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by Rifki Khoirudin

A TIME-VARYING OF PROPERTY RESIDENTIAL PRICE IN INDONESIA: A VAR APPROACH

Abstract

The crisis 2008 started with asset price bubbles which spread to other sectors, thus driving a recession. Turmoil in the housing sector can directly harm the domestic economy and financial stability. The aim of the research is the analysis of the macroeconomic variables can effect asset price in Indonesia and to analysis how the inflation targeting framework work directly to asset price. Contribution of the research such the early warning system to asset sector that crisis 2008 started with asset price bubbles. The Inflation Targeting Framework (ITF) policy used by the Central Bank has shown its effectiveness in the property sector. It can be seen that a negative response is shown from property prices when there are inflationary shocks. The response of interest rates to fluctuations in housing prices is stronger than the response of housing prices to fluctuations in interest rates. It indicates that the interest rate stimulus is more reactive to changes in housing prices as an accommodation of housing price volatility. GDP and money supply will respond negatively to property price fluctuations, which can lead to a crisis because GDP responds negatively. The strengthen of fiscal and monetary policy which can soften the volatility of asset price.

Keywords: Asset Price, Inflation Targeting Framework, Fiscal Policy, Monetary Policy

JEL Classification: (E4, G1, H4)

Introduction

The attention of the government, policymakers, academics, and economists to the housing sector is increasing. It is inseparable from the 2008 global crisis or what is known as the subprime mortgage. The crisis started with asset price bubbles which spread to other sectors, thus driving a recession. Turmoil in the housing sector can directly harm the domestic economy and financial stability. Since 2005, Bank Indonesia has implemented an inflation targeting framework (ITF) policy. ITF policies can efficiently stabilize prices but cannot stem the fluctuations in asset price bubbles. Researchers try to build modeling as a first step to mitigate turmoil in the housing/property sector. Figure 1 explains Indonesia's property price index's growth. The level of price fluctuation does not move far from its mid-value. However, there were certain moments when there was a significant price decline, such as in 2008. The crisis in the US spread and affected the Indonesian property price index, so the growth in the property price index touched -21.01%. The highest property price index growth occurred in the first quarter of 2013, reaching 4.4%. In recent years, it has been noted that the development of the property price index is not more than 0.5%, so the chart in Figure 1 after 2017 tends to decline. The effects of the pandemic show that residential property prices have decreased.

Many previous researchers have developed research related to the property sector, such as Bernanke and Kuttner (2005), who developed the sensitivity of the property sector to changes in monetary policy. Mishkin (2007) added that the property sector is linked as a transmission in monetary policy. The monetary sector cannot be separated from the property sector because, in some instances, the property sector is used as loan collateral to affect financial system stability. Not only in the monetary sector, but several studies also link the relationship between the property sector and the economy, such as research developed by Ahearne et al. (2015), Vargas-Silva (2018), and Iacoviello and Neri (2010).
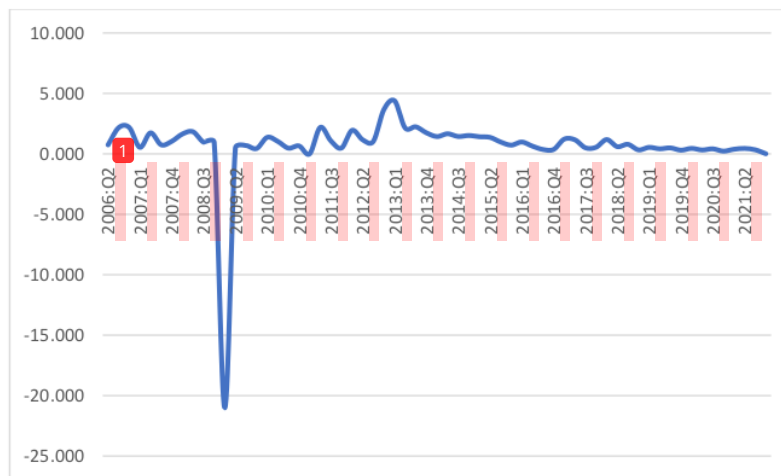
Fig 1. Growth of Price of Residential Property

