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A time-varying of property residential price in Indonesia: a VAR approach

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Abstract: The crisis of 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 research aims to analyze macroeconomic variables that can affect asset prices in Indonesia and how the inflation-targeting framework directly affects asset prices. This study contributes to the current research, such as the early warning system for the asset sector that the crisis of 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 strengthening of fiscal and monetary policy can soften the volatility of asset prices.
Keywords: Asset Price; Inflation Targeting Framework; Fiscal Policy; Monetary Policy
JEL Classification: E4; G1; H4

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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 deviate significantly 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. Nurpita and Oktavia (2021) argue that the property sector in Indonesia has an essential role in driving the national economy.

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, affecting the stability of the financial system.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. (2005), Vargas-Silva (2008), and Iacoviello and Neri (2010).

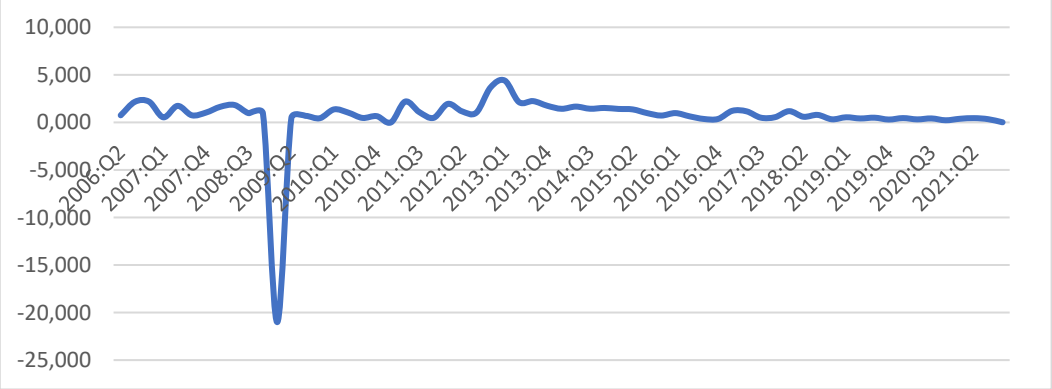


Figure 1 Growth of Price of Residential Property

The literature that links the monetary sector and the property sector has been developed by many previous researchers, such as research designed by Bjørnland 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 Schätz 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 (2002) 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 and 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 and Tsolacos (1999). The study revealed that inflation and interest rates strongly affected the UK housing market share. Beltratti and Morana's research (2010) estimates that macroeconomic variable shocks influence 40% of the variation in housing prices in G-7 countries. In their study, Adams and Füss (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. (2007) with Generalized Autoregressive Conditional Heteroskedasticity (GARCH) shows that there is a response from housing prices (REIT) to the volatility of monetary policy uncertainty.

This study related to Umar et al. (2019) explained that the direct effect of the monetary policy transmission mechanism on property prices is the income effect. When interest rates rise, the interest expense of any unpaid loan or new loan application will increase. Thus, disposable income will decrease. The fall in discretionary income can affect the level of consumption. The impact on the level of consumption is contingent on the movement of interest rates, followed by the tightening of monetary policy. The faster changes in interest rates will affect household disposable income. A study by Elbourne (2008) utilized the SVAR approach. The result indicated a simulation of an impulse response of around a 12-15% decrease in consumption following monetary policy shocks through changes in property prices. The research results do not support evidence that credit channels and the wealth of monetary policy transmission play an important role in the variation in output in response to monetary policy changes.

To bridge the gap between all previous studies, this study developed the interrelation between macroeconomic variables and property prices in Indonesia and analyzed the shock of property prices to macroeconomic conditions and vice versa. The contribution of this study to the literature by using time series data and applying VAR approach can analyze the shock-related problems on macroeconomic variables and property price and vice versa, then analyze the structural interrelation between macroeconomic variables, property prices, and VAR model has better empirical appropriateness on a macroeconomic model.

