

Leveraging consumer behavior and macroeconomic factors to increase real estate investment potential**Raden Aswin Rahadi^{a*}, Danang Pangestu Gusti Bagaskara^a, Sudarso Kaderi Wiryono^a, Asep Darmansyah^a, Dzikri Firmansyah Hakam^a, Tuntun Salamatum Zen^a and Kurnia Fajar Afgani^a**^a*School of Business and Management, Institut Teknologi Bandung, Bandung, Indonesia***CHRONICLE***Article history:*

Received: July 4, 2023

Received in revised format: August 2, 2023

Accepted: September 5, 2023

Available online: September 6, 2023

*Keywords:**Vector Autoregression**Macroeconomic**Real Estate**Consumer Behavior**Time Series Analysis**Market Cycle***ABSTRACT**

The Indonesian real estate market has shown promising development in recent years, attracting investors seeking lucrative opportunities. This research aims to increase the success rate of real estate investments in Indonesia by examining the connection between macroeconomic factors and consumer behavior. This study employs vector autoregression (VAR) models to investigate the influence of macroeconomic data on the Indonesian house price index (HPI). We intend to determine the primary determinants of the HPI by analyzing various macroeconomic indicators, including GDP growth, CPI, crude oil, interest rates, and the unemployment rate. In addition, the research investigates the role of consumer behavior in Indonesian real estate searches. Real estate developers and investors can gain valuable insight into the effect of consumer preferences, motivations, and decision-making processes on demand functions by understanding consumer preferences, incentives, and decision-making processes. A comprehensive analysis of historical data and econometric modeling techniques are employed to accomplish research objectives. The research is conducted using pertinent macroeconomic indicators, real estate market data, and consumer surveys.

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1. Introduction

Real estate is essential to the Indonesian economy, providing employment and investment opportunities. The residential real estate market consists of single-family homes, apartments, and townhouses, while the commercial real estate sector consists of office buildings, retail space, and warehouses. The rental market is an essential aspect of the real estate industry, and it is common to have rental agreements between owners and tenants (Valerio Roncagliolo, 2022). Real estate investments can take the form of direct ownership, equity, or debt. Real estate is appealing to investors because of the competitive long-term total return potential driven by income generation and capital appreciation (Vonlanthen, 2023). Fixed rents for some property types are attractive diversification options because they can provide stable returns over many economic cycles and historically have low correlations with other asset classes. A real estate investment can hedge against inflation if the lease includes regular contractual rent increases or frequent mark-to-market clauses. In Indonesia, real estate is regulated by the Indonesian Land Law, which ensures that real estate rightfully belongs to an Indonesian person or an Indonesian-owned company. Land and building rights are transferred by title or deed and may be purchased, leased, mortgaged, or transmitted in whole or in part (Wardana, 2014). A title search is an essential step in the buying and renting process as it ensures that the seller or borrower owns the property without a lien or other claims on the property. Residential real estate is a significant part of the Indonesian real estate market, with many Indonesians investing in properties to store value or generate rental income. While there are real estate investment opportunities in Indonesia, there are challenges, such as a lack of precise regulation, limited financing

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ISSN 2561-8156 (Online) - ISSN 2561-8148 (Print)

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doi: 10.5267/j.ijds.2023.9.008

options, and affordable housing. The Indonesian government is actively addressing these challenges by introducing reforms and measures to encourage foreign investment in the property market and improve access to finance for property development (Guedes, Iachan, & Sant'Anna, 2023). The impact of macroeconomic data on the Indonesian house price index (HPI) is examined using vector autoregression (VAR) models in this study. We aim to identify the main drivers of HPI by considering various macroeconomic indicators such as GDP growth, inflation, interest rates, crude oil, CPI, and unemployment rate. Consumer behavior is essential in determining the elements of pricing concepts that affect property prices. Several important factors influence this concept, including the physical condition of the property, the design concept implemented, the marketing strategy used, the accessibility of the location, and the uniqueness of the location (Rahadi, Wiryono, & Koesrindartoto, 2015). Consumers evaluate the physical condition of a property to assess its value and potential to increase in value. Design concepts such as architecture and amenities reflect user preferences and influence their willingness to pay. An effective marketing campaign highlights a property's unique attributes and creates perceived value. The ease of access to transportation and facilities impacts its convenience and attractive location uniqueness. Beautiful views and neighborhood features add to its attractiveness and upside potential. Understanding these consumer-driven factors enables real estate stakeholders to make informed decisions when pricing and locating real estate.

2. Literature review

Real estate is a popular investment choice for many individual and institutional investors due to its potential to generate stable income and long-term capital appreciation. However, it is essential to evaluate the performance of real estate investments relative to other asset classes to understand the factors contributing to overall returns (Deng, 2023). The influence of multi-year, fixed-rate leases on property revenue stability over economic cycles is one element to examine. Another consideration is the historical link between real estate and other asset types. This might highlight the potential advantages of adding real estate to an investing portfolio in terms of diversity. The purpose of this literature study is to investigate these two criteria and thoroughly assess the long-term total returns on real estate investments.

2.1 Categories of Real Estate

This definition of residential property is limited to privately-owned homes occupied by the owner, commonly known as single-family residential property. Residential properties that are rented or leased are classified as commercial real estate. Office buildings, retail spaces, warehouses, and hospitality facilities such as hotels and motels are all examples of commercial real estate (Painter, 2020). Commercial real estate can provide income through rent and appreciation in value due to various factors such as market conditions, development strategies, and property-specific characteristics.

2.2 Residential Property

Many people choose to invest in real estate by buying a home to live in, which is a form of direct equity investment. However, most buyers cannot pay the total purchase price upfront and must borrow money. In countries with established mortgage markets, lenders typically require a down payment of 10-20% of the property's purchase price. Homeowners' wealth increases (or decreases) as the value of their home increases (or decreases), which can be amplified by mortgage leverage. In countries with less developed mortgage markets, buyers may need to save longer or rely on family support to finance the purchase (Swinkels, 2023). Mortgages are either maintained on the balance sheet of the originator or bundled into securities and sold in the financial markets. These securitized debt products, such as residential mortgage-backed securities (RMBS), enable investors to participate in residential debt securities in an indirect manner.

2.3 Commercial Real Estate

The typical perception is that commercial real estate is suitable for wealthy individuals and institutional investors due to the asset's size, complexity, and relative illiquidity. Owning commercial real estate directly involves active management, making it even more complicated (Painter, 2020). The success of an equity investment in commercial real estate is determined by a number of variables, including general economic and real estate market circumstances, property management, and the amount and terms of external financing.

