Correlation between building attributes and room rates for private home rentals converted from quaint old houses in Osaka City through a hedonic approach

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1. Introduction

1.1 Background
This paper attempts to demonstrate the economic rationality of conserving old private houses in Osaka City by understanding the market value of old private homes with a traditional appearance, using a hedonic approach.

Because of the social demands for a sustainable society, reduced environmental impact, and the preservation of local townscapes and historical assets, the utilization of existing buildings is becoming more important. Historical buildings, such as old private houses, reflect long-term culture and local traditions. However, in the free market, their historic value is not always given priority, and economic investment decisions dictate whether they should be preserved or not. Houses in Osaka City that were built more than 50 years ago have been destroyed at a rate of approximately 20% in 5 years. However, the value of historical buildings is precious because they are difficult to restore once they are damaged or destroyed. The use of old houses is an important issue in the field of architecture and is significant beyond a market-oriented economy. However, unless they are considered to be special cultural properties, once they are judged to have a low market value, there is no incentive to renovate them; they become dilapidated, and they are more likely to be demolished in the future. Therefore, in order for the remaining old private houses to survive and create a sustainable trend, a certain market value needs to be found for such properties without imposing any effort or burden on the owner or the local government. Even old houses that are difficult to market because they do not satisfy modern demands or do not comply with road access requirements, and other laws and regulations, can be converted to lodging facilities such as private home rentals. This may open up avenues for the use of these houses based on potential values that were not previously considered.
In recent years, private home rentals have become one of the candidates for residential conversion because of the increase in underutilized real estate resulting from a declining population, a shortage of accommodations caused by an increase in the number of tourists to Japan, and the spread of the shared economy. Relevant research is lacking because this is a relatively new trend. If there is a new phenomenon in which old private homes with declining market value are being converted to private home rentals to avoid being destroyed, it would be meaningful if we could identify what attributes of the property would bring high rates. Such findings may be known empirically by experts in the lodging industry, but none of the previous studies have quantitatively clarified them.

A property may have problems with insulation, floor space, the surrounding environment, or accessibility to roads and transportation when it is marketed as a residence. However, when it is converted to a private home rental, its performance as a residence is rarely a decisive issue because the guests do not own it as an asset, do not live there continuously, and the length of stay is short. Rather, the unique atmosphere and traditional building, unique Japanese building and old private homes or non-quaint and inferior performance and location can be expected to be decided on. This is possible if the market and the owners recognize that the properties can regain their marketability by converting them to private home rentals.

1.2 Previous research

In a study on the depreciation of residential property values in Japan, Maeda2 estimated the depreciation over time for houses that are well maintained. This estimate suggests that 39 years after construction, prices for wooden houses are reduced by half, while those for non-wooden houses took 70 years to be reduced by half. Watanabe et al.3 found that the age of a building is a major factor in the filling of vacant rental properties. Previous studies have shown that the asset value of houses in Japan correlates with the age of the building, and older houses are generally valued at a depreciated rate. However, little research has been conducted on adding value by converting vacant houses to private home rentals. Here, rather than treating quaint and non-quaint old private homes collectively, we will treat them separately to obtain a clearer picture of the two models and compare them.

1.3 Purpose

Lodging fees generally converge to a value based on a market’s comprehensive assessment of the property’s attributes based on the balance between supply and demand. Assuming that the market value of private home rentals is expressed in terms of the accommodation rate per unit of stay, we will derive the relationship between building attributes and room rates for detached private home rentals in a strategic region of Osaka City [Note 1]. We will do this for homes that have a traditional appearance and are estimated to be at least 50 years old (henceforth referred to as “quaint old private home rentals”) and other private home accommodations (hereafter referred to as “non-quaint old private home rentals”) using a hedonic approach. By comparing the hedonic price models obtained, we will examine the relationship between building attributes and market value for quaint and non-quaint old private home rentals. Here, rather than treating quaint and non-quaint old private homes collectively, we will treat them separately to obtain a clearer picture of the two models and compare them.

