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Hybrid Geoinformatic-Statistical Analysis for Assessing Single-Family-Home Values: The Case of College Station, Texas

A. A. Taibah and M. A. Sharkawy*

King Abdulaziz University, Jeddah, Saudi Arabia, and
**Texas A&M University, College Station, Texas, U.S.A.*

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Abstract. This study investigates the impact of certain residential development elements on the value of single-family homes (SFH) within an urban setting. Development elements such as gatedness, level of amenity, and size and proximity of nearest city-park were investigated. Appraisals of SFH in the City of College Station, Texas; and market values and other SFH's multiple listing services data for approximately 1326 randomly distributed SFH's are utilized as the database for this study.

The methodology of this research integrates traditional econometric techniques used in value analysis, namely the hedonic price function, with cutting edge geoinformatic technology. Automated spatial analysis tools offered efficient and accurate generation, validation, manipulation, and assessment of development variables. Furthermore, resolution of spatial autocorrelation encountered in statistical analysis was facilitated using residual mapping processes along with traditional residual plots and other statistical remedies.

Findings indicate that the power of the hybrid geoinformatic-statistical model in analyzing, explaining, and presenting change in real estate value is significant. Furthermore, findings indicate that gated ness of a development has a higher positive impact on home values in such a development than the level of amenities provided, *e.g*. trails, playgrounds, common greens, *etc.*

Keywords: Value analysis, Real estate appraisal, Hedonic price function, Gated communities, Spatial analysis.

1. Introduction

The analysis and projection of residential property values has been studied for decades. Rosen[1] followed by Freeman[2] established the theoretical basis of hedonic analysis. The hedonic model is able to capture the implicit prices of products and their characteristics, hence guiding both the consumer and producer in making decisions in the market space. In the realm of real estate markets, hedonic analysis has been extensively explored and widely applied.

Can[3] groups the determinants of property value into three major categories: structural, neighborhood, and location variables. Many empirical studies have explored the variant effects of such categories on property value. Studies also indicate that the housing market is subject to many external factors, such as the adverse effect of environmental pollutants, flood zone status, high voltage transmission lines, and toxic waste disposal sites on nearby residential property. Similarly, many have studied positive neighborhood externalities such as, the relative impacts of various sizes of shopping centers, world-class water bodies, school district quality, and proximity to transit stations, among others.

For developers, gated communities can offer a marketing differential, or present another way to target specific market niches. Southern California builders report faster sales in gated communities[4]. For the homeowner, gated-ness can mean a sense of privacy, a sense of security, present a sense of arrival, and deliver a sense of exclusiveness. Similar benefits resulting from developer provided amenities might influence the buyer's decision. However, in the larger part of the literature, such benefits have been generally alluded to rather than formally studied in an input/output or cost/benefit format. Empirical documentation of such relationships could guide residential development decision-making.

On the other hand, it is observed when reviewing the literature that real estate econometric studies are generally characterized as lacking of the geographical context and spatial representation[5]. Although in recent studies, efforts have been made to incorporate GIS applications into real estate value analysis, the extent and potential of employing geoinformatic techniques in such studies has not been fully explored. For example, spatial autocorrelation is not uncommon in real estate data because neighborhood properties share numerous location characteristics. There

are certain statistical tests and remedies to overcome this phenomenon but they do not help in identifying, neither the responsible spatial element, nor specify it's geographical location and extent. This research explores the aforementioned issues by combining conventional methods in real estate value analysis, namely the hedonic price model that essentially uses empirical data, with GIS digital technology that employs spatial data, into a hybrid model. It is confined to externality impacts on single-family property sales prices, in an economic-geographic context for the City College Station, Texas.

2. Literature Review

2.1 The Hedonic Model

Housing and property values have concerned economists, real estate practitioners, geographers, urban planners, and policy makers since the dynamics of the housing market has been linked to urban growth, directly or indirectly, and reported to reflect on reshaping the urban landscape[6].

The most conventional approach to estimating property value involves using the hedonic price function to account for the implicit partial value attributed to a component of a commodity in a given marketplace[1-2]. Structural variables (*i.e.*, number of bedrooms, bathrooms, presence or absence of fireplace, *etc.*), neighborhood variables (*i.e.*, school district, public amenities, safety, *etc.*), and location variables (*i.e.*, distance to central business district, distance to shopping center, distance to neighborhood park, *etc.*) are examples of partial components used to determine property value in this model[7].

Though a residential property value is determined mainly by building components and land values; there are factors, known as "sources of externalities", that positively or negatively affect property valuation[8]. Examples of negative neighborhood externalities include environmental pollution[9], power lines[10], toxic waste disposal sites[11], and underground storage tanks[12], among others. Smolen, Moore, and Conway[13] who investigated the effect of hazardous chemical and proposed radioactive waste landfills on surrounding real estate values, referred to the adverse economic impact that they found of such sites as a "disamenity" effect.

