Targeting Investments for Neighborhood Revitalization

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How should we allocate public resources for revitalizing low-income urban neighborhoods? Once public investments in an area reach some minimum threshold, do they leverage substantial private resources? To address these questions, we examine a coordinated, sustained, and targeted revitalization strategy begun in 1998 in Richmond, VA. The strategy was developed through a data-driven, participatory planning process that garnered widespread support. Our analyses reveal that the program produced substantially greater appreciation in the market values of single-family homes in the targeted areas than in comparable homes in similarly distressed neighborhoods. The greatest impacts occurred when public investments over 5 years exceeded $21,000 per block, on average. This appears to make the strategy potentially self-financing over a 20-year horizon, with public contributions offset by future increments in property tax revenues from target areas.

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Can strategic investments of limited public resources trigger the revitalization of distressed, low-income urban neighborhoods? If so, how should we allocate resources spatially to leverage the most private investment in these neighborhoods? For decades these questions have sparked debate among planners, local officials, scholars, and advocates (e.g., Bright, 2000; Downs, 1981; Grogan & Proscio, 2000; Keating, 1990; Keating, Krumholz, & Star, 1996; Lemann, 1994; Marquez, 1993; Pierce & Steinbach, 1987; Rubin, 1994; Stoecker, 1997).

Remarkably little reliable evidence has been brought to bear on these questions, due to the methodological challenges of identifying and measuring the influences other than the intervention on neighborhood trajectories (Bartik, 1992; Baum, 2001; Bloom & Glispie, 1999; Erickson & Friedman, 1989; Fulbright-Anderson, Kubisch, & Connell, 1998; Galster, Temkin, Walker, & Sawyer, 2004; James, 1991; Mueller, 1995; Rossi, 1999; Taub, 1990; Weiss, 1972, 1998). Two approaches have dominated the literature. The *post-intervention, absolute-change approach* examines neighborhood changes after some revitalization initiative has occurred; change is attributed solely to the initiative. Thus the counterfactual is assumed to be no change (see, e.g., Blank, 2000; Grogan & Proscio, 2000; Morley, 1998; Proscio, 2002; Walsh, 1997). The *post-intervention, relative-change approach* compares neighborhood changes observed during the period in which an intervention is reputedly having an impact to coincident changes in control neighborhoods. Here the counterfactual is assumed to be the change observed in control neighborhoods, so only relative advantages of the intervention over the control neighborhoods are taken as evidence of impact (see, e.g., Mueller, 1995; Smith, 2003; Taub, 1988, 1990; Taylor, 2002; Vidal, Howitt, & Foster, 1986; Weiss, 1972; Zielenbach, 2003).

The main shortcoming of these approaches is that either counterfactual may be seriously misleading. For example, if the designated neighborhood was declining rapidly (both absolutely and relative to other low-income neighborhoods) before a revitalization initiative, then even after intervention it may continue on a downward trajectory. According to the conventional approaches this would signal that there had been no programmatic impact even if the rate of decline had slowed; thus this potentially positive outcome would be overlooked. Of course, if this change in the trend also occurred in control neighborhoods after

the intervention, citywide factors may have affected all neighborhoods. The upshot of this example is that a superior counterfactual can be estimated by considering both pre- and post-intervention information in both targeted neighborhoods and control neighborhoods, while adjusting for coincident citywide factors.

Two important recent methodological developments provided the opportunity to use these superior counterfactuals. The first is the *difference-in-differences* model, which can be used to compare differences in the levels of an outcome indicator between target and control neighborhoods before and after the intervention (Ellen, Schill, Susin, & Schwartz, 2001; Ellen & Voicu, 2006; Schill, Ellen, Schwartz, & Voicu, 2002; Schwartz, Ellen, Voicu, & Schill, in press; Smith & Hevener, 2005). The second is the *adjusted interrupted time series* model, which can be used to compare differences in the levels and trends of an outcome indicator between target and control neighborhoods before and after the intervention, while controlling for coincident citywide changes in trends (Galster, Temkin, et al., 2004). Studies employing these methods demonstrated convincingly that revitalization initiatives in New York; Denver; Portland, OR; and Camden, NJ, involving combinations of new and infill residential construction, home rehabilitation, infrastructure improvements, and various pubic services generated substantial improvements in property values in the surrounding neighborhoods. They found further that impacts were directly related to the scale of the initiative and the extent to which it involved owner-occupied dwellings, and that these impacts decayed beyond a distance of 2000 feet. Though this emerging evidence clearly demonstrates that revitalization strategies can significantly alter trajectories of low-income neighborhoods, it says nothing about whether there is a minimum threshold for investment beyond which sizable impacts ensue, and if so, what this threshold might be.[1]

Surveys undertaken by Taub, Taylor, and Dunham (1984) indicated that property owners in blighted Chicago neighborhoods would only undertake renovations if at least one third of neighboring owners did the same, though the precise threshold varied by race of owner and neighborhood population. Bleakly, Holin, Fitzpatrick, & Hodes (1983) examined policies that spatially targeted Community Development Block Grant (CDBG) and other investments in 30 Neighborhood Strategy Areas in 20 cities from 1979 to 1981. They reported that neighborhood physical conditions improved when there was a higher-than-average concentration of CDBG expenditures per block. Finally, Galster, Walker, Hayes, & Boxall (2004) measured the relationship between CDBG expenditures and subsequent changes in a variety of neighborhood indicators across 17 cities during the 1990s. They found that such expenditures did not have a noticeable relationship to altered census tract trajectories unless they exceeded the sample mean expenditure.

In order to shed more light on these issues, we examine a coordinated, sustained, and spatially concentrated strategy of targeted investment begun in 1998 by the City of Richmond, VA, in conjunction with the Richmond office of the Local Initiatives Support Corporation (LISC). This Neighborhoods in Bloom (NiB) program was a major departure from common municipal practice in the United States, in that it concentrated federal CDBG funds and Home Investment Partnership (HOME) funds on a small number of blocks in each of seven neighborhoods. The explicit goal was to achieve a critical mass that stimulated self-sustaining private market activity. LISC focused its resources as well, to a large extent funneling dollars to community development corporations (CDCs) working in NiB neighborhoods.

The combined investments of the City of Richmond and LISC in the NiB areas have been substantial, though their intensity varies substantially. We present econometric analyses of the impacts of these various intensities of revitalization investments on the market values of houses sold before and after the initiation of targeting. We measure the net effect of both the direct impacts of public and nonprofit investment and the indirect impacts of leveraged private investments.

The Richmond Neighborhood Revitalization Strategy

Both internal and external forces led Richmond to target CDBG and HOME funds to a few neighborhoods. Internally, the city administration faced pressures from planning staff, who argued that the longstanding practice of sprinkling development funds across all low-income neighborhoods had not allowed the city to accomplish its mission in any of them. Some city councilors had also tired of being lobbied by civic associations and CDCs for CDBG funds. Externally, the city's CDCs had grown frustrated with the uncertainty surrounding the annual process of applying for CDBG and HOME dollars to support their housing projects. Because this process required at least a year, the CDCs urged the city to make a multiyear commitment of resources to a small number of areas so that they could plan acquisition, rehabilitation, and new construction more effectively.

With strong leadership by the acting city manager and two city councilors, the city decided in 1998 to develop a strategy for concentrating CDBG, HOME, general fund

projects, and service resources in a few neighborhoods for a period sufficient to achieve a critical mass that leveraged for-profit investment. To make this strategy palatable to city councilors and their constituents whose neighborhoods would not initially be targeted, the city devised a data-driven, participatory process.

First, it established an internal planning task force comprising the acting city manager and representatives of key city departments, staffed by the Department of Community Development. The staff identified indicators of neighborhood condition and development potential for each of the 49 neighborhoods (defined by the city on the basis of census blocks) that could potentially receive CDBG or HOME dollars.[2] They then categorized each neighborhood into one of four treatment groups based on their indicators: (1) *Redevelop:* extensive problems and few assets; (2) *Revitalize:* significant decline but some assets; (3) *Stabilize:* marginal decline and considerable assets; (4) *Protect:* few problems, good assets but requiring reinvestment. Second, Community Development Department staff met regularly with representatives of Richmond's civic associations and the community-development industry to discuss the targeting concept, present indicator data, and tour prospective target neighborhoods.