The literature that links the monetary sector and the property sector has been developed by many previous researchers, such as research designed by Bjornland and Jacobsen (2010) using the VAR approach linking monetary and macroeconomic variables with housing prices in Norway, Sweden, and the UK, the results of the study show that housing prices will directly respond Changes in interest rates. Research by Bredin et al. (2011) with the same approach shows that housing prices (using REITs data) react negatively to changes in interest rates. Both studies show that housing prices are sensitive to the monetary sector. With a different approach, such as research by Schatz and Sebastian (2019) using housing price data in the UK and Germany, the VECM approach results in a long-term balance between macroeconomic indicators (consumer price index, government debt, and unemployment rate) on housing prices. Other results show a positive relationship between housing prices, the consumer price index, and government debt. The dynamics of housing prices can also be influenced by other macroeconomic factors, such as research by Lastrapes (2012) using the VAR approach, which shows that in the short term, housing price increases occur due to shocks from the money supply. Studies on the relationship between the monetary and property sectors have been extensively developed. Bjørnland & Jacobsen (2010) employed the VAR approach linking monetary and macroeconomic variables with housing prices in Norway, Sweden, and the UK. The results showed that housing prices would directly respond to interest rate changes. Research by Bredin et al (2007) utilized the same approach and showed that housing prices (using REITs data) respond negatively to interest rate changes. Both analyses reveal that house prices are sensitive to the monetary sector. Similar results also showed by research from Brooks & Tsolacos (1999). The study revealed that inflation and interest rates strongly affected the UK housing market share. Beltratti and Morana's research (2019) estimates that macroeconomic variable shocks influence 40% of the variation in housing prices in G-7 countries. In their study, Adams and Fuss (2010) showed that economic variables such as industrial production, unemployment, and money supply could affect the housing sector. It contrasts with research by Gupta et al. (2010), which states that housing price growth in South Africa responds negatively to monetary influences and housing price responses depend on market segmentation. Another approach developed by Bredin et al. (2017) with Generalized Autoregressive Conditional Heteroskedasticity (GARCH) shows that there is a response from housing prices (REIT) to the volatility of monetary policy uncertainty.

Research Method

The VAR model was developed by conducting impulse response analysis and forecast-error variance decomposition, which was applied to determine the shock of one variable to another. The VAR model was introduced by Sims (1980), which has several similarities to the model where each variable used has a lag value to explain its relationship to other variables. The equation of the VAR model is as follows:

$$y_t = A_0 D_t + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_k y_{t-k} + \varepsilon_t$$

Where is a vector of endogenous variables with; is a vector of the determinant of the equation for a constant, trend, binary variable, etc.; is the parameter matrix with the determinants of the variables; is the parameter matrix at lag l of the vector; is a vector of random components. The VAR model uses data that is portionimonius and lag in the model to reduce the problem of autocorrelation from the components of the residual value equation and makes it possible to obtain the appropriate degree of freedom value (Kilian, Lutkepohl, 2017). To determine the optimum lag length in the model using AIC (Akaike criterion), BIC (Schwartz-Bayesian criterion), and HQC (Hannan-Quinn criterion) (Enders, 1995). $y_t y_t = (y_{1t} \ y_{2t} \ y_{3t} \ \dots . \ y_{nt})^T D_t A_0 A_i y_t \varepsilon_t \varepsilon_t = (\varepsilon_{t1} \ \varepsilon_{t2} \ \varepsilon_{t3} \dots \varepsilon_{tn})^T$.

Table 1. Definition of Variables

| Variables	Description	Source
House Price (LnP)	Residential property price index (2002=100)	Bank Indonesia
GDP (LnGDP)	Gross domestic product using constant prices (2010=100)	Bank Indonesia
Inflation (INF)	Inflation describes price changes	Bank Indonesia
Exchange Rate (LnEXC)	Rupiah exchange rate against the dollar	Bank Indonesia
Money Supply (LnMS)	The money supply in a broad sense	Bank Indonesia
Interest rate (r)	The central bank reference rate	Bank Indonesia

Sims (1980) states that the combined VAR model with the least squares method is a property of a time series with stationary variables. Kilian and Lutkepohl (2017) state that an essential step in building a VAR model is the application of a stationary test, a variable that is not stationary has statistical consequences that can produce spurious regressions. The application of the stationarity test uses the ADF (augmented dickey-fuller), and PP (Philips-perron) approaches. Application of two stationarity tests to compare the results of stationarity with the application of a test that eliminates the problem of heteroscedasticity in the data (PP approach). The stationarity test equation is as follows:

$$\Delta y_t = \alpha_0 + bt + \delta y_{t-1} + \sum_{j=1}^{k} \gamma_j \Delta \gamma_t + \varepsilon_t$$

