Predicting the Vacant Land Price of Ratchadapisek Road, the Bangkok New Central Business District

Review of Integrative Business & Economics Research

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ABSTRACT

Rachadapisek Road in Thailand holds significance in the country's economic landscape due to its real estate value. The road is associated with prestigious developments and properties, impacting the economic growth and property market in Thailand. The land prices along Rachadapisek Road have seen appreciation over the years, reflecting the area's desirability and potential for investment. This increase in land value contributes to the overall economic prosperity of Thailand, attracting investors and developers to capitalize on the strategic location and commercial opportunities offered by properties along Rachadapisek Road. This study aims to predict the price of vacant land and analyse the key factors influencing land prices. Data from 100 land parcels advertised through various media channels were collected, including physical attributes such as land shape, distance to the nearest settlement, frontage road width, and distances to the nearest MRT station. Descriptive statistics and Pearson's correlation were used to calculate the data, remove outliers, and identify highly correlated variables (0.70 or higher). The Multiple Regression Analysis (MRA) technique was then applied to establish the land price prediction model. The findings revealed that significant variables influencing land prices in this area were the distance to community centres and shopping areas, proximity to other prominent locations, land conditions, and land size. The MRA equation, represented as *Land Price = 248,416.76 + 180.98 (Area) + 51,959.36 (Fill) - 79.65 (Shop) - 34.00 (Place)*, illustrates the model, with an R Square value of 0.7025, indicating the model's suitability for predicting land pricing within the specified boundary. To enhance the land price predicting model for future studies and real estate projects, it is recommended to modify the variables to better align with the specific context of the studied area.

Keywords: Ratchadapisek road, land price, Central Business District, Multiple Regression Analysis.

Received 22 January 2024 | Revised 3 August 2024 | Accepted 8 September 2024.

1. INTRODUCTION

The central business districts (CBD) of Bangkok, including Silom, Sathorn, Sukhumvit, and Asoke contain various real estate projects (Bangkok Citysmart, 2017). As a result, the Bangkok Central Business District has expanded into nearby neighbourhoods, including the

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

Rama IX neighbourhood along Ratchadapisek Road (or Bangkok New CBD) (Home EE, 2023) which is a preferred location for investment organisations due to the proximity of the Stock Exchange of Thailand (SET) office building there. The transportation system on Ratchaphisek Road also being supported by the Mass Rapid Transit System (MRT), there are 6 underground MRT stations, which are Lad Prao, Ratchadapisek, Sutthisarn, Huay Kwang, Thailand Cultural Centre, and RAMA IX, respectively (Mass Rapid Transit Authority of Thailand, 2023). Then, it could be implied that Rachadapisek Road holds significance in the country's economic landscape due to its real estate value. The road is associated with prestigious developments and properties, impacting the economic growth and property market in Thailand. The land prices along the Road have seen appreciation over the years, reflecting the area's desirability and potential for investment. This increase in land value contributes to the overall economic prosperity of Thailand, attracting investors and developers to capitalize on the strategic location and commercial opportunities offered by properties along Rachadapisek Road (Fresh Property, 2021).

Land is an essential factor in real estate developments, and each location has its unique characteristics. Land value is a vital cost of real estate developments. Higher land costs mean that project developers must create higher valued products to cover the higher land costs and to maintain a profit level from their developments. Land values vary according to surrounding factors, such as environment, social, and economic situations. (Worachairungreung, Thanakunwutthirot, & Ninsawat, 2021). According to the problem that the range of physical characteristics, land uses, infrastructures, and relevant legal concerns, the land prices in the aforementioned areas are highly unpredictable. Property appraisers currently rely on their intuitions or experience when evaluating the value of lands, but their considerations are non-systematic and subjective. The calculation of the land value in the real business case is impacted by this issue. To determine the systematic structure of the land parcels and to establish the pricing structure of land parcels in the aforementioned perimeter, the authors pursued the correct valuation practice that is based on statistical techniques that predict the land value based on the location and the surrounding physical attributions.

2. LITERATURE REVIEW

Land is categorised as a noncurrent asset; it will be difficult for businesses to make up for sudden financial shortages. (Almagribi, Lukviarman, & Setiany, 2023) Consequently, it is necessary to identify the physical characteristics that affect the value of the land as well as present a suitable statistical model for assessing the appropriate land prices for selecting land with the potential to hold. The number of independent variables has been determined by our analysis of the literature, and it was noted that the independent variables of this study relate to the physical attributes of the land parcels in the study area. Where the price of the land parcels along Ratchadapisek Road is designated as the dependent variable. Table 1 below lists the research variables (physical attributions).