By early 1999, this process produced widespread support for the targeting concept, dubbed "Neighborhoods in Bloom" (NiB), and a rough consensus about which neighborhoods should be targeted. The City Council unanimously approved the neighborhoods proposed by the city administration for targeting in May 1999.[3] Figure 1 shows the 300 blocks that collectively make up the targeted NiB areas.[4]

The Target Areas

Implementation of NiB began in July 1999. The city designated two geographic scales of treatment intensity within NiB: smaller *impact areas* receiving CDBG- and HOME-funded investments (described below), and larger *target areas* (encompassing the impact areas) which received priority for certain city services, detailed below.[5] Table 1 summarizes key indicators in the NiB target areas and contrasts them with citywide averages. It shows that the target areas overall evinced the classic symptoms of distress, with higher-than-citywide percentages of persons in poverty, female-headed households, and vacant and renter-occupied property.[6] City surveys in target areas prior to NiB indicated that 70% of properties had code violations, and 11 crime "hot spots" were present. Home sales data for 1998–1999 show that single-family homes sold, on average, for $44,490 inside NiB, but $98,500 outside NiB. It is also clear that there was variation among the NiB areas, though all NiB areas had effective CDCs and showed potential for revitalization.[7] This variability provides important context for interpreting our results.

Implementing the Neighborhoods in Bloom Program

In each target area, the city's Community Development Department organized a NiB team comprising key stakeholders, including representatives of neighborhood civic organizations, CDCs, and the Richmond Redevelopment and Housing Authority (RRHA). Each team reviewed existing plans for its area, determined precise boundaries of the impact area, and developed a 2-year work plan and budget. Each work plan designated specific buildings to be acquired and rehabilitated or demolished, and showed where new housing was to be constructed. The city allocated a portion of its CDBG and HOME funds to each neighborhood based upon its plan; CDCs then applied to implement work designated in the plan. Ongoing performance was monitored by each NiB team in monthly or bimonthly meetings with the CDCs, city planners, managers and inspectors, and neighborhood residents.[8]

City Investments

Between program startup in July 1999, and February 2004, the city spent roughly $16.6 million in the NiB target areas. The bulk of the spending, $13.9 million, was allocated to site-specific investments: acquisition (27%), clearance and demolition (2%), new construction (25%), and rehabilitation of dilapidated housing (46%).[9] The sources of these funds were CDBG (45%), HOME (33%), other federal grants (8%) and loans (6%), city funds (3%), state grants (1%), and other (2%).[10] The remainder of city spending constituted $2.7 million in capital improvement funds for streetlights, alleys, sidewalks, and street improvements throughout the NiB.

LISC Investments

LISC also made substantial investments in the City of Richmond since July 1999: $7.5 million overall, of which $4.7 million was directed into NiB target areas.[11] LISC provided pre-development, construction, rehabilitation, and down-payment assistance, as well as some permanent mortgage financing. Roughly two thirds of LISC NiB investments went toward developing single-family housing; the bulk of the remainder went into commercial projects.

Additional City Services

The city also focused extra program and staff resources in the NiB target areas. At the beginning of the program,

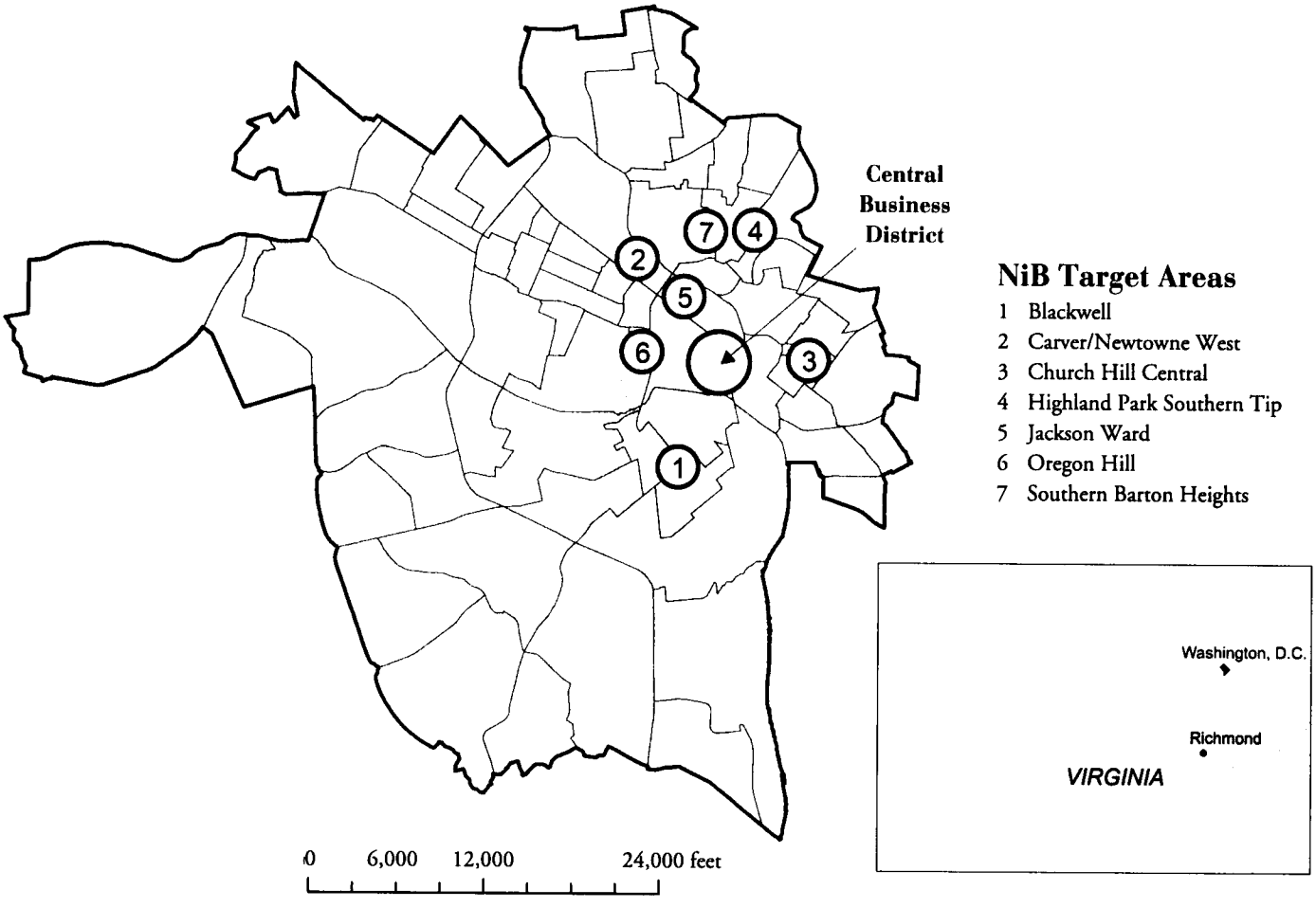

Figure 1. City of Richmond, with NiB target areas.

Note:
Boundaries shown are 2000 census tracts.

Source: Map prepared by I-Shian Suen, Virginia Commonwealth University.

the city undertook a comprehensive exterior code enforcement evaluation of the properties in the area. Each owner whose property was in violation received a notification letter and an offer of city financial assistance in rectifying the problems if he or she was income-eligible.[12] The city also added staff to its Law Department and Real Estate Office in order to focus more attention on accelerating vacant, tax-delinquent NiB properties through the tax-sale process. The Virginia Department of Historic Resources delegated to the city its authority to review properties listed (or eligible to be listed) on the National Register of Historic Places for compliance with federal regulations before renovation. Richmond was able to abbreviate this process, which normally took 6 months or more, to as little as 2 months. Finally, to assist low-income residents who might be displaced if NiB properties appreciated rapidly in value, the city added a housing counselor dedicated solely to NiB. The counselor assisted renters in finding alternative quarters and enrolled senior homeowners whose property values increased after rehabilitation in the senior-citizen property tax abatement program.

Measuring the Impacts of the NiB Revitalization Program

Clearly, the City of Richmond and LISC implemented a neighborhood revitalization strategy that was carefully planned, spatially targeted, temporally sustained, and programmatically comprehensive. In this section we assess

Table 1. Characteristics of NiB neighborhoods in 2000[a].