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. According to Khan and Ahmed (2011), SVAR model has better empirical appropriateness on macroeconomic models that enable structural shock identification based on economy theory. Chuku et al. (2011) stated that SVAR allows the examination of unpredictable effects on one or more variables in a system/model. 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 I 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 & Lütkepohl, 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).

$$y_t y_t = (y_{1t}\ y_{2t}\ y_{3t}\ \ldots . y_{nt})^T D_t A_0 A_i y_t \varepsilon_t \varepsilon_t = (\varepsilon_{t1}\ \varepsilon_{t2}\ \varepsilon_{t3}\ \ldots \varepsilon_{tn})^T.$$

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. Therefore, Kilian and Lütkepohl (2017) state that the application of a stationary test is a crucial stage in developing a VAR model. A variable that is not stationary has statistical consequences that can lead to 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.

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. A unidirectional pattern exists 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

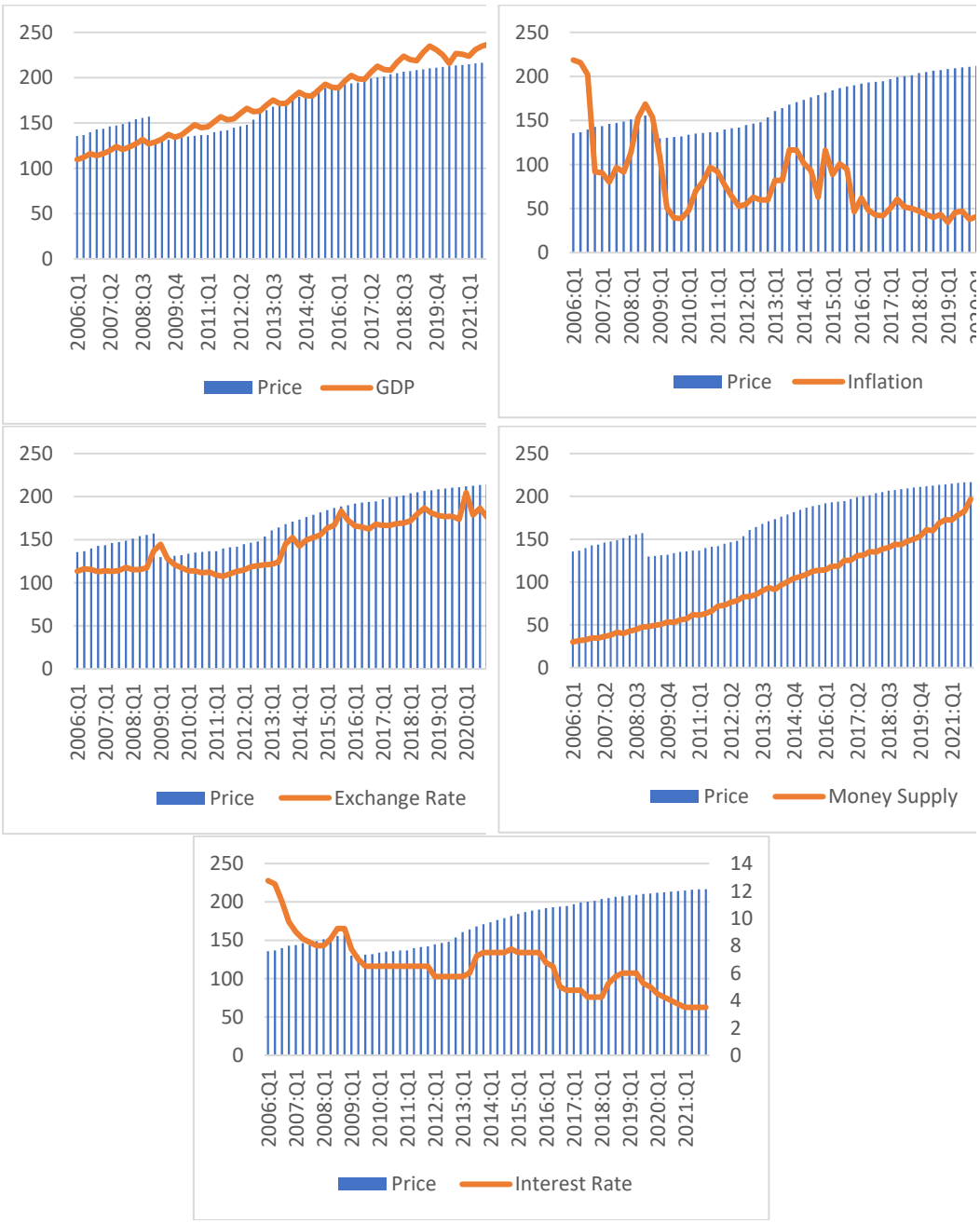


Figure 2 Macroeconomic Indicators and Price of Residential Property

