

# **Examining the Impact of Cul-de-sac Islands on Residential Property Values: A Case Study of Feng Shui in Harris County, Texas**

Qisheng Pan<sup>1</sup>, C.C. Lee<sup>2</sup>, Zhonghua Jin<sup>3</sup>

1. Department of Public Affair and Planning, University of Texas at Arlington, 601 W. Nedderman Drive, Arlington, TX 76019
2. The STOA Foundation, 6001 Savoy Dr., Suite 100, Houston, TX 77036
3. Department of Urban Planning and Environmental Policy, Texas Southern University, 3100 Cleburne St. Houston, TX 77004

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## 1. Introduction

The traditional philosophy, *Feng Shui*, has deep-rooted in Chinese culture and adopted into the daily life of people in the East Asian communities. Its influence has also gradually spread to the rest of the world. Many believe that ‘Qi’, or often referenced as air flows, would significantly affect the well-being of a person, a household, a community, or even a nation. People who do not fully understand the logic behind the concept would think it is nothing but one of many ancient superstitions. *Feng Shui* theory Actually intends to explain the causal relationship between human life and its built environment.

In *Feng Shui* theory, the power of nature is worshiped by mythicizing the sky as the 'Father' who fertilized the 'Mother' Earth and gave birth to all forms of life, and the rain is the carrier of 'Qi' that is the energy or natural force filling the space between the sky and the Earth. This concept influenced the ancient Chinese architecture in a way that the water containing energy needs to be preserved for prosperity, and the sites selected for residential, business, and many other uses need to avoid strong wind that may blow away 'Qi' (Xu, 1998).

In modern times, *Feng Shui* has inspired many architects who aim to create a physical environment to enhance human well-being and to improve the relationship between people and the built environment (Bonaiuto et al. 2010). The experts who are sophisticated in *Feng Shui* practice are called *Feng Shui* Masters. They are often respected in Asian culture as they give people practical recommendations and advice to achieve harmony in their daily lives in the surrounding environment and the society (Bahauddin and Soon, 2019). In the United States, *Feng Shui* is not a new concept. It has often been regarded as a form of art that firstly became popular in residential units and then spread into commercial buildings (Knoop, 2001).

By following *Feng Shui* theory, housing location can be evaluated by simulating the flow of ‘Qi’. For example, in a residential cul-de-sac, each home is considered to encounter different levels of energy flow. In a common cul-de-sac, the follow of ‘Qi’ can be illustrated in Figure 1 below. It illustrates that energy flows into the cul-de-sac from the pathway. Houses in position 3 would be considered the least desirable one because the site would experience the strongest wind and the energy or ‘Qi’ will be blown away badly. Houses in position 4 may receive the strongest energy while Site 5 would experience the weakest energy. Houses in both positions are often considered

less desirable. Houses in position 1 and position 2 are assumed to be more favorable units because they may receive moderate amounts of energy.