Table 1. The research variables and descriptions

Independent Variables	Descriptions	Unit	Measurement	Reference
Area	Land Parcel Size	Wah[2][1] (1 Wah^2 = 4 m^2)	The Size of Land parcels being used as sample (Number)	Benjamin, Guttery, & Sirmans (2004);

[1]In Thai, a Wah is a unit of measurement for area; one Wah^2 is equivalent to four metres

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Independent Variables	Descriptions	Unit	Measurement	Reference
				Khumpaisal *et al.* (2017); Duangdee (2019)
Wide	The Access Road Width	Metre	Given 1 = 1.00 – 4.00 Metre Width 2 = 4.01 – 5.00 Metre Width 3 = 5.01 – 5.50 Metre Width 4 = 5.51 – 6.00 Metre Width 5 = 6.00 Metre to Wider	Dechapun (2015); Yunan (2018)
Shape	Shape of the Land Pieces	Geometrical Shape	Given 1 = Polygonal 2 = Triangle 3 = Trapezoid 4 = Rectangular 5 = Square	Yunan (2018); Duangdee (2019)
Fill	Elevation of Land	Dummy Variable	Given 0 = Unfilled 1 = Filled	Dechapun (2015)
Front	Length of Land Frontage, Adjacent to the Access Road	Metre	The Length of Land Frontage (Number)	Khumpaisal *et al.* (2017)
MRT	The Proximity of the Land Parcel to the Nearest MRT Station	Metre	Distances from the Land Parcel to the Nearest MRT Station (Number). Please note that every land parcel sample is gathered within a 500-metre radius of each MRT station.	Sittichoketrakun (2018)
Road	The Proximity of the Land Parcel to the Nearest Main Road	Metre	Walking Distance from the Land Parcel to the Nearest Main Road	Yunan (2018); Duangdee (2019); Dechapun (2015)
Shop	Distance from Land Plot to Shopping Centre or the Nearest Source of Shopping Community	Metre	Walking Distance from the Land Parcel to the Nearest Source of Shopping	Sampathkumar *et al*. (2015)
Place	The Proximity from the Land Parcel to The Nearest Landmark	Metre	Walking Distance from the Land Parcel to the Nearest Landmark (Such as the Republic of China Embassy, Temples, School etc.)	Garang *et al*. (2021)

3. METHODOLOGY

3.1 Scopes

The authors specified the scope of this research as follows:

3.1.1 Geographical area: The study area's perimeter radius is roughly 500 metres, as this is under the Transit Oriented Development (TOD) theory (Calthorpe, 1993), and it extends from Lad Prao

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MRT Station to RAMA IX Station along Ratchadapisek Road. The Muang Thai Complex, the Thailand Cultural Centre, and the Street Ratchada Shopping Centre, among other attractions, are significant landmarks in the study area. In any case, the land parcels under study must have at least one legitimate access point.

3.1.2 The frontage road of the land parcels must be at least 4 metres wide because that is the maximum width that any vehicle can typically travel.

3.1.3 Every land parcel must comply with the law regarding accessibility. For instance, being a public road, in the form of servitude for the adjacent land parcel, or used publicly for a long time, etc. Additionally, the land parcels that were obtained through the data-collecting process must have a land area of 140 m2 or more, because any real estate development can reasonably use this area. The authors examined statistical modelling techniques, relevant physical aspects that affect land value, current methods of valuing land, as well as any environmental factors that may have an impact on land value.

3.1.4 The samples for this study were the vacant land parcels in the analysed area (which may have buildings attached), regardless of whether the landowners were willing to sell or not. 100 samples of land parcels in the studied area, were obtained by the authors' site survey, together with searching data on the lands that the owner wants to sell, website searching, advertisements or even the sold parcel (from Huay Kwang's Department of Land Office).

3.1.5 To gather the physical characteristics (independent variables) of the aforementioned land parcels, the authors use observation checklists to gather data from samples (empty land parcels) as well as telephone interviews with landowners or the Department of Land.

3.1.6 Descriptive statistics, Pearson's correlation, and multiple regression analysis (Benjamin, Guttery, & Sirmans, 2004) were the statistical methods used to predict the price structure of land parcels in the studied area.

