The Effect of Residential Investment on Nearby Property

Cleveland, Ohio

Authors

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Abstract

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This study analyzes the effect of both new and rehabilitation residential investment on nearby property values in Cleveland, Ohio. The methodology used is hedonic price regression with spatial lagged variables that are generated applying geographic information systems. There are four major findings. First, the effect of investment on property values is geographically limited. Second, new investment has a greater impact on nearby property values than rehabilitation. Third, there is evidence that new construction and rehabilitation have a significantly positive impact in low-income areas, as well as predominantly non-minority neighborhoods. Finally and most importantly, the research suggests that small-scale investment has no impact on nearby property values. Thus, investment policy, which promotes and encourages investments that are not sufficiently large, may not be able to improve tax bases and enhance neighborhoods. We also found that results could be misleading if spatial lagged variables are inappropriately measured.

Introduction

For decades, many have sought to understand the factors causing fluctuations in housing values, including economists, real estate practitioners and geographers. Urban planners and policymakers have a special interest in housing values, since the dynamics of the housing market is linked to the reshaping of the urban landscape.

A hedonic approach is commonly used to estimate property values derived from structural variables, such as type of housing, number of bedrooms, living space and presence of a fireplace, garage or basement; location variables, such as distance to central business districts (CBDs), distance to shopping centers and transportation networks; and neighborhood variables, such as schools, public services and safety (Can, 1990). The housing market is also subject to external factors, such as environmental pollution, highway and airport noises, and the presence of underground storage tanks. These factors can affect property values either positively or negatively. The former increases property values whereas the latter decreases them.

Direct business investments in housing rehabilitation (rehab) and new construction can be identified, but the true effects and benefits to government and society, and the interconnection between these outputs and the total value imparted has not been adequately addressed in a formal input/output or cost/benefit context. For example, long-term positive impacts that rehab investment may have on increased homeownership (stable neighborhoods, resultant increased property tax payments to political jurisdictions and increases in property values) have often been alluded to but not documented.

Empirical studies show that residential investments such as new construction and rehabilitation have a positive effect on nearby property values (Simons, Quercia and Maric, 1998). Thus, properties located near the sites of neighborhood investments are expected to have higher values than those far away do. However, the positive effects of residential investments can be reduced by the overall neighborhood's effect on property values. This is because the former may refer to a very limited geographic area, whereas the latter may refer to a relatively large area, such as a school district and other neighborhood variables, which represent and capture an aggregate effect. For instance, school quality variation within school districts is usually neglected.

There are, however, a number of issues that the literature has not addressed and that may have significant impacts on housing policymaking and neighborhood redevelopment practices. First, the geographic scope of the effect of residential investment on nearby property values is undetermined. This is an important issue since the aggregate marginal effect of residential investments depends on the geographic scope. The larger the geographic scope, the higher the marginal social benefits are.

Second, the literature does not indicate in which area—relatively less affluent or wealthier—the effect of residential investment on nearby property values is more significant. This is an important issue since policymakers want to know whether residential investment has a positive and significant impact on neighborhood redevelopment in poor areas. The answer to the question can also be used to evaluate the effectiveness of government and community efforts in revitalizing inner cities through subsidizing housing development.

The third issue is whether the size of residential investment contributes to increases in nearby property values. This issue is also closely associated with a fourth issue, which strategy—either small and spatially diverse investment or large and spatially concentrated investment—urban policy should promote and encourage in order to yield larger total marginal effects on nearby property values. The policy implications are substantial.

This study provides answers for the aforementioned issues by conducting the hedonic price regression with spatial lagged variables that are generated using GIS (geographic information systems) and used to capture the effect of residential investment on nearby property values. GIS is used in linking parcel data to neighborhood data derived from United States Census Data for 1990. Statistical tests allow us to test the significance of spatial lagged variables that are used in this article to address all the research questions mentioned.

This research is organized as follows. The next sections discuss the literature, present the model and research questions, describe the study area and data, and discuss the results. The final section discusses policy implications and conclusions.

Literature Review

Hedonic price regression has been widely used in housing market analysis. The estimation of housing attribute demand and the impact of public services are conducted by Kain and Quigley (1970), Linneman (1980), Palmquist (1984) and Bajic (1985). Bajic (1985) and Anselin and Griffith (1988) analyzed the spatial effect of the marginal prices of attributes.

Studies on the neighborhood effects on property values include landfills (Pettit and Johnson, 1987; Cartee, 1989; and Nelson, Genereux and Genereux, 1993); air pollution (Ridker and Henning, 1967); racial discrimination (Nourse, 1976; Vandell and Zerbst, 1984; and Holmes and James, 1994); crime and vandalism (Li and Brown, 1980); underground storage tanks (Dotzour, 1997; and Simons, Bowen and Sementelli, 1997); and earthquake (Willis and Asgary, 1997). The common conclusion from these studies is that property values are positively and negatively correlated with desirable and undesirable neighborhood characteristics, respectively.

Can (1990) groups the determinants of property value into the following categories: location, structural and neighborhood variables. According to urban economic theory, location variables enter the price determination equation of property values because residents living far away from employment centers incur higher commuting costs and should be compensated by lower land and housing prices in order to maintain spatial equilibrium. Neighborhood variables are also capitalized into property values through the amenity effect.

Empirical studies suggest that there is an effect of the concentration of a large number of new housing units on the value of nearby existing properties, and the effect, if present, is restricted geographically (Segal, 1977; and Varady, 1986). This implies that the geographic scope of new housing construction is limited

(DeSalvo, 1974; Dear, Fincher and Currie, 1977; Quigley, 1982; and Varady, 1986).

Simons, Quercia and Maric (1998) demonstrated that new housing construction has a substantial positive impact on nearby property values. On average, they found that the sale price of an existing home increased by $670 for each new unit erected within two to three blocks. Rehabilitation was found to have a small negative effect on sales price, a counterintuitive finding.

This research extends Simons, Quercia and Maric's (1998) work by substantially improving the measures of spatial lagged variables.[1] Various spatial lagged variables are also generated to examine the spatial decay of investments on nearby property values, which enables us to understand the geographic limits of the effect. More importantly, interactive terms are used to address the agglomeration/scale effect of neighborhood investment, which is absent in their article. The effect of agglomeration/scale of investment may have a profound impact on policymaking with respect to investment direction.

