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Factors Causing Fluctuations in Residential Land Prices: A Case Study in Tu Son City, Vietnam

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The study aims to determine the degree of impact of residential land price fluctuations and discuss policy implications for more effective management of land prices. Through a two-step survey, we survey land price experts to determine the factors that influence land price fluctuations. A model of influencing factors is evaluated based on testing criteria. Twenty-four factors from 8 groups of factors cause land price fluctuations. The impact rate of the different groups of factors ranges from 4.41% to 24.77%. Their impact index ranges from 2.55 to 4.71. The group of factors related to the COVID-19 pandemic has the most significant impact rate and impact index. The factors related to investment in building infrastructure have the lowest impact rate and impact index. To manage land prices and the real estate market well, it is necessary to pay attention to the factors that have stronger impacts first, and then the weaker ones.

Keywords

Factors, Fluctuations, Land prices, Tu Son City, Vietnam

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1. Introduction

Land price is one of the factors that affects the economy of countries. When land price fluctuates, many other sectors are affected as well (Aziz et al., 2021). Besides, land price is also the basis for determining financial obligations related to land and conducting land transactions. Land price also strongly impacts the real estate markets (Ha et al., 2021; Quynh and Hanh, 2015). Land price is a parameter to express the value of land in terms of money, which is a widely accepted means of comparing the value of commodities in the market. According to Walters (1983), the price of land is the perpetuity of land ownership in countries where private ownership of land exists, and equal to the estimated present value of the amortized rents in the future. In Vietnam, land price is known as land use right prices because the land collectively belongs to the people. They do not have the right to own land, only the right to use the land. Land prices are used to determine the financial revenue from land including land use levies, rent and taxes, income taxes from the transfer of land use rights, and penalties for administrative violations of land. They are also used to calculate compensation for land when the State recovers land, determine the value of land use rights to contribute capital to a mortgage, and so on and so forth.

Up to now, many researchers have studied land prices in many different aspects and at different levels of expertise. Several researchers have studied one or several factors that affect land prices (Dirgasová et al., 2017; Downing, 1973; Fan et al., 2021; Pham and Phan, 2021; Simangunsong et al., 2017; Tra et al., 2020). Ahlfeldt and McMillen (2018) and Wen and Goodman (2013) investigate the relationship between residential land prices and other factors such as public land rents and land acquisition. In addition, some authors focus on factors that affect the price of a particular type of land such as residential, agricultural, commercial, forest, or industrial land (Dirgasov et al., 2017; Downing, 1973; Hultkrantz, 1991; Jiang et al., 2013; Kheir and Portnov, 2016; Le, 2017; Protopapas and Dimopoulos, 2019; Song et al., 2022). Ha et al. (2021) and Liem and Lan (2021) focus on land pricing models. Huang and Du (2020), Alam (2018), Lu and Wang (2020), and Mera (1992) evaluate the impact of several factors on a specific land price. Mitsuta et al. (2012) assess the impact of economic factors on land prices. Quynh and Hanh (2015) use software applications to identify factors that affect land prices. Scott (1983) and Wang et al. (2019) study the factors that reduce land prices. Nam et al. (2019) study the factors that affect the winning price of land at auctions. Liu et al. (2013) research the relationship between land price and macroeconomic fluctuations while Katafuchi (2021) examines the impact of the COVID-19 pandemic on residential land prices.

It can be seen that studies to date have mainly focused on the factors that affect the land price of a specific land parcel and show the different levels of impact of these factors at different locations in a specific period. Factors that affect the price of a particular land parcel are understood as the elements that determine its value (higher or lower) compared to the value of other land plots at a specific time and in certain areas. Factors that affect the price of a land plot include its distance to the center; its shape, area, and size; its legality and usage restrictions; the socio-economic conditions of the area where it is located, etc. Even so, it remains unclear which factors cause the mass price fluctuations of land plots in a particular region over a specified period. *Therefore, our study aims to address the above research gap; specifically, to identify the factors that cause land price fluctuations and propose solutions to effectively manage land prices*.