Similarly, many studies have investigated examples of positive neighborhood externalities on residential property values. Sirpal[8] who studied the relative impacts of various sizes of shopping centers on surrounding residential properties found that the size of a source of externalities, such as an existing shopping center, has a positive contributory effect on values. Also it is determined that new investment in a neighborhood has positive impact on nearby property value as found by Ding, Simons, and Baku[14]. The quality of school districts and their impact on residential property value has been previously studied with various findings[15].

2.2 The Value of Amenity

In terms of neighborhood amenities, several studies have been conducted with focus ranging from the impact of views on property value[16-17], beach quality[18], urban water parks, *etc.* Hammer, Horn, and Coughlin[19] report that a rather lengthy research tradition holds that public parks have a positive effect on adjacent land value. However, the authors continue to indicate that the actual research to support such a conclusion is scattered and the analysis involved is relatively rudimentary.

Nonetheless, at the neighborhood scale, quantifying the variant effect of neighborhood park remains to be a controversial issue with contradicting results in the literature. Hendon[20] conducted a study in the Dallas Fort Worth area about the park as a determinant of property value and found inconclusive results in determining the full extent of the relationship. In Philadelphia, however, Coughlin and Kawashima[21] found results that supported the hypothesis that open space of various kinds has a positive effect on the capital and rental value of nearby property. Peiser and Schwann[22], who were interested in a specific type of open space known as “inner greenbelts”, looked at the example of the Greenway Park subdivision in Dallas and found contradicting results. The author’s survey instrument revealed a high value (15%) attributed to greenbelts by owners while the statistical model shows the opposite.

At the development scale, gated communities are commonly perceived as a desirable setting by homeowners, however, not much empirical evidence to support this notion exists in the body of literature. Bible and Hsieh[23] studied this phenomenon by examining 284 sales from six different neighborhoods in a medium size metropolitan area. The results

indicate that the gated community factor is positive and significant. Moreover, they estimate the value added by the gate factor based on the typical home estimation and show an increase of 6.07% of their sale price.

Similarly, a study presented in the 2001 American Real Estate Society Annual Meeting by Weaver[24] investigated the contribution of gated community to overall market value of a residential property. The author attributes a value of $7,750 to the gate factor.

2.3 GIS in Real Estate Value Analysis

Regardless of the empirical approach employed in a study, one common shortcoming in most studies on urban housing market factor analysis is that readers often have little notion about where these variables are situated spatially in the urban and suburban landscape, and how they relate to each other[5]. Questions of location involve some type of spatial analysis; that is, the ability to describe and compare the spatial and/or the spatio-temporal distribution of a phenomenon[25]. Sharkawy[26] first utilized GIS to investigate spatio-temporal changes in office sub-market distribution in Atlanta. Dobson[27] first recognized GIS's potential as a viable tool in addressing concerns of place-based information integrated with people-based information.

Recent publications in the real estate literature present results from economic/ statistical models in a geographical context[28]. Ding, Simons, and Baku[14] analyzed the effect of new and rehabilitation residential investment on nearby property values in Cleveland, Ohio with the intention to capture the geographical extent of such an effect. GIS capabilities were used to generate spatially lagged variables to be included in the price model. They concluded that the impact is scale dependent and is geographically limited. In other words, only new investments had a significant effect that will decay with distance from the investment location.

GIS is defined as an integrated collection of hardware, software, data and liveware that operates in an institutional context[29]. By defining a GIS's focus more precisely, Maguire[29] in a synthesis of widely held views in the GIS literature arrived at another distinguishing definition. Essentially, GIS although very broad in its applicability, distinguishes itself from other technologies and information systems in its general

overall focus on spatial entities and spatial or spatio-temporal relationships.

Efforts in incorporating GIS capabilities in real estate research include an assessment of single-family housing prices as affected by racial segregation in Bryan, Texas[25]. In this study, the author combined hedonic modeling, GIS, spatial measures, and spatial autocorrelation measures to determine if residential segregation exists. Can[7] conducted a residential quality assessment study employing alternative approaches using GIS. Here GIS was effective in the graphical representation of neighborhood boundary delineation based on socioeconomic criteria defined by the author. The author also reports that GIS was effective in information exchange as well as the generation of topological information. In the arena of residential market segmentation, a recent study of the Boston residential real estate market was conducted using GIS[28]. The author's main goal in this study was to explore the utility of GIS in urban housing market analysis and concludes that:

> "Without an effective and efficient tool to portray the results of market segmentation spatially, it is nearly impossible to know whether sub-markets are spatially mutually exclusive or overlapping, how markets are segmented by different stratifiers differ from each other in terms of location, size of market area, population and housing density, etc."[28].