2.4 Oil Price

The VAR model uses quarterly data as log oil prices measured in US dollars per barrel. This data provides a time series analysis of US oil prices from 2000 to 2022. Large fluctuations in crude oil prices have significantly impacted the global economic situation, causing large-scale movements (Abaidoo & Agyapong, 2022). These shocks, caused by oil price fluctuations, then affect local economies.

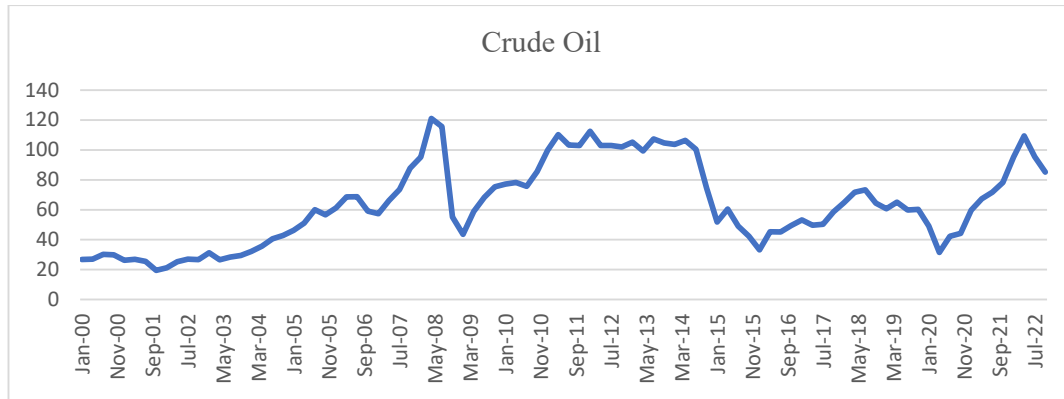


Fig. 1. Crude Oil Price Index

Source: Federal Reserve Economic Data (2000-2022)

An analysis of oil prices reveals large fluctuations over the years. Prices climbed from a low of \$25.31 per barrel to a 2008 high of \$121.1 per barrel. It then plummeted to \$43.5 in 2009. From 2016 to 2020, the price fluctuated between \$35 and \$70. Recently, after the Russia-Ukrainian war, prices have risen to \$85 in 2022, demonstrating the dynamism of the oil market.

2.5 Interest Rate

Most people who buy real estate rely heavily on debt, such as mortgages and loans. In other words, a significant portion of the property's value is financed by borrowing. Interest rate levels, therefore, play an essential role in shaping real estate demand. Low-interest rates lower borrowing costs and make it easier for individuals to obtain loans to purchase real estate. This can lead to increased demand as more and more people tend to enter the real estate market. Conversely, higher interest rates can lead to higher borrowing costs, reducing demand for real estate as higher borrowing costs may deter potential buyers. Therefore, interest rates directly impact an individual's decision-making process regarding real estate investments.

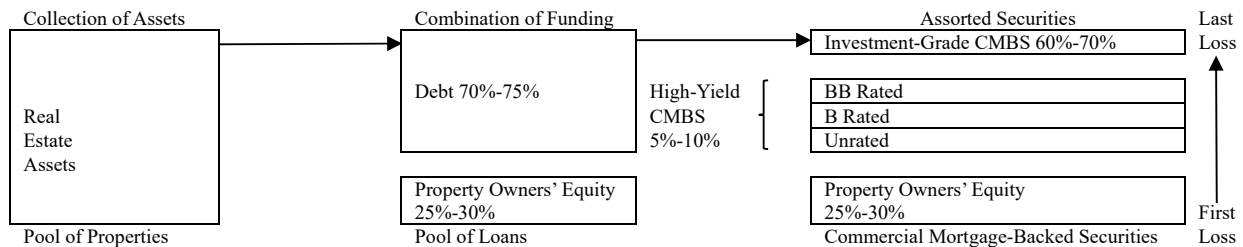


Fig. 2. CMBS (Commercial Mortgage Backed Security) Structure

Source: Author's Analysis

Individuals prefer to finance home purchases with debt. On average, the debt-to-housing ratio is between 70% and 75%. The terms of these obligations are typically 10 to 25 years (Vojtech, 2020). It clarifies the common practice of borrowing for home purchases. It highlights the importance of understanding the dynamics of debt financing in the real estate market and its potential impact on individuals and the economy.

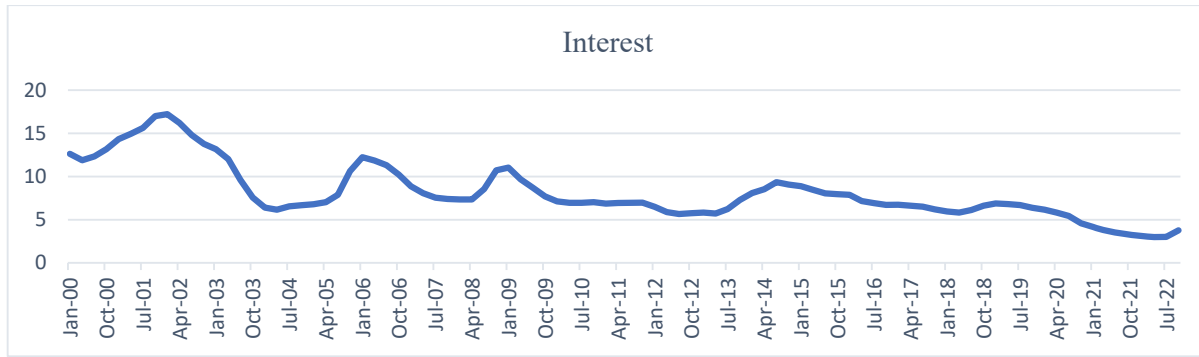


Fig. 3. Indonesia Interest Rate Index

Source: Federal Reserve Economic Data (2000-2022)

2.6 Consumer Price Index

. CPI indirectly reflects inflationary pressures because it measures changes in the total cost of living, including goods and services. HPI also tracks price movements in the real estate market (Ting, 2013). A positive link between the two indexes shows that rising general inflation tends to correspond with rising housing prices. This correlation indicates that changes in consumer purchasing power due to inflation can affect housing affordability, demand, and, thus, the house price index (Li & Zhang, 2021).

