“The VECM implementation for measuring the impact of monetary variables on Indonesia Property Prices Index”

AUTHORS	Rifki Khoirudin Pramono Hari Adi Suharno

ARTICLE INFO	Rifki Khoirudin, Pramono Hari Adi and Suharno (2024). The VECM implementation for measuring the impact of monetary variables on Indonesia Property Prices Index. *Investment Management and Financial Innovations*, *21*(4), 79-89. doi:10.21511/imfi.21(4).2024.07
DOI	http://dx.doi.org/10.21511/imfi.21(4).2024.07
RELEASED ON	Tuesday, 08 October 2024
RECEIVED ON	Wednesday, 19 June 2024
ACCEPTED ON	Monday, 16 September 2024

JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
45	0	4

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Rifki Khoirudin (Indonesia), **Pramono Hari Adi** (Indonesia), **Suharno** (Indonesia)

THE VECM IMPLEMENTATION FOR MEASURING THE IMPACT OF MONETARY VARIABLES ON INDONESIA PROPERTY PRICES INDEX

Abstract

The basic human need for housing makes property investment safer than other sectors because demand tends to be stable despite changing economic conditions. The decision to invest is influenced by various aspects, including economic variables, including GDP, property credit growth, non-performing loans (NPLs), interest rates, exchange rates, and money supply, which are then examined for their influence on the Residential Property Price Index (RPPI) in Indonesia through this research using a Vector Error Correction Model (VECM) with quarterly data from 2003 to 2022. The findings show that GDP, interest rates, and money supply have a significant long-term impact on the RPPI. In the short-term, GDP and property credit growth have a negative impact on RPPI, while NPL and exchange rate do not. Causality tests indicate a bidirectional relationship between NPL and GDP with RPPI, with probability values exceeding 0.05. This study provides valuable insights into the monetary factors affecting residential property prices and suggestions for future research.

Keywords monetary policy, property market dynamics, economic indicators, Price Index Analysis

JEL Classification R21, E44, E52, G21

Received on: 19th of June, 2024
Accepted on: 16th of September, 2024
Published on: 8th of October, 2024

Rifki Khoirudin, S.E., M.Ec. Dev., Faculty of Economics and Business, Universitas Jenderal Soedirman, [Jenderal Soedirman University], Indonesia; Faculty of Economics and Business, Universitas Ahmad Dahlan [Ahmad Dahlan University], Indonesia. (Corresponding author)

Pramono Hari Adi, M.S., Dr., Prof. Faculty of Economics and Business, Universitas Jenderal Soedirman [Jenderal Soedirman University], Indonesia.

Suharno, S.E., M.Si., Dr. Prof. Faculty of Economics and Business, Universitas Jenderal Soedirman, [Jenderal Soedirman University], Indonesia.

Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

The primary physiological need for self-actualization can be fulfilled by owning residential property, according to Maslow's hierarchy. Individuals' satisfaction with purchasing property is significantly influenced by economic factors, such as income levels and consumer credit (Liu & Li, 2018). The property sector consistently offers excellent investment opportunities, is considered safe compared to other sectors, and is an essential asset for households with promising returns (Krulický & Horák, 2019). House price fluctuations impact economic dynamics and consumer spending, underscoring its essential role in investment portfolios (Anundsen et al., 2016).

Understanding the impact of economic crises on financial systems is crucial for evaluating the effectiveness of regulatory measures. Historical events, such as the 2008 global financial crisis, reveal the interplay between policy decisions and market stability. The crisis, triggered by the subprime mortgage crisis, triggered an economic downturn exacerbated by the Federal Reserve's interest rate policy (Lin et al., 2019). In Asia, resilience to crises is supported by strict regulations, such as macroprudential policies adopted after the 1997–1998 crisis to control credit and property prices (Lee et al., 2015). Indonesia, which

has implemented inflation targeting since 2005, regulates the regional property market through the RPPI, which reflects market cycles (Bank Indonesia, 2023).

The research aims to address the scientific problem of understanding how various economic factors supply Residential Property Prices Index.

1. LITERATURE REVIEW

Residential property is used for living, usually owned individually or collectively, such as a house, apartment, or condominium. Residential property price refers to the monetary value assigned to the property unit. As a relatively expensive necessity, house prices tend to keep increasing. Consumers who need a house often have to buy immediately without waiting for their savings to be sufficient for a cash purchase. Residential property is part of the real estate industry and has a significant role and characteristics, so changes in this sector can impact macroeconomic stability (Qian et al., 2015). According to Rahadi et al. (2022), one of the critical factors in property development is the property price, which affects the developer's profit margin and the reason for property selection. This literature emphasizes the importance of determining residential property prices in a given period and their economic impact.

Macroeconomic dynamics involve the interaction of various indicators that contribute to national economic performance. The housing market significantly influences macroeconomic stability and growth, as noted by Lekhuleni and Ndlovu (2023) who highlight how real estate boom and bust cycles can increase financial system vulnerabilities and affect global house prices. This underscores the critical role of macroeconomic indicators in real estate price dynamics. The relationship between the supply-demand dynamics of the housing market and GDP is clear. This is in line with Adams and Füss (2010) who state that real estate changes can impact GDP directly and indirectly. Direct effects include increased income in real estate boosting GDP, faster capital flows encouraging investment, and higher downstream income from related industries. Indirect effects involve GDP growth from substantial bank credit for real estate development, increased government tax revenue, and increased aggregate demand through asset price inflation and wealth effects.

