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The effect of new residential construction on housing prices

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ABSTRACT

New construction is generally expected to create positive externalities. We use a hedonic model to estimate the premium paid for new houses as well as the influence of new residential construction on the selling prices of existing houses considering the number and relative size of the newly constructed houses in the area. The results indicate even atypically large new houses command a premium. Construction of houses of average size relative to the reference group has little effect on existing house prices except to create some competition for houses that were achieving relatively high prices considering their attributes. Meanwhile, construction of a concentration of larger than average size houses exerts a small positive effect on existing house prices, especially for those houses that are selling for a relatively low price. The effect is the strongest when the new construction is located within one-quarter mile.

1. Introduction

Most new housing construction in the U.S. occurs on the rural periphery of cities where large areas of open land can accommodate subdivisions of homogeneous houses; however, in recent decades homebuilders have been responding to consumer demand for new construction inside urbanized areas to reduce commute time and cost. This new private development ranges from the construction of a single house on an existing lot to assemblage of vacant acreage on which an entire new subdivision is constructed. Such infill has not been restricted to central city areas, but instead is occurring in established communities throughout urban areas. What is consistent is that the new houses are often larger than existing structures in the surrounding area and create incongruous residential patterns within the urban landscape in contrast to the homogeneous nature of most American suburban residential development.

We examine the value of newly constructed houses inside built up areas as well as the influence that new residential construction has on surrounding residential property values with a focus on the influence of the construction of larger than average houses. Theory suggests that building new houses within existing urban neighborhoods may create both positive and negative externalities for private land owners in the area and the general public. Creating more dense urban environments through development inside existing urban areas on smaller lots rather than on larger suburban tracts is often encouraged by local governments to improve efficiency through reduced sprawl, increased ridership on mass transit, and economies of scale for provision of services and infrastructure financed through increased tax revenue (Burchell and Mukheri, 2003; Lang and Danielsen, 2002). Development in existing urban areas creates housing without eliminating rural open space while suburban expansion increases infrastructure costs and duplication of services. Suburban

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development often increases automobile traffic congestion and air pollution because of longer commutes (McConnell and Wiley, 2012).

In addition to the fiscal, social, and ecological benefits, new construction may create benefits for adjoining private property owners as well. New buildings can have positive spillover effects on existing neighborhoods through a creating more vibrant neighborhood as vacant lots are populated. If vacant lots create external diseconomies through attracting dumping, allowing criminal use, or creating an eyesore, then building new houses will eliminate the external diseconomy, increase resident population, improve the aesthetics of the area and raise surrounding property values (DeSalvo, 1974). New construction can be more aesthetically pleasing than unkempt lots or dilapidated buildings, which improves the views from existing houses. However, such infill development may result in adverse effects on surrounding properties through increased traffic congestion and lost open space (Malpezzi, 1996). New houses could also compete directly with existing houses in the same market segment or indirectly through filtering through linked submarkets, potentially reducing the values of nearby existing houses by increasing supply while demand remains constant (Simons et al., 1998).

Most previous research has focused on how government expenditures and subsidies for city center redevelopment influence surrounding property values; only limited research has focused on the influence private residential construction has on the local housing market both inside the central city as well as beyond the central core, and none has considered the differential effect of new construction across the price distribution of houses, which raises the question of whether these effects differ depending on the existing housing stock among which this development takes place. We add to the literature by examining not only how the presence of new construction and the concentration of new houses may affect the value of the new houses as well as the existing surrounding neighborhood, but also whether house price effects are influenced by the extent of atypicality of new development, particularly house size.[2] The size and range of these effects of private housing construction throughout the urban area are unknown.

Several factors contribute to the incentive for homebuilders to construct large new houses that may be perceived as overbuilding or atypical for an existing urban neighborhood. The cost of constructing new houses in built-up areas can be higher than on the urban fringe because of higher land and assemblage costs, more restrictive regulations, title complications, and possible brownfield remediation. Existing infrastructure may require upgrading (Farris, 2001), increasing the buildable price range. The small footprint allowed on urban lots must be offset with greater height to accommodate the increased square footage expected in modern houses[3]. Meanwhile, aesthetic and privacy concerns arise as critics fear the houses will overwhelm existing smaller houses, destroy neighborhood character, and block sunlight and air movement (Lang and Danielsen, 2002; Szold, 2005). Some critics such as Hinshaw (2002) suggest that constructing large houses in an established neighborhood of small houses is the epitome of public rudeness, that incompatible size development benefits only the new house owners, not the surrounding property owners. Researchers have not reached agreement on the relative value of houses of various sizes in a single neighborhood (Haurin, 1988; Turnbull et al., 2006).

Hamilton (1976) hypothesizes that property tax capitalization effects drive down the relative value of larger houses and increase the relative value of smaller houses in the same area. Thus, new houses will tend to sell for higher prices than comparably sized neighboring used houses; however, the price premium for a new house could vary depending on its size relative to its neighbors. Similarly, the effect of new construction on the prices of neighboring existing houses may also depend on the relative sizes of the houses. Even if the new larger houses have a positive spillover on neighboring property values, those increased values will result in higher taxes and possibly contribute to a housing affordability problem for existing urban residents. Despite the lack of knowledge about the impact of the construction of larger new houses on surrounding properties, many American cities have adopted policies to discourage or limit their construction (Nasar et al., 2007). Understanding the magnitude and characteristics of the influence of new construction on existing property values is essential in understanding the impact of urban policies designed to encourage or control private investment in urban areas. Developers are also interested in the influence that surrounding existing houses exert on the price they can achieve on new construction, which affects the profitability and attractiveness of infill projects to the private homebuilding industry.

The number of new houses constructed in an area may also be important in understanding the price effect. A small number of new houses in an area increase the probability that the new houses will be perceived as out of character for the neighborhood while a large number of new houses reduces their atypicality, but increases the perception that the older existing houses are unusual. Thus, both the stock and flow of new construction may be relevant in understanding the price effects.

To examine the value of newly constructed houses inside built up areas as well as the influence that new residential construction has on surrounding residential property values, we employ a hedonic estimation of the impact of new construction on house sales prices in Baton Rouge, Louisiana over an 18-year period. We further focus on whether construction of houses of larger scale than average houses in the area has a positive or negative impact on the sales prices of the new houses and the existing houses in the same area. Furthermore, this study differs from most previous work on housing in its focus on changes in the full distribution of prices. New construction may be valued more by high-income buyers who want the most expensive new features or by buyers at the low end of the price range whose only other alternative is an old

[2] Haurin (1988) argues that atypical houses by definition do not fit the neighborhood and so are priced to sell for less or take longer to sell.

[3] According to the U.S. Census Bureau (2010), the median size of a new single-family house in the US has risen from 1605 sf in 1984 to 2227 sf in 2005.

house in poor condition. Additionally, proximity to larger new houses may be more important to sellers of lower priced houses with the greatest potential for appreciation through association or neighboring large new houses may help maintain the prices of existing higher priced houses. The variance in new construction spillover effects on house prices among different priced neighborhoods may contribute to a housing affordability problem if house prices in lower income neighborhoods are disproportionately influenced by the construction of new and larger structures. An effective method for examining the distribution of price premiums within a housing market is quantile regression. Quantile regression allows for heterogeneity in property value impacts by allowing the estimated coefficients to vary along the distribution of the dependent variable. Hence, it can be used to investigate distributional or equity aspects of outcomes. Thus, this study offers additional empirical evidence on the relationship between prices and new construction. The methodology employed here allows for more robust interpretation of the effect of both new construction and relative house size. The results will add to the knowledge about the externality effect of relative house size and assist in the policy debate about the positive and negative influences of new construction on the community.

We find that newly constructed houses sell at a premium even if they are larger than the average size of existing houses in the surrounding area with a larger price effect among houses valued lower than other, similar properties. While similar size existing houses sell for less when competing against new houses, the prices of smaller existing houses are pulled upward. This effect is especially evident among houses suffering from lower values than comparable units. Not only the presence of new construction, but also the concentration of new houses in a neighborhood influences the price effect. A concentration of new, larger houses produces a larger positive price effect, especially among houses bringing lower prices for a given bundle of attributes in the market.

The rest of the paper is organized as follows. Section 2 provides background information from previous research. Section 3 presents a detailed description of data and construction of the control variables used in a simple empirical framework. Section 4 offers an explanation of the empirical results obtained using quantile regression. Section 5 offers conclusions and implications.

2. Previous research

Most of the location choice studies in the literature are based on the monocentric city model first proposed by Alonso, Mills and Muth in the 1960s [see Glaeser (2008) for a review]. Higher-income residents can afford to commute via automobile and so trade off commuting time/distance for the larger houses and lots they can afford in suburban areas. Cities grow outward over time with new dwellings always found at the city's edge. Brueckner and Rosenthal (2009) suggest from their analysis of the neighborhood and resident characteristics of 331 American cities that more high-income households would live closer to the city center if newer housing stock were available, so as American cities develop and redevelop from the center outward over time, eventual central redevelopment creates a young housing stock inside the urban area once again, attracting high-income residents who were previously concentrated in the suburbs.

2.1. Relative value of new construction

One study has been conducted that shows the values of new residences constructed inside the city center and first generation suburbs are influenced by the neighboring existing and new structures. Ryan and Weber (2007) find that the assessed value of new residential buildings in distressed Chicago neighborhoods varies, with new residential buildings built on scattered infill lots assessed at higher values than residential buildings grouped in entirely new neighborhoods. Their research is limited in that it only considers price effects in low-income neighborhoods and the majority of the properties are rentals; however, the results illustrate the importance of understanding the context in which new construction takes place and the relative concentration of new construction.

The effect of neighborhood attributes on existing house values has been examined in many studies; however research on the influence of new residential construction in urban areas is limited, often focusing on the impact of government subsidized housing projects on tax assessment values. There is even less research that focuses on the relationship between the relative size of new and existing houses in the neighborhood and the resulting influence on value through the spillover effect.