	Blackwell	Carver/ Newtowne	Church Hill Central	Highland Park Southern Tip	Jackson Ward	Oregon Hill	Southern Barton Heights	Richmond City
Total population	1,376	898	1,505	1,417	1,077	814	1,346	197,790
Race								
White	3%	11%	5%	2%	24%	92%	4%	39%
Black	96%	86%	93%	98%	72%	2%	94%	57%
Hispanic	2%	3%	2%	1%	4%	6%	2%	3%
Age								
Under 18	33%	20%	22%	28%	17%	14%	30%	22%
18–64	55%	68%	58%	57%	74%	81%	58%	65%
65 and older	13%	12%	20%	15%	9%	5%	2%	13%
Households w/children under 18	452	183	328	402	179	115	400	43,178
Married couple (own child)	15%	14%	20%	27%	32%	50%	21%	33%
Male head household (own child)	5%	4%	3%	4%	5%	8%	9%	5%
Female head household (own child)	49%	51%	46%	39%	49%	25%	48%	42%
Other[b]	31%	30%	31%	31%	14%	17%	21%	19%
Housing Units	651	557	822	647	775	431	580	92,282
Occupied	77%	71%	78%	82%	66%	91%	81%	92%
Vacant	23%	29%	22%	18%	34%	9%	19%	8%
Owner occupied	33%	43%	36%	44%	31%	42%	37%	46%
Renter occupied	67%	57%	64%	56%	70%	58%	63%	54%
Poverty[c]								
Population in poverty by census tract	601: 35% 602: 34% 603: 39%	402: 28%	203: 21% 206: 26% 207: 41%	109: 29%	302: 31%	412: 16%	110: 32% 111: 21%	21%

Notes:

a. Percentages may not add to 100 due to rounding.

b. Includes non-households, other relatives (e.g., grandparents), non-relatives, and group quarters.

c. Some NiB areas are wholly contained within one census tract; others are in portions of two or three tracts.

Sources: Population, age and housing data aggregated from Census 2000 SF1 block data tables by Brooke Hardin, Richmond Department of Community Development. Poverty rates from City of Richmond (2002).

the impacts of these 5 years of effort and what they suggest about the most efficacious way to reinvest by addressing the following research questions:

Does the observed pattern of neighborhood change (measured by single-family home prices) support the hypothesis that the NiB program significantly altered trajectories of the target neighborhoods from what they would have been in the absence of interventions?

Is there any evidence of a nonlinear relationship between home prices and dollars invested in individual blocks in NiB impact areas, suggesting the existence of a public investment threshold?

We first briefly describe our method for measuring neighborhood impacts, the investment data we used to measure inputs and the home sales data we used to measure outcomes. We then present our statistical answers to these research questions.

Using the AITS Method to Measure Neighborhood Impacts

Galster, Temkin, et al. (2004) labeled the method we employ adjusted interrupted time series (AITS). It is based on a quasi-experimental research design called interrupted time series (Campbell & Stanley, 1963; Cook & Camp-

bell, 1979; Shadish, Cook, & Campbell, 2002) modified significantly to: (1) compare interruptions in time trends between (at least) two sets of geographic areas; and (2) adjust for any changes in trends that were coincident with the intervention and affected the entire city. The strength of AITS is that it establishes a convincing counterfactual against which actual changes in target areas can be compared, allowing us to plausibly (though not definitively) deduce causation. It does so by extrapolating the pre-intervention trend (time series) in the target neighborhoods' outcome indicator into the post-intervention period. The extrapolation is adjusted, however, for any: (1) common changes in other distressed neighborhoods that were not targeted for revitalization (such as rising gang or illegal drug activities); and (2) broader factors (such as the state of the economy) that affected the outcome indicator in all of the city's neighborhoods. So, for example, if during the post-intervention period all neighborhoods trended upward x percent more rapidly than they had during the pre-intervention period, the extrapolation in the target areas would be adjusted upward by this factor. The ultimate AITS test of impact then involves measuring the difference between actual and counterfactual indicator time series in target neighborhoods.[13] Our multiple regression model for this purpose is presented in Appendix A.

The Richmond NiB program officially began during the 1999/00 fiscal year (though the data we use show some minor investments by the city prior to this). For our statistical analysis, however, we have used the 1998/99 fiscal year as the start of the "post-NiB" period in order to take into account the possibility that people learned about the program and acted on that information before most NiB investments were actually put in place. Our results were robust to changing this definition of when the intervention began.

Input and Outcome Indicators

Ideally, indicators of neighborhood inputs and outcomes meet three criteria; they should be measured: (1) frequently; (2) over an extended period, both before and after intervention; and (3) at a small geographic scale. We were fortunate in the case of Richmond to have data for an outcome indicator, individual single-family home sales from 1990–2003, which meet all three criteria extremely well.[14] Moreover, home sales prices are well known to capitalize many changes in the underlying desirability of neighborhoods, and thus represent a powerful summary measure of neighborhood trajectory (Freeman, 1979; Galster Hayes, & Johnson, 2005; Palmquist, 1992) and were appropriate for the NiB areas, whose housing stock averages roughly 50% single-family units.[15]

The original data set consisted of the property tax records, including information on the last two sales, of 14,484 real property parcels in Richmond, 12,453 of which were single-family homes. From these records we created a file of individual sales records, with property characteristics, for single-family homes. The properties were geocoded to exact street addresses or census block centroids to add latitude and longitude coordinates and census block identifiers, as well as to determine if a home was inside or outside of a NiB target area.[16] After final cleaning, our database consisted of 15,889 single-family home sales with associated property characteristics; 623 of these sales occurred in target areas during the period 1990–2003.

Data on investments serving as inputs to NiB from July 1998 through the early part of FY 2003/04 were provided both by the City of Richmond and by Richmond LISC. Whenever possible we obtained records of project-specific, hard-cost disbursements by street address. These project addresses were geocoded to add census block identifiers so that we could tabulate total investments for blocks inside and outside NiB target areas.[17] City disbursements (primarily CDBG and HOME) were identified by fiscal year; LISC investments were identified by specific date, which we converted to fiscal year. Data did not permit us to allocate infrastructure investments to particular blocks, so we adopted the convention that they were expended equally across all NiB blocks; this estimate was approximately $9,000 per NiB block.

The investment data that we could geocode shows considerable variation across the 300 blocks within NiB. No site-specific investments from any program source could be identified for 86 NiB blocks. Total, city, and LISC investments in the 214 NiB blocks with some identifiable investments from the period are summarized in Table 2, which also shows whether cumulative investment from all sources was above or below the median ($20,100) for individual blocks. The 107 blocks with total (i.e., city and LISC) cumulative investments below the median averaged only $7,000 invested per block. By contrast, the remaining 107 blocks with cumulative investments above the median averaged $190,800 invested per block. None of these figures include the estimated $9,000 average per block spent on infrastructure improvements.

The city was generally more likely to concentrate its investments in certain blocks within NiB than was LISC, as Table 3 shows. For 75% of the blocks on which LISC made investments each represented less than 0.5% of the total LISC invested cumulatively in NiB; the corresponding figure for the city was only 49% of blocks. Only 13.9% of LISC's investments were made on blocks each amounting to between 1.0 and 4.9% of its total investments, whereas

the comparable figure for the city was 28.6%. However, LISC did concentrate a larger share of funds (3.5%) than the city (0.9%) in blocks with at least 5% of more of their respective NiB portfolios.

Selection of Areas Comparable to NiB to Use as Controls

In establishing a counterfactual for the AITS method, it is desirable to identify control areas that are not ultimately targeted for revitalization investments but are otherwise similar to those that are. Lower-income housing submarkets may evince idiosyncratic home price trends not well reflected in patterns for the citywide market. We identify as potential controls all Richmond census tracts with 1990 median values of designated owner-occupied housing less than $69,000, excluding those blocks previously designated as NiB.[18] This designation produced a substantial geographic area, much of it adjacent to NiB, in which 4,603 home sales occurred during our study period.