2. Method

2.1 Subject

Domestic private home rentals in Japan are divided into three categories according to registration method: (i) hostels in accordance with the Hotel Business Act (hereinafter referred to as “Hostels”), (ii) private home rentals in accordance with the New Law (hereinafter referred to as “New Law Private Home Rentals”), and (iii) private home rentals in accordance with the Strategic Region (hereinafter referred to as “Strategic Region Private Home Rentals”). In addition, according to the rental method and type of building, these are classified as “detached house entirely renting,” where an entire detached house is rented out to a group of guests; “apartment entirely renting,” where an entire apartment is rented out to a group of guests; and “detached house separately renting,” where a detached house is separated and rented out to multiple guests. To select the subjects of this study, we first surveyed the Osaka City Public Health Center, which has jurisdiction over hotel business and private home rentals. We obtained the “List of Establishments in the Hotel Business, Strategic Region Private Home Rentals, and New Law Private Home Rentals (as of September 30, 2019)” and collected the number and location of (i) Hostels, (ii) New Law Private Home Rentals, and (iii) Strategic Region Private Home Rentals, respectively. Next, the locations of these private home rentals were cross-checked with the residential building database of Zenrin Geo Intelligence [Note 2] to identify and categorize all private home rentals in Osaka City (Table 1).

To discuss the design of the independent exterior and interior of a house occupied by a group of guests, the subject of analysis was the private home rental of detached houses rather than apartment buildings. In order to align conditions other than explanatory and dependent variables in capturing the relationship between room rates and building attributes, we also excluded private home rentals in which a single building was
divided and rented out separately to multiple guests. Therefore, we focused on "detached house entirely renting" private home rentals, where an entire house was rented out to a group of guests. Likewise, for the purpose of the controlled study, we took into account that the room rates will be affected by the number of days provided depending on the method of registration of the private home rentals. The study covers only those private home rentals that were registered as (3) Strategic Region Private Home Rentals, which accounts for approximately 70% of the private home rentals of detached houses in Osaka City, as of September 2019.

2.2 Selection of target properties

2.2.1 Selection of quaint old private houses in Osaka City

Detached houses that were entirely rented out to groups of guests in a strategic region of Osaka City and were considered quaint old private home rentals were selected as follows:

1 For the 1311 detached houses in the aforementioned strategic region of Osaka City, there was no database that allowed us to inquire about the exact year of construction (Table 1). Interviews with the government and map maintenance companies revealed that creating such a database would require considerable effort and expense. Even if the exact year of construction of the property could be determined, it might not reveal the history of subsequent renovations and redecorations, and the property might have lost the exterior and interior appearance that it had when it was built. For the purpose of this study, it was not necessary to know the exact year of construction of each private house, so the degree of traditional appearance was judged from the exterior images of the private houses to estimate whether they were more than 50 years old. First, based on the location of the private houses, exterior photographs of the buildings of the side facing the road were obtained using a map information service [Note 3]. Based on the photographs obtained, we selected quaint old private home rentals according to the following procedure. We surveyed experts, previous studies, and local government landscaping standards to determine the criteria for a traditional appearance. According to the "Commentary on Standards for the Beautification of Traditional Buildings" of Osaka City, which refers to standards for materials, colors, exterior contours, roofs, eaves, etc., we created a flowchart of the evaluation procedure, as shown in Figure 1. First, the building had to have a sloping tiled roof, such as Japanese tiles or pantiles. Then, one of the following three conditions had to be met: (i) deep eaves, (ii) natural materials such as earth or wood used for the exterior walls, and (iii) stone used for the foundation. If a house met any of these conditions, it was classified as a quaint old private home rental. Therefore, we judged a house to be a non-quaint old private home rental if it had a tiled roof but did not meet the requirements for overhanging eaves and exterior materials (Table 2).