2.2. Externalities

Because it is fixed in place, the value of property is influenced not only by its inherent characteristics, but also by its surroundings. An externality occurs if the land use on one lot alters the productive opportunities of another lot. Such interdependency is common within neighborhoods and can be complex. Thus, the change in land or structure may have a "neighborhood effect" that alters the land and structure values on surrounding properties. The change in wealth due to this spillover effect is the change in value (positive or negative) of one property on which there have been no improvements. If the spillover is an economically positive externality, enhancing society's wealth, the value of the affected lot increases. If the spillover is a negative externality, the value of the neighboring property will decrease (Schall, 1976). Researchers have examined the influence of a range of factors on housing prices via positive and negative externalities, including environmental quality and aesthetics [See Boyle and Kiel (2001), Bourassa et al. (2005), and Nguyen-Hoang and Yinger (2011) for examples].

2.3. Influence of new construction

New construction should upgrade the area if it removes negative externalities. Unfortunately, most of the empirical studies on this topic have focused only on the impact of government-subsidized multifamily housing on surrounding property values rather than considering the influence of all new residential construction, especially single-family houses. Also, most studies have simply measured the presence of new construction without consideration of the relative size of the housing units. The results have been mixed. Nourse (1963) and Schafer (1972) compare sales price indices for developed land within three blocks of government subsidized rental housing projects and control neighborhoods in St. Louis, Missouri and Los Angeles, California. Both studies use transfer taxes to estimate prices rather than a direct measure. They also both used an aggregate property price index that does not isolate residential prices from other land uses. Neither finds a significant influence of construction of public rental housing on price changes. Later DeSalvo (1974) uses a sample of 50 New York City neighborhoods to show that construction of subsidized rental housing positively influences the rate of increase in the assessed value of properties of all types located within three blocks of the construction as compared to those located further away. The increase in value is more noticeable in medium rent neighborhoods.

Three studies in Cleveland employ hedonic price equations to examine the effect of construction of subsidized market-priced residential units on surrounding housing prices when the new housing is substantially more expensive than existing units. Ding and Knaap (2003) find that subsidized housing units constructed in the previous five-year period had a positive effect on single-family house sales prices in the surrounding zip code. Simons et al. (1998) to illustrate that the degree of concentration of new construction may affect the magnitude of the price effect, suggesting that the number of new units constructed nearby is a better specification than simply a dummy variable representing new construction that disregards the number of units. The analysis reveals that the price effect is generally larger in higher-income neighborhoods; however a positive effect is found within a five-block area in lower-income areas as well. This study is extended in Ding et al. (2000), who incorporate spatially lagged variables and interaction variables to consider the impact of the scale of these new developments on single-family house transactions. The results indicate that the price effect appears to decline rapidly after 150 feet and is more significant in lower-income neighborhoods, in contrast to the findings in their earlier study. Their results concerning the scale of investment in new construction are mixed, with a concentration of large-scale developments (measured by investment value) having a negative effect in high-income neighborhoods, but a positive effect in low-income neighborhoods, whereas a concentration of medium-scale developments has a positive influence in high-income neighborhoods. The results from this series of analyses indicate that multiple measures of new construction should be tested to find the proper specification of the variables.

Ellen et al. (2001) employ a difference-in-difference approach to compare average prices of residential properties (apartment buildings, condominiums, and single-family houses) in rings near newly constructed one- to four-family subsidized owner-occupied housing developments in distressed New York City neighborhoods with prices of comparable properties outside the ring. They also find positive price effects are largest and most immediate on properties within 500 feet of the new units and are related to the scale of the development. Employing a hedonic equation to compare prices in target and control neighborhoods, Rossi-Hansberg et al. (2010) suggest that the effect of a combination of federally funded rehabilitation and new construction on surrounding land prices in a few disadvantaged Richmond, Virginia neighborhoods dissipates more slowly with distance than the effects found by previous studies of house price effects of subsidized construction.

2.4. Importance of relative house size

Haurin (1988) describes atypicality as the degree to which a house's observed attributes deviate from typical levels in a neighborhood. One characteristic on which a house may differ significantly from its neighbors that is easily observable is floor area or size. Researchers have debated the relative value of houses of different sizes in a neighborhood, focusing on the value of the atypically larger or smaller house. Haurin (1988) suggests that atypical houses sell for less because they do not fit the neighborhood. Fewer buyers strongly prefer houses that are different from the majority of houses in the area, so it takes longer to match buyers with these houses. Therefore, owners may have to discount the price to find a buyer in an average time on the market. Turnbull et al. (2006) show that, theoretically, both larger- and smaller-than-average houses in a neighborhood generate lower offers from typical buyers. The typical buyer who is attracted to a neighborhood would be expected to prefer the average house in that neighborhood. Therefore, the majority of buyers shopping for houses in a neighborhood would avoid houses that are significantly larger or smaller than the average, resulting in these properties selling at a discount if marketing duration is held constant. Their empirical analysis of the resales of single-family houses at least 2 years old indicates that larger houses in a neighborhood of smaller houses sell at a discount compared to larger houses in homogeneous neighborhoods (where neighborhood is defined as a circle of one-half mile radius surrounding a house). They also find that smaller houses in a neighborhood of larger houses sell at a premium relative to a homogeneous neighborhood at a decreasing rate as the size disparity increases. Thus, buyers may pay a premium for a slightly smaller house among larger houses, but the premium does not persist as the disparity becomes significant.

Leguizamon (2010) finds that average size houses within 0.25 mile of larger houses sell for less than houses surrounded by others with the same or less floor space in Columbus, Ohio. However, houses located between 0.25 and 0.6 miles from a larger house sell for more than houses that are surrounded by similar size or smaller houses. She interprets the results to mean that house owners want to be associated with higher consuming individuals, but do not want to confront the disparity directly. Rather, they prefer to maintain similar status with their immediate neighbors, but enjoy association with the part of town that contains larger houses. The author suggests that smaller houses among larger houses are priced relatively lower than in homogeneous neighborhoods because the smaller house feels less valuable relative to the perceived value if the house were located in a more homogeneous neighborhood.

2.5. Differences among price levels

A study by Guerrieri et al. (2010) based on 20 years of Case-Shiller Chicago house price indices suggests that initially low priced neighborhoods are much more price elastic than initially high priced neighborhoods. Low priced neighborhoods that are in close proximity to high priced neighborhoods are the most price elastic. In addition, while low priced neighborhoods are likely to appreciate (depreciate) more on average, there is a large degree of heterogeneity among the low priced neighborhoods. Thus, price fluctuations in response to external shocks such as new construction may vary among price levels.

In addition, Newsome and Zietz (1992) suggest that housing characteristics may not be equally valued across a given distribution of house prices. There may be noticeable differences in the elasticity of house price with respect to housing characteristics across the distribution of house prices. Subsequent analysis of Orem/Provo, Utah house sales data employing quantile regression (Zietz et al., 2008) demonstrates that purchasers of higher price houses value some house characteristics, such as square footage or the number of bathrooms, differently from buyers of lower priced houses. They find that the premium for a newer house is smaller among higher-priced houses with lower-priced houses exhibiting the largest discount for age. Mak et al. (2010) also find that the effect of age on price varies across the price distribution for condominiums in Hong Kong while Kim et al. (forthcoming) identify differential housing price responses for several house characteristics such as floor area across the distribution of house prices. Coulson and McMillen (2007) use quantile regression to suggest that new construction will only create a supply side shock at the top-quality level of the housing market that results in a lower relative price and thus filtering as consumers move to higher quality houses. The price movements then ripple down to the lowest priced houses in the area.

In summary, previous research seems to indicate that new construction tends to sell for higher prices than surrounding existing houses, but the price premium may not be uniform. In addition, new construction generally has a positive spillover effect on the price of existing houses in the area, but this effect varies with the number of units in the new development. Also, the size of the newly constructed houses relative to existing houses is a consideration in understanding the spillover effects. It appears that buyers prefer houses whose immediate neighbors are of similar or slightly larger size. They will pay a premium to be near, but not adjacent to larger houses. However, these effects may not be uniform across the price distribution. Based on these limited previous findings, we examine the spillover effects of construction of houses of various relative sizes on the sales prices of new and existing houses considering that the effect of new construction may be uneven among price submarkets.

3. Data and empirical models

3.1. Hedonic empirical model[4]

A pooled cross-sectional hedonic regression is the baseline econometric technique of this paper. When a traded product contains multiple attributes, a hedonic regression is used to estimate the value added to the final product by individual features. This method is widely employed in real estate and urban economics to determine the contribution of different parcel or dwelling characteristics to a property's ultimate price (Schuetz et al., 2008; Voicu and Been, 2008). The basic premise is that a property represents a bundle of both desirable and undesirable attributes to utility-maximizing consumers, all of which contribute to the market value of the house as revealed through a market transaction, i.e., a property sale. The hedonic pricing model decomposes the transaction price into various components such as house and lot size, house features, accessibility of the property's location and local amenities. The estimated parameters of the model provide information about the relative contribution (significance and magnitude of effect) of any given house characteristic. In the current work, the sale price of a house is specified to be a function of the vectors of house characteristics, H; a vector of location and time trend variables representing fixed effects for the exact geographic location and year and season of sale, F; and a vector of variables of interest, N, representing the existence, concentration, and relative size of new construction. The variables comprising H and F are similar to those contained in the hedonic models cited above. Our model differs by inclusion of the new construction variables in vector N similar to the method used by Schuetz et al. (2008) to examine the effects of nearby foreclosures on house prices. The specification is:

$$\ln Price = c + \alpha H + \varphi F + \beta N + \epsilon \qquad (1)$$

where c is the regression constant and ε the error term. Palmquist (1991) and others note that economic theory alone does not provide sufficient guidance for selecting the functional form of particular explanatory variables within hedonic equations. The log-linear hedonic specification is used. Thus, the coefficient of a dummy variable can then be interpreted as the percentage change in the dependent variable (house price) associated with the independent variable (i.e. variable that captures if a house i is new construction or if the house i is in close proximity to new construction).

