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Can online search sentiment predict housing demand in Indonesia?

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Abstract. This study examines the role of online search-based sentiment in predicting housing demand in Indonesia. Using the generalized least squares (GLS) method, this study analyzes panel data from 11 cities in Indonesia during 2017.I-2024.IV. The results exhibit that in addition to housing prices, economic conditions, and demographic factors, housing demand is also impacted by psychological factors in the form of sentiment that can be predicted through online searches via Google trends, which are so-called online search sentiments. The strength of the relationship between online search sentiments and housing demand for sale and rental categories varies with the volatility of housing prices. Furthermore, we also found that the relationship between online search sentiment with the keyword "house for rent" and housing demand in the rental category is more substantial in cities outside Java. Our study can be utilized as a consideration for investors, consumers, and policymakers' decision-making, as well as the development of research in real estate economics.

Keywords: real estate; demand; sentiment; online; Google trends.

1. Introduction

Along with the development of civilization, the housing demand is driven by housing price movement and high consumer sentiment [1], [2] . It needs to be noticed by the government, economists, investors, and all stakeholders involved to find solutions through accurate predictions and appropriate policies. However, most housing sentiment is calculated by an index sourced from micro data from surveys and macro data from a market-based approach with various proxies that reflect market behaviour [2] . Therefore, the results cannot be published directly quickly, data availability cannot predict the housing demand simultaneously, and the results are always delayed due to periodic publication [3]. Information on the current real estate market will be published one month, quarter or even a year later.

Nowadays, the movement of market sentiment can be reflected by internet searching. Giant online search engines like Google have provided a valuable database for movements in economic activities [4], [5]. Online search indexes have been widely applied to predict economic sentiment, especially in the capital market [5]. Although the number is still relatively limited and dominated by price movements [4] [5], empirical findings clearly state that online searches can be applied to predict sentiment in the real estate market. However, online search sentiment is more closely related to search information that helps consumers decide between buying or renting a house. A qualitative-based search conducted by Huarng [6] finds that online search sentiment successfully predicts seasonal time series of housing demand. Unfortunately, quantitative research in this area that focuses on housing demand is still limited. Therefore, it is urgent to provide research to measure online search sentiment in predicting the housing demand.

This research aimed to fill the gap by examining the effect of online search sentiment measured by the Google trend searching volume on retail housing demand in 11 big cities in Indonesia. Our analysis divides housing demand based on the sales and rental categories and how their online

search sentiments correlate. Our research contributes to some theoretical and empirical concepts. First, following the housing demand theory [7], [8], this study proves that an increase in the sale and rental category of housing prices will reduce the housing demand for the sale and rental categories, respectively. Second, we also contribute to the studies [7] and [9] that an increase in rental prices causes an increase in the demand for home ownership and vice versa. Third, our extended analysis of online search sentiment shows that searches for “house for sale” and “house for rent” represent a demand positively and negatively correlated with the demand for home ownership, respectively. Conversely, searches for “house for sale” and “house for rent” are negatively and positively correlated with the housing demand for the rental category. Furthermore, the predictive power of "house for rent" on demand in the rental category is more pronounced in cities outside Java Island. These findings add to the previous studies [3], [6], [10] by providing a new overview of the capability of online-based searches in predicting the housing demand. The results can be implemented as a guide in investment, purchasing, and policy-making for investors, consumers, and policymakers, as well as the development of theoretical research in the field of real estate in the future.

2. Literature Review

2.1 Housing Demand

The development of real estate sector analysis found that the determinant factors of housing demand are diverse. In addition to price levels, housing demand is also influenced by economic and demographic conditions such as income, inflation, population, and GDP [7] [9] . Recently, behavioural economics has modified the theoretical aspect of real estate by filling the psychological aspects of real estate economics, building a postulation that sentiment can support consumers in encouraging their fulfilment of housing needs. Hui and Wang [1] constructed a sentiment index by summing up all the probabilities of sentiment-based transactions, showing that sentiment can be employed to predict not only prices but also housing transactions, including demand. Dong [2] used principal component analysis (PCA) to show that housing purchasing intention can be stimulated by sentiment. Overall, empirical research suggests the importance of the sentiment effect as a psychological factor as a market predictor, especially demand in the real estate sector.

2.2 Online Search Sentiment

The presence of digital technology that has entered people's lives and economies requires scholars to develop economic models in the real estate sector by incorporating the current digital influence. Veldhuizen [11] and Venkatraman [12] find that the description of online search capabilities is a new proxy for seeing the strong influence of sentiment in predicting the development of the real estate sector. Specifically, as sentiment has been traditionally calculated through many compositions showing its ability to predict housing demand, sentiment based on online searches should have the same ability. Thus, in addition to predicting changes in general transactions and prices, online search sentiment also has an influence that cannot be omitted in predicting housing demand. Based on qualitative research, Huarng et al. [6]concluded that Google Trends can provide information related to housing demand. Recently, Rizun [4] added the understanding that data from the freely available domain, Google Trends, can provide deeper insights into the statistical movements of demand and supply in the real estate market. The results of this review provide a clear picture of the ability of online search sentiment to influence the movement of housing demand.

