Comparative Study on Value Determining Factors of Factory and Logistics Warehouse

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***Abstract*: The manufacturing industry as a major sector for economic activity in Korea is of great importance, whereas its factories and logistics warehouses are of little interest to both investors and researchers as investment goods. The purpose of the study is to comparatively analyze industrial property, especially focusing on factories and logistics warehouses; there exists similarities and differences among industrial property depending on its type.**

In this study, a Hedonic Price Model is applied to examine the value factors of industrial properties. Empirical analysis is implemented with real transaction data samples of factories and logistics warehouses around Gyeong-gi Province, South Korea.

The results show in most model that the factors which significantly affect property value are building age and ceiling height. Also, this study confirms that factors, such as road width and floor area, are significant variables contributing to industrial property value.

This study provides useful data both for decision makers in the manufacturing industry to rent or buy industrial properties and for developers and government policy makers to plan to establish relevant policies.

***Index Terms*: Factory, Industrial Property, Logistic Warehouse, Rent, Sales Price, Comparative Study**

I. INTRODUCTION

Factories and logistics warehouses are the predominant types of industrial property. Factories are defined as buildings or structures equipped with manufacturing facilities for a manufacturing process [1]. Both a factory site and facilities are included in a factory: facilities for manufacturing (product processing, product assembly, product repair), facilities for management and support, and additional facilities for welfare [1].

Logistics warehouse markets have steadily been expanding over time. Retail market growth (from sources such as department stores, large-scale discount stores, supercenter stores, and online markets) has boosted demand for parcel delivery services. In addition, investors and managers of REITs and Real Estate Funds have recently become attracted to industrial properties, such as logistics warehouses, and have increased investment.

Office buildings are regarded as one of the most profitable commercial property types in real estate markets, since they basically guarantee stable income. However, office building investment conditions have been rapidly deteriorating; the sales prices of office buildings have been continuously increasing, while vacancy rates and return on investment have been stagnant, or even getting worse. Therefore, to reduce investment risks and increase return on investment, investors have become interested in industrial properties [2].

The manufacturing industry as a major business for economic activity in Korea is of great importance, however factories and logistics warehouses where manufacturing activities are executed are of little interest to both investors and researchers as investment goods. Therefore the majority of existing literature has dealt with residential or commercial properties; there have not been many studies on industrial property which has distinctive characteristics compared to a commercial or residential property.

This study tries to comparatively analyze price affecting factors and their correlation for industrial property, focusing on factories and logistics warehouses. Empirical analysis is implemented with real transaction data samples from factories and logistics warehouses around Gyeong-gi Province. This study is distinctive in that it is implemented using real transaction rent and sales data of factories and logistics warehouses, which raises its reliability compared to existing research. This study also provides useful data for decision makers in the manufacturing industry to rent or buy factories or logistics warehouses. It is also useful for suppliers and government policy makers to plan for industrial land sales and for establishing relevant regulations and policies.

II. LIERATURE REVIEW

There have not been many earlier studies on industrial property as centers of production activities, compared to research on residential or commercial property. Subjects in literatures regarding industrial property have mostly been about location decisions [3-4], customers' decision making process to move-in [13], structure advancement [14-15], customer satisfaction [7], and development of industrial districts and their improvement plans [8-9].

Most studies on the price decision factors of industrial property applied Hedonic Price Models. Earlier studies set dependent variables as the asking price, appraisal and assessment price, selling in lots price, and appraised land value. The reason why earlier studies used those dependent variables is that it seems difficult to collect objective transaction price

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data for factories and logistics warehouses. In addition, factories and logistics warehouses have not been favored as investment objects in real estate markets, since they are mostly sold and traded for actual usage purposes. Therefore, not many investors are interested in industrial property as income generating real estate.

Ambrose (1990) [10] studied factors affecting the sale and rent price of logistics warehouses. As for the sale price of logistics warehouses, the result suggested that significant factors were office size, number of dock-high doors, and railroad access. A for the rent prices of logistics warehouses, significant factors affecting price were the office size, number of dock-high doors, number of drive-in doors, and presence of a sprinkler system.