Model and Research Questions

The first hypothesis is that the effect of residential investment on nearby property values declines with distance between the location of the residential investment and the proximity to nearby housing. If so, the effect will eventually vanish over distance. Thus, the key question is where the boundaries lie. Different spatially lagged variables are used to capture changes in the effect of residential investment. The basic model is expressed as:

$$P = \beta_0 + \beta_1 S + \beta_2 N + \beta_3 IN + \beta_4 IR = e, \qquad (1)$$

where:

P = Housing price;
S = Vector of structure variables;
N = Vector of neighborhood variables (including location);
IN = Vector of investment of new construction;
IR = Vector of investment of rehabilitation; and
e = Disturbance term.

A linear functional form is chosen for the housing price equation because it is easy to interpret the coefficients, and the model's properties are well known.

It is expected that both β_3 and β_4 have a significantly positive sign and decrease as the houses are further from the location of residential investment. However, it may conversely be argued that new housing construction may depress the sale price of a nearby existing unit directly or indirectly by increasing supply while holding demand constant. We do not expect this to occur in the Cleveland market since huge difference in sales prices between existing and new ones preclude direction competition (Simons, Quercia and Maric, 1998).

The second hypothesis is that the effect of residential investment on nearby property values changes across neighborhoods. For instance, residential investment in a relative less affluent area might have a larger effect than in a wealthier neighborhood. This phenomenon is referred to as spatial drift of coefficients (Can, 1990). A common approach to capture neighborhood effect is to include interactive terms in Equation (1). Suppose that spatial drift is captured by $\beta_3 = \beta_{30} + \beta_{31}N + e$ and $\beta_4 = \beta_{40} + \beta_{41}N + e$. Combining them with Equation (1) yields the following model:

$$P = \beta_1 + \beta_1 S + \beta_2 N + \beta_{30} IN + \beta_{40} IR + \beta_{31} IN \cdot N + \beta_{41} IR \cdot N + e. \qquad (2)$$

It is expected that both β_{31} and β_{41} are significant.

The third and last hypothesis is related to economies of scale in the positive externality resulting from residential investment. If the economies of scale are present, the marginal gains in nearby property values will increase with the size of the residential investment. This is an important issue because policymakers focus on the promotion of neighborhood development through subsidizing residential development. One of the key questions is which investment, small, spatially diverse or large, spatially concentrated investment policy might best maximize property values in the neighborhood. Non-linear investment variables are added in Equation (1) to test this hypothesis. Those research questions, to our knowledge, have not been addressed adequately in the literature, thus we consider this article as a substantial extension of Simons, Quercia and Maric's work (1998).

Study Area and Data Preparation

The study area for this research is the city of Cleveland, Ohio. Typical of a mature Midwestern central city with a declining industrial base, Cleveland's population declined from about 915,000 in 1950 to 506,000 in 1990, a reduction of 45%. Since 1950, the number of housing units has declined from 270,900 to 224,300, a reduction of 46,600 units, or 17% (U.S. Department of Commerce). To offset this substantial decline, promoting new housing is the top priority in the city development administrators' agenda. Aggressive housing subsidy policies have increased new housing starts since 1991 by a factor of five over the previously anemic levels prior to program inception (the average was only about 50 units per year). Community development corporations (CDCs) are active in Cleveland and are supported by local foundations. Annual resources available for community development are in excess of $35 million. Moreover, top-city community development leadership in recent years has been very supportive of the role of nonprofit organizations in housing development. Nearly all of the housing projects built in the city in recent years have had major CDC involvement. The city also has had a residential land bank lot program in operation since 1988.

Data used in this study were collected from different sources. The structural data of sale transactions of properties were obtained from the Cuyahoga County Auditor/Amerestate database. Structural variables included the house style, type of basement, type of external wall, season of sales, garage size, building age, living space, number of bedrooms and many others. Neighborhood demographic characteristics were obtained from 1990 U.S. census data. Neighborhood variables used in this study include median household income, poverty ratio, the percentage of African-American population, household changes in the period of 1980–90, crime and delinquency. The crime and property tax delinquency data were extracted from data used by Simons, Quercia and Maric (1998). GIS was used to link neighborhood data to the structural data of properties through its overlay function.

The Department of Community Development, city of Cleveland, provided neighborhood residential investment data, which included information such as location, date, type (new or rehabilitation), and amount of investment and property tax abatements. These parcels were placed in real space using GIS. Nearly all new housing projects in the city were heavily subsidized by city government. For instance, a typical new "market rate" housing unit would cost \$130,000 to develop and build, but after a city subsidy of \$25,000 per unit, the property would be sold for about \$105,000 (Simons and Sharkey, 1997). The data used in this study are residential investments for property tax abatement purposes. They neglect the value of improvements, not the value of the unit or its sales price.

Only single-family houses sold in 1996 and 1997 were selected. After cleaning data (such as deleting records with missing observations, deleting non-arms-length transactions and omitting observations whose parcel identification numbers were not matched in a geographic information file), we ended up with 7,751 total sales from 1996 and 1997 sales. Matching sales and investment data to the corresponding geographic file is a key in this study since spatial lagged and locational variables are generated with GIS. Without GIS, the task of measuring these variables is prohibitive from the cost and time perspective. Sales of more than \$200,000 were deleted as outliers. In addition, sales of less than \$2,000 were also excluded because the structure may not be physically present. Thus, 7,633 observations were used in the regression analyses. These sales were also placed in real space, and thus could be recognized as proximate to residential housing investment. Exhibit 1 lists the descriptive statistic of structural and neighborhood variables. The typical unit sold for \$54,200, contained 1,230 square feet of living area, had 2.9 bedrooms and 1.1 baths, and was located on a lot with frontage of 41 feet.

