The Determinants of Neighborhood Transformations in Philadelphia Identification and Analysis: The New Kensington Pilot Study

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Executive Summary

With William Penn Foundation support, a large-scale study has been undertaken to measure and evaluate the benefits of community investment within the City of Philadelphia. The study focuses on place-based investment strategies and the measurements of impacts on neighborhood quality and neighborhood revitalization. Techniques developed by The Wharton School GIS lab are used to measure public investment's impact on surrounding property values.

This study reports results for the pilot study area of New Kensington. In this area, where the New Kensington Community Development Corporation (NKCDC) has partnered with the Pennsylvania Horticultural Society (PHS) on a greening strategy, the focus is on analyzing the direct impact of greening investment on neighborhoods. The NKCDC and PHS model includes tree planting, and stabilizing vacant land by replacing abandoned lots with "clean & green" landscapes of mowed grass, ringed with trees. The study identifies the significant impacts of greening oriented place-based investment strategies for improving quality of life and for revitalization of disinvested urban neighborhoods.

The study finds that vacant land improvements result in surrounding housing values increasing by as much as 30%. New tree plantings increase surrounding housing values by approximately 10%. In the New Kensington area this translates to a $4 million gain in property value through tree plantings and a $12 million gain through lot improvements. Indirect effects, such as encouraging additional investment on surrounding properties and neighborhood reinvestment more broadly, are also likely to be large. Moreover, the direct and indirect impacts to the city's property tax base are likely to contribute to the overall fiscal health of the city.

The data used include sales and attribute characteristics for properties in New Kensington, provided by the City of Philadelphia's Board of Revision of Taxes, and greening investment data provided by NKCDC and PHS. The spatial database is constructed by the Wharton GIS Lab. A large-scale study for the city, now under way, incorporates a number of place-based investments, including commercial corridor improvements. The results, we believe, will help identify public investment strategies' contribution to community revitalization.

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I. Introduction

Despite the importance of community revitalization efforts, there has been little research on identifying and measuring the potential for public investment to improve neighborhood quality. In part, this is because the statistical requirement for undertaking such research requires data and large scale computer power that have previously not been available. This paper contributes to the literature by identifying a method to evaluate and measure the benefits of major community-wide, place-based investment strategies. Community-based investments can provide significant public and private benefits to neighborhood residents, as well as citywide gains. While individuals are incentivized to undertake investments to improve their own properties, they individually may lack the incentive or capacity to improve public spaces. Nonetheless, such improvements, which may need to be implemented by community-wide or by public investment strategies, may have major benefits to individuals and to the community as a whole. [1]

The potential benefits of these investments can be identified by measuring the additional value people place on living in neighborhoods where such investments have taken place. In this study, we employ hedonic regression techniques to control for the many attributes that contribute to property values. We then test for the impact of public investment by identifying when and where they occur and their impact on the transaction prices of nearby properties, controlling for all other characteristics that impact the properties' value.

The research focuses on what creates neighborhood values and the impact of public intervention on neighborhood revitalization. The goal is to identify and analyze those determinants that contribute to neighborhood transformation. We believe the findings

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[1] Because public investments are collective goods, which require coordinated action and cannot be purchased by individuals on their own, such investments may yield positive returns that are potentially large.

will serve as the basis for informed discussions for future investments in neighborhood transformation in Philadelphia, and as applicable, in other cities.

Currently, the model has been applied to the New Kensington Community Development Corporation's (NKCDC) development boundaries in eastern-north Philadelphia. The study is moving forward to evaluate determinants of neighborhood housing values for the entire city.

