The Effects of Low Income Housing Developments on Neighborhoods

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Abstract

This paper evaluates the impacts of low income housing developments on the neighborhoods in which they are built. A discontinuity in the formula determining the allocation of tax credits to low income housing developments 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. Estimates indicate that a 30 percent increase in the tax credit generates an increase of approximately 6 low income housing units on a base of 9 units per tract. We find that low income housing developments cause median household incomes to decline by about 5 percent in neighborhoods near the 30^{th} percentile of the income distribution and this effect decays monotonically with distance. Further, we provide evidence that developers differentially select gentrifying neighborhoods as locations for their developments. Failure to account for this selection can lead to faulty conclusions about the impact of these developments on local housing values.

1 Introduction

A long literature going back to Schelling (1971) attempts to understand the extent to which neighborhoods change as a result of immigration of the poor. Endogenous sorting of households across neighborhoods makes it difficult to empirically isolate new neighbor effects from other factors that might drive neighborhood gentrification and decline. In this paper, we empirically examine the impacts of the influx of the poor on surrounding neighborhoods. To achieve exogenous variation in the characteristics of new neighbors, we exploit variation in the location of poor households generated by rules governing the allocation of federally funded low income housing tax credit (LIHTC) units across space. In addition, our analysis provides new evidence on the local impacts of this important federal housing program.

Since its inception in 1986, the LIHTC program has subsidized the construction and renovation of over one million housing units in the United States. The federal government has committed to spending about $3 billion per year on the program in each year since 1986. Table 1 shows trends in the contribution of LIHTC subsidized housing construction to the housing stock. The growth in the number of LIHTC units during the sample period is significant. Developers established 475 thousand LIHTC units between 1993 and 1999, making up 2.3 percent of the rental housing stock at the end of the period. By 2003, LIHTC units accounted for 3.5 percent of rental units in the U.S. Meanwhile, the number of public housing units has declined from a peak of 2.4 million in 1995 to 1.8 million in 2003, representing 5.3 percent of rental housing units nationwide. The LIHTC expansion compensated for about half of the decline of over 20% in the stock of public housing units between 1993 and 2003. 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.

We find that low income housing developments cause median household incomes within 1 km of the project site to decline by about 5 percent in neighborhoods near the 30^{th} percentile of the income distribution. In addition, we show that owner turnover rates are higher near new LIHTC projects. These effects decay approximately monotonically with distance. Finally, we provide evidence that developers differentially select gentrifying neighborhoods as locations for their developments. Failure to account for this selection can lead to faulty conclusions about the impact of these developments on local housing values.

Isolating causal effects of LIHTC developments requires exogenous variation in the allocation of developments across space. To achieve pseudo-random assignment in the location of developments, we exploit a discontinuity in the size of the tax credit and the probability that proposed developments receive the credit based on characteristics of the census tracts in which projects are proposed. Because these characteristics are measured using data from the 1990 census, the tracts falling on either side of the cutoff above which extra incentives are provided for LIHTC developments were not identifiable prior to 1990. Using a regression discontinuity design, we demonstrate a significant response in subsidized housing supply as a result of tax credits. Estimates indicate that the 30 percent increase in the tax credit is associated with an increase of 6 low income housing units on a base of 9 units per tract.

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, it only allows us to make statements about the impact of low income housing developments for areas that are fairly poor, though not extremely poor. A model presented below demonstrates that the incentives of developers to build low income versus market rate housing may differ markedly by local economic conditions. Data presented below indicate that poorer tracts receive more low income units on average than richer tracts, and only part of this pattern is explained by higher tax incentives to develop in lower income tracts.

This paper builds on a body of research assessing the impact of subsidized housing on neighborhoods. Schwartz et al. (forthcoming) examine the impact of housing developments in New York City. Using detailed repeat sales data to measure housing values, they find that while low income housing developments are located in relatively depressed neighborhoods, they have large positive effects on local housing values. Furthermore, they find larger effects for more depressed neighborhoods. Green et al. (2002) present weak evidence that LIHTC projects in Milwaukee decrease property values but show mixed evidence for other areas.

Cummings & DiPasquale (1999) and McClure (2000) examine the extent to which the LIHTC efficiently finances new housing construction and serves its intended low income population. They find that over time the tax credit dollars that end up funding construction and rehabilitation have increased as state authorities have added cost oversight. Cummings & DiPasquale provide evidence that LIHTC projects that received the higher tax credits are more costly to develop than other similar projects. They also present evidence of increasing returns to scale. Finally, they demonstrate that LIHTC residents are likely sufficiently wealthy to rent unsubsidized apartments in poor neighborhoods. We provide further evidence to this effect.

This paper proceeds as follows. Section 2 describes the LIHTC program. Section 3 proposes a model that provides intuition about the incentives faced by LIHTC developers. Section 4 discusses the data and empirical methodology. Section 5 presents estimates of the impact of the LIHTC program on housing supply. In Section 5, we demonstrate that the discontinuity in the size of the tax credit and in the probability of granting the credit generates a significant response in the number of new low income units constructed for census tracts with otherwise similar attributes. Section 6 evaluates the impacts of subsidized rental units on neighborhood outcomes and argues that responses are likely from the demand side of the housing market. Finally, Section 7 discusses implications for policy and concludes.

2 The LIHTC Program

The LIHTC program was established as part of the Tax Reform Act of 1986 to encourage redevelopment of poor areas with quality rental housing. In every year, Congress allocates to states a fixed amount per resident exclusively for tax credits to low income housing developers to be paid out over the subsequent 10 years.[1] Potential projects must meet one of two criteria to be eligible for the tax credit. Either at

[1] Congress allocated $1.25 per resident all years 1986 to 2001 except 1989 when it allocated $0.93. In 2001, funding was increased to $1.75 per resident.

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.[2] 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, implying that the second criterion represents the preponderance of projects. 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 or federally subsidized projects and 70 percent for new construction or substantial rehabilitation.[3] 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 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. Because of this population restriction, only 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 built between 1994 and

[2]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.

[3]Each year, this amounts to about 4% or 9% of eligible basis tax credit over the course of 10 years.

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.

In each year of the program, all but a few states have allocated all of their available LIHTC money.[4] As such, within the guidelines explained above, the states have some latitude on whether to accept projects proposed by developers into the program. 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, independent of DDA status, as part of the location criteria.[5] In addition, a large fraction of states allocated extra points for development proposals that had fewer units than average. Most states give 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 as a function of the fraction of households eligible to pay reduced rents. Table 2 demonstrates that LIHTC subsidized rental units are more concentrated in poor areas. While only 9 percent of the growth in rental units between 1990 and 2000 in tracts with between 0 and 40 percent of households eligible for reduced rents was LIHTC subsidized, 49 percent of the increase in 51-60 percent eligible tracts was LIHTC subsidized. In the poorest areas, while the aggregate stock of rental units declined by 130 thousand units, the stock of LIHTC units increased by 27 thousand units.

One component of a thorough analysis of the welfare consequences of subsidized

[4] States are allowed to roll over any unused funds for one year.

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

housing units for poor households is to estimate the number of units that would have been built absent the subsidy, also known as “crowd out". Table 2 shows that even in the richest areas, 64 percent of rental apartments in the private market rented at below LIHTC regulated rents in 2000, up from 49 percent in 1990. In the poorest areas, the market rate was below the regulated rent for 85 percent of apartments rented in 2000, up from 80 percent in 1990. Given these rents and the fact that most LIHTC renters have incomes just below the eligibility cutoff of 60 percent of AMGI (Wallace, 1995), it appears likely that significant crowd-out of market provided units exists due to LIHTC units. This suggestive evidence of significant crowd-out is consistent with that reported in Sinai & Waldfogel (2005), who find that project based developments including public housing exhibit about 70 percent crowd-out. We present further evidence in support of almost complete crowd out in Section 6.

Table 3 presents summary statistics about LIHTC developments, demographics and housing characteristics for the same regions as those examined in Table 2. The top part of the table demonstrates a large jump of 7.1 in the average number of LIHTC subsidized units established between 1994 and 1999 across the tax credit discontinuity. More projects partly accounts for this difference, but most of it can be explained by the fact that projects installed in tracts that barely qualify have 26.9 more units on average than projects in tracts just below the discontinuity.