Buttimer et al. (1997) [11] analyzed factors affecting the rent price of logistics warehouses. The results showed that physical factors affecting logistics warehouse rent prices were building age, office proportion, ceiling height, and presence of sprinkler system. By using a time-series analysis method, the authors argued that the rent price of logistics warehouses was positively (+) affected by the employment-to-population ratio of the year before.

Lockwood and Rutherford (1996) [12] analyzed the determinants of value for industrial property in the Dallas area. They studied determinants of industrial property value by using a linear structural relations (LISREL) model. Lockwood and Rutherford insisted that physical characteristics, regional market influences, and location factors were the primary determinants of value at the time of industrial properties' sale.

Park (2009) [13] conducted a survey on small & medium industry located in Daegu Metropolitan City to find the factors affecting potential consumers' decisions to move into flatted factories, focused on both public policy and the building itself. The survey showed significant considerations for potential customers to base their decision to move into a flatted factory based on the sale price, rent, area of common use space, value of tax breaks, and financial support, in this order. In the case of policy planning, customers put a priority on sale price, then rent support and tax favors. Customers' priority is given to financial factors when they make the decision to move into a flatted factory.

Kim and Kim (2013) [14] reported that there were significant factors affecting the sales price of factories: rent, specific rate of use, and the age of a building. In addition, they suggested that the age of building, was the most significant factor affecting price. However, the number of samples used totaled less than one hundred, which made it difficult to generalize the results of the study.

Lim and Lee (2013) [15] constructed a sales price and rent model for flatted factories by using a spatial regression model based on spatial autocorrelation. They also investigated sub-market segmentation. Their study showed that flatted factories located in metropolitan areas were segmented into five sub-markets. Industrial district locations and those facing main street & crossroad locations had relatively higher asking prices compared to other locations. They also found divergent market perspectives. For example, tenants preferred smaller size units; while on the other hand, investors favored larger size units. These findings might provide suppliers and policy makers with guidelines at the planning stage.

Hwang and Choi (2014) [16] examined customer satisfaction levels and the intention to recommend offices in Seoul Digital Media Business District. According to their research, significant factors were institutional factors (tax favors, support of the Industrial Complex Corporation, availability of consultation for loans), location and environmental factors (location, accessibility, ease of access to public transportation), and business factors (accessibility to target market, school-work links, manpower planning). However, the result showed that economic factors (low sales price, maintenance expenses, and neighborhood living costs) were insignificant, so they were rejected. The authors explained this was because offices in Seoul Digital Media Business District were located near newly developed, relatively inexpensive districts, which affected their desirability and results.

As mentioned above, this study collected and comparatively analyzed real transaction data of factories and logistics warehouses. Therefore, the results of this study seem to be much more reliable as compared to earlier literature.

III. METHODOLOGY

A. Hypothesis

Both factories and logistics warehouses are significantly affected by locational characteristics, such as industrial transportation accessibility (i.e. distance to expressway IC). Common characteristics in manufacturing business, places of production, storage, and sale are highly variable, so that fast and convenient transportation is significant in the sales and profit of the manufacturing industry. Therefore, it is assumed that wider access to transportation and the state of the surrounding roads are significant factors. The road width of an industrial site may affect the sale and rent price of factories and logistics warehouses as well.

Total floor area and lot area, which show the building size, are significant factors affecting the price of all types of property, including industrial property. The larger the surface area, the bigger its property, which means more tenants can be secured. In other words, more tenants are needed to reduce the vacancy rate. Therefore, as the size of industrial property gets bigger, its unit price may decrease.

Building age lead to a degree of deterioration in a building, so it affects sale or rent price of all types of

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property. Property with ample space for parking is highly valued and favored by lessees, tenants, and investors.