Background for the New Kensington Study

NKCDC and PHS have worked in partnership to establish a community-based vacant land management system in parts of the Fishtown, New Kensington, and Port Richmond neighborhoods of New Kensington. The goal has been to address the problems of vacant land, where previously developed lots have been abandoned, the buildings have been demolished, and the land left unattended. It is the intent of vacant land management to improve the overall appearance and "curb appeal" of the community, thereby helping to stem population loss, attract new residents, and encourage reinvestment. Through this program, there were four types of conversion through which unmanaged parcels were transformed. *Stabilized lots*, maintained by NKCDC and the community, are those cleared of trash and debris and planted with grass and trees. Vacant parcels were also transformed into commercial use for *urban agriculture and horticultural retail*, while other lots became *community gardens* or *side yards*. This program has served as an inspiration for a citywide strategy in Philadelphia to address the overwhelming blight contributed by the city's 31,000 vacant land parcels.

The foundation for this program began in 1993, when NKCDC initiated work on a strategic plan for the neighborhood. Through this planning process, the community identified vacant land as a problem in the neighborhood. At the same time, PHS's Philadelphia Green program was working with the city's Office of Housing and Community Development (OHCD) on developing a pilot program to test the feasibility of a neighborhood-based approach to vacant land management. With shared interests to convert vacant land into desirable open space, the two organizations formed a partnership. Through the OHCD-funded program and supplemental support from the William Penn Foundation and The Pew Charitable Trusts, this partnership was sustained over a period of seven years.

Starting in 1995, the program was run collaboratively by NKCDC and PHS, with NKCDC and community volunteers taking the lead in implementation. During the initial years, PHS planted street trees and established community gardens with organized block groups. In 1996, NKCDC and residents implemented the first large-scale tree planting on six vacant lots. Following this planting, joint effort between both organizations resulted in the establishment of community gardens, street-tree plantings, and stabilization of vacant land. NKCDC also began administering a side yard program in 1996 that facilitated the transfer of vacant property to adjacent homeowners. Based on the desire of the neighborhood's Open Space Committee to have a local resource for garden materials and plants, NKCDC established the Garden Center, where residents can obtain garden materials and attend horticultural demonstrations and workshops. Greensgrow, a 3/4-acre hydroponics farm and nursery operating on a former vacant lot purchased by NKCDC, was also established during the time of this program. NKCDC's Land Use Management staff now provides ongoing support to these initiatives.

The scope and scale of the community-wide investment in New Kensington makes it an important area of study. The research in New Kensington serves as a test-bed for the larger citywide study. It also demonstrates the utility of precisely accounting for where and when place-based investment occurs for identifying the impact on the surrounding area's property values and the potential for community wide revitalization.

II. Literature Review

This research is an extension of the housing price measurement and modeling literature developed over the last two decades. The literature has developed the use of hedonic and repeat-sale price indexes to identify the factors that determine willingness to pay for housing. These factors include physical attributes of the housing itself as well as neighborhood attributes. Economic and socio-demographic factors as well as physical assets and shifts in these factors can help to explain the movement of neighborhood price indexes over time.

In more detail, neighborhood price indexes are based on house price models, which attempt to explain spatial or temporal variation in house prices. These models are frequently used to mark residential property values to market, in other words, to determine what properties will sell for in the market. Hedonic models relate transaction-

based house prices to characteristics of the lot, the structure, and the neighborhood. Repeat-sales models measure changes in house prices as the average rate of appreciation for properties that have sold at least twice and have not undergone major structural changes between sale dates within neighborhoods. Hybrid models combine hedonic and repeat-sales specifications to obtain more efficient parameter estimates. With spatial information, house price models can produce neighborhood price indexes that measure changes in neighborhood house values and can also measure the impact of specific public investments and neighborhood amenities on the willingness of homebuyers to pay to live in an area. To construct these models requires the use of geographic information on latitude and longitude of the location of housing and of the neighborhood amenity, as well as the timing of the introduction of the amenity to the neighborhood. Precise data on the location and timing of place-based public investment allow the identification of the investment's impact on improving perceived neighborhood quality. Location is used as an explicit and fundamental element within the modeling process with geographical information systems (GIS) software and spatial databases.