2 Based on the location, name, and exterior image of the property selected in (1), we further selected properties that could be matched with the information registered on private home rentals brokerage websites. This was to eliminate properties that could not be linked to the property information on the brokers’ websites, in order to conduct a later analysis based on factors such as unit room rates, exterior and interior photos, and total floor area. We used the property database of Airbnb [Note 4] provided by Airbnb, Inc., an American social networking service that is the world’s largest private home rentals brokerage service.

3 Based on detailed exterior and interior photos available on Airbnb, we eliminated those that were not timber construction. We also eliminated those that were judged not to be quaint old private home rentals because of the year of construction or because of a major renovation prior to 50 years ago based on the information provided in the property description. As a result, 120 quaint old private home rentals were selected for analysis.

2.2.2 Selection of non-quaint old private home rentals in Osaka City

Similarly, non-quaint old private home rentals were selected as a comparison group. Detached houses that were entirely rented out to groups of guests in a strategic region of Osaka City and were considered non-quaint old private home rentals were selected as follows:

1 Using Airbnb’s property database, we selected “entire house rental” and “detached house” private home rentals in Osaka City.
2 The properties selected in (1) were cross-checked against those in the “List of Establishments in the Hotel Business, Strategic Region Private Home Rentals and New Law Private Home Rentals (as of September 30, 2019)” of the Osaka City Public Health Center to select the “Strategic Region Private Home Rentals.”

3 From the properties selected in (2), those that were quaint old private home rentals were excluded.

4 We randomly selected non-quaint old private home rentals so that the regional distributions of quaint and non-quaint old private home rentals were similar and the ratio of the number of properties per administrative district was similar for each type. As a result, 122 non-quaint old home rentals were selected for analysis.

2.3 Analysis method

Based on the assumption that the value of a product is composed of a combination of the values of the attributes of the product, the hedonic approach [Note 5] is known as an econometric method that uses regression analysis to derive functions to estimate the value of each attribute. The hedonic price models were obtained for both quaint and non-quaint old private home rentals in Osaka City. It was assumed that their market value (ie [0] room rates) are a combination of [1] regionality, [2] land value, [3] size, [4] accessibility from the nearest station, [5] agglomeration level around the nearest station, and [6] traditional design. The hedonic price model is a regression equation model constructed by assuming that the value of a product is expressed in terms of the price in the hedonic approach. We modeled the following: [1] “ward and nearest station” were used for regionality, [2] “roadside land price” was used for land value, [3] “total floor area” was used for size, [4] “distance to the nearest station” was used for accessibility from the nearest station, [5] “number of lines at the nearest station” was used for agglomeration level around the nearest station, and [6] “level of presence of traditional design” was used for the traditional design (Table 3). Here [0] room rates were based on Airbnb unit room rates per person per night as of February 11, 2020; [1] ward and the nearest station were identified from the property address; [2] roadside land prices were based on the National Tax Administration’s published roadside land prices as of January 01, 2020; [3] total floor area was based on the Residential Buildings Database [Note 2]; [4] distance from the nearest station was measured from the walking route using a geographic information system; [5] the number of lines at the nearest station was surveyed using a geographic information system; and [6] the level of presence of
traditional design was assessed based on interior photographs from the Airbnb property database using the procedure described in the next section.

2.4 Evaluating the level of presence of traditional design
We collected interior photographs of quaint and non-quaint old private home rentals selected in the previous section from the Airbnb database. Because the spatial configuration and design of rooms are decisive factors in booking, we evaluated the level of presence of traditional designs based on interior photographs. Based on previous research\(^1\) that traditional Japanese houses have been characterized by the appearance of their structural members as a design feature, we classified residential accommodation into four grades, from 1 to 4, as shown in Figure 2, based on the following two criteria: (i) the structure, such as wooden column-exposed walls and Japanese-style roof trusses, should be expressed for the interior; (ii) the presence of Tatami or Japanese-style fittings, such as Fusuma and Shoji, should also be expressed. Examples and evaluation criteria for each grade are presented in Table 4. We excluded six of the 120 private homes from the analysis because we were unable to identify the room rates at the same time as the others.