This research extends the works of Bible and Hsieh[23] and Weaver[24], by differentiating between different gatedness levels. In addition, this research expands the body of literature in understanding implications of gatedness as compared to amenities, with a potential profound impact on residential development policymaking with respect to development cost allocation. Finally, this study demonstrates the significance and potential of integrating advanced geoinformatic techniques with conventional real estate value analysis methods which presents ground for the advancement of real estate analysis, leading to better urban policy decisions and responses to market dynamics.

3. Model and Research Questions

A hybrid geoinformatic-statistical model is intended to answer the research questions posed by this study. The concept of the hybrid model is to integrate GIS capabilities into the hedonic analysis process beyond data generation, validation, and mere geographical display as done by previous studies.

The first hypothesis is that advanced geoinformatic techniques, such as residual mapping and visual correlation analysis, will assist in determining critical variables and in understanding hedonic relationships, and model performance. Figure 1 shows an overview of the hybrid model and illustrates the process of integration between the two techniques.

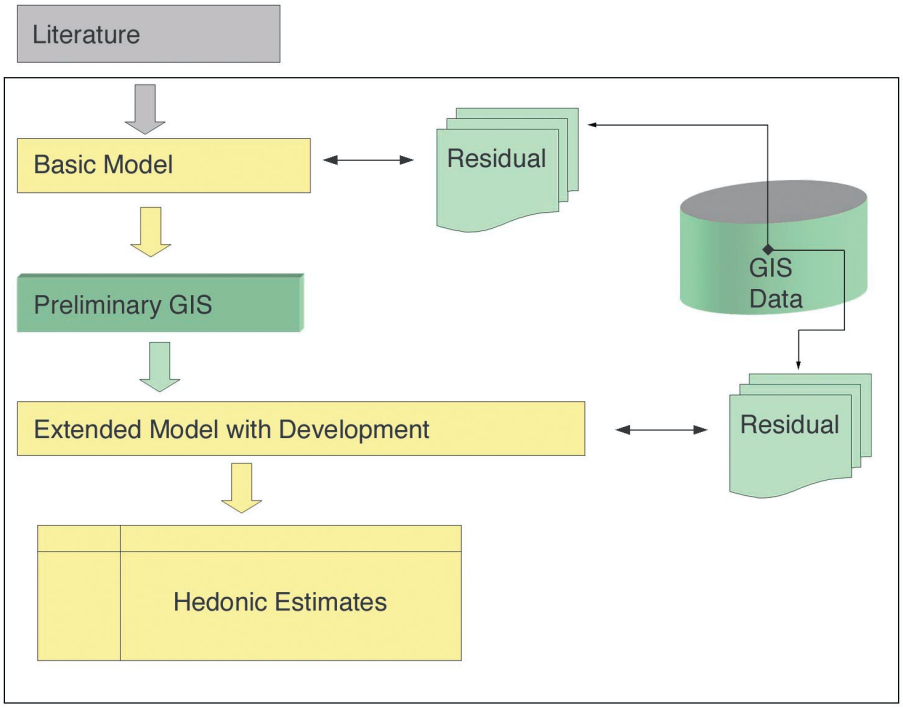

Fig. 1. The hybrid geoinformatic-statistical model.

The process starts with a basic model that is defined based on previous research findings, local market conditions, and extent of pre-existing data. The model is expressed as:

$$Ln\,(p) = B_0 + B_1S + B_2D + B_3L + e, \tag{1}$$

where:

P = Housing price;
S = Vector of structural attributes;
D = Vector of date sold by year;
L = Location variable;
e = Disturbance term.

After testing the functional form using Ramsey RESET test and Box-Cox transformation, the log-linear form is found superior to other form such as linear and semi-log. However, when performing the Durbin Watson test, it reveals that heteroskedastisity is evident although greatly improved by the log-linear transformation. These diagnostics and their findings are consistent with most studies found in the literature and are common with real estate data[3,8,14].

The second hypothesis initially involved the effect of proximity to city park on value. However, once preliminary GIS analysis techniques were applied, namely mapping for visual correlation no clear trend was detected, see Fig. 2. Instead the figure shows certain value correlations with residential development boundaries. This finding led to a shift in research focus to investigate this correlation. Preliminary study of the relationship led to the consideration of certain development attributes such as gatedness and developer provided amenity.