### From Qi Strength Viewpoint

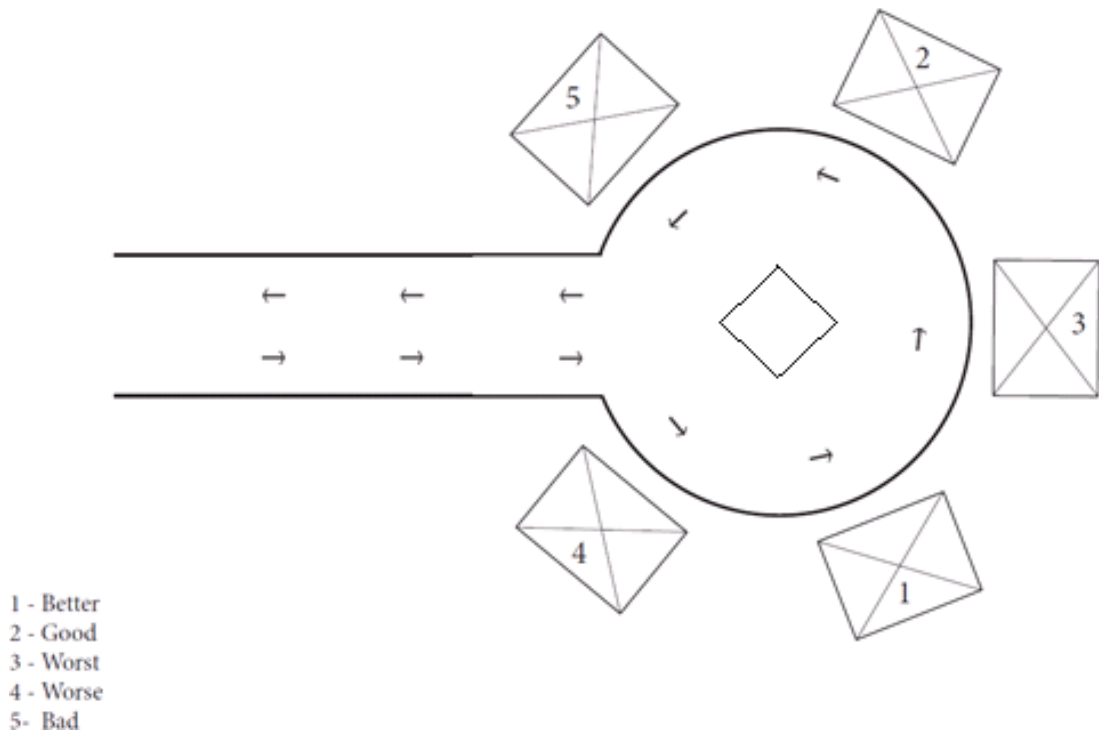


Figure 1 The strength of “Qi” and its impacts on the houses in a Cul-de-sac

However, when a blockage exists within a cul-de-sac, it would interrupt the flow of ‘Qi’. For example, an island in the middle may have a tree, a plant, a monument, or a fountain to block the strong flow of ‘Qi’. Because different type of island may have very different effects, this study examines the impacts of different types of cul-de-sac islands on residential property values. It chooses Houston area in Texas as an empirical case. Two research questions are to be answered. First, whether a cul-de-sac island has significant impact on single family home value; Second, what level of impact each cul-de-sac island type has on single family home values.

## 2. Literature Review

Many Asian scholars highlighted the influence of *Feng Shui* on both traditional and modern landscape. Xu (1998) examined the courtyard building styles in Beijing and provided a profound base to explain the cultural influence of *Feng Shui* on Chinese residential buildings. Wu et al. (2008) attempted to create an artificial neural network by incorporating *Feng Shui* characteristics, such as environmental quality, to forecast the future real estate prices. *Feng Shui* has played a more important role in rural areas than urban areas in China. Tam (1999) conducted a correlation analysis with three factors, including *Feng Shui*, accessibility, and building age to estimate their impacts on housing prices. His study confirmed that *Feng Shui* played a determining role on housing prices, especially in the rural areas of China.

*Feng Shui* is also an influential concept in the oversea Chinese communities. To explore the connection between Feng Shui and home values, Choy et al. (2007) examined the real estate prices in Hong Kong using the popular hedonic price model. They found that home buyers often get discount prices for properties with “unlucky” floor numbers. Lin et al. (2012) adopted the hedonic method to estimate the influence of *Feng Shui* on Taiwan's housing market. They found that housing units with bad *Feng Shui* practices have negative impacts on housing prices, and the consumers of expensive houses are more likely to care about their home design with *Feng Shui* concepts.

In East Asia, *Feng Shui* has been considered to have significant influence on the choices of home buyers and the designs of urban planners. Yan and Lum (2020) developed a survey with 26 *Feng Shui* elements to collect homebuyer's viewpoints in Malaysia using the Kruskal–Wallis ANOVA tests. They found that home orientation, main entrance, and street location are the most influential characteristics.

Hong et al (2007) discussed the practice of *Feng Shui* in urban planning and landscape design in Seoul. They argued that *Feng Shui* benefits urban sustainable development and it is necessary to bring the traditional *Feng Shui* concepts to concurrent urban planning by integrating *Feng Shui* with landscape ecology principles.

There has been a growing interest in the Western countries reacting to *Feng Shui*. *Feng Shui* was treated as irrational superstitious in the 1990s, but slowly getting accepted by the majority while people who get a better understanding of its concept (Mills, 1999). Bond (2008) is one of a few scholars who paid attention to the existence of *Feng Shui* influence in the Western housing market. He used comparison analysis and the hedonic model to estimate the effects of *Feng Shui* design on housing prices. Though the author reported some mixed results, he proved that good *Feng Shui* design has a positive impact on housing prices.