As the economy is revitalized, the demand and supply of industrial property will increase. Industrial property is more deeply influenced by economic fluctuations compared to other types of real estate, such as commercial or residential properties. This applies to all types of industrial property, including factories and logistics warehouses. Interest rates, accession rates, unemployment rates, and GRDP are common indicators for industrial property to show economic trends and fluctuation.

The supporting facilities of industrial property may also affect its rent or sale price since they improve work efficiency and convenience. Factories need hoists, along with sufficient power and water supply. Therefore, supporting facilities affect industrial property value.

Regardless of type, there are common factors affecting industrial property value, so that it is necessary to comparatively analyze value affecting factors.

B. Model and Variables

In this study, a Hedonic Price Model is applied to examine the value factors of industrial properties. The basic premise of this model is that "the value of goods is determined by the implicated characteristics of the goods" [17]. A customer buys or rents a property by the implied value of the property. The value of these characteristics is referred to as the hedonic price [18].

The Hedonic Price Model(HPM) is able to estimate values by using four methods: a linear function, semi-log, log-log, and Box-cox transformation. There are no specific or mandatory rules to select any one type out of the four methods, it solely depends on the researcher's judgment. A log-log function is applied when it is convenient to compare with other variables. The estimated coefficient value between each characteristic and price represents the price elasticity of variables. In addition, it is useful to indirectly compare variables; the different unit of each variable may be converted with the exception of the dummy variable. The dummy variable is not allowed to be applied in log. The model in this study is shown in (1).

$$logY_i = \alpha + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 + \varepsilon_i (1)$$

Where, Y is the dependent variable, representing the value (sales or rent) of a property. Log-log function is relatively more realistic as compared to a linear function, since it could reflect the law of diminishing marginal utility of the price value and characteristics of real estate property [19].Based on the model above, this study summarizes the variable descriptions in Table1.

Table 1: Variables Description

Variables	Description	Unit
*Ln*Rent	*Ln{*[(Deposit × Conversion rate/12)+Monthly rent]/Rentable area}	USD
*Ln*Sales price	*Ln(*Price for property/Sq.m)	USD
*Ln*Expressway IC	*Ln(*Distance to the nearest expressway IC)	km
Corner facing the medium width road	Corner location with more than 12m width of road= 1	dummy
*Ln*Lot area	*Ln(*Floor area on official Building Ledger)	m^2
*Ln*Total Floor area	*Ln(*Total Floor area on official Building Ledger)	m^2
*Ln*Age	*Ln(*Building age)	year
*Ln*Parking	*Ln(*Number of parking/lot area)	
*Ln*Ceiling height	*Ln(*Height of main building)	m
*Ln*Hoist	*Ln(*Total weight of hoist)	ton
*Ln*Electricity(Power supply)	*Ln(*Supply amount of electricity)	kw
Waste water disposal	If equipped with waste water disposal = 1	dummy
*Ln*Interest rate	*Ln(*Interest rate on a loan for small & medium industry)	%
*Ln*GRDP	*Ln(*GRDP by regions)	mil. USD
*Ln*Employment to population ratio	*Ln(*Monthly employment to population ratio by regions)	%
*Ln*Average operation rate	*Ln(*Monthly average operation rate on manufacturing industry)	%

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C. Descriptive Statistics

Table 2 shows the descriptive statistics for factory and warehouse value. The descriptive statistics of the factories' sale and rent price are as follows. The average sale price of factories is $3,966,062 (USD) and an average rent of $3,801 (USD). The distance to the nearest expressway IC on average is 2.7km~3km, the average building age is 14~16 years, the gross area of factories on average is 3,374~3,661m^2, and the average rent area of each unit is 619.4m^2. The ceiling height of factories are about 6.7~9.15m on average. The average amount of electric power supply is 108.9kw~441.54kw. As for macro environment characteristics, the interest rate is about 5.2%, and the employment-to-population ratio is approximately 59% on average.

The convertible rent of logistics warehouses is $12.68 per m^2 and sales price is $18,246,764 (USD). The average distance to the nearest expressway IC is 4.8~4.9km, and the building age is about 11.6~13.3 years on average. The gross area of logistics warehouses is approximately 5,132~8,606m^2, and the ceiling height is 6.2~8m on average.