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. We can partially evaluate the validity of this assumption by examining the extent to which observable tract characteristics vary across the threshold. The lower two sections of Table 3 show demographics and housing characteristics in 1990 as a function of neighborhood incomes. The final column of Table 3 shows estimated regression discontinuity (RD) coefficients at the qualified status threshold controlling for county fixed effects with the given observable characteristics as dependent variables. Consistent with the raw data, few observables have large estimated RD coefficients. Most demographic and housing characteristics vary insignificantly across the discontinuity at 50 percent eligibility. Of the variables examined, only population, total housing units, log median household income and the fraction of owner occupied housing units that were detached differ significantly across the qualified threshold and their magnitudes are small. 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 directly handle the smaller initial population and number of housing units in qualified tracts in the estimation methodology developed in Section 4. Table 3 also characterizes the neighborhoods near the QCT eligibility threshold, from which we obtain exogenous variation in LIHTC developments. These neighborhoods have an average poverty rate of 25 percent, are about 30 percent black and 60 percent high school graduate. Rents are about $395 per month as measured in 1990 dollars.

3 The LIHTC Development Decision

In this section, we model the decision to develop LIHTC projects faced by a profit maximizing developer. The key endogenous elements of the model are LIHTC project location and size. The model generates a positive supply response to the tax credit. In addition, it provides a framework for analyzing the potential endogenous selection of LIHTC developments to areas with higher expected future housing values. Following presentation of the model, we demonstrate that as predicted by the model, the amount of LIHTC development empirically depends on prevailing local housing market characteristics.

3.1 The Model

We consider a two-period model. In the first period, LIHTC units rent for the minimum of market rent r_1 and LIHTC regulated rent. In the second period, the expected discounted rent net of maintenance cost for all units is r_2. The marginal cost of constructing or rehabilitating each unit is c, which is potentially reduced by the tax credit of t percent. Applications for the tax credit cost K to potential LIHTC developers. Each area has N sites for which developers can either propose low income housing developments or build market rate units.[6] Developers receive a fixed cost draw f from the distribution $G(f)$ for each potential development site. The fixed cost parameter includes land preparation and acquisition costs, which include the opportunity cost of developing market rate units. Therefore, it may vary systematically with r_1. Assuming that f is random captures the idea that potential development sites differ in terrain or the size of existing structures to be demolished or rehabilitated.

The government accepts LIHTC tax credit proposals with some probability $P(q, t)$, where q is the number of units proposed and t is the tax credit that varies with qualified status. State qualified action plans indicate that smaller projects and projects located in qualified tracts are preferred. As such, we assume that $P_q < 0$ and $P_t > 0$. Based on the observation that over 95% of total units constructed in LIHTC subsidized projects are low income, we allow accepted projects to include no market rate units.

In areas where LIHTC regulated rents are at or above market rents, a potential developer's expected profit function at each site is given by

$$\Pi(q, t) = P(q, t)[q(r_1 - c(1 - t) + r_2) - f] - K. \tag{1}$$

The developer's first-order condition is

$$P_q[q(r_1 - c(1 - t) + r_2) - f] + P[r_1 - c(1 - t) + r_2] = 0. \tag{2}$$

The probability a project proves profitable is therefore

$$\pi(q, t) = G\left(q(r_1 - c(1 - t) + r_2) - \frac{K}{P}\right). \tag{3}$$

Because the support of G is over higher values of f in higher rent areas, the probability any potential development site in these areas proves profitable for LIHTC development may be very low. This prediction is roughly consistent with data in

[6] In the empirical work below, we treat either census tracts or census blocks as having N available development sites.

Table 3 showing that the prevalence of LIHTC developments is low in rich neighborhoods.[7]

We now characterize how the developer's choice of project size, the probability of investment, and the total number of observed installed units in a location respond to qualified status through the tax credit. While in reality qualified tracts receive a 30 percent higher tax credit, we model the move from unqualified to qualified as a marginal change in order analyze the relevant incentives with a minimum of notational cost. The analytical results presented below can be derived using a similar logic in the discrete case.

Not surprisingly, the number of units per project likely responds positively to small changes in the tax credit. Using the implicit function theorem on (2), we see that

$$\frac{\partial q^*}{\partial t} = -\frac{P_{qt}[q^*(r_1 - c(1-t) + r_2) - f] + P_q c q^* + P_t(r_1 - c(1-t) + r_2) + Pc}{P_{qq}[q^*(r_1 - c(1-t) + r_2) - f] + 2P_q[r_1 - c(1-t) + r_2]} \tag{4}$$

which is positive if the magnitude of P_q is sufficiently small and $P_{qt} \geq 0$. Developers face a trade-off in their choice of q, since increasing the number of units increases profits conditional on acceptance yet reduces the likelihood of proposal acceptance. The terms in the numerator capture how the tax credit alters this trade-off, as increasing the tax credit increases the profit per unit and reduces the adverse effects of size if $P_{qt} \geq 0$. In the extreme case, if the base number of units and marginal cost are large, it may be optimal to reduce the number of units proposed.

The marginal effect of the tax credit on the probability a project is proposed is

$$\frac{d\pi}{dt} = g(\cdot)\left[q^* c + \frac{K}{P^2} P_t\right] > 0. \tag{5}$$

The investment response combines two effects. First, higher tax credits indicate a higher per unit profit, increasing the probability that a project's expected profit clears the fixed cost hurdle. Second, the probability of project acceptance rises, and

[7] Locally funded incentives and legal restrictions such as inclusionary zoning ordinances likely generate the small number of LIHTC developments in high rent census tracts.

the importance of this depends on the size of the application cost.[8] In places with no preferences for projects located in qualified tracts, the second term in brackets disappears. By utilizing data on applications, we will examine the probability that projects are proposed as a function of the tax credit, as expressed in (5).

The actual number of installed projects is given by $I = NP(q,t)\pi(q,t)$. The response of I to the tax credit depends on the probability of a project being proposed and the probability it is chosen given that an application was submitted:

$$\frac{\partial I}{\partial t} = P_t NG(\cdot) + PN\frac{\partial G(\cdot)}{\partial t} > 0. \tag{6}$$

Given that units per project q^* is increasing in the tax credit, we see that the total number of low income units should also be greater in qualified tracts.

The model indicates that we should see a positive response of applications, installed projects, and installed units to the tax credit. A final important implication of the model is that the location of LIHTC developments is endogenous to expected future rent r_2. Conditional on the tax credit, LIHTC developments are more likely to be established in areas with higher expected future rents. That is,

$$\frac{\partial I}{\partial r_2} = P_q NG(\cdot)\frac{\partial q^*}{\partial r_2} + PN\frac{\partial G(\cdot)}{\partial r_2} > 0 \tag{7}$$

As seen in (7), assessing the effects of low income housing developments on housing values requires accounting for the selection of developments into areas with higher expected future rents. It is straightforward to see that this nonrandom selection occurs to a greater extent in qualified tracts than in other areas. That is, the marginally treated area is likely to be further down the distribution of expected future rents than the marginal non-treated area. The next major section describes how the regression discontinuity estimator that we employ purges our estimates of this selection bias.

[8] The Envelope Theorem ensures that the term capturing the endogenous response of q is 0.

3.2 Further Empirical Observations

Table 4 provides information on the importance of LIHTC units in local housing markets. We split the data by DDA status and by whether the state gives preference for projects in qualified areas. LIHTC units represent a less important part of the housing stock in DDAs relative to other areas. In particular, while LIHTC units represent 16 percent of the rental housing built between 1990 and 2000 in 40 to 50 percent eligibility tracts outside of DDAs, they represent only 10 percent in DDAs. Across the qualified threshold, LIHTC units represent 29 percent of new rental housing outside of DDAs relative to just 15 percent inside DDAs. This gap is not surprising given that the available tax credit is the same for both groups in this subsample whereas DDAs have higher construction costs and a higher opportunity cost of developing low income units, as measured by fair market rents. In addition, Table 4 documents that LIHTC units form a particularly important part of the housing stock in low income areas, representing 27 percent of new rental units. Near the policy threshold, LIHTC construction accounts for 13 percent of new rental units in areas with 40-50 percent of households income eligible and 24 percent of new rental units in areas between 50 and 60 percent income eligible.