Mak and Ng (2005) discussed the different interpretation of *Feng Shui* between Form School and the Compass School. They stated that the *Feng Shui* practitioners, such as architects and designers, are in the Form school, which provides scientific support in analyzing the physical built environment. They tried to answer the question about whether architects tend to incorporate *Feng Shui* design into their projects, such as the selection of environment and interior design. Their study confirmed that architects tend to align with the principle of *Feng Shui* in their design.

In terms of methodology, a popular approach used in housing market analysis is the hedonic price model. Lin et al (2012) used the hedonic model to evaluate the impacts of the house facing orientation and air pollution on property value. They concluded that homes facing the south often gain premiums in property value. So (2009) included *Feng Shui* as an explanatory variable in a hedonic model to test its influence on residential property transactions. He concluded that both government policies and *Feng Shui* play critical roles in property valuation.

### 3. Methodology

This study adopts the hedonic pricing models, a traditional linear regression, to estimate the impact of Feng Shui characteristics on single-family homes.

$$Y = a_0 + \sum_{i=1}^n b_i F_i + \varepsilon$$

Where:

- Y is the dependent variable, the home transaction price
- F is the Feng Shui housing characteristics, such as position, direction, home size, and home age.
- $\varepsilon$  is the residual
- i, a, and b are parameters.

#### **4. Empirical Study**

This study selects the Houston region as an empirical case. Houston is the 4<sup>th</sup> largest city in the US in terms of population. The majority of middle-class population reside in its suburbs. There are a large number of single-family residential units located in Harris County, the core county of the Houston region. In recent years, the region has experienced a vast population increase. Its urban areas continuously sprawl and more and more new houses have been built in the suburbs far from the central city. Houses close to the urban center are usually old, thus often have more tree coverage while the newer communities far from the city center tend to have fewer trees. There are visible differences between the islands of cul-de-sac within a mature neighborhood compared with those in a new neighborhood. For example, houses built in the 1960s usually have big and tall trees while the newly built houses only have small trees with low branches.

#### **Data**

To identify the cul-de-sacs with islands, this study adopts ArcGIS and Google maps as the primary tools to manually identify the islands and their types within a cul-de-sac. First, the road network is obtained from the US Census, and ArcGIS is used to identify the endpoints of regional road network. In general, the end of a road is considered as a potential cul-de-sac in a residential neighborhood. Second, to tell the cul-de-sac with or without an island, we utilize the satellite imageries on Google map to manually check each cul-de-sac island. Last, we assume different types of islands may have different levels of impacts on households. Thus, we class cul-de-sac islands into five categories: bush, grass, plain, tree, and others. The definition for each type is provided as follows:

- Plain: an island is constructed as plain concrete with no visible vegetation;
- Grass: an island with only visible grass and/or minimal vegetation;
- Bush: an island with bush or low height vegetation;
- Tree: an island with visible trees, regardless of the size of the trees.
- Other: the rest islands.

InfoUSA data is used to obtain home sales price, home size, and home age for each house. By taking into account of the inflation factor, the home sales prices recorded at transactions were

adjusted to 2018 dollar value using the Consumer Price Index (CPI) provided by the U.S. Bureau of Labor Statistics.

There are a total of 3,092 cul-de-sacs with an island identified within Harris County. The total number of households in these cul-de-sacs with an island is 13,587. On average, there are 4.4 households in each cul-de-sac. Houses in each cul-de-sac are numbered from 1 to 5 based on their position.

### **Data Analysis**

The logarithm values of the total home sales price and price per square footage are used to examine the impact of *feng shui* on the values of houses in the cul-de-sac with different types of islands. Among the total 13,587 cul-de-sac houses, there are 11,844 or 87.17% houses located within a cul-de-sac with tree-type island, 1,164 or 8.57% houses located within a cul-de-sac with grass-type island, 303 or 2.23% houses located within a cul-de-sac with bush-type island, 276 or 2.03% houses located within a cul-de-sac with plain-type island, and 39 or 0.28% houses located within a cul-de-sac with other-type island.