3. Method

We employed data from 11 high housing-dependency cities in Indonesia. The quarterly housing price and demand are retail commercial property demand index in sales and rental categories

gathered from the Central Bank of Indonesia, Bank Indonesia (BI), from 2017 to 2024. Data for online search sentiments are the Google search volume index with the keywords in the Indonesian Language of "rumah dijual" (English: House for Sale) and "rumah disewakan" (English: House for Rent), which were downloaded from Google Trend (GT). Finally, data for control variables are City minimum wage, gross regional domestic product, Consumer price index, number of populations, and population density provided by the Indonesian Statistical Bureau (BPS).

We employed the dataset to investigate the effect of online search sentiment on housing demand by analyzing the following Equation:

$$H_{i,t}^{D} = \alpha_0 + \alpha_1 S_{i,t} + \alpha_2 P_{i,t-1} + \alpha_3 \text{Control}_{i,t} + \mu_i + \upsilon_t + \varepsilon_{i,t} \quad (1)$$

Where $H_{i,t}^{D}$ is the housing demands of the city i at time t, while $S_{i,t}$ is online search sentiments in the city i at time t. $P_{i,t-1}$ represents housing prices of the city i at time t. $\text{Control}_{i,t}$ is control variables including wage, GDP, CPI, population, and density of the city i at time t. Finally, μ_i denotes country-specific, υ_t represents unchanging latent attributes and temporal heterogeneity, and $\varepsilon_{i,t}$ is the disturbance term of the direct effect model.

We employ various tests to provide a confident result based the basic generalized least square (GLS) model to meet the absence of autocorrelation and heteroscedasticity. First, our primary analysis examines Equation (1). Second, a moderation analysis is employed to identify whether the correlation between online search sentiment and housing demand is strengthened or weakened by different housing prices for sale and rental categories. Finally, we analyze the possibility of different geographical heterogeneity.

4. Result

4.1 Baseline Analysis

Table 1 shows the result of the baseline analysis. First, following the demand theory, the variable sale price has a negative and significant coefficient on the demand for houses in the sale category. It shows that the demand for houses, especially in the sale category, is elastic to changes in price [7], [8]. Second, following the theory of demand for substitution goods [7], [9], we confirm that there is an increase in housing demand in the sale category when the housing price in the rental category increases. Conversely, increasing the sale category's housing price improves the rental category's housing demand.

Table 1. The result of the baseline analysis

Dependent:	Housing Demand for Sale Category			Housing Demand for Rent Category		
	(1)	(2)	(3)	(4)	(5)	(6)
Online Search Sentiment						
House for Sale	0.0578***	0.0526		-0.2099***	-0.1641***	
	(0.0342)	(0.0323)		(0.0618)	(0.0580)	
House for Rent	-0.2373***		-0.2044***	0.1220**		0.0486
	(0.0379)		(0.0327)	(0.0597)		(0.0566)
Prices						
L.Price for Sale	-0.6455***	-0.8256***	-0.6700***	0.0467**	0.0479***	0.0518***
	(0.1079)	(0.1145)	(0.1078)	(0.0214)	(0.0215)	(0.0217)
L.Price for Rent	0.1724***	0.1874***	0.1620***	-0.0241	-0.0356	-0.0231
	(0.0173)	(0.0188)	(0.0162)	(0.0460)	(0.0460)	(0.0468)
Controls	YES	YES	YES	YES	YES	YES
Obs.	186	186	186	341	341	341
Wald Chi^2	324.99	236.02	317.28	206.91	206.91	189.03

( )=standard error, *p<0.1, ** p<0.05, and *** p<0.01.

Third, the model in column (1) shows that online search sentiment with the keyword "house for sale" is positively and significantly correlated when the keyword "house for rent" has a negative and significant effect on demand for houses in the sale category. In the model in column (4) where

online search sentiment with the keyword "house for rent" is positively and significantly correlated when the keyword "house for sale" has a negative and significant effect on housing demand in the rental category. These results confirm that the tendency of housing demand is not only disclosed from changes in the housing price in the category and other categories that are substitutes but also from sentiment [1], [2] through online searches activities [4], [6]. In the sale category, housing demand can be interpreted from the intensity of online searches with "house for sale" or other related keywords. Conversely, the decline in demand can be considered from the increasing intensity of online searches with the keyword "house for rent". We discovered the opposite results with the housing demand in the rental category. Housing demand in the sale category increased with the boost in searches for "house for sale" and decreased when there were more searches for "house for rent". On the other hand, demand for rental houses increases along with the growth in searches for "house for rent" and decreases when searches for "house for rent" enlargement.

4.2 Moderation Analysis

Table 2 shows the moderation effect of prices on the relationship between online search sentiment and housing demand. The results show that the relationship between online search sentiment with the keyword "house for sale" and housing demand in the sale category weakens when housing prices in the rental category increase. Conversely, the relationship between searches with the keyword "house for rent" and housing demand in the sale category strengthens when the rental price increases. Meanwhile, the relationship between online searches for "house for rent" and housing demand in the rental category weakens when the price of houses in the sale category increases and strengthens when the price of houses in the rental category decreases.