In this study, the factors that contribute to residential land price fluctuations in Tu Son City, Vietnam, during the period of 2017-2021 are examined because Tu Son City is a new city with rapid rates of urbanization and industrialization, and residential land prices frequently fluctuate. However, there are no studies to date that assess the factors that cause land price fluctuations. Tu Son City is 18 km northeast of the capital city of Hanoi (Fig. 1) and was established in 2021 (Standing Committee of the National Assembly, 2021). Tu Son City has a natural area of 6,108.86 ha (Department of Natural Resources and Environment of Tu Son City, 2022). The population of Tu Son in 2021 was 181,495 people in 12 wards. In terms of the economic structure in 2022, industry and construction accounted for 76.2%, trade and services accounted for 22.8%, and agriculture accounted for 1.0% of the economy (Tu Son City Statistical Office, 2022). During 2017-2021, the average residential land price increased about 2.13 times (Tu Son City Statistical Office, 2022).

2. Material and Methods

2.1 Research Steps

To assess the impact of factors that cause fluctuations in residential land prices, 6 steps were carried out (Fig. 2). Step 1 involved the collection of data on the natural socio-economic conditions of Tu Son City. A questionnaire was developed in Step 2 and a survey conducted to identify the factors that might cause fluctuations in land prices. A research model of hypothetical factors that cause fluctuations in residential land prices was built in Step 3. Step 4 investigated the impact of hypothetical factors on fluctuations in residential land prices according to a 5-point Likert scale with a printed questionnaire. Step 5 tested the hypothetical model through the data collected in Step 4 according to the evaluation criteria. Finally, Step 6 involved discussing and proposing policies related to land prices.



Figure 1 Geographical Map of Location of Tu Son City, Vietnam

2.2 Data Collection

Secondary data on the natural socio-economic conditions were collected at the offices of the People's Committee of Tu Son City. Primary data were collected in 2 steps in May and June 2022 from random face-to-face surveys with experts who understand the factors that cause land price fluctuations in Tu Son City. The experts are land, real estate and independent appraisers, property developers, and real estate investors. They work for state agencies and economic organizations or operate independently and are knowledgeable about land prices in the study area. The sample size in the survey for the first step of the study was determined by using (Cochran, 1963; Yamane, 1967):

$$n = \frac{z^2 * p * (1-p)}{e^2}$$
(1)

where n is the sample size and Z is the value after looking up this value on the Z distribution table based on the selected reliability. Typically, the 95% confidence interval used corresponds to Z = 1.96, and p is the percentage of a successful n sample size estimation. We choose p = 0.5 so that the product $p^*(1-p)$ is the largest. This ensures that the sample n estimate is large enough, and e is the allowable error (±0.15). This study uses e = 0.10 so the sample size is 96.





The purpose of the survey in Step 1 is to identify the factors that might cause land price fluctuations. Each survey respondent was asked to state the influential factors on the questionnaire according to his or her point of view. The processed data results showed that 28 factors probably affect fluctuations in residential land prices, including credit, real estate speculation, real estate supply and demand, etc. The study selected 25 factors that were assessed to affect land price fluctuations by more than 50% (majority) of the total number of survey respondents. The remaining 3 factors that were evaluated to affect price fluctuations by less than 50% (minority) of the respondents were eliminated. The selected factors were classified into 8 groups according to their characteristics. Each group of factors was considered to be a latent factor with 3 to 4 independent factors called observed variables (Table 1). The fluctuations in residential land prices are considered to be the dependent variable (Y) and affected by the latent variables, as shown in Table 1 and Equation 2. The research model of hypothetical factors that has 8 independent variables and 1 dependent variable is shown in Fig. 2.

