Residential Real Estate and Inflation Hedging Ability: Evidence from 14 Major Cities in Indonesia

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Abstract

This paper examines the effectiveness of residential real estate as a hedge instrument against inflation by analyzing quarterly city-level housing price data across 13 cities and one metropolitan area in Indonesia over the period 2003–2025. The empirical results from a nonlinear autoregressive distributed lag (NARDL) framework indicate that residential real estate does not protect from inflationary pressures in the long or short run. Heterogeneity analysis reveals that smaller property sizes perform better in terms of hedging ability, although this is only detected in several cities. Our findings show that residential real estate primarily serves as a consumption good rather than a financial asset for inflation protection in the Indonesian context.

Keywords: Emerging Market, Housing Market, Hedging Instrument, Residential Property, Urban Real Estate.

JEL: G11, R30.

Indeed, research on real estate and inflation hedging has been extensively conducted for the past half a century. Early studies include those by Fama & Schwert (1977), Kearl (1979), and Spellman (1981), with subsequent contributions from other researchers, such as Hartzell et al. (1987), Gyourko & Linneman (1988), Rubens et al. (1989), Dokko et al. (1991), Hoesli et al. (1997), Bond & Seiler (1998), Onder (2000), Anari & Kolari (2002), and Adrangi et al. (2004). In the most recent study, Lee et al. (2011), Hardin et al. (2012), Taderera & Akinsomi (2020), Ekemode (2021), Fehrle (2023), Dittmann (2024), Karp & Wolski (2025), Muckenhaupt et al. (2025), and the literature study by Piazzesi & Schneider (2016). The majority of the mentioned studies focused on the United States market, while only a few focused on emerging market countries.

While many studies conclude that real estate effectively hedges against inflation, others find that these assets cannot provide such protection—see Muckenhaupt et al. (2025) for a detailed review of these inconclusive results. Contradictory findings emerge in Indonesia, where Magweva & Sibanda (2020) confirm that the infrastructure sector—including real estate and composite stocks—cannot hedge against inflation in the short or long term. Conversely, Nurdina et al. (2024) found that property and real estate stocks can hedge against both inflation and interest rate pressures despite negative profitability across all quantiles.

Our study makes three gradual contributions to the international and local real estate literature. First, this study provides current evidence from Indonesia—one of the largest emerging economies alongside China, India, Brazil, and Mexico—while most existing evidence is based on developed economies. Second, this study employs granular city-level data from 13 major cities and one metropolitan area to avoid relying on stock market data, which enables us to understand how local housing market dynamics and regional characteristics shape the real estate sector's performance. Third, contrary to the widespread perception that taking residential property as a reliable investment asset, our results suggest that residential real estate primarily functions as a consumption good rather than a hedging instrument in the Indonesian context. This has important implications for both individuals and investors.

This paper is organized into four sections. Section 1 provides a literature review and discusses the concepts of residential function and hedging ability. Section 2 explains the datasets, methods, and econometric models used in this study. Section 3 presents the empirical results and provides an overview of the evolution of the Indonesian real estate market, its implications, and additional insights. Section 4 summarizes the findings, acknowledges the limitations, and suggests future research agendas.

1. LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

1.1. Previous Studies

We began our review by tracing relevant studies back to their origins. We acknowledge that this process yields a large number of results. Therefore, we filtered the results using the Web of Science (WOS) database by selecting articles indexed only in the SSCI and ESCI.

An initial study was conducted by Fama & Schwert (1977). They investigated the effectiveness of several assets in hedging inflation risk, including government bonds, private residential real estate, and stocks. They found that residential real estate provides complete protection against both expected and unexpected inflation. Since then, numerous studies have examined this topic in various contexts, employing different methods and covering various types of real estate. Although this review does not cover all relevant studies, it provides a chronological list of research on this topic from 1977 to the present. See Appendix A (Table A1) for further details.

As shown in Table A1, most studies have examined hedging ability in developed countries, primarily the United States. These studies are comprehensive and employ various approaches, models, and datasets. Nevertheless, different conclusions were reached. Furthermore, the table shows that studies on developing countries are limited. From many perspectives, it is difficult to accept that findings from the United States can be generalized to developing countries, such as Indonesia.

In this subsection, we focus on previous studies in the Indonesian context, as they are the most relevant to our research interests. Using the WOS database, we identified at least two relevant studies. The first study was conducted by Magweva and Sibanda (2020). The researchers assessed the returns on stocks in real estate, infrastructure, and general equity. They used the IDX Infrastructure Index and the FTSE Indonesia Index, covering the period from 2009 to 2019, to evaluate the respective returns from real estate, infrastructure, and general listed equity. Using the ARDL model, they found that listed common stocks were ineffective in hedging inflation. Similarly, stocks in infrastructure and real estate are ineffective at hedging inflation in the short or long term. While this study primarily focused on the infrastructure and real estate sectors, it was limited to stocks rather than physical real estate.