Where is a constant, is a trend factor, is an operator in the form of first differences. The ADF test can test for existence in a unit root. $\alpha_0 \ b \Delta y_t$

Result and Discussion

In the third quarter of 2006-2008, residential property prices in Indonesia showed an increasing trend, but a global crisis in 2008 worsened economic conditions, including property prices which dropped in the next quarter. There is a unidirectional pattern between the decline in property prices and several macroeconomic indicators, such as GDP, inflation, exchange rates, and interest rates. The GDP cycle showed a contractionary phase in 2008, which was in line with the decline in residential property prices. The impact of the global crisis reduced people's purchasing power, as reflected in the drastically declining inflation rate. In 2006-2008 all variables had positive correlation values, meaning that there was a unidirectional relationship between residential property prices and macroeconomic indicators except for the money supply variable. When there is a negative correlation, it means that a decrease in property prices is followed by an increase in the money supply in a broad sense. The crisis that occurred in 2008 was different from the crisis in 2020. In the 2020 pandemic crisis, property prices decreased but not as steeply as in the 2008 crisis and the adjustment period was faster. It can be seen that in the first quarter of 2021, residential property prices increased. However, there is a reasonably large gap between the increase in property prices and the inflation rate. The 2020 crisis caused inflation to be at its lowest point during the observation period, while the decline in property prices was not as low as in the 2008 crisis. In addition, interest rates decreased in the 2008 and 2020 crises.
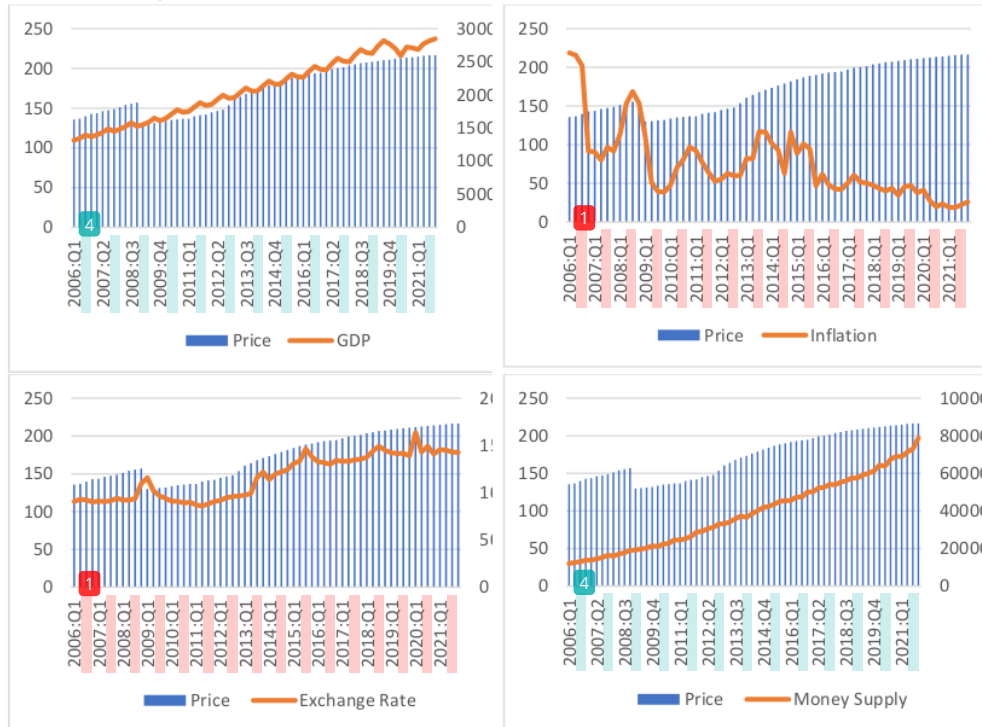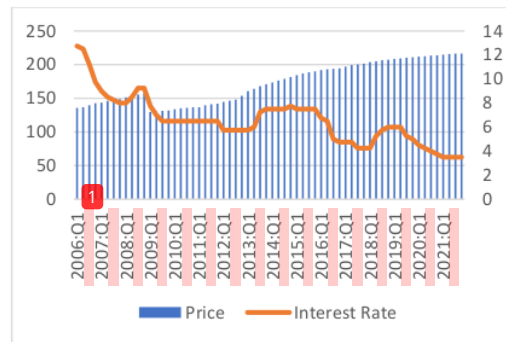
Fig 2. Macroeconomic Indicators and Price of Residential Property

All variables have a mean value more significant than the standard deviation value, indicating that all data on the variables used have high variability. The highest inflation rate reached 15,740, with the lowest at 1,330, while interest rates showed the highest at 12,750 and the lowest at 3.50. All data has skewed to the left, which is based on a negative skewness value, except for inflation and interest rates, which have a positive skewness value. The kurtosis value on the variable used has a positive value and is the highest in the inflation variable and the lowest in the exchange rate variable.

