Impacts of macroeconomic factors on the real estate bubble in Vietnam's big cities with industrial zones

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Abstract: The real estate market is an important part of every economy, but if it grows unreasonably, a real estate bubble may form and lead to consequences for the whole economy. Currently, the real estate market in Vietnam is still in the early stage and operates in a way quite different from the world market and has not kept up with the development of that in other countries. Having experienced a hard time during the COVID-19 pandemic, witnessing a period of shocking increases in housing prices everywhere in Vietnam, it is very practical to analyse the factors affecting the formation of the real estate bubble so that measures to control it can be implemented. Using data from 2011 to 2021, with variables representing residential land price bubbles in big cities with industrial zones, namely Hanoi, Bac Ninh, Bac Giang, Ho Chi Minh, Binh Duong and Dong Nai, the authors construct a model to find macro factors affecting the formation of a real estate bubble in cities with industrial zones in Vietnam. They include economic growth, inflation, lending interest rates, M2 money supply, credit growth, migration rate and the provincial competitiveness. On that basis, the authors have proposed recommendations to prevent the real estate bubble in Vietnam.

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1   Introduction

Land has always been one of the many precious resources of every country. With more than 30 years of implementing comprehensive economic renovation, from 1986 until now, Vietnam has transformed from a purely agricultural country into a country with a stable and maintained economy. Contributing to that remarkable development cannot be without mentioning the field of real estate investment where many projects in the fields of production and business, many housing areas, urban areas are planned and built with modern infrastructure. All have created a new face for the country, improved people's lives, and promoted the economy towards industrialisation and modernisation.

However, the real estate market is also a starting channel causing the world financial crisis, so building and developing a sustainable and safe real estate market is not a simple matter. Once this market has negative phenomena, whether it is freezing or overheating, it will affect the remaining markets. The phenomenon of overheating growth, also known as the real estate bubble, has appeared in developed countries such as Japan (1980–1992), China (1992), and the USA (2006–2008). Both domestic and foreign economies suffered greatly when the bubble burst. A number of factors are believed to be the main cause of bubbles in the markets of the above countries due to the large amount of money flowing into real estate, uncontrolled credit and investor sentiment.

Vietnam's real estate market was born young, has not followed the natural laws of the market, has not kept up with the development of countries around the world, but has also experienced ups and downs since the Land Law (1993) was in effect until now.

Over the past two years, Vietnam's economy has been affected a lot by the COVID-19 pandemic, many policies have been issued by the State to regulate the financial system, thereby recovering the economy and stabilising people's lives. One of the policies applied is to cut bank interest rates to a low level. This has the positive effect of making access to loans easier than before, but it also has a negative effect that people

withdraw money from banks to invest in more profitable channels such as securities or real estate. Since then, the demand for real estate in recent years has tended to increase higher, there has appeared a phenomenon of 'price fever' in some localities near big cities for the residential land plot segment.

Thus, it is very important to study the real estate bubble and the factors affecting it, thereby proposing suggestions to control the strong development of the market. In particular, the real estate market in cities with many industrial parks is an object that has not been widely studied in Vietnam. The control of the asset bubble, specifically the real estate bubble, has both contributed to policy making and reflected the stable and effective development of the real estate market. After having literature review, determining the research objectives, the authors conduct an overview study of foreign and domestic researches related to the real estate bubble and the influence of macroeconomic factors on the real estate bubble, thereby finding a gap in the studies done. Then, the authors propose a research model suitable to the research objectives, and at the same time build hypotheses about the relationship between macroeconomic variables, local-specific variables and house price-on-income index representing the real estate bubble of cities with industrial zones in Vietnam.

2 Literature review

2.1 Real estate bubble definition

The definition of real estate bubble in domestic and foreign studies have certain differences, but in general 'real estate bubble' is still a phenomenon of unreasonable rapid increase in real estate prices and potential risk of 'price adjustment' or a future price collapse.

According to Case and Shiller (2003), when the expected future price increases, the demand and housing prices increase sharply in the present and do not match the actual demand and value, leading to the formation of a real estate bubble. According to Kindleberger and Aliber (2005), a real estate bubble is a rapid and continuous increase in housing prices over a certain period of time. Himmelberg et al. (2005) argue that the willingness to pay high prices for properties that they expect to appreciate in the future is the cause of the real estate bubble. McKibbin and Stoeckel (2006) define a real estate bubble as a phenomenon of widespread speculation in residential real estate prices, causing housing prices in the market to far exceed the reality.

Economists all agree that the real estate bubble has a very negative impact on the economy. When the real estate bubble bursts, it will cause great damage to the economy and it will lead to the volatility and recession of the real estate market and related markets. The consequences of the real estate bubble not only affect a country, but it can also spread to the whole world due to the globalisation of the economy and deep international economic integration.