The following study was conducted by Nurdina et al. (2024). Their study covered the period from July 2018 to June 2023 and examined 92 stocks in the property and real estate sector. The researchers employed the 7FF model, also known as the Fama–French seven-factor model. This model incorporates inflation and interest rates, as well as five other common variables: market factor, size, book-to-market ratio, profitability, and investment. After running the datasets using OLS, the researchers found that all quantiles of stocks in the property and real estate sectors can hedge against inflation and interest rates.

In summary, although both studies relied on linear models and broadly similar datasets, they reached different conclusions because of key differences in data construction and model specification. Magweva and Sibanda (2020) aggregate stock performance into a single index over the sample period and include two control variables—GDP growth rate and crude oil prices—despite covering a different time span. In contrast, Nurdina et al. (2024) used more granular data in the form of closing stock prices. They also used a longer sample period and incorporated seven additional covariates. These differences in data granularity, time coverage, and covariate selection likely explain why the two studies reached different conclusions.

The only similarity between these two studies is their focus on the inflation-hedging ability of real estate stocks. Neither study examines whether physical real estate serves as an effective hedge against inflation. This distinction is important because real estate stocks and physical properties represent fundamentally different assets. Like other equities, real estate stock prices are highly volatile, often fluctuating on daily and hourly basis in response to market sentiment. In contrast, physical real estate remains stable in the short term, typically adjusting gradually—often on a monthly rather than daily basis. As a result, the inflation-hedging properties of these two asset types may differ substantially.

1.2. Residential Real Estate: Between Living and Investment

Residential real estate refers to permanent physical structures primarily designed to serve as living spaces for individuals and households. These properties function as dwellings that provide shelter, rest, and access to nearby amenities. In the Indonesian context, the characteristics and forms of residential housing vary considerably across cities.

In large metropolitan areas such as Jabodetabek, apartments have become increasingly common due to land scarcity and high population density. In contrast, horizontal housing remains dominant in medium-sized and smaller cities. This category includes detached houses, cluster housing, and mixed-use residential-commercial buildings (*ruko*). In addition, boarding houses (*indekos*) are widely present across Indonesian cities and cater to certain segments of the housing market, including students, young workers, and new migrants.

Traditionally, owning residential real estate is associated with long-term settlement in a particular city. Households intending to reside permanently or for an extended period usually prioritize home ownership. However, not all urban residents choose to purchase property. Many individuals prefer renting due to temporary employment, educational mobility, or financial constraints. In these cases, both homeowners and renters primarily use residential property for consumption purposes, treating housing as a consumption good that provides shelter and living services.

However, residential real estate is not solely intended for living. Some individuals acquire housing units as investments. In this case, property ownership is viewed as a form of wealth storage. These investors can often be identified by their residence in one city while owning multiple properties in other locations. They purchase residential units to earn capital gains from future price appreciation. Alternatively, they can earn income by leasing properties to individuals or business entities.

Based on quantitative evidence, it is reasonable to expect that owning residential real estate will generate revenue and protect assets from inflation erosion. For example, Ekemode (2021) demonstrated that residential property assets provide significant protection against actual, expected, and unexpected inflation in the short term. However, the effectiveness of this hedging ability varies across property types and property locations. Zouari & Nasreddine (2023) compared residential real estate with other financial asset classes and found that housing and bonds serve as effective hedges against unexpected inflation. However, by comparing listed and physical real estate, the results demonstrate that listed real estate has no hedging ability against inflation. Similarly, Wolski (2023) provides evidence from Poland showing that using real estate as a hedging instrument is not always wise, since this asset may fail to protect wealth from inflation.

Thus, the dual role of residential real estate as both a consumption good and an investment asset reflects the hybrid nature of housing markets in Indonesia. People may own houses purely for consumption or for both consumption and investment.

1.3. Hedging Ability Against Inflation

Using a price-based approach, return is defined as the change in real estate prices over a certain period relative to the acquisition price. The ability to hedge against inflation is determined by comparing the percentage change in returns with the inflation rate. The result will show whether the asset value increases, decreases, or remains constant over time. For practical classification, Fehrle (2023) suggests five categories of hedging performance. For nominal returns that exceed inflation, it is considered an excessive hedge. When returns move one-to-one with inflation, it is a perfect/full hedge. Meanwhile, when the return is positive but smaller than the inflation rate, it is considered a partial hedge. If no return is obtained while inflation continues, it is considered a non-hedge. For a negative change in returns while inflation still increases, the assets represent a hazard.