2.5 Building hedonic pricing models
Hedonic price models were constructed for quaint and non-quaint old private home rentals in Osaka City to show the relationship between room rates and building attributes. [1] The

| Attributes       | Indices                                   | Unit                  | Survey method                                                                 |
|------------------|-------------------------------------------|-----------------------|-------------------------------------------------------------------------------|
| Market value     | Room rate                                 | yen/night             | Survey of room rates on Airbnb (as of Feb. 11, 2020)                         |
| Regionality      | Ward                                      | -                     | Identify by address                                                           |
| Nearest station  | -                                         | -                     | Survey on geographic information system                                       |
| Land value       | Roadside land price                       | 1000 yen/m\(^2\)      | Survey of property evaluation standards by National Tax Agency                 |
| Size             | Total floor area                          | m\(^2\)               | Survey of residential buildings database                                       |
| Accessibility    | Distance to the nearest station           | m                     | Measure walking distance to the nearest station using GIS                      |
| Aggregation level| Number of lines at the nearest station    | -                     | Measure number of lines from the nearest station using GIS                    |
| Traditional design| Level of presence of traditional design   | -                     | Grade based on interior photos from Airbnb database                          |

Table 3. Building attributes and modeled indices and survey methods

![Figure 2. Flowchart for evaluating the level of presence of traditional design](image)

3. Results

3.1 Quaint old private home rentals (114 samples)
Descriptive statistics values are shown in Tables 5 and 6.
As shown in Figure 3, the \(P\)-value of the hedonic price model was sufficiently small \((P < 0.0001)\) to meet the criterion for significance \((P < 0.05)\). Because the adjusted coefficient of determination \(R^2 = 0.66\) was above 0.5, the fit of the model was also evaluated to be acceptable. There were zero outliers that exceeded three times the quantile range \((Q = 3)\) from the quantile point \((0.1)\). In addition to the variables of the regionality of [1] ward and the nearest train station, [6] the level of presence of traditional design was selected as a valid variable, as shown in Table 7. The model shows that [1] regionality is highly correlated with [0] room rates, but [6] the level of presence of traditional design was significantly correlated with [0] room rates regardless of [1] regionality.

3.2 Non-quaint old private home rentals (122 samples)
Descriptive statistics values are shown in Tables 8 and 9.
Similarly, as shown in Figure 4, the \(P\)-value of the hedonic price model was sufficiently small \((P < 0.0001)\) to meet the criterion for significance \((P < 0.05)\). The adjusted coefficient of determination \(R^2 = 0.28\) was below 0.5, which is a lower fit than the model for the quaint old private home rentals. It was decided to use this model because it was believed to show certain trends for non-quaint old private home rentals, although it was conditional on the model’s low explanatory power. As shown in Table 10, in addition to the variable of [1] ward and the nearest train station, which represent regional
characteristics, [4] distance to the nearest train station, and [2] roadside land prices were selected as variables. [6] The level of presence of the traditional design was not selected as a valid variable. The correlation between [4] distance to the nearest station and [0] room rates was shown to be greater for non-quaint old private home rentals.

3.3 Bivariate correlation

In order to summarize the characteristics of the hedonic price models for quaint and non-quaint old private home rentals, the effective variables (P < 0.01), which are independent of regional characteristics, were classified based on positive and negative parameters, as shown in Table 11. For quaint old private home rentals, [6] the level of presence of traditional design was highly correlated with [0] room rates. For non-quaint old private home rentals, [4] the distance to the nearest station was highly correlated with [0] room rates. To obtain the relationship between these attributes and room rates in more detail, we examined bivariate correlations.

3.3.1 Relationship between [6] level of presence of traditional design and [0] room rates in quaint old private home rentals

For each grade, a mean analysis of variance was performed, as shown in Figure 5 and Table 12. Significance was shown for grades 1, 2, and 4, where the group standard deviation is below the shaded area in the figure (α = 0.05). A relationship was obtained for the higher grades with higher room rates.
3.3.2 Relationship between distance to the nearest station and room rates for non-quaint old private home rentals

Graphs and statistics were obtained, as shown in Figure 6 and Table 13. Shorter distances to the nearest station were correlated with higher room rates. In the case of non-quaint old private home rentals, the relationship is similar to that of the general real estate market, where marketability increases with closeness to a station and higher roadside land price.