It was also noted that Thai appraisers are currently using the market comparison approach, using the invented tools, such as Weighted Quality Scores (WQS), along with their own experience and intuitions. We started by reviewing an analysis of the physical factors that influence the value of vacant land, so these factors had been categorised into 9 variables (see Table 1).

Multiple regression analysis (MRA) was then chosen to set up the prediction model in relation to the development of a statistical model. This method can be utilised as a mass valuation method for a large number of properties, however this model (Yilmazer & Kocaman, 2020). The following equation shows the formation of Multiple Regression Analysis Model.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots\ldots + \beta_k X_k + e$$

Where Y = value of dependent variable
X = value of independent variables
β = Constants
e = coefficient Errors of the samples

3.2 Field Survey

To observe the physical characteristics and selling prices of land parcels in the study area, the

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authors conducted surveys. The field surveys were facilitated by the observation checklists of the land attributions that include the shortlists of land price, location, and photographs). Finally, 100 sets of data were collected by the authors from this field investigation. However, some outliers had to be eliminated since their physical attributions in a data graph or dataset were abnormally high or abnormally low data points in comparison to the closest data point and the rest of the nearby coexisting values (Lemonaki, 2023). As a result, 74 datasets remained to be processed for further statistical analyses.

3.3 The Administration of the Research's Variables

The authors started with the usage of descriptive statistic techniques to minimise the outlier sets of data, In this regard, it was thought that the outlier's deduction by comparing errors between the actual value and the predicted value, then removing the highly inaccurate outliers off the data sets in order to exclude some independent variables, which have the high correlation coefficients off, as these may have the significant correlation to other variables, and cause some dissent. Therefore, Pearson's s Correlation has been used to find out the relationship between each variable, to deduct the significant correlated factors, the researcher specified that the independent variables that contain Pearson's correlation greater than 0.7 (Turney, 2023) shall be removed from the model.

3.4 Application of Multiple Regression Analysis Model

The structure of land parcels' values along the Ratchadapisek Road, and the surrounding area, were predicted using the Multiple Regression Analysis (MRA) technique, which analysed the raw data and results of each independent variable. The authors recommended the testing procedure to test the effectiveness of the model, this is order to minimise some errors, which are caused while applying this model in the studied area.

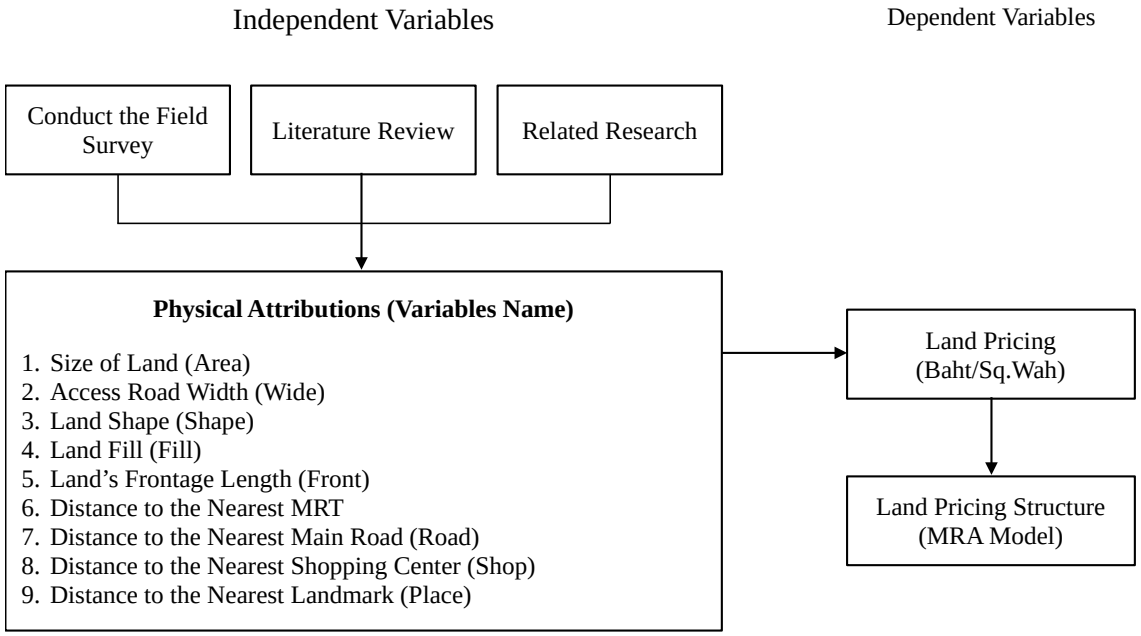

Figure 1. Summary of research process**.**

4. RESULTS

As mentioned above, the authors used the Pearson correlation to determine the strength and direction of a linear relationship between two variables after the outliers were eliminated (Turney,