For all the houses located in cul-de-sacs with islands, houses in position 3 have both the lowest average per square footage value and the lowest house sales prices. Houses in position 5 have the highest average per square footage value, and houses in position 1 have the highest house sales prices. Houses in position 4 performance are lower than position 1 and 5, but better than position 2 and position 3.



	ln(SQFT)	ln(Price)																								
<b>All houses in cul-de-sac with island</b> (13,587 houses)	<table border="1"> <caption>Ln CPI SQFT Data (All houses)</caption> <thead> <tr><th>Point</th><th>Value</th></tr> </thead> <tbody> <tr><td>P1</td><td>4.295</td></tr> <tr><td>P2</td><td>4.275</td></tr> <tr><td>P3</td><td>4.270</td></tr> <tr><td>P4</td><td>4.295</td></tr> <tr><td>P5</td><td>4.310</td></tr> </tbody> </table>	Point	Value	P1	4.295	P2	4.275	P3	4.270	P4	4.295	P5	4.310	<table border="1"> <caption>Ln CPI Price Data (All houses)</caption> <thead> <tr><th>Point</th><th>Value</th></tr> </thead> <tbody> <tr><td>P1</td><td>12.210</td></tr> <tr><td>P2</td><td>12.185</td></tr> <tr><td>P3</td><td>12.165</td></tr> <tr><td>P4</td><td>12.195</td></tr> <tr><td>P5</td><td>12.205</td></tr> </tbody> </table>	Point	Value	P1	12.210	P2	12.185	P3	12.165	P4	12.195	P5	12.205
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<b>Grass-type Island</b> (1,164 houses)	<table border="1"> <caption>Ln CPI SQFT Data (Grass-type Island)</caption> <thead> <tr><th>Point</th><th>Value</th></tr> </thead> <tbody> <tr><td>P1</td><td>4.115</td></tr> <tr><td>P2</td><td>4.110</td></tr> <tr><td>P3</td><td>4.070</td></tr> <tr><td>P4</td><td>4.140</td></tr> <tr><td>P5</td><td>4.110</td></tr> </tbody> </table>	Point	Value	P1	4.115	P2	4.110	P3	4.070	P4	4.140	P5	4.110	<table border="1"> <caption>Ln CPI Price Data (Grass-type Island)</caption> <thead> <tr><th>Point</th><th>Value</th></tr> </thead> <tbody> <tr><td>P1</td><td>11.755</td></tr> <tr><td>P2</td><td>11.755</td></tr> <tr><td>P3</td><td>11.685</td></tr> <tr><td>P4</td><td>11.755</td></tr> <tr><td>P5</td><td>11.715</td></tr> </tbody> </table>	Point	Value	P1	11.755	P2	11.755	P3	11.685	P4	11.755	P5	11.715
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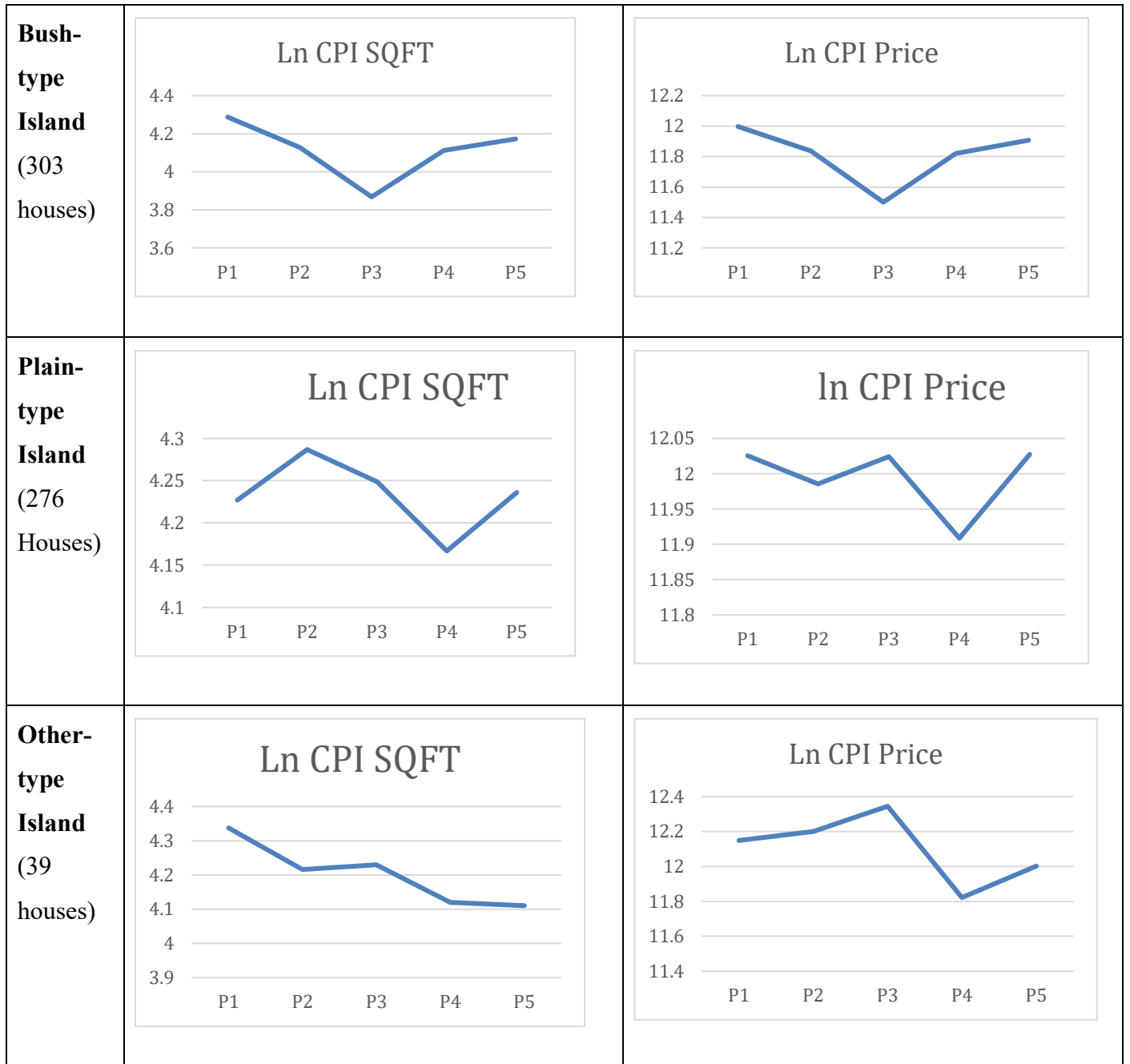