The Wharton School's GIS Lab has constructed a GIS database for New Kensington and for the City of Philadelphia that combines value and attribute data (property parcel price, square footage, and amenities of unit) with location and topological information (for example street address, latitude and longitude, distance from Central Business District, school district etc). The integration function of GIS allows the analysis of change on a property-by-property basis and the aggregation of houses into neighborhoods that function as interdependent units. The database and software allow the computation of impact for many place-based variables defined at different geographical scales for neighborhoods and for the city as a whole.

There is substantial literature on using hedonic regression methods to measure the impact of amenities on property values and a number of these studies focus on greening investments. However, most of these studies are small-scale and focus on a limited number of properties and on the impact of, for example, a few parks or a few large-scale open spaces.

Philadelphia has been a site for several of these small-scale studies. An early investigation of Philadelphia, in 1972, analyzes 300 property sales and uses seven sites—three parks, three schools, and one school-park combination—as measures of open space. Regression analyses of property transactions recorded in neighborhoods around the sites

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show that distance from the site impacts property values, leading the author to conclude, "There appear to be locational advantages to school and park facilities, and these advantages have been capitalized in the sale price of nearby property." (p.126, Lyon 1972). A second Philadelphia study in 1974 analyzes the 336 property transactions in the area of Pennypack Park (Hammer et al. 1974). Regression analysis shows that the park accounts for a positive impact on land value at 40 feet.

Studies that focus on greening investments in other urban areas include a Boulder, Colorado study, which examines the effect of greenbelts on property values in three areas (Correll et al. 1978). The average value of properties adjacent to the greenbelt is found to be 32% higher than those located 3,200 feet away. This study is also small-scale and focused on only a few variables that might influence price. An additional study of Worcester, Massachusetts in the early 1980s examines the relationship between four parks and the values of all properties sold within a 4,000-foot radius of each park in the preceding five years (More et al. 1982). This study shows that a house located 20 feet from a park sold for $2,675 more than a house 2,000 feet away. The impact of parks on house values was again studied in Dayton and Columbus, Ohio (Kimmel 1985). Analysis of two samples of 100 houses each in the vicinities of the 170-acre Cox Arboretum and the 152-acre Whetstone Park provides evidence that for every additional foot of distance a property is located away from these parks, the selling price of that property decreases by $3.83 and $4.87, respectively. Finally, an empirical study in Salem, Oregon in 1986 shows that open space (in this case, a greenbelt) at the fringe of an urban area positively influences the land values that extend inward from the fringe to about 5,000 feet (Nelson 1986).

These investigations are, of necessity, small-scale, as larger studies were difficult to implement due to the immaturity of computational methods. This study for New Kensington and the full-scale study for the City of Philadelphia will incorporate sales for thousands of homes (more than 200,000 for Philadelphia) and more than 50 variables, mapped at different scales. The study is innovative in its scale, measurement precision, and incorporation of impacts at different levels of spatial aggregation. The results presented in this report of the New Kensington research tracks the impact of hundreds of stabilized lots, as well as other place-based investments, using data on over 3,000 property sales.

III. Data and Methodology

The methodology for this study is based on hedonic regression analysis. This analysis provides a valuation model, which estimates the value at which a property will sell based on property and neighborhood attributes and market transaction prices for these properties. These models control for structural characteristics, such as the number of stories and total square footage and elements of location.

The price of any property is equal to the present discounted value of all future services that will be provided by that property while it is owned by its current owner, plus the present discounted value of the price at which the owner will be able to sell the property in the future. Property values are impacted by neighborhood amenities and change with improvement and deterioration in these amenities. To measure neighborhood effects and the impacts of public investments, census tract dummies and nearness to greening policy interventions, as well as nearness to disamenities, such as vacant lots, are included.

These models also include the time when the property sold. The transaction price of any given property is a function of the market conditions in the time period in which it transacted as well as its hedonic characteristics—that is, the physical features of the house or lot and the features of its location and neighborhood—that affect the price at which it transacts.

