Landscape and House Appearance Impacts on the Price of Single-Family Houses[1]

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Abstract

This research examined the impacts of improvement in landscape quality and exterior house features on residential property values. These two combined factors are referred to as 'curb appeal' — i.e., the visual appearance of a property as viewed from the curb in front of a house. It is well understood regarding residential property that curb appeal affects house value, but a quantitative estimate of the size/magnitude of the effect is not available. This study developed a quantitative indicator of curb appeal, included it in a hedonic house pricing model, and determined its independent effect on values. Results confirmed that curb appeal has a positive impact on house value, with landscape and house appearance approximately equal in impact. With improved curb appeal, house price can increase up to 17%.

Index words: hedonic model, house price, curb appeal, landscape quality, exterior house features/appearance.

Significance to the Nursery Industry

Past research on the impact of landscape quality on residential property value has reported an estimated 10 to 12% increase in property value as quality of landscaping improved from average to excellent. A criticism of this research is that it focused on landscape quality while ignoring exterior features of a house that certainly affect value. For a residential property, the combination of landscape quality and house appearance (including quality and maintenance of front house features) is referred to as curb appeal. Accurate information is needed on the impact of improved curb appeal on residential property value. In this regard, this research (a) developed an independent variable to quantify the appearance/quality of exterior curbside house features (e.g., paint condition and color coordination; type of windows and shutters; type of front door; etc.); and (b) included this variable, along with a landscape quality variable, in a re-specified hedonic house price model. Results from the model indicate that curb appeal has a positive impact on house value, with landscape and house appearance approximately equal in impact. With improved curb appeal, house price can increase up to 17%. This study is important for the landscape and nursery industries because it connects landscape quality to the term curb appeal — a popular and widely recognized term associated with residential property value — and shows the relative importance of landscape quality (as compared to exterior house appearance) in determining property value.

Introduction

A residential property is comprised of many characteristics that affect its value. The characteristics include house structural characteristics (e.g., square footage, number and size of garages, presence of a fireplace); environmental factors (e.g., a 'good view,' proximity to desirable public facilities, proximity to a landfill); neighborhood characteristics (e.g., crime level, local traffic, and quality of public education); and location factors (e.g., distance to the central business district) (20). Previous real estate research developed various estimates of the impacts of these factors on house value.

Two additional factors that impact residential property value are landscape quality and house appearance (based on exterior house features). In this research, these two factors in combination are referred to as 'curb appeal' — i.e., the visual appearance (or 'look') of a property as viewed from the curb in front of a house. Curb appeal is assessed by a potential buyer when he/she drives by a property or arrives for a viewing. As curb appeal diminishes, a residential property will be slower to sell and have decreased value (3).

What contributes to curb appeal of a house is debatable. Numerous popular books and self-help pamphlets are available and TV programs offer advice on how to improve curb appeal. A review of literature revealed no academic studies on curb appeal, per se; however, the topic has been addressed in bits and pieces in real estate research. A study by Portnov, Odish, and Fleishman (17) examined the impact of external house changes on house prices in Haifa, Israel. The study formulated a variable called MAJOR CHANGES to estimate the total cost of selected house modifications such as room and roof modifications, addition of permanent storage areas, and addition of balconies. The study reported that the MAJOR CHANGES variable had a significant positive effect on house price. A review of 125 previous house price studies by Sirmans, Macpherson, and Zietz (20) revealed a limited amount of curb appeal features in hedonic house price models. For example, independent variables were included for the type of house exterior (brick, stucco, wood, siding, etc.), type of roof (composition, wood shingle, metal, tile, etc.) and whether the house had 'new paint.' The models included other exterior house features — e.g., the presence of a deck, swimming pool, storage shed, and separate shop space — but these are not considered curb appeal features because they are not visible from the front of a house.