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. A negative correlation between property prices and the money supply indicates that a decrease in property prices is followed by an increase in the money supply in a broad sense. The 2008 financial crisis was distinct from the 2020 financial crisis. In the pandemic crisis of 2020, property prices decreased, but not as drastically as in 2008, and the adjustment period was shorter. The first quarter of 2021 witnessed an increase in residential property prices . However, a reasonably large gap exists 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.

Table 2 shows that 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

Table 3 shows the result of unit root test. 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), it is transformed into the first difference form I(1).

Table 3 Stationery Variables

Variables	ADF		pp	
	Trends	**No Trends**	**Trends**	**No Trends**
LnP		Levels		
	-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*
LnP		FirstDifference		
	-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. Figure 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.

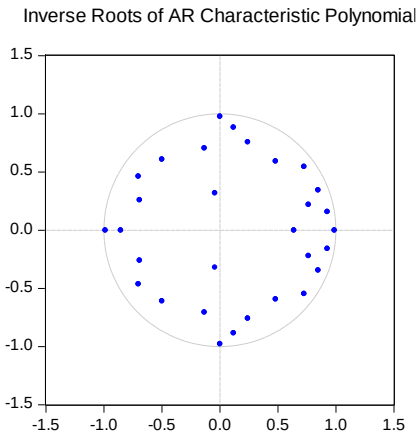


Figure 3 Inverse Roots of AR Characteristic Polynomial

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. Figure 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. Otrok and Terrones (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. When there is turmoil in these two variables, other monetary policies, such as interest rates and money supply, 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 initial response volatility and began to stabilize at the next time horizon.