In general, three empirical issues arise when performing hedonic analyses: omitted variables bias, endogeneity, and spatial issues (dependence, autocorrelation). In particular, hedonic analyses are often severely impacted by omitted variables bias. Home prices are very complex and are derived from a number of factors and characteristics, many

[4] The underlying theory and a summary of empirical results of applied hedonic pricing models are thoroughly described in, for example, Sirmans et al. (2005), so they are not detailed here.

of which are unobservable to researchers. When one of these unobserved variables is correlated with both the dependent and at least one independent variable, then estimates of the coefficients on those independent variables will be biased. In our case, if being surrounded by new construction is correlated with an unobserved characteristic such as neighborhood quality that we would expect to impact home price positively, then the estimated coefficient on the externality effect of new construction will be biased upwards because we are capturing the effect of neighborhood quality in that estimate. Researchers suggest three quasi-experimental approaches to overcoming omitted variables bias: instrumental variables, regression discontinuity, and fixed effects (see Greenstone and Gayer; 2009). We choose the fixed effects approach.

Fixed effects analysis controls for omitted variables by including a large set of dummy variables for small groups of observations, in our case, observations that are within a small geographic area or the same house observed more than once. These dummy variables then pick up the effects of any time-invariant unobserved variables on house prices, allowing for unbiased estimates of any remaining variables that either vary amongst houses within the chosen scope of the fixed effects or over time. The geographic scale of the fixed effects clearly matters. In this paper, we will use two scales: the census block groups and, for the sub-sample of houses that sell more than once during the sample period, individual houses. Thus, one of our approaches to measuring the effect of the new construction on property values is a repeat sales fixed-effects hedonic analysis.

Endogeneity bias occurs when the dependent variable is co-determined with one or more independent variables. In our case, the non-random selection of where new construction occurs may present such a problem. Then, if this selection effect is not controlled for, we would be likely to find a positive correlation between sales price and being surrounded by new construction even if there is no causative effect of new construction on price. The repeat-sales fixed effects approach controls for this by implicitly controlling for the unobservable home attributes. Census block groups fixed effects will be unlikely to mitigate this problem because even within blocks it is more likely that higher value houses would attract new construction. With this in mind, we expect that the estimates from the census block fixed effects models will be biased upwards and thus expect the repeat sales fixed effects estimates to be smaller.

We also need to address the spatial nature of housing data. Spatial dependence is when the values of nearby or neighboring homes are co-determined. Spatial autocorrelation is when the error terms for different observations, rather than being independently identically distributed, are correlated for spatially close observations. Our approach controls for this by using fixed effects and error-clustering at various geographic levels following Davis (2004) and Heintzelman (2010) among others. These tools essentially employ a simplified version of the spatial weighting matrix where we allow for spatial dependence at the scale of the fixed effects; observations within the same block, or property, are assumed to be spatially dependent, but independence is assumed for any observations not in the same respective area. Similarly, we allow error terms to be correlated for observations within blocks, or properties, but assume zero correlation of the error terms for observations in different areas. This clustering also implicitly adjusts the standard error estimates for heteroskedasticity.

3.2. Quantile regression model

Quantile regression allows us to examine how the influence of housing attributes and externalities such as new construction may vary across the distribution of house prices. Previous research (Coulson and McMillen, 2007; McMillen, 2008; Zietz et al., 2008; Mak et al., 2010; Liao and Wang, 2012; Zahirovic-Herbert and Chatterjee, 2012) identifies significant variations in the values of physical attributes across conditional quantiles. Similar quantile variations may exist in the value attributed to a new house and proximity to new construction as suggested in Coulson and McMillen's (2007) findings relative to new construction.

To investigate the differences in willingness to pay for new construction and proximity to new construction, we examine the willingness to pay along the distribution of house prices at various quantiles or percentiles. Thus, we estimate the coefficients on the same variables as in the base hedonic model, but we allow the coefficients to vary with the quantile. The model becomes:

$$\ln Price = c_\tau + \alpha_\tau H + \varphi_\tau F + \beta_\tau N + \epsilon \quad (2)$$

in which the estimated coefficients depend on the quantile, τ, of the distribution natural log of house price.

Quantile regression allows researchers to examine upper and/or lower reference curves as a function of several independent variables of interest without having to impose strict parametric assumptions (Buchinsky, 1994; Mata and Machado, 1996; Koenker and Hallock, 2001). In general, quantile regression provides a more complete picture of the distributions of the dependent variable given a set of regressors; researchers can estimate any point on the distributions and as many points on the distribution as they wish to estimate. Different coefficient estimates at different quantiles would be a manifestation that a pure OLS model is inadequate to explain the underlying relationship between the variables of interest. In addition, the estimated coefficient vector of quantile regression is more robust to outliers as the objective function minimizes the weighted sum of absolute deviations.

3.3. Variables

The house characteristics, H, include standard house physical features. (Table 1 lists the variables used in the empirical models.) The sales price (*Price*), number of bedrooms (*Bedrooms*), number of bathrooms (*Bathrooms*), number of fireplaces (*Fireplaces*), and living area (*LivingArea*) are drawn directly from the MLS report for each sale. The *NetArea* variable is calculated as the difference between the total square footage under roof less the square footage of living area. It captures the size of utility rooms,

Table 1
Variable descriptions.

Variable	Description
Panel A: baseline hedonic model	
Dependent variable	
Price	Selling price
House characteristics	
Bedrooms	Number of bedrooms
Bathrooms	Number of bathrooms
Fireplaces	Number of fireplaces
LivingArea	Square feet of living area
LivingArea_Squared	Living area squared
NetArea	Square feet of other area under roof
NetArea_Squared	Net other area squared
Townhouse	Dummy variable for attached house (1 = townhouse)
Age	Continuous measure of age for houses one year or older
Age _Squared	Age squared
Age_Range[a]	Dummy variable for house age range, not including new houses (⩾1)
Vacant	Dummy variable for vacant house (1 = vacant)
Renter	Dummy variable for renter occupied house (1 = renter)
RepeatSale	Dummy variable for house sold more than once during period (1 = sold 2 or more times during study period)
Panel B: new construction variables of interest[b]	
New construction	
New_House	Dummy variable for new house (1 = house <1 year old when sold)
Bigger_New	Dummy variable for new house larger than average (Total sf in living area > average sf for all houses in Census Block Group)
New_Construction	Dummy variable for presence of New house sales within 1/2 mile radius of house *i* and within 1 year of house *i*
Bigger_New_Construction	Dummy variable for presence of Bigger_New house sales within 1/2 mile radius of house *i* and within 1 year of sale of house *i*
New_Quarter	Number of New houses sold within 1/4 mile radius and within 1 year of sale of house *i*
Bigger_New_Quarter	Number of Bigger_New houses sold within 1/4 mile radius and within1 year of sale of house *i*
New_Half	Number of New houses sold between 1/4 and 1/2 mile radius and within 1 year of sale of house *i*
Bigger_New_Half	Number of Bigger_New houses sold between 1/4 and 1/2 mile radius and within 1 year of sale of house *i*
New_Mile	Number of New houses sold between 1/2 and 1 mile radius and within 1 year of sale of house *i*
Bigger_New_Mile	Number of Bigger_New houses sold between 1/2 and 1 mile radius and within1 year of house *i*

[a] Age range categories are: 1–3, 4–5, 6–10, 11–15, 16–20, 21–30, 31–40, 41–50, 51–75 years and 76+ years. We use these to construct the Age1 to Age9 dummy variables. There were some observations with missing values. For these cases, we construct the appropriate age dummy variable using the difference between the reported date of construction and the date of sale. We dropped observations for which even this information was missing.
[b] A general spatial model of the impact of a new construction on subject property value. See Fig. 1.

garages, covered porches, carports, etc. *Townhouse* is a dummy variable to designate if a house is attached or detached. The age of resale houses is entered into the model in two different ways. When excluding new houses from the analysis, a continuous measure of *Age* in years is used. When both new and existing houses are included, the age of resale houses is represented by a series of dummy variables (*Age1* – *Age9*) representing age categories from 1 to 3 years to 76 or more years. Because previous research has shown that vacant properties sell for a discount, we include *Vacant*, a dummy variable indicating an unoccupied property. Similarly, we define *Renter* as a dummy variable that indicates the presence of a renter in the house during the transaction period. *RepeatSale* variable controls for properties that sell more than once during our sample period.[5] This variable is omitted in the analysis that examines only repeat sales.

[5] Research indicates that houses with certain characteristics tend to sell more often. For example, Clapp and Giaccotto (1992) find that repeat sales often occur on lesser quality properties. Similarly, Case et al. (1997) find frequently transacted properties tend to smaller and less homogeneous. They also appreciate faster. Hwang and Quigley (2004) find that there are often substantial changes in quality between the repeat sales on a single property.

As mentioned earlier, fixed effects analysis controls for omitted variables by including a large set of dummy variables for small groups of observations, in our case, observations that are within a small geographic area. Thus, location is indicated by a set of dummy variables that control for 265 census block-groups, the boundaries of which are used from the census closest in time to the observed transaction date. Fixed effects for year and season of sale are obtained using appropriately defined sets of dummy variables.