In addition to external house features, landscaping is an important aspect of curb appeal because it provides an aesthetically pleasing environment surrounding a house, and many buyers realize the functionality of trees and shrubs. Tree cover provides shade in summer and shelter in winter to reduce heating and cooling costs. Trees and plants create a buffer from noise and traffic, and shrubs and flowers provide

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food and shelter for birds and insects, which is an important environmental factor for some homeowners. A number of studies examined the impact of improved landscaping on the value of a residential property. Studies have found that tree cover adds 2–9% to the value of existing houses and a single tree can add as much as 2% (1, 2, 7, 13, 22). Newly built houses on tree-planted lots have a 7% higher price than those on bare lots (19). Lawn area and type of grass affect property value, with increased lawn area (up to a limit) having a positive impact on price (5, 6). Specific landscape characteristics, such as hedges or walls and landscaped curbs, each add 4% to property value; however, an above-average density of vegetation has a negative impact on price (6). When overall landscaping (including trees, plants, grasses and other landscape features) improves from average quality to excellent quality, house price increases by 10–12% (9, 21). An estimated 30% of the price increase is due to added tree cover (21). Perceptions of homeowners on the value of landscaping generally agree with the empirical research results — for example, one study reported that homeowners believe that improved landscaping can increase property value 5–11% for landscapes with sophisticated designs that incorporate a variety of different plant types and sizes and include flowers and colored hardscapes (4).

Exterior house features and landscaping are viewed simultaneously by a prospective home buyer and both components of a residential property contribute to curb appeal and motivate buyer interest. In the attempts to identify the separate and combined effects of the many factors that affect house values, it is known that the exclusion of one component from a statistical model may bias the estimated coefficients of the included variables. General hedonic house price studies such as those reviewed by Sirmans, Macpherson, and Zietz (20) included only limited information on detailed front house and landscape features that impact curb appeal. By comparison, the landscape quality studies by Henry (9) and by Stigarll and Elam (21) included detailed landscape features, but only limited exterior house features were included in their models; consequently, their reported impacts of improved landscaping on house price may be overstated if the landscape quality variable captured the impact of the missing exterior house features variable. In the model used in this research, variables for both landscape quality and exterior front house features were included to create a curb appeal variable to capture the total impact of curb appeal on house value. The model used allowed estimation of the individual impacts of improved house features and improved landscaping on house price.

The approach used in this study to measure the impact of curb appeal on house price involved a two-step process. In the first step, an instrument was constructed and used to score curb appeal for a sample of houses. The curb appeal measure was designed to reflect the impression of a prospective buyer toward a residential property at first viewing. The evaluation of curb appeal was necessarily impacted by some degree of subjectivity that entered into the scoring process. The evaluation instrument was reviewed by architects and design professionals to validate the instrument. In the second step, a hedonic house price model was specified to include the standard variables for house structural characteristics and location and neighborhood factors, plus a curb appeal variable was added to capture the effect of curb appeal on house price. The research hypothesis of this study was that curb appeal affects residential property value.

An outline of the rest of the paper follows. The evaluation instrument used to score curb appeal based on landscape quality and exterior house features is explained, followed by the hedonic house price model specification that relates house sale price to house characteristics and the curb appeal components (of landscape quality and exterior house appearance). The estimation results for the model are then presented, and estimates are provided of the impact of improved curb appeal on property value and the relative importance of improved landscape quality and house appearance on house price.

Materials and Methods

A single-family house is an example of a heterogeneous good. In economics, Rosen (18), building upon Lancaster's (11) approach to consumer theory, developed the hedonic model to explain the price of a heterogeneous good as a function of its characteristics. The hedonic model has been widely used in landscape quality studies and house price studies. In hedonic models of housing markets, a house price variable is regressed on a set of explanatory variables that accounts for house characteristics and location factors. This research developed an additional explanatory variable to quantify the curb appeal of a residential property (and its components of landscape quality and house appearance), and included this variable in a hedonic house price model. The estimated regression coefficient for the curb appeal variable was used to measure the contribution of curb appeal to house value. Influences from other house characteristics, such as house size, were held constant by the regression in order to evaluate the impact of improved curb appeal on house value.

The sample dataset used in the hedonic analysis included 75 single-family houses that sold in the Melonie Park neighborhood of Lubbock, Texas, between January 1, 2003, and December 31, 2005. Lubbock is located in the southern part of the Texas Panhandle and is the center of a multi-county agricultural region. The major industries of the city are education and health care. In July 2004, the city population was 208,075 (24). During the study period, the average sale price of a Melonie Park house was $162,153 compared to $120,433 for all house sales in Lubbock and $244,000 for the United States (23). At the time of the study, Melonie Park was considered an established (developed in the 1960s), upper middle-class neighborhood, similar to neighborhoods of this type in other U.S. cities.