The challenge in designating control areas, especially in a small city the size of Richmond, is proximity and potential spillovers. If, as aforementioned studies have found, property value gains occur over 2,000 feet beyond the revitalized site, control areas proximate to the borders of NiB may be indirectly inflated by the revitalization efforts. To include them as the standard against which NiB home price gains are compared would thus produce a downward bias on the estimated NiB impact. On the other hand, to exclude all geographic areas proximate to NiB borders from the control areas might affect the attributes of the control group in some non-random way. Since there is no obviously correct choice here, we experiment with several options, as explained further below.

Results in NiB Target Areas

In our main results shown in Figure 2 (complete regression results are in Appendix B) the *citywide* line indicates the annual average price of a standard Richmond home as a percentage of its base year price in FY 1990/91.[19] All of the lines in Figure 2 portray regression-estimated trends to control for differences in the characteristics of the homes sold at different time periods. There was no statistically significant change in average prices from the base year until FY 1996/97, when prices increased an average of 4.7% and continued to grow steadily thereafter. By the close of our analysis period in FY 2003/04, an average home in Richmond would have been expected to sell for 86.7% more than in FY 1995/96.

Results for the target areas are summarized by a second line in Figure 2 which again indicates the price trend for the NiB target areas as a percentage of the FY 1990/91 citywide baseline price, holding home attributes constant. We can see from this that prices in the target areas during the pre-NiB period were 35.5% below the citywide average.[20] These two lines are parallel for the first 9 years of the study period, indicating no difference in price appreciation between the city and target areas over this pre-NiB time.[21]

With the start of NiB in 1998/99, Figure 2 shows that the situation changed dramatically. As already noted, prices in the city overall began to appreciate rapidly in this period, but they grew considerably faster in the target areas. Our model estimates indicate that the average sales price in the target areas increased 10.85% per year faster than prices of comparable homes in the city overall.[22] As a result, prices in the target areas reached the citywide average for comparable homes in 2002/03 (where the two lines cross) and ended up over 100% higher than the city 1990/91 baseline

Table 2. NiB blocks with cumulative positive investments above and below the median, FY 1998/99–2003/04.

	Total investment		City investment		LISC investment	
	Median or less ($1 to $20,100)	Above median (>$20,101)	Total investment median or less	Total investment above median	Total investment median or less	Total investment above median
Blocks with non-zero investments	107	107	31	81	98	46
Average cumulative investment per block	$7,000	$190,800	$11,200	$167,600	$6,600	$143,400

Note:
Total and City figures exclude all infrastructure investments which were not block-specific. There are 300 NiB blocks, but only blocks with non-zero cumulative investments for each investment category are included in this table

Source: Unpublished City of Richmond data analyzed by authors.

Table 3. Percent of cumulative total, city, and LISC investments in NiB blocks, FY 1998/99–2003/04 for blocks with positive investments.

	Source of investment		
	Total	**City**	**LISC**
NiB blocks with non-zero investments	214 (100.0%)	112 (100.0%)	144 100.0%)
% of blocks receiving 0.1–0.4% of a source's total NiB investment	72.9%	49.1%	75.0%
% of blocks receiving 0.5–0.9% of a source's total NiB investment	10.7%	21.4%	7.6%
% of blocks receiving 1.0–1.9% of a source's total NiB investment	8.4%	14.3%	7.6%
% of blocks receiving 2.0–2.9% of a source's total NiB investment	6.5%	8.0%	4.2%
% of blocks receiving 3.0–3.9% of a source's total NiB investment	0.5%	4.5%	0.7%
% of blocks receiving 4.0–4.9% of a source's total NiB investment	0.5%	1.8%	1.4%
% of blocks receiving 5.0% or higher of a source's total NiB investment	0.5%	0.9%	3.5%

Source: Unpublished City of Richmond data analyzed by authors.

by the end of our study period in 2003/04; the comparable figure for the city as a whole was 87% higher.[23] These results suggest a highly positive impact of NiB investments on single-family home prices in the target areas.[24]

This conclusion is buttressed by price trends in control areas comparable to NiB but not targeted for revitalization investments. Figure 2 shows that homes in these areas started the pre-NiB period valued 22.5% lower than identical homes in the rest of the city (excluding the NiB), though their appreciation was keeping pace. After NiB started there were no statistically significant differences between home prices in these control areas and the rest of the non-NiB areas of the city. This vital finding demonstrates that NiB areas outperformed other distressed neighborhoods as well as non-distressed areas of Richmond. Moreover, by demonstrating that control areas did not change their trajectories after NiB, these results show that the NiB program did not merely relocate residents and resources from other distressed neighborhoods, but yielded net gains for the city.

Our results can also be used to estimate the rates at which public and nonprofit investments were capitalized into NiB. Our AITS estimates indicate that by the end of the period, the $21.33 million invested by the city and LISC during the first 6 years of the NiB program increased the aggregate value of single-family homes in NiB target areas by $44.98 million more than if they had increased at the same rate as the rest of Richmond. This represents an impressive capitalization rate of 211%, without even considering effects on other sorts of properties besides single-family homes.[25] We cannot be sure what portion of this gain in aggregate home values was due to induced investments financed by private property owners, but interviews with key informants suggest that leveraging was substantial.

Consequences of Different Spatial Concentrations of Investment

We next consider the results of the AITS model that measures the differences in impacts (both price levels and appreciation rates) based on the amount of the investment in a target area block. We experimented with several alternative cut points for distinguishing among amounts of investments on a block, and the median ($20,100) was by far the most powerful discriminator. Here we report on a robust AITS model distinguishing whether the amount of cumulative, site-specific investments from both the city and LISC in a NiB block was: (1) zero; (2) non-zero but at or below the median of $20,100, or (3) above the median.[26] We emphasize that this median does not include area-wide city investments (infrastructure, services) that could not be allocated to particular blocks, which, as noted earlier, we estimated cumulatively at $9,000 per NiB block. Our AITS estimates of this model indicated that there were no statistically significant differences in impacts between blocks receiving zero and median-or-less investments, although both types did receive home appreciation benefits from being in the NiB. By contrast, blocks receiving investments greater than the median evinced a persistent and large fillip in their price levels compared to other NiB blocks, though their appreciation rates were no greater.

These results are portrayed graphically in Figure 3. In the pre-NiB period, the target areas and citywide price trajectories are the same as in Figure 2. At the start of the post-NiB period, however, we can distinguish two trend lines for the target areas. One measures impacts for blocks with above-median, and the other for median-or-lower levels of investment.

The line for median-or-lower investment in Figure 3 has a trajectory roughly similar to that of line for the overall

