

AN ANALYSIS OF LANDMARK IMPACT FACTORS ON HIGH-RISE RESIDENTIAL BUILDINGS VALUE ASSESSMENT

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ABSTRACT. Due to the improvement of high technology and the excessive congestion of cities, the number of high rise buildings has been increasing gradually. Also the number of studies about this issue has been rising relatively. However the previous research on super high rise buildings focused mostly on the use of public space from building plan perspective, survey 'of residents' satisfaction evaluation, construction technology and structural technology. Little research is done on the economic analysis of landmark factors. The purpose of this study is to find landmark factors that can be quantitatively measured, collect data on super high rise residential buildings in Seoul. Find the intrinsic values of the landmarks, and analyze how these values differ in areas with different densities, i.e. in Gangnam-area and Yeongdeungpo-gu and in other areas. It is expected that the results of this study can be used to set an appropriate price of super high rise building in consideration of its landmark value in different area.

KEYWORDS: Hedonic pricing model; Super high rise building; Landmark factor; Standard of value; Value assessment

1. INTRODUCTION

1.1. Background and purpose of research

These days, the number of super high-rise residential building is increasing more than we expect. Land price hike due to the expansion of city and population concentration in cities caused high dense housing development. To improve the efficiency of land use, solve the problem of doughnut phenomenon, and cope with new types of urban residence, super high rise residential buildings have been built. Such buildings originated in New York and Chicago in the 1930s but they became a type of urban

residence in Hong Kong and other Asian cities in the 1970s through 1990s due to the development of urban areas. The construction of high rise residential buildings is not limited to certain countries. It has been happening in major cities around the world especially in the Middle East and Asia since late 1990s including Korea, China, UAE, Japan and so on.

In Seoul, super high rise residential buildings are considered more attractive than high rise residential buildings in terms of buying value (Han et al., 2005). They are considered more luxurious residences than high rise apartments because they provide more

comfortable environment, various amenities, and maintenance services using high tech systems. Super high rise apartment buildings have turned into luxury apartments using information technology and the concept of apartments and stores in one building. They have become a new type of urban residence and it is expected that the number will continue to grow.

Such super high rise apartments affect urban landscape and urban culture. They are important especially because of their symbolic importance as landmarks in the region (Lee, 2006). Helsley and Strange (2008) indicated that height and size, the landmark factors, play an important role in the formation of the price of super high rise building.

Previous research on super high rise buildings focused mostly on the use of public space from building plan perspective, survey of residents' satisfaction evaluation, construction technology and structural technology. But little research is done on the economic analysis of landmark factors.

The survey result of super high rise residential buildings by Seoul city reveals that in the past these buildings were concentrated in the Gangnam-area including Gangnam-gu, Seocho-gu, and Songpa-gu, and Yeongdeungpo-gu with Yeouido, but new ones are being constructed in Yongsan-gu, Dongjak-gu, Guro-gu and other areas. In other words, the density of super high rise residential buildings is higher in the Gangnam-area and Yeongdeungpo-gu than in other areas: Yongsan-gu, Dongjak-gu, Guro-gu and so on.

Thus, the purpose of this study is to find landmark factors that can be quantitatively measured with the collected data on super high rise residential buildings in Seoul. Then find the intrinsic values of the landmarks, and analyze how these values differ in areas with different densities, i.e. in Gangnam-area and Yeongdeungpo-gu and in other areas. By comparing

these two areas according to the impact of landmark value on the prices, it is expected that the results of this study can be used to set an appropriate price of super high rise building in consideration of its landmark value in different area.

1.2. Scope and procedure of study

The definition of super high rise building differs from country to country according to the size and technology level of the country. In the case of Korea, the literature review represented that a building with more than 30 or 40 floors can be considered to be a super high rise building. Lee et al. (2007) analyzed the status of super high rise residential buildings in Korea using a facility information management system. They found that buildings with more than 30 floors are seldom found outside of Seoul and major cities. But there are more than 8,000 residential buildings with 21-30 floors.