2.2 Real estate bubble measurements

Real estate bubble is a concept that is difficult to be measured and recognised due to the unique characteristics of real estate. But some researchers have found and used the following two main methods to measure it:

- • Basic value approach: Estimate the basic value of the house and compare the observed price with the baseline value, if the difference between the two values is significant, there is a basis to conclude that at some point, there is a bubble in residential real estate (Caspi, 2016). In particular, the baseline value of real estate is measured by the value of money benefits from exploiting the useful features of the real estate, such as rental money, not the difference in value between buying price and selling price.

According to Mikhed and Zemčík (2009), the discounted cash flow formula to find the baseline value is expressed in formula (1):

$$P_t^f = \sum_{j=1}^{\infty} \frac{R_{t=j}}{(1+r)^j} \tag{1}$$

where

P_t^f the baseline value of the property at time t

R_t annual rent at time t

r capitalisation rate.

For residential real estate, rent (R) is a value that does not change much over time, so we assume R is constant. Therefore, the rental capitalisation model is often used when appraising the price of real estate, which is described by the following formula:

$$P_t^f = \frac{R}{r} \tag{2}$$

According to formula (2), since R is fixed, P_t^f also does not change over time, implying that real estate exists forever. Each year, there will be part of depreciation deducted from the real estate rental to accumulate. This accumulated depreciation will be used to repair and embellish houses after a period of time to ensure that the property can be used permanently. The discount rate r is calculated based on risk premium analysis from real estate leasing activities. Real estate leasing often carries more risks than ordinary savings at banks, so r is often higher than long-term savings interest rates i (Ngọc, 2014). From computing R and r, we can estimate P_t^f.

Since $r \geq i$, we have the following formula

$$P_t^f = \frac{R_{t+1}}{(r-g)} \leq P_t^{f\,max} = \frac{R_{t+1}}{(i-g)} \tag{3}$$

In which:

$P_t^{f\,max}$ upper limit value of baseline value

g growth rate of rent.

In the cases $P_t^f > P_t^{f\,max}$, we have a basis to confirm that a real estate bubble exists in the market. The other cases when $P_t^f < P_t^{f\,max}$, there is not enough basis to confirm the existence of a bubble in the real estate market at time t. According to Ngọc (2014) and

Long (2020), the basic value approach has the disadvantage that when the bubble level is relatively low, it is difficult to apply this method to draw conclusions. Therefore, researchers often replace it with the fundamental factor approach.

• Fundamental factor approach (Case and Shiller, 2003): Survey of house price/rent index (P/R) or house price/household income (P/I). If this index increases significantly in a certain period, it is evidence of the existence of real estate bubble.

This method is applied by many researchers such as Mikhed and Zemčík (2009) with the real estate bubble in the USA or Coskun and Jadevicius (2017) to consider the existence of a house price bubble in Turkey. The price to rent ratio (PR) and the price to income ratio (PI) are two factors used to check that real estate prices move according to changes in the basic factors or not. The researchers show that if the relationship between real estate prices and rent or between property prices and income is close, there will be no bubble in the real estate market. The correlation between real estate prices and basic factors is identified through the method of testing the stationarity of the series of PR or PI indexes.

The results obtained after testing the stationarity of the house price index (PRICE), and the household income (INCOME) or rent price (RENT), there are possibly four possible cases (according to Mikhed and Zemčík, 2009):

• Case 1: P and I (or R) are both stationary series. Since property prices and average household income (or rent) are fixed over time, we can therefore conclude that the real estate market does not exist in a bubble.

• Case 2: P is a stationary series, I (or R) is a non-stationary series. In this case, P does not change with time, while I (or R) increases with time. This will cause the price of residential real estate to be lower than the basic value of residential real estate.

• Case 3: P is a non-stationary series, I (or R) is a stationary series. Residential real estate prices will gradually move away from the basic value of residential real estate, which proves that there is a housing bubble in the market.

• Case 4: P and I (or R) are both non-stationary series. P and I (or R) both increase over time, so to determine whether there is a bubble in the real estate market, we need to test the stationarity of the PI (or PR) indexes. If the PI (or PR) index series does not stop, it is the basis for the conclusion of the existence of a housing real estate bubble. On the contrary, if the PI (or PR) series stops, it is proof that the residential real estate market is not in a bubble.

2.3 Literature review on real estate bubble and impacts of macroeconomic factors on real estate bubble

2.3.1 Researches outside Vietnam

So far, in the world, there have been many theoretical studies and models related to real estate prices as well as real estate bubbles and factors affecting real estate bubbles in different countries.

Pillay (2008) shows that GDP growth rate has a significant effect on housing prices in Singapore. Nyakabawo et al (2015) and Chen (2012) found that economic growth has a negative effect on real estate prices.

Many researchers find that the consumer price index has a negative effect on the real estate market (Amonhaemanon et al. (2013) and Wadud et al. (2012).

Meanwhile, many studies have found a negative effect between credit interest rates and the real estate market such as the study of Engsted and Pedersen (2014), Kivedal (2013), Tsatsaronis and Zhu (2004) and Xu and Chen (2012). At the same time, there are also some studies that find the opposite effect such as Gasparėnienė et al. (2016), Tse et al. (2014) and Wadud et al. (2012).