Housing data. Housing characteristics and prices of the 75 Melonie Park houses were obtained from the Multi-List Service (MLS) in Lubbock. The sample largely included ranch-style, brick houses built by an assortment of builders in the 1960s. Each house had a different 'look' with its own unique exterior features. Specific housing characteristics used in the study included sale price, total square footage of living space, the number of days the house was on the market, the number of exterior home features (such as a covered patio or sprinkler system that is not part of curb appeal), an index of Lubbock house prices, and a dummy variable for two-story houses. Selected housing characteristics and their statistical properties are presented in Table 1.

To construct the house curb appeal variable, an evaluation was conducted of a house's external features that contributed to house curb appeal. The evaluation was conducted on each of the 75 properties in spring 2006 using a detailed evaluation form. Designers and professionals in related

Table 1. House characteristics for the Melonie Park neighborhood, Lubbock, TX, 2003–05.

Variable	Mean	Standard deviation
Sales price, $	162,153	46,699
Price per sq. ft., $	60.45	7.03
House size, sq. ft.	2,686	695
Days on market	85	55
Age, years	39	2.39
Lot size, sq. ft.	9,733	1,842
Percent with:		
3 or more exterior features	24.0	
Two stories	13.3	
4 or 5 bedrooms	45.3	
2.5 or more bathrooms	45.3	
Sample size (n)	75	

Source: 2003–05 Multi-List Service (MLS), Lubbock, TX.

fields were consulted during development of the evaluation criteria.[4] Although a difference in time existed between the occurrence of a sales transaction in 2003 to 2005 and the house evaluation in spring 2006, pictures taken at the time of sale (available from the MLS) were used to reconcile any differences between 2006 versus 2003–05 house features. It is important to point out that few material changes of any sort occurred in the sample properties over the study period.

For each property in the sample, house curb appeal was evaluated based on eight individual exterior house features plus two additional items that accounted for special positive features and unusual negative features of the sample houses. Each of the ten items was scored independently and then summed for an overall score of house curb appeal. House evaluation features included: condition of the paint; paint color and its coordination with other features such as brick and roof shingles; type of windows and shutters; whether the windows were appropriate for the house; type of front door; type of storm door; type of porch supports; and type and condition of a front garage door. A house was scored higher depending on the number and type of special positive features such as a special porch design, special roof features, etc. A deduction was assessed for houses with unusual negative features such as: thin-layer roof shingles, large visible satellite dish, an enclosed garage made into a room, etc. Evaluation scores ranged from –3.0 to 18.8 (Table 2). The evaluation scores were divided into three categories based on quartiles: Q_1 for *Low* house curb appeal; Q_2–Q_3 for *Average* house curb appeal; and Q_4 for *High* house curb appeal. The designations of *Low*, *Average*, and *High* were used to reflect a prospective buyer's feeling regarding a given house's curb appeal as compared to other houses in the neighborhood.

Landscape data. Landscape characteristics were collected on each of the 75 sample houses using a detailed evaluation of selected landscape features. The evaluation was conducted in spring 2006, and pictures taken at the time of sale in 2003 to 2005 (available from the MLS) were used to reconcile any changes in landscaping. Landscape architects were consulted during development of the evaluation criteria (see Footnote 4).

[4]The house and landscape evaluation forms were designed with the advice of faculty in the Departments of Landscape Architecture and Design at Texas Tech University. The forms are included in Elam and Stigarll (8).

For each house in the sample, landscape curb appeal was evaluated on nine features, including eight individual landscape features and one rating of the coordination of those features. Each item was scored independently and then summed for an overall score of landscape curb appeal. Landscape was evaluated on tree cover and quality, grass quality, volume and diversity of foundation plants, plant maintenance, concrete condition and size, amount of soft- and hardscapes, and design coordination. Evaluation scores ranged from –1.5 to 19.0. Following the same procedures used for categorization of house curb appeal, quartiles were used to designate landscape curb appeal with Q_1 for *Low* landscape curb appeal; Q_2–Q_3 for *Average* landscape curb appeal; and Q_4 for *High* landscape curb appeal. Summary statistics of the landscape evaluations are presented in Table 2.