If we know the hedonic function, then regression analysis can be used to estimate the parameters of this function. For example, a common hedonic price function is

$$P_{it} = \alpha X_i^{\beta_1} e^{\beta_2 Y_1 + \gamma_1 T_{i1} + \gamma_2 T_{i2} + \ldots + \gamma_n T_{in}}$$ or, in logs,

$$\ln P_{it} = \alpha + \beta_1 \ln X_i + \beta_2 Y_i + \gamma_1 T_{i1} + \gamma_2 T_{i2} + \ldots + \gamma_n T_{in}$$

where P_{it} is the transaction price of property i during time period t; X_i and Y_i are hedonic attributes of the property (with X measured continuously–say, square feet of living space–and Y measured discretely–say, presence of central air conditioning); $T_{i\tau}$ are dummy variables indicating whether the transaction took place during time period τ; and α, β_j, and γ_τ are the parameters to be estimated. In particular, the series of parameters γ_τ is the price index.

The New Kensington development area dataset of house sales is a subset of the 1980 to 2003 Philadelphia County transaction dataset. Provided quarterly by the city, the data are appended in such a way as to not overwrite any previous sales of a property. In doing this, the citywide dataset includes almost 200,000 observations of house sales. The New Kensington area is defined by zip codes 19125 and 19134. (In a separate smaller regression, the New Kensington area is defined by zip code 19125.)

Average selling price for a home, unadjusted for inflation, is $37,671. Average building size is 1,263 square feet, and average lot size is 1,041 square feet. The majority of homes are row houses of masonry or brick structure, two or more stories, There are a few houses built on corner lots, with garages, with brick or frame exteriors, that are one story, semi-detached or detached. The sample has approximately 3,000 observations, which are evenly split between the quarters of the year in which they are sold. Observations do exist throughout the time period, but the sample is weighted to more recent transactions, with over 12 percent of sales transacting in the active market of 2002.

These transactional/structural data are supplemented by various spatial attributes of the properties. Greening data, available from the New Kensington Community Development Corporation and the Pennsylvania Horticultural Society, have made the location of new tree plantings, settled side yards, community gardens, and stabilized lots known and the proximities to transacting properties measurable. In addition, there are two parks (Conrad Square and Palmer Park) in the community that add to open space benefits. The data show 481 newly planted trees, 32 settled side yards, 217 stabilized lots, and 15 parcels of land developed into community gardens in the New Kensington area.

Additional geospatial referencing was made possible through public data that the city maintains. First, the shortest distance between each property and the nearest of the neighborhood Market-Frankford El stations, Spring Garden, Girard, Berks, York-Dauphin, Huntingdon, and Somerset, was calculated. To capture the effect of transit on house prices, each property was classified into a range dummy (less than 1/8 mile, 1/8 to 1/4 mile, 1/4 to 1/2 mile, 1/2 to 3/4 mile, and greater than 3/4 mile). The majority of parcels are within the 1/4 to 1/2 mile band. Distance variables to the waterfront and the Central Business District (CBD, measured as City Hall) were also calculated; New Kensington houses are on average 2.67 miles away from the CBD and 0.60 miles from the waterfront. In addition, the percent of total parcels that are vacant lots was calculated

for each block. The sample is almost evenly split between the categorical dummies of no vacant lots, up to 5 percent, 5 to 10 percent, and more than 10 percent.

To analyze the average impact of public investments on properties, we identify the average property and use this as our base case to measure how that property's value changes with nearness to public amenities and disamenities. Thus, the results are analyzed in terms of a "standard house." For New Kensington, this house is transacted in 2003 and categorized by masonry structure, without a garage, not on a corner, greater than one-story, row house which is not near any new greening actions, between 1/2 to 3/4 mile away from the El, and on a block with over 10 percent of parcels being vacant. The average price for this house is $35,000.

The methodology for this study also allows the measurement, in the form of a price index, of how much the same property will sell for over time in New Kensington. The house price indexes measure the quarterly appreciation rate in home values. To compute them, a vector of dummy variables is created that takes a value of "1" if a home transacted in that particular year and quarter, and a value of "0" otherwise. This vector is added to the regression specification and estimated using the full sample of home sales from 1980 Q1 through 2004 Q1. Technically, by taking the antilog of each coefficient and subtracting one, the estimate of average quarterly appreciation since 1980 Q1 is recovered. The index is then obtained by setting the baseline period of 1980 Q1 equal to 100, and then applying the quarterly appreciation rates to this number in order to generate the index.