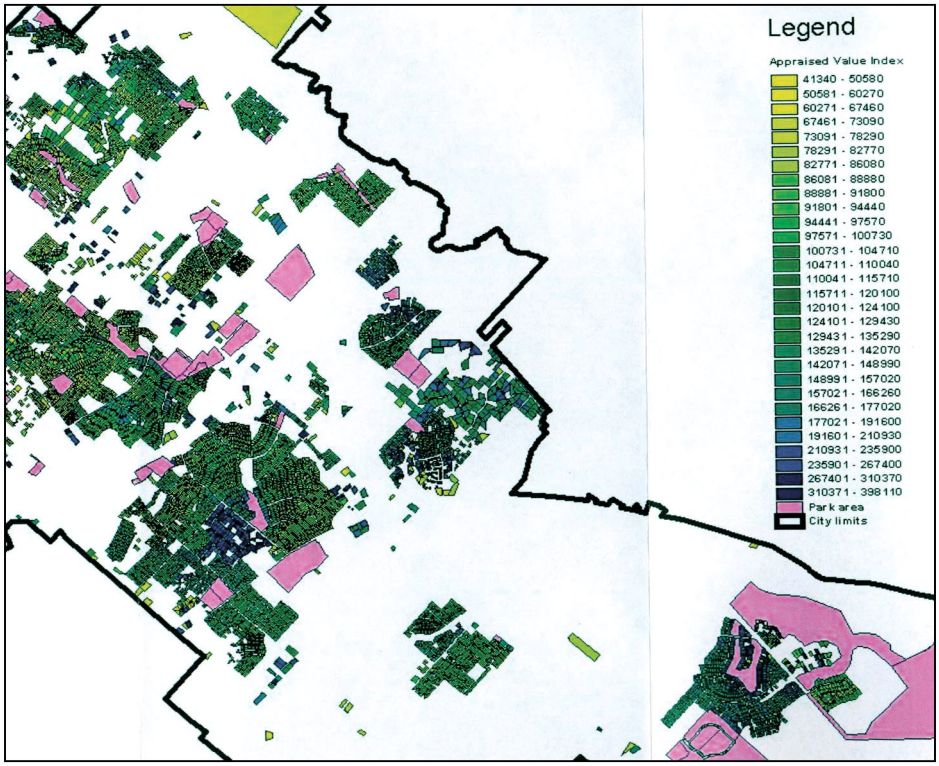

Fig. 2. Visual correlation analysis of property value.

This phenomenon is referred to as spatial autocorrelation[30], which is a common violation of the basic assumptions underlying the general linear model in econometric procedures. Kennedy explains that autocorrelation occurs when residual terms are correlated with one another, which when applied in terms of real estate data, means that properties within the same locale will share common characteristics of that locality.

The second hypothesis was accordingly defined, namely that the introduction of gate and amenity variables, combined in categories, into the basic model will reduce the effect of spatial autocorrelation that is encountered. Furthermore, we expect to be able to visually prove that the model is successful in reducing the effect of spatial autocorrelation through residual mapping techniques. If successful, this would be an important achievement because it means that rather than relying on conventional statistical techniques of transforming the data to overcome such a problem, instead now we can identify spatial variables that can be introduced into the model to reduce or eliminate this effect. Hence better understanding critical market conditions and relationships. Our analyses indicate that a combined term that represents various levels of gate and amenity within each development would best represent these variables. Combining these terms with Equation (1) yields the following model:

$$Ln\,(p) = B_0 + B_1\,S + B_2\,D + B_3\,L + B_4\,GA\_AMN + e, \qquad (2)$$

where:

GA_AMN = Vector of various levels and combinations of gate and amenity in a subdivision. It is expected that B_4 would be positive and significant. Noteworthy is the method we chose to define categories for gatedness and amenity levels. After realizing the extent of variation of the two factors in the market, gatedness and amenity level were stratified into high, medium, low, and none strata. Analysis then indicated that this stratification caused multicollinearity between the gate and amenity factors. For instance, it was found that high quality gates and high levels of amenity usually went hand in hand, similarly developments with no amenities usually had no gates, *etc*. As a result and based on analysis of the market composition, we found that one gate/amenity (GA_AMN) variable with four strata would best represent the market condition. Four categories of development variables were identified, namely: high gatedness/high amenity, high gatedness/less amenity, low gatedness/high amenity, and low or no gatedness/low or no amenities.

Finally and most importantly, the third hypothesis is that gatedness would have a higher impact on SFH value than amenities would. This hypothesis is based on indications of the market that we gathered through interviewing with local real estate brokers, appraisers, and developers. If true, such a finding would have substantial implications in the realm of housing development decision-making as well as in residential market analysis. To our knowledge, those questions have not been adequately addressed in previous empirical studies, thus we consider this article as a significant addition to the body of literature.