Contrary to similar evaluations of the impact of landscape quality on house price (9), noticeably absent from the landscape evaluation was any consideration for landscape quality of adjacent homes. At the time of the study, Melonie Park was an established and well-kept neighborhood where homeowners generally maintained an understood level of quality with respect to the landscape appearance. Therefore, adjacent landscapes that would tend to detract from the property value were largely absent from the neighborhood.

Hedonic price model. To measure the effect of curb appeal on house sale price, a regression model was specified relating house sale price to selected house characteristics and to a curb appeal variable (designed to capture the combined effects of landscape appeal and house appeal). Although there is not a strong theoretical backing for the functional form of a hedonic house price model, the semi-log form has its advantages over the linear form (12). Among its advantages are: (1) it allows for the dollar value of a characteristic to vary with the size and quality of a house; (2) the coefficients can be interpreted as the approximate percentage change in price for a unit change in an explanatory variable; and (3) it helps mitigate the common statistical problem of heteroskedasticity. The semi-log model used is:

$$\ln(\text{PRICE}) = \beta_0 + \beta_1 \text{SQFT} + \beta_2 \text{HPI} + \beta_3 \text{EXT} + \beta_4 \text{LVL2} + \beta_5 \text{DAYS} + \beta_6 \text{CURB} + \varepsilon; \quad (1)$$

where

ln(PRICE) = natural log of the house sale price (in $s);

Table 2. Curb appeal summary for sample houses in the Melonie Park neighborhood, Lubbock, TX.

Statistics	House curb appeal	Landscape curb appeal	Overall curb appeal
Overall mean	12.0	11.6	11.8
Standard deviation	3.1	3.8	3.0
Min	–3.0	–1.5	–2.31
Max	18.8	19.0	17.3
Mean by category:[z]			
Low	8.3	6.8	8.3
Average	12.3	11.7	12.0
High	15.6	16.3	15.2

[z]*Low* is first quartile (Q_1); *Average* is second and third quartiles (Q_2–Q_3); and *High* is fourth quartile (Q_4).

SQFT = square footage of living area in the house (in 1,000s);
HPI = House Price Index which measures the movement in single-family house prices in Lubbock, TX;[5]
EXT = number of exterior house features that are not considered house curb appeal features (e.g., a backyard storage shed);
LVL2 = dummy variable equal to one for houses with two levels and zero otherwise;
DAYS = number of days a house is on the market prior to sale;
CURB = overall curb appeal score from the house and landscape evaluations;
β_0 and β_i = intercept and slope parameters, respectively;
ε = random error term.

Curb appeal was conceptualized in this research as the visual appearance from the curb of the landscaping and exterior features of a house. Curb appeal is represented in equation form as:

$$\text{CURB} = \alpha\,\text{HCA} + (1-\alpha)\,\text{LCA}, \quad (2)$$

where

HCA = house curb appeal score from the house evaluation;
LCA = landscape curb appeal from the landscape evaluation;
α and $(1-\alpha)$ = proportional weight parameters for HCA and LCA, respectively.

Equation (2) expresses curb appeal as a weighted mean of house curb appeal and landscape curb appeal, with the weights summing to one.

Equation (2) was used to substitute for CURB in Equation (1) to obtain:

$$\ln(\text{PRICE}) = \beta_0 + \beta_1\,\text{SQFT} + \beta_2\,\text{HPI} + \beta_3\,\text{EXT} + \beta_4\,\text{LVL2} + \beta_5\,\text{DAYS} + \beta_6\alpha\,\text{HCA} + \beta_6(1-\alpha)\,\text{LCA} + \varepsilon. \quad (3)$$

This equation relates house sale price to general house characteristics and to the individual variables HCA and LCA, as compared to one combined variable CURB in Equation (1). Equation (3) is referred to as a 'restricted' equation [this terminology is from Kmenta (10)] where the parameters for the variables HCA and LCA sum to β_6 (i.e., $\beta_6\alpha + \beta_6(1-\alpha) = \beta_6$).