The distance over which houses influence the prices of other properties through externalities has not been firmly established; however, the price effects should be limited to a house's submarket. Goodman and Thibodeau (1998) define submarkets as "geographic areas where (1) the price of housing (per unit of service) is constant and (2) individual housing characteristics are available for purchase." Previous studies have examined spillover effects by identifying new and atypical houses located either within two or three city blocks, 300 or 500 feet, 0.25, 0.50 or 0.60 mile, or the same zip code. To define an area small enough to detect effects while assuring a sufficient number of newly constructed houses are located within the impact area to observe a range of effects, we define a one-quarter, one-half, and one-mile radius around each house *i* within

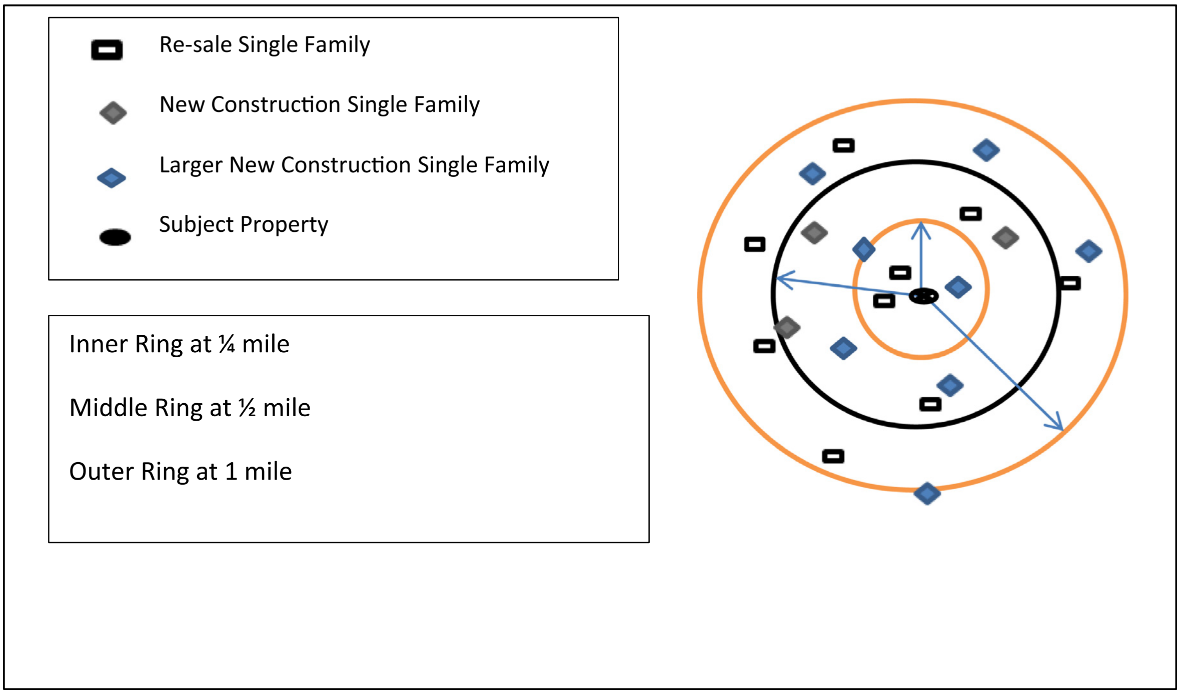

Fig. 1. A general spatial model of the impact of new construction on property value.

which we consider new construction and the relative size of new construction effects.[6]

Our set of variables of interest, *N*, relates to the impact of new construction on the price of the subject and surrounding houses. We examine the effect of new construction and an atypically large new house directly through *New_House*, which is a dummy variable that represents if house *i* is less than one year old when sold and *Bigger_New*, which identifies new houses that contain a greater than average amount of floor area for houses within that census block group. To capture the effect of new construction and the relative size of the new construction on surrounding house values, we add two dummy variables, *New_Construction* and *Bigger_New_Construction*, which equal 1 if there is any new unit sold within one year prior to the subject house sale within one-half mile (and equal 0 otherwise) or any new unit sold within the prior year that is larger than average for the area.[7] To capture the concentration and relative size of all new house construction, we draw three rings around the subject property and calculate two variables for each ring. *New_Quarter* provides a count of newly constructed houses sold within one year prior to the sale of house *i* and located within one-quarter mile of house *i* as defined by a circle with the subject in the center drawn as illustrated in Fig. 1. *Bigger_New_Quarter* provides the count of newly constructed houses within a quarter mile sold within one year prior to house *i* that are larger than average for the area. *New_Half* provides a similar count of number of new houses between one-quarter and one-half mile from the subject and *Bigger_New_Half* a count of new houses larger than the neighborhood average located between one-quarter and one-half mile from the subject. The third set of variables, *New_Mile* and *Bigger_New_Mile* represent similar calculations for the ring between one-half to one mile from the subject house. We calculate the total number of newly constructed houses within the specified distance of a parcel's property centroid utilizing GIS software.

3.4. Data

The house transactions data draw from the Multiple Listing Service (MLS) sales reports for Baton Rouge, Louisiana. We use a sample containing broker-assisted single-family attached and detached housing transactions completed between October, 1984 and April, 2005 sold within contiguous urban neighborhoods within the metropolitan statistical area.[8] The sample period ends three months before Hurricane Katrina affected the area of study. The unique setting from which the data are drawn allows us to sidestep common difficulties encountered in other capitalization studies. In particular, the single school district is coterminous with the unified city-parish government jurisdiction

[6] In addition to a one-mile radius, we tested neighborhood effects using census tracts. In addition to using a count of new construction within one mile of the subject house, we also tested a weighted quantity and distance index measure. The coefficient signs are consistent across all models and magnitudes vary only slightly. Results of these different specifications are available from the authors.

[7] Three distance buffers are used to identify new construction around each subject property, consistent with the literature on the effects of proximate phenomena on property values. Our results from this estimation show that the externality effect is not statistically significant past one-half mile; therefore we use the one-half mile range in a specification that controls only for the presence of new construction.

[8] The subject area is comprised of a contiguous area and excludes houses in Baker and Zachary.

boundaries, a unique feature that minimizes spatial variation in local property tax rates, school spending, as well as other public services. During part of the sample period students were randomly assigned schools with parish-wide busing, thereby eliminating variation in expected school quality usually found across neighborhoods in other urban areas. It also seems reasonable to expect that services vary less within the jurisdiction than across jurisdiction boundaries.

The street system and organized subdivision of central Baton Rouge date from the early 1800s. From the beginning of the twentieth century, industrial development grew to the north to accommodate the oil and shipping industries and their workers while the Louisiana State University campus drew development to the south. Residential suburbanization has continued to the south and east away from the river and the city center (Speights-Binet, 2004); however, some construction has occurred inside the built up area in recent decades. City records indicate that 590 permits for residential construction were issued between 1985 and 2005. Of those, 29 were for subdivisions of 20 or more lots. During the same time period, permits were issued for 9 new major subdivisions of mixed residential and commercial uses and 10 new minor mixed use developments. A popular method of infill in one part of Baton Rouge in the late 1990s was to purchase several existing adjoining extra-large lots, then resubdivide, creating subdivisions of 7–14 lots with large houses, but small lots (Ball, 1999). These houses may greatly exceed the average size of the existing older houses in the neighborhood, creating more heterogeneous mixtures of house sizes and ages.[9]

We apply several filters to systematically clean the data. First, we eliminate non-broker assisted transactions and those missing a key variable, age. MLS listings were published in bi-weekly books during most of the sample period, which means that newly listed houses did not appear in print for up to 14 days. Therefore, in order to restrict the sample to houses with full market exposure, we exclude houses that sold in fewer than 14 days. To eliminate outliers, we exclude houses that took more than 400 days to sell as well as houses that sold for less than $30,000 or more than $1,000,000. In order to minimize data errors, we also exclude houses with unusually small or unusually large living area (less than 300 or more than 4500 square feet), unusual net area of utility rooms, covered porches, and carports (less than 110 and more than 4000 square feet), or unusually small or large numbers of bedrooms and bathrooms (0, 1, 7 or more bedrooms, less than 1 or 6 or more bathrooms).[10] The cleaned data set is comprised of 37,403 transactions. Summary statistics are provided in Table 2.

The average age at the time of sale for houses in the sample is 17.25 years. Only 14% of the houses were less than one year old when they sold. One-half of these new houses were larger than the average house in the area in which they were built. Just over half (55%) of all houses sold during the study period were located within one-half mile of at least one new house that sold within one year prior to the subject house and just over one-third (38%) of houses that sold were located within one-half mile of at least one new house that was larger than average for the area. A slightly smaller percentage (49%) of existing houses sold were located within one-half mile of a new house that sold in the previous year and a similarly smaller 32% of existing house sales took place within one-half mile of a new unit that was larger than average for the area. The number of new houses sold within the previous year within one-quarter mile ranges from 0 to 46. Between one-quarter and one-half mile, the maximum increases to 60 and up to 65 between one-half and one mile. The average number of nearby new house sales in the previous year is 1.83 in the inner ring, 2.13 in the second ring, and 5.81 in the third ring. On average, less than one house containing more than the mean floor space for the area sold within a quarter-mile during the previous year, but an average of 2.64 larger new houses sold within 1 mile. So, most house sales take place in the absence of neighboring new house sales, but a few houses are feeling the effects of nearby large-scale residential development.

4. Results

4.1. Existing house sales sample analysis

Table 3 reports the ordinary least squares estimates based on a subsample of houses that were at least one year old when sold, thus excluding new houses and creating a reduced sample of 32,191 observations. We present four models in which we include the house characteristics, including age and age squared, a dummy variable for repeat sales, and a series of measures of the existence as well as the number and size of new houses constructed within different distance rings from the subject property. The explanatory power of the models is strong with an R^2 of just over 90%. Column 1 contains the baseline model estimate for ln *Price*. The base model specifies the natural log of sales price as a function of the house characteristics plus location and time period dummy variables (not reported). Coefficients on the house characteristics follow expectations including a negative sign on age and positive sign on age squared to reflect the relatively higher value of historic properties. Larger houses tend to sell for higher prices than houses with less living area.