Base on this, nearly 30 residential buildings with 30 or more floors in Seoul are selected as research subjects for this study. Through the literature review of previous studies, this study finds the factors influencing the price of super high rise residential building including its landmark factor and what the significantly influential factor is among the variety of factors. And a quantification method is explored using real estate GIS internet sites and actual surveys. Then quantitative data on the landmark factors and housing price determinants are collected, a Hedonic Pricing Model is set and a multiple regression analysis is carried out to select the factors within the significance level and estimate their values. Lastly, a multiple regression analysis is carried out to find the impact of the relativity of landmark factors on the price value by comparing the super high rise residential buildings in Gangnam-area and Yeongdeungpo-gu with those in other areas.

2. THEORETICAL EXAMINATION

2.1. Previous studies

As can be seen in Table 1, research on super high rise residential buildings has been carried out actively since late 2000, when the number of these buildings started to soar. Diverse studies have been conducted, but most of them focused on the problems of newly built buildings and solutions such as performance evaluation and satisfaction level of residents, functions of apartment, such as floor impact sound, handling of interior traffic flow, external environment issue such as environmentally friendliness, and the use of public space. Also, though the studies that deal with hedonic model exist, they have

not coped with the super high rise building's materials yet. Given this, there is not enough research on the impact of landmark factors, an important attribute of super high rise building, influencing the price of the building. Therefore, it will be meaningful to find the impact of landmark factors on the formation of price in an area with higher density of super high rise buildings and the other with lower density. It is expected to make clear the difference in the influence of the external traits of super high rise buildings between the higher density regions: Gangnam-area and Yeongdeungpo-gu and the lower density regions: other than the higher density regions mentioned above, which have an expected impact on the value evaluation.

Table 1. Previous studies of super high rise buildings and hedonic model

Researcher	Title	Main content
Cho (1996)	A study of construction plans for apartments with stores in city center-focusing on the case of Hanyoung apartments in Sinsa-dong, Gangnam-gu	Found problems of these buildings from urban planning perspective through an analysis of the sites. Suggests low to mid height apartments with stores to vitalize city function
Im and Lee (1997)	A study on residential environment factor comparison of the city, high-rise housing-commercial complex and high-rise apartment	Suggests ways to improve the problems of super high rise apartments with stores by comparing them with super high rise apartments
Morancho (2003)	A hedonic valuation of urban green areas	By the result of the hedonic technique, the research analyses the link between housing price and urban green area.
Shin et al. (2004)	A study on the planning strategy of super tall building for improving publicness	Analysis indices are drawn from the public concept of super high rise buildings. Problems are analyzed in various ways using these indices and methods to promote the public of super high rise building are presented
Jeong et al. (2005)	A comparative study on the developing trends and characteristics of high-rise housing at world wide cities	This study examined the characteristics and environments of high-rise construction trends in these selected cities by analyzing the current trends in high-rise building in the world
Park et al. (2005)	A POE process model for super-tall residential building	Developed an evaluation model for residents and managers to find the status of use
Park et al. (2007)	An analysis of a skyscraper's effect on the economy and society	Economic and social roles and effects of super high rise buildings are drawn and their importance is analyzed
Ko et al. (2007)	Estimating the value of eco-friendly factors within an apartment housing price	This study estimates the value of eco-friendly factors impacting on the apartment housing price focused on the new town 'Pyeong-chon'
Helsley and Strange (2008)	A game-theoretic analysis of skyscrapers	To present a game-theoretic model of skyscraper development predicts dissipative competition over the prize of being tallest, a prediction consistent with the historical record

2.2. Definition of super high rise building

In Korea, there is no clear definition of super high rise building. But in general, a building with 21 floors is used as a criterion because these buildings are required to use earthquake resistant design for structural safety. In the case of Europe, however, a building with 12 or more floors is considered a high rise building. In Chicago, a building with 70-100 floors is considered a super high rise building. As the criterion for super high rise building differs according to the region or the level of technology development, it is difficult to define the super high rise building according to the number of floors (Song, 2002). And the super high rise buildings require special conditions that are different from the general conditions required for its design, construction, and maintenance of a building in a certain region and period due to its height.

In Korea, most of apartment buildings have 20 or more floors due to technology development, high land price and consumer demands since 2000. Therefore, it is difficult to define a building with 25 or more floors as a super high rise residential building. As discussed above, super high rise is a relative concept and different researchers will use different definitions. In this study, a super high rise building is defined as a building with 30 or more floors.