Comprehending the factors that influence house prices is essential in housing market analysis. Various studies mention that macroeconomic variables significantly influence house prices, such as Cró and Martins (2023) who investigated the effect of macroeconomic indicators on countries that depended on the tourism sector from 2000 to 2018 using VECM. The results showed that tourism activity affects economic growth. The development of the economy encourages tourists to stay and ultimately affects house prices. Lekhuleni and Ndlovu (2023) applied the VECM. They found that all fundamental macroeconomic variables have a significant connection with house prices in the short and long term. Thus, the combination and balance between fiscal and monetary policies are necessary to ensure the housing market's growth.

The relationship between the banking sector and the housing market is an essential economic area that has received attention from various studies. Other studies have explored the relationship between the banking sector and residential property prices, such as Bhatt and Kishor (2022) and Panagiotidis and Printzis (2016). These studies identified the relationship between mortgage loans in the Greek economy and 18 other developed countries. In the Greek economy, mortgage credit is the most critical variable for housing in the long term. Meanwhile, in 18 developed countries from 1991-2020, it was found that the banking sector had a surge effect on house price growth in some quarters, moreover, the presence of credit as the main driver caused a boom in the housing market. Likewise, Cleanthous et al. (2019) used a VECM model to analyze the macroeconomic and house price relationship in Cyprus in the 2005Q4-2016Q4 quarters. Overall, the results showed a causal relationship between bank lending for housing and significantly affecting the long term.

Furthermore, residential properties are usually more affordable for international buyers when the domestic exchange rate strengthens against other

http://dx.doi.org/10.21511/imfi.21(4).2024.07

countries' currencies. Previous periods of weakening exchange rates can raise property prices and boost supply and demand levels in the property market. Akkay (2021) said that the appreciation of the US dollar against the Lira significantly affected house prices. As explained by Muddasir and Dondaş (2023), when the exchange rate rises, the loan is more significant, which increases inflation, and the currency depreciates, directly resulting in house prices.

The influence of macroeconomic variables on the housing market varies between countries and can provide valuable insights into the dynamics of real estate investment. The studies in Turkey conducted by Sumer and Özorhon (2020) using the VAR method show that the use of macroeconomic variables such as exchange rates affects investors' perception of housing as a tool of investment. Ya-Chen and Shuai (2013) empirically analyzed short-term house price changes in China from July 2005 to December 2012. The results revealed the existence of a positive correlation between the exchange rate and house prices. Therefore, China currently controls foreign capital to stabilize real estate prices. Meanwhile, in India, Mahalik and Mallick (2011), using quarterly data from 1996Q1 to 2007Q1 with a VECM model, found a dynamic causality relationship affecting house prices in the presence of a shock from macroeconomic variables.

Many researchers have developed literature on the relationship between RPPI and various variables. Previously, Duja and Supriyanto (2019) and Pontines (2020) have used interest rate, inflation, and exchange rate variables to measure their influence on RPPI. Furthermore, Ding (2022) added population, mortgage interest rates, and stock prices to analyze macroeconomic factors affecting house prices. Yan (2019) used monetary policy to predict house price changes, while Mironiuc et al. (2021) combined the financial sector with Environmental, Social, and Governance (ESG) to analyze the price sensitivity of residential property in EU-28 countries. The results found that the economic dimension is vital in determining residential property prices.

Economic factors affecting residential property prices may vary in their influence across contexts. Applying a Tirana-based Vector Error Correction Model (VECM), Marku et al. (2020) analyzed residential property prices using short-term and long-term monetary factors. They revealed that interest rates have a notable effect in the long term, while exchange rates show no long-term impact on house price volatility. Meanwhile, Cró and Martins (2023) observed the importance of Gross Domestic Product (GDP) and bank credit in influencing house prices in tourism-dependent countries in the short and long term. Lekhuleni and Ndlovu (2023) also found a relationship between exchange rates and GDP that transcends the short term and affects house prices in the long term.

The impact of changes in macroeconomic variables on the housing market is complex and varies across countries. Utilizing VECM, Alvan Bozdereli and Rahmatzada (2022) indicated that inflation has a positive long-term effect, while GDP and the exchange rate have been negatively impacted in the long term. Cleanthous et al. (2019) investigated the correlation between loans and housing prices and discovered that loans significantly affect housing prices in the short term. In contrast, Azwan and Masih (2019) outlined an asymmetric (short-term) and symmetric (long-term) connection between bank debt and housing prices. However, the link between housing credit and housing exhibits short- and long-term asymmetry. An increase in housing debt amplifies house price inflation, especially in the short term.

The variations in the way monetary variables affect the housing market can provide important insights into the dynamics of house prices in different countries. Huang (2023) illustrate that the effect of money supply on house prices in China operates unidirectionally, suggesting that money supply positively affects house prices, while house prices do not affect money supply. In contrast, Bahmani-Oskooee et al. (2023) observed a symmetric relation where, in the short term, money supply affects house prices; nevertheless, in the long term, money supply negatively affects house prices. Furthermore, asymmetrically, there is a long-term relationship between money supply and house prices. Feng (2022) corroborates that money supply maintains a long-term correlation with real estate prices.