Columns 2 through 4 of Table 3 focus on the spillover effects of new construction on the prices of existing houses. The second model adds two dummy variables that capture whether any newly constructed houses sold within one-half mile of the subject house at the time of the sale. The mere existence of new houses selling nearby is

[9] There were also new townhouses constructed during this time period that could result in an increase in smaller size houses in the area. A check of the location of townhouse developments indicates that these were constructed in areas away from existing single-family houses and were small in scale.

[10] The number of excluded transactions based on the filters is as follows in the order they were applied: Missing information (3499); age more than 100 years (4); sold in fewer than 14 days or more than 400 days. (15,397), sold for less than $30,000 or more than $1,000,000 (2494); contained less than 300 sf or more than 4500 sf of living area (303); contained less than 110 sf or more than 4000 sf net area of utility rooms, covered porches, and carports (4469); 0, 1, or 7 or more bedrooms (18); less than 1 or 6 or more bathrooms (1484); outside of study area (5110).

Table 2
Data summary statistics.

Variable	Mean	Std. Dev.	Minimum	Maximum
Dependent variable				
Price	121,385	74,167	30,000	975,000
House characteristics				
Bedrooms	3.30	0.65	1	7
Bathrooms	2.06	0.52	1	5
Fireplaces	0.72	0.54	0	3
LivingArea	1,951.95	638.03	359.00	4,500.00
NetArea	707.51	318.94	110.00	3,925.00
Townhouse	0.04	0.20	0	1
Age	17.25	16.50	0	100
Vacant	0.40	0.49	0	1
Renter	0.05	0.21	0	1
RepeatSale	0.52	0.50	0	1
New construction				
New_House	0.14	0.35	0	1
Bigger_New	0.07	0.26	0	1
New_Construction	0.55	0.49	0	1
Bigger_New_Construction	0.38	0.48	0	1
New_Quarter	1.83	4.57	0	46
Bigger_New_Quarter	0.83	2.79	0	38
New_Half	2.13	4.47	0	60
Bigger_New_Half	0.97	2.55	0	37
New_Mile	5.81	5.81	0	65
Bigger_New_Mile	2.64	2.63	0	42

Note: Statistics are based on full sample of repeat and new house sales. Summary statistics for dummy variables for season and year of sale are not reported.

insignificant; however, the sale of new houses larger than average for the neighborhood within one-half mile has a significant positive effect on the sales price of existing houses. To examine this relationship more closely, we add variables that measure the count of new houses sold in proximity to the subject property in rings up to one mile in model 3. These new houses are sold in the year prior to the subject property, so are competing for the same buyers as existing houses that are for sale at that time. The construction of new houses within one-quarter mile appears to have a positive effect on the selling prices of neighboring existing houses. In particular, the results indicate that increasing new construction nearby has a significant positive impact on the price at which a house will sell. Each newly constructed house within one-quarter mile of the subject property and whose sale occurs within a year prior to a subject house sale increases the sales price of a house by 0.27% (column 3). The impact becomes statistically insignificant as the distance from the subject property increases beyond one-quarter mile. The difference in the results between model 2 and 3 supports Simons et al.'s (1998) assertion that the degree of concentration, not simply the existence of new construction, is relevant to understanding the price effect. It also highlights the importance of examining the amount of new construction at varying distances from existing houses.

However, if we consider the relative size of the new houses being constructed in the neighborhood, we see that it is the construction of new houses that contain more than the area average square footage within one-quarter mile that creates the significant positive price effect on existing house prices.[11] Each newly constructed house sold within the last year that is larger than the average house in the neighborhood within one-quarter mile of the subject increases the sales price of a single-family house by 0.87% (column 4) and is insignificant beyond that distance. Meanwhile, a small negative effect is felt if new similar sized houses are constructed between one-quarter and one-half mile away. We do not find evidence to support Leguizamon's (2010) suggestion that smaller house buyers want larger houses nearby, but not too close. Taken together, our results indicate that the spillover effects of new construction on existing houses are strongest within one-quarter mile; however the magnitude of the positive influence depends not only on the presence of new houses, but also their relative size.

We also recognize that the impact of new construction on the surrounding property may differ among housing submarkets. Grigsby et al. (1987) suggest that housing submarkets are defined not by location, but instead as a collection of houses that are close substitutes for one another, but relatively poor substitutes for houses offering different packages of housing services. This view suggests that spatially separated houses in different neighborhoods that offer a similar package of housing services may be considered close substitutes by market participants. Thus, submarkets may be comprised of non-contiguous pieces of real estate. This could be especially applicable to our case where new construction could be viewed as a close substitute to a house less than 3 years old that would be relatively similar in terms of size and amenities, but not a substitute for a house 15–20 years old despite their geographic proximity. We would expect that in such submarkets, the effect of any positive externality from new construction would be lower.

To test this hypothesis, we constructed a sample restricted to only the 3748 houses that sold when they were 1–3 years old, the closest substitutes for new construction. The results for the variables of interest are shown in Table 4. (The coefficients on the house characteristics are consistent with the full sample.) The coefficient on the variable representing new construction one-quarter to one-half mile away as well as the dummy variable for any bigger new construction become insignificant while the positive effect of the number of bigger new houses constructed within one-quarter mile declines, but remains significant. Thus, we see that the spillover effect of building a concentration of new larger houses nearby is persistent even among relatively new neighborhoods; however the effect is dampened somewhat as compared to neighborhoods that contain older houses.

It is possible that some neighborhoods attract new construction because of other positive developments in the area. An increase in existing house values may be partially

[11] We evaluated the null hypotheses of equality of coefficients. A Wald test for the variables *New_Construction* and *Bigger_New_Construction* ($F = 1.30$, $p = 0.2570$) does not reject the null, indicating there is no statistically significant difference between the coefficients of the two variables. A joint test indicates they are jointly significant ($F = 6.09$, $p = 0.0034$). A Wald test of the equality of coefficients for the variables *New_Quarter*, *New_Half* and *New_Mile* ($F = 3.37$, $p = 0.0222$). A similar test of *Bigger_New_Quarter*, *Bigger_New_Half*, and *Bigger_New_Mile* is also statistically significant ($F = 4.58$, $p = 0.0050$).

Table 3
Hedonic model estimates of house sales price for existing houses.

Explanatory variables	Dependent variable ln (*Price*)			
	Model (1)	Model (2)	Model (3)	Model (4)
House characteristics				
Bedrooms	−0.0171***	−0.0169***	−0.0172***	−0.0171***
	(0.0054)	(0.0055)	(0.0054)	(0.0054)
Bathrooms	0.0190***	0.0191***	0.0192***	0.0196***
	(0.0049)	(0.0049)	(0.0049)	(0.0049)
Fireplaces	0.0183***	0.0181***	0.0184***	0.0187***
	(0.0048)	(0.0048)	(0.0048)	(0.0048)
LivingArea	0.0007***	0.0007***	0.0007***	0.0006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NetArea	0.0002***	0.0002***	0.0002***	0.0002***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LivingArea_Squared	−0.0000***	−0.0000***	−0.0000***	−0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NetArea_Squared	−0.0000***	−0.0000***	−0.0000***	−0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Townhouse	−0.0896***	−0.0894***	−0.0889***	−0.0884***
	(0.0241)	(0.0241)	(0.0240)	(0.0240)
Age	−0.0132***	−0.0130***	−0.0129***	−0.0127***
	(0.0009)	(0.0008)	(0.0008)	(0.0008)
Age_Squared	0.0001***	0.0001***	0.0001***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Vacant	−0.0657***	−0.0657***	−0.0659***	−0.0657***
	(0.0038)	(0.0038)	(0.0038)	(0.0038)
Renter	−0.0985***	−0.0982***	−0.0981***	−0.0977***
	(0.0078)	(0.0078)	(0.0078)	(0.0078)
RepeatSale	0.0129***	0.0127***	0.0125***	0.0124***
	(0.0031)	(0.0030)	(0.0030)	(0.0030)
New construction variables of interest				
New_Construction		−0.0016	0.0087**	0.0025
		(0.0055)	(0.0038)	(0.0053)
Bigger_New_Construction		0.0223***		0.0143**
		(0.0076)		(0.0062)
New_Quarter			0.0027***	−0.0014
			(0.0010)	(0.0009)
Bigger_New_Quarter				0.0087***
				(0.0024)
New_Half			−0.0005	−0.0015*
			(0.0004)	(0.0008)
Bigger_New_Half				0.0015
				(0.0010)
New_Mile			0.0004	0.0005
			(0.0003)	(0.0005)
Bigger_New_Mile				−0.0003
				(0.0010)
Constant	10.3595***	10.3604***	10.3569***	10.3626***
	(0.0367)	(0.0367)	(0.0365)	(0.0365)
Year dummies included	Yes	Yes	Yes	Yes
Season dummies included	Yes	Yes	Yes	Yes
Fixed effects	265 census block groups			
Observations	32,191	32,191	32,191	32,191
R^2	0.9032	0.9035	0.9035	0.9039

Note: Model (1) presents the baseline hedonic model. Model (2) includes the variables *New_Construction* and *Bigger_New-Construction* to examine the influence of the construction and sale of any new houses within one-half mile of the existing subject house within one year prior to the sale of the subject house. Model (3) contains *New_Construction*, *New_Quarter*, *New_Half*, and *New_Mile* to examine the effect if any new houses built and sold within one-half mile in addition to the effect of the number of new houses constructed and sold within one-quarter, one-half, and one-mile radius within one year prior to the sale of the subject house. Model (4) adds the variables *Bigger_New_Construction*, *Bigger_New_Quarter*, *Bigger_New_Half*, and *Bigger_New_Mile* to examine the influence of relative size as well as the number of newly constructed houses. Clustered standard errors are presented in parentheses. Coefficients on dummy variables for season and year of sale and location controls based on census block groups are not reported. Stars denote statistical significance.