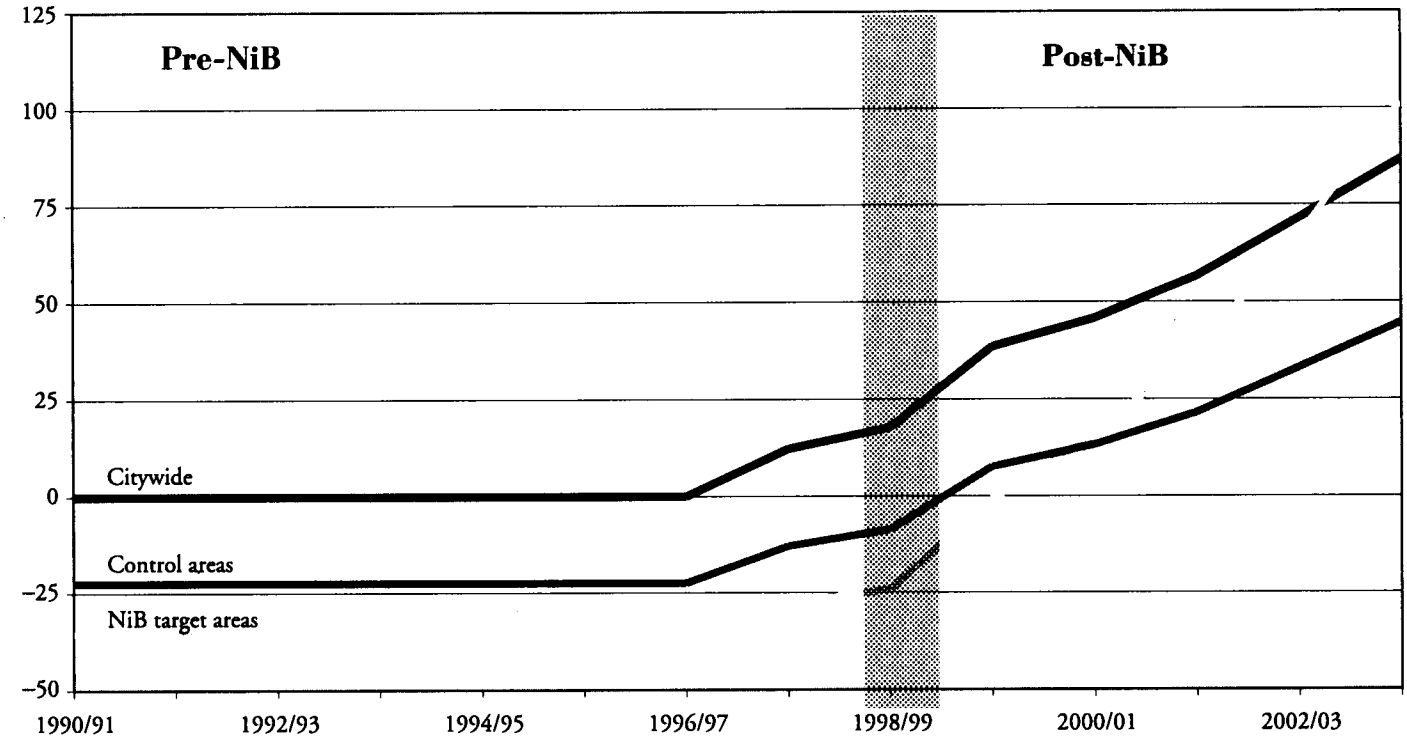

Figure 2. Percent differences over time in constant-quality Richmond home prices from 1990/91 citywide baseline, by location.

target area in Figure 2, increasing 10.5% per year in the post-NiB period compared to the rest of Richmond. This indicates that blocks receiving lower levels of investment experienced only slightly slower rates of price increase than the overall target area, which averaged 10.85% per year. Thus it appears that all NiB blocks benefited from the program, not just those where intensive investment levels occurred. This is likely due to localized spillovers from the blocks receiving high investments, the area-wide infrastructure improvements and services, and a positive investment psychology, about which we comment below. The blocks with investment above $20,100, however, evinced a price boost of 47.1% at the start of the post-NiB period (where the line jumps up in FY 1998/99 in Figure 3) and then continued with relative price increases of 10.5% per year. Variations in investment intensity above this threshold did not produce significantly different home price impacts, which is consistent with predictions of game-theoretic models of investor behavior in a prisoners' dilemma context (Rothenberg, 1967; Taub, Taylor, & Dunham, 1984).[27]

Testing for Robustness

We prepared several variants of the basic AITS model (shown in Appendices A and B) to ascertain how sensitive the core results were. The primary test consisted of varying the mutually exclusive categorizations of control areas and areas contiguous to NiB neighborhoods where potential spillovers might occur. When we estimated models varying spillover areas from 1,000 to 2,000 to 5,000 feet, the NiB impact estimate remained highly statistically significant in all cases and varied in magnitude by less than a percentage point. Unfortunately, our efforts to ascertain whether there were spillovers proved inconclusive. There were insufficient sales observations within 1,000 feet of the target areas to yield any precision; there was no observed impact within the 2,000 feet; and there were too many confounding influences within 5,000 feet to attribute the observed positive price impact to NiB-related spillovers.

The second robustness check involved accounting for two coincident investments that occurred in parts of NiB but were not directly associated with the program. The first was a HOPE VI public housing revitalization grant of $26 million invested on a site in the Blackwell area during 1997–2004. The second was approximately $100 million spent by Virginia Commonwealth University expanding its campus along a major thoroughfare adjacent to the Carver area. When we omitted these two neighborhoods from the NiB designation, the impact estimates for the remaining

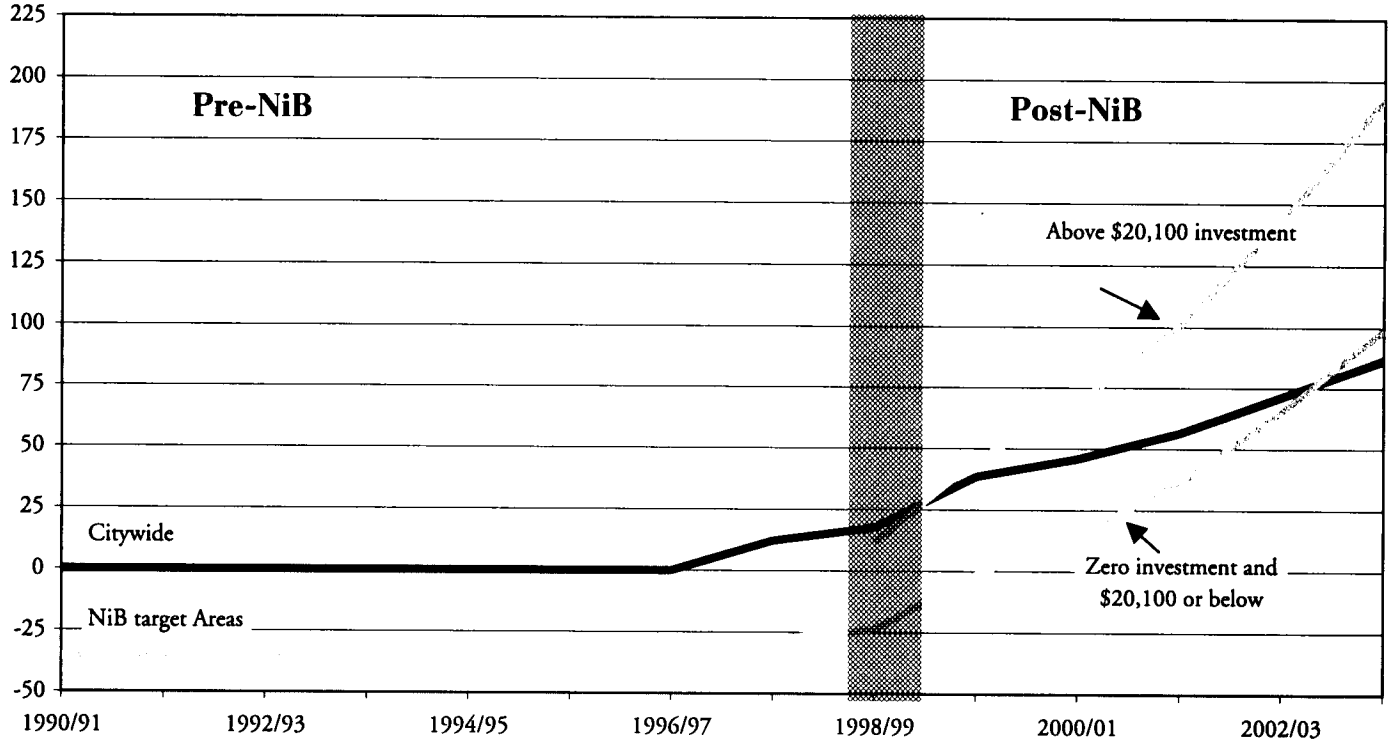

Figure 3. Percent difference over time in constant-quality Richmond home prices from 1990/91 citywide baseline, by investment per block.

Note:
Control areas are as in Figure 2.

five areas again remained virtually unchanged in magnitude or statistical significance. We thus are confident that our estimates of impacts from targeted NiB investments by the City and LISC are not sensitive to the specification of control areas or to the potential failure to account for other, idiosyncratic investments occurring in NiB areas.

The Fiscal Impacts from Neighborhoods in Bloom

A comprehensive examination of the fiscal impacts of the NiB program on the City of Richmond is beyond the scope of this study.[28] However, we can make rough estimates of their magnitude. We used our results to estimate increases in the aggregate values of single-family homes in the NiB target areas. We applied the city's property tax rate ($13.80 per mil, with assessed value equal to market value) to this increment in aggregate value and then projected the product into the future and assumed a discount rate of 3% per year to estimate the present value of the additional property tax revenues we expect NiB to generate.

