24	0.29
	(0.09)	(0.13)	(0.08)	(0.12)
All Controls	0.28	0.22	0.24	0.27
	(0.09)	(0.12)	(0.08)	(0.12)
Obs.	154,186	47,437	48,404	46,464

Notes: Entries list coefficients and standard errors on the number of eligible blocks within one kilometer of block group centroids. The dependent variable is the number of low income LIHTC units within a 1 km ring of the block group centroid. Additional controls in all specifications include the number of census blocks in each tract in the ring and the cubic polynomial in eligibility fraction interacted with eligibility fraction greater than 0.5 summed up over all blocks in the ring and the total number of census blocks in the ring interacted with county fixed effects. Standard errors are clustered at the county level. Additional controls in the second row include all controls from the most complete specifications in Table 4. Coefficients can be interpreted as the additional number of low income units built per block as a result of being eligible for the higher tax credit. Obs. refers to the number of observations (block groups). All block groups with missing values for any of the control variables are excluded.

Table 7: Estimated Effects of 100 LIHTC Units on Neighborhood Composition

	All		Stable		Gentrifying	
Outcome	1	2	3	4	5	6
Panel A: OLS Results						
Fraction of Owners	0.013	0.009	0.010	0.009	0.014	0.010
Entering 1995-2000	(0.003)	(.002)	(0.003)	(0.003)	(0.003)	(0.002)
Fraction of Renters	0.011	0.008	0.015	0.011	0.010	0.005
Entering 1995-2000	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
Change in log Median	-0.009	-0.008	-0.015	-0.012	-0.010	-0.007
Household Income	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)
Change in log Median	0.008	0.011	0.004	0.008	0.000	0.007
Housing Value	(0.005)	(0.004)	(0.004)	(0.004)	(0.006)	(0.005)
Panel B: IV Results						
Fraction of Owners	0.037	0.059	0.176	0.201	0.045	0.063
Entering 1995-2000	(0.026)	(0.026)	(0.060)	(0.061)	(0.053)	(0.053)
	(0.047)	(0.042)	(0.081)	(0.080)	(0.068)	(0.064)
Fraction of Renters	-0.015	-0.010	-0.029	-0.030	0.039	0.043
Entering 1995-2000	(0.025)	(0.026)	(0.056)	(0.056)	(0.049)	(0.051)
Change in log Median	-0.123	-0.093	-0.094	-0.065	-0.199	-0.215
Household Income	(0.057)	(0.054)	(0.111)	(0.101)	(0.120)	(0.118)
	(0.067)	(0.070)	(0.110)	(0.110)	(0.140)	(0.140)
Change in log Median	0.105	0.149	0.083	0.106	0.014	0.056
Housing Value	(0.061)	(0.066)	(0.082)	(0.084)	(0.098)	(0.105)
	(0.088)	(0.099)	(0.100)	(0.140)	(0.140)	(0.150)
Included Controls:						
Demographics	No	Yes	No	Yes	No	Yes
Housing	No	Yes	No	Yes	No	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A reports OLS results from regressing outcome variables listed in the first column on 100s of LIHTC units built 1994-1999 within 1 km of block group centroids. Standard errors are clustered at the county level. Panel B reports IV coefficients estimated using the regression discontinuity estimator and a cubic control function. The first set of reported standard errors in Panel B are robust to heteroskedasticity. Additional standard errors in Panel B allow for arbitrary spatial dependence within 8 km. Control variables match those listed in the notes to Table 4. See Table 6 for sample sizes. Sample sizes are slightly smaller at 152,751 for fraction of renters entering 1995-2000 and 150,317 for change in median housing value due to data limitations.