Indexes are created for the New Kensington neighborhoods, defined as zip codes 19134 and 19125, as well as for Philadelphia as a whole. Figure 1 shows these nominal house price indexes. The terminal value of 173.9 implies that the typical Kensington home appreciated at 8.1% annually since 1993. The index for the city as a whole appreciated at 7.3% over the same period. Both indexes experience similar general trends related to the cyclical housing market. The market has seen growth throughout the late nineties and contracted after 2001 with the overall recession that followed 9/11, and has, since then, recovered sharply, as mortgage rates were at historic lows.

Figure 1. House Price Indices
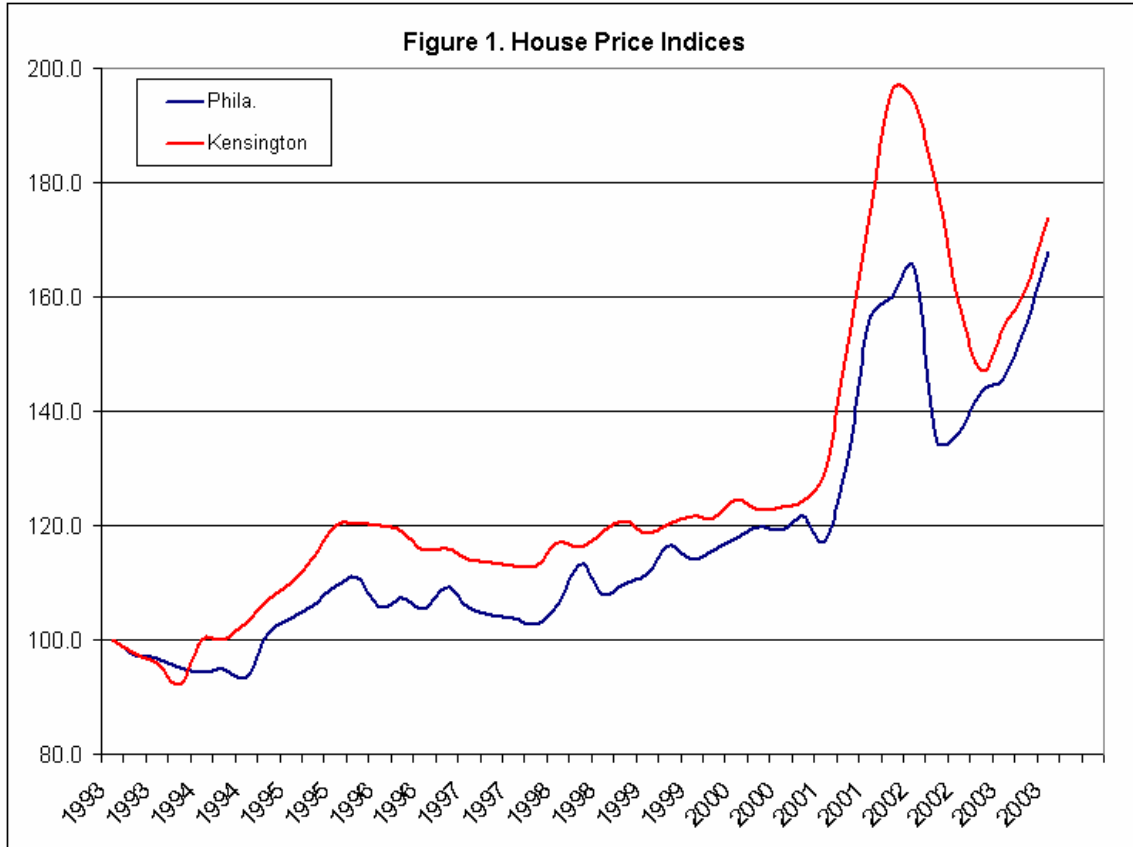
IV. Hedonic Regression Results

To determine the impact of community and public investment activities on neighborhood house values, the hedonic regression methodology, described above, is employed. The result of the basic regression model assumes house price is a function of structural attributes and date of sale. Bigger homes sell for more but at a declining rate shown by the positive coefficient on building size and the negative coefficient on building size squared. Garages have a significant, positive effect on house prices.