Cumulative residential investments from 1990 to 1995 were counted. Investments in 1996 were not considered because new construction may not be finished in

Exhibit 1 | Descriptive Statistics of Structural and Neighborhood Variables

	Mean	Maximum	Minimum	Std. Dev.
PRICE	54,192.99	198,000	2,200	28,569.28
CON_G_VG	0.04	1	0	0.21
CON_AVG	0.58	1	0	0.49
CON_FAIR	0.24	1	0	0.43
CON_POOR	0.10	1	0	0.31
BSM_CRAWL	0.05	1	0	0.21
BSM_SLAB	0.05	1	0	0.23
BSMFINISH	0.00	1	0	0.07
BSM_PART	0.09	1	0	0.28
STYLE_BUN	0.40	1	0	0.49
STYLE_RAN	0.13	1	0	0.34
EXTWALL_1	0.04	1	0	0.19
EXTWALL_2	0.45	1	0	0.50
EXTWALL_3	0.12	1	0	0.32
SALE_96	0.52	1	0	0.50
WINTER	0.16	1	0	0.36
SPRING	0.27	1	0	0.45
FALL	0.27	1	0	0.44
FIREPLACE	0.13	9	0	0.38
GAR_CAPAC	1.25	7	0	0.77
HEAT	0.04	1	0	0.21
PORCH	0.71	1	0	0.45
BEDROOM	2.93	8	0	0.77
BATH	1.10	4	0	0.28
AGE	70.97	197	2	21.52
LIVING_ARE	1,230.31	4,080	0	320.41
FRONT	41.15	500	5	11.86
DEPTH	123.91	1,372	11	38.54
POV89R	19.05	75	3	13.49
INC90	22,150.66	34,789	4,999	6,160.58
AAP90	24.97	154	0	38.30
HH_CH	−3.72	36	−61	7.90
CR_TYP	25.49	172	8	11.33
DELQ	2.56	38	0	4.25
DISTCBD	6.04	10.82	0.45	1.80
EW	0.39	1	0	0.49

Exhibit 1 | (continued)

Descriptive Statistics of Structural and Neighborhood Variables

	Mean	Maximum	Minimum	Std. Dev.
NEW150	1,102.17	700,500	0	16,369.95
NEW300-NEW150	3,937.52	1,861,750	0	35,687.09
NEW500-NEW300	8,640.30	1,640,000	0	60,768.51
REH150	1,044.33	214,500	0	6,915.39
REH300-REH150	3,325.90	704,787	0	22,759.70
REH500-REH300	7,026.71	815,141	0	32,215.73
NEWNUM150	0.01	7	0	0.19
NEWNUM300-NEWNUM150	0.05	19	0	0.42
NEWNUM500-NEWNUM300	0.12	17	0	0.78
REHNUM150	0.04	3	0	0.23
REHNUM300-REHNUM150	0.11	5	0	0.39
REHNUM500-REHNUM300	0.23	6	0	0.63
LGSCALENEW	523.38	700,500	0	13,747.84
MDSCALENEW	410.60	201,000	0	6,399.70
SMSCALENEW	168.05	148,280	0	4,074.80
LGSCALEREH	295.72	214,500	0	4,990.54
MDSCALEREH	688.02	90,000	0	4,558.32
SMSCALEREH	60.46	28,165	0	917.37

Note: Sample size = 7,633.

1996 and not be capitalized into the housing price market yet. Some sales occurred before the investments might have been made, which also poses serious measurement concerns. In doing so, we assumed that the effect of all investment before 1995 would be manifested in the housing market in 1996 and afterward. Thus, there were a total of 543 new housing units and 595 houses with substantial rehabilitation, respectively. The mean values of the invested amounts were $82,071 for new units (median value $67,500) and $31,031 for rehabilitation units ($25,802 median value).

Finally, GIS was employed to calculate distance measures between the sites of residential investments (new construction and rehabilitation) and the location of sale transactions as well as distance to the Cleveland CBD. Sales and investment sites were geocoded through Parcel-IDs, and the geometric centers (centriods) are used as location representatives. Therefore, distances between sales and investments sites are calculated between centroids. Various distance measures (150, 300 and 500 feet) were used to reflect and demonstrate the spatial decay effect of residential investments on nearby property values. There were 120 and 229 sales within the 150-feet zone, close to the residential investments.

Empirical Results

Exhibit 2 presents the estimate results of Equation (1). Two types of investment variables are used. One is the total dollars and the other is the total number of projects. Since the results are similar for non-investment variables, our analysis focuses on results with total dollars. In addition, the Box-Cox transformation on the dependent variables is conducted to test the nonlinearity of the housing sales pricing. The results show that the Box-Cox transformation has little impact on the overall estimates of sales price.[2]

Overall, this model fits the data well. The independent variables explain nearly 61% of the dependent variables. The model derives expected signs at various significant levels for most of the variables. For instance, twenty-nine out of the thirty-five non-investment variables (including structural, location and neighborhood variables) are significant with expected signs.[3]

The structural variables explain the price difference very well. Homes in good or very good condition sold for $10,000 more, while a house in average condition sold for $4,000 more. Substantial amounts were discounted if the house condition was fair or poor. Exterior walls of aluminum/vinyl siding and brick types cost approximately $250 and $5,500 more, respectively. It also costs more than $5,000 to add a bath (the cost for a half bath was substantially lower). A square foot of interior living space increased value of just under $18 per square foot. Annual price appreciation between 1996 and 1997 was more than $1,500. Seasonal variables were also significant. Winter and spring are the best seasons for consumers to purchase a house. In winter, the price is reduced by over $1,700, ceteris paribus. Housing stock depreciates at about $300 per year of age. House price increases by more than $800 for every mile away from the Cleveland CBD. This result goes against the expected theory, but can be explained by the large number of relatively inexpensive houses close to the downtown area. Many of the city's higher-priced neighborhoods are at the edge of the municipal boundary with the inner ring suburbs.

All neighborhood variables, except the poverty ratio, are significant with expected signs at least at the 90% level. Property values increase with median household income and decrease with African-American population, population changes, crime, delinquency and poverty ratio.[4] The housing market is also spatially segmented. Housing sales west of the Cuyahoga River are typically $2,000–$3,000 more expensive than on the east side of the city, holding all else constant.