2.3. Hedonic pricing model

In economics, Hedonic Pricing Model theory is a method of estimating demand or value. It decomposes the item being researched into its constituent characteristics, and obtains estimates of the contributory value of each characteristic. This requires that the composite good being valued can be reduced to its constituent parts and that the market values those constituent parts.

$$Y = \alpha + \sum_{i=1}^n \beta_i X_i + \varepsilon \quad (1)$$

where: Y = Price: calculated by the model; α = Constant: term; β = Coefficient: representing building characteristics; X = Attribute of property; ε = Error: term.

In real estate economics, it is used to adjust for the problems associated with researching a good that is as heterogeneous as buildings. Because buildings are so different, it is difficult to estimate the demand for buildings generically. Instead, it is assumed that a house can be decomposed into characteristics such as number of bedrooms, size of plot, or distance to the city center. A hedonic regression equation treats these attributes (or bundles of attributes) separately, and estimates prices (in the case of an additive model) or elasticity (in the case of a log model) for each of them. This information can be used to construct a price index that can be used to compare the price of housing in different cities, or to do time series analysis. As with CPI calculations, hedonic pricing can be used to correct for quality changes in constructing a housing price index. It can also be used to assess the value of a property, in the absence of specific market transaction data. It can also be used to analyze the demand for various housing characteristics, and housing demand in general. It has also been used to test assumptions in spatial economics (Wikipedia, 2010).

In Hedonic price modeling, regression analysis is performed as a multi-regression model by setting the price as the dependent variable and the various characteristics of a building as independent variables in order to calculate regression coefficients of independent variables through multiple regression analysis.

3. SETTING HYPOTHESIS AND CATEGORIZATION OF THE VARIABLES

3.1. Classification of landmark factor

Previous studies on landmark factors focused on the identification of landmark factors based on surveys. Appleyard (1969) classified landmark factors into form, visibility, and significance. The variables for the form include movement, contour, size, shape, surface, quality, and signs. The variables for the visibility include viewpoint intensity, viewpoint significance, and immediacy. The variables for the significance include use intensity, use singularity, and symbolism. Based on this, he analyzed the correlation between the landmark and each variable through various surveys.

Kim et al. (2002) classified the landmark recognition factors into history & culture, size, visual form, location, and uniqueness parametric factors based on a survey and defined the details. The landmarks in city center are classified into four types as shown in Table 2 according to those five factors. A great majority of super high rise buildings in city center belong to Type 2 or Type 4 as show in Table 2. This means that size and visual form parametric factors are most influential factors. The detailed items of size parametric factor include volume,

height, and scale. And that of visual form parametric factor includes visual uniqueness. Based on this, the landmark factors for super high rise residential buildings in city center can be defined as size and visual form. In his subsequent study, a regression analysis is carried out to calculate the recognition range of each landmark factor. And the study found that the size parametric factor has the greatest impact. These studies are very important as the market for super high rise buildings, which will become significant landmarks in the city, is increasing drastically. In other words, these studies are crucial, because they identified the factors affecting the landmark recognition, thus enabled the identification of the intrinsic values of landmark factors for determining the price of super high rise building. However, these studies are based on surveys and they are not conducive to quantitative measurement. This study tries to explain landmark factors in consideration of the results and problems found by previous studies.

In this study, size such as building height and area and visual form are set as landmark variables because they are easier to quantify. Among the variables suggested by Appleyard (1969) and Kim et al. (2002), it is difficult to use quantitative criteria for history and culture,

Table 2. Four types of landmarks (Kim et al., 2002)

Item	Prominent landmark recognition factor (details)	Landmark examples
Type 1	History and culture (Historical significance and event)	Namdaemun, Seoul Train Station, Deoksugung palace, Myeongdong Cathedral, and Seoul City Hall
Type 2	Size (Volume, height, and scale)	63 Building, Namsan Tower, and KOEX
Type 3	Uniqueness (Uniqueness and name)	National Assembly Hall, Sejong Center for the Performing Arts, and Seoul Arts Center
Type 4	Visual form (Visual uniqueness and uniqueness of figure)	LG Building, COEX, and SK Building

and it is difficult to secure quantitative data for visit experience and workplace variables without conducting a survey. The method to set landmark variables from the size perspective is as follows.

According to Appleyard (1969) study, relativity is important for landmark factors. This means that a building can be a landmark not because of its absolute height or area but because of its relative height or area in comparison with other buildings in the vicinity.