Table 2: Descriptive Statistics

Variables	Unit	Factory Rent		Factory Sales		Warehouse Rent		Warehouse Sales	
		Mean	S.D	Mean	S.D	Mean	S.D	Mean	S.D
Rent Price	USD	3,801	4,198,912			12.864	6,645		
Sales Price	USD			3,966,063	4,201,067			18,246,764	18,015,010
Dist. to exp. way IC	km	2.7	0.91	3	1	4.9	4	4.8	4.05
Corner facing medium width road	dummy	0.254	0.43						
Road width	m					16.1	9	16	9.28
Floor area	m^2	619.4	177.2	3,031	969	8,643	11,471	5440.6	4559.68
Gross area	m^2	3,661	992.62	3,374	3,243	8,606	11,352	5132.7	4948.2
# of parking/lot area	load	0.012	0.004	0.02	0.036				
Age	year	16.4	5.36	14.78	6.55	11.6	7	13.3	8.52
Ceiling height	m	6.7	2.13	9.15	2.96	8	3	6.2	2.94
Hoist	ton	5.2	5.71	7.03	8.746				
Electricity(Power supply)	kw	108.9	107.16	441.54	438.5				
Interest rate in loan month	%	5.2007	0.4757	5.15	0.58				
Employment to population ratio	%/month	59.4508	1.09489	59.53	1.03				
Average operation rate	%/month	77.0886	2.24314	78.52	2.28				

IV. EMPIRICAL RESULTS

In this study, factors affecting the value of industrial property (factories and logistics warehouses) are analyzed to find correlation for each variable. Additionally, the study analyses the rate at which factors influence property value, by using a log-log function, with the exception of the dummy variable. The result shows as follows.

Model 1 shows the estimated result of a regression model regarding factory rent price based on a log-log transformation. As the dependent variable, the convertible rent per floor area, varies by 1%, the independent variables account for the fluctuation. The manufacturing operation ratio varies the most, then the interest rate on loans, GRDP, and rentable area, in sequence. This shows that economic trends significantly affect factory rent price.

Model 2 shows the estimated result of a log-log transformation of a sales price model of factories located in Korea. As the dependent variable, sale price per lot unit area, varies by 1%, the independent variables follow the fluctuation. The employment to population ratio (accession rate) shows the most variation, then GRDP, ceiling height, and lot area, in

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sequence. This also shows that economic trends significantly affect the sale price of factories. However, the sample of this model is selected from a specific area in Korea, therefore, the results should be interpreted with the fact that location influence is ruled out.

Model 3 is the estimated result of a log-log formation of a sale price regression model of logistics warehouses. As the dependent variable, the sale price of total floor unit area, varies by 1%, the most highly varied independent variable is the ceiling height. Then, the total floor area, lot area, width of front road, and distance to expressway IC follow in sequence. This implies that logistics warehouses with high ceilings, of reasonable size, and close to expressway accessibility are highly valued.

Model 4 is the result of a log-log transformation of a rent price model for logistics warehouses. As the dependent variable, the converted rent price per rentable unit area, varies by 1%, the most highly varied independent variable is the ceiling height. Then, the distance to CBD, lot area, and distance to express IC follow. This result appears similar to result of Model 3. As for the rent and sale price affecting factors of logistics warehouses, the elasticity of the ceiling height is the most significant. Ceiling height, width of front road, and the distance to neighboring cities are significant factors affecting the rent price of logistics warehouses.