There are two major interesting findings with regard to the effect of residential investments on nearby property values from Exhibit 2. The first one is that results overwhelmingly support the notion that residential investments increase nearby property values. A dollar investment of new construction, for instance, will raise

Exhibit 2 | Estimated Results of the Base Model

Variable	Coeff.	*t*-Stat.	Variable	Coeff.	*t*-Stat.
C	23,360.10	6.23	*C*	23,257.25	6.18
CON_G_VG	9,951.00***	5.94	*CON_G_VG*	9,998.16***	5.96
CON_AVG	4,058.83**	3.02	*CON_AVG*	3,982.57**	2.95
CON_FAIR	−2,193.40	−1.73	*CON_FAIR*	−2,268.43	−1.78
CON_POOR	−3,018.85**	−2.30	*CON_POOR*	−3,010.93**	−2.29
BSM_CRAWL	−8,864.81***	−8.29	*BSM_CRAWL*	−8,904.21***	−8.30
BSM_SLAB	−7,676.97***	−7.77	*BSM_SLAB*	−7,747.41***	−7.82
BSMFINISH	5,419.88	1.73	*BSMFINISH*	5,302.13	1.69
BSM_PART	5,031.18***	6.49	*BSM_PART*	4,982.57***	6.41
STYLE_BUN	−2,571.68***	−5.24	*STYLE_BUN*	−2,607.26***	−5.30
STYLE_RAN	−3,511.09***	−4.19	*STYLE_RAN*	−3,593.33***	−4.28
EXTWALL_1	−5,510.65***	−4.81	*EXTWALL_1*	−5,502.44***	−4.79
EXTWALL_2	336.35	0.72	*EXTWALL_2*	354.44	0.76
EXTWALL_3	5,544.17***	7.48	*EXTWALL_3*	5,536.58***	7.45
SALE_96	−1,529.78***	−3.70	*SALE_96*	−1,536.93***	−3.71
WINTER	−1,773.83**	−2.76	*WINTER*	−1,772.51**	−2.75
SPRING	−586.26	−1.08	*SPRING*	−561.77	−1.03
FALL	102.22	0.19	*FALL*	79.14	0.15
FIREPLACE	5,490.48***	9.62	*FIREPLACE*	5,493.70***	9.60
GAR_CAPAC	2,380.41***	8.17	*GAR_CAPAC*	2,357.73***	8.07
HEAT	2,250.96*	2.11	*HEAT*	2,328.02*	2.18
PORCH	1,243.76**	2.37	*PORCH*	1,240.33**	2.36
BEDROOM	−969.07***	−2.86	*BEDROOM*	−988.82***	−2.91
BATH	5,037.43***	6.12	*BATH*	5,193.01***	6.30
AGE	−295.89***	−17.83	*AGE*	−299.22***	−17.99
LIVING_AREA	17.50***	18.59	*LIVING_AREA*	17.47***	18.50
FRONT	164.47***	8.70	*FRONT*	162.24***	8.57
DEPTH	30.52***	5.33	*DEPTH*	32.83***	5.77
POV89R	−65.80	−1.36	*POV89R*	−48.92	−1.01
INC90	0.87***	9.59	*INC90*	0.88***	9.64
AAP90	−92.64***	−9.46	*AAP90*	−93.79***	−9.54
HH_CH	−88.56**	−2.51	*HH_CH*	−80.95**	−2.29
CR_TYP	−285.02***	−10.39	*CR_TYP*	−287.97***	−10.45
DELQ	−187.99**	−2.68	*DELQ*	−198.38***	−2.81
DISTCBD	884.79***	4.07	*DISTCBD*	859.46***	3.93
EW	−2,890.37***	−4.22	*EW*	−2,825.30***	−4.04

Exhibit 2 | (continued)

Estimated Results of the Base Model

Variable	Coeff.	t-Stat.	Variable	Coeff.	t-Stat.
NEW150	0.06***	3.94	*NEWNUM150*	4,568.17***	3.51
NEW300-NEW150	0.02*	2.08	*NEWNUM300-NEWNUM150*	891.15	1.32
NEW500-NEW300	0.01	1.76	*NEWNUM500-NEWNUM300*	621.41	1.84
REH150	0.13***	4.16	*REHNUM150*	2,108.46**	2.26
REH300-REH150	−0.01	−1.29	*REHNUM300-REHNUM150*	−761.85	−1.29
REH500-REH300	0.00	0.38	*REHNUM500-REHNUM300*	135.80	0.35
R^2	0.609			0.607	
Adj. R^2	0.607			0.605	

Note: The adjusted R^2 value is close to R^2, we report only the R^2 value afterward.
*Significant at the 90% level.
**Significant at the 95% level.
***Significant at the 99% level.

housing prices within 150 feet area (zone 1) by 6.1 cents.[5] This means that a house will sell for about $5,000 (average investment amount of $82,000*0.06) more if a new house is constructed nearby. The average increase is about $4,500 if the number of units, instead of total dollar amount of new constructions, is used. Rehabilitation also has a significant impact on nearby housing sales prices. A house is expected to sell for almost $4,000 (average investment amount of $31,000*0.127) more if it is located within 150 feet of a substantially rehabbed house. That figure is slightly more than $2,000 if the number of rehabilitation is used.

The second finding involves the effect of residential investment on property values. As expected, the effect declines at a high rate over distance and vanishes within a limited geographic scope. In general, the effect of new construction is confined to zone 2 (150 to 300 feet buffer area) compared to zone 1 for rehabilitation. Even for new construction, the magnitude of the effect on zone 2 has been substantially diminished, compared to zone 1. This illustrates that results are overestimated if data are organized based on map book page relation as Simons, Quercia, and Maric (1998) did. The negative sign for rehabilitation in Simons, Quercia and Maric may be due to the poor measurement in the spatial lagged variables.

These findings can be used to calculate positive externalities resulting from the residential investments. Such calculation can then be used to determine the magnitude of subsidies and property tax abatement by municipal governments in promoting neighborhood development and revitalization.

Exhibit 3 presents the estimated results of the extended model with interactive terms. Based on the previous results, only zone 1 (less than 150 feet) is included in order to focus on the changes in property values resulting from residential investments. It is revealed, by examining the interactive terms, that the effect is more significant in the relatively less affluent and predominantly white areas. These results are also consistent with the ones resulting from an alternative approach running Equation (1) on separate data sets. The data sets are obtained by dividing the observations into two groups, one with a median income $23,000 and up and the other with a median income less than $23,000. The results are summarized in Exhibit 4. The effect of new construction varies substantially across neighborhoods. This is striking in contrast to rehabilitation since there is moderate or little change in its impact on nearby property values. Furthermore, residential investment usually does not have any impact on property values beyond 300 feet away for new construction and 150 feet away for rehabilitation. These conclusions are proved to be consistent throughout our study.