Kim et al. (2002) study found that the recognition level of ‘63 Building’ is twice as high as that of ‘Korea World Trade Center (KWTC)’ even though their heights differ by only 20 m. This is because ‘63 Building’ is located in a place with more visual openness than ‘KWTC’. In other words, the recognition effects of a landmark are different according to their relative locations.

As seen in Table 3, the higher the buildings in the vicinity turn out the lower the recognition

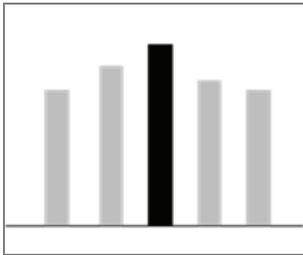
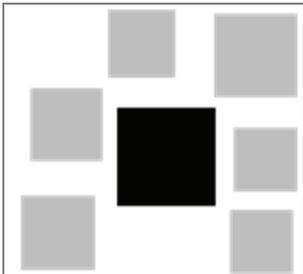
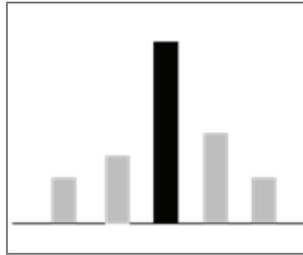
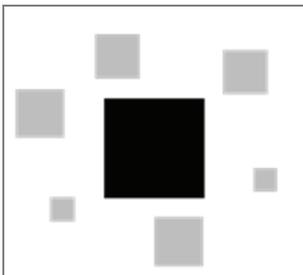
level. Thus the status of a building as a landmark decreases. In addition, the larger the buildings in the vicinity show the lower the recognition level of the respective building.

This study selected the relative heights and areas of the building being analyzed and the buildings in the vicinity as landmark variables, analyzed the intrinsic values of the landmark factors of these buildings, and compared the effects of landmark factors by comparing those in higher density area and those in lower density area.

3.2. Hypotheses setting and selection of variables

To measure the values of landmark factors contained in super high rise residential buildings, this study has set the first hypothesis as the landmark factors influence the price of super high rise residential building. If the landmark factors of each sample are found

Table 3. The relativity of height and area of super high rise building

Comparison of relative heights	Comparison of relative areas	Example (Gangnam, Mapo-gus)
		
		

to be statistically significant using the pricing model, the hypothesis that the landmark factors influence the price will be accepted. Second, if the landmark factors influence the price, the impact of a single landmark and that of a landmark among other high rise buildings are compared. Because the coefficient of each explanatory variable estimated using the hedonic pricing model is an index that explains the landmark's impact on the price.

This study used the price per m² as a dependent variable and building, location, and landmark attributes as independent variables. For the building attributes, height, total floor area, the number of years after completion, and the number of households are used. The height of the highest building in the complex is used as the height. And the total floor area of all buildings is used as the total floor area. And all the households in the complex are used as the number of households. Using these, it was possible to find the physical size of a complex. To find out depreciation due to aging of the building, the number of years after completion is used.

For the location attribute, the average price per m² of residential buildings in the same

administrative district is used. In general, the location attribute is represented by access to transportation, convenience facilities, and green facilities. As these attributes are already incorporated in the market price of residential buildings in the neighboring area, this study used the average unit price of the buildings in the vicinity as the location attribute.

For the landmark attributes, this study used the landmark factors defined above such as relative height and area and visual form. First, for the relative height, the difference between the average height of the buildings within 200 m radius of the building being analyzed and that of the building being analyzed is used.

$$Hr = Ha - E(Hc) \quad (2)$$

where: Hr = relative height; Ha = Height of the target building; Hc = Average height of the buildings within 200 m radius of the target building.

For the relative area, the difference between the average area of the buildings within 200 m radius of the building being analyzed and that of the building being analyzed is used just like the relative height.

Table 4. Price explanatory variables for super high rise residential buildings

Attribute category	Variable	Unit	Definition
Building attributes	Height	m	Height of the tallest building in the complex
	G.F.A	m ²	Gross space of the tallest building in the complex
	Period	year	Years since building completion
	N_house hold	house hold	Number of households in the complex
Location attribute	Price_D	₩10,000/m ²	Average price per m ² for residential buildings in the district
Landmark attributes	R_Height	m	Difference between the height of the building being analyzed and average height of buildings within 200 m in radius
	R_Area	m ²	Difference between the area acreage of the building being analyzed and average area of buildings within 200 m in radius.
	Form	Dummy	Uniqueness of the form

$$Ar = Aa - E(Ac) \quad (3)$$

where: Ar = relative area; Aa = Area of the target building; Ac = Average area of the buildings within 200 m radius of the target building.