Table3: Estimated Regression Results

	Mode1 1		*Mode1 2*		*Mode1 3*		*Mode1 4*	
	Factory				Warehouse			
Dep. Var.	*ln*Rent		*ln*Sales		*ln*Sales		*ln*Rent	
(constant)	24.757		-4.057		8.072		9.061	
*ln*Exp. way IC	0.018		0.01		-0.115	***	-0.097	***
*ln*CBD					-0.104		-0.188	**
*ln*Port					-0.069		-0.045	
*ln*Road Width	0.025		0.067	***	0.12	**	0.195	***
*ln*Gross area	0.04		-0.03		-0.293	***	-0.029	
*ln*Floor area	-0.035		-0.127	***	-0.138	***	-0.136	***
*ln*Age	-0.047	**	-0.026	*	-0.093	**	-0.073	*
*ln*Parking	-0.023		0.014		0.107		0.103	*
*ln*Int. rate	0.648	***	-0.078	**				
*ln*GRDP	0.236	***	0.405	**	-0.066		0.044	
*ln*Employ. to pop. ratio	0.184		0.459	**	0.114		0.018	
*ln*Ceiling height	0.073	*	0.148	***	0.398	***	0.212	***
*ln*Hoist	0.042	***	0.03	***				
*ln*Electricity	0.103	***	0.056	***				
Cold storage					0.246	***	0.294	***
*ln*Rent area	-0.118	***						
Waste water disposal	0.056		0.06					
*ln*Avg. opr. rate	0.413	**	0.468					
Major tenant							-0.179	***
N	642		317		130		138	
F value	23.978		19.686		10.644		20.682	
R square	0.59		0.686		0.794		0.764	
adj. R square	0.565		0.651		0.719		0.727	

*Notes; *** denotes 1% significance level; ** denotes 5% significance level; * denotes 10% significance level*

V. DISCUSSION AND CONCLUSION

This study comparatively analyzes industrial property, especially focused on factories and logistics warehouses; there exist similarities and differences among industrial property depending on their type. The results show that the factors significantly affecting property value in most models are building age and ceiling height. The distance to expressway IC's shows significance in two Models. In the case of factory models, the samples are collected in a single industrial complex. Therefore, provided that the distance variation appeared to be insignificant, the estimated result may vary.

Gross area and floor area negatively influence the value of all types of industrial property. This implies that as the size of industrial property gets bigger, its unit price goes down. Therefore, investors should note the above fact when they make investment decisions.

As for the interest rate variable, it is not reflected in Model 3 and Model 4. This variable may be counted as an affecting factor to all types of industrial property. Moreover, Model 1 and Model 2 show the opposite result. It is because high interest rates increase debt burdens; in that case, it seems to be more economical to rent as tenants than to buy the property.

In this study, ceiling height, building age, road width, and floor area show significance in industrial property value in three of the models, even though samples and conditions are different. Therefore, this confirms that these factors, such as ceiling height, building age, road width, and floor area, are significant variables to industrial property price.

The variation of the independent variable is shown in Table 4 in order of elasticity when the dependent variable, rent, and sales price, varies by 1%.

Table 4: Variables' Influence by Model

Model	Variables' influence
Factory sales price	Employment-population rate (+) > GRDP(+) > Ceiling height (+) > Floor area (-)
Warehouse sales price	Ceiling height (+) > Gross area (-) > Floor area (-) > Road width (+) > Distant to exp. way IC (-)
Factory rent	Interest rate (+) > Avg. opr. rate on manufacturing industry (+) > GRDP (+) > Rentable area (-)
Warehouse sales price	Ceiling height (+) > Road width (+) > Distant to CBD

This study has theoretical and practical implications, in that the study analyzes price decision factors of industrial property by using their real transaction price data. However, there are some limitations as well.

First, since there have not been many studies on this subject, it is difficult to obtain reliable data. Therefore, the available data is collected from the network of the author.

Second, due to the limitation of data collection, some of the significant factors affecting industrial property value in related earlier studies show insignificance in this study (i.e. distant to expressway interchange in Model 1 and 2). It seems that the sample distribution is limited and concentrated in certain areas. This requires further related research. In addition, due to cross section data limitations, the time period of property transactions is not long enough. Therefore, in Models 3 and 4, the macro environmental variables show not much significant relevance to the value of industrial property. This also needs additional studies, with this study as a stepping stone.

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