The 'unrestricted' counterpart of Equation (3) is:

$$\ln(\text{PRICE}) = \beta_0 + \beta_1\,\text{SQFT} + \beta_2\,\text{HPI} + \beta_3\,\text{EXT} + \beta_4\,\text{LVL2} + \beta_5\,\text{DAYS} + \gamma_1\,\text{HCA} + \gamma_2\,\text{LCA} + \varepsilon. \quad (4)$$

[5]The Office of Federal Housing Enterprise Oversight (OFHEO) publishes the Housing Price Index (HPI) using data provided by Fannie Mae and Freddie Mac (16). The HPI is a measure designed to capture changes in the value of single-family homes in the U.S. as a whole, in various regions of the country, and in individual states and the District of Columbia. The HPI used in this study was for the Lubbock, Texas, Metropolitan Statistical Area (MSA), which includes Lubbock and Crosby counties.

The coefficients of HCA and LCA of Equation (4) are related to the parameters of Equation (3) as follows:

$$\gamma_1 = \beta_6\alpha$$
$$\gamma_2 = \beta_6(1-\alpha).$$

In this case, there's 'exact identification' and a one-to-one correspondence between the restricted parameters in terms of the unrestricted coefficients. With exact identification, a unique solution can be found for α and β_6 in terms of the coefficients γ_1 and γ_2:

$$\beta_6 = \gamma_1 + \gamma_2$$
$$\alpha = \gamma_1 / (\gamma_1 + \gamma_2).$$

Estimates of the parameters β_6 and α were found by first obtaining least-squares estimates of the unrestricted coefficients, γ_1 and γ_2, of Equation (4), then using the solutions for β_6 and α (shown above) to obtain the corresponding parameter estimates.

The parameter β_6 $(=\gamma_1+\gamma_2)$ represents the effect on house sale price of a one-unit change in curb appeal. A test of the hypothesis that $\beta_6 = 0$ versus $\beta_6 \neq 0$ is a test of whether curb appeal affects house price. The term $\text{var}(\hat{\beta}_6)$ is equal to $\text{var}(\hat{\gamma}_1) + \text{var}(\hat{\gamma}_2) + 2\text{cov}(\hat{\gamma}_1, \hat{\gamma}_2)$, where 'var' represents variance and 'cov' represents covariance. Estimates of the variances and covariance were obtained from the least-squares regression results for Equation (4). The null hypothesis was tested using a t-test where $t = \hat{\beta}_6 / \sqrt{\text{var}(\hat{\beta}_6)}$.

Equation (2) expresses overall curb appeal as a weighted mean of house curb appeal and landscape curb appeal with the weights, α and $(1-\alpha)$, representing the proportional effects. The proportional effect of house curb appeal is determined by the size of $\alpha = \gamma_1 / (\gamma_1 + \gamma_2)$. If $\gamma_1 > \gamma_2$, then $\alpha > 0.5$ and house curb appeal has a larger proportional influence than landscape curb appeal on house price. If $\gamma_1 = \gamma_2$, then $\alpha = 0.5$ and house curb appeal and landscape curb appeal have equal effects. The hypothesis that $\gamma_1 = \gamma_2$ versus $\gamma_1 \neq \gamma_2$ was tested using the coefficient estimates for γ_1 and γ_2 from Equation (4). The t-statistic for this test is: $t = (\hat{\gamma}_1 - \hat{\gamma}_2) / \sqrt{\text{var}(\hat{\gamma}_1 - \hat{\gamma}_2)}$, where $\text{var}(\hat{\gamma}_1 - \hat{\gamma}_2) = \text{var}(\hat{\gamma}_1) + \text{var}(\hat{\gamma}_2) - 2\text{cov}(\hat{\gamma}_1, \hat{\gamma}_2)$. This testing approach was used because the standard errors and covariance of $\hat{\gamma}_1$ and $\hat{\gamma}_2$ were directly available from the least-squares regression results, whereas the expression for the standard error of $\hat{\alpha}$ required an approximation based on a Taylor series expansion (10).