Exhibit 5 presents the characteristics of locations of residential investment with breaking points determined in Exhibits 6 and 7. Location pattern analysis illustrates that large-scale residential investments (new construction and rehabilitation) were concentrated in white-dominant neighborhoods. Large-scale new constructions (larger than $70,000) tend to locate in neighborhoods with high-property values. They, for instance, were located in neighborhoods whose average nonwhite population is 38%, which is remarkably low compared to 76% and 54% for middle- and small-scale new constructions, respectively. Middle-scale residential investment tends to occur in areas with the lowest housing values and the highest nonwhite population percentage, although it is a dominant type of investment. There were thirty-five sales located to new constructions worth more than $88,000, whereas the average sale price was around $54,000. In contrast, middle- and small-scale new constructions were located in areas with low property values. The average prices were approximately $36,000 and $56,000 respectively. The insignificance of middle-scale new constructions clearly has something to do with their locations.

Typically, the rehabilitation has no impact on properties located beyond the 150-foot buffer. Housing located in the 150-to-300-foot buffer is still more affected by new construction than less affluent areas.

Examining the coefficients across tables suggests that the model is stable. Comparing Exhibits 2 and 3 (first columns in both tables), the average changes of all significant structural and neighborhood variables is 5.6%.

Exhibit 8 presents the results with two types of investment variables: linear term and nonlinear term.[6] The reason to include these two variables for each type of

Exhibit 3 | Neighborhood Effect on Investment Impact

Variable	Coeff.	*t*-Stat.	Variable	Coeff.	*t*-Stat.
C	24,177.98	6.48	*C*	23,776.53	6.34
CON_G_VG	9,277.00***	5.55	*CON_G_VG*	9,639.77***	5.74
CON_AVG	3,728.29**	2.78	*CON_AVG*	3,898.18	2.89
CON_FAIR	−2,331.38	−1.84	*CON_FAIR*	−2,249.71	−1.77
CON_POOR	−2,936.97**	−2.25	*CON_POOR*	−2,877.32*	−2.19
BSM_CRAWL	−8,883.65***	−8.32	*BSM_CRAWL*	−8,883.00***	−8.29
BSM_SLAB	−7,590.50***	−7.70	*BSM_SLAB*	−7,644.30***	−7.73
BSMFINISH	5,297.02	1.69	*BSMFINISH*	5,258.63	1.67
BSM_PART	4,953.37***	6.40	*BSM_PART*	4,958.14***	6.39
STYLE_BUN	−2,626.51***	−5.36	*STYLE_BUN*	−2,639.32***	−5.37
STYLE_RAN	−3,626.84***	−4.34	*STYLE_RAN*	−3,617.91***	−4.31
EXTWALL_1	−5,413.66***	−4.74	*EXTWALL_1*	−5,458.63***	−4.76
EXTWALL_2	286.38	0.62	*EXTWALL_2*	308.11***	0.66
EXTWALL_3	5,609.94***	7.58	*EXTWALL_3*	5,609.52	7.55
SALE_96	−1,563.63***	−3.79	*SALE_96*	−1,589.85***	−3.84
WINTER	−1,744.28**	−2.72	*WINTER*	−1,753.64**	−2.72
SPRING	−624.04	−1.15	*SPRING*	−578.25	−1.06
FALL	84.51	0.16	*FALL*	59.96	0.11
FIREPLACE	5,451.12***	9.58	*FIREPLACE*	5,448.80***	9.54
GAR_CAPAC	2,395.33***	8.24	*GAR_CAPAC*	2,355.34***	8.07
HEAT	2,121.61*	2.00	*HEAT*	2,225.45*	2.09

Exhibit 3 | (continued)

Neighborhood Effect on Investment Impact

Variable	Coeff.	*t*-Stat.	Variable	Coeff.	*t*-Stat.
PORCH	1,145.95*	2.19	*PORCH*	1,140.65*	2.17
BEDROOM	−964.92***	−2.86	*BEDROOM*	−930.09**	−2.74
BATH	5,046.17***	6.15	*BATH*	5,124.81***	6.22
AGE	−288.60***	−17.41	*AGE*	−292.29***	−17.52
LIVING_AREA	17.40***	18.53	*LIVING_AREA*	17.40***	18.45
FRONT	164.90***	8.75	*FRONT*	162.65***	8.59
DEPTH	30.02***	5.22	*DEPTH*	32.81***	5.76
POV89R	−68.00	−1.41	*POV89R*	−62.83	−1.30
INC90	0.85***	9.39	*INC90*	0.85***	9.42
AAP90	−90.35***	−9.16	*AAP90*	−90.21***	−9.08
HH_CH	−68.21	−1.93	*HH_CH*	−69.90*	−1.97
CR_TYP	−316.64***	−11.36	*CR_TYP*	−302.94***	−10.80
DELQ	−162.57**	−2.33	*DELQ*	−168.70**	−2.41
DISTCBD	995.83***	4.60	*DISTCBD*	931.37***	4.28
EW	−2,931.61***	−4.32	*EW*	−2,941.07***	−4.30
NEW150	0.70***	8.02	*NEWNUM150*	29,497.69***	5.44
REH150	0.30**	2.35	*REHNUM150*	5,408.79	1.40
*NEW150*INC90*	−3.15E-05***	−6.71	*NEWNUM150*INC90*	−1.02***	−3.59
*REH150*INC90*	−1.28E-05	−1.67	*REHNUM150*INC90*	−0.28	−1.25
*NEW150*AAP90*	−0.00***	−5.06	*NEWNUM150*AAP90*	−122.01***	−4.54