A second model, augmented by geospatial variables, doubles the explanatory power of the model. For the most part, the structural attributes retain their strength and significance from the base model. The census tract dummies are strong and capture many nuances of the neighborhoods. These variables control for socio-economic conditions, thus enabling a test for the impact of neighborhood investment while controlling for other characteristics of the census tracts in which they occur. The focus is on testing for the impact of three public/community investments, public transit, tree plantings, and lot

stabilization; however, we also include the impact of vacant land on surrounding property values.

Vacant Land

Each block in the neighborhood is characterized by the percentage of the block's parcels that are vacant lots. On average, vacant lots are about 10 percent of total parcels on a block. Each block is grouped into one of the following: 0, 0 to 5, 5 to 10, and greater than 10 percent of parcels as vacant lots. In the model, the neighborhood groupings showing more vacant lots display lower house prices. The charts below identify the effect of vacant lots on the price of lots.

Considering the standard house would be located on a block with over 10 percent of parcels being vacant lots, if the only characteristic of the house that was changed was its location to a block with zero vacant lots, the house would be priced $4,370 (11.6 percent) more. If placed on a block with 0 to 5 percent vacancy, the house would be priced $2,260 (6 percent) more; and, if on a block with 5 to 10 percent vacancy, $1,120 (4 percent) more.

Figure 2
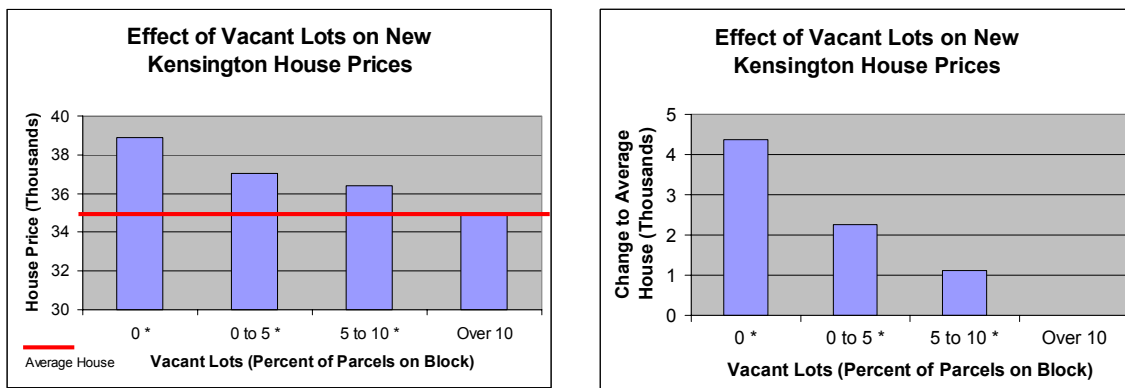
Transit

The Kensington neighborhood is close to the Market-Frankford El subway line, a major public transit connection for the city. The proximity to the closest station is computed for each house in Kensington. On average, they are located about half of a mile from the El

and range from being located right near the stations to just over 1 mile away. Each house sale is classified into the groups of less than 1/8, 1/8 to 1/4, 1/4 to 1/2, 1/2 to 3/4, and over 3/4 of a mile in distance. There was not a continuous trend to transit's effect. Houses within 1/8 of a mile experienced the lowest values, the next two groups experienced higher prices, and the prices start to decrease again for houses over ½ mile away. The initial upward trend may be demonstrating that people prefer not to live right next to the noise and other negative effects of an elevated subway, but as the subsequent decline shows, there is a loss of value by being located out of walking distance (about ½ mile) to transit. This trend is likely to escalate the farther a house is located, but since the neighborhood is small enough to have a maximum distance of just over a mile, the effect may not fully materialize until the research is expanded citywide.