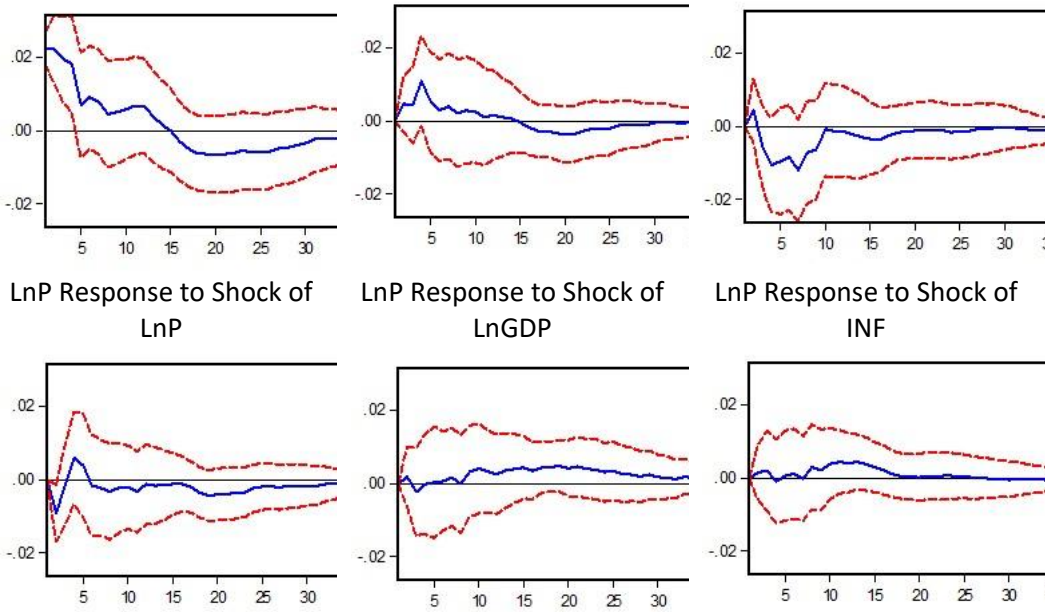
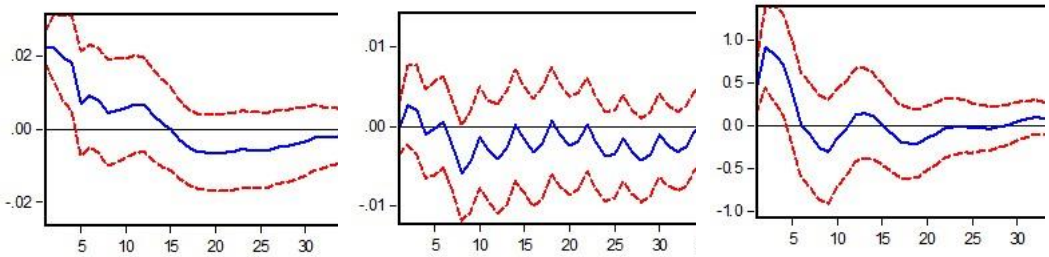


Figure 4 Impulse response function (with 95% error bands) for the response of LnP to Shock of Macroeconomic Indicators

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

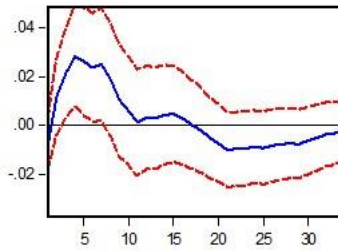
in line with research developed by Benati (2021). However, there has been a change in the response pattern of inflation to property price fluctuations. There will be an increase in prices so that inflation will increase. The volatility of the inflation response indicates that property price fluctuations 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 responsive to changes in housing prices as an accommodation for housing price volatility and a response to prevent property market price rises.



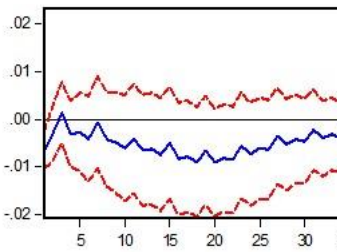
LnP Response to Shock of LnP

Response of LnGDP to Shock of LnP

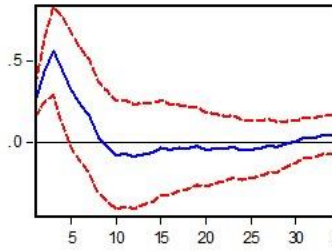
INF Response to Shock of LnP



Response LnEXC to Shock of LnP



LnMS Response to Shock of LnP



Response r to Shock of LnP

Figure 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. Table 4 explains that inflation, GDP, and exchange rates primarily determine residential property prices. In the shortest time horizon (5th), inflation has a variability in property prices of 1-10%, with an average time of 4,531%.

Table 4 Variance Decomposition

	Dynamic Horizons	LnP	LnGDP	INF	lnEXC	LnMS	r
Average Forecast	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
	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, 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. On the basis of the results of the impulse response, a number of research findings indicate that the fluctuation in GDP response is more volatile than the property price response to GDP fluctuations. Inflation is crucial due to its high variability relative to other macroeconomic indicators, as indicated by 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 responsive to changes in housing prices as an accommodation for housing price volatility and a response to prevent property market price rises.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. The limitation of this study was not to conduct the business cycle variable to capture the volatility of output on property price in Indonesia.

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