4. Conclusion

The hedonic price model for quaint old private home rentals indicated that besides regionality, such as the ward and the nearest station, level of presence of traditional design is significantly correlated with room rates. Similarly, in the case of non-quaint old private home rentals, the distance to the nearest station and roadside land price were correlated with higher room rates. In the case of non-quaint old private home rentals, the relationship is similar to that of the general real estate market, where marketability increases with closeness to a station and higher roadside land price.
the relationship in more detail. For quaint old private home rentals, a correlation was shown between a higher grade of [6] level of presence of traditional design and higher [0] room rates. For non-quaint old private home rentals, a correlation was shown between shorter [4] distances to the nearest station and higher [2] roadside land prices, and higher [0] room rates.

From the above, it became clear that in addition to regionality, traditional design is important for quaint old private home rentals, whereas for non-quaint old private home rentals, in addition to regionality, accessibility to the nearest station is important. In both cases, these attributes were correlated with the room rates. Wooden houses that are older and inferior in location tend to be less valued in the real estate market, but in the case of conversion to private home rentals, the traditional design is valued uniquely as an old house. In the non-quaint old private home rentals, regardless of the traditional design, the relationship is similar to that in the general real estate market, with shorter distances to the nearest station and higher roadside land prices, leading to higher room rates. Instead of the distance to the nearest station or the roadside land price, the added value of quaint old private home rentals is thought to include interiors that consist of column-exposed walls and Japanese roof trusses, and the presence of Japanese-style fittings such as Tatami, Fusuma, and Shoji, which evoke an atmosphere of the old days. In contrast to the practice in the real estate market, in which older wooden houses are generally assessed as worthless, their conversion to private home rentals by utilizing traditional designs can increase their value. The potential value of old wooden houses converted to private home rentals has been discovered, which will contribute to preventing the loss of such houses and will encourage the voluntary use of stock to maintain and preserve them.

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Notes
Note 1) Private home rentals based on a special system under the Hotel Business Act in national strategic special zones. In 2016, Ota
Ward in Tokyo, Osaka City, and other cities were designated as national strategic special zones.

Note 2) “Housing Point Data” by Zenrin Geo Intelligence Co. Ltd. was used. It is an annual database containing the location of residential buildings (latitude and longitude), building area, building type, and the number of housing complexes in Japan.

Note 3) Using the Street View feature of Google Maps provided by Google LLC (as of November 2019).

Note 4) Airbnb has the most registrations (over 6 million) as of 2019 and is the most popular registered private home rentals brokerage site in Japan. It also has the most registrations in Japan as of 2019 (over 40,000).

Note 5) Based on the concept that the price of a good can be explained by the attributes that compose the good, the price of a good is considered to be the aggregate of various attribute values of the good, and the value of each attribute is estimated using regression analysis. It was theorized by Rosen,8 and a general equilibrium model was developed by Roback.9 The hedonic regression equation was fitted to the model by assuming a general functional form that includes the Box-Cox transformation term, as follows:

\[ y^{\lambda} = \beta_0 + \sum_{i=1}^{n} \beta_i x_i^{\lambda} + u. \]

Note 6) Method for selecting explanatory variables: the forward selection method is a stepwise approach for obtaining significant regression models by sequentially incorporating and removing significant explanatory variables, and the method of Efroymson10 is the mainstream.

Note 7) It is a measure for detecting multicollinearity between independent variables. It is the diagonal element of the inverse of the correlation coefficient matrix between the independent variables, and if the value is high, it is considered to be better to exclude the variable from the analysis. A standard value of 10 is commonly used.

Note 8) It is a method of finding the most plausible relational equation by minimizing the sum of the squares of the errors in the processing of the measurements, including errors.

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