Table 8: Estimated Effects of Each Additional LIHTC Unit on Local Housing Construction

	All		Stable		Gentrifying	
Outcome	1	2	3	4	5	6
Panel A: OLS Results						
Renter Occupied Units	0.555	0.528	0.339	0.309	0.500	0.471
Built 1995-2000	(0.102)	(0.108)	(0.063)	(0.059)	(0.097)	(0.099)
Owner Occupied Units	0.091	0.086	0.082	0.080	0.109	0.101
Built 1995-2000	(0.023)	(0.022)	(0.020)	(0.019)	(0.043)	(0.040)
Panel B: IV Results						
Renter Occupied Units	0.862	0.803	1.016	0.991	0.530	0.366
Built 1995-2000	(0.131)	(0.133)	(0.251)	(0.246)	(0.279)	(0.291)
	(0.306)	(0.331)	(0.222)	(0.217)	(0.409)	(0.451)
Owner Occupied Units	0.021	-0.036	0.258	0.220	-0.036	-0.183
Built 1995-2000	(0.081)	(0.086)	(0.156)	(0.154)	(0.177)	(0.196)
	(0.494)	(0.530)	(0.411)	(0.399)	(0.726)	(0.772)
Included Controls:						
Demographics	No	Yes	No	Yes	No	Yes
Housing	No	Yes	No	Yes	No	Yes
County FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Panel A reports OLS results of regressing outcome variables listed in the first column on 100s of LIHTC units built 1994-1999 within 1 km of block group centroids. Panel B reports analogous IV coefficients estimated using the regression discontinuity estimator and a cubic control function. Dependent variables are measured within 1 km rings of block group centroids. Control variables and standard error calculations are described in the notes to Tables 4 and 7 respectively.

Table A1: Estimates of Placebo Treatments at Different Eligibility Thresholds

	0.3	0.4	0.5	0.6	0.7
Panel A: All Project Types					
Number of LIHTC Low	1.979	-0.735	5.562	-3.112	4.306
Income Units	(1.595)	(1.495)	(2.496)*	(2.871)	(4.975)
Number of LIHTC Low	0.002	0.013	0.011	-0.003	0.032
Income Units/1990 Rentals	(0.005)	(0.012)	(0.004)*	(0.005)	(0.026)
Number of LIHTC Low	0.041	-0.018	0.061	-0.044	0.047
Income Projects	(0.019)*	(0.018)	(0.028)*	(0.036)	(0.068)
Units Per Project	-1.073	1.981	6.014	-0.403	-0.376
	(12.209)	(10.720)	(10.982)	(9.367)	(20.243)
Panel B: New Construction					
Number of LIHTC Low	0.908	-0.127	3.975	-1.342	1.570
Income Units	(1.161)	(1.019)	(1.510)**	(1.833)	(3.155)
Number of LIHTC Low	0.003	0.002	0.008	-0.004	0.024
Income Units/1990 Rentals	(0.004)	(0.002)	(0.003)**	(0.003)	(0.025)
Number of LIHTC Low	0.023	-0.015	0.049	-0.019	-0.000
Income Projects	(0.017)	(0.014)	(0.019)*	(0.020)	(0.039)
Units Per Project	-10.308	8.856	11.396	7.252	29.718
	(15.213)	(12.131)	(14.849)	(12.117)	(45.175)
Panel C: Rehabilitation Projects					
Number of LIHTC Low	1.071	-0.608	1.587	-1.770	2.737
Income Units	(1.006)	(1.118)	(2.075)	(2.321)	(3.850)
Number of LIHTC Low	-0.001	0.011	0.003	0.001	0.007
Income Units/1990 Rentals	(0.002)	(0.013)	(0.003)	(0.004)	(0.007)
Number of LIHTC Low	0.018	-0.003	0.013	-0.025	0.047
Income Projects	(0.008)*	(0.011)	(0.020)	(0.030)	(0.060)
Units Per Project	-14.345	-6.689	7.718	-2.048	-6.068
	(23.063)	(23.105)	(23.381)	(12.085)	(21.055)
Included Controls:					
Cubic Polynomial	Yes	Yes	Yes	Yes	Yes
Demographic Controls	Yes	Yes	Yes	Yes	Yes
Housing Controls	Yes	Yes	Yes	Yes	Yes
County Fixed Effects	Yes	Yes	Yes	Yes	Yes

Estimates differ from those in Table 4 only in the eligibility fraction thresholds.