It is important to note that hedonic house price equations, such as Equation (4), are not typically estimated for a single neighborhood. Most hedonic research reflects a city- or county-wide focus; however, a single neighborhood focus allows location related characteristics to be constant for all properties in the sample. By using a single neighborhood in this study, it eliminated the need to include variables to account for variation in sale prices associated with different school districts or different neighborhoods within Lubbock, and in addition it allowed us to focus on differences in curb appeal features and their effect on house prices.

Results and Discussion

Estimation results. The least-squares regression results for Equation (4) are shown in Table 3. The R^2 indicates that 92 percent of the variation in the log of house prices is explained by the explanatory variables. The average error in predicting

Table 3. Estimated regression coefficients for hedonic house price model, equation (4).

Response variable: ln(PRICE)

Explanatory variable	Regression coefficient	Coefficient estimate	Standard error	P-value	VIF
Intercept	$\hat{\beta}_0$	10.44	0.24	< 0.0001	
SQFT	$\hat{\beta}_1$	0.2690	0.0190	< 0.0001	1.83
HPI	$\hat{\beta}_2$	0.0036	0.0018	0.0464	1.06
EXT	$\hat{\beta}_3$	0.0242	0.0092	0.0105	1.26
LVL2	$\hat{\beta}_4$	0.1043	0.0328	0.0023	1.36
DAYS (divided by 10)	$\hat{\beta}_5$	–0.0019	0.0019	0.3047	1.17
CURB	$\hat{\beta}_6$	0.0223	0.0041	< 0.0001	—
HCA	$\hat{\gamma}_1$	0.0120	0.0036	0.0016	1.42
LCA	$\hat{\gamma}_2$	0.0102	0.0033	0.0025	1.64
Summary statistics					
n		75			
R^2		0.92			
F-value (df = 67)		103.62	(p < 0.0001)		
Root MSE		0.0829			
Coefficient of variation, CV in %		0.69			
Breusch-Pagan test (df = 7)		8.41	(p = 0.30)		
Moran's I test		–0.935	(p = 0.35)		

the log sale price is less than 1 percent of the mean log sale price (CV = 0.69). These goodness-of-fit measures indicate that the explanatory variables in the regression are useful in understanding variation in the sample of house sale prices. The F-statistic of 103.6 ($p < 0.0001$) indicates clear rejection of the hypothesis that all the parameters in Equation (4) are equal to zero.

A concern in estimation of a multiple regression equation is possible collinearity in the explanatory variables. Collinearity causes the standard deviations of the regression coefficients to become large and makes it difficult to find significance for individual coefficients even though a definite relation exists. Variance inflation factors (VIFs) were calculated to aid in identifying collinear variables (Table 3). Based on standard rules of interpretation of VIFs, collinearity was not a problem in estimation of Equation (4) (15). Other potential concerns in estimation of a hedonic house price equation include heteroskedasticity and spatial autocorrelation (12). Heteroskedasticity was not found to be a problem based on the Breusch-Pagan test and spatial autocorrelation was not indicated by Moran's I test (Table 3) (14, 15).

The estimated regression coefficients for the housing characteristics in Equation (4) are consistent with previous research and *a priori* expectations (Table 3). Variables for square footage (SQFT), exterior features (EXT), Housing Price Index (HPI), and two levels (LVL2) all have positive coefficients and are statistically significant ($p < 0.05$). The estimated coefficient for the number of days a house was on the market prior to sale (DAYS) is negative, as expected, but not significant. The coefficient for CURB is positive and highly significant ($p < 0.0001$). This provides strong support for the research hypothesis that improvement in curb appeal has a positive impact on house sale price. The individual effects of landscape quality ($\hat{\gamma}_1$) and house appearance ($\hat{\gamma}_2$) are both significant.

Previous studies of the residential housing market presented detailed models with more structural characteristics included than what is used in this study. Henry (9) found that the addition of other characteristics added little to the explanatory power in his model, and some variables, such as the number of bedrooms and square footage, were highly correlated and led to multicollinearity. Similar results were seen in this study when a large number of detailed structural variables were included such as number of bedrooms, bathrooms, fireplaces, garages, etc., and consequently they were omitted. In addition, various measures of interior quality were initially included in the model; however, the results were not significant because there was not enough variation in the sample.