In some cases, changes in interest rates seem to be the result of financial institutions' reactions to fluctuations in the real estate market. Studying the relationship between residential real estate prices and bank lending in Hong Kong, Gerlach and Peng (2005) assert that although the simultaneous correlation between lending rates and real estate is large, the results of the author shows that the direction of influence from real estate prices to bank credit is higher than the impact of credit on real estate prices. The study of Bardhan et al. (2003) found that there is a positive relationship between stock income and the number of new houses built. This implies that the development of the stock market will increase the income of investors and they will use a part of that income to reinvest in real estate. In Vietnam, Ngọc (2014) when assessing the impact of economic factors on the formation of the real estate bubble in Ho Chi Minh City, also included the stock index in the model, but the author did not find any statistically significant relationship between these two factors.

Case and Shiller (2013) examined the emergence of a housing price bubble in the USA and found that per capita income explained most of the change in property prices in most states over the period 1985–2002.

Liu et al. (2016) and Chen (2012) respectively apply the unit root test method and ADF/VECM test standards and show that the housing bubble exists in China, while the study by Caspi (2016) examines whether the increase in Israeli house prices between 2008–2013 reflects the existence of a housing bubble, concludes that house price increase may be the result of changes in fundamentals such as rent and loan interest rates rather than the existence of a bubble.

Coskun et al. (2020) conducted a study on the housing market bubble in Turkey from 2010 to 2014 using Case and Shiller's (2003) model to build a house price-to-income index PI and PR but have not found evidence to confirm the existence of a real estate bubble in Turkey at that time.

The study by Alkali et al. (2018) explores the relationship between real estate prices and macroeconomic variables in Nigeria, whereby they determine economic growth, inflation rate, exchange rate, interest rates and crude oil prices are the main determinants of property prices in Nigeria.

Do and Le (2022) found a linkage between real estate bubble and stock bubble in Vietnam. Recent studies identify bubbles on the US stock market (Phillips et al., 2015), crypto currencies market (Corbet et al., 2018) and oil and gold markets (Gharib et al., 2021). Some other papers find the contagion effect between real estate and stock markets, such as Hu and Oxley (2018), Gharib et al. (2021) and Zhao et al. (2021). Caporin et al. (2021) found that the spillovers from the REITs onto the equity market in the US has varied over time and contagion rose especially during the global financial crisis and the European sovereign debt crisis.

2.3.2 Researches in Vietnam

Researching on the real estate market in Vietnam, Cẩn and Nam (2002) focused on analysing in detail the situation of the real estate market in the period before 2003, from which the authors proposed solutions. aims to make the real estate market become more developed. Orientations for Vietnam's real estate market have been provided, but the study has not clarified the real estate market in some specific regions.

Vương and Sơn (2008) researched the relationship between capital and money markets and the real estate market in the period 2005 to 2007. Research results show that real estate and securities have a very high correlation. It is clear that although there are periods in the same direction and periods in the opposite direction, both markets are influenced by many psychological factors.

Cường (2006) summarise and summarise the experience of developing the real estate market of a number of economies in the world. This study summarises the experiences of some countries in developing the real estate market; analyse the real estate market development in Vietnam in the period 2000–2006; propose some solutions to orient the development of the real estate market. This study has not mentioned the situation of real estate bubble development in Vietnam, specifically in Ho Chi Minh City (HCMC). Trung (2011) uses the real estate rate of return to measure the extent of the real estate bubble and understand the factors affecting this rate; combined with analysing the real estate market situation and summarising the experience of controlling the real estate bubble of some countries in the world.

Ngọc (2014) shows that the index representing the bubble PR (house price/rent ratio) depends on its past self and shocks from variables such as GDP, inflation, foreign investment, long-term lending rates, real estate loans, money supply and VNIndex.

The research paper by Toản and Trang (2018) tests the influence of financial factors on the real estate market in Ho Chi Minh City, showing factors such as economic development, credit supply, interest rates, the development of the stock market are factors that affect the real estate market in Ho Chi Minh City.

Yen et al. (2020) found that in the long run, economic growth and inflation cause the real estate price index to increase. Conversely, an increase in interest rates tends to make a decrease in real estate prices.

Tien et al. (2019) found that the main reason leading to the formation of a real estate bubble is the investor's overemphasis on real estate prices, the ineffective regulation of investment capital, and the impact of transparency. Transparency of the real estate market affect many other factors of the real estate market but only at a low level.

In summary, in previous domestic and overseas studies, cities with many industrial zones contributing a significant part to the growth of Vietnam's gross domestic product, have not been included and/or considered in detail. Secondly, the specific factors of each city such as the proportion of migrant population, immigration or provincial competitiveness have not been included in the control variables of the research model. Thirdly, the time scope of previous works is mainly the period before the outbreak of the COVID-19 pandemic. There is no latest research updating on Vietnam's economic situation after the pandemic and its impact on the real estate bubble. Therefore, this paper aims to fill the aforementioned research gap.