One potential benefit of LIHTC units relative to market provided units is quality. Indeed, in most states LIHTC applications receive extra points if the proposed units are large enough to house families. Table 5 demonstrates that this quality difference, as measured by the number of bedrooms, is quite large. Panel A shows the distribution of bedrooms in LIHTC units while Panels B and C present analogous statistics for rental units in census tract and micro data respectively. The distribution of bedrooms in LIHTC units closely resembles that observed in the broader market. The modal LIHTC unit, representing 43 percent of the total, has two bedrooms. This is close to the 40 percent of units in the market with two bedrooms. Similarly, 29 percent of LIHTC units have one bedroom compared with 32 percent of units in the census. Average market rental unit sizes increases monotonically with area income. However, LIHTC units are of similar size regardless of tract income. If the number of bedrooms is an indicator of quality, this suggests that while the LIHTC program is meant to target lower income households, LIHTC housing may in fact be preferable to surrounding units in the same neighborhood. In addition to showing that LIHTC units are on average of higher quality than market units, Table 5 also shows that LIHTC unit size increases across the qualified threshold. We conjecture that this is likely to be a strategic response by developers to increase the probability of project acceptance.

4 Empirical Approach

The primary objective of this paper is to estimate the change between 1990 and 2000 in various outcomes y that have occurred in response to the treatment of low-income projects or units x installed nearby. We first consider how to estimate parameters of interest using tract level data. We then generalize our methodology to allow for estimation of the distribution of causal effects as a function of distance using data that is geographically disaggregated beyond the tract level. The final part of this section discusses how we construct the data.

4.1 Basic Empirical Model

We endeavor to estimate the parameter β_1 in the equation

$$\Delta y_k = \beta_0 + \beta_1 x_k + \delta' Z_k + \varepsilon_k \tag{8}$$

where k indexes some unit of geography and Z_k is a vector of initial characteristics that may influence the outcome. As argued in the previous section, estimating the specification described by (8) using OLS regression does not generally yield consistent estimates of β_1 since the error term ε_k is unlikely to be orthogonal to the treatment x_k. 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 characteristic that also influences the change in the outcome Δy_k. Developers and state housing authorities likely form expectations regarding changes in a host of neighborhood characteristics like future rents and demographics that cannot be predicted with variables in Z when proposing and selecting projects.

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.[9]

This eligibility cutoff generates a discontinuity in the likelihood that projects located in a tract receive additional tax credits. We will 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 at the census tract level is

$$x_i = \gamma_0 + \gamma_1 D_i + f(e_i) + G' Z_i + u_i \tag{9}$$

where the running variable e_i represents the fraction of households meeting the income requirement and i indexes census tracts. $D_i = 1$ if $e_i \geq 0.5$ and 0 otherwise. The control function, $f(e_i)$, of the running variable is a cubic polynomial excluding constant terms where the cutoff is subtracted from e_i and the polynomial coefficients are allowed to differ below and above the cutoff. The covariates captured in the vector Z should be orthogonal to the treatment variable D_i conditional on e_i, and are included as a robustness check and to improve precision. Commensurate with the discussion of Table 3 above, we always include county fixed effects as part of Z. We remain agnostic about appropriate additional controls. As such, below we present results using several different sets of control variables.

The reduced form relationship between the change in the tract-level outcome Δy_i

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

and the eligibility for extra tax credits is given by

$$\Delta y_i = \alpha_0 + \alpha_1 D_i + f(e_i) + AZ_i + \eta_i. \tag{10}$$

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.

4.2 Generalizing The Geography

Evaluating the effects of LIHTC developments at the census tract level presents several 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 that is akin to a measurement error problem. Incorporating information from surrounding tracts may also improve efficiency by incorporating all useful identifying information. Data on many outcomes including housing values are available for block groups, a more disaggregated level of geography than census tracts. Using this more disaggregated data allows us to more precisely measure how the treatment changes as a function of distance.

To handle these extensions, we assume that the process generating the treatment occurs at the census block level while the effects of the treatment occur as functions of distance to block group centroids. We have data on outcomes at the block group level and we observe the exact locations of LIHTC projects. Define r to index rings of width 0.5 km that are centered at each block group centroid. We aim to estimate the vector of equations given by (11).

$$\Delta y_g = \beta_0 + \beta_{1r} x_{gr} + \delta' Z_g + \varepsilon_{gr} \tag{11}$$

where g indexes block group and x_{gr} gives the number of units or projects in rings r about the centroid of block group g. As with (8), equation (11) may be misspecified due to unobserved variables correlated with x_{gr} that influence Δy_g. To obtain exogenous variation in the number of projects in a ring, we use the tax credit rules by summing (9) across tracts i within ring r to create the number of units or projects in each ring.

$$x_{gr} = \sum_{i(gr)} B_{igr}(\gamma_0 + \gamma_1 D_i + f(e_i) + G' Z_i + u_i) \tag{12}$$

where B_{igr} is the number of census blocks in ring r around block group g that are in tract i. This formulation implies that we can use $\sum_{i(gr)} B_{igr} D_i$ as an instrumental variable for x_{gr} when estimating the following equation.

$$\Delta y_g = \psi_0 + \psi_{1r} x_{gr} + \sum_{i(gr)} [B_{igr}(\delta_0 + f(e_i) + Q' Z_i] \ + \widetilde{\delta}' Z_g + \widetilde{\varepsilon}_g \tag{13}$$

Assuming the empirical model in (9) 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 $\widetilde{\varepsilon}_g$.

The strategy outlined above allows for identification of the parameter of interest ψ_{1r} 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 and allows for identification of a more diverse set of treatment effects.

4.3 Data

The Department of Housing and Urban Development makes available data on LIHTC projects placed in service from 1987 through 2003. These data provide information regarding specific project location including the geocoded project street address, census tract, and metropolitan statistical area. In addition, these data report information regarding the size of projects through the number of units and the number of units reserved for those individuals qualifying for reduced rent. For a majority of projects, the distribution of unit size by number of bedrooms is also provided. Other project level characteristics include the type of construction (new versus rehab), and whether the project qualified for extra tax credits through an increase in the eligible basis.

In all, the data provide information on 24,504 projects. Unfortunately, missing data is a significant difficulty. Information on project location is missing for 9.5 percent of projects, the number of units is missing for 4.9 percent of these projects, tract qualified status is missing for 9.7 percent of observations, 13.5 percent are missing DDA status, and 37.3 percent are missing data on the number of bedrooms. Assuming that missing information on location does not differ across the 50 percent eligibility cutoff, missing data problems, while regrettable, do not adversely affect our empirical strategy.

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.[10] Since the outcome variables we will examine are partly built using 2000 census data, 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 LIHTC projects with census tract and block group level data from 1990 and 2000 normalized to 1990 geography. These data provide information on demographic characteristics, housing values, and characteristics of the housing stock. We observe relevant variables such as the number of renter and owner occupied units, median rents, and the local vacancy rate. We use similar data from the 1980 census normalized to 1990 tract geography to examine the relationship between the number of projects and neighborhood growth and decline. Normalizations are done using population allocation factors derived from census block geography reported by the Census Bureau. The sample used for all regressions only include 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 and 27 percent of

[10] Information on the universe of LIHTC projects is available only after 1994.

the 166,443 block groups for which we have data. In addition, we exclude from the sample 14,638 block groups that are greater than 4π in area.

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 states host a large number of LIHTC projects, make applications data readily available, and contain states both with and without preferences based on QCT status. 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. As is consistent with the evidence presented above, the poorer region at the lower left to the West of the Loop received considerably more LIHTC projects than other areas. Outside the West side, there are two distinct pockets of poor tracts. The tracts including the Cabrini Green housing project include a cluster of projects as does the Uptown neighborhood in the upper part of the map. Census tracts just above the qualified threshold (shaded light blue) are noticeably more likely to receive projects than other areas. This phenomenon is particularly noticeable in Uptown. Wealthy areas only have a few scattered projects. Figure 1 also indicates the extent to which the use of block groups rather than census tracts improves the spatial density of the data.