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2023). Table 2 summarises how each variable relates to the others. The Front variable was omitted from the collection of variables by the authors following the computed coefficient because it had a strong correlation with Area (0.77). Thus, there were 8 variables to be input into the MRA model. After the outliers were deducted, and the Pearson's correlation was performed, 74 sets of data were input into the established MRA model, the stepwise multiple analysis was drawn to derive the R Square and Adjusted R Square value, as these indicate the appropriateness of the multiple regression model.

Table 2. The Pearson's correlation coefficients

	Area	Wide	Shape	Fill	Front	MRT	Road	Shop	Place
Area	1.00								
Wide	0.30	1.00							
Shape	-0.08	-0.03	1.00						
Fill	-0.34	0.01	0.15	1.00					
Front	0.77	0.31	-0.14	-0.33	1.00				
MRT	0.09	0.09	-0.07	-0.13	0.06	1.00			
Road	-0.22	-0.27	0.08	0.16	-0.15	-0.05	1.00		
Shop	-0.03	-0.04	0.06	0.00	0.04	-0.12	0.51	1.00	
Place	0.02	0.02	-0.03	0.20	-0.06	0.07	-0.08	0.35	1.00

The value of R Square, and Adjust R Square were derived at 0.7108 and 0.6752, respectively (see Table 3). They indicate that the multiple regression analysis is reliable enough to be performed in the equation form, to identify the variances and deviations of land prices slated for sale.

Table 3. The regression statistics and r indicators

Regression Statistics	
Multiple R	0.8431
R Square	0.7108
Adjusted R Square	0.6752
Standard Error	24336.63
Observations	74

Then, the Stepwise analyses were performed to determine the Degree of freedom (DF), the F value ratio and the F value are all considered test statistics that are used to decide whether the model as a whole has a statistically significant ability to predict (Dallal, 2023).

Table 4. The regression statistics and significant F

	df	SS	MS	F	Significance F
Regression	4	93509971071	23377492768	40.73	0.00
Residual	69	38497644695	592271456.8		
Total	74	1.33117E+11			

The F Value was calculated to be 40.73, and the Significant F value is less than 0.05. It means that at least one independent variable in the MRA model has a significant influence on the price of land in the study area, and its significance level has to be 0.05 (95% confidence).

To validate the MRA model's accuracy and applicability when applied to various case

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studies. The significant confidence at 95% for testing both MRA coefficients and correlation, as shown in Table 5, was determined by the authors using the MRA coefficient analysis together with the coefficients' standard of error.

Table 5. The MRA coefficient standard error and correlation coefficients after stepwise analysis

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Correlation
Intercept	248,416.76	14,785.81	16.80	0.00	218,919.86	277,913.65	
Area	180.98	24.26	7.46	0.00	132.59	229.38	0.42
Fill	51,959.36	11,142.51	4.66	0.00	29,730.67	74,188.05	0.10
Shop	-79.65	11.11	-7.17	0.00	-101.80	-57.49	-0.63
Place	-34.00	7.66	-4.44	0.00	-49.28	-18.72	-0.42

The P-value (significance level) of each variable is determined to be less than 0.05 (Sig 0.05), indicating that the independent variables, which are Area, Fill, Shop, and Place all have a significant impact on land prices in the studied area. The MRA equation may narrate the divergence of the range of land prices at 71% because the R Square value obtained by the MRA is 0.71 (Dallal, 2023).

Then, we applied the studied variables to the Land Pricing Model, which was constructed based on the MRA equation above, the model is formed as the equation below.

Land Price = 248,416. 76 + 180.98 (Area) + 51,959.36 (Fill) - 79.65 (Shop) - 34.00 (Place)

According to the results of multiple regression analysis, the significant factors/variables that affect the land price are ranked from most to least important as follows:

1) The "Shop" or proximity to the local shopping centre or community mall, which is the most significant factor that influences the price of land. This variable is inversely related to the land price in that the selling price will be higher for land that is close to the mentioned premises than the property that is farther away from the shopping centre. The coefficient value also indicates that a 1-metre difference will result in a decrease of 79.65 baht per 4 m2 in land pricing. This is confirmed by Yunan (2018), who found the constant value of the distance to the nearest of -109,260 indicated the inverse relationship with the land price. In this regard, the price of the land would reduce by 109,260 Baht for every 4 m2 if it were positioned one metre away from the closest retail mall.