3   Methodology

This study focuses on using the fundamental factor approach (Case and Shiller, 2003) to measure the real estate bubble in 6 localities with industrial parks in Vietnam. After examining the existence of the real estate bubble, the authors will test the influence of macro factors on it.

3.1   Dependent variables

The PI representing the real estate bubble in the six cities studied is calculated as follows:

$$PI = \frac{PRICE}{INCOME} \qquad (4)$$

In which:

PRICE   the average land price of the city by year

INCOME   the average household income per year.

To calculate the residential land price by year, the authors take the average price of each district according to the Report of the Vietnam Association of Realtors (VARS), consult more data from the website Batdongsan.com and real estate market research companies (Savills, CBRE, JLL) and then based on the weight of each district to calculate the average price for each city in the research area. Specifically, the formula for calculating the residential land price is calculated as follows:

$$PRICE_{it} = \sum W_j \times PRICE_{jt} \qquad (5)$$

where

$PRICE_{it}$ average land price of city i at time t

*W*   weight of district area j

$PRICE_{jt}$ average land price of district j at time t.

The average INCOME household income per year is collected by the author from the CEIC data source. This is the factor that creates the basic value of real estate. If the PI is higher, it means that the land price exceeds the basic value of the real estate. According to Kindleberger and Aliber (2005), if at a certain period, the house price-to-income ratio is unusually high compared to the long-term average, it can prove that the area has the existence of a real estate bubble.

Figure 1 shows that the fluctuations of the PI of the six studied cities are quite high compared to the average.

According to the qualitative method, we can see that a real estate bubble is forming in the period from 2011 to 2021. At the same time, in 2020, PI simultaneously bottomed in all six localities, possibly due to the blockade policy during the COVID-19 pandemic making the market freeze, people unable to do transactions, prices level off and people's incomes reduced.

Figure 1 A PI index of six studied areas for the period 2011–2021
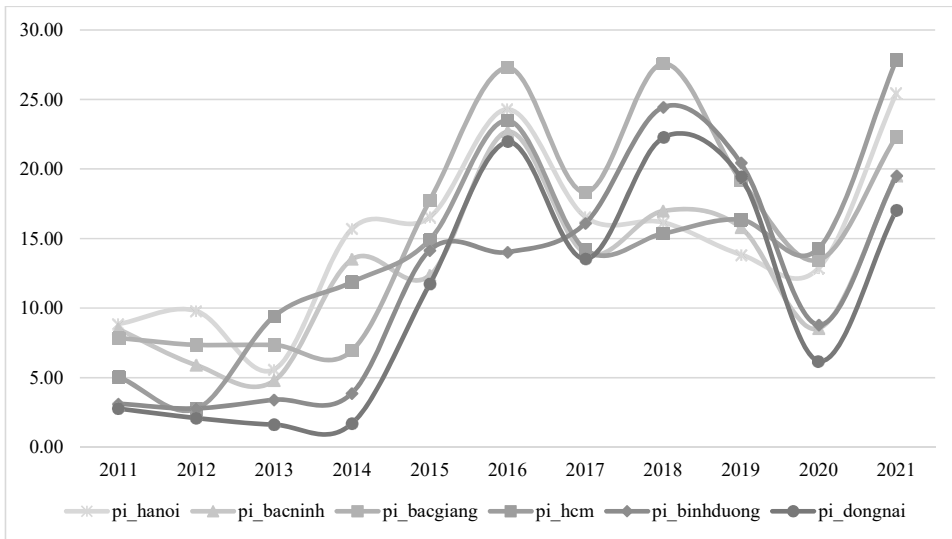
Source: Data collected by authors

Table 1 PI Index of the six cities with industrial zones

Locality	Year with highest PI	Points	Average
Ha Noi	2021	2.4	
Bac Ninh	2018	22.7	
Bac Giang	2016	27.2	
Ho Chi Minh City	2021	22.3	
Binh Duong	2021	19.5	
Dong Nai	2016	21.9	
6 cities			13

3.2 Independent variables

Inheriting previous studies, the authors put the variables GDP, CPI, interest rate, money supply M2, stock index, credit growth into the model to study the factors affecting the real estate bubble in cities with industrial zones. In addition, the authors added to the model two control variables, namely the net migration rate and the provincial competitiveness index (PCI) of each research locality. All data is collected for the period 2011–2021.

GDP growth rate represents the annual economic growth rate collected by the authors from World Bank data.

The consumer price index CPI used to measure inflation is collected by the authors from World Bank yearly data.

The basic lending interest rate (LRATE) is collected by the authors from World Bank annual data.

The M2 money supply balance, also known as the total means of payment, is collected by the authors from Vietstock Finance's annual data.

The stock index of the Ho Chi Minh City Stock Exchange (VNIndex) represents the Vietnamese stock index collected by the authors from Trading View annual data.

Credit growth (LGROWTH) is collected by the authors from the yearly data of the State Bank of Vietnam.