5 Housing Supply Results

5.1 Tract Level Estimates

Table 6 presents a variety of tract level "first stage" estimates of the impacts of the 30 percent additional tax credit on various measures of LIHTC housing supply. Each element of Table 6 is an estimate of γ_1 under different specifications of (9). Panel A shows estimated impacts of the additional tax credit on number of 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 the cubic control function as explanatory variables. Conditional on this control function, there are 6 more units per tract estimated to be caused by the tax credit. This amounts to a 2 percent increase in the housing stock. 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 precisely estimated. Figure 2 plots predicted values of the cubic control functions and average values of outcome variables within percentile bins against the fraction of eligible households. Graphs in Figure 2 exhibit noticeable discontinuities at the QCT eligibility threshold.[11]

Specifications shown in columns 2-4 of Table 6 show additional analogous estimates of γ_1 when more controls are included in the regression. The controls are county fixed effects, distance to MSA central business districts, demographic characteristics of the tract including racial composition, education, median family income, poverty rate, and population density, and 1990 tract housing characteristics including unit vacancy rate, rental share of units, log of total units, average building age, average number of bedrooms, and the fraction of units comprised of detached houses, attached units, and mobile homes. If the control function is adequately accounting for the association between supply and the fraction of eligible households, we would

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

expect that adding further controls would have little impact on the estimated discontinuity in supply at the 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 supply discontinuity. 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.

Table A1 displays results of estimated regression discontinuity coefficients for placebo QCT eligibility thresholds. We show estimates of the supply specifications with the full set of controls at eligibility thresholds of 0.3, 0.4, 0.6, 0.7 and for comparison purposes the true value of 0.5. With only a few exceptions, the estimated discontinuity at the placebo thresholds are statistically insignificant and closer to zero than the estimates using the true eligibility threshold.

Table 6 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 normalized new units 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 area fixed effects, or demographics and housing characteristics. Finally, the discontinuity in units per project is slightly larger for new projects, however it is still statistically insignificant.

In Panel C, we report similar estimates for rehabilitation projects. With the exception of units per project, these estimates merely represent the difference between the results displayed in Panels A and B. The estimated discontinuity at the QCT threshold is statistically insignificant for each measure of the supply of rehab projects. In the full specification, tracts just above the threshold receive 2 extra rehab units, 0.003 more normalized rehab units, and 0.01 additional rehab projects on average. These results indicate that approximately one quarter of the supply effect of the QCT designation is through rehabilitations. Finally, rehab projects in tracts meeting the QCT requirement are larger by 11 units per project, however as with new construction this estimate is not statistically significant.

5.2 Evidence from Applications Data

The additional projects and units observed in QCTs can either be due to developers proposing more projects or to states accepting projects with a higher probability. In this subsection, we investigate the potential importance of these two mechanisms by estimating the effect of QCT designation 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 units to higher anticipated tax credits. Similarly, we can evaluate the importance of the state's preference for projects located in QCTs by examining the change in the acceptance rate of projects as a result of QCT status.

In 2003 the QCT criterion was expanded to allow tracts with a poverty rate exceeding 25 percent to be considered a QCT. The applications data are from 2004 and 2005, so we use the additional information provided by the tract poverty rate when estimating the effect of QCT status on applications. Rather than estimating the discontinuity at the 0.5 income eligibility cutoff, we instead include control functions for both eligible fraction and poverty rate and instrument for QCT status using indicator variables for whether tracts meet the income and poverty rate requirements. The reported estimates are IV coefficients that summarize the effect of QCT status on application decisions.

Table 7 Panel A displays estimated pure supply responses using applications data from California, Texas and New Jersey in 2004 and 2005. As with the number of installed units, we observe a significant supply 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 changes the coefficient only slightly to 18. We also find a significant effect for the number of proposed LIHTC units as a fraction of 1990 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 7 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 6 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 supply we documented in Table 6 is at least in part due to a greater developer willingness to locate projects in qualified tracts. Evidence in Table 7 also shows that only about one-quarter of the additional proposals above the threshold are actually accepted, implying that developers may be reaping large profits from LIHTC developments.

5.3 Ring Level First Stage Results

As discussed in Section 4.2, we examine the effects of LIHTC projects using data on outcomes at the block group level. Table 8 presents first stage estimates of γ_1 from Equation (12). Each entry is from a separate regression and can be interpreted as the additional number of projects or units built per census block as a result of the additional 30 percent tax credit. We impose a radius of 1 km on the inner ring rather than 0.5 km in order to provide sufficient variation to produce tightly estimated parameters. Standard errors are clustered at the metropolitan area level. This level of clustering allows for a more general covariance structure of the error term than would be implied assuming error covariances decay monotonically with

Euclidean distance. Therefore, standard errors are overstated. Nevertheless, it should be noted that beyond 2.5 km clustered standard errors imply a weak first stage.

Specification (1) of Table 8 displays the estimated coefficients for each distance ring, controlling only for the eligible household control function, county fixed effects, and the number of census blocks in the ring interacted with county fixed effects. The estimated effect of tax credits on the number of projects per block varies between 0.005 and 0.016, depending on the ring distance. Column (4) shows analogous estimates including a full array of controls. These estimates are similar at between 0.004 and 0.013 additional projects per block because of qualified status. The right half of Table 8 shows similar estimates for the number of installed units. The estimates displayed in Column (7) show that the higher number of projects corresponds to between 0.36 and 0.47 additional units per block in response to the greater tax credit. Again, these estimates change only slightly when the full set of controls are included, as shown in Column (10).

We also report first stage estimates for the samples of tracts in gentrifying and declining neighborhoods. We define gentrifying areas as those block groups experiencing an increase in real housing values between 1980 and 1990. Each subsample represents roughly half of the full sample. In every ring, gentrifying areas received more projects and units as a result of the extra tax credit than did declining areas. This evidence is consistent with the prediction from the model that LIHTC developers prefer locating projects in gentrifying neighborhoods. The results reported in Table 8 Columns (1), (4), (7) and (10) form the first stage for the neighborhood outcome results discussed in the next section.

We have demonstrated in this section that LIHTC housing supply responds significantly across the tax credit discontinuity. Unfortunately, the results presented in Tables 6-8 do not provide much information on the nature of the LIHTC developers' cost function. The reason is that both the size of the tax credit and the probability of proposal acceptance change across the qualified status discontinuity. Because we do not observe application data from the relevant period, we cannot distinguish between these forces. Instead, we focus on using the exogenous variation provided by the qualified status discontinuity to study the effects of low income housing developments on their surrounding neighborhoods. This is the goal of 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 have a significantly negative impact on neighborhood incomes and increase turnover of owner-occupied households. Based on evidence that the quantity of owner occupied units changed little or fell in response to new LIHTC units nearby, we interpret our estimates as capturing shifts in the demand for living in neighborhoods with new 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 valuation of a local amenity developed by Rosen (1974) is to estimate the response in house values to exogenous shocks in the amenity. We focus primarily on median incomes and owner churn rates as measures of neighborhood trajectory because they are available at the block group level of aggregation and provide tighter estimates than are available using housing values. In a similar paper, Chay and Greenstone (2005) apply Rosen's 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 Neighborhood Outcomes

Table 9 reports regression discontinuity IV estimates of ψ_1 in Equation (13) for two outcomes of interest. Table 9 Panel A shows negative responses of block group log median household income to nearby low income developments. By our estimates, each new development causes about a 5 percent decline in median household income within 1 km. The magnitude of this decline falls with distance to new projects such that beyond 2.5 km we find effects of less than 0.02 in absolute value. 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 1,000 units, tenant incomes would have to be drastically lower than neighborhood incomes to generate the estimated declines in neighborhood income. Furthermore, projects built 1 to 1.5 km away show similar effects on median incomes as projects built in the inner ring, where the block groups associated with the data on outcomes are located. We therefore interpret these income changes as primarily reflecting changes in the composition of non-LIHTC renters and owners.

Table 9 Panel B reports estimated effects of LIHTC developments on the fraction of owners who moved between 1990 and 2000 in each block group. Point estimates for inner distance rings are consistently positive at 3.4 percentage points per project within 1 km, 6.7 percentage points per project between 1 and 1.5 km and 2.9 percentage points per project between 1.5 and 2 km. All of these estimates are statistically significant with controls and are stable across specifications. The average fraction of owners moving between 1990 and 2000 in census tracts with between 40 and 60 percent eligible households is 0.45. Estimates for rings beyond 2 km are not statistically different from 0. This marked increased churn rate of due to LIHTC projects is consistent with LIHTC projects inducing a downward shift in neighborhood desirability. A similar exercise reveals that the impact of LIHTC projects on the fraction of renters moving between 1990 and 2000 is not statistically significant for any distance ring.[12]

Understanding the selection process used by developers for site location is crucial to the interpretation of our results. Evidence from the model and the first stage results reported in Table 8 provides support for the claim that LIHTC developers endeavor to locate in gentrifying areas. As such, a key potential threat to identification of the impact of low income housing developments on any neighborhood outcome is the selection of developments into gentrifying neighborhoods. Such a se-

[12] The census does not separately tabulate incomes by housing tenure to the block group level.

lection process would generate a positive correlation between LIHTC developments and housing values that is not causal.