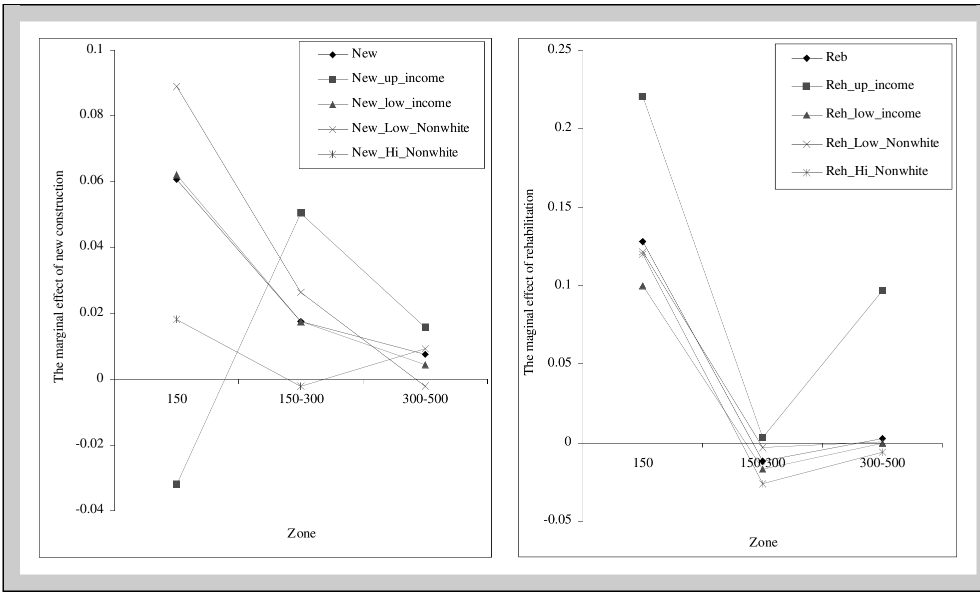
Exhibit 3 | (continued)

Neighborhood Effect on Investment Impact

Variable	Coeff.	*t*-Stat.	Variable	Coeff.	*t*-Stat.
*REH150*AAP90*	0.00	1.17	*REHNUM150*AAP90*	23.87	1.12
R^2	0.611			0.608	
Adj. R^2	0.609			0.606	

Note: The adjusted R^2 value is close to R^2, we report only the R^2 value afterward.
*Significant at the 90% level.
**Significant at the 95% level.
***Significant at the 99% level.

Exhibit 4 | The Spatial Changes in the Effect of Residential Investments



residential investment, instead of the Box-Cox transformation, is that it allows us to test not only nonlinearity but also the shape of the regression curve with respect to residential investment variables. The Box-Cox transformation can only test the nonlinearity. If both the coefficients of the linear and nonlinear terms are significant with opposite signs, the effect of residential investment will be either U-shaped or inverse U-shaped.

We concluded from Exhibit 8 that the effect of residential investment on nearby property values is linear for new construction and strictly nonlinear for rehabilitation with respect to investment size. Both *NEW150* and *REH150*REH150* have a significantly positive sign. Neither the nonlinear term of new construction nor the linear term of rehabilitation is significant, indicating that new construction does not exhibit economies of scale in the effect of residential investment on nearby property values, whereas rehabilitation does. This implies that the marginal effect resulting from new construction does not increase with the size of new construction, while the marginal effect from rehabilitation does increase with the size of rehabilitation.

Exhibit 9 presents results with investment variables that are broken into different categories: large, medium and small. The increases in the coefficients of large-scale investments are remarkable. It is, however, surprising to find that small-scale investment has no impact on nearby property values at all. The effect of middle-scale investment depends on neighborhood characteristics. The effect, for example,

Exhibit 5 | Neighborhood Characteristics of Residential Investment Sites

Category of Investment	Number of Investments	Number of Sales within 150 feet	*PRICE*	*POV89R*	*INC90*	*AAP90*	*HH_CC*	*DELQ*	*DUSCBD*
New: >70,000	34	37	88,864	28	17,151	38	−7	3	4.49
New: 60,000–70,000	44	51	36,878	27	17,422	76	−5	9	5.57
New: <60,000	19	32	55,603	28	11,732	54	−41	12	2.47
Reh: >32,500	41	49	50,840	31	17,079	38	−7	4	4.54
Reh: 15,000–32,500	159	230	33,370	31	16,812	51	−8	5	4.43
Reh: <15,000	29	41	30,919	31	16,807	50	−6	5	4.17