Figure 2 The impact of *feng shui* on the values of houses in the cul-de-sac with different types of islands

In this study, the majority of cul-de-sac islands have trees. Over 87.9% of the houses are located in the cul-de-sac with a tree-type island. In this type of cul-de-sacs, houses in position 5 have the highest average values per square footage, and houses in position 1 have the highest unit sales prices measured in the logarithm of dollar per square foot. However, houses in position 2 have the lowest values measured in both total sales price and in the unit prices (the average values per square footage). Position 1 and position 3 have a similar average per square footage value that are lower than those in positions 4 and 5. The prices of houses gradually increase from the bottom at position 2 to higher values in positions 3, 4, and 5.

Less than 9% of houses or 1,164 houses are located in the cul-de-sac with a grass-type island. Houses in position 3 have the lowest values in both average values per square footage and average sales prices. Different from those in cul-de-sac with tree-type island, houses in positions 4 and 2 show relatively high values measured in both values.

There are 303 houses located in the cul-de-sac with a bush-type island, where houses in position 1 have the highest values measured in both sales prices and in average values per square footage. Houses in position 5 have the second-best performance, higher than positions 2 and 4. Houses in position 3 still have the lowest values in both measures.

Houses located in the cul-de-sac with a plain-type island have inconsistent patterns in sales prices and average square footage values. Houses in position 4 has the lowest values in both measures. Houses in position 2 has the highest average square footage values but their sales prices are lower than those in positions 1, 3, and 5. In terms of average square footage, houses located in positions 1, 3, and 5 also have close values that are higher than those in position 4 but lower than those in position 2.

There are also a small number (39) of houses located in the cul-de-sac with other-type island. They have the highest square footage values in position 1 and then gradually decrease in positions 2, 3, 4, and reach the lowest values in position 5. In terms of total sales prices, these houses have the highest values in position 3 and the lowest values in position 4.