Considering the standard house falls into the 1/2- to 3/4-mile category, if the only characteristic of the house that was changed was being located within 1/8 mile of the El, the house would be priced 19 percent less. If placed 1/8 to 1/4, the house would be priced 15 percent less. The ideal location of 1/4 to 1/2 would price the house 1 percent more, while the declining effect of distance would be shown over 3/4 mile as the house would again be priced 3 percent less. In terms of the standard house, distance to the El can influence the price by a total of $7,500.

Figure 3
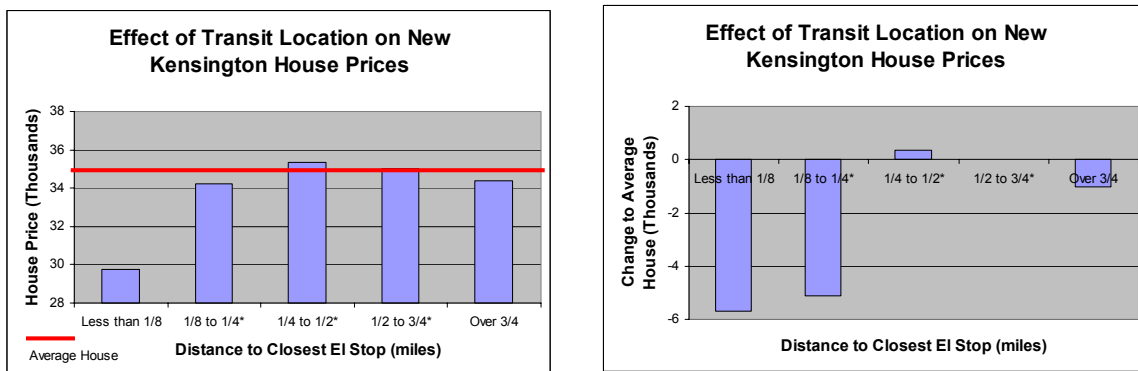
Tree Plantings

The model included a dummy variable for each sale within 50 feet of a new tree planting on the sidewalk of the street. Although the distance was only based on the closest tree, often PHS had planted trees in groupings, so the dummy serves as a proxy for an

improved appearance of the overall streetscape. The tree plantings showed a significant, positive effect on house price of about 9 percent. This equates to a $3,400 premium on the standard house.