Table 10 examines the impact of LIHTC projects and units on reported values of owner-occupied single family homes at various distances from new LIHTC developments. We use single family homes because this is the housing value measure that is reported consistently over time by the Census Bureau. Panel A reports coefficients from OLS regressions of the change in block group log median housing values on the number of LIHTC projects or units built within the listed distance rings. These results consistently indicate a positive equilibrium relationship between gentrification and the location of LIHTC developments regardless of specification or distance ring. These estimates exhibit one particularly curious feature that calls into question their validity. Their magnitudes, while small, hardly attenuate with distance. This may reflect the fact that the location of gentrifying census block groups is spatially correlated and some of the determinants of gentrification are unobserved.

Table 10 Panel B reports IV estimates for the effects on housing values. These results show that accounting for selection reverses the sign of the estimated coefficient for the inner distance ring. Depending on the array of control variables included, each LIHTC project within 1 km is estimated to cause a decline in housing values of about 2 percent. Like the other outcomes examined, estimated effects die out beyond 2 km away from block group centroids. While point estimates for housing values are consistent with LIHTC developments being negatively valued by neighborhoods, they are not statistically significantly different from 0.

Tables 8-10 report the impacts of LIHTC projects that are new construction or rehabilitation. Because a sizable fraction of rehabilitations were of public housing units, one might expect to find larger effects from new newly constructed projects only. We choose not to emphasize these results because both types of projects vary across the same qualified status discontinuity. Therefore, we cannot isolate exogenous variation in the two types of projects separately. Nevertheless, evidence in Table 6 indicates that the significant response of the higher tax credits comes in the form of new construction. Therefore, it may not be unreasonable to estimate Equation (13) using new construction projects only. Doing so produces empirical results that are two to four times larger in magnitude than the results reported in Tables 9 and 10, with similar levels of statistical significance.

6.2 Accounting For Potential Housing Supply Responses

In order for the tax credit to induce a truly exogenous shift in the public goods provision in neighborhoods, LIHTC developments must not influence the aggregate supply of owner-occupied housing in the relevant market. In other words, in Tables 9 and 10 we hope to capture shifts in demand for housing holding supply fixed. If new low income units cause a shift in the supply of market rate housing, our estimates would at least partly reflect movements along the housing demand function. Similarly, if they cause a shift in the composition of the quality of market rate owner-occupied housing, then our estimate would be partly picking up this shift rather than local valuation of the change in the local public good. This is one reason to examine characteristics of owners and the value of owner-occupied units.[13] If the markets for rental units and owner-occupied units are separate or sufficiently spatially integrated, there should be little supply response in the owner-occupied market to shifts in the supply of rental units.

Using Sinai & Waldfogel's (2005) methodology, we evaluate the potential existence of local supply responses to the installation of low income units nearby. We estimate Equation (13) using the change between 1990 and 2000 in owner occupied units, renter occupied units and total housing units as dependent variables respectively within various rings as dependent variables. Total housing units is the sum of the other two measures plus vacant units. The housing supply results are reported in Table 11.

We find that within 1 km, renter occupied and total housing units increase by 0.23 and 0.16 respectively for every LIHTC unit built, with no significant response in the number of owner occupied units. This magnitude is consistent with about half of LIHTC units being new construction and no owner occupied housing supply

[13] Indeed, based on the evidence in Table 5 on quality it would be a bad idea to try to infer valuation based on rents.

response to LIHTC developments. This supply responses in the rental and total housing markets fall monotonically as the distance ring is expanded outwards such that by 3 km out the net impact of new LIHTC units in the neighborhood is not significantly different from 0. If anything, the very local impact on the quantity of owner occupied units is negative. Given this evidence, we can interpret the housing values estimates as a lower bound on neighborhoods' valuation of low income projects.

7 Conclusions

This paper demonstrates that low income housing developments have an impact on the neighborhoods in which they are located. This impact decays spatially and reaches as far as 3 km away. There exists a significant response in the number of low income units and projects developed in areas that provide additional tax credits for their development. The discontinuity at 50 percent eligibility of households for reduced rents generates exogenous variation in the tax credit across similar census tracts. We use this exogenous assignment across space in the location of low income developments to identify spatial impulse-response functions showing that LIHTC developments depress local median household income and increase turnover in owner occupied housing units within 3 km of these projects. Further, point estimates indicate that LIHTC projects depress neighborhood median housing values in census block groups near the qualified status discontinuity. We show the importance of using the discontinuity in the size of the tax credit as a function of tract incomes to correct for the selection of LIHTC developments into gentrifying areas.

Our estimates are useful in evaluating the efficacy of the LIHTC program. One key component of such an evaluation is a better understanding of the supply function of low income housing, and how this interacts with market supply both in the quality and quantity dimensions. While we find that LIHTC units are of higher quality, as measured by the number of bedrooms, than the average unit housing their target population, we do not find that LIHTC developments have a significant effect on the age of the rental housing stock in their neighborhoods. As demonstrated by Dunn et al. (2005) for California, LIHTC projects may cost significantly more to build because of state government regulation. They estimate that California regulation requiring developers receiving the tax credit to pay the state-regulated prevailing wage increases project costs by approximately 20 percent.

This paper also contributes to the literature on neighborhood dynamics. Results indicate that low income housing and residents are negatively valued by their neighbors. The arrival of a new LIHTC development depresses neighborhood incomes and causes a significant number of houses to change ownership. While these results do not allow us to precisely distinguish the mechanism behind these responses, they indicate that low income developments may be important in impeding gentrification or precipitating decline.