Figure 1: Chicago Data

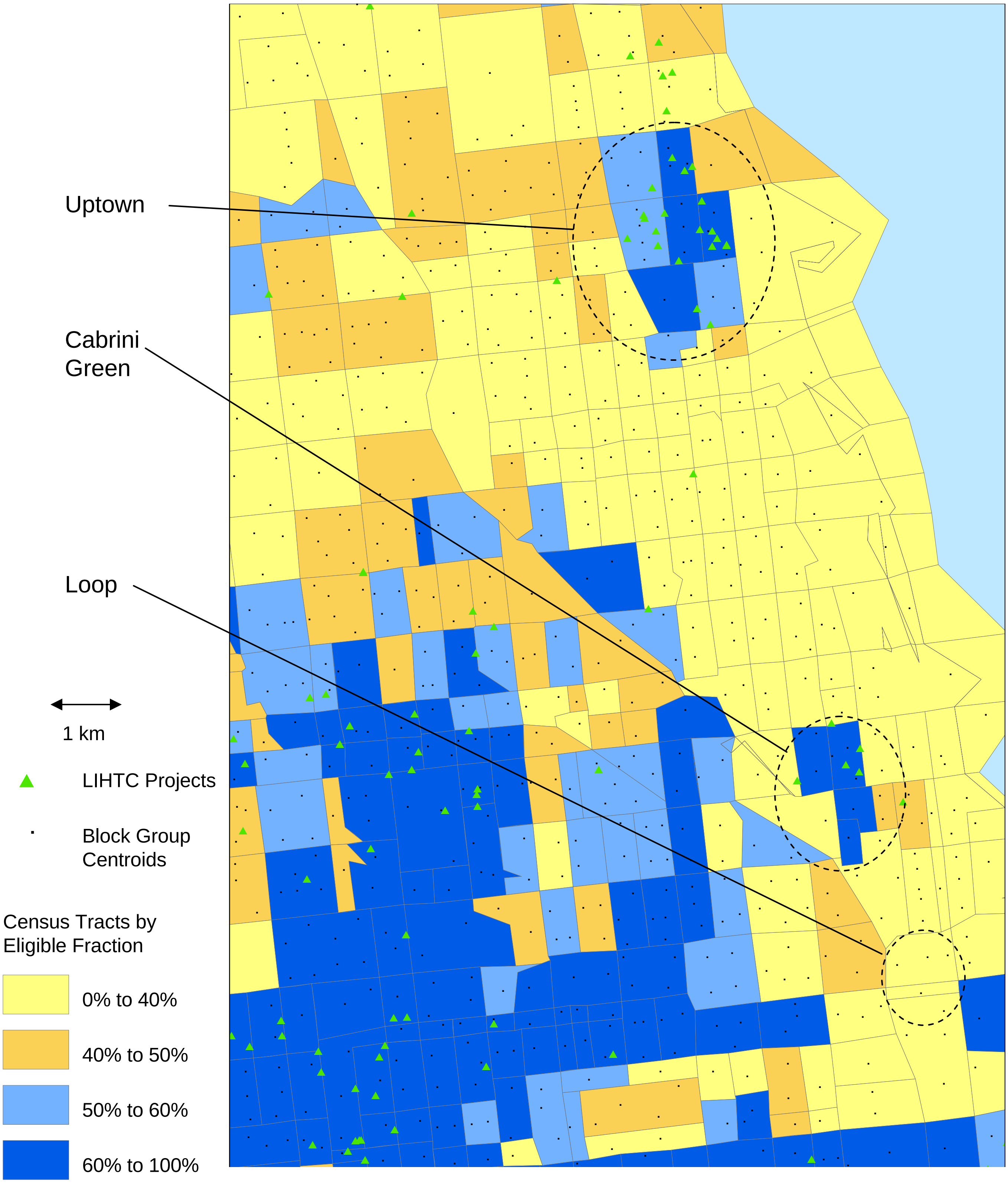

Figure 2: Response of Developments at the Qualified Census Tract Eligibility Threshold