In the housing market analysis, NPLs are an essential monetary factor affecting real estate prices. Ben Salem et al. (2020) noted that NPLs are

affected by interest rates and money supply, indicating that NPLs have surged due to more outstanding household lending, especially in the real estate sector. Consequently, the real estate price index shows a positive correlation with NPLs. Furthermore, Wan (2018) and Dong and Xia (2018) reinforce these findings by underlining the positive impact of NPLs on house prices. A decline in housing prices leads to a reduction in bank assets, which signifies a deterioration in the balance sheet of housing developments and impacts repayment capacity. Besides, a decrease in house prices leads to the devaluation of housing collateral.

It is crucial in housing market studies to consider how various monetary factors affect property prices. For example, NPLs and their relationship with house prices have been the focus of significant research, with many studies highlighting their impact on banking stability and economic health. NPLs and their correlation with house prices are studied by Ben Salem et al. (2020) and Wan (2018), highlighting implications for banking stability and economic health. Variations in the impact of economic growth on real estate prices across studies and countries were explored by Beltratti and Morana (2010), Bouchouicha and Ftiti (2012), and Gholipour et al. (2021), indicating diverse analytical approaches and contextual factors.

The diversity of findings in the literature on the effect of economic growth on property prices indicates the importance of identifying the gap in this field. This study's research gap differs from previous research, namely Bouchouicha and Ftiti (2012), which states that there is neither a solid short-term nor long-term effect/correlation between economic growth and real estate prices. On the other hand, Beltratti and Morana (2010) state that GDP strongly influences market prices and property stock prices. Gholipour et al. (2021) found no solid short-term or long-term correlation between economic growth and real estate prices. Meanwhile, there are further differences in models or analytical tools among previous studies and macroeconomic conditions across studies due to research locations in different countries.

Various studies have explored the relationship between macroeconomics and house prices. Findings suggest a significant correlation, with macroeconomic indicators positively impacting house prices. Besides, the research highlights the interrelationship between macroeconomic parameters and housing prices in the short and long term. The research enhances understanding of how macroeconomic dynamics interact with house prices, specifically focusing on the Indonesian context. This research uses the VECM technique to analyze the effect of monetary variables on residential property prices in Indonesia, which provides insights into the short- and long-term dynamics. The study aims to investigate the relationship between macroeconomic indicators and residential property prices in Indonesia. Thus, to achieve the objective of this research and to empirically examine it, the following hypotheses are developed:

H1: There is a significant positive relationship between Gross Domestic Product and Indonesia's Residential Property Price Index.

H2: There is a significant positive relationship between Property Credit Growth and Indonesia's Residential Property Price Index.

H3: There is a significant negative relationship between Non-Performing Loan and Indonesia's Residential Property Price Index.

H4: There is a significant negative relationship between Interest Rate and Indonesia's Residential Property Price Index.

H5: There is a significant positive relationship between the increase in Exchange Rate and Indonesia's Residential Property Price Index.

H6: There is a significant positive relationship between the increase in Money Supply and Indonesia's Residential Property Price Index.

2. METHODOLOGY

Data were collected from the national statistical agencies (Badan Pusat Statistik or BPS) and Bank Indonesia (the Indonesia Central Bank) to investigate the correlation between macroeconomic parameters and house prices in Indonesia over the quarterly period from 2003Q1 to 2022Q4. Besides, this research's paramount concern is the relationship between the dynamics of macroeconomic in-

http://dx.doi.org/10.21511/imfi.21(4).2024.07

dicators (GDP, property credit growth, NPL, interest rate, exchange rate, and money supply) and house prices as the dependent variable. House prices in this research use residential property prices index because they have a broader scope than property in the form of houses.

Highlighting the relationship between macroeconomic dynamics and residential property prices in Indonesia, VECM is used to test the relationship between the research variables following some previous studies (Cleanthous et al., 2019; Lekhuleni & Ndlovu, 2023). To accurately estimate the relationship between variables, it is necessary to determine the existence of unit roots and cointegration between time series. This aims to assist in implementing the VECM method by assuming that all variables are endogenous.

In the first stage, the Augmented Dickey-Fuller (ADF) test is used to test the unit root of each series with the hypothesis when:

H0: *θ = 0 i.e., the time series are non-stationary and need differencing (have unit roots).*

Hα: *θ < 0 i.e., the time series is stationary (does not have a unit root).*

The ADF test can be expressed by the Ordinary Least Squares (OLS) relationship as follows:

$$\Delta y_t = \alpha_0 + \beta_t + \theta y_{t-1} + \sum\nolimits_{i=1}^{p} \delta_i \Delta y_{t-i} + \varepsilon_t, \qquad (1)$$

where *t* denotes the deterministic trend, α and β are constants, and *p* is the lag order chosen based on Akaike information criteria (AIC) and Schwartz information criteria (SC). If the calculated value, in absolute terms, is more than the *t*-statistic or the *p*-value is less than 5%, then reject the null hypothesis and conclude that the time series is stationary. If the null hypothesis is rejected at level, then the non-stationary time series order is set as I(0). Meanwhile, if the null hypothesis is rejected at the first difference, the order of the stationary series is set as I(1). This also applies to the second difference, where the stationary sequence order is designated as I(2).