*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Table 4
Hedonic model estimates of house sales price restricted to 1–3-Year old existing houses.

New construction variables of interest	Dependent variable ln (*Price*)	
	Model (4) all existing houses	Model (5) existing houses 1–3 years old
New_Construction	0.0025	−0.0023
	(0.0053)	(0.0105)
Bigger_New_Construction	0.0143**	0.0060
	(0.0062)	(0.0092)
New_Quarter	−0.0014	−0.0012
	(0.0009)	(0.0012)
Bigger_New_Quarter	0.0087***	0.0038**
	(0.0024)	(0.0019)
New_Half	−0.0015*	−0.0004
	(0.0008)	(0.0006)
Bigger_New_Half	0.0015	−0.0001
	(0.0010)	(0.0018)
New_Mile	0.0005	0.0013
	(0.0005)	(0.0008)
Bigger_New_Mile	−0.0003	−0.0006
	(0.0010)	(0.0016)
Year dummies included	Yes	Yes
Season dummies included	Yes	Yes
Fixed effects	265 census block groups	
Observations	32,191	3748
R^2	0.9039	0.9551

Note: This table shows only the new construction variables. Clustered standard errors are presented in parentheses. Stars denote statistical significance.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Table 5
Hedonic model estimates of house sales price for houses in census tracts with above median income.

New construction variables of interest	Dependent variable ln (*Price*)	
	Model (4) all existing houses	Model (6) houses in census tracts with above median income
New_Construction	0.0025	−0.0001
	(0.0053)	(0.0050)
Bigger_New_Construction	0.0143**	0.0137**
	(0.0062)	(0.0052)
New_Quarter	−0.0014	−0.0019*
	(0.0009)	(0.0011)
Bigger_New_Quarter	0.0087***	0.0067***
	(0.0024)	(0.0024)
New_Half	−0.0015*	−0.0012
	(0.0008)	(0.0008)
Bigger_New_Half	0.0015	0.0008
	(0.0010)	(0.0008)
New_Mile	0.0005	0.0010*
	(0.0005)	(0.0005)
Bigger_New_Mile	−0.0003	−0.0012
	(0.0010)	(0.0010)
Year dummies included	Yes	Yes
Season dummies included	Yes	Yes
Fixed effects	265 census block groups	
Observations	32,191	15,630
R^2	0.9039	0.9125

Note: This table shows only the new construction variables. Clustered standard errors are presented in parentheses. Stars denote statistical significance.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

the result of these other positive effects rather than the direct effect of neighboring new construction. One way to examine this possibility is to split the sample into houses located in areas more likely to attract new construction versus those less likely to attract new construction. We use relative household income as an indicator of which neighborhoods would be more likely to attract such investment. In Table 5, we select existing house sales located in census tracts where the median household income is larger than the median census tract household income for all observations.[12]

The signs on all the significant variables in model based on the higher income neighborhood subsample are consistent with results based on existing house sales in all neighborhoods. We do not find a systematically different response of housing prices in higher income neighborhoods to construction of larger houses in their midst.

4.2. Repeat sales analysis

We perform a property-level fixed effects analysis by looking only at the 16,583 houses that have sold more than once during the study time period and were not less than one year old (new construction) at the time of the first transaction. The fixed effects effectively eliminate static, otherwise unobserved, property-level characteristics from the error term of the regression, leaving only those factors that are changing over time. By restricting the sample to homes that sell more than once, we risk the introduction of sample bias. However, an examination of summary statistics suggests no large systematic differences in observed characteristics between those houses that sell once versus multiple times during the sample period. Houses selling more than once tend to be somewhat larger in living area and net area and have a correspondingly larger sales price, but these differences are not substantial. More importantly, the fixed effects analysis implicitly controls for anything, observed or unobserved, that makes these homes different, and so any differences should not be reflected in the estimated effect of new construction externality. Table 6 shows that signs on all the coefficients of interest are consistent with base model that includes houses that sold only once during the study period. The size of newly constructed houses within one-half mile is again important when only repeat sales are considered with the construction of bigger houses exerting a positive effect.[13]

[12] We develop the above/below median income classification by assigning each sale observation between 1984 and 1994 the 1990 median income for the census tract in which it is located. We do the same for sales between 1995 and 2005, assigning each observation the 2000 median income for its census tract. We then find the median among the median income value assigned to each property. Those observations assigned a median income above the median of all observations are classified as located in higher income neighborhoods.

[13] We restrict our model to only the dummy variables *New_Construction* and *Bigger_New_Construction*. This allows us to test whether the sales of new houses near the time of the repeat sale of a subject house has a differential influence on price than if new houses were also sold nearby at the time of the first sale of the subject house.

Table 6
Repeat sales estimates of house sales price.

New construction variables of interest	Dependent variable ln (*Price*) at last sale Model (7) repeat sale houses
New_Construction	0.0048
	(0.0049)
Bigger_New_Construction	0.0513***
	(0.0049)
Year dummies included	Yes
Season dummies included	Yes
Fixed effects	Property level
Observations	16,583
R^2	0.4610

Note: This table shows only new construction variables. Clustered standard errors are presented in parentheses. Stars denote statistical significance (**$p < 0.05$, *$p < 0.10$).
*** $p < 0.01$.

4.3. Full-sample analysis

Our models so far capture the estimated spillover effect of new construction on the values of neighboring existing houses. We now expand the analysis to include new house (less than one year old) sales so that we can identify any price premium associated with new construction as well as the relative effects of constructing new houses scattered among existing houses versus concentrated developments of new houses. We re-estimate the base model, but add the variables used to identify new houses and atypically large new houses and substitute categorical age variables for existing houses one year or older. The R^2 increases slightly. The signs on the coefficients are consistent with the estimations that excluded new house sales. (Table 7 reports the results.) Once again, the model specifies the natural log of sales price as a function of the house characteristics, location and time period dummy variables (not reported), but adds a dummy variable to indicate if the subject house is newly constructed as well as if a new house is larger than average size for the area. The results indicate that new houses sell at a premium relative to surrounding older houses. New houses that provide more living area than the average house in the area sell at an even higher premium than new houses of similar size as existing houses. Thus, atypically larger new houses do not appear to sell for less as would be suggested by Haurin (1988) or Hamilton (1976).

Once again, when the two dummy variables that capture whether any newly constructed houses sold within one-half mile and within one year prior to the subject sale are added, we see that the sale of new houses larger than average for the neighborhood has a significant positive effect on the sales price of other houses, including other newly constructed houses. The results indicate that concentrated new construction nearby has a significant positive impact on the price at which a neighboring house will sell. The impact declines and becomes statistically insignificant as the distance from the subject property increases. If we consider the relative size as well as number of new houses being constructed in the neighborhood, we see that it is the construction of a greater number of new houses that contain more than the area average square

Table 7
Hedonic model estimates of house sales price for new and existing houses.

Explanatory variables[a]	Dependent variable ln (*Price*) Model (8) new and existing houses
House characteristics	
Bedrooms	−0.0204***
	(0.0055)
Bathrooms	0.0230***
	(0.0046)
Fireplaces	0.0210***
	(0.0045)
LivingArea	0.0007***
	(0.0000)
NetArea	0.0002***
	(0.0000)
LivingArea_Squared	−0.0000***
	(0.0000)
NetArea_Squared	−0.0000***
	(0.0000)
Townhouse	−0.0732***
	(0.0237)
Age1	0.2365***
	(0.0150)
Age2	0.1892***
	(0.0154)
Age3	0.1246***
	(0.0140)
Age4	0.0647***
	(0.0140)
Age5	0.0299**
	(0.0132)
Age6	−0.0141
	(0.0121)
Age7	−0.0387***
	(0.0116)
Age8	−0.0291**
	(0.0128)
Age9	0.0427**
	(0.0173)
Vacant	−0.0535***
	(0.0033)
Renter	−0.0943***
	(0.0076)
RepeatSale	0.0145***
	(0.0028)
New construction variables of interest	
New_House	0.2735***
	(0.0174)
Bigger_New	0.0390***
	(0.0071)
New_Construction	0.0015
	(0.0054)
Bigger_New_Construction	0.0144**
	(0.0067)
New_Quarter	−0.0008
	(0.0005)
Bigger_New_Quarter	0.0053***
	(0.0019)
New_Half	−0.0013**
	(0.0006)
Bigger_New_Half	0.0016*
	(0.0008)
New_Mile	0.0006
	(0.0005)
Bigger_New_Mile	−0.0006
	(0.0009)
Constant	10.0670***
	(0.0430)
Year dummies included	Yes
Season dummies included	Yes

(*continued on next page*)

Table 7 (*continued*)

Explanatory variables[a]	Dependent variable ln (*Price*) Model (8) new and existing houses
Fixed effects	265 census block groups
Observations	37,403
R^2	0.9129

[a] A *New_House* represents whether a house is less than 1 year old at the time of sale. *Age1* to *Age9* ranges are: 1–3, 4–5, 6–10, 11–15, 16–20, 21–30, 31–40, 41–50 and 51–75 years with 76+ years as the reference category. Clustered standard errors are presented in parentheses. Coefficients on dummy variables for season and year of sale and location controls based on census block groups are not reported. Stars denote statistical significance.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

footage within one-quarter mile that creates the largest positive price effect on neighboring house prices; however, the positive price influence of larger new house construction appears to be felt over a longer distance when the effect on new house sales is included.[14] The small negative effect if new similar sized houses are constructed between one-quarter and one-half mile persists in this model.

4.4. Quantile regression analysis

In the prior analyses we implicitly assume that property value effects, in percentage terms, are constant across the distribution of houses by price. Instead, one would expect that the effects of many of the covariates would differ depending on the value of the house. We test this hypothesis of heterogeneity using quantile regression. The quantile regression results in Table 8 provide a more detailed explanation of the price effects of new construction.