2) “Place” or the distance to the landmarks, for example, People's Republic of China’s embassy, School, Thai Temples, and Mosques. This variable is inversely correlated to the land price in the manner that if the land is located close to the mentioned places, the land price would be higher than the land parcel remote from the places.

3) “Fill" or the height of the land parcel itself, while comparing it with the frontage access road. This variable is correlated directly with the land parcel price (Benjamin, Guttery, & Sirmans, 2004). If the land is filled, its price would increase to 51,959.36 Baht/ 4 m^2 consequently.

4) "Area" or the size of the land is the least significant factor in the model's formation. This variable's variation is here correlated directly with the size of the land area. If the land area rose by 4 m2, the selling price would rise by 180.98 Baht/4 m2. Similarly, the smaller the parcel of land, the lower the asking price. This is confirmed by Khumpaisal *et al.* (2017) that larger land parcels have greater development potential than smaller ones, which leads to their higher land prices.

One significant observation from the MRA was the “MRT” variable was not included

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in the final Multiple Regression Analysis (MRA) Model. This exclusion was attributed to the uniformity of land samples, which were collected within a 500-meter radius around each MRT station and predominantly exhibited a rectangular shape. Such uniformity led to "overfitting" in the MRA model, limiting its ability to capture diverse patterns and potentially reducing its applicability to a wider population (Minitab blog 2015). This overfitting issue persisted across multiple MRA attempts, even after eliminating variables with high correlation. However, this limitation has been addressed and will be discussed in the conclusion and recommendations.

5. CONCLUSION AND RECOMMENDATIONS

The development of a statistical model for appraising land value in the studied area revealed four prioritised physical factors: Shop, Place, Fill, and Area. These factors, with their assigned constant values and coefficients, collectively constitute a predictive model. To align with the research topic and assumptions, the variable "MRT" was considered by utilising the distance (in metres) from the datasets to the mass transit system's (MRT) stations. It's essential to note that the actual travel distance is not a variable in this context; however, a change to the actual travel distance could influence the coefficient, subsequently impacting the MRA model. Furthermore, we suggested that future researchers gather more samples than what was described in this paper and that they be collected more than 500 metres from the nearest MRT station. They may accomplish this by using the distances listed in each city's Transportation Oriented Development (TOD) plan or by using other landmarks as a reference point. Each sample shall have different attributions. These would lessen inaccuracy throughout the MRA calculation steps and prevent an "overfitting" of the samples that had been collected.

It is crucial to acknowledge that this study, constrained by time limitations, did not undergo a validity and reliability test for the MRA land price model. Therefore, we recommend that future researchers conduct such tests. Additionally, it is advised to evaluate the model's applicability by testing it on other land parcels, whether within a similar studied area or not. This involves utilising the variables outlined in Equation 2 and inputting the collected data values into the equation. If the calculated land price closely aligns with or only slightly differs from the actual selling price of the land, this model could be considered reliable for predicting land prices in the studied area.

Regarding the implication of the established MRA model towards the land use policy, our results confirmed with (Lee, S.H.; Kim, J.H.; Huh, J.H, 2021) that a forecast on land prices driven insights into the real estate market, which has the potential to greatly impact economic policy. Policymakers can use the model for adjusting or addressing infrastructure development, zoning laws, and urban planning by using accurate forecasts. Governments can better distribute resources, control housing markets, promote economic growth, and ensure sustainable development by anticipating changes in land values.

In conclusion, the study advocates for the refinement of the land price prediction model in subsequent research endeavours and real estate undertakings. The authors propose the modification of variables to align more precisely with the nuanced contextual intricacies of the studied area, thereby ensuring a more robust and contextually relevant predictive tool for the dynamic real estate development business. We suggest that other variables affecting land prices should be studied to cover more, such as land use, land planning etc. shall be established as the independent variables for the further studies (Ton et al., 2024)

APPENDIX

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Figure 2. Studied area

ACKNOWLEDGEMENT

We appreciate the anonymous reviewer's insightful remarks and recommendations, which enabled us to finish this paper. Your recommendations were very appreciated, and we addressed the necessary corrections. Moreover, we would like to thank the Innovative Real Estate Programme, Thammasat University for supporting us during this research, and faithfully thank to Thammasat Economic School, and the RIBER editor team for the given opportunity to publish in the RIBER Journal

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