The multivariate regression model equation that is used to determine the impact rate of factors on fluctuations in residential land prices has the following form:

$$Y = \beta_0 + \beta_1 * CO + \beta_2 * AD + \beta_3 * PL + \beta_4 * IN + \beta_5 * IH + \beta_6 * SD + \beta_7 * SP + \beta_8 * CR + \mathcal{E}$$
(2)

where Y is a dependent variable that represents the fluctuations in residential land prices, β_0 is a constant, and β_1 , β_2 , β_3 , β_4 , β_5 , β_6 , β_7 , and β_8 are the regression coefficients of the corresponding variables that are in the group of factors related to the COVID-19 pandemic, administrative unit upgrades, planning, investment in building infrastructure, industrial and handicraft development, residential land supply and demand, speculation, and credit, respectively. CO, AD, PL, IN, IH, SD, SD, SP, CR are the independent variables that are in the group of factors related to the COVID-19 pandemic, administrative unit upgrades, planning, investment in building infrastructure, industrial and handicraft development, residential land supply and demand, speculation, and credit, respectively. Step 2 directly involved those who responded to the survey in Step 1 to understand how they felt about the impact of each factor selected based on a 5-point Likert scale (very impactful - 5 points; quite impactful - 4 points; moderately impactful -3 points; somewhat impactful -2 points; not *impactful – 1 point*) (Likert, 1932). The dependent variable Y is also shown on the pre-printed survey form based on a 5-point Likert scale (Very volatile -5points; Fairly volatile – 4 points; Moderately volatile – 3 points; Somewhat volatile – 2 points; Not volatile– 1 point) (Likert, 1932).

Table 1	Groups of Hypothetical Factors that Cause Fluctuations
	in Residential Land Prices

Group of Factors	Group of Factors
H1. Group of factors related to COVID-19 pandemic (CO)	H5. Group of factors related to industrial and handicraft development (IH)
Level of impact (CO1)	Industrial development level (IH1)
Measures to prevent and control the pandemic (CO2)	Handicraft development level (IH2)
COVID-19 pandemic outbreak cycle (CO3)	Level of increase in demand for workers (IH3)
H2. Group of factors related to administrative unit upgrades (AD)	H6. Group of factors related to residential land supply and demand (SD)
Undertakings (AD1)	Supply of residential land (SD1)
Implementation plan (AD2)	Demand for residential land (SD2)
Result (AD3)	Forecast of supply and demand for residential land (SD3)
H3. Group of factors related to planning (PL)	H7. Group of factors related to speculation (SP)
Socio-economic development planning (PL1)	Paying unusually high land prices at land auctions (SP1)
Land use planning (PL2)	Disseminating inaccurate information to push up the price of residential land (SP2)
Urban construction planning (PL3)	Creating virtual demand for residential land (SP3)
H4. Group of factors related to investment in building infrastructure (IN)	H8. Group of factors related to credit (CR)
Distribution of projects (IN1)	Credit interest rate (CR1)
Building level (IN2)	Collateral (CR2)
Implementation plan (IN3)	Borrowed time (CR3)
Performance results (IN4)	Fluctuations in residential land prices (Y)

The questionnaire included the 25 selected elements. Each factor has 5 levels of impact; the respondents had to choose 1 of the 5 levels. The number to be investigated is determined based on the minimum sample size required to test the model. The sample was determined based on the requirements of the exploratory factor analysis (EFA) and multivariate regression with at least 5 observations for 1 measurement variable (Hoang & Nguyen, 2008). Therefore, with 25 measurement variables, the sample is 125. For the multivariate

regression analysis, the minimum sample needs to be 50 + 8 * p (p is the number of latent variables - p = 8) (Tabachnick & Fidell, 1996), so the minimum sample to be surveyed is 50 + 8 * 8 = 114. To ensure both the minimum requirements of the EFA and multivariate regression analysis are met, the survey investigated 120 experts in land price.