Figure 4
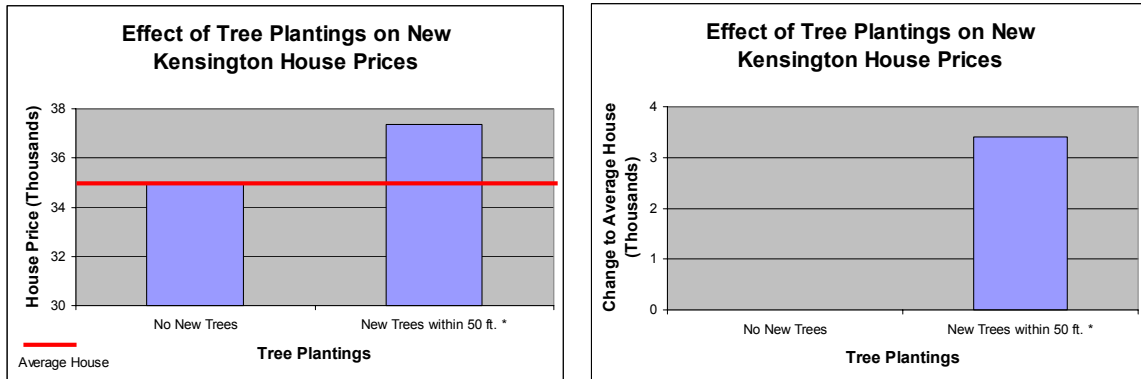
Lot Stabilization

It is difficult to ascertain some effects of greening on house prices since the model is based on sales. Positive improvements such as side yards and gardens may encourage homeowners not to sell. Moreover, NKCDC asks for such homeowners to agree not to sell within the next few years after acquiring adjacent lots as side yards. Thus we have few observations of sales after improvements in side yards and gardens. We focus on the impact of stabilized lots, for which dummy variables were created for any sales on adjoining or facing properties sold after the greening took place. The sales prices near stabilized lots are significantly higher. The model indicates a long run rise of 30% to the neighbors of vacant lots that NKCDC has come in and cleaned and greened. On the standard house, this would imply a $13,000 increase in value.

Figure 5
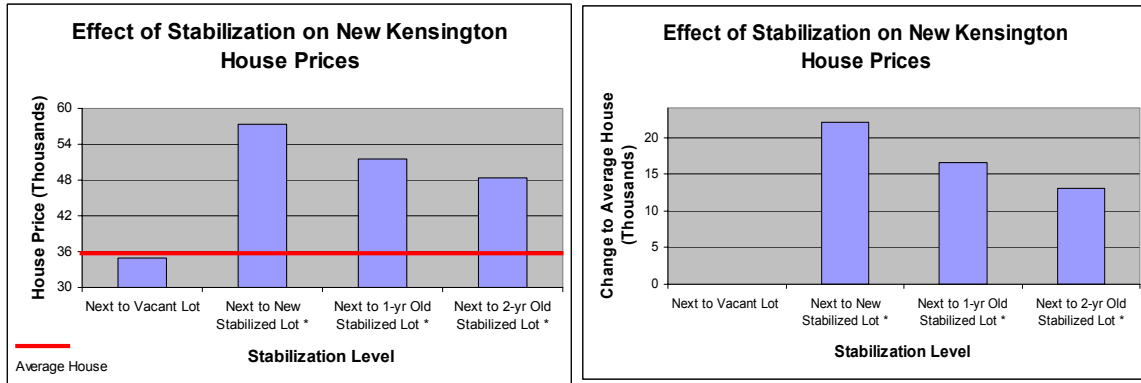
Additional Regressions

To confirm these results, we test a third model which augments the structural variables substantially with a larger dataset that includes more property detail, including property condition. These data are newly available from the City of Philadelphia's Board of Revision of Taxes. The results on building characteristics are reasonable and the results on public investment variables confirm the previous findings for the sparser model.

Results shown in Table 1 below summarize the coefficients of interest on greening variables and indicate, as in the earlier results, their major impact on neighborhood values in New Kensington. Adjacency to vacant land decreases neighborhood values by 18%, while tree plantings increase values by 14% and a location within one quarter mile from a park increased values by 10%.

Table 1 Effects of Greening on Home Values		
Variable	**Value**	**Significant?**
Adjacent to Vacant Lot	**-18%**	**Yes**
<=100 feet of New Tree	**14%**	**Yes**
<=1/4 mile of Park	**10%**	**Yes**

V. Conclusion

This report examines the impact that vacant land management, greening investment, and public transportation systems have on property values in the New Kensington section of the city. Using precise measurement enabled by construction of a geographic database, based on the location of property parcels and the timing of property transactions, as well as the location and timing of public investment, we are able to identify the impact of public investments on neighborhood values. We find that vacant land improvements result in surrounding housing values increasing by as much as 30%, a large impact. New tree plantings increase surrounding housing values by approximately 10%. In the New Kensington area this translates to a $4 million gain in property value through tree plantings and a $12 million gain through lot improvements.

The objective of the study is to examine neighborhoods in Philadelphia that have undergone revitalization efforts and identify key determinants that brought change to these neighborhoods. New Kensington is a pilot site for a larger study that will analyze the impact of a range of public investments in Philadelphia. It is anticipated that the findings of these studies will inform policy discussion on neighborhood investments in New Kensington and the City of Philadelphia and that they will be applicable to other US cities facing the challenge of disinvested neighborhoods and the need to evaluate neighborhood reinvestment strategies.

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