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Figure 1: Chicago Data

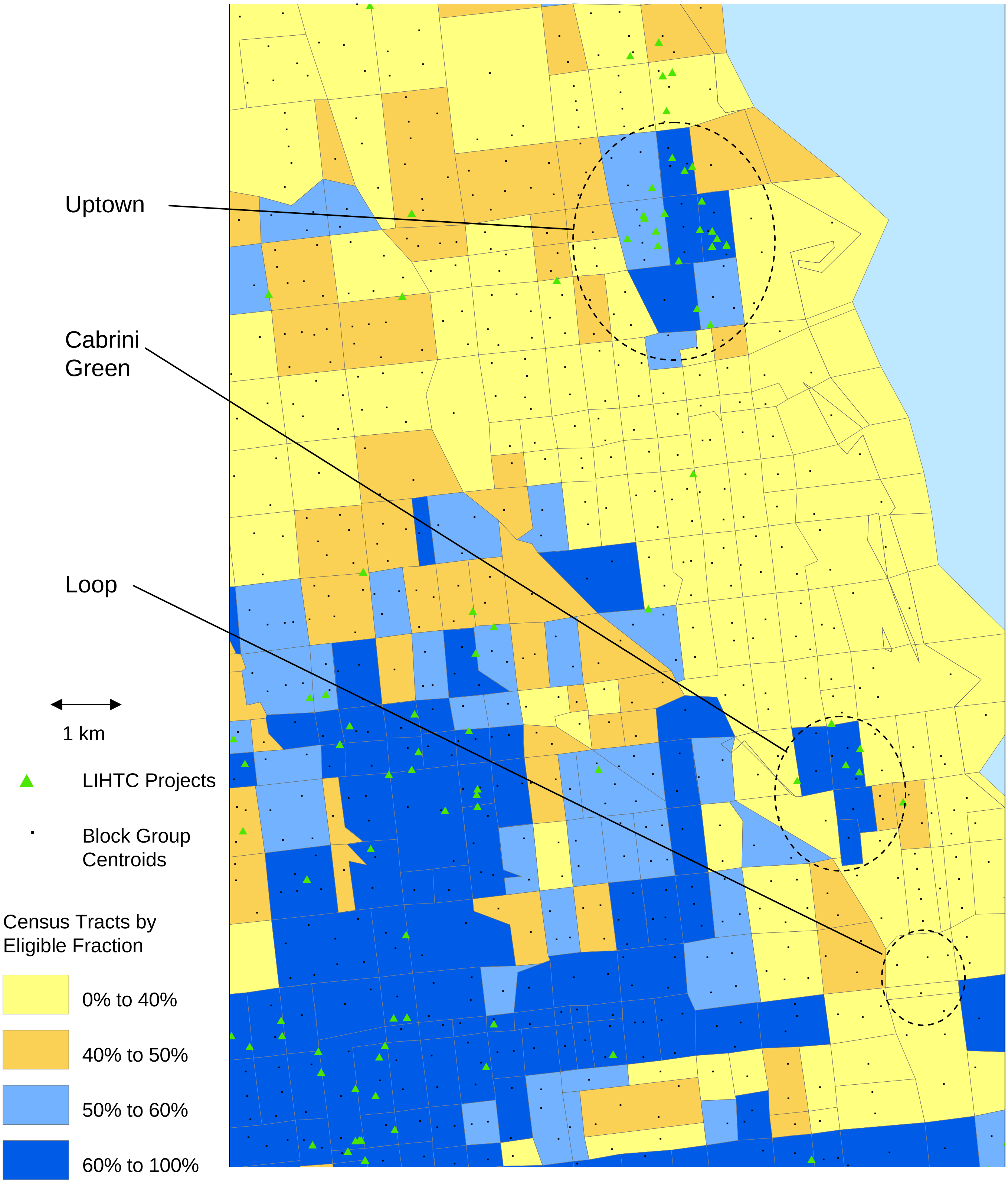

Figure 2: Supply Response at Qualified Census Tract Eligibility Threshold, All Metro Area Tracts

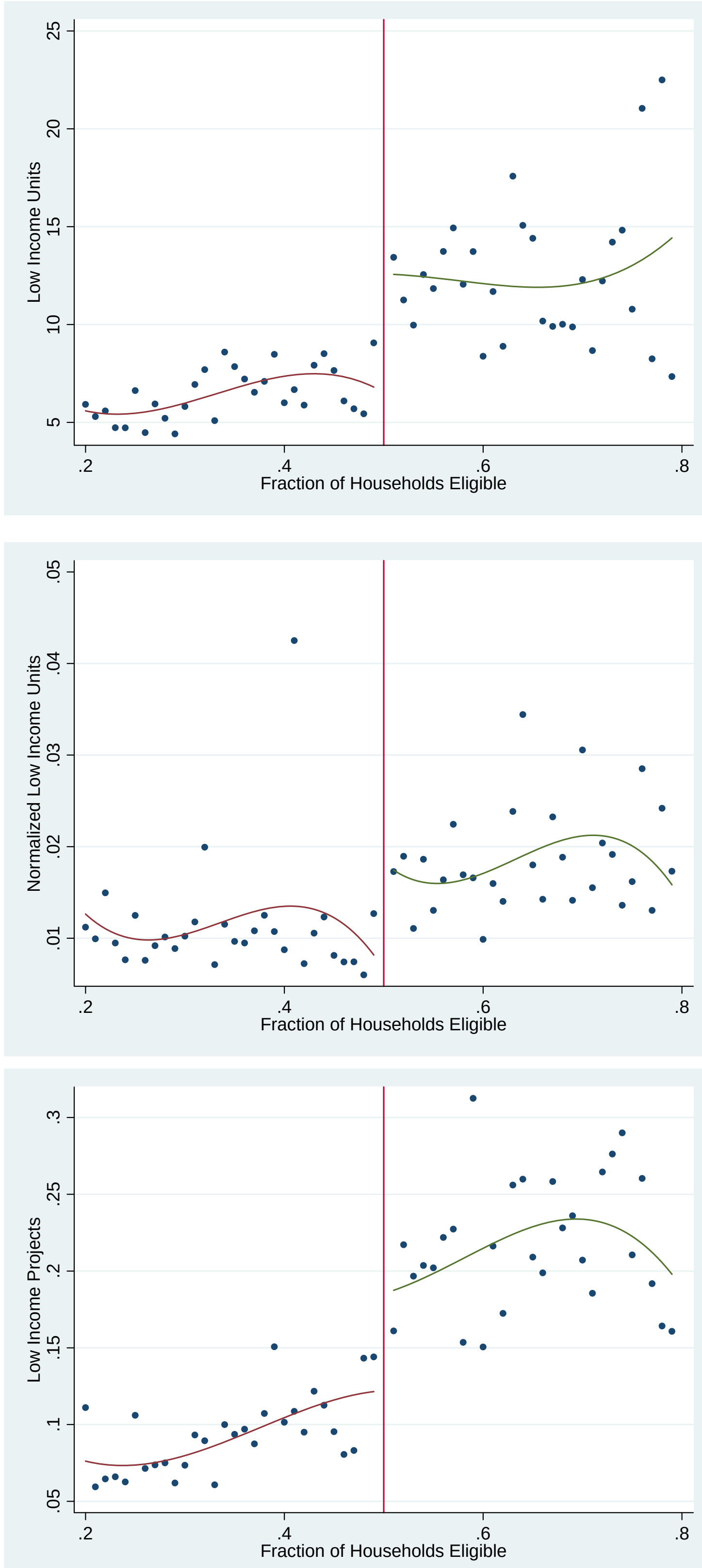

Table 1: Components of the United States Housing Stock 1987-2003
(thousands)

	1993	1995	1997	1999	2001	2003
LIHTC: All Units	318	452	608	792	976	1,170
LIHTC: New Construction Only	144	214	309	425	535	658
Public Housing	2,235	2,434	1,860	1,865	1,861	1,793
Total Subsidized Units	5,331	5,642	6,236	7,065	6,573	6,552
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	0.009	0.013	0.018	0.023	0.029	0.035
Fraction of Rentals Public Housing	0.067	0.071	0.055	0.055	0.055	0.053

Notes: All entries except those regarding the LIHTC use data from the American Housing Survey. The LIHTC numbers assume no projects were taken out of service prior to the listed year.

Table 2: HUD's Involvement in the Housing Market 1990-2000
(all housing numbers in thousands)

	Percent of Households Eligible for Rent Reduction					
	0%-40%	**40%-49%**	**49%-50%**	**50%-51%**	**51%-60%**	**60%-100%**
2000						
New Construction LIHTC Units	210	28	3	3	25	30
Total LIHTC Units	333	75	7	10	65	112
HUD Units in Any Program (1998)[a]	799	323	31	31	287	835
Renter Occupied Housing Units	20,455	3,782	302	298	2,278	2,844
Fraction Renting Below Regulated Level	0.64	0.76	0.78	0.77	0.79	0.85
Owner Occuped Housing Units	47,393	3,698	242	210	1,408	997
1990						
New Construction LIHTC Units	20	4	0	0	1	3
Total LIHTC Units	42	15	1	3	10	27
Renter Occupied Housing Units	18,257	3,608	293	289	2,230	2,974
Fraction Renting Below Regulated Level	0.49	0.66	0.70	0.69	0.71	0.80
Owner Occuped Housing Units	39,023	3,472	233	206	1,391	1,019
Difference						
New Construction LIHTC Units	190	24	3	3	23	27
Renter Occupied Housing Units	2,199	173	9	9	48	-130
Fraction of Rental Growth LIHTC	0.09	0.14	0.30	0.27	0.49	-0.21
Count of 1990 Census Tracts	33,203	4,713	377	357	2,737	3,894

Notes: Sample includes housing units in 1990-definition metropolitan areas only. Numbers are based on authors' calculations using the LIHTC and "A Picture of Subsidized Households" data sets available from HUD in addition to US census tract data.