Exhibit 6 | Histogram of New Construction

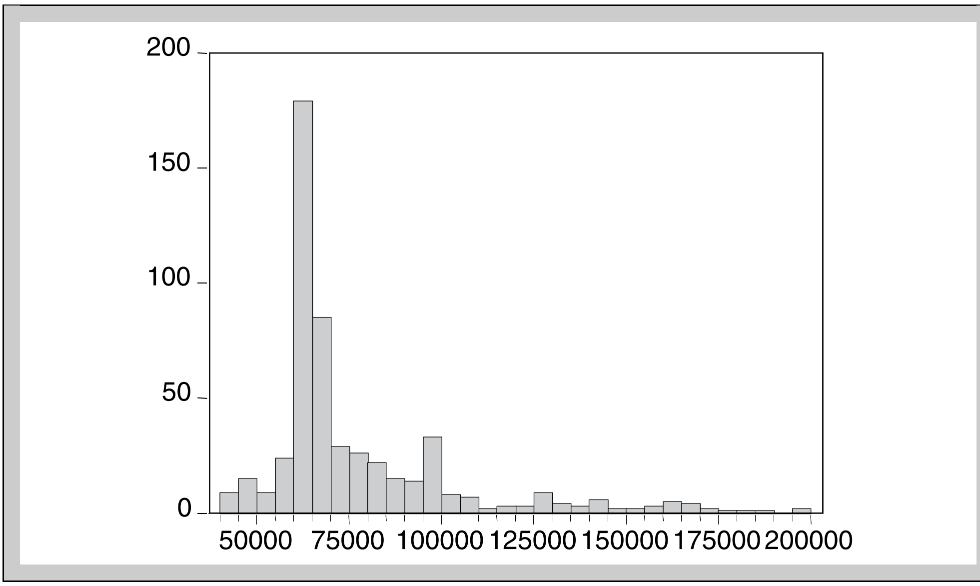


Exhibit 7 | Histogram of Rehabilitation

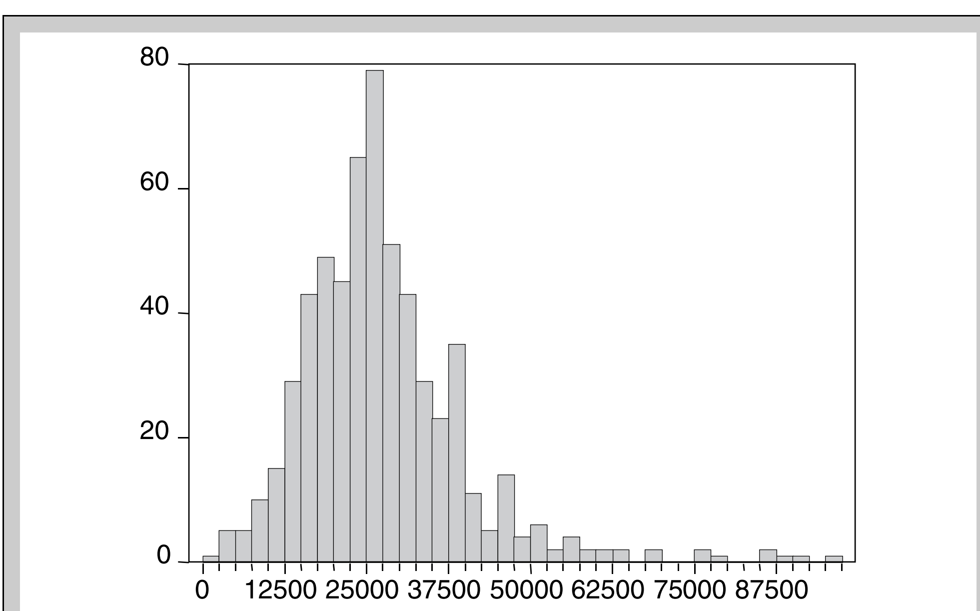


Exhibit 8 | The Scale Effect (1)

	All Cases		Income ≥ \$23,000		Income < \$23,000		*AAP90* ≥ 25%		*AAP90* < 25%	
Variable	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.	Coeff.	*t*-Stat.
NEW150	0.13**	4.62	1.12	1.80	0.11**	3.72	0.01	0.26	0.22**	5.30
*NEW150*NEW150*	−8.47E-08	−1.53	−1.71E-05	−1.87	−3.78E-08	−0.68	3.51E-08	0.42	−1.83E-07**	−2.40
REH150	−1.00E-02	−0.21	0.30	1.02	−0.06	−1.18	−0.04	−0.59	−0.01	−0.17
*REH150*REH150*	1.48E-06**	3.62	−2.09-06	−0.30	1.65E-06**	3.93	1.62E-06*	2.81	1.44E-06**	2.54
Sample	7,633		3,913		3,720		1,908		5,725*	

*Significant at the 90% level.
**Significant at the 95% level.

Exhibit 9 | The Scale Effect (2)

Variable	All Cases		Income ≥ \$23,000		Income < \$23,000		*AAP90* ≥ 25%		*AAP90* < 25%	
	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.	Coeff.	t-Stat.
LGSCALENEW	0.10***	6.81	−0.30**	−2.37	0.12***	7.76	0.06*	2.12	0.13***	6.46
MDSCALENEW	1.99E-02	0.61	0.37**	2.58	−0.01	−0.32	−0.02	−0.51	0.15	1.97
SMSCALENEW	1.03E-01	1.87	−0.20	−0.86	0.00	0.00	−0.04	−0.57	0.12	1.10
LGSCALEREH	1.86E-01***	4.42	0.16	1.09	0.18***	4.17	0.26**	3.82	0.15*	2.93
MDSCALEREH	0.07	1.52	0.36**	2.06	0.01	0.22	0.01	0.22	0.07	1.02
SMSCALEREH	−0.21	−0.92	−0.76	−1.07	−2.52	−1.09	−0.51	−1.90	0.18	0.44
Sample	7,633		3,913		3,720		1,908		5,725	

*Significant at the 90% level.
**Significant at the 95% level.
***Significant at the 99% level.

is significant in wealthier or white dominant areas. Large-scale investment has a prevalent impact through neighborhoods except in a wealthier area.

Before concluding, one general implication of these findings may be noted. The positive externalities in terms of the increased value of nearby properties resulting from residential investments in new or rehabilitated housing units are expected to influence the value of the latter as a secondary or feedback effect. The value or the sales price of a residential unit is influenced by the median/average price of the housing stock in a given neighborhood. To the extent that investment in a residential unit increases the median/average home price of the surrounding properties, it will have a positive impact on the value of the new or remodeled unit itself. Such an overall increase in the value of residential units in a neighborhood may reflect the increase in the land value, as the area becomes more desirable.[7]

Policy Implications and Conclusion

This study documents the effect of residential investments on nearby property values. It examines not only the issue of the spatial decay of the effect but also the spatial drift of the effect. More importantly, this article examines the scale effect of investment on the housing market. Conclusions may have profound impact on the policymaking process regarding neighborhood revitalization and inner-city redevelopment.

One of the most significant findings is that the effect of residential investments hardly extends beyond one block (300 feet on average, assumed). This conclusion is consistent with previous work and remains true regardless of whether the total dollar or total number is used in the regression analysis (Segal, 1977; Vardady, 1986; and Simons, Quercia, and Marci, 1998). New construction's impact on nearby property values is more spatially extensive than that of rehabilitation. Houses will sell for $4,500 more if a new construction is located within 150 feet and for $2,000 more if a rehabilitation is present nearby. Various tests in this study suggest that new construction has no impact on property values beyond 300 feet away, compared to 150 feet for rehabilitation.

The study findings also suggest two additional issues. First, the effect of residential investment, particularly for new construction, varies across neighborhoods. The effect of new construction is much greater in either low-income or in predominantly white areas, compared to either upper-income or nonwhite dominant areas, respectively. This indicates the presence of the influence of racial and income factors on the housing market. Rehabilitation, however, has a much larger impact in a wealthier area for unknown reasons.

Second and more importantly, a small scale of investment may have little impact on sale price whereas a larger scale does. Consequently, policy should encourage investments that are concentrated and large enough to observe the effect. Conversely, small and spatially diverse investment should be discouraged.

Third, with respect to community revitalization and public policy, the implication of this study is that the positive effect of residential investment can be maximized if the investment sites are selected to be 150 feet apart from each other. In other words, a concentrated residential investment strategy, known as the "demonstration block" approach in community revitalization literature, in contrast to the 150-foot spread approach suggested by this study, will have a smaller positive impact on the value of proximate properties.