The net migration rate (MOVE) of the six research cities is collected by the authors from the annual data of the General Statistics Office (GSO). According to GSO, the net migration rate is calculated by taking the difference between the number of in-migrants and the number of out-migrants of a locality during the study period and taking the average per 1,000 inhabitants of that locality. The calculation formula is as follows:

$$NMR = \frac{I - O}{P_a} \tag{6}$$

where

NMR net migration rate

I number of in-migrants in the year

O number of out-migrants in the year

P_a average population (or mid-year population).

The PCI of the six research cities is collected by the authors from public data on the website www.pcivietnam.vn, which is done by the Vietnam Chamber of Commerce and Industry. This is an index that measures and evaluates the quality of economic governance, the degree of convenience and friendliness of the business environment, and the administrative reform efforts of city governments in different regions of Vietnam.

3.3   Research model

The authors propose the following model to examine the impacts of macroeconomic factors on real estate bubble in cities with industrial zones:

$$PI = \beta_0 + \beta_1 MOVE + \beta_2 PCI + \beta_3 GDP + \beta_4 CPI + \beta_5 LRATE + \beta_6 M2$$
$$+ \beta_7 LGROWTH + \beta_8 VNI + \varepsilon$$

In which:

β_0 intercept coefficient

β_i estimated coefficient (slope)

ε random error

PI house price-to-income index.

3.4 Hypothesis

- Net migration rate (MOVE)

  The net migration rate is calculated based on the immigration rate and the emigration rate. When a province has an increased number of immigrants, the demand for housing or real estate will also increase, causing the price of real estate to also be affected, thereby affecting the formation of a real estate bubble. In terms of supply and demand, the migration rate will have an impact on the price of real estate, so to consider the influence of migration we can build the following hypothesis:

  Hypothesis 1:

  H_{11}: Net migration rate affects the real estate bubble in the six studied cities.

- PCI

  The PCI was built and calculated based on ten component indexes, including the index of land access and market transparency, which is one of the factors affecting the real estate bubble. The authors believe that this index can be used to quantify the transparency of the market to apply to the measurement model. From that, we have a research hypothesis as follows:

  Hypothesis 2:

  H_{12}: Provincial competitiveness has an impact on the real estate bubble in the six studied cities.

- Economic growth rate (GDP)

  The increase in demand for real estate often causes property prices as well as rents to increase. Research by Pillay (2008), Nyakabawo et al. (2015) and Chen (2012) found that economic growth has an impact on the real estate bubble. Thereby, we build a hypothesis to examine the relationship between economic growth and the real estate bubble:

  Hypothesis 3:

  H_{13}: Economic growth has an impact on the real estate bubble in the six studied cities.

- Inflation rate (CPI)

  Real estate is considered by many as a shelter channel when the inflation rate is high, but in fact, when inflation is too high, it can also slow down economic growth and reduce people's demand for renting or buying real estate. Therefore, inflation often has a two-way effect on the real estate market, we have the following hypothesis:

  Hypothesis 4:

  H_{14}: Inflation has an impact on real estate bubbles in six studied cities.

- Lending rate (LRATE)

  When interest rates are low, investors or households will be able to borrow cheap capital, so the demand for real estate will increase. In this study, the authors propose

hypothesis about the relationship between interest rates and real estate bubbles as follows:

Hypothesis 5:

H_{15}: Interest rates have an impact on real estate bubbles in six studied cities.

- Money supply M2 (M2)

When the credit policy is relaxed, capital inflows into the real estate market will increase and have an impact on the formation of a real estate bubble. Research by Chen (2012), Wong (2001), Pillay (2008) and Coskun et al. (2020) showed the impact of money supply on real estate prices and bubbles. From there, the authors build the following hypothesis:

Hypothesis 6:

H_{16}: Money supply growth has an impact on real estate bubbles in the six studied cities.

- Credit growth rate (LGROWTH)

Research by Xu and Chen (2012), Wong (2001), Pillay (2008) and Coskun et al. (2020) both show that when the credit policy is relaxed, capital poured into the real estate market will increase and have an impact on the formation of a real estate bubble. Therefore, the authors build a hypothesis as follows:

Hypothesis 7:

H_{17}: Credit growth has an impact on the real estate bubble in the six studied cities.

- VNIndex (VNI)

The real estate market and the stock market are proven to have a close relationship with each other (Vương and Sơn, 2008). Bardhan et al. (2003) found that there is a positive relationship between stock income and the number of new houses built in this country. The stock index has also been included in the model by Ngọc (2014) when studying financial factors affecting the phenomenon of real estate bubbles in Ho Chi Minh City, but he has not found a statistically significant impact of stock indexes to real estate bubble. Therefore, the authors propose a hypothesis about the relationship of these two factors as follows:

Hypothesis 8:

H_{18}: The development of the stock market has an impact on the real estate bubble in the six studied cities.