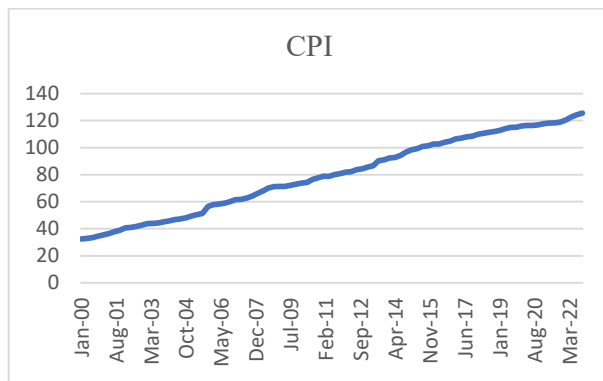


Fig. 4. Indonesia Consumer Price Index

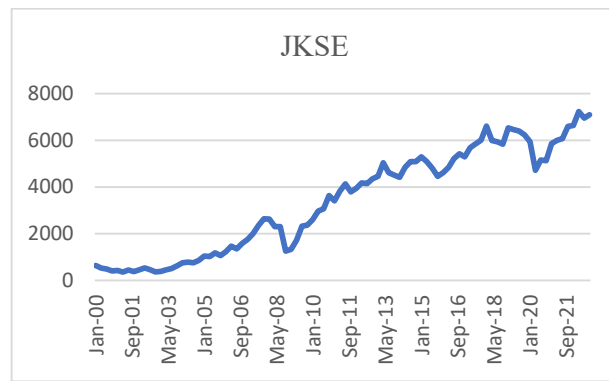


Fig. 5. Jakarta Stock Exchange Composite

2.7 Market Performance

Jakarta composite index is the parameter of Indonesia's Economy. Over the long term, the JKSE exhibits an upward trend in the long run, with occasional short-term fluctuations representing periods of economic booms and recessions (Anand, 2021).

Source: Federal Reserve Economic Data (2000-2022)

2.8 Unemployment Rate

The unemployment rate (UR) is a ratio that indicates the percentage of unemployed people to the total labor force. This study aims to assess how macroeconomic indicators affect real estate prices. Therefore, it was hypothesized that the local unemployment rate would have a more direct impact on housing prices. As a result, raw national unemployment data were used. The results suggest that regional and national trends show similar patterns with only minor percentage variations, suggesting consistent overall national trends (Mehta, 2023).



Fig. 6. Indonesia Unemployment Rate Index

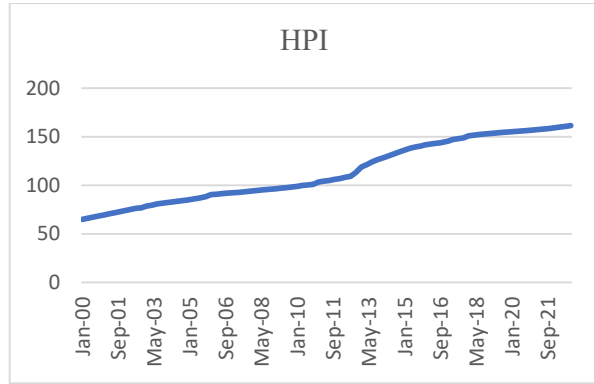


Fig. 7. Housing Price Index

Source: Federal Reserve Economic Data (2000-2022)

2.9 Housing Price Index

The Home Price Index (HPI) is a comprehensive single-family home price volatility measure. This calculation uses the weighted median price index methodology for repeat sales, providing an accurate and timely picture of housing price trends across different geographies (Jara, 2016). The dataset used for this particular study consists of quarterly median single-family home sales prices taken from official records in Indonesia.

2.10 Gross Domestic Product

Gross Domestic Product (GDP) is a key economic statistic that represents the entire value of a country's products and services generated. It serves as an essential measure of economic growth and development. By analyzing various factors such as consumption, investment, government spending, and net exports, GDP provides insight into the overall health and performance of the economy (Wang & Chen, 2022).

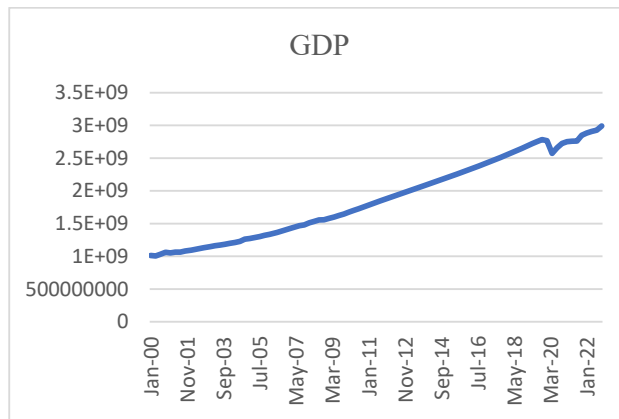


Fig. 8. Gross Domestic Product

Source: Federal Reserve Economic Data (2000-2022)

2.11 Consumer Behavior

Excessive optimism is the primary psychological distortion in the real estate market (Farlow, 2004). The results show that households believe buying a home is not a significant risk and that house prices will rise by an average of 11% yearly. This attitude shows excessive optimism. Households are generally too optimistic about future interest rate levels and have little

reaction to the risk of interest rate fluctuations (Case, 2003). Overconfidence greatly influences behavior in the real estate market (Shiller, 2005). The causes for the occurrence of overconfidence have been linked to cognitive processes (Farlow, 2013). Herd behavior is critical in human decision-making. People do not always assess independently due to societal pressure. The notion that no one is incorrect helps to explain herd behavior, which has been shown to be the source of mispricing and speculative bubbles. From (Rahadi R. , Wiryono, Koesrindartoto, & Syamwil, 2013), physical condition, design concept, marketing, location accessibility, and location uniqueness will influence real estate pricing.

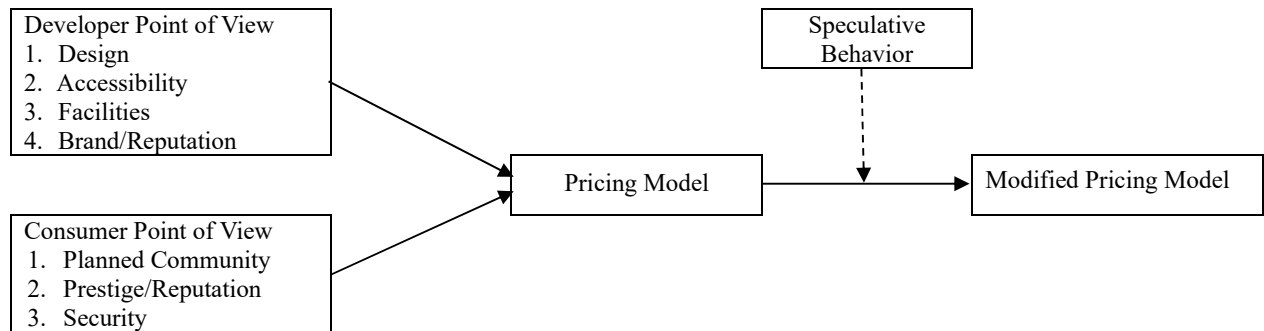


Fig. 9. Real Estate Pricing Attributes Consumer Behavior
(Source: Rahadi et al. 2015)

2.12 Demand Function

The demand concept, the willingness to purchase a product, depends on many factors, but the most important is the product's price. Economists generally recognize that consumers tend to buy less when prices go up and more when prices go down. This concept, known as the law of demand, is almost universally accepted. However, consumer purchasing decisions are also influenced by income, preferences, and the price of alternatives and complements (Fritz & Gambera, 2023). Economists strive to connect all these effects to a relationship called the demand function, which assigns unique values to product quantities based on the importance of some independent variable.