The impact of house appearance as compared to landscaping on overall curb appeal is found by examining the coefficients in Equation (2) where $\hat{\alpha}$ equals 0.54 for house curb appeal and $(1 - \hat{\alpha})$ equals 0.46 for landscape curb appeal. These coefficients indicate the proportional size of each component of overall curb appeal. The fact that the coefficients are similar in size and not significantly different ($p > 0.20$) indicates that house appearance and landscaping provide approximately equal contributions to overall curb appeal of a residential property.

Impact of improved curb appeal. The results from estimation of Equation (4) were used to measure the impact of improved curb appeal on the sale price of a house. The estimated coefficient for the CURB variable ($\hat{\beta}_6 = 0.022$) indicates that a one-unit increase in curb appeal is associated with a 2.2% increase in house price (Table 3). The coefficients from Equation (4) and the sample means of the variables were used to calculate price flexibilities, which measure the percentage change in house price for a one-percent change in an explanatory variable. The three largest price flexibilities are for SQFT (0.72), HPI (0.50), and CUBR (0.27) (Table 4). The price flexibility for SQFT, for example, indicates that a 1% increase in SQFT is associated with a 0.72% increase in house sale price. By comparison, a 1% increase in CURB is associated with a 0.27% increase in house price, or about one-third that of SQFT. One would expect the flexibility for SQFT to be the largest because house size is a principal determinant of house value.

Table 4. Price flexibilities, beta coefficients, and partial coefficients of determination for hedonic house price variables in equation (4).

Explanatory variable	Price flexibility[z]	Beta coefficient	Partial coefficient of determination[y]
SQFT	0.72	0.69	0.75**
HPI	0.50	0.07	0.06*
EXT	0.04	0.11	0.09*
DAYS	–0.02	–0.04	0.02
CURB	0.27	0.28	0.31**
HCA	0.15	0.14	0.14**
LCA	0.12	0.14	0.13**

[z]Price flexibility = $\hat{\beta}_i$ * (mean value of explanatory variable) from Equation (4).

[y]Between ln(PRICE) and the explanatory variable in column one, holding all other explanatory variables constant. A single * indicates significance at the 0.05 level and double ** indicates significance at the 0.01 level.

In order to gain further understanding of the impact of curb appeal on house price, the least-squares regression coefficients in Table 3 were converted to beta (or standardized) coefficients shown in Table 4. A beta coefficient measures the variation in the response variable relative to the variation in an explanatory variable in the common unit of a standard deviation. Thus, the magnitudes of beta coefficients may be directly compared as measures of the relative contribution of each variable to variations in house sale price in the sample period.

The largest beta coefficient in Table 4 is 0.69 for SQFT. This indicates that a one standard deviation increase in SQFT is associated with a 0.69 standard deviation increase in house sale price. The second largest beta coefficient is 0.28 for the CURB variable which indicates that when CURB increases by one standard deviation, house price increases by 0.28 standard deviation. The two components of curb appeal — i.e., house curb appeal (HCA) and landscape curb appeal (LCA) — have equal beta coefficients (0.14) indicating that improvement in either component has a similar impact on house sale price.

The hypothesis that improved curb appeal has a positive effect on house sale price was tested using partial coefficients of determination. These statistics measure the percent of variation in house price that is explained by a given explanatory variable after the effects of all the other explanatory variables are removed. Table 4 presents the partial coefficients of determination for the explanatory variables in Equation (4). Larger coefficients are found for variables that have the strongest association with house price. The partial coefficient of determination between house price and curb appeal is 0.31 ($p < 0.01$), indicating that, after removing the effects of the other variables, 31% of the variation in house price is explained by curb appeal. This is the second largest partial coefficient of determination behind that of 0.75 for SQFT.

Yet another approach to measure the impact of curb appeal on house sale price is from forecasts of house prices with curb appeal at varying levels. House sale price was forecasted using Equation (4) with the curb appeal variable set at *Low*, *Average*, and *High* levels, and with the other variables at their sample mean values (Tables 1 and 2). The house price forecasts for the three levels of curb appeal (in the Melonie Park neighborhood) are presented in Table 5. The results show that houses with *Average* compared to *Low* rating had an estimated $12,337 (or 8.6%) higher price, while houses with *High* compared to *Average* rating had an $11,521 (or 7.4%) higher price. Houses with *High* rating had a $23,858 (or 16.6%) higher price than houses with a *Low* rating.