2.3 Statistical analysis

The survey data on the influencing factors and their influence were processed by using SPSS 20.0 software. The reliability of the scale was verified by Cronbach's alpha coefficients. The data are considered reliable when the Cronbach's alpha coefficients range from 0.60 to 0.95 (Hair et al., 1998). The total correlation coefficient must be greater than 0.3 (Hair et al., 1998). The EFA is used to reduce a larger number of measurement variables into a smaller set of variables (factors) to make them more meaningful but still contain most of the information of the original set of variables (Hair et al., 1998). The EFA is assessed through an appropriate Kaiser-Meyer-Olkin (KMO) coefficient, Bartlett's test, eigenvalue coefficient, total explanatory variance, and load factor. Variables are only accepted when the KMO value is in the range of 0.5 to 1.0, and its weight factors in the other factors are less than 0.35. The factor loading of the same variable in 2 different factors must be greater than 0.3. According to Hair et al. (1998), with a sample size of about 100, weights of 0.55 should be used, so for a sample size of 128, we use a load weight greater than 0.55 in this study. Besides, the scale is only accepted when the total variance explained is greater than 50%; Barlett's coefficient with a significance level (Sig) less than 0.05 ensures that the factors are correlated with each other.

The impact level of each factor on fluctuations in land prices was determined according to the value of the impact index based on 5 levels (Very impactful - *impact index* ≥ 4.20 ; quite impactful - *impact index* $3.40 \div 4.19$; moderately impactful - *impact index* 2.60 - 3.39; somewhat impactful - *impact index* $1.80 \div 2.59$; and not impactful - *impact index* < 1.80) (Likert, 1932). The impact index of each factor was determined by using:

$$F_i = \frac{1}{n} * \sum_{i=1}^{q} \sum_{j=1}^{n} x_{ij}$$
(3)

where F_i is the impact index of the ith factor; n is the number of respondents; q denotes the number of impact factors; and x_{ij} is the jth respondent's score for factor i. The impact index of the kth factor group is determined with:

$$Fav_{k} = \frac{1}{p} * \sum_{k=1}^{m} \sum_{z=1}^{p} F_{kz}$$
(4)



Figure 3 Research Model of Hypothetical Factors that Cause Fluctuations in Residential Land Prices

where Fav_k is the average impact index of the kth factor group; m is the number of factor groups; p denotes the number of factors of group k; and F_{kz} represents the impact index of the zth factor in the kth group. The general impact level on the fluctuations in land prices is determined by:

$$Fav = \frac{1}{m} * \sum_{k}^{m} Gav_k$$
⁽⁵⁾

where Fav is the average impact index of all the factor groups (general impact level on fluctuations in land prices), m is the number of factor groups, and Fav_k is the average impact index of the kth factor group.

3. Results

3.1 Land Price Fluctuations During Period of 2017-2021

The average market residential land prices in Tu Son City were collected from real estate business firms in 12 wards during the period of 2017-2021. The average market land price is defined as the average residential land price of the land plots that were bought and sold during the research period in each ward.

Residential land prices were highest in Tan Hong and Dinh Bang Wards (65.16 million VND/m^2 (2,728.64 USD) and 64.29 million VND/m^2 (2,692.21 USD) in 2021, respectively) due to their central location, which makes them the most convenient location for business and trade. As a result of unfavorable business and commercial conditions, Trang Ha Ward had the lowest land price (11.33 million VND/m^2 (474.46 USD in 2021). During the study period, the price of residential land increased unevenly in the different wards. Land prices increased the most in Chau Khe Ward (2.98 times) due to increased demand for industrial land (Fig. 4). Dong Ngan Ward experienced the smallest increase in land prices due to lower demand for land.

3.2 Research Model Test Results

The first model test showed that the Cronbach's alpha coefficients of the 8 groups of factors range from 0.797 to 0.973, so they meet the test criteria (greater than 0.55). However, the correlation coefficient of the total variable of the factors related to level of handicraft development is 0.294, which is less than 0.30 (Table 2), so it does not meet the test criteria. This factor is excluded and a second test was performed. The data in Table 3 show that the Cronbach's alpha coefficients are all greater than 0.70 and correlation coefficients are all greater than 0.60, so the test criteria are met. The collected data are reliable and qualified for the next test.