2.13 Oligopoly Market

An oligopolistic market structure is defined by the presence of a limited number of firms operating in a particular market. These companies offer similar, compatible, or differentiated products through branding and marketing. Examples include breakfast cereals, bottled or canned beverages, petroleum, and cement. A vital feature of an oligopoly market is that a few firms dominate, resulting in interdependent pricing. Each company's pricing strategy is influenced by the expected reaction of other competitors (Adachi, 2023). The characteristics of oligopoly markets:

1. There are a small number of potential sellers.
2. The products each seller offers are close substitutes for those provided by other firms and may be differentiated by brand or homogeneous and unbranded.
3. Entry into the market is challenging, with reasonably high costs and significant barriers to competition.
4. Firms typically have substantial pricing power.
5. Products are often highly differentiated through marketing, features, and other non-price strategies.

2.14 Real Estate Investment Risk

Real estate investments can underperform due to fluctuations in asset values due to macro- and macroeconomic conditions and interest rate levels. The fund management team's capacity to pick assets, generate money, manage and react to changes in government legislation is vulnerable to a variety of hazards. Management of underlying real estate includes operating costs, renting and leases, handling maintenance and improvements, and disposing of real estate. Investing in troubled real estate and real estate projects exposes them to additional risks, such as regulatory difficulties, building delays, and cost overruns (Salisu, 2023). Funding risk exists as well, since long-term financing on reasonable conditions may not be available. Leverage is often used to increase investor returns but can also magnify losses and increase the risk of default. These factors underscore the importance of carefully evaluating and managing the risks associated with real estate investments to minimize potential adverse effects on investors (Kelliher, 2022).

3. Material and Method

The research methodology of this study aims to provide a comprehensive analysis of the characteristics and potential benefits of real estate investment in Indonesia, particularly concerning the following objectives evaluate the long-term total return of real estate investments and analyze the contribution of revenue generation and capital appreciation compared to macroeconomic. Analyze real estate returns over different economic cycles and analyze historical correlations between real estate investments and macroeconomic classes to determine the potential return of real estate in a portfolio. The research uses quantitative techniques, including an extensive literature review, quantitative analysis of historical data, interviews with industry experts, and statistical tools such as correlation analysis and time series analysis. This study approach is designed to provide rigorous and informative commentary that can guide investment decisions and contribute to the development of the local real estate market.

3.1 Data and Method

We collect data for this study using secondary sources. Quantitative data are gathered from secondary sources such as Bank Indonesia, Federal Reserve Economic Data, and Indonesia Stock Exchange (PHEI). These data sources are analyzed using statistical tools, correlation analysis, and time series analysis VAR to test hypotheses and provide a rigorous and comprehensive analysis of the characteristics and potential benefits of real estate investment in Indonesia provided. This research approach offers a solid foundation for research and helps ensure that the data collected are reliable and relevant to the research question. VAR used a function from the impulse response function and forecast error variance decomposition.

3.2 Demand Function Based on Consumer Behavior

Studies by various academics have explored the factors that influence residential property preferences. Several studies have investigated the rise of gated communities in the United States and have shown that people choose these communities based on lifestyle, prestige, and security considerations (Blakely, 1997). Consumer behavior in real estate was also analyzed to identify internal determinants (e.g., motivations, perceptions, attitudes) and external determinants (e.g., affinity groups, culture, social class) as influencing factors. Furthermore, Canadian research indicates that buyers are prepared to spend extra for houses with superior interior air quality, lighting, and acoustics (Spetic, 2005). Another study focused on consumers' willingness to pay higher rents for improved façade designs that make buildings more sustainable and energy efficient.

In Jakarta, Indonesia, the factors influencing real estate prices were explored through a synthesis of literature reviews and insights from industry experts. The key factors affecting property prices have been identified from the perspective of property developers and consumers of residential real estate. These factors include design, accessibility, facilities, brand/reputation of the developer, as well as the proposed community or gated concept, reputation, and security from a consumer perspective (Rahadi R. , Wiryono, Koesrindartoto, & Syamwil, 2013). Physical features such as façades, infrastructure and product specifications have been found to influence consumer perceptions of property prices. Development concepts such as development scope, thematic design, and world-class facilities are also influential. In addition, location-related factors such as direct access to toll roads, proximity to family, work, activity centers, shopping malls, education centers, and unique features of the location influenced property price decisions.

This research highlights the importance of various environmental factors in shaping consumer preferences for household products. Factors related to physical quality, development concept, and location significantly impact property prices. Understanding these factors is essential for property developers and consumers to make residential real estate decisions.

Source: Rahadi et al. 2015

Table 1. Factor Analysis Result

Factor	Location accessibility	Physical qualities	Factors Design Concept	Marketing Concept	Location uniqueness
Facade		0.633			
Infrastructure		0.759			
ROW		0.754			
Rooftop Design		0.873			
Product specification		0.810			
Floor plan layout		0.790			
Overall physical qualities		0.685			
Green concept				0.593	
Development scale				0.819	
Theme and story				0.784	
Following trends			0.548		
Grand cluster			0.641		
Premium facilities			0.774		
Cluster concept			0.724		
Type variations			0.636		

Overall Concept		0.825
Direct toll road access	0.786	
Located near family	0.563	
Located near workplace	0.809	
Good security system	0.858	
Good social communication	0.854	
Ease of accessibility	0.863	
Located near the activity center	0.874	
Located near the shopping center	0.820	
Located near the education center	0.855	
Located near the religious center		0.750
Unique location		0.807
Overall location		0.734

From the previous research (Rahadi, Wiryono, & Koesrindartoto, 2015) According to the conclusions of the investigation, the primary elements affecting favorable responses from respondents are connected to the location, followed by the idea and physical attributes attribute. The research findings reveal that consumer behavior is influenced by various factors when it comes to real estate prices. The most significant factor is location accessibility, accounting for approximately 34.32% of the influence. The physical qualities of the property contribute to around 24.99% of the influence, while the design concept factor holds a weight of 19.54%. The uniqueness of the location plays a role of 10.79% in influencing consumer behavior, and marketing concepts contribute 10.35%. These findings highlight the importance of considering these factors when analyzing and understanding consumer preferences in the real estate market. Property is considered an oligopoly market due to its high barriers to entry and limited competition from a few firms; firms typically have substantial pricing power and the presence of a unique and specialized product.