For the visual form, the value was measured by using the existence or non-existence of traditional box type RC structure curtain wall as a dummy variable. According to available literatures, the objects taken are evaluated the certain figures, from '0' to '1'. Detailed data for each variable have been collected using a field survey, Seoul Geographic Information System (GIS), real estate portal sites, and building registries.

3.3. The list and details of selected objects: super high rise residential buildings in various areas of Seoul

This study selected 30 super high rise residential buildings with 30 or more floors in 11 administrative districts in Seoul for analysis. Figure 1 shows the locations of super high rise residential buildings in Seoul. They represent luxury residences and they are concentrated in Gangnam-area and Yeongdeungpo-gu, which have higher income level. This will enable a comparison of the impact level of landmark factors on the determination of price in an area with higher density of super high rise residential buildings and an area with lower density.

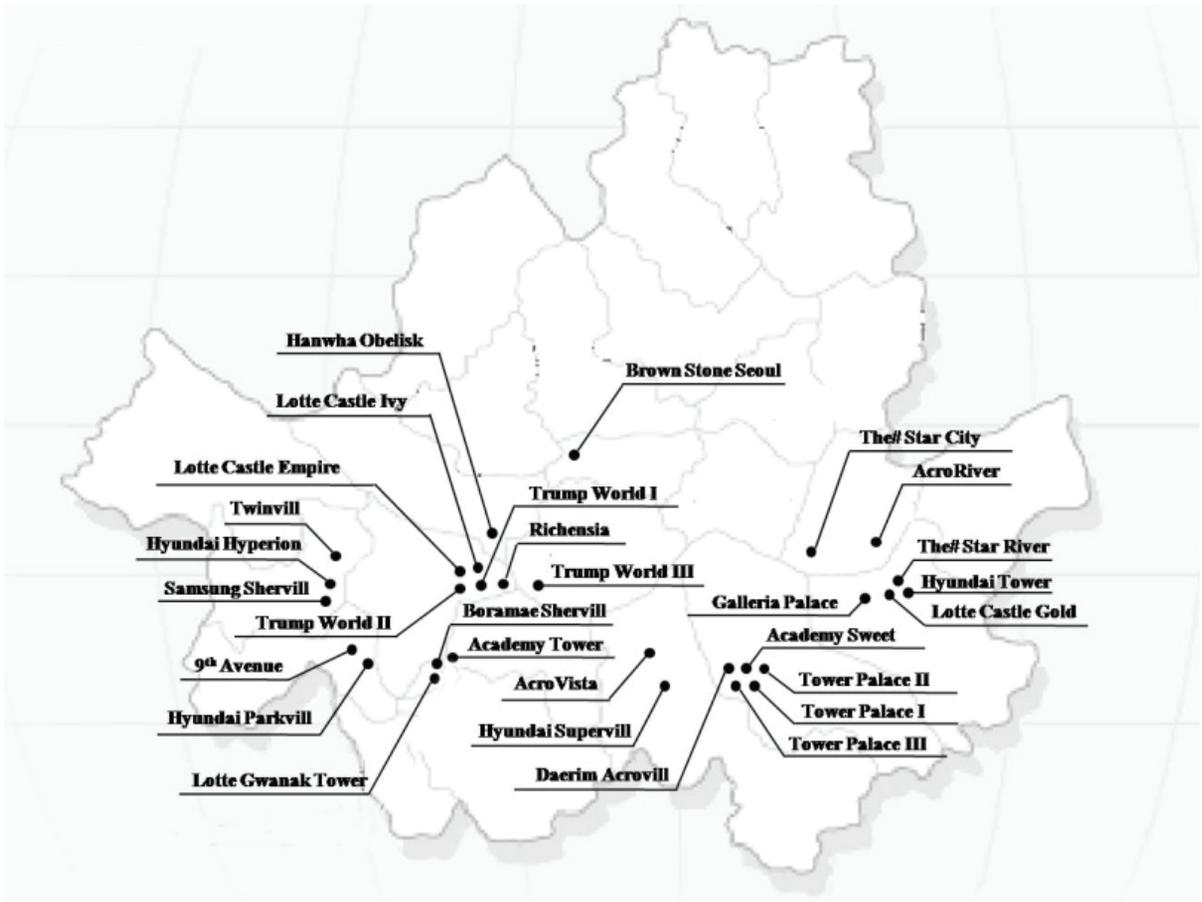


Figure 1. Location of super high rise residential buildings in Seoul

Table 5. Basic information of the buildings in Seoul

No.	Building	Location (Gu)	Height (m)	G.F.A (m ²)
1	Tower Palace III	Gang-nam	262.82	223,538
2	Hyundai Hyperion	Yang-chun	250.73	387,632
3	Tower Palace I	Gang-nam	211.50	457,999
4	The# Star City	Gwang-jin	192.40	418,415
5	Tower Palace II	Gang-nam	184.65	296,652
6	Academy Sweet	Gang-nam	169.70	102,379
7	Daerim Acrovill	Gang-nam	163.00	202,983
8	Hyundai Supervill	Seo-cho	150.60	226,180
9	Brown Stone Seoul	Joong-gu	150.40	75,078
10	Galleria Palace	Song-pa	149.40	265,698
11	Lotte Castle Gold	Song-pa	148.35	242,282
12	Richensia	Young-deung-po	145.30	86,880
13	Academy Tower	Dong-jak	141.90	81,848
14	Trump World I	Young-deung-po	132.90	78,667
15	Nasan Sweet	Dong-jak	132.90	84,165
16	The# Star River	Song-pa	128.10	76,449
17	Trump World II	Young-deung-po	127.20	68,423
18	Hyundai Parkvill	Gu-ro	126.15	46,653
19	Lotte Castle Empire	Young-deung-po	126.00	129,489
20	Samsung Shervill	Yang-chun	125.20	112,140
21	RiverTower	Young-deung-po	123.32	64,888
22	AcroRiver	Gwang-jin	123.32	64,879
23	9th Avenue	Gu-ro	122.38	80,254
24	AcroVista	Seo-cho	119.63	258,338
25	Lotte Gwanak Tower	Dong-jak	118.44	60,188
26	Lotte Castle Ivy	Young-deung-po	112.25	140,423
27	Hanwha Obelisk	Ma-po	109.85	120,054
28	Twinvill	Yang-chun	107.06	96,516
29	Hyundai Tower	Song-pa	106.55	30,808
