The Impact of the Explanatory Variable Patterns and Learning Techniques Used on the Real Estate Price Estimation Models in Japan

Tsubasa Isogai, Ayuko Komura and Hirohisa Hirai
Department of Industrial Engineering and Management
Kanagawa University
Kanagawa, Japan
r201903778hy@jindai.jp, komura-a@kanagawa-u.ac.jp, hirai@kanagawa-u.ac.jp

Abstract

Hedonic methods have been widely used in real estate price estimation. However, hedonic methods use multiple regression analysis, which makes it difficult to consider many of the complex motivations and preferences that shape real estate prices due to multicollinearity. Neural networks (NNs) have attracted considerable attention in recent years as an analytical method that compensates for the shortcomings of hedonic methods. An advantage of the proposed approach is that, by using NNs, there is no need to assume explicit functions between the input and output of the studies, because the NN learns directly from the observed data. As research on the NN methodology in real estate price estimation has progressed, many studies have compared the accuracy of hedonic methods with NN. One of the representative studies compared the accuracy of hedonic methods and neural network models for estimating house prices in Turkey and showed that NN can be a better alternative to hedonic methods. However, there are some problems with the study of real estate price estimations using NNs. First, the choice of explanatory variables for the model has not been examined sufficiently. Previous studies often employ only micro variables as explanatory variables in their models, and few studies employ macro variables in their models, even though macro variables such as GDP have a significant impact on the formation of real estate prices. Previous studies constructed neural network models with microdata and environmental factors (macro variables) such as air pollution as explanatory variables. As a result, they reported that a model incorporating macro-variables related to the environment was more accurate. Current studies on real estate price estimation using NNs in Japan often consider only micro variables. Therefore, this study aims to clarify the impact of the explanatory variable patterns used in the model by comparing two variable patterns: one in which only micro variables are used as explanatory variables, and the other in which both micro and macro variables are used. We also identify which of the three methods (hedonic methods, NN, and deep neural network (DNN)) is best suited for these two cases. The results show that models with both micro and macro variables as explanatory variables are more accurate than the ones with only micro variables. The results also show that using a DNN is more accurate than using hedonic methods or an NN. However, the method used should be considered on a case-by-case basis, as NN may be more accurate in cases with only micro variables as explanatory variables.

Keywords
real estate price estimation, hedonic methods, neural network, deep neural network, explanatory variable patterns.

Biographies
Tsubasa Isogai is a graduate student of the Department of Industrial Engineering and Management at Kanagawa University, Japan.

Ayuko Komura is an assistant professor in the Department of Industrial Engineering and Management at Kanagawa University, Japan. Her research topics include operating profit stability and management controls. She earned her Ph.D. in business administration at Meiji University. She received a fellowship from the Japan Society for the Promotion of Science between 2017 and 2019.

Hirohisa Hirai is a professor at the Department of Industrial Engineering and Management at Kanagawa University, Japan. He earned his Ph.D. in Engineering at Osaka University. His research is an empirical study in management

accounting, firm analysis, and applied statistics, particularly firm valuation. He has received awards from several academic societies in accounting and management.