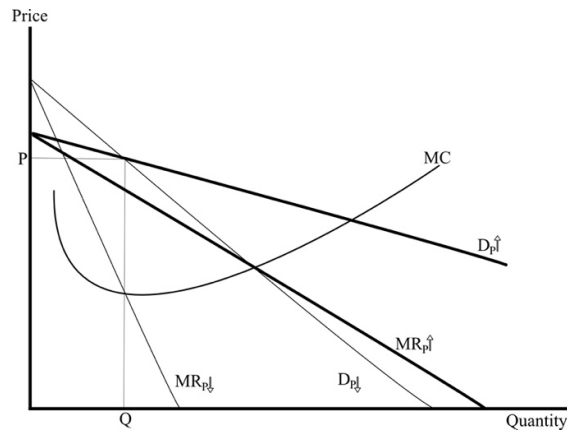


Fig. 10. Kinked Demand Curve in Oligopoly

In an oligopoly market, the demand curve for real estate is influenced by many factors. First, demand increases as consumers prioritize accessibility to locations crucial to their decision-making. This consumer behavior parameter reduces the elasticity of demand as customers search for a particular location, allowing sellers to charge higher prices due to the limited supply of properties. As demand increases, so does marginal revenue, and each additional unit sold positively impacts revenue. To determine the optimal price in this oligopoly market, sellers aim for the point where marginal cost equals marginal return. This price range ensures that production levels are achieved to maximize profits. However, it is essential to note that the marginal cost of real estate does not change as demand increases. Instead, factors such as fluctuations in interest rates and labor costs can affect marginal costs. These external factors influence the overall cost structure, which can influence the pricing decisions of real estate sellers in oligopolistic markets.

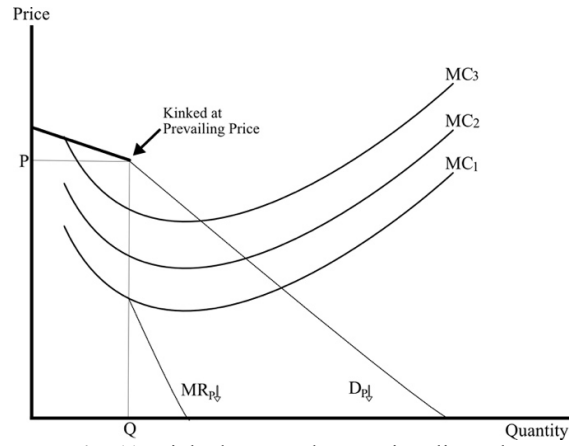


Fig. 11. Kinked Demand Curve in Oligopoly

Consumer preferences, limited supply, and the distinctive nature of commodities drive the demand curve for real estate in an oligopoly market. The declining elasticity of demand and increasing marginal returns indicate the potential for higher prices. Sellers strive to find the optimal price point where marginal cost equals marginal return, but external factors such as interest rates and labor costs can change the cost structure. Understanding these dynamics is essential for buyers and sellers operating in oligopolistic real estate markets.

3.3 Vector Autoregression Method

Researchers have relied on models that impose predetermined constraints on the coefficients. Vector autoregressive (VAR) models, however, offer a dynamic approach to analyzing time series data, allowing the data itself to determine the dynamic structure of the model. This study used a VAR model to study changes in house prices over time and how they interact with macroeconomic indicators.

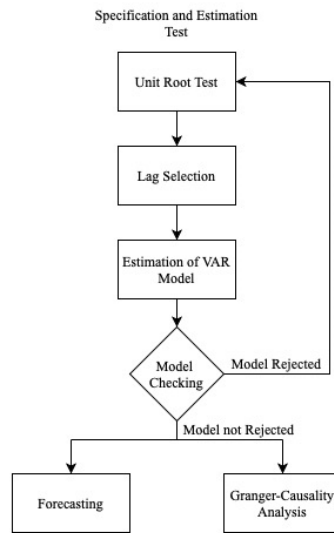


Fig. 12. Flow Chart of VAR Analysis Procedure

Source: Author's AnalyA VAR model consists of a set of equations, each variable described by its lag value and the current and past lag values of all other variables in the system. Importance of Y_b lagged one period is written as Y_{t-1} . An n -variable VAR system can be written as in the equation:

$$\Gamma(\phi)X_t = I - \Gamma_1\phi - \Gamma_2\phi^2 - \dots - \Gamma_n\phi^n \tag{1}$$

where X_t is an $n \times 1$ vector of variables; Γ is an $n \times 1$ vector of constants; V_t is an $n \times 1$ vector of random variables, each serially uncorrelated with constant variance and zero means. Equation (1) is an $n \times n$ matrix of a normalized polynomial is the lag operator $\phi(\phi^R X_t = X_{t-1})$, with the first entry of each polynomial on Γ 's being unity. The ordinary least squares (OLS) method is used for the estimation.

3.4 Preliminary Testing And Analysis

A unit root test was performed to assess the properties of the economic time series. In practice, regression analysis is challenged because most economical time series exhibit volatility that hinders the identification of useful information and patterns. It is well known that applying ordinary least squares estimation (OLS) to temporary data can lead to misleading results. To solve this problem, the data were differentiated, and nonstationary time series were transformed into stationary time series. This has allowed us to identify valuable information in our data. The extended Dickie-Fuller test (ADF) was performed on both the level form and the first derivative of the data series and was used to assess uniform root nonstationary in all macroeconomic indicators. The results showed that the nonstationary was rejected at the 1% and 5% significance levels considering the first difference. This supports the conclusion that all data series become stationary after the first differentiation.