Latent and Observed	Total	Latent and Observed	Total			
Variables	Correlation	Variables	Correlation			
H1. Group of factors	related to	H5. Group of factors	s related to			
COVID-19 pandemic (0	CF - Alpha =	industrial and handicraft development				
0.892)	[(HF - Alpha = 0.913)				
		Industrial				
Level of Impact	0.769	Development Level	0.938			
		(HF1)				
Measures to Prevent	0.004	Handicraft	0.001			
and Control the	0.884	Development Level	0.294			
Pandemic		(HF2)				
COVID-19 Pandemic	0.7(1	Level of Increase in	0.007			
Outbreak Cycle	0.761	Demand for Workers	0.896			
	1 . 1 .	(HF3)	1 . 1 .			
H2. Group of factors	related to	Ho. Group of factors	s related to			
aaministrative unit upg	graaes (AF -	residential land supply	ana aemana			
Alpha = 0.00	5)	(DF - Alpha = 0).820)			
Undertakings	0.947	Supply of Residential	0.694			
		Land Domand for				
Implementation Plan	0.834	Demand for Desidential Land	0.882			
		Forecast of Supply				
Pocult	0 763	and Domand for	0.706			
Kesult	0.703	Residential Land	0.790			
H3 Group of factors	related to	H7 Group of factors	s related to			
nlanning (PL - Alnha	y = 0.973	speculation (SF - $Alpha = 0.797$)				
	1 0.775)	Paving Unusually	nu 0.777)			
Socio-economic	0 779	High Land Prices at	0.832			
Development Planning	0.779	Land Auctions	0.052			
		Disseminating				
		Inaccurate				
Land Use Planning	0.831	Information to Push	0.784			
0		Up the Price of				
		Residential Land				
Uniter Constant in		Creating Virtual				
Urban Construction	0.799	Demand for	0.818			
Planning		Residential Land				
H4. Group of factors	related to	H& Group of factors re	lated to evadit			
investment in building i	nfrastructure	$\frac{110. \text{ Group of factors re}}{(CR - Alpha = 1)}$	(1000000000000000000000000000000000000			
(IF - Alpha = 0)	.801)	(CK - Alphu - ().004)			
Distribution of	0.867	Credit Interest Rate	0.771			
Projects	0.007	(CR1)	0.771			
Building Level	0.695	Collateral (CR2)	0.693			
Implementation Plan	0.847	Borrowed Time (CR3)	0.719			
Performance Results	0.793					

 Table 2
 Results of Reliability Analysis of Scale (First Test)

Latent and Observed	Total Correlation	Latent and Observed	Total Correlation		
H1 Group of factors	correlated to	v al labits	Correlation		
COVID-19 pandemic (0 0.892)	CF - Alpha =	Performance Results	0.793		
		H5. Group of factors	s related to		
Level of Impact	0.769	industrial and handicra	ft development		
		(HF - Alpha = 0)	0.772)		
Measures to Prevent		Industrial			
and Control the	0.884	Development Level	0.603		
Pandemic		(HF1)			
		Level of Increase in			
COVID-19 Pandemic	0.761	Demand for Workers	0.841		
Outbreak Cycle		(HF3)			
H2. Group of factors	related to	H6. Group of factors	s related to		
administrative unit up	grades (AF -	residential land supply	and demand		
Alpha = 0.88	35)	(DF - Alpha = 0)	0.820)		
	0.047	Supply of Residential	0.604		
Undertakings	0.947	Land	0.694		
	0.004	Demand for	a a a a		
Implementation Plan	0.834	Residential Land	0.882		
		Forecast of Supply			
Result	0.763	and Demand for	0.796		
		Residential Land			
H3. Group of factors	related to	H7. Group of factors	s related to		
planning (PL - Alpha	a = 0.973	speculation (SF - Alp	ha = 0.797)		
		Paying Unusually			
Socio-economic	0.779	High Land Prices at	0.832		
Development Planning		Land Auctions			
		Disseminating			
		Inaccurate			
Land Use Planning	0.831	Information to Push	0.784		
6		Up the Price of			
		Residential Land			
		Creating Virtual			
Urban Construction	0.799	Demand for	0.818		
Planning		Residential Land			
H4. Group of factors	related to				
investment in building i	nfrastructure	H8. Group of factors re	lated to credit		
(IF - Alpha = 0)	.801)	(CR - Alpha = 0)).804)		
Distribution of	0.017	Credit Interest Rate	0.551		
Projects	0.867	(CR1)	0.771		
Building Level	0.695	Collateral (CR2)	0.693		
Implementation Plan	0.847	Borrowed Time (CR3)	0.719		