30	Trump World III	Yong-san	100.00	52,965

4. ANALYSIS OF VALUES OF LANDMARK FACTORS

4.1. Hypothesis verification

4.1.1. Basic statistics information

Basic statistics of 30 super high rise residential buildings showed that Price_B, a

dependent variable, ranged from 267 (₩10,000/m²), the minimum, to 1,241 (₩10,000/m²), the maximum. Independent variables that were selected as price determinants for this study also showed diverse standard deviations and had minimum and maximum values.

Table 8. An analysis of correlation coefficients of explanatory variables that are set again

		Unit price (10,000 won/m ²)	Number of years after completion (Year)	Unit price in the vicinity (10,000 won/m ²)	Ratio against average floors with in 200 m radius	Ratio against average building area within 200 m radius	One landmark or part of landmarks
P e a r s o n c o r r e l a t i o n	Unit price (10,000 won/m ²)	1.000	-.460	.533	.468	.523	.052
	No. of years after completion (Year)		1.000	-.183	-.369	-.364	.106
	Average unit price in the vicinity (10,000 won/m ²)			1.000	.149	.140	-.118
	Ratio against average floors within 200 m radius				1.000	.305	-.021
	Ratio against average building area within 200 m radius					1.000	-.017
	Uniqueness of the form						1.000

Table 9. Results of regression analysis

Model	Nonstandardized coefficient		Standardized coefficient B	Significance probability	Multicollinearity		
	B	Standard error			Tolerance	VIF	
	(Constant)	-22.657	114.338		.845		
1	No. of years after completion (Year)	-13.105	7.775	-.165	.052	.776	1.288
	Unit price in the vicinity (10,000 won/m ²)	.829	.114	.645	.000	.944	1.059
	Ratio against average building floors within 200 m radius (m)	1.596	.691	.220	.030	.825	1.212
	Ratio against average building area within 200 m radius	.535	.011	.308	.003	.830	1.205
	Uniqueness of the form	103.272	57.762	.156	.056	.977	1.023

4.1.3. Setting and verification of analysis model

To estimate using the hedonic pricing model, it is necessary to select variables and the form of regression function. Before doing this,

variables that have high correlation with other variables were excluded using multicollinearity verification indicated above. And the linear functional formula for the factors affecting the unit price can be expressed as follows.

$$Price_B = a + \beta1Period + \beta2Price_D + \beta3R_Height + \beta4R_Area + \beta5Form \tag{4}$$

where: α is a constant and $\beta_1 \sim \beta_5$ are regression coefficients representing the intrinsic values of attributes.