4. Study Area and Data Preparation

College Station is a college town with a steady rate of growth, in contrast to recent reports that the nation's economic growth is slowing. At the national level, housing starts have decreased over the past year, but in College Station, new dwelling units increased the housing inventory by 2.5 percent in 2000. This increase indicates that the population has also increased this year by 3.4 percent over 1999, the third consecutive year that the City has exceeded the 2.8 percent average annual growth rate that has been the trend in the last decade. The population estimate for the year-end is expected to be just over 68,000 – roughly 40% of which are Texas A&M students. The local resident population began outnumbering the student population in the late 1980's and this trend continues today. Due to many factors, including the University's traditional insulation of the City against wide market downswings as well as continuous growth in the local job market, it is anticipated that population growth will continue into the next decade at a modest rate ranging from 2 to 3 percent annually[31].

The city adopts a policy that encourages growth, attracting many corporations to relocate their headquarters to the area, thus increasing the local market economic base. A spin off of such growth is the increasing number of master planned residential communities that have been approved in the year 2000. A total number exceeding 1500 new lots are created as a result of new and ongoing development[31].

Data used in this study were collected from different sources. Appraised values were obtained from Brazos County Appraisal District (BCAD). Sales price data consist of confirmed sales values for single-family residential properties recorded by Brazos County Multiple Listing Services (BCMLS) and validated by data from BCAD in the years (1997-

2000). Structural data are obtained from the BCMLS that pertain to the structural characteristics of the single-family residential properties. Table 1 shows a list of structural variables and their definition.

Table 1. Definition of variables.

Variables		Definitions
DEPENDENT VARIABLE		
LN_PRIC		Price of sold property in the year 1996-99
STRUCTURAL ATTRIBUTES		
BDRM		No. of bedrooms
BATH		No. of bathrooms (half bath is counted as 0.5)
HEAT_SF		Total heated area in sq. ft.
GARG_CAP		No. of garage capacity
ACRE		Lot area in acres
FIRE		Dummy – Fireplace
FAN		Dummy – Ceiling fan
RAIS_CEL		Dummy – Raised ceiling
UR_IN		Dummy – Utility rm. in house
AGE		Dummy – Age of building in years
SOLD	97	Dummy – Sold in 1997
	98	Dummy – Sold in 1998
	99	Dummy – Sold in 1999
	00	Dummy – Sold in 2000
LOCATION ATTRIBUTES		
TAMU_ML		Distance to TAMU campus in miles
DEVELOPMENT ATTRIBUTES		
GA_AMN	HI-HI	Dummy – Development has high gate effect and high amenity level
	HI-LESS	Dummy – Development has high gate effect and less amenity level
	LO-MORE	Dummy – Development has low gate effect and more amenity level
	NO-NO	Dummy – Development has no gate effect and no amenity level

GIS coverage of the City of College Station were obtained from their GIS department that contained some attribute data pertaining to parcels based on the BCAD database. However the attribute data did not include detailed property structural data, which was later spatially joined based on the address field. Other spatial variables such as distance to Texas A&M University campus were generated using GIS multiple ring buffering techniques. Since the study area is characterized by not having a central business district (CBD), and while economic reports indicate that

Texas A&M University is the largest single employer in town, it made sense to take that into account as a location variable. Development gatedness and level of amenity data was collected from local real estate brokers as part of a data exchange agreement. Then this data was coded, stratified, and placed in real space using spatial joins and geo-processing methods. Linking sales and structural attribute data to their geographical location is key for integrating them with other spatially lagged data generated with GIS. Overall, we believe that to extend real estate value analysis process to its fullest and most extensive potential, the preparation of a GIS environment to operate within is critical.

Only SFH that sold in the period 1997-2000 were included in the sample. After cleaning, validating and geo-processing, 1326 observations were deemed valid, complete and placed in real space to be considered in the study. This is the net count of observations after performing various diagnostics on the data and eliminating outliers. For example, properties with less than 2 bedrooms were out of the norm and therefore excluded. Also, some properties were found to have average price ranges yet situated on lots that are far beyond the average city lot size, hence skewing the data. Table 2 lists the descriptive statistics for structural, location, and development variables. The average property sold for $134,205, measured 2022 square feet of heated area, had 3.5 bedrooms, 2.2 bathrooms, with a garage capacity of 1.9 cars, and was located on a lot measuring 0.29 acres.

Table 2. Descriptive statistics.

	Minimum	Maximum	Mean	Std. deviation
PRICE	34000.00	595000.00	134205.33	65858.18
BDRM	2.00	5.00	3.52	0.58
BATH	1.00	4.00	2.28	0.52
HEAT_SF	702.00	6700.00	2022.36	662.00
ACRE	0.07	4.13	0.29	0.22
GARG_CAP	0.00	3.00	1.90	0.51
AGE_YR	0.00	89.00	12.30	11.98
TAMU_ML	0.38	15.15	3.46	1.71
HI_HI	0.00	1.00	0.23	0.42
HI_LESS	0.00	1.00	0.05	0.23
LO_MORE	0.00	1.00	0.35	0.48
SOLD_98	0.00	1.00	0.33	0.47
SOLD_99	0.00	1.00	0.38	0.49
SOLD_00	0.00	1.00	0.14	0.35

5. Findings and Conclusions

Table 3 presents the hedonic estimates of the proposed extended model with development variables (equation 2). Using the development category with low or no gate/low or no amenity as a reference category (*i.e.*, not included in the model), the other three categories were included in the model.