To assess returns at an aggregate level, we rely on changes in the Residential Real Estate Price Index (RREPI). Similarly, to capture the consumption commodity prices, we used inflation calculated from the Consumer Price Index (CPI) movement. The relationship between these two indices provides a basis for assessing whether residential real estate serves as an inflation hedge. Therefore, co-movement is more important to this study, and the causal relationship becomes irrelevant.

Furthermore, these explanations can be expressed mathematically as follows:

$$RREPI_t = \beta CPI_t + \epsilon_t \tag{1}$$

where RREPI denotes the residential real estate price index, CPI represents the consumer price index, β is the coefficient of return obtained on real estate due to inflation, and ϵ is an error term reflecting other factors outside the model that affect returns. The equation can also be expressed in a log-linear form for empirical estimation.

Based on this framework and the preceding discussion in the previous subsection, we propose the following hypothesis for this study:

H_1: Residential real estate is an effective asset as a hedging instrument against inflation pressure in Indonesia.

2. DATA AND METHODS

2.1. Datasets and Sources

This study used several datasets obtained through open access from multiple sources. First, the RREPI was obtained from the Central Bank of Indonesia (www.bi.go.id), while the CPI was obtained from BPS-Statistics Indonesia (www.bps.go.id). Then, six control variables were obtained from seven different sources, as presented in Table 1.

Table 1. Datasets and Sources

No.	Dataset	Sources
1.	Residential Real Estate Price Index (RREPI)	Central Bank of Indonesia

2.	Consumer Price Index (CPI)	BPS-Statistics Indonesia
3.	Interest rate	1. Central Bank of Indonesia 2. BPS-Statistics Indonesia 3. Federal Reserve Economic Data (FRED)
4.	IDX composite index	Yahoo Finance
5.	Total population	BPS-Statistics Indonesia
6.	Regional Gross Domestic Product	BPS-Statistics Indonesia
7.	Financial crisis 2008 period	Bureau of Economic Analysis (BEA)
8.	Covid-19 period	1. World Health Organization (WHO) 2. Cabinet Secretariat of the Republic of Indonesia

The time span covers 91 quarterly observations from 2003Q1 to 2025Q3. This period was determined by data availability, particularly for the RREPI. We select the first quarter of 2003 as the starting point, corresponding to the initiation of quarterly residential property price surveys conducted by the Central Bank of Indonesia in the primary market. In terms of geographical coverage, this study includes 13 cities and one metropolitan area. The cities are Medan, Padang, Palembang, Bandar Lampung, Bandung, Semarang, Yogyakarta, Surabaya, Denpasar, Pontianak, Banjarmasin, Manado, and Makassar. Meanwhile, Jabodetabek-Banten is a metropolitan area. This metropolitan consists of multiple neighboring cities, such as Jakarta Utara, Jakarta Timur, Jakarta Selatan, Jakarta Barat, Jakarta Pusat, Bogor, Bekasi, Depok, Tangerang, Cilegon, and Serang. All the cities covered in this study are spread across five islands: Sumatra, Java, Kalimantan, Bali, and Sulawesi. Only Maluku and Papua were excluded due to data limitations.

2.2. Empirical Strategy

Compared with alternative approaches—such as cointegration, Granger causality, standard ARDL, and vector autoregression—NARDL is suitable for capturing the asymmetric responses in the data. Evidence of such asymmetry has been documented by Zhang et al. (2024), where real estate prices respond differently under the inflation and deflation regimes. Therefore, to accommodate the possibility of asymmetry in the price movement of real estate, we chose NARDL as the benchmark for our model.

The nonlinear autoregressive distributed lag (NARDL) model was first proposed by Shin et al. (2014). The NARDL model offers several advantages over other models. First, it facilitates the analysis of the potential relationships between linear and nonlinear cointegration variables. Second, it allows us to examine the impact of CPI on real estate prices using short- and long-term scenarios. Third, the NARDL model decomposes CPI into negative (deflation) and positive (inflation) regimes. Fourth, the NARDL model allows CPI and real estate prices to have different integration orders. Fifth, the NARDL model produces asymmetric dynamic multiplier graphs that provide a clear visualization of the adjustment paths following positive and negative shocks. Additionally, the NARDL model is robust and performs well with relatively small sample sizes (Hemrit and Benlagha, 2020). Taken together, these features make NARDL more suitable than the standard cointegration techniques for analyzing the hedging ability of residential real estate.