Table 2. Dickey-Fuller Test (%)

Variable	Diff	P-value < 0,05	Stationary
HPI	Second diff	1,031e-07	Stationary
CPI	First diff	1,226e-14	Stationary
CrudeOil	First diff	4,611e-11	Stationary
Interest	First diff	0,0017	Stationary
Market	First diff	8,101e-17	Stationary
UR	First diff	2,869e-18	Stationary
GDP	First diff	8,763e-12	Stationary

Source: Author's Analysis

$$\Delta OIL_t = \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \tag{2}$$

$$\Delta IR_t = \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \tag{3}$$

$$\Delta CPI_t = \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \tag{4}$$

$$\Delta JKSE_t = \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \tag{5}$$

$$\Delta UR_t = \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \tag{6}$$

$$\begin{aligned} & \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} \\ & + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \\ \Delta HPI_t = & \end{aligned} \quad (7)$$

$$\begin{aligned} & \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} \\ & + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \\ \Delta GDP_t = & \end{aligned} \quad (8)$$

$$\begin{aligned} & \alpha_{10} + \sum_{i=1}^3 \beta_{11i} \Delta OIL_{t-1} + \sum_{i=1}^3 \beta_{12i} \Delta IR_{t-1} + \sum_{i=1}^3 \beta_{13i} \Delta CPI_{t-1} + \sum_{i=1}^3 \beta_{14i} \Delta JKSE_{t-1} \\ & + \sum_{i=1}^3 \beta_{15i} \Delta UR_{t-1} + \sum_{i=1}^3 \beta_{16i} \Delta HPI_{t-1} + \sum_{i=1}^3 \beta_{17i} \Delta GDP_{t-1} + e_t \end{aligned}$$

All the above data is stationary after the difference.

After confirming the stationarity of all variables in the first derivative, we performed a cointegration test. The aim was to explore possible long-term relationships between these variables by formulating a VAR model. Cointegration refers to common stochastic trends among macroeconomic indicators, which allows them to be combined over time. These indicators may diverge from each other in the short term but tend to converge on similar trends over time. If the variables are cointegrated, but the corresponding cointegration vectors are not integrated into the VAR model, then the model using only first derivative data becomes unsuitable. The Johansen cointegration test, based on the methodology introduced by (1990) and extended by Johansen (1991, 1995), was used to assess the presence of cointegrations and determine the number of cointegration vectors. The results of the Johansen cointegration test showed no long-term relationship in the VAR model, confirming the acceptability of his simple VAR model.

4. Result

4.1 Impulse Response Function Analysis

After performing unit root and cointegration tests, it was decided that the first derivative of the data series should be used in the VAR model. As part of this study, his six VAR equations (2)–(8) were developed to account for his two aspects of the data. First, the statistical significance of each macroeconomic indicator on house prices was tested. The quantitative impact of these indicators on real estate prices was then evaluated. A comprehensive analysis was performed to assess macroeconomic indicators' importance and quantitative effects on real estate prices using these VAR equations. Impulse response functions are essential in applied research because they provide insight into how one variable responds to shocks in other variables. As part of this study, impulse response functions were developed to determine how the Home Price Index (HPI) responds to shocks to one standard deviation rise in each of five macroeconomic indicators and to the HPI itself over a quarterly period starting in 2000. Check whether These functions indicate whether the impact is positive or negative, temporary or permanent. In addition, confidence intervals for impulse response functions are constructed to assess the statistical significance of the variable's response to shock. A reply is significant if the confidence interval line does not cross the zero line. The X-axis typically represents time and indicates the duration of the impulse response. After the system is hit, each point on the x-axis corresponds to a specific time or delay. The Y-axis represents the variable's response to an impulse or shock, displaying the magnitude of each variable in the VAR model's response to the shock introduced. The values on the y-axis indicate how far each variable deviates from its long-term equilibrium due to the shock. We can understand the short- and long-term effects of shocks on the variables in the VAR model by examining the IRF. Plots show how each variable reacts over time after exogenous perturbations. No parameter estimates were reported in this study, as VAR analysis mainly focuses on determining dynamic relationships between variables. Figs. 13-19 show the HPI impulse response functions for the indicated changes.

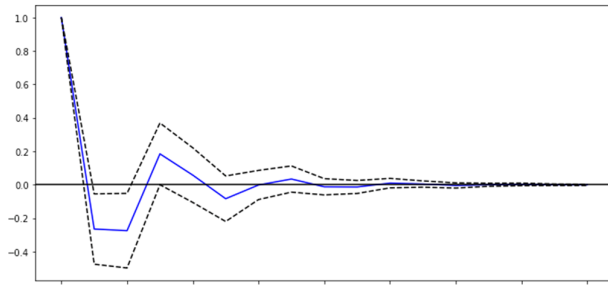


Fig. 13. Response of HPI to HPI
Source: Author's Analysis

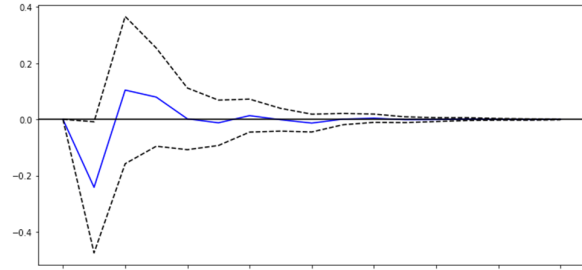


Fig. 14. Response of HPI to CPI
Source: Author's Analysis

As shown in Fig. 13, Changes in current house values are reflected in the Housing Price Index (HPI). The one standard deviation positive move in current property prices will cause the HPI to experience a significant gain in the first quarter. However, while the price falls below the zero line in the second quarter, it recovers and turns positive at the end of the third month. House prices stay high for one quarter, followed by a period of volatility like fluctuations for two quarters. These fluctuations gradually subsided after the six quarters, suggesting that current house price changes are more likely to positively impact following quarter house prices than over the longer term. In particular, the positive confidence interval line crosses the zero line, indicating the statistical significance of the HPI response to rising house prices. Fig. 14 shows how changes in the Consumer Price Index (CPI) affect the Housing Price Index (HPI). An inflationary shock (CPI) triggers a dynamic reaction in house prices. The initial negative impact was observed in Q1, with HPI dropping below the zero line and potentially reaching a minimum of 0.2% by the end of Q2. After that, HPI gradually increases and reaches positive territory from the third quarter onwards. Next quarter, HPI will oscillate around zero. In particular, the confidence interval line does not cross the zero line, suggesting that HPI does not show a significant response to changes in CPI.