We made the conservative assumption that the home price appreciation gains resulting from NiB between 1998/99 through 2003/04 would persist only until 2007/08 (10 years after the start of NiB), after which home prices would retain their position relative to the rest of the city for only another 10 years. Under these assumptions, the 1997/98 discounted present value of increased future property tax revenues generated by NiB-spawned appreciation of single-family homes in target areas over the next 20 years is $13.2 million. Note that this includes additional revenues from single-family homes only; it does not consider any (unmeasured, but probably positive) changes in the market values of other sorts of residential or non-residential properties in the target areas.[29] Thus, it is not unreasonable to assume that the total additional property tax revenues in the NiB would be considerably greater than $13.2 million.

By comparison, recall that the city (excluding LISC) invested $16.6 million (or $15.2 million discounted present value in 1997/98) during the course of NiB.[30] Thus, we draw the remarkable conclusion that NiB produced such a robust fiscal return on the city's initial investment that it will likely pay for itself in 20 years through enhanced tax

revenues.[31] We note that this felicitous outcome for the city was at least partially attributable to complementary investments in and around NiB by LISC, HOPE VI, and Virginia Commonwealth University, for which the city did not pay.

Conclusions

Richmond's strategy to revitalize neighborhoods by targeting of substantial public and nonprofit investments over a sustained period had substantial positive impacts on the residential investment climate in these targeted areas. Moreover, this strategy did not undermine other distressed neighborhoods that were targets of such investment. Three factors seem to be responsible for this success.

First, there was a coincidence of committed leadership, competent city staff, and an effective planning process. From its inception, the Neighborhoods in Bloom program enjoyed strong leadership from the city manager and several city councilors. Within the community at large, LISC and several CDCs actively supported and helped to organize the initiative. The city staff charged with organizing and implementing the Neighborhoods in Bloom program has been widely regarded as competent and helpful.[32] The city administration and Community Development Department, as well as LISC and its affiliated CDCs, actively solicited the input of affected parties to develop consensus about the need for targeting and which neighborhoods should be included. They used a data-driven method of prioritizing the neighborhoods that all could understand and agree was objective. As a result, city councilors and the larger public were able to support the initiative overwhelmingly.

Second, the City of Richmond created a critical mass of resources and applied them strategically, investing $21.33 million over 5 years in target areas comprising 300 blocks. The funds and services provided by the city (CDBG, HOME, and capital improvement funds; focused code enforcement; giving priority to tax-delinquent sales and property disposition in NiB; staffing an accelerated historic preservation review; and housing counseling) represented a large-scale, comprehensive package of revitalization initiatives, and do not include the funds and services provided by LISC. Moreover, Richmond committed resources with substantial certainty over a multiyear period. But, even more critically, these initiatives were spatially focused so they reached threshold concentrations that stimulated private market activity and brought about perceptible changes in the target neighborhoods.

Third, Richmond had a community development industry that functioned well, anchored by the Richmond Community Development Alliance (RCDA), which had been organized by Richmond LISC in the 1990s. The RCDA sought to ensure that CDCs expanded capacity, cooperated with each other, and spoke to the city in a coherent voice. Although Richmond's CDCs did not form until the early 1990s, by the onset of NiB they had developed good working relationships with the city, lenders, appraisers, and other private-sector partners. Thus, most of them were capable of rapidly increasing their housing production when NiB's resources became available.

Neighborhood Reinvestment Thresholds

Our study contributes to a body of recent, methodologically sophisticated work that attempts to quantify the impacts of major investments in lower-income urban neighborhoods. It is important to emphasize, however, that none of the impacts measured in these prior studies are nearly of the magnitude we observed in Richmond. We believe that this is a product of the unusual degree to which the NiB program was targeted geographically, resulting in concentrated, sustained, highly visible interventions.

Coupled with other emerging evidence, our study's findings suggest that reinvestment thresholds occur at two spatial scales—at the census tract level and at the block level. Regarding the larger scale, Galster, Walker, et al. (2004) concluded that CDBG expenditures do not have a noticeable relationship with altered neighborhood trajectories unless they exceed roughly $261,000 per census tract over 3 years (an average of $87,000 per tract per year). Our findings here are consistent with those results, since each of the 12 census tracts encompassing the NiB target areas received an annual average investment of $297,000 ($232,000 from CDBG alone) and indeed evinced significantly altered trajectories. At the smaller scale, we observed much larger positive impacts when a block received at least $21,000 in site-specific investment over 5 years in addition to benefiting from public and nonprofit infrastructure investment that averaged $9,000 per block over the same period, for a total of $30,000 per block over 5 years, or $6,000 per block per year. Because these investment thresholds have great practical policy significance they deserve to be validated by additional research.

Even though the Richmond evidence suggests that private investment increases significantly above a relatively low threshold of public investment, this should not be taken out of context. We believe it likely that the property investment psychology across the entire target area was undergirded by both (1) a highly visible, participatory planning process culminating in the designation of a target area (and subsequent significant site-specific investment in at least some of it) and (2) NiB-related infrastructure

improvements and service enhancements across the entire NiB area. This would be consistent with the notion forwarded by Goetze (1976) and Galster (1987) that well publicized public investments in an area can build neighborhood confidence. This is an important outcome, with real value.

However, our estimates of block-level thresholds are only suggestive, not definitive. Because of data limitations, we were unable to explore the extent to which thresholds may differ according to the degree of distress of the neighborhood in question and the precise form of the investments being employed, both key topics for future research. Moreover, the observed patterns occurred in the larger context of a booming city and regional economy. Nevertheless, we agree with a recent U.S. Government Accountability Office study (2005) that CDBG and other public and nonprofit investments should be more spatially targeted than they generally are in most communities.

Concerns and Caveats

We recognize that our analysis of neighborhood revitalization is only partial. Home price is but one potential indicator of the success of a community revitalization effort (Galster, Hayes, et al., 2004; Sawicki & Flynn, 1996). Moreover, we know that higher property values are not an unmitigated good for all residents of an area. Indeed, it is a legitimate and longstanding concern of planners that rapid appreciation may produce unwanted residential displacement (Newman & Ashton, 2004; Slater, Curran, & Lees, 2004). However, according to both city officials and housing advocates who we interviewed, NiB has caused little displacement during its first 5 years, though it may increase if prices continue to escalate. The minimal displacement is likely due to several factors: (1) high initial vacancy rates; (2) emphasis on infill construction, using vacant lots, and upgrading of dwellings by incumbent owners; and (3) housing counseling provided through NiB services.

Implications for Policy, Planning Practice, and Future Neighborhood Research

Our study has focused on what happens when a city chooses to invest significant neighborhood revitalization resources in a geographically focused and sustained way. Since, in the case of Richmond, the bulk of these resources came from federal sources, our study has implications for current debates in Washington, DC, over the future of the CDBG program. Our research provides strong support for the notion that federal urban revitalization funds can generate impressive, perhaps even self-financing, revitalizations of distressed neighborhoods when invested strategically. Such efforts should pass any reasonable performance efficacy tests for federal programs (U.S. GAO, 2005). We question the wisdom of reducing CDBG spending by 40% as proposed in the Bush administration's Strengthening America's Communities initiative.

Richmond used a data-driven process, targeting neighborhoods based upon quantitative characteristics that proved compelling for local decision makers. Implicit in this approach is a model of what makes a neighborhood a viable, desirable place. As planners in Richmond and other cities try to target revitalization expenditures they should make this model more explicit, not only to justify focusing on particular neighborhoods, but also to determine when the improvements in these neighborhoods have improved their prospects for private investment sufficiently to allow public funds to move on to other areas.

Similarly, targeting public and nonprofit resources to revitalize a neighborhood relies on an implicit model of neighborhood decline and renewal. Neighborhood revitalization could advance more rapidly if this model were explicit, tested for accuracy, and widely understood in practice. Thus developing a predictive model of neighborhood change in multiple dimensions is clearly the next major scholarly frontier in neighborhood research.

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We express our gratitude to the many persons (real-estate developers and appraisers, lenders, public officials, nonprofit community development corporation staff, and advocacy group representatives, as well as the neighborhood residents) who gave confidential interviews in which they shared their perceptions of the impacts of targeted public and nonprofit investments in the neighborhoods included in this article.

Notes

1. For examples of theoretical models suggesting the existence of such a threshold, see Galster (1987, ch. 3); Granovetter (1978); Granovetter

and Soong (1988); Rothenberg (1967); and Taub, Taylor, and Dunham (1984).