By adding several relevant control variables, the complete basic model in Equation (1) can be expressed as follows:

$$\ln RREPI_{it} = \alpha_i + \tau_i T_t + \sum_{j=1}^{p} \theta_{ij} \ln RREPI_{i,t-j} + \sum_{j=0}^{q} \left(\beta_{1ij}^{+} \ln CPI_{i,t-j}^{+} + \beta_{2ij}^{-} \ln CPI_{i,t-j}^{-} \right) + \gamma_i Z_{it} + \epsilon_{it} \quad (2)$$

where α represents the intercept, β^{+} and β^{-} are the long-run asymmetric parameters of the primary independent variable, T is a dual trend that captures the annual and quarterly movement patterns, and Z is a control variable consisting of the interest rate (Časta 2025), IDX composite index (Fang et al. 2018), total population (Gong and Yao 2022), GDP (Laurinavičius et al. 2022), and two dummies for the financial crisis of 2008 and COVID-19 (Qian et al. 2021; Adekoya et al. 2023; Baral & Mei, 2023). Further, $ln\,CPI^{+}$ and $ln\,CPI^{-}$ represent the positive and negative partial sums, respectively, calculated as follows:

$$\ln CPI_{it}^{+} = \sum_{j=1}^{t} \Delta \ln CPI_{ij}^{+} = \sum_{j=1}^{t} max\left(\Delta \ln CPI_{ij}, 0\right) \quad (3)$$

and

$$\ln CPI_{it}^{-} = \sum_{j=1}^{t} \Delta \ln CPI_{ij}^{-} = \sum_{j=1}^{t} min\left(\Delta \ln CPI_{ij}, 0\right) \quad (4)$$

Moreover, following Shin et al. (2014), to obtain the long- and short-term impacts, we can rewrite equation (2) using the error correction form as

$$\Delta \ln RREPI_{it} = \rho_i + \varphi_{1i} \ln RREPI_{i,t-1} + \left(\varphi_{2i}^{+} \ln CPI_{i,t-1}^{+} + \varphi_{3i}^{-} \ln CPI_{i,t-1}^{-}\right) + \left(\sum_{j=1}^{p-1} \delta_{1ij} \Delta \ln RREPI_{i,t-j} + \sum_{j=0}^{q-1} \delta_{2ij}^{+} \Delta \ln CPI_{i,t-j}^{+} + \sum_{j=0}^{q-1} \delta_{3ij}^{-} \Delta \ln CPI_{i,t-j}^{-} \right) + \tau_i T_t + \gamma_i Z_{it} + \epsilon_{it} \quad (5)$$

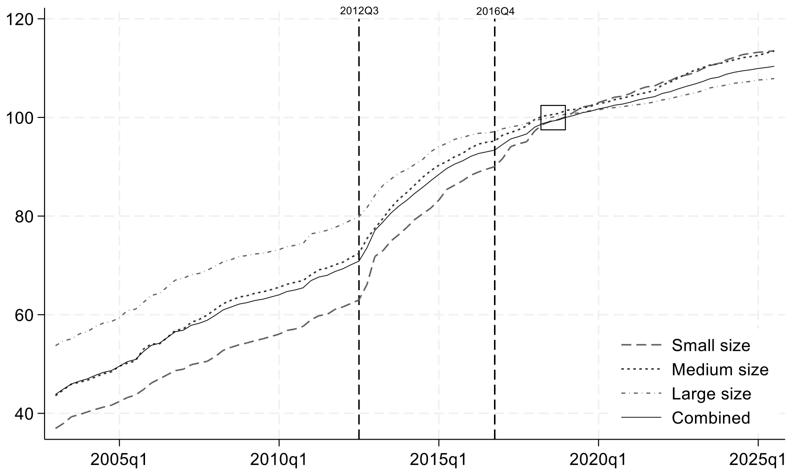
where the estimator in the first row provides the long-run parameter, and the second row provides the short-run parameter, denoted by Δ. For the third row, we obtain the parameter for the trend and control variables that are outside our interest.