If the time series is not stationary at the level and when integrated in the same order, then the Johansen cointegration test can be used to obtain the sum of the cointegrating vectors. The multivariate cointegration model can be expressed as follows:

$$\Delta y_t = \alpha_0 + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t, \qquad (2)$$

where Π and Γ_i are coefficient matrices, Δ is the symbol of difference, and *p* is the lag order chosen based on Akaike Information Criteria (AIC). Then, the ratio test can be used to determine the number of cointegrating vectors using the Trace test and the Maximum Eigenvalue test, which can each be calculated as follows:

$$\mathrm{T}(r) = -\mathrm{T} \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right), \qquad (3)$$

$$\lambda_{\max}(r, r+1) = -\mathrm{T} \ln\left(1 - \hat{\lambda}_{r+1}\right), \qquad (4)$$

where $\hat{\lambda}_i$ is the expected eigenvalue of the characteristic roots, and T is the sample size. The null hypothesis of the Trace test (equation 3) investigates the number of r cointegrating vectors against alternative n cointegrating vectors. The null hypothesis of the Maximum Eigentest (equation 4) investigates the nuer of *r* cointegrating vectors against the alternative *r* + 1 cointegrating vectors. Therefore, if the variables used are cointegrated after applying the Johansen test, it can be concluded that there is a long-term equilibrium relationship between the variables.

Furthermore, it can be stated that the existence of an equilibrium relationship can apply to the VECM scheme in the long term. The methods used in this research have provided tremendous benefits, especially in helping to analyze causality and relationships in the short and long term. Therefore, this research will use the VECM in the form of:

$$\Delta(RHPI) = \beta_0 + \sum_{i=1}^{n-1} \partial_{11} \Delta\left(RHPI_{t-i}\right) + \sum_{i=1}^{n-1} \partial_{12} \Delta(X_{t-i}) + \alpha_0 + \varepsilon_t, \qquad (5)$$

whereby *RHPI* stands for housing wealth; *X* is the explanatory variable factor, β_0, ∂_{11}, ∂_{12}, α_0 are its estimated parameters, and εt is the random error term. Furthermore, all variables are in their origi-

nal form, or there is no logarithmic form. The applied modeling has several limitations, such as difficulty in determining the optimally chosen lag. A trade-off exists between increased forecast uncertainty and enhanced accuracy of the model from the addition of lags. Therefore, it is necessary to rely on the information criterion test in determining the appropriate lag to use. It should be noted that different information criteria may yield different results. This model is market-focused, not hedonic price variables such as property characteristics.

3. RESULTS

Stationarity testing uses the Augmented Dickey-Fuller unit root test. This test aims to test the data's potential stationarity at the first level and to check whether the data used in this research is integrated at the first level. The results shown in Table 1 indicate that the ADF test does not reject the null hypothesis or is not stationary in level form, especially for the money supply variable because it has a value of 1. Then, the test is continued at the first differencing level, showing that it still needs to meet the stationary requirements on the same variable. Therefore, it is continued at the second differencing with the results showing that all variables used have a probability value of less than 0.05. Therefore, all variables are stationary at the second difference without unit root and have the same integration order of I(2).

Based on the ADF test, the data fulfills the stationarity requirement at the second degree and the variables used are integrated in the same order. Therefore, the cointegration test is used to determine the long-term equilibrium relationship between these variables. Thus, this research uses infinite post-VAR estimation to test the lag order. This uses Akaike Information Criteria (AIC) and Schwartz information criteria (SC). AIC shows the maximum lag length of 2 with a value of 63.95613, and SC shows a value of 67.52802. This research uses the practical principle of choosing the lower value criterion. The latter is based on the fact that the lower the value, the smaller the residual relation, and the more stable and better the model. Therefore, Table 2 shows that lag two is used.

The existence of cointegration vectors between the variables used indicates the existence of short-term and long-term equilibrium relationships. Based on the cointegration test results shown in Table 3, the p-value statistics for VECM in bovariate and multivariate mode with lag order 2. Besides, Table 3 shows seven integration relationships exist between variables. This formed the basis for building a VECM model for the long term. Furthermore, the causality test results explain that of the seven integration relationships, only the NPL and GDP variables have a two-way causality relationship with a probability value of 0.0510. The rest, the unidirectional causality relationship, is only owned by the variables of RPPI to property credit growth, GDP to property credit growth, GDP to money supply, property credit growth to NPL, and exchange rate to money supply. A causal relationship is absent because the statistical results show a probability value of less than 0.05.