Table 3: Average Characteristics of Areas by Eligibility Status

	Percent of Households Eligible for Rent Reduction						
	0%-40%	**40%-49%**	**49%-50%**	**50%-51%**	**51%-60%**	**60%-100%**	**RD Coeff**
LIHTC Projects Proposed & Built 1994 to 1999							
Total Units	6.2	7.7	8.8	16.2	13.7	14.1	6.4*
Low Income Units	5.5	7.4	8.6	15.7	12.9	13.1	5.6*
Projects	0.07	0.11	0.15	0.19	0.21	0.23	0.06*
Units Per Project	84.9	68.3	60.1	87.0	66.9	61.1	12.20
1990 Census Demographics							
Population	4,608	4,045	3,849	3,856	3,766	3,044	-252*
Housing Units	1,868	1,677	1,557	1,560	1,483	1,176	-116*
Percent Black	0.08	0.22	0.29	0.30	0.37	0.53	0.01
Percent High School Graduate	0.81	0.65	0.61	0.60	0.57	0.50	-0.01
Poverty Rate	0.08	0.20	0.25	0.26	0.30	0.45	0.00
Median Household Income	38,695	22,754	20,142	19,548	17,729	12,015	57
Log Median Household Income	10.51	10.01	9.89	9.86	9.76	9.33	-0.01*
Renter Tenure < 10 Years	0.50	0.42	0.41	0.40	0.39	0.36	-0.01
Owner Tenure < 10 Years	0.89	0.86	0.85	0.86	0.84	0.81	0.00
1990 Census Housing Characteristics							
Average Age, Owner Occupied	27.81	36.58	37.52	38.26	39.54	41.36	0.31
Average Age, Renter Occupied	26.24	31.83	32.49	32.30	33.42	33.39	-0.35
Avg. # of Units, Owner Occ.	2.17	2.42	2.53	2.33	2.68	3.21	0.09
Avg. # of Units, Renter Occ.	8.37	9.19	8.85	9.49	9.73	13.14	0.60
Fraction Detached, Owner Occ.	0.80	0.69	0.64	0.68	0.65	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	80,232	76,576	69,920	70,084	59,546	-137
Log Median Housing Value	11.53	11.07	10.98	10.94	10.91	10.71	0.01
Median Gross Rent	545	414	397	393	385	323	-3
Log Median Gross Rent	6.25	5.98	5.94	5.93	5.91	5.71	-.010
ΔLog Med. Housing Value 80-90	0.10	0.09	0.09	0.07	0.10	0.09	-0.01

Notes: Each element in the table is the mean of the variable listed at left over the tracts in the relevant income eligibility group. The "RD Coeff" column reports the coefficient on an indicator for greater than 0.5 in an OLS regression of the variable listed at left on a cubic in eligible fraction interacted with the 0.5 cutoff indicator controlling for county fixed effects. 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.

Table 4: Low Income Units and the Quantity of Housing

	Non-DDAs	DDAs	Total
< 40 Percent Eligible Tracts			
LIHTC Low Income Units as a Fraction of . . .	141,768	42,285	184,053
Rental Units in 1990	0.012	0.007	0.010
Rental Units < 10 Years Old in 2000	0.06	0.06	0.06
Total Units < 10 Years Old in 2000	0.01	0.02	0.01
40-50 Percent Eligible Tracts			
LIHTC Low Income Units as a Fraction of . . .	29,018	8,882	37,900
Rental Units in 1990	0.012	0.006	0.010
Rental Units < 10 Years Old in 2000	0.16	0.10	0.13
Total Units < 10 Years Old in 2000	0.06	0.04	0.05
50-60 Percent Eligible Tracts			
LIHTC Low Income Units as a Fraction of . . .	30,859	10,140	40,999
Rental Units in 1990	0.020	0.010	0.016
Rental Units < 10 Years Old in 2000	0.29	0.15	0.24
Total Units < 10 Years Old in 2000	0.16	0.09	0.14
>60 Percent Eligible Tracts			
LIHTC Low Income Units as a Fraction of . . .	34,152	16,727	50,879
Rental Units in 1990	0.018	0.015	0.017
Rental Units < 10 Years Old in 2000	0.31	0.21	0.27
Total Units < 10 Years Old in 2000	0.21	0.16	0.19

Notes: DDA stands for Difficult Development Area. Calculations are based on aggregates in the given group. Numbers in the Total column reflect information in the preceding columns in addition to data from a few metropolitan areas for which DDA status is not available.

Table 5: The Distribution of Bedrooms in LIHTC and Market Units

Percent Eligible	Number of Bedrooms 0	1	2	3	4+	Mean
	Panel A: LIHTC Units Built 1990-2000					
0-40	0.03	0.29	0.45	0.20	0.03	1.90
40-50	0.04	0.33	0.42	0.17	0.04	1.83
50-60	0.07	0.24	0.44	0.20	0.05	1.93
60-100	0.08	0.30	0.35	0.22	0.06	1.89
All	0.04	0.29	0.43	0.20	0.04	1.90
	Panel B: Tract Level Data					
0-40	0.05	0.30	0.42	0.19	0.04	1.89
40-50	0.07	0.34	0.39	0.16	0.03	1.76
50-60	0.09	0.36	0.37	0.16	0.03	1.70
60-100	0.11	0.36	0.34	0.16	0.04	1.66
All	0.06	0.32	0.40	0.18	0.04	1.83
	Panel C: Census Microdata					
0-40	0.02	0.22	0.46	0.25	0.05	2.10
40-50	0.02	0.32	0.46	0.17	0.03	1.85
50-60	0.04	0.37	0.44	0.14	0.02	1.74
60-100	0.06	0.43	0.38	0.12	0.02	1.62
All	0.03	0.34	0.44	0.17	0.03	1.81

Notes: The results for Panel C are calculated by examining the distribution of bedrooms for renting families in the listed income group. Income groups are assigned based on metropolitan area of residence and family composition.

Table 6: 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

Standard errors are calculated from 500 block bootstrap samples drawn using MSA level clusters. Sample includes all census tracts in metropolitan areas excluding Washington, DC. Demographic controls are fraction white, fraction black, fraction hispanic, log median family income, log per capita income, and the poverty rate from 1990. Housing controls are vacancy rate, the fraction of housing units that are rentals, log median value, log rent, 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 and fraction over 50 units.

Table 7: Qualified Census Tract Status and LIHTC Applications

	1	2	3	4
Panel A: Proposed projects				
Number of Proposed LIHTC Low	16.611	16.819	18.023	18.368
Income Units	(6.457)**	(6.476)***	(6.865)***	(6.876)***
Number of Proposed LIHTC Low	0.043	0.044	0.046	0.047
Income Units/2000 Rentals	(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	3.478	3.726	4.052	4.166
Income Units	(3.060)	(3.059)	(3.207)	(3.197)
Number of Accepted LIHTC Low	0.003	0.004	0.003	0.003
Income Units/2000 Rentals	(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 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 addition to the fact that qualified status is granted to tracts with poverty rates of over 25 percent. Therefore, controls include cubic polynomials interacted with being above the qualified thresholds in both eligible fraction and poverty rate plus an indicator for whether the tract qualifies. Additional control variables are the same as those used in Table 6. 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.

Table 8: First Stage Results for Rings - Block Groups

Distance	LIHTC Projects						Number LIHTC Units					
	County FE Only			County FE + Other Controls			County FE Only			County FE + Other Controls		
Ring (km)	All	Gentrifying	Declining	All	Gentrifying	Declining	All	Gentrifying	Declining	All	Gentrifying	Declining
	1	2	3	4	5	6	7	8	9	10	11	12
0 - 1	0.0050	0.0073	0.0015	0.0040	0.0066	0.0014	0.36	0.44	0.16	0.28	0.40	0.15
	(0.0023)	(0.0033)	(0.0013)	(0.0019)	(0.0025)	(0.0013)	(0.09)	(0.13)	(0.07)	(0.08)	(0.11)	(0.07)
1 - 1.5	0.0052	0.0042	0.0015	0.0032	0.0028	0.0014	0.41	0.38	0.15	0.32	0.34	0.15
	(0.0022)	(0.0025)	(0.0023)	(0.0017)	(0.0021)	(0.0021)	(0.12)	(0.13)	(0.10)	(0.09)	(0.12)	(0.10)
1.5 - 2	0.0087	0.0099	0.0007	0.0067	0.0086	0.0007	0.41	0.49	0.12	0.34	0.46	0.12
	(0.0051)	(0.0060)	(0.0022)	(0.0039)	(0.0047)	(0.0022)	(0.16)	(0.21)	(0.09)	(0.13)	(0.18)	(0.09)
2 - 2.5	0.0129	0.0137	0.0008	0.0103	0.0124	0.0008	0.44	0.40	0.15	0.33	0.34	0.14
	(0.0097)	(0.0098)	(0.0015)	(0.0077)	(0.0085)	(0.0015)	(0.26)	(0.28)	(0.08)	(0.20)	(0.25)	(0.08)
2.5 - 3	0.0159	0.0191	0.0011	0.0132	0.0180	0.0011	0.47	0.47	0.19	0.38	0.42	0.18
	(0.0134)	(0.0162)	(0.0017)	(0.0111)	(0.0150)	(0.0017)	(0.31)	(0.38)	(0.10)	(0.25)	(0.35)	(0.10)
3 - 3.5	0.0125	0.0190	0.0000	0.0110	0.0177	0.0000	0.32	0.53	0.07	0.30	0.48	0.08
	(0.0098)	(0.0140)	(0.0016)	(0.0087)	(0.0126)	(0.0016)	(0.19)	(0.30)	(0.09)	(0.17)	(0.27)	(0.09)
3.5 - 4	0.0094	0.0136	0.0009	0.0089	0.0118	0.0011	0.32	0.49	0.15	0.31	0.42	0.15
	(0.0078)	(0.0105)	(0.0013)	(0.0068)	(0.0087)	(0.0012)	(0.15)	(0.24)	(0.09)	(0.13)	(0.20)	(0.09)
Obs.	106,098	48,338	47,341	100,533	47,278	46,619	106,098	48,338	47,341	100,533	47,278	46,619