Table 3. Estimated results of equation (2).

Model	Unstandardized coefficients		Approx. attributed value	t	Sig.
	B	Std. Error			
(Constant)	10.4120000	0.034		306.404	0.000
BDRM	6.265E-03	0.008		0.779	0.436
BATH	4.882E-02	0.012	$6000	4.180	0.000
HEAT_SF	4.105E-04	0.000	$49/ft2	37.451	0.000
ACRE	5.590E-02	0.018	$6916	3.171	0.002
GARG_CAP	8.764E-02	0.008	$11756	10.859	0.000
AGE_YR	–6.564E-03	0.000	$ –864/yr	–15.659	0.000
FIRE	4.563E-02	0.011	%5.0	4.106	0.000
FAN	3.280E-02	0.012	%3.0	2.775	0.006
RAIS_CEL	1.564E-02	0.009	%1.6	1.783	0.075
UR_IN	5.636E-02	0.010	%5.7	5.914	0.000
SOLD_98	3.460E-02	0.011	%3.5	3.278	0.001
SOLD_99	8.062E-02	0.010	%8.4	7.838	0.000
SOLD_00	0.1140000	0.013	%12.0	9.070	0.000
TAMU_ML	2.747E-03	0.003		0.921	0.357
HI_HI	0.1310000	0.014	%14.0	9.467	0.000
HI_LESS	0.1160000	0.017	%12.0	6.749	0.000
LO_MORE	1.158E-02	0.009		1.254	0.210

Dependent Variable: LN_PRIC Adj. $R^2 = 0.918$

Altogether, the model fits the data well and possesses a high explanatory power. Independent variables explain almost 92% (Adj. R^2 = 0.918) of the variation in property value. Compared to most findings in the literature, the explanatory power of this model is among the highest reported findings. Figure 3 shows how well the model line fits the data. The model produced expected coefficient signs for all variables included. Twelve out of the fourteen non-development variables (including structural, location, and date variables) were significant with expected signs.

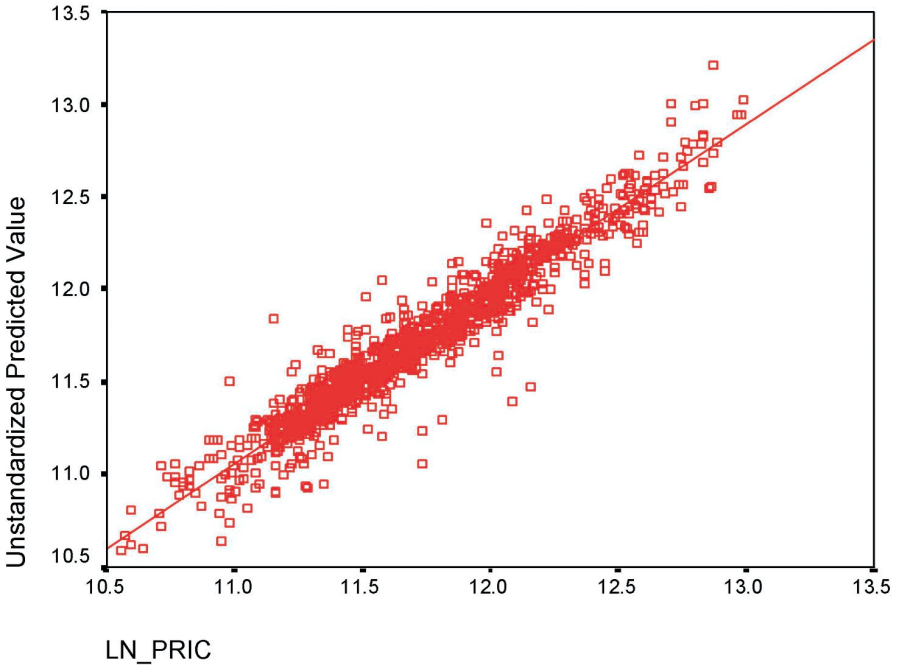

Fig. 3. Model fit to data.

Coefficients of the structural variables explain price variations sensibly. Interpretation of the model estimators is based on the average home in our sample with a market value of $134,205. A home value increases $49 for every square foot ($441 for every square meter) of heated area. It is found that the added value attributed to one full bathroom is approximately $6000. The hedonic value of a standard car garage with a two-car capacity is approximately $23,500. The indicated discount on home value for one year of age is $864. Ceiling fans are estimated to add 3% to the average home value. In agreement with the city's economical annual report that

indicates a steady annual growth rate that exceeds the national average for several years, the model shows substantial appreciation in home values from 1997-2000. It is indicated by the model that the average home appreciated 3.5%, 8.4%, and 12% in the years 1998, 1999, and 2000 respectively.