Finally, GIS enabled us to examine the spatial effect of residential investment on the housing market at the "micro" level. Therefore, we proved that rehabilitation also plays a significant role in neighborhood revitalization and community redevelopment. This strikingly contradicts the conclusion of Simons, Quercia and Maric (1998), whose conclusion may partially be attributed to the inappropriate measurement of spatial lagged variables. This study shows that the investment impact never reached more than two to three blocks away.

In summary, our research in Cleveland shows that residential investment in new construction or rehabilitation has a positive impact on the value of properties located within the 150-foot radius of the investment site. This study also indicates that such an impact is larger in low-income neighborhoods as well as in predominantly white neighborhoods. Moreover, in order to improve the real estate tax base and enhance neighborhood property value, residential investment in new construction and rehabilitation must be sufficiently large. It should be noted that our research findings pertain only to Cleveland and they cannot be generalized in other housing markets. A replication of this study in other areas would show the extent of the external validity of our case study.

Appendix

Variables and Definitions

Variable	Definition
PRICE	Prices of sold properties in 1996 and 1997
CON_G_VG	Dummy—very good and good conditions
CON_AVG	Dummy—average condition
CON_FAIR	Dummy—fair condition
CON_POOR	Dummy—poor condition
BSM_CRAWL	Dummy—basement type of crawl
BSM_SLAB	Dummy—basement type of slab
BSMFINISH	Dummy—basement finished
BSM_PART	Dummy—basement partially finished
STYLE_BUN	Dummy—style of bungalow

Variables and Definitions (continued)

Variable	Definition
STYLE_RAN	Dummy—style of ranch
EXTWALL_1	Dummy—exterior walls of ASB shingles
EXTWALL_2	Dummy—exterior walls of aluminum / vinyl siding
EXTWALL_3	Dummy—exterior walls of brick / stucco, brick, stone, stucco, and frame / brick
SALE_96	Dummy—sold in 1996
WINTER	Dummy—sold in winter
SPRING	Dummy—sold in spring
FALL	Dummy—sold in fall
FIREPLACE	Dummy—fireplace
GARAGE	Numbers of garage capacity
HEAT	Dummy—ot forced hot air heat
PORCH	Dummy—porch
BEDROOM	Numbers of bedrooms
BATH	Numbers of bathrooms (half bath is counted as 0.5 full bath)
AGE	Age of the building at the time it is sold
LIVING_AREA	Square feet of interior space
FRONT	Lot frontage in feet
DEPTH	Lot depth in feet
POV89R	Poverty percentage in tract, 1989
INC90	Median household income in tract, 1990
AAP90	African-American percentage in tract, 1990
HH_CH	Household change in tract, 1980–1990
CR_TYP	Type 1 crime index in tract
DELQ	Percentage of housing units within 1–2 blocks over 15% delinquent on property taxes
DISTCBD	Distance to the CBD of Cleveland
EW	Dummy—side of Cleveland metro. 1 for the east
NEW150, 300 500	New construction ($) within 150, 300 and 500 feet, respectively
REH150, 300 ,500	Rehabilitations ($) within 150, 300 and 500 feet, respectively
NEWNUM150, 300, 500	Number of constructions within 150, 300, and 500 feet, respectively
REHNUM150, 300, 500	Number of rehabilitations within 150, 300, and 500 feet, respectively
LGSCALENEW	Total investments of larger than $70,000 new constructions within 150 feet
MDSCALENEW	Total investments of new constructions between $60,000 and $70,000 within 150 feet

Variables and Definitions (continued)

Variable	Definition
SMSCALENEW	Total investments of smaller than $60,000 new constructions within 150 feet
LGSCALENEW	Total investments of larger than $32,500 rehabilitations within 150 feet
MDSCALENEW	Total investments of rehabilitations between $15,000 and $32,000 within 150 feet
SMSCALENEW	Total investments of smaller than $15,000 rehabilitations within 150 feet

Endnotes

1 The map-book page approach roughly captures the spatial influence, since it does not distinguish whether the sites of investment locate at the geometric center or on the edge of book pages. Thus, distances between investment sites and sale transactions may vary, ranging from less than 100 feet to more than 500 feet. Based on our results, investment sites exceeding 500 feet exert little influence on housing values.

2 λ is set to 0.55 and 0.80, respectively. It is revealed that results of Cox-Box transformation on the dependent variable is very similar to that of the linear model, although the overall fit of Cox-Box transportation slightly improves, from 0.609 to 0.613 (R^2). Most variables retain their significance level and signs except two become insignificant and one becomes significant in the Cox-Box transformation. Results are not reported here, but are available upon request.

3 There exists a moderate multicollinearity among independent variables, particularly among neighborhood variables such as *POV89R*, *INC90*, *AAP90*, *HH_CH* and *CR. TYP DELQ*. The correction coefficient between income and African-American is −0.35, which is not high as expected. In addition, the age variable and the distance to the CBD are also correlated with these neighborhood variables. Separate model specifications without *POV89R* and *AAP90*, respectively, are tested and yield similar results. This indicates that multicollinearity does not affect the estimates of coefficients and the generality of the conclusions. In addition, the partial correlation coefficients range from 0.50–0.77. Correlation coefficients among structure variables are below 0.5 (there are only a couple of exceptions) whereas correlation coefficients between investment variables and other variables are all less than 0.5. The White test indicates the presence of heteroskedasticity in the sample, which is common in large cross-section data. We tested alternative model specifications, including non-linear ones, and found out that the linear model fits data well.

4 The mean of household changes (−3.7) indicates the outmigration of population. Hence, a stable population will contribute significantly to housing prices.

5 Zone 1 is denoted as a 150-foot buffer area, zone 2 as 150–300 foot buffer area and zone 3 as 300–500 foot buffer area.

[6] Results with non-investment variables are not reported in order to save space. In addition, the focus is in the 150-foot buffer. This is same for the Table 6. Complete results will be provided upon request.

[7] On this point we are indebted to an anonymous reviewer who made a stimulating remark on casting the positive externalities on the proximate properties in terms of the ''prisoner's dilemma'' (Poundstone, 1992), and in terms of an increase in land value within the neighborhood.

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