No matter of island types, houses in positions 1 and 5 are having relatively high valuations except for those within the cul-de-sac with a plain-type island or grass-type island. Houses in position 2

are the most desirable ones within the cul-de-sac with plain-type island in terms of average per square footage values, but are the least desirable ones within the cul-de-sac with a tree-type island. Houses in position 3 generally have the lowest valuation but have the highest values in the cul-de-sacs with a plain-type island measured by average house sales prices. Houses in position 4 in the cul-de-sacs with a grass-type island have the highest unit prices and relatively higher home sales prices.

In our linear regression analysis, the home sale prices are adopted as the independent variable, and four explanatory variables include cul-de-sac island type, household position, home age, and home size.

First, inflation needs to be taken into consideration because the InfoUSA data set contains home sales or transactions in multiple years. We adjusted home sale prices using Consumer Price Index published by U.S. Bureau of Labor Statistics. Since the data was retrieved by 2018, we use 2018 as the base year to adjust home sale prices. To better fit the variables into a linear regression model, CPI adjusted home sale prices are converted into logarithmic values.

In the regression analysis, island type is represented by a number based on the size of the objects on the island. For example, plain islands are considered to have relatively low impact of energy flow, they are recorded as a number of 2, and islands with a flag are coded by a number of 3. Islands with vegetations are considered having moderate level of impact. Thus, islands with grass are coded as 4, islands with bushes are recorded as a number of 5. Islands with a tree planted are considered to have higher level of impact and are coded as 6. Other types of islands have the minimal impact, with a number of 1. Additionally, home positions are classified from 1 to 5 as previously discussed. Table 1 listed different type of islands with their codes.

Table 1. Type and Code of Island

Island Type	Island Code	Number of Islands
Other	1	36
Plain	2	276
Flag	3	3
Grass	4	1,164
Bush	5	303
Tree	6	11,844
<b>Total</b>		<b>13,626</b>

Our analysis is based on 13,626 observations. the regression results shows that  $R^2$  is 65.1%. It means that the model explains 65.1% variation of the property values. Table 2 shows the regression results.

Table 2. Results of Regression Analysis

	<i>Coefficients</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
<b>Intercept</b>	11.285	315.50	0.00	11.215	11.355	11.215	11.355
<b>Island Type</b>	0.050	9.77	0.00	0.040	0.060	0.040	0.060
<b>Home Position</b>	0.002	0.56	0.57	-0.004	0.007	-0.004	0.007
<b>Home Age</b>	-0.110	-31.69	0.00	-0.117	-0.103	-0.117	-0.103
<b>Home Size</b>	0.314	66.44	0.00	0.305	0.323	0.305	0.323

The regression results show that island type, home age, and home size are significant indicators. Island type has positive effects on home sale price, indicating that the larger size of the island objects the higher level of impacts on home values. Complying with the *Feng Shui* theory, islands with a tree have higher influence on the energy flow within a cul-de-sac than a plain island with no vegetation or object planted. Home position also shows positively related with home sale price, indicating homes with higher position codes are more likely to have higher sales prices. According to the *Feng Shui* Theory, the existence of an island interrupts the flow of ‘Qi’ in a cul-de-sac. It reduces the direct impact of strong wind or overloaded energy flow, and redirects wind to nurture the environment with harmony. However, the impacts of home position are insignificant according to the regression results.

Home age has significantly negative effects while home size has significantly positive effects on home sale prices. The older homes tend to depreciate more in the housing market. The larger the home size, the higher the home sale prices. These results are consistent to the common sense.

## 5. Conclusions

In the *Feng Shui* theory, the existence of a cul-de-sac island would potentially change the energy distribution within the cul-de-sac. It has been considered as a barrier to slow down the wind that

carries 'Qi'. This study reports that each type of island causes different outcomes because the type and the shape of cul-de-sac islands affect energy flows unevenly.

However, there are also some limitations in this research. First, the size of trees has not been considered as an influential factor. Some cul-de-sacs may have very large trees, especially in the community developed many years ago, while some new neighborhoods only have small trees. Second, we have utilized the google image as a reference to determine the cul-de-sac island type manually, which may yield some margin of errors.

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