A house with a raised ceiling would show an increase of 1.6% compared to a house with standard height ceilings. It is also indicated by the model that the hedonic value attributed to having the utility room inside the house rather than in the garage is worth 5.7% of a home value. Distance to Texas A&M campus is shown to be insignificant hence not affecting SFH values. This finding goes against the theory of market equilibrium but can be explained. We suspect this is due to the relatively small size of the city, less commuting distances, and absence of rush hour traffic congestion. This simply means that expenses incurred by commuters are negligible and are not reflected in property values. Another unexpected finding is that number of bedrooms is insignificant. This might be because more than 95% of the study sample consists of three and four bedroom houses. According to local real estate brokers, there is relatively minimal impact on overall value between the two types.

Most significantly, with respect to the development variables, there were two main findings. First, adding the gate/amenity factor to the model does show marginal improvement that is measured by the increase in Adj. R^2 (from 0.910 to .0918) a reduction in the mean square error of the model (from 1.658E-02 to 1.508E-02), but above all through residual mapping. By examining Fig. 4, we show before and after shots of residual distributions in geographical space. The exhibit shows Woodcreek and Pebble Creek subdivisions as two examples of developments that include gate/amenity attributes. Under estimation by the basic model of properties within those developments is clearly indicated by the higher concentration of red parcels. On the other hand, and after taking the gate/amenity factor into account, it becomes clear the model has a more balanced outcome in terms of unexplained residuals. For example the ratio of over prediction to under prediction in Woodcreek before including the gate /amenity variable was 76% to 24% respectively. After including the gate/amenity variable in the model the ratio became more balanced to 44% over prediction to 56% under prediction. The ability to represent residuals graphically, their geographic distribution and extent, and their improvement as shown is a significant contribution of this paper.