Table 2. Description of Variables

	LnP	LnGDP	INF	lnEXC	LnMS	r
Means	5.136	14,527	5,375	9,345	15,035	6,555
Maximum	5,377	14,861	15,740	9,703	15,879	12,750
Minimum	4,866	14,090	1,330	9,059	13,997	3,500
Std Dev	0.177	0.236	3,281	0.201	0.539	2,000
Skewness	-0.051	-0.245	1,426	-0.018	-0.326	0.860
kurtosis	1,430	1,769	4,982	1,336	1870	4,172
Obs	64	64	64	64	64	64

This study applies the unit root test of Augmented Dickey-Fuller, and Phillips-Perron (PP) approaches to test the presence of non-stationary stochastic in time-series data. The use of PP is also to eliminate the problem of heteroscedasticity in the data. The unit root test applies "trend and intercept" as a unit root test with "trend" and applies "intercept" as a unit root test with "no trend." The ADF test in the form of level I(0) shows that only the interest rate variable rejects H0, and in the PP test, three variables reject H0, namely LnGDP in the form of trend, INF, and r. when the variable is not stationary at I(0) then it is transformed into the first difference form I(1).

Table 3. Stationery Variables

Variables	ADF		pp	
	Trends	No Trends	Trends	No Trends
		Levels		
LnP	-1,621	-0.192	-1,737	-0.253
LnGDP	-2,828	-1,239	-4,443***	-0.369
INF	-2,966	-1,704	-3,911**	-3,362**
lnEXC	-2,685	-1,099	-2,597	-0.897
LnMS	0.603	4,184	0.619	3,883
r	-4,321***	-3,157**	-3,305*	-2,869*
		FirstDifference		
LnP	-7,055***	-7,099***	-7,053***	-7,110***
LnGDP	-1,670	-1,539	-11,549***	-11,650***
INF	-6,551***	-6,634***	-7,116***	-7,077***
lnEXC	-9,746***	-9,827***	-10.053***	-10.142***
LnMS	-11,006***	-9,105***	-11.125***	-9.157***
r	-4,728***	-4,663***	-4,644***	-4,540***

The stability of VAR if the roots lie on the circle. Fig 3 shows the value of the inverse roots characteristic of the AR polynomial located within a circle, which means the VAR system is stable. Based on the VAR stability test, it can be concluded that VAR estimation can be used for impulse response function (IRF) and forecast error variance decomposition (FEVD) analysis is stable and has optimal lag.
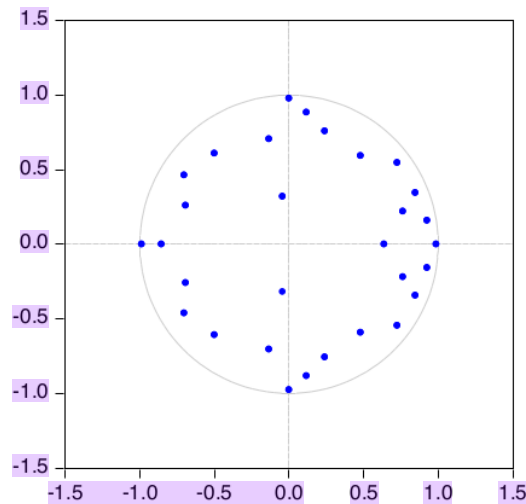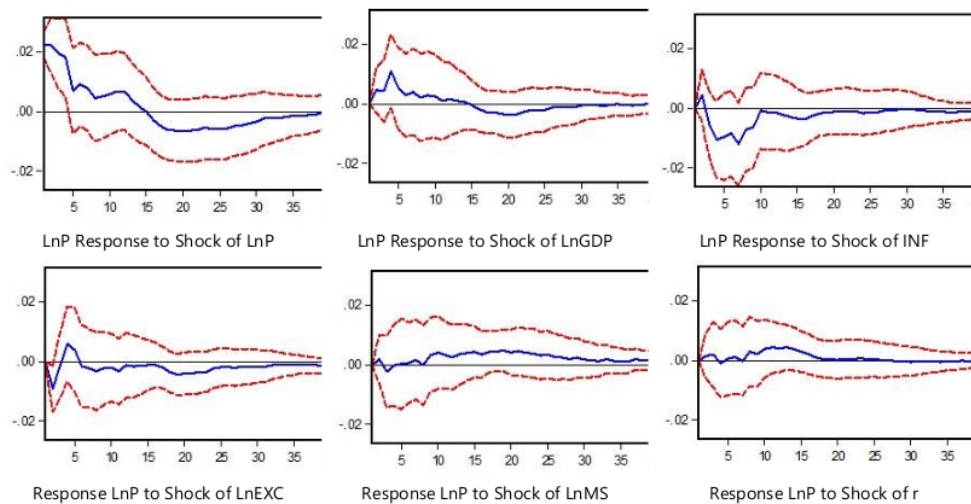
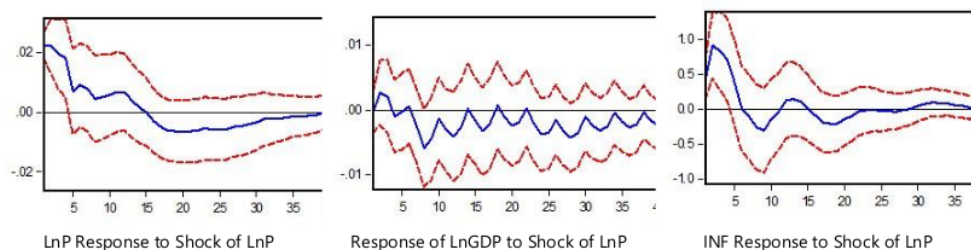### Inverse Roots of AR Characteristic Polynomial