Table 3Results of Reliability Analysis of the Scale (Second Test)

According to Table 4, the KMO value is equal to 0.936 which meets the condition: $0 \le KMO \le 1$ so the EFA is consistent with the current data. Besides, the Barlett's test results give Sig values equal to 0.00 and less than 0.05 (Table 4). This shows that the measurement variables are linearly correlated with the representative factor. The factor loading of the components is greater than 0.60 (Table 5), so the EFA analysis has practical significance, and the independent variables show the accuracy of the regression analysis model.

Table 4	KMO and	Bartlett's	Test Results
	inite una	bui tiett 5	I COL INCOULO

KMO Measure	0.936	
	Approx. Chi-Square	1854
Bartlett's Test of Sphericity	Df	172
	Sig.	0.000

According to Table 6, the correlation between the dependent and independent variables is different. The group of factors related to planning has the strongest relationship with land price change (the largest correlation coefficient of 0.820). The group of factors related to real estate supply and demand has the weakest relationship with fluctuations in residential land prices (the smallest correlation coefficient of -0.464).

The results of the multivariate regression analysis in Table 7 shows that the Sig coefficients range from 0.000 to 0.003 which are less than 0.01, so the regression model is significant, and the independent variables affect the dependent variable Y. The adjusted R^2 value which is equal to 0.853 indicates that the independent variables are affected by 85.3% of the land price fluctuations, and the remaining 14.7% is due to non-model variables and random errors. In addition, the Durbin-Watson coefficient in this study has a value of 1.841, which ranges from 1.5 to 2.5, so no first-order correlation occurs. The variance inflation factor (VIF) of all the variables included in the model is less than 2, so the research model does not have multi-collinear phenomena.

From the standardized regression coefficient, the regression equation is determined as follows:

$$Y = -0.913 + 0.58*CF + 0.32*AF + 0.22*PF + 0.10*IF + 0.19*HF + 0.25*DF + 0.36*SF + 0.33*CR$$
(6)

Observed Variable	Code	Latent Variable (Group of Factors)							
(Factor)	Code	1	2	3	4	5	6	7	8
Level of Impact	CF1	0.773							
Measures to Prevent and Control the Pandemic	CF2	0.814							
Repeat Cycle	CF3	0.762							
COVID-19 Pandemic Outbreak Cycle	AF1		0.864						
Implementation Plan	AF2		0.672						
Result	AF3		0.861						
Socio-economic Development Planning	PL1			0.843					
Land Use Planning	PL2			0.778					
Urban Construction Planning	PL3			0.692					
Distribution of Projects	IF1				0.798				
Building Level	IF2				0.897				

Table 5Weight of Rotation Matrix

(Continued...)

(Table 5 Continued)

Observed Variable	ble Carla Latent Variable (Group of Factors)								
(Factor)	Code	1	2	3	4	5	6	7	8
Implementation Plan	IF3				0.835				
Performance Results	IF4				0.841				
Industrial Development Level	HF1					0.796			
Level of Increase in Demand for Workers	HF3					0.863			
Supply of Residential Land	DF1						0.877		
Demand for Residential Land	DF2						0.891		
Forecast of Supply and Demand for Residential Land	DF3						0.882		
Paying Unusually High Land Prices at Land Auctions	SF1							0.776	
Disseminating Inaccurate Information to Push Up the Price of Residential Land	SF2							0.805	

(Continued...)