Notes: Entries list coefficients and standard errors on number of eligible blocks in each listed ring in separate regressions of the number of projects or units on a cubic polynomial in eligibility fraction interacted with eligibility fraction greater than .5, the number of census blocks in the ring and county fixed effects. Standard errors are clustered at the metropolitan area level. All controls from the most complete specifications in Tables 9-11 are included. Coefficients can be interpreted as the additional projects or units built per block as a result of being eligible for the higher tax credit. Obs. refers to the number of observations (block groups) used to estimate regressions in the first row. Regressions in lower rows include more observations because fewer rings are made up only of tracts with 0 households. Only block groups in tracts with between 20 percent and 80 percent of households eligible for reduced rent are included. All block groups of greater than 4π sq. km are excluded.

Table 9: Estimated RD Effects of LIHTC Developments on Neighborhood Outcomes

Panel A: Log Median Household Income

Distance Ring (km)	LIHTC Projects		100s of LIHTC Units	
	1	2	3	4
0 - 1	-0.036	-0.050	-0.054	-0.078
	(0.025)	(0.026)	(0.038)	(0.039)
1 - 1.5	-0.046	-0.040	-0.064	-0.048
	(0.031)	(0.038)	(0.042)	(0.045)
1.5 - 2	-0.027	-0.029	-0.058	-0.058
	(0.017)	(0.017)	(0.037)	(0.035)
2 - 2.5	-0.031	-0.038	-0.087	-0.109
	(0.012)	(0.013)	(0.035)	(0.037)
2.5 - 3	-0.021	-0.018	-0.067	-0.059
	(0.011)	(0.010)	(0.033)	(0.034)
3 - 3.5	-0.005	0.020	-0.018	0.067
	(0.015)	(0.014)	(0.054)	(0.048)
3.5 - 4	-0.059	0.012	-0.165	0.033
	(0.023)	(0.018)	(0.068)	(0.050)

Panel B: Fraction of Owners Moving in Previous 10 Years

Distance Ring (km)	LIHTC Projects		100s of LIHTC Units	
	1	2	3	4
0 - 1	0.018	0.034	0.028	0.054
	(0.014)	(0.015)	(0.021)	(0.023)
1 - 1.5	0.041	0.067	0.056	0.082
	(0.019)	(0.025)	(0.024)	(0.027)
1.5 - 2	0.031	0.029	0.067	0.058
	(0.010)	(0.011)	(0.023)	(0.021)
2 - 2.5	0.006	0.007	0.016	0.018
	(0.007)	(0.008)	(0.020)	(0.021)
2.5 - 3	0.003	0.005	0.011	0.015
	(0.006)	(0.006)	(0.019)	(0.019)
3 - 3.5	-0.010	-0.004	-0.036	-0.015
	(0.008)	(0.008)	(0.029)	(0.027)
3.5 - 4	-0.040	-0.028	-0.107	-0.075
	(0.013)	(0.011)	(0.036)	(0.030)
Included Controls:				
Demographics	No	Yes	No	Yes
Housing	No	Yes	No	Yes
County FE	Yes	Yes	Yes	Yes

Notes: Entries list coefficients and standard errors on the number of projects or 100s of units in each listed ring in separate regressions of change in log median household income or owner turnover on the controls listed at the bottom of the table. The aggregate cubic polynomial interacted with census fixed effects always enters as a series of control variables. Included controls are the same as those used for Table 8.

Table 10: Estimated Effects of LIHTC Developments on Housing Valuse 1990-2000

Panel A: OLS Results

Distance Ring (km)	LIHTC Projects		100s of LIHTC Units	
	1	2	3	4
0 - 1	0.012	0.010	0.029	0.024
	(0.001)	(0.001)	(0.002)	(0.002)
1 - 1.5	0.012	0.009	0.020	0.013
	(0.001)	(0.001)	(0.002)	(0.002)
1.5 - 2	0.012	0.010	0.022	0.014
	(0.001)	(0.001)	(0.002)	(0.002)
2 - 2.5	0.012	0.010	0.022	0.015
	(0.001)	(0.001)	(0.002)	(0.002)
2.5 - 3	0.010	0.007	0.019	0.012
	(0.001)	(0.001)	(0.002)	(0.002)
3 - 3.5	0.009	0.007	0.019	0.012
	(0.001)	(0.001)	(0.002)	(0.002)
3.5 - 4	0.007	0.005	0.015	0.009
	(0.001)	(0.001)	(0.001)	(0.001)

Panel B: RD Results

Distance Ring (km)	LIHTC Projects		100s of LIHTC Units	
	1	2	3	4
0 - 1	-0.034	-0.026	-0.038	-0.049
	(0.033)	(0.036)	(0.052)	(0.048)
1 - 1.5	0.010	0.054	0.062	0.013
	(0.048)	(0.060)	(0.067)	(0.063)
1.5 - 2	0.009	0.018	0.034	0.017
	(0.025)	(0.027)	(0.049)	(0.048)
2 - 2.5	0.026	0.030	0.071	0.062
	(0.021)	(0.022)	(0.054)	(0.050)
2.5 - 3	-0.014	-0.009	-0.025	-0.037
	(0.016)	(0.016)	(0.044)	(0.043)
3 - 3.5	-0.047	-0.036	-0.103	-0.135
	(0.019)	(0.019)	(0.055)	(0.056)
3.5 - 4	-0.070	-0.060	-0.099	-0.119
	(0.034)	(0.035)	(0.057)	(0.056)
Included Controls:				
Demographics	No	Yes	No	Yes
Housing	No	Yes	No	Yes
County FE	Yes	Yes	Yes	Yes

Notes: Panel A reports OLS estimates of coefficients on number of projects and 100s of units within listed distance rings. Regressions producing these results do not control for eligible household fraction in any way. Panel B reports analogous IV coefficients estimated in the same way as all coefficients reported in Table 9. The dependent variable is the change in log value of owner occupied single family homes between 1990 and 2000. Control variables match those listed in the notes to Table 6.

Table 11: Effects of LIHTC Units on the Quantity of Housing

Distance Ring (km)	Owner Occupied Units	Renter Occupied Units	Total Housing Units
0 - 1	-0.054	0.231	0.161
	(0.125)	(0.119)	(0.186)
0 - 1.5	0.068	0.144	0.211
	(0.056)	(0.053)	(0.084)
0 - 2	0.023	0.091	0.113
	(0.038)	(0.036)	(0.056)
0 - 2.5	0.011	0.079	0.092
	(0.032)	(0.030)	(0.048)
0 - 3	-0.018	0.090	0.067
	(0.036)	(0.035)	(0.054)
0 - 3.5	-0.107	0.060	-0.088
	(0.071)	(0.065)	(0.104)
0 - 4	-0.238	0.055	-0.404
	(0.193)	(0.151)	(0.305)

Reported regression discontinuity coefficients are on number of low income units in each ring. Dependent variables are changes between 1990 and 2000 in counts of the variables listed at the top of the columns within each of the rings listed at left. Controls are the same as those used in Table 9. Total housing units includes vacant units.

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

Standard errors are calculated from 500 block bootstrap samples, allowing for clustering at the county level. Sample includes all census tracts in metropolitan areas excluding Washington, DC. Demographic controls are fraction white, fraction black, fraction hispanic, log median family income, log per capita income, and the poverty rate from 1990. Housing controls are vacancy rate, the fraction of housing units that are rentals, log median value log rent, 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 and fraction over 50 units.