2. Neighborhood conditions were assessed with rates of vacancy, crime, poverty, and owner-occupancy. Neighborhood potential was assessed with an inventory of non- and for-profit institutions, employment, vacant land, infrastructure, and actual and planned private investments.

3. The Community Development staff recommended five neighborhoods: Church Hill Central, Southern Barton Heights, Highland Park Southern Tip, Carver/Newtowne, and Blackwell. The city administration added Jackson Ward and Oregon Hill. Because Oregon Hill did not fall into either of the two most distressed neighborhood categories, it did not receive CDBG or HOME funds (until FY 2003/04) and NiB services; it did receive general funds (starting FY 2000/01) as well as significant LISC investment, however.

4. Note that, with the exception of Oregon Hill, NiB areas do not correspond to one or more census tracts.

5. Since the inception of NiB, the boundaries of the impact areas have grown (often in response to CDC requests), increasing from 931 properties in July 1999 to 1,959 properties in FY 2004. The larger, target area boundaries have remained constant, however. Hence, this study uses only the boundaries of the larger, target areas.

6. More neighborhood information can be obtained in Accordino, Galster, and Tatian (2005).

7. Oregon Hill, in particular, is considerably different from the other areas in terms of racial composition and poverty rate. Nevertheless, this small neighborhood's mostly moderate-income population and aging, historically significant housing have made it an appropriate target for nonprofit and LISC housing intervention.

8. In addition, the CDCs, city staff, LISC, and private lenders met on a quarterly basis to discuss neighborhood needs and strategies, and the Richmond Community Development Alliance (a group of nonprofit and for-profit housing developers) met frequently with the city's Community Development staff and RRHA to discuss technical and policy issues.

9. The city estimated that 419 new or substantially rehabilitated housing units were constructed under the auspices of the NiB (Table 2C in Accordino, Galster, et al., 2005). These figures are based on unpublished City of Richmond data compiled by the Urban Institute (Sacks, 2004).

10. These figures represent two thirds of the combined total of Richmond's annual CDBG allocation of about $6.3 million and its HOME allocation of about $4.8 million.

11. This information is based on unpublished Richmond LISC data compiled by the Urban Institute.

12. This strategy is analogous to the U.S. Department of Housing and Urban Development's Federally Assisted Code Enforcement Program, which was initiated in 1968 to offer low-interest loans and grants to low-income homeowners in strategically chosen distressed areas to remedy code violations. We thank Professor Ted Koebel of Virginia Polytechnic and State University for this information.

13. A more thorough explanation of the AITS approach and its advantages over other evaluation methods is provided in Galster, Temkin, et al. (2004).

14. We purchased data from First American Corporation, a commercial supplier of business data.

15. The authors calculated this percentage from data for census tracts containing NiB target areas.

16. Geocoding was done using ArcGIS 8 against a street file from the City of Richmond's Central Address File and the ArcGIS street map supplement. Property addresses that could not be geocoded to a sufficient level of precision were excluded from the analysis. This resulted in 507 parcels (< 5%) being removed. Outliers, consisting of sales in the top and bottom 2% of sales prices and lot sizes, were excluded from this file, as we had less confidence that they would both be representative of sales in Richmond and involve arms-length transactions.

17. Geocoding was done with a combination of ArcGIS 8, the address lookup feature of the Census Bureau's American Factfinder web site, and the ESRI Street Map.

18. This yielded a set of almost 30 tracts or segments of tracts, with an approximate aggregate median value of $49,000, which is considerably less than the citywide median of $99,500.

19. The estimated values of the model's "sale year" variable parameters indicate the difference between the prices of a home sold in that year compared to the first quarter of 1991, controlling for other features of that home.

20. The relative difference between the baseline and target area price levels is given by the coefficient of the target area level variable; for more see Appendices A and B.

21. The target period trend relative to the overall citywide trend is given by the coefficient of the target area trend variable as described in Appendix A. Since the estimated coefficient of this term is not significant, however, we interpret this as a zero price increase relative to citywide prices.

22. The coefficient of the target area post period trend variable is highly statistically significant and yields this implication; for more see Appendix A.

23. Figure 2 should not be interpreted to mean that actual average home prices in NiB were above the citywide average by 2002; this was not the case. The characteristics of NiB homes are generally much inferior to those of others.

24. We were unable to ascertain the degree to which NiB home price appreciation was due to sales of homes that were newly built or rehabilitated under the auspices of NiB or others proximate to them that did not receive subsdies, because we had no way of distinguishing among these properties.

25. This calculation is based on the following facts: 1,182 single-family homes in NiB; mean value of these homes was $44,490 at start of NiB; NiB investments generated a 10.85% price impact annually according to AITS model, which is compounded over 6 years.

26. As a preliminary trial, we replaced the target area post period and target area post period trend variables with five dummy variables denoting intensity of investment: (1) no site-specific investment (only area-wide infrastructure); (2) $1–5,000; (3) $5,001–20,100; (4) $20,101–107,100; (5) over $107,100. The last four categories break positive site-specific investments into quartiles. This, and several other variations consistently confirmed that only past $20,100 were statistically significant differences in impacts observed.

27. "Prisoners' dilemma" gaming models explain how risk-averse property owners will avoid being the first to invest in rehabilitation in a blighted neighborhood for fear of major losses if no other owners follow suit. The suboptimal result is that no one will rehabilitate, even if all would benefit if this could be undertaken jointly. Only once some threshold level of collective investor confidence is surpassed will the quantum amount of rehabilitation be undertaken.

28. Such an examination would require a general equilibrium analysis of the housing market in all neighborhoods, resulting changes in households' residential locations, employment locations, and retail shopping patterns.

29. Residential units that are not single-family homes represented roughly half of all units in the target areas in 2000. For this exercise, we

assumed an annual reassessment of property that accurately reflected actual market value increases.

30. This is based on a timing of expenditure as shown in Table 2 in Accordino, Galster, and Tatian (2005).

31. This conclusion is not highly sensitive to discount rate assumptions. If a 5% rate is assumed, the respective revenue and cost discounted present values are $10.5 and 14.3 million, respectively.

32. This was the overwhelming result of a series of key-informant interviews we conducted in conjunction with this research.

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Appendix A: Specification of the AITS Regression Model

The basic AITS regression specification we used may be expressed symbolically as:

$$V_t = c + b\,[\text{STRUCT}] + d\,\text{DIMP}_t + e\,\text{DPOSTIMP}_t + f\,\text{TRIMP}_t + g\,\text{TRPOSTIMP}_t + h\,\text{DCON}_t + j\,\text{DPOSTCON}_t + k\,\text{TRCON}_t + m\,\text{TRPOSTCON}_t + n\,[\text{TIME}] + p\,[\text{SPACE}] + \varepsilon \quad (1)$$

where the variables are defined as follows:

V	log of single-family home sales value
c	Constant term
[STRUCT]	Vector of structural characteristics of the home being sold: building living area, lot acreage, number of stories and rooms, structure age, building materials, and amenities. With exception of living area and lot size, which were continuous, all characteristics were expressed as dummy variables, with the most common value being omitted for each characteristic; see Appendix B for listing.
DIMP	*Target area level:* Dummy denoting sale occurred in one of the NIB target areas; both pre- and post-intervention observations equal one; zero otherwise.
DPOSTIMP	*Target area post period level:* Dummy denoting sale occurred in one of the NIB target areas *and* during the post-intervention period (i.e., after the commencement of NIB investments, FY 1998/99–2003/04); zero otherwise.
TRIMP	*Target area trend:* Slope variable for prices in target areas both pre- and post-intervention; equals 1 if sale occurred in target areas during first year of the study period (i.e., FY 1990/91), equals 2 if sales occurred in target areas during second year, etc.; zero otherwise.