4   Examining real estate bubble in big cities with industrial zones

To detect the existence of real estate bubbles in the study areas, the fundamental factor approach with the house price-to-income index PI is used. According to Mikhed and Zemčík (2009), the authors test the stationarity of the house price series and the income series each city, thereby concluding about the existence of a real estate bubble in the research period. Specifically:

To test the stationarity of the property price variable (P) and the income variable (I) of each city in the period 2011-2021, the authors used the extended Dickey and Fuller test (ADF). The test results show that both the real estate price series and income variable series in cities with industrial zones are non-stop series. Therefore, the authors take the first difference, the ADF test then shows that the real estate price series and income series of each city stop at 1% and 5% significance level respectively.

To test the stationarity of the real estate price on income series (PI) of each city with industrial zones, similarly to testing the stationarity of P and I series, the authors uses the ADF test method and results show that the PI series of all six cities are not stationary. Therefore, the authors conduct a test of cointegration between the two series of real estate prices and income. Regressing P_hanoi to I_hanoi, the results show that the regression coefficients are statistically significant, the authors continue to save the residuals. Then, this residual is tested for stationarity similar to the real estate price series and income series by the ADF test.

Based on the test results, the authors conclude that P_hanoi and I_hanoi do not exist cointegration because the random error of the regression P_hanoi to I_hanoi is a non-stationary series. Therefore, this proves that real estate prices have increased not due to income factor – which is often considered to be a fundamental factor forming housing prices, there exists the appearance of a real estate bubble in Hanoi for the period 2011–2021.

Similar regression of P on I of the remaining five cities and stationarity test of random errors have been done, the results show that real estate prices and income are not co-integrated. The growth rate of real estate prices has been separated from the growth rate of income. Based on the results, the authors have enough evidence to believe that there is a real estate bubble in cities with industrial zones in the period 2011–2021.

5 Regression model results

5.1 Statistic description

Table 2 describes the variables used to regress factors affecting the real estate bubble in Vietnam in the period 2011–2021.

Table 2 Statistic description of variables

Variable	Obs	Mean	Std. dev.	Min	Max
PI	66	13.24371	7.388762	1.626318	27.82682
MOVE	66	0.1239894	0.1571141	–0.052	0.586
PCI	66	60.88152	4.742604	45.34	70.16
GDP	66	0.0563782	0.0149042	0.026	0.07076
CPI	66	0.0514518	0.0484501	0.00631	0.18678
LRATE	66	0.0916718	0.0311015	0.0696	0.16954
M2	66	7,499,435	3,380,046	2,665,046	1.34e+07
VNI	66	772.6691	334.1333	351.55	1,498.28
LGROWTH	66	0.1436636	0.0300341	0.0875	0.188

Table 3   Correlation matrix of model variables

	PI	MOVE	PCI	GDP	CPI	LRATE	M2	VNI	LGROWTH
PI	1.0000								
MOVE	−0.1746	1.0000							
PCI	−0.2714	0.1758	1.0000						
GDP	0.1132	−0.1653	−0.0590	1.0000					
CPI	−0.5425	0.0115	0.1980	0.0356	1.0000				
LRATE	−0.6050	0.0269	0.2045	−0.0282	0.9657	1.0000			
M2	0.5637	0.1035	−0.0376	−0.4607	−0.6459	−0.6885	1.0000		
VNI	0.5437	0.0791	−0.0936	−0.5043	−0.5809	−0.6259	0.9655	1.0000	
LGROWTH	0.4627	−0.1275	−0.1165	0.4393	−0.3374	−0.4676	0.0578	0.0673	1.0000

The results of the correlation coefficient between the independent variables in the model are less than 0.8. Therefore, there is no multicollinearity in the research model. The selected variables are suitable for inclusion in the estimate.

5.2 Selecting an appropriate regression model

In order to study the factors affecting the real estate bubble in big cities with industrial zones in the period 2011–2021, the authors estimate the proposed model based on three methods: normal linear regression (pooled OLS), fixed effects model (FEM) and random effects model (REM).

Table 4 Regression results of 3 models

Variables	FEM	REM	Pooled OLS
	PI	PI	PI
MOVE	–15.14	–6.828	–6.589*
	(11.05)	(4.255)	(3.885)
PCI	–0.361**	–0.328**	–0.321**
	(0.137)	(0.135)	(0.136)
GDP	174.1***	183.6***	183.9***
	(60.70)	(59.70)	(60.31)
CPI	–118.2*	–113.5*	–113.2*
	(61,09)	(61.01)	(61.66)
LRATE	260.2**	243.5**	242.2**
	(119.8)	(118.8)	(120.0)
M2	2.58e-06***	2.26e-06***	2.24e-06**
	(9.06e-07)	(8.47e-07)	(8.54e-07)
VNI	–0.00463	–0.00216	–0.00199
	(0.00805)	(0.00765)	(0.00772)
LGROWTH	107.5***	106.2***	106.0***
	(31.22)	(31.27)	(31.60)
Constant	–21.67	–23.35	–23.65
	(15.63)	(15.62)	(15.78)
Observations	66	66	66
R-squared	0.661	0.6568	0.637

Notes: Standard error in brackets. $***p < 0.01$, $**p < 0.05$, $*p < 0.1$.