Regression analysis showed the R^2 value of 0.821 and the significance level of less than 0.001 from variance analysis, which rejects the null hypothesis of regression coefficient being 0 and verifies that the variables are significant. In other words, the regression coefficients, $\beta_1 \sim \beta_5$ are significant independent variables that affect the unit price of super high rise residential building, the dependent variable.

4.2. Analysis of the impact of landmark factors

A regression analysis done after removing highly correlated independent variables showed low correlation between the remaining variables. And the VIF values were all under 10, which mean there is no multicollinearity. Of the independent variables, all variables except the number of years after completion were positive (+). The number of years after completion was negative (-), which means longer years after completion affected negatively to the unit price. Especially, the standardized coefficient of the average unit price of the buildings in the vicinity was 0.645, which means it influenced the dependent variable more than any other landmark factors or the number of years after completion.

As for the impact of landmark factors, when a building's relative height increases by 1m, its price increased by 15,960 won. When its relative area increases by 1m², its price increased by 5,350 won. Lastly, visual uniqueness also had more positive (+) effects on the price than no visual uniqueness.

4.3. A comparative analysis of the impact of landmark factors according to the density of super high rise residential buildings

Independent variables such as the number of years after completion, unit price of the

buildings in the vicinity, relative height, relative area, and visual uniqueness identified using the regression equation played significant roles in determining the unit price of super high rise buildings. A regression analysis is conducted by area to find the impact of these factors on super high rise buildings in the higher density area and those in lower density area.

(1) One sample test (Kolmogorov-Smirnov)

If a sample has normal distribution, the hedonic price function is valid. But, the sample for the regression analysis by area might not have normal distribution because it is too small. Therefore, whether the sample has normal distribution or not was checked using one sample test (Kolmogorov-Smirnov). In all areas, the significance level (p-value) of the Z value of K-S was over 0.05. This does not reject the null hypothesis, which means the sample has normal distribution.

(2) A comparative analysis of landmark factors by area

An analysis using the hedonic price function for the higher density area and the lower density area showed that the impacts of price determinants in the higher density area and lower density area were different. The standardized coefficients of landmark factors were different, which means the impact of landmark factors differ according to the relative height and area. In the case of lower density area, the standardized coefficient for the unit price of the buildings in the vicinity was 0.296 with 0.790 occurring in the higher density area, and the coefficients for relative height and area were 0.488, and 0.462 respectively. This means that the super high rise buildings in the lower density area have become definite landmarks due to their scarcity in the area and it influenced the price greatly.

Even though the impact of landmark factors on the unit price in higher density area

was statistically significant, the standardized coefficient for the unit price of buildings in the vicinity, a location attribute, was 0.790, which is much higher than that for other factors. This means that due to higher density, its importance as a landmark is not as strong as its investment benefit, or the feeling of psychological and social superiority of living in luxury housing. Also, the standardized

coefficient for the ratio against average building floors within 200 m radius and the ratio against average building area within 200 m radius revealed 0.199, 0.060 separately which were by far lower than that of counterparts (0.488, 0.462) in lower density area. This result provides the information which can play the crucial role considering the real value of the super high rise buildings.