TRPOSTIMP	*Target area post period trend:* Slope variable for prices in target areas post-intervention; equals 1 if sale occurred in target areas during first year of the NiB period (i.e., FY 1998/99), equals 2 if sale occurred in target areas during second year, etc.; zero otherwise.
DCON	*Control area level:* Dummy denoting sale occurred in one of the control areas; both pre- and post-intervention observations equal 1; zero otherwise.
DPOSTCON	*Control area post period level:* Dummy denoting sale occurred in one of the control areas *and* during the post-intervention period; zero otherwise.
TRCON	*Control area trend:* Slope variable for prices in control areas both pre- and post-intervention; equals 1 if sale occurred in control areas during first year of the study period (i.e., FY 1990/91), equals 2 if sales occurred in control areas during second year, etc.; zero otherwise.
TRPOSTCON	*Control area post period trend:* Slope variable for prices in control areas post-intervention; equals 1 if sale occurred in control areas during first year of the NiB period (i.e., FY 1998/99), equals 2 if sale occurred in control areas during second year, etc.; zero otherwise.
[TIME]	Set of time trend variables defined for all observations; includes three seasonal dummies for sales occurring in second, third, and fourth quarters and 13 yearly dummies for sales occurring in FY 1991/92, FY 1992/93, . . . FY 2003/04 (FY1990/91 is excluded category).
[SPACE]	Set of spatial heterogeneity correction variables (Can, 1997; Can & Megbolugbe, 1997); this includes the normalized latitude (X), longitude (Y), their squared values, and their interaction terms to control for systematic variations in prices across space.
ε	A random error term

All lower case letters in the equation (*b*, *c*, *d*, etc.) represent coefficients to be estimated. The subscript "t" denotes a time period for which the indicator is measured; here it is one fiscal year.

We used a log-linear model specification, which is conventional and allows for the implicit value of each attribute to be affected by the levels of others. This specification allows us to express the estimated impacts as percentage changes from the base sales price. White's standard errors are used here in conducting significance tests since they are robust to a range of unspecified heteroskedasticity in _.

The AITS model deals with the neighborhood selection bias challenge (due to the fact that neighborhoods were not randomly selected for treatment through the NiB program) by permitting both the level and slope of the home price indicator in the target areas to differ from that of other, control neighborhoods prior to any intervention. Statistical significance of the coefficient *d* is equivalent to testing for a difference in pre-intervention levels of the home price indicator in the impact and control neighborhoods; statistical significance of the coefficient *f* is equivalent to testing for a difference in pre-intervention slopes of the home price indicator in the impact and control neighborhoods. Because these potentially idiosyncratic, pre-intervention target area levels and slopes are modeled explicitly as a basis for estimating a post-intervention counterfactual, the selection bias challenge is effectively overcome. Put differently, even if the NiB target areas were on a different trajectory than control neighborhoods prior to intervention, by measuring the change in their trajectories before and after intervention we obtain an unbiased estimate of the intervention's effect.

The test for statistical significance of the coefficient *e* of the variable DPOSTIMP is equivalent to testing that there is a discontinuous, time-invariant change in the home price levels in the impact neighborhood after the intervention. The size of coefficient *e* provides the quantitative estimate of that impact. The test for statistical significance of the coefficient *g* of the TRPOSTIMP variable is equivalent to testing that there is a change in the price-time slopes (appreciation rate) in the target areas. The product of coefficient *g* and the TRPOSTIMP variable provides the (time-dependent) magnitude of impact. Should both the shift and slope post-intervention coefficients prove to not be significantly different from zero, the hypothesis of impact would be rejected.

To test whether the magnitude of the NiB investment mattered, we specified a regression similar to [1] except that we replaced DPOSTIMP and TRPOSTIMP with two analogous variables: (1) the original variable multiplied by 1 if cumulative investment in the block through the study period were equal to or less than the median for all blocks

with some investment ($20,100), and 0 if not, and (2) the original variable multiplied by 1 if cumulative investment in the block through the study period were greater than the same median, and 0 if not. We tested alternative specifications of the investment variables, including finer-grained categorizations and various spatially-weighted sums of all investments in nearby blocks. None of these alternatives yielded a different result than the simpler model above.

Appendix B: Regression Results

Basic impact model predicting log of sales price.

N	15,889
R^2	0.7127
Adj. R^2	0.7116
Fvalue (prob.)	654.41(<.0001)
Deg. freedom (corrected)	15,888

Independent variables	Parameter estimate	SE[a]	Signif.	% change due to a one-unit change in x[b]
Intercept	10.94426	0.03083	***	
Impact variables				
Target area level	−0.43838	0.13373	**	−35.49
Target area trend	−0.03845	0.02119		−3.77
Target area post period level	0.12275	0.10776		13.06
Target area post period trend	0.10298	0.02963	***	10.85
Comparable area level	−0.25445	0.03957	***	−22.47
Comparable area trend	−0.00766	0.00626		−0.76
Comparable area post period level	0.03775	0.02980		3.85
Comparable area post period trend	0.01182	0.00845		1.19
Control variables				
Sale date Apr–Jun	0.04586	0.00826	***	4.69
Sale date Jul–Sep	−0.00950	0.00919		−0.95
Sale date Oct–Dec	−0.01041	0.00927		−1.04
Sale date 1991/92	0.02676	0.02845		2.71
Sale date 1992/93	−0.03399	0.03244		−3.34
Sale date 1993/94	−0.02642	0.02915		−2.61
Sale date 1994/95	−0.03774	0.03001		−3.70
Sale date 1995/96	0.03027	0.02503		3.07
Sale date 1996/97	0.04609	0.02550		4.72
Sale date 1997/98	0.11521	0.02472	***	12.21
Sale date 1998/99	0.16275	0.02412	***	17.67
Sale date 1999/00	0.32672	0.02385	***	38.64
Sale date 2000/01	0.37807	0.02344	***	45.95
Sale date 2001/02	0.44942	0.02360	***	56.74
Sale date 2002/03	0.53994	0.02320	***	71.59
Sale date 2003/04	0.62405	0.02485	***	86.65
Bldg. living area (100s sq. ft.)	0.02060	0.00144	***	2.08
Lot acreage	0.14867	0.03038	***	16.03
2 stories	0.07534	0.00960	***	7.83
3+ stories	−0.08450	0.01664	***	−8.10

Regression results continued

Independent variables	Parameter estimate	SE[a]	Signif.	% change due to a one-unit change in x[b]
1–5 rooms	−0.11360	0.01613	***	−10.74
6 rooms	−0.04772	0.01141	***	−4.66
7 rooms	0.00827	0.00861		0.83
9 rooms	0.01728	0.00965		1.74
10+ rooms	0.00475	0.01244		0.48
2 baths	0.08327	0.00835	***	8.68
3+ baths	0.24972	0.01404	***	28.37
No fireplaces	−0.13144	0.00851	***	−12.32
2+ fireplaces	0.11822	0.01145	***	12.55
Wood exterior	−0.13473	0.00925	***	−12.60
Aluminum exterior	−0.11192	0.01121	***	−10.59
Asbestos exterior	−0.15839	0.01403	***	−14.65
Stucco exterior	−0.14716	0.01634	***	−13.68
Other exterior (except brick)	−0.16422	0.01847	***	−15.14
Dry wall interior	−0.05170	0.01748	**	−5.04
Central A/C	0.12180	0.00696	***	12.95
Forced air heating	−0.07900	0.00869	***	−7.60
Wall heating	−0.11101	0.01392	***	−10.51
Radiant heating	−0.07589	0.01581	***	−7.31
Other heating (except hot water)	−0.18480	0.01599	***	−16.87
Built 1910 or earlier	0.06976	0.02044	***	7.22
Built 1911–1920	−0.05843	0.01780	**	−5.68
Built 1921–1930	0.00167	0.01279		0.17
Built 1931–1940	0.10132	0.01121	***	10.66
Built 1951–1960	−0.02506	0.00908	**	−2.48
Built 1961–1970	0.04846	0.02103	*	4.97
Built 1971 or later	0.18972	0.02300	***	20.89
Spatial heterogeneity correction variables				
X	−0.08404	0.00517	***	−8.06
Y	0.19879	0.00402	***	21.99
X * X	−0.06301	0.00280	***	−6.11
X * Y	−0.12446	0.00467	***	−11.70
Y * Y	−0.00372	0.00323		−0.37

Notes:

a. This is White's robust standard error estimate.

b. This is the percent change in home prices associated with a one-unit change in the independent variable, using the formula $100\,(e^{b}-1)$, where b is the parameter estimate.

Significance (two-tailed): *$p < 0.05$ **$p < 0.01$ ***$p < 0.001$