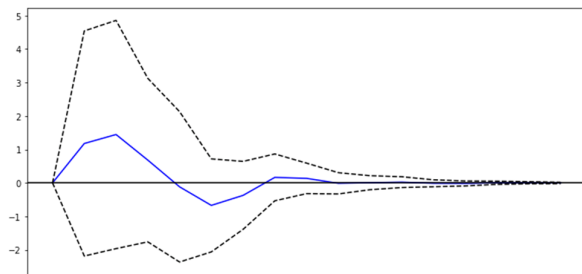


Fig. 15. Response of HPI to OIL

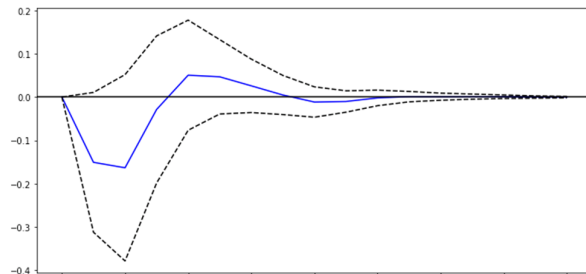


Fig. 16. Response of HPI to Interest

Source: Author's Analysis

Fig. 15 shows the link between fluctuations in oil prices and the Housing Price Index (HPI). A one standard deviation shock in oil, the HPI shows a slight upward trend in the first two quarters, as shown by the dotted line. However, in the next four quarters, HPI will be adversely affected by the oil shock. The most substantial decline in HPI occurred at the end of the third quarter, reaching a standard deviation of -0.5%. After five quarters, HPI began to recover, showing a positive effect within a +0.3% standard deviation. After the duration ends, the effect returns to zero. Notably, none of his 95% confidence intervals for responses crossed the zero line, suggesting that the impact of the oil shock on HPI is not statistically significant.

Source: Author's The effect of mortgage interest rate changes on the house price index (HPI) is represented in Fig. 16. A positive shock to the interest rate leads to pronounced fluctuations in the HPI, indicating the influence of interest rates on housing prices and their sensitivity to the mortgage market. When the interest rate increases, housing prices immediately experience a negative response, resulting in a decline during the first quarter. This relationship can be explained by higher financing costs, such as when purchasing a house with 70-75% debt, reducing housing demand, and leading to a fall in housing prices. Subsequently, housing prices start to recover and peak at the end of the third quarter, followed by fluctuating patterns until the end of the ninth quarter, eventually stabilizing around the zero line. Notably, the negative confidence interval line intersects the zero line, indicating the statistical significance of HPI's response to mortgage interest rates.

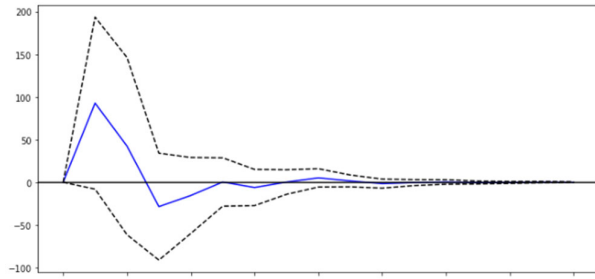


Fig. 17. Response of HPI to JKSE

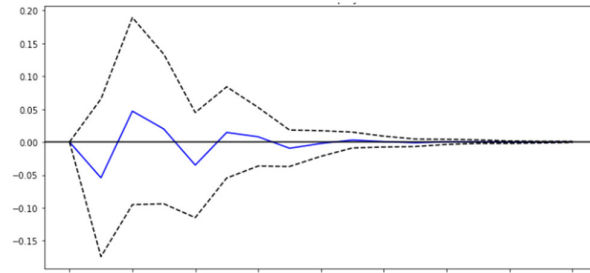


Fig. 18. Response of HPI to Unemployment Rate

Source: Author's Analysis.

Figure 17 gives information on the link between the Housing Price Index (HPI) and the Stock Price Index (SPX) where in Indonesia using Jakarta Composite Index (JKSE). When there was a positive shock to stock indices, the HPI initially registered a significant rise, reaching the nearly 100 mark in the first quarter, which was in line with short-term expectations. However, the HPI dropped rapidly, reaching 25 in mid-Q2 and finally returning to 0 in Q4. The adjustment process was rapid, and he reached stable levels within three-quarters of the shock. Since then, the HPI has remained relatively flat and hovered around zero, indicating no significant fluctuations during this period. No crossing between the confidence interval line and the zero line means that the HPI does not show a statistically significant response to changes in the stock index (JKSE).

Source: Author's Analysis

Examine how variations in the unemployment rate affect the housing price index in Fig. 18. A positive shock to the unemployment rate would immediately lead to a fall in house prices. This suggests that rising unemployment will reduce people's willingness and ability to buy homes, leading to lower demand and temporary price declines. The reaction of the house price index to the unemployment rate led to a short-term contraction in aggregate demand, with the HPI falling 0.05% of its standard deviation in the second quarter. House prices then fluctuated up and down until the fourth quarter, but from the shock, it stabilized after six quarters. The impact on HPI did change, the confidence interval line closes the zero line, indicating statistically has an effect.

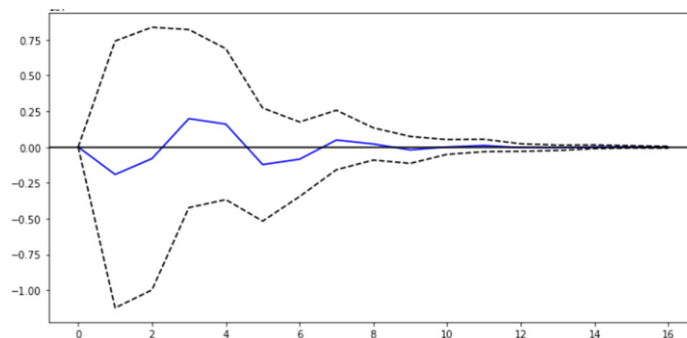


Fig. 19. Response of HPI to GDP

Examine the impact of GDP fluctuations on the housing price index in Figure 19. Analysis shows that a significant shock to GDP has a relatively small impact on the Home Price Index (HPI). The HPI shows a slight downward trend of 0.25% after the shock in Q1 but quickly returns to baseline levels 0 in Q2. Then in the third quarter, HPI rose slightly by 0.25%. However, from this point on the shock stabilizes at 0, indicating no further significant effect on HPI. Furthermore, the confidence interval line does not cross the zero line, confirming that the observed change in his HPI is not statistically significant. Thus, while GDP has some impact on HPI in the short term, its overall effect is limited, suggesting that other factors may significantly impact house prices.

4.2 Forecast Error Variance Decomposition Analysis

Forecast Error Variance Decomposition (FEVD) is helpful in econometrics and other multivariate time series analysis applications. It helps interpret VAR models by showing the relative importance of shocks. In particular, it decomposes the forecast error variance for each macroeconomic indicator, providing insight into the proportion of error variance attributable to each variable. This decomposition is similar to the prediction error fraction R^2 , where the higher the proportion of prediction error

attributable to a variable, the more critical that variable is in explaining or predicting the target variable. In this regard, the focus is on determining the percentage of divergence in the Property Price Index (HPI) caused by changes in individual macroeconomic indicators. For example, suppose the HPI forecast error variance is primarily due to the mortgage interest rate (IR). In that case, this suggests that the mortgage IR contributes significantly to the HPI forecast. By analyzing the FEVD, we gain insight into the contribution of each macroeconomic indicator to explaining HPI volatility.