(Table 5	Continue	d)
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Observed Variable (Factor)	De Cada Latent Variable (Group of factors)								
	Coue	1	2	3	4	5	6	7	8
Creating Virtual Demand for Residential Land	SF3							0.915	
Credit Interest Rate	CR1								0.664
Collateral	CR2								0.739
Borrowed Time	CR3								0.714

		Dependent Variable (Y)	CF	AF	PL	IF	HF	DF	SF	CR
	Pearson's Correlation	1	0.792**	0.641*	0.820^{*}	0.472**	0.653**	0.464^{*}	0.761**	0.570**
Dependent Variable (Y)	Sig. (2-tailed)		0.001	0.036	0.024	0.000	0.001	0.028	0.001	0.004
(1)	Ν	128	128	128	128	128	128	128	128	128

Table 7 Results of Linear Regression Analysis

Crown of Fostows	Regression	4	Multicollinearity	Order of	
Group of Factors	Coefficient	t	Error (Sig.)	VIF	Influence
Constant	-0.913				
H1. Group of factors related to COVID-19 pandemic	0.58	6.548	0.000	1.867	1
H2. Group of factors related to administrative unit upgrades	0.32	5.349	0.001	1.641	4
H3. Group of factors related to planning	0.22	6.471	0.003	1.3.78	6
H4. Group of factors related to investment in building infrastructure	0.10	5.349	0.000	1.655	8
H5. Group of factors related to industrial and handicraft development	0.19	4.576	0.000	1.741	7
H6. Group of factors related to residential land supply and demand	0.25	3.470	0.002	1.887	5
H7. Group of factors related to speculation	0.36	4.942	0.000	1.640	2
H8. Group of factors related to credit	0.33	5.082	0.003	1.852	3
Sig. $F = 0.000$					
Coefficient $R^2 = 0.926$					
Corrected R^2 coefficient = 0.853					
Durbin-Watson = 1.841					

4. Discussion

Land price fluctuations are affected by the 8 groups of factors with 24 variables at the same time. The impact rate of the groups of factors is different and ranges from 4.41% to 24.77%. The impact index of the groups of factors is also different and ranges from 2.55 to 3.48 (*not impactful to quite impactful*) (Figs. 5 and 6). The group of factors related to the COVID-19 pandemic has the largest impact rate and concurrent impact index. The group of factors related to real estate speculation has a smaller impact rate and impact index, so it has the second largest impact rate and impact index followed by the group of factors related to credit and administrative unit upgrades with impact rates of 13.88% and 13.67%, and impact index of 4.27 and 3.98 (*very impactful and quite impactful*), respectively. The group of factors related to investment in building infrastructure has an impact index (3.05 - moderately impactful) that is the seventh largest but its impact rate (4.41%) only ranks eighth (Fig. 5).





The group of factors related to development in industrial and handicraft has an impact rate of 8.11%, which is ranked seventh, but the impact index (3.96 - *quite impactful*) is fifth in rank. The group of factors related to real estate supply and demand also has an impact rate and impact index that rank fifth and eighth with values of 10.82% and 2.55 respectively (*somewhat impactful*) (Figs. 5 and 6). Thus, there is a difference in the order of the impact rate and impact index

of the groups of factors. The difference in the impact rate of the groups of factors is more obvious than their impact index. The greatest difference is found between the impact rate of the group of factors related to the COVID-19 pandemic and investment in building infrastructure, which is 5.61. The greatest difference in the impact index is found between the group of factors related to the COVID-19 pandemic and supply and demand for residential land, which is 1.85 (*somewhat impactful*) (Fig. 7). The difference in the impact rate of the other groups compared to the group of factors with the lowest impact rate is also larger than the difference in the impact index on land price fluctuations.