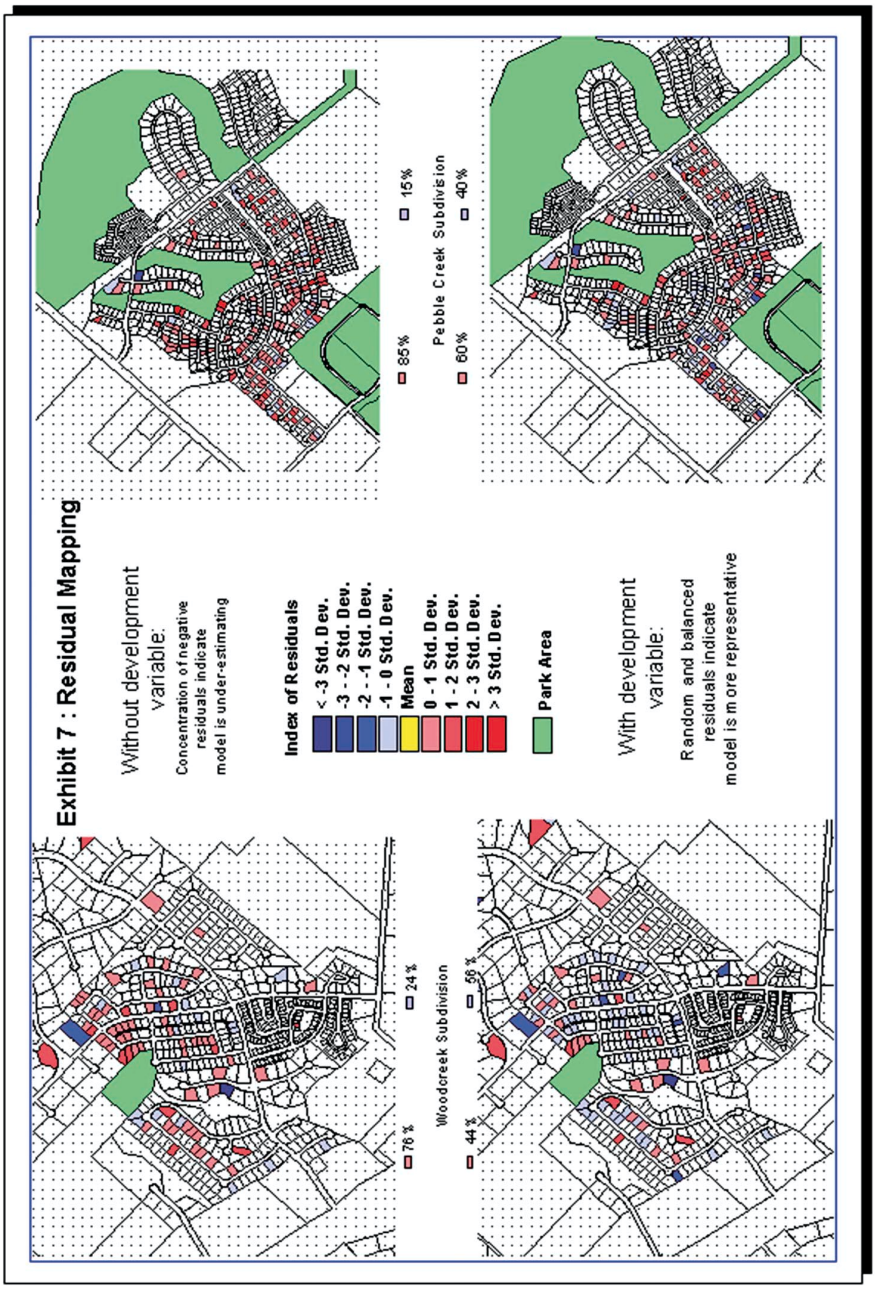

Fig. 4. Residual mapping.

Finally, results have shown that the hypothesized higher impact of gatedness as compared to level of amenity is accepted. Properties within developments with high quality gates and lower levels of amenity show a premium of 12% increase in value relative to other properties while the reverse condition shows to be insignificant. That is properties within developments with higher levels of amenity but with low gate quality are indicated as unaffected by such a variable.

This finding is contrary to the practice followed by developers who seem to put more weight and higher investment in amenities, while the statistical evidence shows that it is gatedness that provides the higher value. Therefore, in terms of effective cost benefit practice and higher profits, it is the recommendation of this study that developers should focus higher investment on improved and higher quality gatedness while cutting cost in the amenity department.

In conclusion, this study finds that hypothesis one is valid, namely that a hybrid model has a higher value in selecting variables. The hybrid model showed to be highly efficient and beneficial in enhancing the hedonic process results as well as in explaining and displaying model outcome. The study also finds that hypothesis two is valid, namely that introducing combined gatedness/amenity levels in the model reduce spatial autocorrelation. Most significantly, the study finds that gatedness has a higher impact on value than the level of amenities in a development.

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استخدام المنهج المعلوماتي الجغرافي – الإحصائي المدمج في تحليل قيمة العقار المنزلي وتطبيقه على السوق العقاري بمدينة كولج ستيشن بولاية تكساس الأمريكية

عمرو عبدالرحمن طيبة و محمد عاطف شرقاوي*

جامعة الملك عبدالعزيز – جـدة – المملكة العربية السعودية

*و * جامعة تكساس إيه أند إم – كولج ستيشن – تكساس – الولايات المتحدة الأمريكية*

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المستخلص. تهتم هذه الدراسة بتحليل مدى تأثير بعض العناصر التصميمية أو التطويرية على قيمة العقار المنزلي. اهتمت الدراسة بعناصر مثل البوابة للمجمع السكني، ومستوى الخدمات الموفرة من قبل المطور، وكذلك القرب من حديقة عامة مع الأخذ في الاعتبار حجم الحديقة. العينة المدروسة تتكون من ١٣٢٦ منزل تم اختيارها بشكل عشوائي من القواعد البيانية الخاصة بالسوق العقاري لمدينة كولج ستيشن بولاية تكساس الأمريكية.

المنهج البحثي المتبع يعتمد على الدمج أو التهجين بين الطرق التقليدية لتحليل القيمة العقارية في المجال الاقتصادي، وبين أحدث تقنيات التحليل المكاني ونظم المعلومات الجغرافية. هذه التقنيات أثبتت كفاءتها ودقتها في إيجاد القياسات غير المتوفرة، والمصادقة أو التعديل على البيانات الموجودة، وكذلك التقييم للمتغيرات المطروحة في هذه الدراسة. بينت الدراسة أيضًا إمكانية استخدام تقنيات التحليل المكاني ونظم المعلومات الجغرافية في معالجة أو التقليل من بعض مشاكل التحليل الإحصائي للبيانات المكانية أو الجغرافية.

تشير نتائج البحث إلى أن استخدام المنهج المعلوماتي الجغرافي–الإحصائي المدمج أو المهجن في تحليل وتوضيح وعرض التغيرات التي تطرأ على قيمة العقار أثبت كفاءة عالية. كذلك فإن الدراسة أثبتت أن

متغير البوابة بالمجمع السكني كان له التأثير الإيجابي الأكبر عندما قورن بمتغير مستوى الخدمات المتوفرة.

الكلمات المفتاحية: تحليل عقاري، تقييم عقاري، تحليل مكاني، الخدمات الترفيهية، المجمعات السكنية، بوابة المجمع السكني.