To choose among these three models, the authors use Hausman test, which then shows that Prob > chi2 > 0.01. Therefore, the model has a correlation between the independent variable and the random component. Therefore, we should not use a fixed-effects model, but should use a REM.

Next, the authors use more Breusch_Pagan Larange test to choose between OLS and REM models. Here, we see the p-value of the test is 0.4372 > 0.01, so random effects don't exist, using the REM model for the problem under study is not appropriate.

Therefore, the authors have chosen the pooled OLS estimation method for the model in this study to ensure the appropriateness and reliability for the research model.

The variance magnification coefficient VIF shows that the model does not have multicollinearity, so the model estimation results are reliable and the research model is suitable.

The authors use Wooldridge test to further check the reliability of the model. Woolrigde test results have p-value > 0.01 (significance level 1), so the model does not have serial autocorrelation.

The coefficient of determination R^2 of the model is 63.7%, therefore, the independent variables included in the model explain more than 63.7% of the real estate bubble formation during the research period. This is acceptable because the model is only considering outstanding variables, the real estate bubble also depends on many factors that this research model has not considered.

5.3   Testing hypotheses on regression coefficients

With the hypotheses given in Section 3.3, the model has the following conclusion.

Table 5   Testing of regression hypotheses

Hypothesis	Explanation	Accept/reject
H_{11}	The rate of immigration has an impact on the formation of a real estate bubble	Accept
H_{12}	Competitiveness has an impact on the formation of a real estate bubble	Accept
H_{13}	Economic growth has an impact on the formation of a real estate bubble	Accept
H_{14}	Inflation has the effect of forming a real estate bubble	Accept
H_{15}	Interest rates have an impact on the formation of real estate bubbles	Accept
H_{16}	Growth in money supply has the effect of forming a real estate bubble	Accept
H_{17}	Credit growth has an impact on the formation of a real estate bubble	Accept
H_{18}	Stock index has an impact on the formation of a real estate bubble	Reject

6   Discussion

From the regression results, we have:

$$PI = -23.6 - 6.589*MOVE - 0.321*PCI + 183.9*GDP - 113.2*CPI$$
$$+ 242.2*LRATE + 0.000224*M2 + 106*LGROWTH + \varepsilon$$

The β_{MOVE} (–6,589) is statistically significant at the 10% level, implying that the migration rate has a negative impact on the formation of real estate bubbles in big cities with industrial zones in the period 2011–2021. Migration from one place to another will certainly affect the real estate market in two ways. Specifically, people migrating from

one city to another will cause real estate price in the later city to tend to increase because the demand for real estate increases in the short term and the supply of real estate is less elastic. The demand for real estate in the original city is reduced, leading to a fall in property price in this city. In this study, we found a negative relationship between migration rate and real estate prices of the cities welcoming immigrants.

The β_{PCI} (–0.321) is significant at the 5% level, implying that the competitiveness index has a negative impact on the formation of real estate bubbles in big cities with industrial zones in the period 2011–2021. The PCI is an index that evaluates and ranks the governments of Vietnam's provinces and cities in terms of the quality of economic management and building a favourable business environment for the development of private enterprises. Therefore, the higher the competitiveness index, the higher the quality of local economic management, so that real estate prices are maintained stably, and the possibility of forming a real estate bubble decreases.

The β_{GDP} (183.9) is statistically significant at 1% level, meaning that economic growth has a positive impact on the formation of real estate bubbles in big cities with industrial zones in the period 2011–2021. Most domestic and foreign studies show that the rapid growth of the economy increases the living standards and income of the actors in the economy, of which a large part will be invested in preferred assets, including real estate. Because the real estate creation process often takes a long time, in the short term, the sensitivity of real estate supply is very low, an increase in demand for real estate often causes property prices as well as rents to increase. Previous studies such as Pillay (2008), Nyakabawo et al. (2015) and Chen (2012), all conclude similarly that when economic growth bursts, it can create a bubble and a crisis in the market, causing the growth rate of the real estate market to slow down.

The β_{CPI} (–113.2) is significant at the 1% level. This result implies that inflation has a negative impact on real estate price in big cities with industrial zones in the period 2011–2021. When inflation is high, the currency depreciates making people lose confidence in the currency and they tend to shift their investment to safer channels such as real estate. But in fact, too high inflation can inhibit economic growth and reduce people's demand to rent or buy real estate. Therefore, inflation often has a two-way effect on the real estate market. The regression results of the model are consistent with previous studies such as Amonhaemanon et al. (2013) and Wadud et al. (2012) that the consumer price index has a negative impact on the real estate market. Inflation also reduces the amount of real money circulating in the economy, causing the demand for goods to decrease, contributing to a decrease in the demand for real estate. In the condition that the supply of real estate remains constant, the decrease in demand for real estate will cause real estate prices to tend to decrease.