Compared with previous studies on factors that affect land prices, the groups of factors that cause changes in land prices are different in number, group name, and impact level. According to Tra et al. (2020), there are 6 groups of impact factors, of which the group of factors related to infrastructure has the largest impact rate. According to Yen and Tra (2021), there are 9 groups of factors that have effects, in which the group of factors related to supply and demand for residential land has the largest impact. According to this study, there are 8 groups of factors that cause land price fluctuations. The impact rate of the group of factors related to the COVID-19 pandemic is the largest. In particular, unlike previous studies, this study also shows the impact index (level of impact) of the groups of factors in addition to their impact rate.

To effectively manage the financing of land and the real estate market, including the land market, it is necessary to pay attention to the degree of influence that factors have on land price fluctuations. To value land and determine the financial return from land, it is necessary to first pay attention to the COVID-19 pandemic because it had the highest impact rate and impact index on land prices. Specifically, it is necessary to pay attention to its level of impact, waves of infection, and measures to prevent and control the pandemic and determine land prices or predict land price fluctuations as accurately as possible. Next, it is necessary to pay attention to the group of factors related to real estate speculation because it is second in having an impact. According to the survey results, the forms of real estate speculation include paying unusually high prices when participating in land auctions and then refusing to buy land which would push up land prices in neighboring areas, providing inaccurate information about the real estate market, or creating fake land demand to increase land prices. To limit the negative impact of these factors, the State needs to publicize through the media about real estate supply and demand and severely punish those who give inaccurate information or create fake demand for land. For the group of factors related to credit, the State needs to have a policy to adjust interest rates to influence the land market, specifically land prices. When the demand for land decreases, which leads to a decrease in land prices, and affects the state budget revenue from land, it is necessary to reduce interest rates to create favorable conditions for borrowers at credit institutions to buy land. In addition, the term of a loan is also a concern because borrowers should be accommodated and a shorter loan term is important.



Figure 6 Average Impact Indexes of Groups of Factors on Fluctuations in Land Prices



Figure 7 Comparison between Impact and Impact Indexes of Groups of Factors

The group of factors related to administrative unit upgrades and investments in building infrastructure also have a strong impact on land price fluctuations because Tu Son City has implemented infrastructure investment projects, so working and living conditions are improving, and the number of workers are increasing, thus creating more demand for land and leading to an increase in dynamic prices. To ensure adequate land financing for socioeconomic development, this issue should be addressed in the state budget. In addition, it is necessary to pay attention to the group of factors related to planning, including socio-economic development, land, and construction planning because the planning is oriented towards development, construction, and land use. Therefore, many people rely on the factors related to planning to buy land and profit when the plans are implemented. This also caused land price volatility to increase during the study period. Moreover, the industrial and handicraft development of Tu Son City also increases the demand for residential land, so that it becomes more expensive because of the increase in workers. To simultaneously address the impact of the factors on land price fluctuations, it is necessary to accurately forecast the demand for residential land and develop infrastructure to price residential land in line with the needs of the market at the same time. It is necessary to have policies to support low-income people with housing.

5. Conclusion

Fluctuations in residential land prices are influenced by 24 factors in 8 different groups of factors. The impact rate of the groups of factors on land price fluctuations ranges from 4.41% to 24.77%. The impact index of the groups of factors ranges from 2.55 to 4.71. The group of factors related to the COVID-19 pandemic has the strongest impact on land price fluctuations, followed by those related to real estate speculation, administrative unit upgrades, land supply and demand, and those related to credit, planning; industrial and handicraft development, and investment in building infrastructure. To determine the appropriate land price when planning financial revenue from land, the direction of the development of the real estate market, including the land market, should first pay attention to the factors that greatly affect land price movements, followed by less influencing factors. This study has only evaluated the factors that cause fluctuations in residential land prices, so it will be necessary to further study other factors that cause fluctuations in agricultural, commercial, and service land prices. In other regions, similar issues could be studied by using the research methods and results in this paper.

Conflict of interest

The authors declare that they have no competing interests.

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