Fig 3. Inverse Roots of AR Characteristic Polynomial

The IRF method describes a variable response to fluctuations in other variables in the VAR system. The horizontal line indicates the standard deviation value of the response function and is used as a balance point. If the response line is above the balance line, it shows a positive response; if it is below the balance line, the response will be negative. The vertical line shows the period used. Fig. 4 explains the response of residential property prices to macroeconomic indicator shocks. The fluctuation in the LnGDP variable will respond positively from period 1 to period 14 and turn into a negative response from period 15 to 35. Terrones and Otrok (2004) in their research, there is a macroeconomic effect on property prices.

The Inflation Targeting Framework (ITF) policy used by the Central Bank has shown its effectiveness in the property sector. It can be seen that a negative response is shown from property prices when there are inflationary shocks. Other monetary policies, such as interest rates and money supply, when there is turmoil in these two variables are responded positively by property prices. The graph of the money supply response is not significant enough for each time horizon, and the same happens with the fluctuation of interest rates to the response of property prices. The downward trend in inflation, which is not followed by interest rates and money supply, contrasts with research developed by Morana (2006). The effectiveness of interest rates and money supply faces challenges in its application to the property sector, and This happens because the pace of the property sector is growing very fast. The property sector responded negatively to exchange rate fluctuations which showed that when the exchange rate depreciated, the factor components of production in the property sector became more expensive, so the property sector experienced a decline. The free-floating exchange rate regime played a role in the response volatility at the beginning and began to stabilize at the next time horizon.
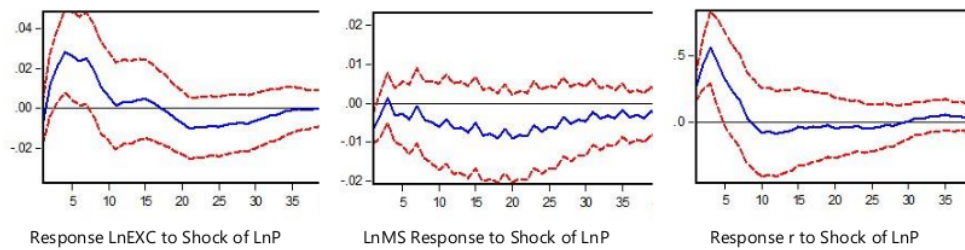
LnP Response to Shock of LnP   LnP Response to Shock of LnGDP   LnP Response to Shock of INF

Response LnP to Shock of LnEXC   Response LnP to Shock of LnMS   Response LnP to Shock of r

Fig 4. Impulse response function (with 95% error bands) for the response of LnP to Shock of Macroeconomic Indicators