Table 1. Results of the augmented Dickey-Fuller unit root test for stationarity

Variable	Levels (prob.)	1st differences (prob.)	2nd differences (prob.)
RPPI	0.8759	0.0008	0.0001
GDP	0.9784	0.0043	0.0004
Growth_Property Credit	0.0000	0.0000	0.0000
NPL	0.0046	0.0000	0.0000
Interest	0.4571	0.0007	0.0000
Exchange Rate	0.9521	0.0000	0.0000
Money Supply	1.0000	0.6652	0.0001

Table 2. Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	–2128.262	NA	6.48e+20	67.78610	68.02423	67.87976
1	–2019.326	190.2056	9.76e+19	65.88338	67.78839	66.63263
2	–1909.618	167.1744*	1.50e+19*	63.95613*	67.52802*	65.36098*

Note: Likehood Ratio (LR); Final Prediction Error (FPE); Akaike Information Criteria (AIC); Schwartz information Criteria (SC); Hannan Quinnon (HQ).

http://dx.doi.org/10.21511/imfi.21(4).2024.07

Table 3. Granger causality test results

Null hypothesis:	F-statistic	Prob.
RPPI does not effect Property credit growth	7.35029	0.0013
GDP does not efffect Property credit growth	5.00769	0.0093
NPL does not effect GDP	6.43777	0.0510
GDP does not effect NPL	8.55399	0.0005
GDP does not effect Money Supply	7.02867	0.0017
Property credit growth does not effect NPL	3.12662	0.0500
Exchange Rate does not effect Money Supply	5.56755	0.0061

Table 4. VECM test result on RPPI

Variable	Short-term relationship	Long-term relationship
GDP	–2.57083	54.2581
Growth_Property credit	–2.43902	–0.37073
NPL	0.21415	0.88434
Interest Rate	–0.28379	2.32254
Exchange Rate	–0.52509	1.40900
Money Supply	0.62010	2.69401

The short-term and long-term relationships are presented in Table 4, which shows the relationship dynamics between macroeconomic fundamentals and house prices. Referring to the hypothesis that has been formulated, the statistical results show the acceptance of the null hypothesis on several variables used. The research observes that NPLs, interest rates, and exchange rates are not statistically significant in the short term, while housing credit growth and NPLs are the variables that are not statistically significant in the long term. Meanwhile, other short- and long-term variables significantly affect house prices. For example, there is a statistically significant and negative relationship between house prices and GDP in the short term, where an IDR 1 increase in GDP is associated with a 2.57 percent decrease in house prices ceteris paribus. This result is consistent with the research of Belke and Keil (2018) who found that the negative and significant relationship between GDP and house prices in Germany is due to both supply-side and demand-side factors. Besides, Xu and Tang (2014) conducted a study in the UK in the period 1971Q1 to 2012Q4 with the result that high construction output will make the price of raw materials for making residential property cheaper, thus allowing a decrease in house prices.

Furthermore, property credit growth in both the short and long term has a negative relationship but is significant in the short term at the 5% level. This concludes the acceptance of the null hypothesis and confirms the absence of a unidirectional short-term and long-term relationship. In contrast to the property loan growth relationship, the exchange rate and interest rate are significant in the long term and have a negative and insignificant effect in the short term at the 5% significance level. This indicates that there is no unidirectional relationship or accepts the null hypothesis.

The NPL variable, both in the short term and long term, does not have a unidirectional and insignificant relationship with RPPI. This means that the variable has a unidirectional relationship with a positive but insignificant effect, so it is statistically unable to explain its effect on RPPI. Finally, the money supply variable shows that, in both the short and long term, it positively influences the RPPI. At a 5% significance level, the relationship in the short term is not significant in influencing RPPI, but in the long term, it is interconnected. Therefore, the money supply variable has no unidirectional relationship with RPPI.

4. DISCUSSION

This research shows that GDP has a significant positive effect on property prices in both the short and long term. This is in line with research by Beltratti and Morana (2010), which states that international house price fluctuations can be partly explained by local and global GDP components. This research further notes that the relationship between house prices and macroeconomic devel-

opments is bidirectional. This means that changes in property prices can affect economic growth (GDP), and conversely, better economic conditions can encourage property prices to rise.

Property credit growth has both a statistically significant and negative impact in the short term, where a 1 percent increase in property credit is associated with a 2.439 percent decrease in house prices. However, property credit growth does not affect long-term house prices. Along with the results in the short term, Tai (2016) conducted a study in the United States between 2002 and 2006 on households and individuals with a history of borrowing bank loans for housing. The results show a statistically significant and negative relationship. Shiller (2019) emphasized that the effect of property credit on house prices in the short and long term can be influenced by various economic factors. In general, in the short term, easier availability of property credit tends to increase demand for housing, pushing prices up. However, in the long term, the effect of property credit on house prices can be more complex and not always as straightforward as in the short term. These results are supported by Setianto (2017) who said that the banking system and regulations have been reformed to become more robust and more stable. One of the policies issued to control credit is to limit the loan-to-value (LTV) ratio. They strengthened and eased LTV policies based on property market conditions.

The relationship between NPL and RPPI in the short and long term is not significant, but it is positive, with values of 0.214 and 0.884, respectively. Aligned with these results, Pan and Wang (2013) conducted research in US metropolitan areas during the period 1990Q1 to 2010Q4 with the results obtained that there are changes in residential property prices on NPLs. However, changes in real estate, which can be detrimental to banks, eventually lead to changes in real estate due to bank lending, creating a property bubble (Hott, 2011). Increased bank lending plays an important role in rising property prices, as Che et al. (2011) who conducted the research in China found that people in Beijing, Shanghai, and Shenzhen pay close attention to the dynamic process of property prices and pay more attention to NPLs when buying a house. When the housing market goes into recession, bank stability weakens, and NPLs increase, so bank profits come from the rapid increase in real estate investment (Zhang et al., 2018). In Indonesia, the relationship between property prices and Non-Performing Loans (NPL) may not always be clear due to several specific factors that influence these two variables. Banking policies and regulations in Indonesia can affect NPL levels differently from property price fluctuations. For example, debt restructuring or special credit policies can reduce NPLs without significantly affecting property prices.