Table 2. The moderation effect of housing prices

Dependent:	Housing Demand for Sale Category			Housing Demand for Rent Category		
	(1)	(2)	(3)	(4)	(5)	(6)
House for Sale	0.4614*** (0.0811)	0.7218 (0.5491)		-0.1643 (0.1859)	0.2023** (0.0983)	
House for Rent	0.1052*** (0.0013)		0.4247*** (0.0760)	0.7201** (0.3136)		0.4910*** (0.1508)
L.Price for Sale	-0.0219 (0.1483)	-0.5166** (0.2042)	0.2528* (0.1554)	0.8427** (0.3397)	0.5579 (0.3657)	0.1000*** (0.0308)
L.Price for Rent	0.0860*** (0.0203)	0.1454*** (0.0242)	0.0176 (0.0208)	-0.1397*** (0.0466)	-0.0236 (0.0434)	-0.1666*** (0.0414)
House for Sale × L.Price for Sale	0.0510*** (0.0084)	-0.0067 (0.0058)		0.0182 (0.0192)	-0.0230** (0.0104)	
House for Sale × L.Price for Rent	-0.0040*** (0.0005)	-0.0003 (0.0006)		-0.0017 (0.0013)	0.0022** (0.0011)	
House for Rent × L.Price for Sale	-0.1169*** (0.0141)		-0.0495*** (0.0079)	-0.0870*** (0.0324)		-0.0623*** (0.0158)
House for Rent × L.Price for Rent	0.0090*** (0.0010)		0.0048*** (0.0009)	0.0125*** (0.0023)		0.0108*** (0.0019)
Controls	YES	YES	YES	YES	YES	YES
Obs.	186	186	186	186	186	186
Wald Chi^2	693.75	266.77	467.62	186.11	127.53	182.57

( )=standard error, *p<0.1, ** p<0.05, and *** p<0.01.

4.3 Heterogeneity Analysis

Indonesia is divided into many islands, with the highest population concentration on Java Island. This makes it possible for there to be differences in the influence of sentiment online both on and outside of Java Island. We analyze this influence with a dummy variable: 1 for cities located on Java Island, otherwise 0. Table 3 reveals that search sentiment with the keyword "house for rent" is positively and significantly correlated with demand for rental houses. The result is more pronounced in cities outside of Java.

Table 3. The moderation effect of internet use intensity

Dependent:	Housing Demand for Sale Category			Housing Demand for Rent Category		
	(1)	(2)	(3)	(4)	(5)	(6)
House for Sale	-0.0325 (0.0479)	-0.0641 (0.0552)		-0.0072 (0.098)	0.0482 (0.0998)	
House for Rent	0.0168 (0.0661)		-0.0473 (0.0688)	0.4033** (0.1355)		0.3724*** (0.1290)
Java Island	-0.1627 (0.2999)	-0.5602 (0.3539)	0.6165** (0.0763)	0.1213** (0.0614)	0.5045 (0.6399)	0.1603*** (0.0446)
House for Sale × Java Island	0.1988*** (0.0427)	0.0743 (0.0468)		0.1024 (0.0876)	-0.0923 (0.0847)	
House for Rent × Java Island	-0.3849*** (0.0766)		-0.1896** (0.0756)	-0.7480*** (0.1569)		-0.6442*** (0.1418)
Controls	YES	YES	YES	YES	YES	YES
Obs.	186	186	186	186	186	186
Wald Chi^2	478.42	265.11	362.08	362.08	120.22	160.16

( )=standard error, *p<0.1, ** p<0.05, and *** p<0.01.

5. Conclusion

This study examines the role of online search as sentiment in predicting changes in housing demand for sale and rent categories in Indonesia. The results contribute to several theories of housing demand. First, the increase in housing prices is negatively associated with the housing demand, and this finding applies to both the sale and rental categories. Second, the increase in the housing price in the sale category will increase the housing demand in the rental category and vice versa. Third, an increase in online search sentiment "house for sale" indicates a high housing demand for sale when housing demand for rent decreases. Conversely, online search sentiment "house for rent" indicates an increase in the housing demand for rent and a decrease in the demand for sale. The relationship between housing demand in the sale category and the sentiment of "houses for sale" weakens when the housing price in the rental category increases, and the sentiment of "houses for rent" strengthens when the housing price in the rental category also increases. Meanwhile, the relationship between housing demand in the rental category and the sentiment of "houses for rent" weakens when the housing price in the sale category increases and strengthens when the housing price in the rental category decreases. In addition, the influence of online search sentiment "house for rent" on housing demand in rental category is more substantial in cities outside Java. This finding can be employed to predict housing demand activities in Indonesia for housing developers, consumers, and the government in implementing investment activities, purchases and rentals, and appropriate policies in the real estate sector.

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