Table 3

Forecast FEVD of HPI (%)

%	OIL	IR	CPI	JKSE	UR	HPI	GDP
1	0.31	0.99	1.92	2.13	2.48	90.68	0.04
2	0.50	2.41	2.60	2.22	3.00	88.45	0.05
3	0.49	3.11	2.49	2.38	5.10	85.63	0.07
4	0.52	3.82	2.50	2.37	5.08	85.59	0.09
5	0.73	3.78	2.48	2.39	5.44	85.06	0.09
6	0.78	3.79	2.38	2.40	5.54	84.89	0.09
7	0.82	3.78	2.47	2.41	5.55	84.84	0.09
8	0.82	3.79	2.48	2.41	5.58	84.79	0.09
9	0.82	3.80	2.47	2.42	5.58	84.79	0.09

The purpose of FEVD (forecast error variance decomposition) analysis in this study is to examine the impact of macroeconomic indicators on household prices. The research includes decomposing the forecast error variance for each indicator over ten periods. By calculating the contribution of each variable, this research interprets the VAR model and assesses the short- and long-term effects of shocks on the Home Price Index (HPI). In the FEVD analysis, each row of variance decomposition represents 100%, indicating that all forecast error variance is due to macroeconomic indicators taken into account. Examining the decomposition results provides insight into the relative importance of each metric in explaining HPI variability. This analysis allows us to understand the impact of shocks on HPI in the short and long term, providing valuable information for policymakers, researchers, and market participants. Analysis of forecast error and variance decomposition shows the impact of different factors on the Home Price Index (HPI) over different periods. First, the HPI has the most significant impact in the first period, accounting for 95% of the effects of the following month's shock. However, that percentage gradually declined to 84% by Quarter 9, suggesting the impact awaits. Interest rates, among other variables considered, affect house prices, while the Consumer Price Index (CPI) and market factors contribute 2.5% to HPI fluctuations over the long term. Also, the unemployment rate is 5.5%. Finally, the GDP and oil variables together contribute to the remaining variance. These results suggest that HPI is primarily influenced by its past values, offering a solid self-reinforcing effect. However, other factors such as interest rates, CPI, market conditions, unemployment, GDP, and oil also play a role, albeit to a lesser extent, in shaping HPI behavior. Understanding these dynamics is critical to understanding the complex interactions between macroeconomic indicators and real estate markets.

5. Discussion and Conclusion

The objective of this research study is expected to:

1. Assess the long-term impact of macroeconomic indicators and consumer behavior on real estate prices. The macroeconomic indicators were oil, interest rate, CPI, JKSE, unemployment rate, GDP, and HPI. Physical condition, design concept, marketing, location accessibility, and location uniqueness were also indicators of consumer behavior.
2. This study aims to look into the impact of multi-year leases on the stability of real estate prices during different economic cycles as well as the historical correlations between real estate investments and macroeconomic performance.

This study examined five macroeconomic indicators using quarterly time series from 2000 to 2022 from Federal Reserve economic data. This data was analyzed using the VAR statistical tool. Based on the findings, the following conclusions were reached:

- The housing price index (HPI) shocks are the largest source of variability in future housing prices in Indonesia, accounting for up to 90.68 percent of the variance in the next quarter and declining to 84.79 percent by the ninth quarter. This finding suggests that current price changes continue to shape people's expectations of future price movements.
- The combined impact of changes in interest rates (IR) and the unemployment rate (UR) on house price volatility is more significant than the impact of changes in oil prices, the consumer price index (CPI), and GDP (GDP). Contribute. The stock market index mortgage rates significantly impact home prices of any of these macroeconomic indicators. In Q1, the mortgage rate shock explained approximately 0.99 percent of the movement, rising to 3.8 percent in Q9.
- Surprisingly, the unemployment rate (UR) significantly influences emerging markets more than other variables. The UR shock accounts for 2.48 percent of the change in house prices since Q1, rising to 5.58 percent from Q9 onward. UR accounts for approximately 37% of the total variance contributed by the five macroeconomic indicators.
- The contributions to the change in house prices after nine quarters of the remaining four variables, namely oil price (OIL), consumer price index (CPI), stock market index (JKSE), and gross domestic product (GDP), differ. Oil accounts for

approximately 0.82 percent of volatility, CPI accounts for 2.47 percent, JKSE accounts for 2.42 percent, and GDP has had a negligible impact on house price volatility since Q9.

- Location accessibility is the most critical factor influencing real estate prices based on consumer behavior, accounting for approximately 34.32 percent of the influence. The physical characteristics of the property account for around 24.99 percent of the influence, while the design concept factor accounts for 19.54 percent. The uniqueness of the location influences consumer behavior by 10.79%, and marketing concepts influence consumer behavior by 10.35%.
- Changes in demand have a direct impact on price dynamics in an oligopolistic real estate market. Price volatility results from changes in marginal returns as demand rises. In this market, the optimal price is determined by the point at which Marginal Cost (MC) equals Marginal Revenue (MR). However, it is important to note that the marginal cost of real estate does not change as demand rises. Instead, while the marginal cost remains constant, interest rates and labor costs can influence the cost structure. To make informed pricing decisions in an oligopolistic real estate market, oligopolistic real estate market participants must understand the relationship between demand, price, and marginal return.

Based This examines the factors influencing real estate prices. Based on consumer behavior and macroeconomics result suggests that an increase in demand will result in an increase in property prices. Consumer behavior, notably a preference for prime locations due to convenience, is critical in shaping demand patterns. Furthermore, the study identifies other factors that can influence property prices. For starters, Home Price Index (HPI) shocks influence future price movements. Moreover, interest and unemployment rates significantly impact the long-term economic gains from a real estate oligopoly. In the real estate sector, efficient production techniques are critical to determining long-term economic returns. It is worth noting that while debt finances a significant portion of capital (70–75 percent), labor accounts for a substantial portion of production costs. Interest rate fluctuations can thus have a considerable impact on real estate demand. Furthermore, changes in unemployment affect labor costs because overwork leads to increased spending, and high unemployment leads to workers being hired at lower wages. This study emphasizes the significance of comprehending external factors such as consumer behavior and macroeconomic indicator rates to comprehend the dynamics of future real estate markets. Industry participants can make informed decisions about pricing strategies and resource allocations by considering these factors.

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