Interest rates are statistically insignificant to RPPI in the short term, but the relationship is significant and positive in the long term. A 1 percent increase in interest rates has an effect of 2.32 percent on the increase in RPPI. The existence of a long-term relationship between interest rates and RPPI indicates that interest rates increase the calculation of total production costs due to rising prices or capital costs, thus having an impact on increasing residential property prices. Marku et al. (2020) conducted the research in Albania from 2010 to 2018, stating that the effect is positive in the long term because housing prices have the highest elasticity. The interest rate will make individuals reluctant to borrow, resulting in a decrease in housing demand. Increased lending rates also lead to increased costs for construction companies, which leads to a decrease in the supply of residential real estate. The effect of both together results in the stagnation of the economic situation. Therefore, the interest rate has a faster impact on demand and needs to be more flexible in the short term.

The insignificant long-term and short-term relationship between the exchange rate and RPPI is due to the volatility of the exchange rate against foreign currencies. Similarly, using the VAR method, Sumer and Özorhon (2020) found that the exchange rate is no longer a measure that affects house prices in Turkey. However, as the purchasing power of the public and foreigners has increased, so has the demand for housing.

The researchers have employed various models and methodologies to gain a comprehensive understanding of how monetary factors influence real estate markets. Likewise, Bahmani-Oskooee et al. (2023) used the NARDL model to estimate the asymmetrical money supply effect on US

http://dx.doi.org/10.21511/imfi.21(4).2024.07

state house prices. The research found a positive relationship between money supply and house prices, which occurs when market operations are open, as market participants' expectations differ when money supply increases. An asymmetrical effect of changes in the money supply affects house prices. Meanwhile, Feng (2022) added his findings in China to the VAR model, stating a long-term relationship between money supply and real estate prices due to the practical impact of monetary policy during 2020. Towards improving the quality of analysis in the future, this research should be expanded by including more non-economic variables as independent factors. This would allow for a more comprehensive examination of the various influences on house prices, potentially providing additional insights into house price dynamics.

CONCLUSION

This VECM study examines the influence of macroeconomic indicators on residential property prices in Indonesia. The study shows that GDP, interest rates, and money supply are essential determinants of RPPI in the long term. This is because, in the long term, these indicators significantly influence RPPI. In the short term, GDP, property credit growth, and money supply have a negative relationship with FPI. However, in the long term, property credit growth does not significantly affect RPPI, while in the short term, interest rate does. Meanwhile, NPL and exchange rates have no significant effect in the short and long term. This research underscores the need for combined fiscal and monetary policies to stimulate housing market risk, which will reduce downward pressure; lower interest rates and strategic price incentives can also play an important role in correcting the difficulties of variables during investment. A limitation of the study is that it uses macroeconomic variables as independent variables, which may limit the scope of understanding the complex interactions that affect house prices. Future research should include a wider range of non-economic variables as independent factors to comprehensively analyze their influence on house prices.

AUTHOR CONTRIBUTIONS

Conceptualization: Rifki Khoirudin.
Data curation: Rifki Khoirudin.
Formal analysis: Rifki Khoirudin, Pramono Hari Adi, Suharno.
Investigation: Rifki Khoirudin, Pramono Hari Adi, Suharno.
Methodology: Pramono Hari Adi, Suharno.
Resources: Rifki Khoirudin.
Software: Rifki Khoirudin.
Supervision: Pramono Hari Adi, Suharno.
Validation: Rifki Khoirudin, Pramono Hari Adi, Suharno.
Visualization: Rifki Khoirudin.
Writing – original draft: Rifki Khoirudin.
Writing – review & editing: Pramono Hari Adi, Suharno.

ACKNOWLEDGMENT

The authors gratefully acknowledge Ahmad Dahlan University for the support and facilities provided in conducting this research. They also greatly appreciate the academic resources that supported the data collection process and careful analysis of our findings. Besides, the authors express their gratitude to Bank Indonesia and Badan Pusat Statistik for their invaluable contribution to the data used in this research.