Figure 5 shows the response of macroeconomic indicators to residential property price fluctuations. This analysis received more attention due to the 2008 global crisis in the financial sector due to the bubble price in the property sector in the US. GDP and money supply will respond negatively to property price fluctuations, which can lead to a crisis because GDP responds negatively. GDP response fluctuations are more volatile than the property price response to GDP fluctuations, and this is an early warning, especially for the Central Bank to tolerate these fluctuations, which can become more significant. It is in line with research developed by Benati (2021). However, there has been a change in the response pattern of inflation to property price fluctuations. There will be an increase in prices, so inflation will increase. The volatility of the inflation response indicates that property price fluctuations can impact other sectors, which can increase overall inflation. The response of interest rates to fluctuations in housing prices is stronger than the response of housing prices to fluctuations in interest rates. It indicates that the interest rate stimulus is more reactive to changes in housing prices as an accommodation of housing price volatility and a response to prevent price bubbles from occurring in the property sector. The response of interest rates to fluctuations in housing prices is stronger than the response of housing prices to fluctuations in interest rates. It indicates that the interest rate stimulus is more reactive to changes in housing prices as an accommodation of housing price volatility and a response to prevent price bubbles from occurring in the property sector. The response of interest rates to fluctuations in housing prices is stronger than the response of housing prices to fluctuations in interest rates. It indicates that the interest rate stimulus is more reactive to changes in housing prices as an accommodation of housing price volatility and a response to prevent price bubbles from occurring in the property sector.

LnP Response to Shock of LnP   Response of LnGDP to Shock of LnP   INF Response to Shock of LnP

Response LnEXC to Shock of LnP   LnMS Response to Shock of LnP   Response r to Shock of LnP

Fig 5. Response of Macroeconomic Indicators to Shock of LnP

Forecast Error Variance Decomposition is a method used to see how changes in a variable are indicated by changes in error variance that other variables affect. This analysis is used to calculate how big the influence of random shocks from certain variables to endogenous variables. Based on the forecast error results, residential property prices are primarily determined by inflation, GDP, and exchange rates. In the shortest time horizon (5th), inflation has a variability in property prices of 1-10%, with an average time of 4,531%.

	Dynamic Horizons	LnP	LnGDP	INF	lnEXC	LnMS	r
	5th	86057	4,005	4,531	4,817	0.330	0.258
	10th	68,654	7,777	16,860	5,341	0.682	0.686
Average Forecast	20th	63,194	7,396	17,202	5,574	3,424	3,210
	30 yrs	60,275	7,725	15.157	6,881	6,789	3.173
	40 yrs	60,147	7,545	14,612	7.158	7,498	3038

In the medium time, horizon (20th), GDP has variability in property prices ranging from 7% with an average of 7,396%, while in the long time horizon (40 years), the variability of the exchange rate on property prices ranges from 7-7.10% with an average of 7.158%. In addition, money supply and interest rate variables cannot be ignored because they have a co-movement toward residential housing prices in Indonesia. Regarding forecast error, it shows that macroeconomic indicators and low-interest rate policies drive housing prices. It is in line with research developed by Jarocinski and Smets (2008), which states that housing price expectations are supported by anti-deflationary policies (low-interest rates) in the long run.

Conclusion

Using data for the 2006-2021 quarter and applying the VAR model, this research aims to investigate the relationship between residential property prices and macroeconomic indicators in Indonesia. Several research findings are based on the results of the impulse response, indicating that the fluctuation in GDP response is more volatile than the property price response to GDP fluctuations. Inflation is vital because it has a large variability compared to other macroeconomic indicators based on forecast error results and other findings. The volatility of the inflation response indicates that property price fluctuations can impact other sectors, which can increase overall inflation. Monetary policy such as interest rates has a more robust response to housing price fluctuations than housing price responses to interest rate fluctuations. It indicates that the interest rate stimulus is more reactive to changes in housing prices as an accommodation of housing price volatility and a response to prevent price bubbles from occurring in the property sector.

There is still debate regarding the relationship between macroeconomic indicators and residential property prices regarding the relationship between variables and the nature of the relationship, whether it occurs directly or indirectly. The VAR model tries to bridge the second point and results that three macroeconomic indicators have variability in property prices, namely GDP, inflation, and

exchange rates based on forecast error results. In terms of forecast error, it shows that housing prices are driven not only by macroeconomic indicators but also by low-interest rate policies; this is in line with research developed by Jarocinski and Smets (2008), which states that housing price expectations are supported by anti-deflationary policies (low-interest rates) in the long run.

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