In addition, Fig. 2a–f present a series of summary charts that help illustrate our quantile regression results. Fig. 2a–f presents a summary of quantile regression results for six variables that capture the density of new construction around the existing house that is offered for sale. The dashed horizontal line in each figure shows the ordinary least squares estimate of the conditional mean effect. The two dotted lines around it represent conventional 95% confidence intervals for the least squares estimate. It is clear that they do not vary with the quantile. For each of the six coefficients, we plot the five distinct quantile regression estimates for τ ranging from 0.10 to 0.90 as the solid curve. For each covariate, these point estimates may be interpreted as the impact of a one-unit change of the covariate on the sales price holding other covariates fixed. Thus, each of the plots has a horizontal quantile, or τ, plotted on x axis and the vertical scale indicates the covariate effect. The dark solid line represents the coefficient estimates at each quantile. Altogether, the quantile regression analysis makes an important case for being wary of standard hedonic estimates that do not account for heterogeneity across the distribution. There are important, significant, impacts that may be hidden in the 'average' coefficient estimated by standard OLS. In fact, there is a statistically significant difference between the coefficients for the top and bottom quantiles on these variables of interest.

The differences between OLS and quantile regression results can be seen in Table 8. Column 1 presents the OLS base model results for comparison. The subsequent columns present the results for the following quantiles: 10%, 25%, 50%, 75%, and 90%. The results indicate that a new house sells at a premium over an existing house, but the size of the premium is larger among houses with values lower than others with similar characteristics. This supports the relatively higher price elasticity of lower priced neighborhoods suggested by Guerrieri et al. (2010). Similarly, a larger than average size house commands a higher premium among properties that despite similar characteristics, are valued at a lower amount in the market. New construction in lower value neighborhoods in urban area may be less common, so the possibility to purchase a new house in an "affordable" range is limited and the limited supply drives up the relative price premium, especially if one is able to purchase a larger house than is commonly available in the neighborhood.

Increasing the number of new houses constructed within a quarter mile has a negative effect on competing houses that sell for relatively high prices considering their characteristics, as would be expected based on Coulson and McMillen (2007). At a further distance, the effect is uniform, negative up to one-half mile, than positive when new houses are constructed between one-half to one mile away. Building larger than average size houses nearby has a positive price effect for all houses up to one-half mile, but the greatest effects within one-quarter mile are evident among the houses that, despite their similar characteristics, sell at a lower price. The small negative effect of construction of larger houses at a distance of one-half to one mile is only significant for houses that command a moderate price relative to similar size and equipped houses.[15]

[14] We evaluated the null hypotheses of equality of coefficients. A Wald test for the variables *New_House* and *Bigger_New* ($F = 133.29$, $p = 0.0000$) rejects the null, indicating that there is statistically significant difference between the coefficients of the two variables. A joint test indicates they are jointly significant ($F = 167.80$, $p = 0.0000$). A Wald test of the equality of coefficients for the variables *New_Construction* and *Bigger_New Construction* ($F = 5.14$, $p = 0.0078$) indicates there is statistically significant difference between the coefficients. A similar test of *New_Quarter*, *New_Half* and *New_Mile* ($F = 4.10$, $p = 0.0091$) indicates there is statistically significant difference between the coefficients of the three variables. A similar test of *Bigger_New_Quarter*, *Bigger_New_Half*, and *Bigger_New_Mile* is also statistically significant ($F = 4.01$, $p = 0.0101$).

[15] We used a Wald test for the hypothesis that the coefficients of the variables of interest are the same for the bottom and top quantile. Thus we test $New\_House_{[q10]} = New\_House_{[q90]}$ ($F = 21.44$, $p = 0.0000$); $Bigger\_New_{[q10]} = Bigger\_New_{[q90]}$ ($F = 4.24$, $p = 0.0394$); $New\_Construction_{[q10]} = New\_Construction_{[qo0]}$ ($F = 10.60$, $p = 0.0011$; $Bigger\_New\_Construction_{[q10]} = Bigger\_New\_Construction_{[qo0]}$ ($F = 6.09$, $p = 0.0136$; $New\_Quarter_{[q10]} = New\_Quarter_{[q90]}$ ($F = 16.42$, $p = 0.0001$); $New\_Half_{[q10]} = New\_Half_{[q90]}$ ($F = 1.94$, $p = 0.1637$); $New\_Mile_{[q10]} = -New\_Mile_{[q90]}$ ($F = 0.12$, $p = 0.7333$); $Bigger\_New\_Quarter_{[q10]} = Bigger\_New\_Quarter_{[q90]}$ ($F = 1.46$, $p = 0.2263$); $Bigger\_New\_Half_{[q10]} = Bigger\_New\_Half_{[q90]}$ ($F = 0.02$, $p = 0.8931$); $Bigger\_New\_Mile_{[q10]} = Bigger\_New\_Mile_{[q90]}$ ($F = 0.43$, $p = 0.95144$). We can reject the hypothesis that the coefficients on *New_House* and *Bigger_New* are equal as well as *New_Construction*, *Bigger_New_Construction* and *New_Quarter*, indicating there is a statistically significant difference between the coefficients for the two quartiles on these variables. We cannot reject the hypothesis for the rest.

Table 8
Quantile regression model estimates of house sales price.

Explanatory variables	Dependent variable ln (*Price*)					
	OLS model	Quantile model				
		q10	q25	q50	q75	q90
House characteristics						
Bedrooms	−0.0204***	0.0087**	−0.0024	−0.0143***	−0.0261***	−0.0390***
	(0.0055)	(0.0039)	(0.0026)	(0.0022)	(0.0020)	(0.0028)
Bathrooms	0.0230***	0.0209***	0.0288***	0.0275***	0.0215***	0.0171***
	(0.0046)	(0.0038)	(0.0027)	(0.0026)	(0.0025)	(0.0032)
Fireplaces	0.0210***	0.0177***	0.0166***	0.0141***	0.0117***	0.0084***
	(0.0045)	(0.0033)	(0.0025)	(0.0021)	(0.0019)	(0.0029)
LivingArea	0.0007***	0.0007***	0.0007***	0.0006***	0.0006***	0.0006***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NetArea	0.0002***	0.0004***	0.0003***	0.0002***	0.0002***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LivingArea_Squared	−0.0000***	−0.0000***	−0.0000***	−0.0000***	−0.0000***	−0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
NetArea_Squared	−0.0000***	−0.0000***	−0.0000***	−0.0000***	−0.0000***	−0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Townhouse	−0.0732***	−0.1466***	−0.1272***	−0.0842***	−0.0523***	−0.0377***
	(0.0237)	(0.0124)	(0.0096)	(0.0063)	(0.0072)	(0.0090)
Age1	0.2365***	0.2809***	0.2844***	0.2615***	0.2252***	0.1980***
	(0.0150)	(0.0146)	(0.0118)	(0.0089)	(0.0072)	(0.0128)
Age2	0.1892***	0.2299***	0.2293***	0.2143***	0.1752***	0.1523***
	(0.0154)	(0.0152)	(0.0120)	(0.0092)	(0.0075)	(0.0124)
Age3	0.1246***	0.1661***	0.1718***	0.1489***	0.1147***	0.0953***
	(0.0140)	(0.0143)	(0.0113)	(0.0087)	(0.0069)	(0.0118)
Age4	0.0647***	0.1038***	0.1045***	0.0845***	0.0575***	0.0371***
	(0.0140)	(0.0151)	(0.0117)	(0.0087)	(0.0067)	(0.0118)
Age5	0.0299**	0.0613***	0.0629***	0.0435***	0.0178***	0.0048
	(0.0132)	(0.0154)	(0.0114)	(0.0083)	(0.0064)	(0.0122)
Age6	−0.0141	0.0112	0.0147	−0.0041	−0.0264***	−0.0383***
	(0.0121)	(0.0156)	(0.0110)	(0.0076)	(0.0057)	(0.0117)
Age7	−0.0387***	−0.0359**	−0.0231**	−0.0355***	−0.0497***	−0.0506***
	(0.0116)	(0.0150)	(0.0109)	(0.0081)	(0.0075)	(0.0126)
Age8	−0.0291**	−0.0247	−0.0262*	−0.0362***	−0.0409***	−0.0414***
	(0.0128)	(0.0190)	(0.0138)	(0.0104)	(0.0097)	(0.0130)
Age9	0.0427**	0.0371	0.0430**	0.0480***	0.0328***	0.0294*
	(0.0173)	(0.0249)	(0.0173)	(0.0124)	(0.0117)	(0.0158)
Vacant	−0.0535***	−0.0598***	−0.0470***	−0.0434***	−0.0407***	−0.0360***
	(0.0033)	(0.0036)	(0.0025)	(0.0020)	(0.0021)	(0.0024)
Renter	−0.0943***	−0.1257***	−0.0951***	−0.0770***	−0.0660***	−0.0570***
	(0.0076)	(0.0103)	(0.0070)	(0.0044)	(0.0047)	(0.0055)
Repeat sale	0.0145***	0.0171***	0.0149***	0.0116***	0.0085***	0.0074***
	(0.0028)	(0.0026)	(0.0019)	(0.0016)	(0.0015)	(0.0021)
New construction variables of interest						
New_House	0.2735***	0.3361***	0.3265***	0.3045***	0.2711***	0.2453***
	(0.0174)	(0.0161)	(0.0127)	(0.0090)	(0.0072)	(0.0125)
Bigger_New	0.0390***	0.0355***	0.0353***	0.0349***	0.0218***	0.0165***
	(0.0071)	(0.0079)	(0.0057)	(0.0041)	(0.0038)	(0.0044)
New_Construction	0.0015	0.0114***	−0.0005	0.0002	−0.0065***	−0.0040
	(0.0054)	(0.0039)	(0.0026)	(0.0024)	(0.0022)	(0.0031)
Bigger_New_Construction	0.0144**	0.0198***	0.0191***	0.0119***	0.0125***	0.0074**
	(0.0067)	(0.0041)	(0.0026)	(0.0024)	(0.0022)	(0.0031)
New_Quarter	−0.0008	0.0002	−0.0010***	−0.0014***	−0.0014***	−0.0018***
	(0.0005)	(0.0004)	(0.0003)	(0.0003)	(0.0002)	(0.0003)
Bigger_New_Quarter	0.0053***	0.0036***	0.0048***	0.0045***	0.0032***	0.0026***
	(0.0019)	(0.0006)	(0.0004)	(0.0004)	(0.0004)	(0.0005)
New_Half	−0.0013**	−0.0015***	−0.0008**	−0.0008***	−0.0005*	−0.0006*
	(0.0006)	(0.0006)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
Bigger_New_Half	0.0016*	0.0012	0.0016**	0.0011**	0.0005	0.0011*
	(0.0008)	(0.0009)	(0.0006)	(0.0005)	(0.0004)	(0.0006)
New_Mile	0.0006	0.0005	0.0006***	0.0009***	0.0008***	0.0004*
	(0.0005)	(0.0004)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bigger_New_Mile	−0.0006	−0.0007	−0.0006**	−0.0010***	−0.0008***	−0.0003
	(0.0009)	(0.0005)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Constant	10.0670***	10.6203***	10.6347***	10.6674***	10.7236***	10.7561***
	(0.0430)	(0.2177)	(0.2154)	(0.2125)	(0.2277)	(0.2464)