REFERENCES

1. Adams, Z., & Füss, R. (2010). Macroeconomic determinants of international housing markets. *Journal of Housing Economics, 19*(1), 38-50. https://doi.org/10.1016/j.jhe.2009.10.005
2. Akkay, R. C. (2021). The Macroeconomic Determinants of the Housing Prices in Turkey. *Erciyes University Journal of Faculty of Economics and Administrative Sciences, 58,* 241-264. https://doi.org/10.18070/erciyesiibd.801319
3. Alvan Bozdereli, A., & Rahmatzada, Q. (2022). Relationship between residential property prices and macroeconomıc variables in Turkey. *Applied Economics Letters, 31*(8), 743-749. https://doi.org/10.1080/13504851.2022.2146646
4. Anundsen, A. K., Gerdrup, K., Hansen, F., & Kragh-Sorensen, K. (2016). Bubbles and Crises: The Role of House Prices and Credit. *Journal of Applied Econometrics, 31,* 1291-1311. https://doi.org/10.1002/jae.2503
5. Azwan, N. I., & Masih, M. (2019). Is the relationship between housing price and banking debt symmetric or non-symmetric? Evidence from Malaysia based on NARDL. In *Munich Personal RePEc Archive* (Issue 94685).
6. Bahmani-Oskooee, M., Ghodsi, H., Hadzic, M., & Marfatia, H. (2023). Asymmetric relationship between money supply and house prices in states across the U.S. *Applied Economics, 55*(31), 3580-3608. https://doi.org/10.1080/00036846.2022.2116390
7. Bank Indonesia. (2023). *Survei Harga Properti Residensial (Survey of Residential Property Prices).*
8. Belke, A., & Keil, J. (2018). Fundamental Determinants of Real Estate Prices: A Panel Study of German Regions. *International Advances in Economic Research, 24*(1), 25-45. https://doi.org/10.1007/s11294-018-9671-2
9. Beltratti, A., & Morana, C. (2010). International house prices and macroeconomic fluctuations. *Journal of Banking and Finance, 34*(3), 533-545. https://doi.org/10.1016/j.jbankfin.2009.08.020
10. Ben Salem, S., Labidi, M., & Mansour, N. (2020). Empirical evidence on Non-Performing Loans and credit frictions: banking sector in Tunisia. *International Journal of Financial, Accounting, and Management, 2*(3), 171-183. https://doi.org/10.35912/ijfam.v2i3.191
11. Bhatt, V., & Kishor, N. K. (2022). Role of credit and expectations in house price dynamics. *Finance Research Letters, 50,* 103203. https://doi.org/10.1016/j.frl.2022.103203
12. Bouchouicha, R., & Ftiti, Z. (2012). Real estate markets and the macroeconomy: A dynamic coherence framework. *Economic Modelling, 29*(5), 1820-1829. https://doi.org/10.1016/j.econmod.2012.05.034
13. Che, X., Li, B., Guo, K., & Wang, J. (2011). Property prices and bank lending: Some evidence from China's regional financial centres. *Procedia Computer Science, 4,* 1660-1667. https://doi.org/10.1016/j.procs.2011.04.179
14. Cleanthous, L. T., Eracleous, E. C., & Michail, N. A. (2019). Credit, House Prices and the Macroeconomy in Cyprus. *South-Eastern Europe Journal of Economics, 17*(1), 33-55. Retrieved from https://www.asecu.gr/Seeje/issue32/issue32-cleanthous-eracleous-mihail.pdf
15. Cró, S., & Martins, A. M. (2023). Tourism activity affects house price dynamics? Evidence for countries dependent on tourism. *Current Issues in Tourism,* 1-19. https://doi.org/10.1080/13683500.2023.2204398
16. Ding, X. (2022). Macroeconomic Factors Affecting Housing Prices: Take the United States as an Example. *Proceedings of the 2022 7th International Conference on Financial Innovation and Economic Development (ICFIED 2022), 648*(Icfied), 2335-2339. https://doi.org/10.2991/aebmr.k.220307.380
17. Dong, J., & Xia, L. (2018). *China | How resilient is the economy to housing price fall?* (Issue March). Retrieved from https://www.bbvaresearch.com/en/publicaciones/china-how-resilient-is-the-economy-to-housing-price-fall/
18. Duja, B., & Supriyanto, H. (2019). The influence of GDP, interest rate, wage, inflation and exchange rate on residential property price in Indonesia. *Planning Malaysia, 17*(1), 389-400. https://doi.org/10.21837/pmjournal.v17.i9.614
19. Feng, P. (2022). The Correlation between Monetary Policy and Housing Price Change Based on a VAR Model. *Mathematical Problems in Engineering, 2022*(1), 1-8. https://doi.org/10.1155/2022/6917593
20. Gholipour, H. F., Tajaddini, R., Farzanegan, M. R., & Yam, S. (2021). Responses of REITs index and commercial property prices to economic uncertainties: A VAR analysis. *Research in International Business and Finance, 58.* https://doi.org/10.1016/j.ribaf.2021.101457
21. Hott, C. (2011). Lending behavior and real estate prices. *Journal of Banking and Finance, 35*(9), 2429-2442. https://doi.org/10.1016/j.jbankfin.2011.02.001
22. Huang, Y. (2023). An Empirical Study on the Interconnections between Money Supply and Housing Price. *Highlights in Business, Economics and Management, 14,* 1-6. https://doi.org/10.54097/hbem.v14i.8927
23. Krulický, T., & Horák, J. (2019). Real estate as an investment asset. *SHS Web of Conferences, 61,* 1-9. https://doi.org/10.1051/shsconf/20196101011
24. Lee, M., Asuncion, R. C., & Kim, J. (2015). *Effectiveness of Macroprudential Policies in Developing Asia: An Empirical Analysis* (439; Issue 439). Retrieved from https://www.adb.org/sites/default/files/publication/162311/ewp-439.pdf
25. Lekhuleni, T. I., & Ndlovu, G. (2023). The dynamic effect of macroeconomic factors on housing prices: Evidence from

http://dx.doi.org/10.21511/imfi.21(4).2024.07

South Africa. *PLoS ONE, 18,* 1-23. https://doi.org/10.1371/journal.pone.0290552

26. Lin, T. C., Hsu, S. H., & Lin, Y. L. (2019). The effect of housing prices on consumption and economic growth – the case of Taiwan. *Journal of the Asia Pacific Economy, 24*(2), 292-312. https://doi.org/10.1080/13547860.2019.1584958