Table 10. Results of regression analysis of areas other than Gangnam-area and Yeongdeungpo-gu

Model	Nonstandardized coefficient		Standardized coefficient Beta	Significance level	Multicollinearity	
	B	Standard error			Tolerance	VIF
Constant	110.942	318.712		.735		
Year after completion (year)	-7.008	13.639	-0.78	.619	.780	1.283
Unit price in vicinity (10,000 won/m ²)	.740	.402	.296	.055	.700	1.429
Ratio against average building floors within 200 m radius	10.033	3.332	.488	.013	.688	1.453
Ratio against average building area within 200 m radius	.039	.013	.462	.013	.764	1.309
Uniqueness of the form	-.007	.006	-.189	.211	.902	1.109

Table 11. Results of regression analysis of Gangnam-area and Yeongdeungpo-gu

Model	Nonstandardized coefficient		Standardized coefficient Beta	Significance level	Multicollinearity	
	B	Standard error			Tolerance	VIF
Constant	-171.366	338.124		.628		
Year after completion (year)	-14.918	9.335	-.286	.154	.521	1.921
Unit price in vicinity (10,000 won/m ²)	1.198	.378	.790	.016	.269	3.713
Ratio against average building floors within 200 m radius	3.096	2.796	.199	.030	.519	1.926
Ratio against average building area within 200 m radius	.008	.020	.060	.051	.716	1.397
Uniqueness of the form	18.061	76.723	.046	.082	.442	2.263

5. CONCLUSIONS

This study identified and quantified the landmark factors that affect the price of super high rise residential buildings in Seoul and found their impacts in the higher density area of Gangnam-area and Yeongdeungpo-gu and in lower density area of other districts in Seoul.

Through literature review, the number of years after completion is set as the building attribute, the unit price of buildings in the vicinity as the location attribute, relative height & area and visual uniqueness as the landmark attributes.

And the hedonic pricing model was applied to these and a multiple regression analysis was carried out. The results showed that an increase of relative height by 1 m increased the price by 15,960 won. And an increase of relative area by 1 m² increased the price by 5,350 won. Lastly, the visual uniqueness also had more positive (+) effects on the building than no visual uniqueness. All of above attributes were statistically significant.

These attributes were set as independent variables and a multiple regression analysis was conducted to find the impact of landmark factors according to the density. Gangnam-area and Yeongdeungpo-gu were set as higher density area and other areas were set as lower density area. One sample test was used to verify normal distribution of the sample.

The regression analysis showed that in the lower density area, the standardized coefficient for the unit price was 0.296 while those for relative height and area were 0.488, and 0.462 respectively. In the higher density area, even though the impact of landmark factors on the unit price was statistically significant, its standardized coefficient for the unit price was 0.790, which is much higher than those for other factors.

As discussed above, this study found that landmark factors affected the price of super high rise residential building. This study also

found that the impact was different when the building was a sole landmark and when the building was among other high rise buildings around. The study results can be used to set an appropriate price for a super high rise residential building in consideration of its landmark value.

This study has several limitations. Among the landmark factors, it simplified the size and visual uniqueness and used dummy variables for them. In addition, there are important factors such as historical background, social issues, recognition level, and the construction company's advertisement but these are difficult to quantify. Therefore, more comprehensive research on the quantification of landmark factors is needed by carrying out research on these factors.

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SANTRAUKA**ŽEMĖS NAUDOJIMO POVEIKIO VEIKSNIŲ ĮVERTINIMO ANALIZĖ, NUSTATANT AUKŠTYBINIŲ DAUGIABUČIŲ GYVENAMŲJŲ NAMŲ VERTĘ**

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Dėl aukštųjų technologijų tobulėjimo ir pernelyg didelės miestų perkrovos ypač padaugėjo aukštybinių pastatų. Taip pat santykinai padidėjo su šiuo klausimu susijusių studijų. Tačiau atliekant ankstesnius ypač aukštų pastatų tyrimus daug dėmesio skirta viešosios erdvės išnaudojimui pastato suplanavimo požiūriu, gyventojų pasitenkinimo tyrimo vertinimu, statybos ir struktūrinėmis technologijomis. Mažai tyrimų atlikta analizuojant ekonominius žemės naudojimo veiksnius. Šio tyrimo tikslas – išsiaiškinti kiekybiškai išmatuojamus žemės naudojimo veiksnius, rinkti duomenis apie ypač aukštus gyvenamųjų namų pastatus Seule, rasti šiems pastatams būdingų vertybių orientyrus ir analizuoti, kaip šie dydžiai skiriasi pagal skirtingo apgyvendinimo tankio teritorijas, t. y. Gamnam, Yeongdeungpo-gu ir kitose vietose. Tikimasi, kad šio tyrimo rezultatai gali būti naudojami nustatant tinkamą ypač aukštų pastatų kainą, atsižvelgiant į žemės naudojimo vertę skirtingose vietovėse.