House curb appeal (HCA) and landscape curb appeal (LCA) are the two components of overall curb appeal. The difference in sale prices of houses with improved HCA or LCA, holding the other component constant at its mean value, was calculated using Equation (4). House sale price forecasts are reported in Table 5 for *Low*, *Average*, and *High* levels of LCA and HCA. Improvement in either LCA or HCA is associated with higher house prices. Houses with *Average* compared to *Low* HCA rating had a $7,333 (or 4.9%) higher price, and houses with *Average* compared to *Low* LCA rating had a $7,636 (or 5.1%) higher price. Houses with *High* compared to *Average* HCA rating had a $6,320 (or 4.0%) higher price, and houses with *High* compared to *Average* LCA rating had a $7,525 (or 4.8%) higher price. For houses across the extremes from *High* to *Low* rating, house prices were $13,653 (or 9.2%) higher for improved HCA and $15,161 (or 10.2%) higher for improved LCA. The differences in the percentage price increases for HCA and LCA, in all cases,

Table 5. Increase in house sale price from improved house and landscape curb appeal based on equation (4).

Curb appeal	Beginning score	Improved score	Beginning sale price ($)[z]	Improved sale price ($)[z]	$ Increase in sale price	% Increase in sale price
Overall (house & landscape)	*Low*	*Average*	143,629	155,966	12,337	8.6
	Average	*High*	155,966	167,487	11,521	7.4
	Low	*High*	143,629	167,487	23,858	16.6
House (w/LCA = *Average*)[y]	*Low*	*Average*	148,717	156,050	7,333	4.9
	Average	*High*	156,050	162,370	6,320	4.0
	Low	*High*	148,717	162,370	13,653	9.2
Landscape (w/HCA = *Average*)[y]	*Low*	*Average*	148,414	156,050	7,636	5.1
	Average	*High*	156,050	163,575	7,525	4.8
	Low	*High*	148,414	163,575	15,161	10.2

[z]Results were calculated using the equation, $\hat{PRICE} = \exp[\ln(\hat{PRICE}) + 1/2\hat{\sigma}^2]$ where $\ln(\hat{PRICE})$ is the log price forecast and $\hat{\sigma}$ = root MSE (0.0829) from Equation (4).

[y]Values for LCA and HCA are from Table 2.

are not significantly different ($p > 0.20$), indicating that improvement in house curb appeal and landscape curb appeal have similar impacts on house price.[6]

Studies that focused on only landscape (and not house features) reported that when landscaping was improved from *Low* to *High* rating, house price increased by 10–12% (9, 21). The present study's estimated 10.2% increase in house price for a similar improvement in landscaping is within the range reported in these other studies. The fact that the results from these studies are so close indicates the robustness of the estimated impact of landscaping to alternative equation and variable specifications. Moreover, it provides support for previous studies on landscape quality that used only a landscape quality variable in their house pricing models.

In summary, this research evaluated the impact of improved curb appeal on residential property values. Curb appeal was conceptualized as having two components — (1) house curb appeal based on the exterior house features as seen from the curb in front of the house; and (2) landscape curb appeal based on the quality of landscaping surrounding the house. Results confirmed that both components are important in determining property value, with each about equally important. With improved curb appeal, residential property value can improve up to 17%. Within a neighborhood, curb appeal is second only to house size in affecting house value. While these results, in a statistical sense, apply only to the neighborhood studied, it is logical that the conclusions apply generally to houses in middle-class neighborhoods in the United States. One implication of the research findings of this study is that attention to curb appeal is important for real estate professionals and homeowners. It may be worth their time and attention to seek input from professional design-builders and landscape architects to improve curb appeal, as well as attention to maintenance.

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[6]The p-values were calculated from a t-test using the difference in log price forecasts (from Equation 4) as approximate percentage changes, with the variance of the difference in forecasted percentage price changes calculated from a standard formula.