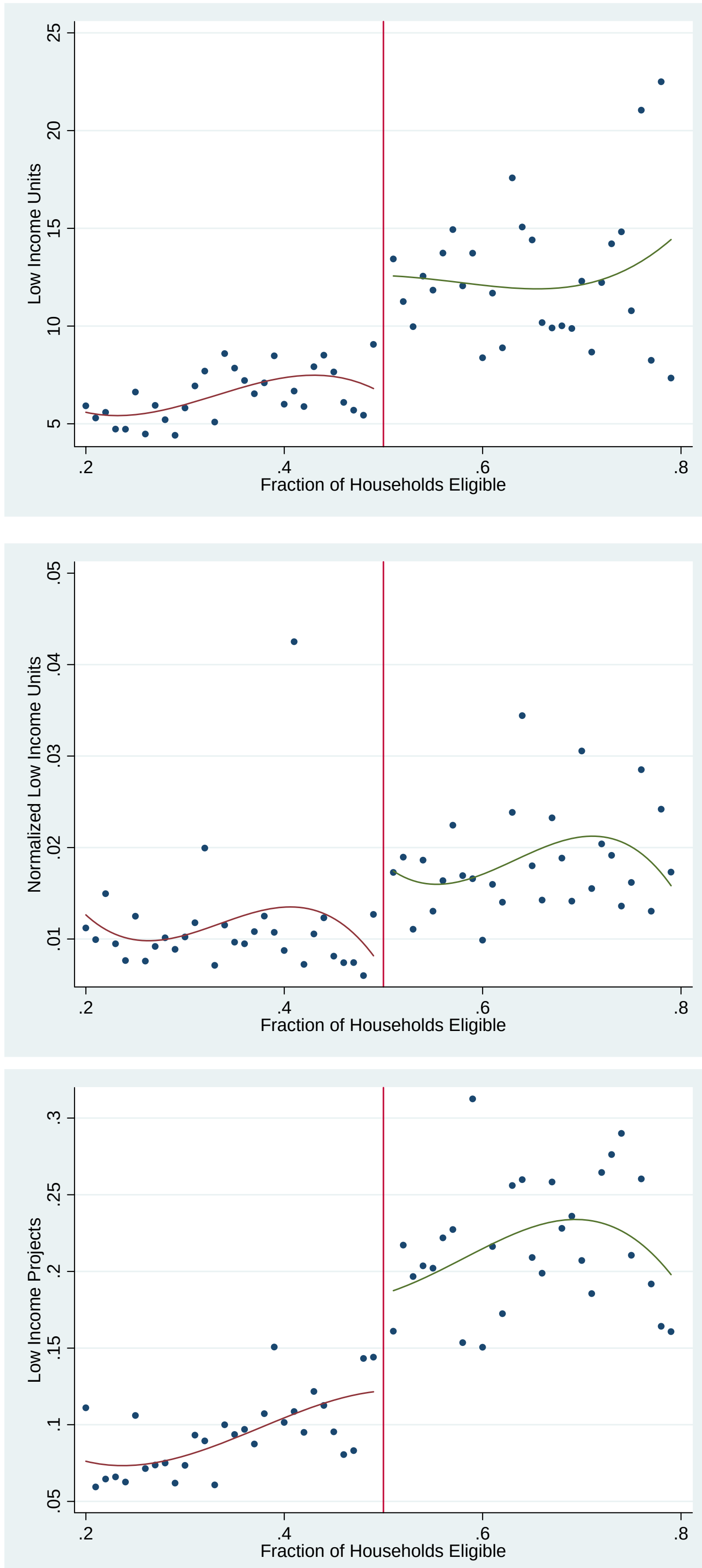

Figure A1: Compare Fit of Different Polynomials