27. Liu, Y., & Li, Z. (2018). Determinants of housing purchase decision: An empirical study of the high education cohort in urban China. *Journal of Asian Architecture and Building Engineering, 17*(2), 299-305. https://doi.org/10.3130/jaabe.17.299

28. Mahalik, M. K., & Mallick, H. (2011). What causes asset price bubble in an emerging economy? Some empirical evidence in the housing sector of India. *International Economic Journal, 25*(2), 215-237. https://doi.org/10.1080/10168737.2011.586806

29. Marku, E., Lleshaj, L., & Lleshaj, A. (2020). VECM Analysis to House Price Index. Case of Tirana. *European Journal of Marketing and Economics, 3*(1), 19. https://doi.org/10.26417/ejme.v3i1.p19-30

30. Mironiuc, M., Ionașcu, E., Huian, M. C., & Țaran, A. (2021). Reflecting the sustainability dimensions on the residential real estate prices. *Sustainability, 13*(5), 1-28. https://doi.org/10.3390/su13052963

31. Pan, H., & Wang, C. (2013). House prices, bank instability, and economic growth: Evidence from the threshold model. *Journal of Banking and Finance, 37*(5), 1720-1732. https://doi.org/10.1016/j.jbankfin.2013.01.018

32. Panagiotidis, T., & Printzis, P. (2016). On the macroeconomic determinants of the housing market in Greece: a VECM approach. *International Economics and Economic Policy, 13*(3), 387-409. https://doi.org/10.1007/s10368-016-0345-3

33. Pinjaman, S., & Kogid, M. (2020). Macroeconomic determinants of house prices in Malaysia. *Jurnal Ekonomi Malaysia, 54*(1), 153-165. https://doi.org/10.17576/JEM-2020-5401-11

34. Pontines, V. (2020). The Real Effects of Loan-to-Value Limits: Empirical Evidence from Korea. *Empirical Economics, 61*(3), 1311-1350. https://dx.doi.org/10.2139/ssrn.3521008

35. Qian, H., Chen, J., Wang, Q., & Liu, C. (2015). A Panel Data Analysis on the Relationship Between Real Estate Value And GDP. *Proceedings of the 2nd International Conference on Civil, Materials and Environmental Sciences, 11,* 134-137. https://doi.org/10.2991/cmes-15.2015.39

36. Rahadi, R. A., Wiryono, S. K., Nainggolan, Y. A., Afgani, K. F., Yaman, R., Azmi, A. S. M., Ismail, F. Z., Saputra, J., Rahmawati, D., & Moulyni, A. (2022). Determining the factors influencing residential property price: A comparative study between Indonesia and Malaysia. *Decision Science Letters, 11*(4), 485-496. https://doi.org/10.5267/j.dsl.2022.6.002

37. Setianto, R. H. (2017). Harga Properti Residensial dan Kredit Perbankan Di Indonesia; Analisis Agregat Dan Dis-Agregat (Residential Property Prices and Banking Credit in Indonesia; Aggregate and Dis-Aggregate Analysis). *Jurnal Manajemen Indonesia, 15*(1), 39.

38. Shiller, R. J. (2019). *Narrative Economics: How Stories Go Viral and Drive Major Economic Events*. Princeton University Press.

39. Sumer, L., & Özorhon, B. (2020). TheExchange Rate Effect on Housing Price Index and Reit Index Return Rates. *The Journal of Financial Researches and Studies, 12*(22), 249-266. https://doi.org/10.14784/marufacd.688468

40. Tai, M. (2016). *House prices and the allocation of consumer credit*. Retrieved from https://scholar.harvard.edu/files/mingzhu_tai/files/jmp_mingzhu_jan25.pdf

41. Wan, J. (2018). Non-performing loans and housing prices in China. *International Review of Economics and Finance, 57,* 26-42. https://doi.org/10.1016/j.iref.2018.02.011

42. Xu, L., & Tang, B. (2014). On the Determinants of Uk House Prices. *Ijer*, 57-64.

43. Ya-Chen, L., & Shuai, Z. (2013). Econometric Analysis on the Relationship between RMB Exchange Rate and Real Estate Price by VAR Model. In *Proceedings of 2nd International Conference on Science and Social Research* (pp. 428-430). Retrieved from https://www.atlantis-press.com/proceedings/icssr-13/7747

44. Yan, N. (2019). Study on the Influence of Monetary Policy on Real Estate Price in China. *Journal of Service Science and Management, 12*(02), 152-171. https://doi.org/10.4236/jssm.2019.122011

45. Zhang, D., Cai, J., Liu, J., & Kutan, A. M. (2018). Real estate investments and financial stability: evidence from regional commercial banks in China. *European Journal of Finance, 24*(16), 1388-1408. https://doi.org/10.1080/1351847X.2016.1154083