(*continued on next page*)

Table 8 (*continued*)

Explanatory variables	Dependent variable ln (*Price*)					
	OLS model	Quantile model				
		q10	q25	q50	q75	q90
Year dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Season dummies included	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	265 census block groups					
Observations	37,403	37,403	37,403	37,403	37,403	37,403
R^2/pseudo R^2	0.9129	0.6651	0.6930	0.7198	0.7442	0.7541

Note: This table summarizes the quantile regression results. Column 1 contains the OLS model estimates for ease of comparison. We also present the results for the following quantiles 10%, 25%, 50%, 75% and 90%. Coefficients on dummy variables for season and year of sale and location controls based on census block groups are not reported. Clustered standard errors are presented in parentheses for the OLS model. Bootstrapped standard errors are presented in parentheses for the quantile models. R^2 is reported for the OLS model and pseudo R^2 is reported for the quantile models. Stars denote statistical significance.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.10$.

Thus, the results illustrate how the valuation of new houses, neighboring new construction, and relative house size may vary across the distribution of prices for similar houses as evidenced in earlier quantile studies of other house characteristics (Coulson and McMillen, 2007; McMillen, 2008; Mak et al., 2010). Meanwhile, construction of larger than average houses exerts a small positive effect on existing house prices when located within one-half mile, especially among houses that command the lowest prices for a given package of attributes.

5. Conclusions

Encouraging new construction within urban areas is promoted as a powerful tool for improving efficiency in the provision of mass transit, utilities and services while saving rural open space. Clearing the way for private development and government investment in subsidies for infill development is expected to remove negative externalities, improving not only the individual parcels on which development occurs, but also creating spillover effects that increase the value of surrounding properties. The resulting rise in value increases residents' wealth and community tax revenues. However, new construction in an already urbanized area can also have negative effects as larger houses are often constructed on small lots that were drawn at a time when smaller houses were envisioned for the property. "Overbuilding" for the neighborhood may harm the value of the new construction as well as existing houses nearby.

This paper studies the impact of new private residential construction of various relative sizes on prices in the Baton Rouge housing market employing a hedonic price model. The study provides a framework for determining the extent to which the concentration and size of new houses relative to other new and existing houses can influence values across the price range. Because the analysis is limited to one American city like most previous studies, the general patterns of influence of new housing construction on surrounding prices are likely to be found in other cities, but the magnitude of the effects may vary somewhat. Because we examine the influence of privately funded housing development throughout an urban area rather than government subsidized projects in only distressed neighborhoods, in contrast to most previous studies, the conclusions can be extrapolated to any city.

Because the average size of new houses has been increasing, the effects of neighboring new construction need to be disentangled from the effects of different relative sizes of the new and existing houses. This study accomplishes this goal by incorporating a series of variables that capture not only the presence of new construction, but also the relative size and number of units. Because previous research has indicated that the scale or concentration of new development may influence the price effect, we specify the number of new units located near other new and existing house sales. To address the varied results depending on the distance measures used in previous studies, we consider a range of distance measures to determine the geographic size of the neighborhood effect. In addition, we employ a quantile regression to explore whether the price effects are uneven across price submarkets for similar houses.

Our results indicate that newly constructed houses sell at a premium even if they are larger than the average size of existing houses in the surrounding area. Thus, atypically large new houses constructed in urban areas are not discounted for their lack of fit with the neighborhood. The positive price effect is more pronounced among houses that command relatively low prices considering their physical characteristics. The cost of construction of new housing inside a built-up metropolitan area can be higher than in suburban areas with lower land prices and fewer constraints. Thus, few new units may be offered at relatively low prices and the demand for these "affordable" units may drive up prices.

The construction of new houses in established neighborhoods has a positive, but insignificant influence on

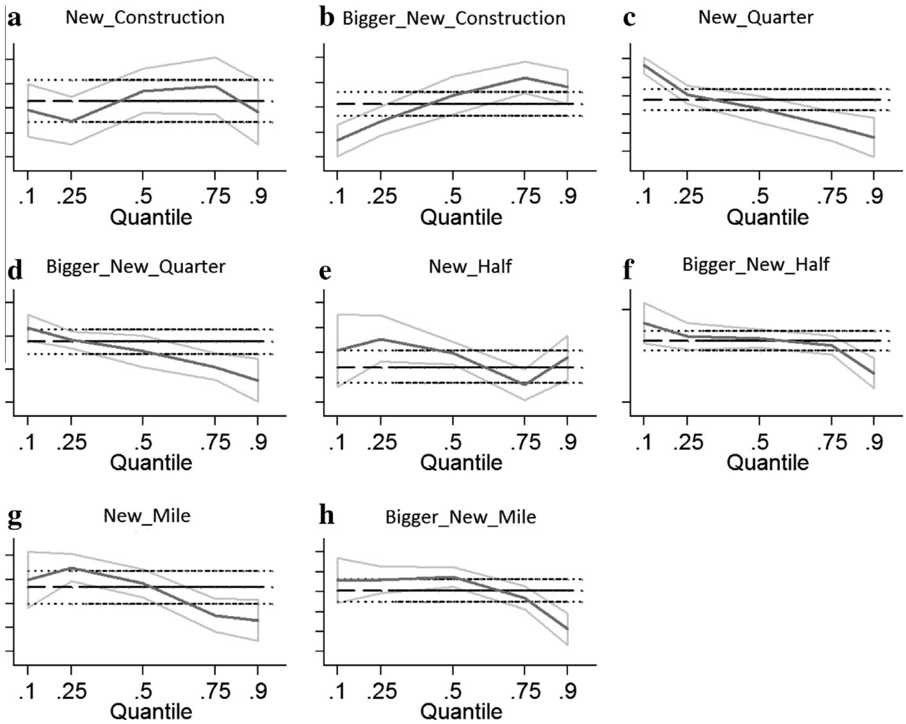

Fig. 2. (a–f) Coefficient estimates by quantile.

existing house prices, in general. However, The prices of existing houses suffer when new similar sized houses are constructed nearby. Thus, the new houses are competing directly with the existing similar sized houses, increasing supply while demand remains constant. Meanwhile, the prices of existing houses in an area in which larger new houses are being constructed are positively influenced by the new construction. The appeal of being located near new and relatively "better" houses raises average prices. This effect is especially evident among houses that are valued relatively low. Thus, the construction of new houses per se may not create a positive externality by raising the values of existing houses in the neighborhood. If new houses of similar size are constructed, buyers will pay a premium for the new houses and existing houses do not benefit from spillover effects. In fact, existing houses that would otherwise achieve a high price considering the bundle of attributes they provide will suffer the most from the competition. As the number of newly constructed houses that are larger than the older existing houses increases, then the positive influence on surrounding houses prices increases, especially among houses that were previously achieving lower prices than their competition. Thus, building a concentration of new, larger houses appears to pull up the value of existing, smaller houses.

We also find that the spillover effect of new construction varies with the distance from the existing house. The negative price effect of nearby new construction of similar size houses diminishes past one-half mile. Similarly, the positive effect of larger new houses declines past one-half mile. Consequently, the positive and negative effects of new construction are most strongly felt within a one-half mile radius. Therefore, communities hoping to increase existing property values through guided infill development must consider both the scale and location of new houses relative to existing residential neighborhoods.

This analysis of the positive and negative influences of new construction in an urbanized area indicates that a simple hedonic model may not be sufficient to reveal the complicated effects of externalities. The results of the quantile regression indicate that price influences may vary not only with the size and number of new houses being constructed, but also with the relative price a house brings in the market. The neighborhoods in which property values have lagged may exhibit the greatest need for revitalization through new construction, but if the response is to build larger houses in the neighborhood, then this will drive up prices not only for the new houses, but also for existing houses, which could cause displacement of current residents. Brueckner and Rosenthal's (2009) model shows how as urban neighborhoods attract new construction, higher-income residents will move into the area. Older, lower-value urban neighborhoods are often the home of elderly and minority residents who have either aged in place with their houses or else moved to the neighborhood in search of low prices and easy access to employment and services. If the average price of housing in these neighborhoods rises as new construction occurs, then gentrification may follow, making the neighborhood unaffordable for vulnerable segments of the population who may be forced to move to less desirable areas that are not attracting development.

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