The β_{LRATE} (242.2) is the 5% level of significance, implying that interest rates have a positive impact on the price increase of real estate in big cities with industrial zones in the period 2011–2021. Normally, lending interest rates and housing prices will have an inverse relationship. However, many studies have found that at many times, lending rates have a positive effect on housing prices. This implies that the lending interest rate is a policy adjustment tool, reflecting the reaction of the State as well as commercial banks to potential risks of the market. This result is consistent with some studies such as Gasparėnienė et al. (2016), Tse et al. (2014), Wadud et al. (2012).

The β_{M2} (0.000224) is at the 5% level of significance, presenting that money supply has a positive impact on the formation of real estate bubbles in big cities with industrial zones in the period 2011–2021, but the impact is relatively small. In other words, the

more money supply increases, the more real estate prices tend to increase. Money supply has an impact on the real estate market through changes in income of investors and credit activities of banks. This finding is similar to that of Xu and Chen (2012), Wong (2001), Pillay (2008) and Coskun et al. (2020).

The $\beta_{LGROWTH}$ (106) is at the 1% significance level, showing that credit growth has a positive relationship with the formation of real estate bubbles in big cities with industrial zones in the period 2011–2021. In other words, the more loosened credit is, the higher real estate prices will be. When the credit policy is loosened, capital poured into the real estate market will increase and have an impact on the formation of a real estate bubble. This finding is absolutely similar to previous studies of Xu and Chen (2012), Wong (2001), Pillay (2008) and Coskun et al. (2020).

The model however still does not find a correlation between the stock index and the formation of a real estate bubble in the big cities with industrial zones in Vietnam.

7   Recommendations

Firstly, according to the results of the research model, the net migration rate of six cities with industrial zones is inversely proportional to the real estate bubble here. Therefore, cities need to focus on regulating the migration rate, limiting the development of industries and occupations that attract a lot of unskilled workers, and instead give priority to developing industries that require high qualifications to reduce population density as the migration rate will decrease.

Secondly, the research model shows that the higher the PCI, the lower the real estate bubble in that city. Therefore, the solution to help cities with industrial zones control the real estate bubble is to improve their competitiveness by enhancing the quality of staff, reforming administrative procedures to minimise processing time for administrative procedures as well as saving costs for people and businesses.

Third, economic growth goes hand in hand with the rise of real estate bubbles in cities with industrial zones. If the growth rate of real estate prices is higher than the growth rate of income, the PI representing the bubble will increase. Thus, it is not because economic growth is positively related to the real estate bubble that we should restrain economic development, but we should regulate it so that people's incomes increase while real estate prices stay stable or slower growth than income.

Fourth, according to the results of the research model, inflation has a negative effect on the growth of real estate bubbles in big cities with industrial zones. In order to control the real estate bubble, inflation should be kept at a stable and reasonable level to avoid overheating, negatively affecting the real estate market in cities with industrial zones. Cities with a lot of industrial zones need to coordinate with the policies set by the state to implement the socio-economic recovery and development program, maintain macroeconomic stability and control inflation, to ensure great balances of the economy.

Fifth, the interest rate has a positive impact on the formation of the real estate bubble in cities with industrial zones. Tightening monetary policy will make money no longer 'cheap' and increase financial costs to finance new loans for real estate investment. In order to minimise the impact of excessive real estate price fluctuations, the state bank should strictly control the credit allocated to the real estate business, directing credit capital flows to meet the legitimate needs of people for housing, contributing to healthy and sustainable development of the real estate market.

Sixth, according to the research model, M2 money supply has a positive impact on the formation of the real estate bubble in cities with industrial zones. In order to control the money supply, the central bank will have to indirectly affect the discount rate between central banks and commercial banks, increasing the discount rate will cause commercial banks to reduce their borrowing needs, leading to their less ability to lend money and the money supply decreases as a result.

Seventh, besides money supply, credit supply is also a factor that has a positive relationship with the real estate bubble measurement. Commercial banks need to develop a consistent and flexible real estate lending policy. They should set a limit on the ratio of real estate loans to total outstanding loans in the long-term, ensuring that the allowed limit is not exceeded, and real estate loan structure is appropriate.

8 Conclusions

The article has shown the relationship between macroeconomic factors and the real estate bubble in cities with industrial zones in Vietnam in the period 2011 to 2021. Research results show that the factors affecting the real estate market in the study area are: economic growth, inflation, lending interest rates, money supply, credit growth, migration rate and the provincial competitiveness. This is a research model that inherits from domestic and foreign studies, combined with testing the suitability and meaning of each variable in the model as well as the reliability of the model. The model regression results also show that the influence of most macroeconomic factors on the real estate bubble is relatively large. Based on the results of the regression model, the authors have proposed a number of suggestions to control the formation the real estate bubble, making the operation in the real estate market more transparent, the psychology of participating investors be stable and thus the real estate bubble formation can be controlled.

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