3. RESULTS AND DISCUSSIONS

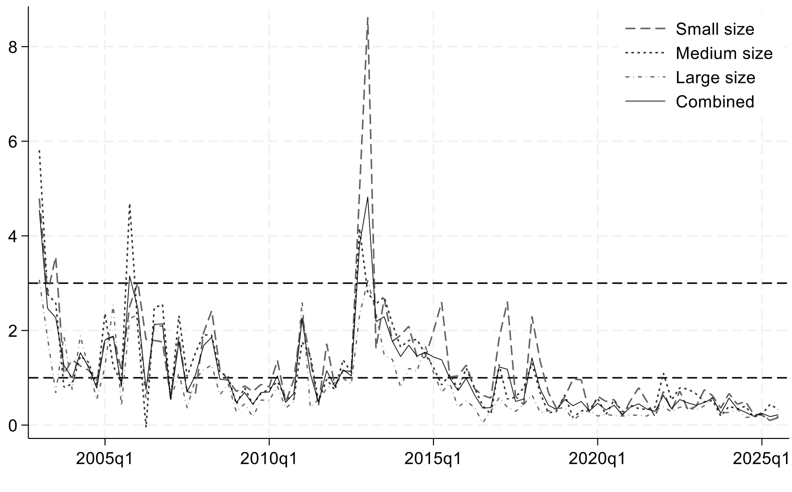
3.1. Indonesian Housing Market Evolution

Using a dataset from the Central Bank of Indonesia, we reveal the long-term evolution of residential property prices in urban areas. Although Indonesia consists of 98 cities, data availability limits the present analysis to 24 cities, comprising 13 major cities and one metropolitan area. The observation period spans 2003 to 2025, providing more than two decades of housing price dynamics.

Following the central bank's classification, residential properties in Indonesia can be grouped into three categories based on building size: small houses (≤ 36 m²), medium houses (36–70 m²), and large houses (> 70 m²). A more detailed classification further divides housing into eight types: type-21, type-36, type-45, type-54, type-60, type-70, type-90, and type-120 units. These size distinctions represent different price levels, which can be interpreted as different market segments based on income levels.



1(a). Price Index



1(b). Price Growth

Figure 1. Quarter Price Movement among Three Different Residential Types

Figure 1 illustrates the evolution of prices across the three housing categories. The price index is standardized to 2018 as the base year (2018 = 100), which explains the convergence of all series in that year—see the hollow square in Figure 1(a). Importantly, the index was designed to capture price changes over time within each category rather than absolute price differences across categories. Therefore, it should be interpreted as reflecting relative price dynamics and growth patterns rather than direct price comparisons between housing types—see Figure 1(b).

From that figure, there are two main points that should be highlighted. First, the price movements across the three housing categories follow broadly similar patterns. However, over the past five years, the prices of large houses have grown more slowly than those of small and medium houses. This pattern may reflect shifts in housing demand, affordability constraints, and changing urban housing preferences. Second, the overall price trajectory can be divided into three distinct regimes, with structural breaks around 2012Q3 and 2016Q4. In the first regime, quarterly price growth generally tends to be around 1−3 percent. In the second regime, the price peaked around 2013Q1 and subsequently decelerated. In the third regime, price growth stabilizes at a lower level, typically below one percent per quarter.

Overall, the residential property prices in Indonesia remain positive in all three regimes. Nevertheless, the pace of growth has slowed in the most recent decade compared with earlier periods. Surprisingly, prices continued to rise even during major shocks, including the 2008 global financial crisis and the COVID-19 pandemic. However, price growth slowed, particularly during the 2008 financial crisis.

3.2. Descriptive Statistics

Table 2 presents the descriptive statistics for the RREPI and CPI at the city level. The results indicate substantial variation in residential property price movements across cities, as reflected in the difference in the standard deviation or variance. Among the 14 observed cities, several exhibit relatively high volatility in real estate prices, including Manado, Makassar, and Surabaya. In contrast, cities such as Padang, Bandar Lampung, Yogyakarta, and Denpasar displayed more stable price movements. Regarding inflation, CPI movement was most pronounced in Pontianak, Bandar Lampung, Padang, and Banjarmasin, whereas the remaining cities exhibited broadly similar inflation patterns.

Table 2. Descriptive Statistics

Variables and Cities	Mean	Std. Dev	Variance	Skewness	Kurtosis
RREPI					
Medan	81.73	22.88	523.51	0.11	1.53
Padang	88.72	15.38	236.48	-0.42	1.81
Palembang	82.06	20.78	431.73	-0.28	1.62
Bandar Lampung	86.38	15.65	245.05	-0.45	1.88
Jabodetabek-Banten	81.38	21.52	463.32	-0.26	1.57
Bandung	78.72	23.29	542.52	-0.08	1.54
Semarang	85.28	16.00	256.17	-0.20	1.57
Yogyakarta	91.41	15.72	246.99	-0.57	2.47
Surabaya	74.82	26.13	682.75	-0.01	1.37
Denpasar	87.19	15.46	239.18	-0.37	1.50
Pontianak	90.16	17.54	307.61	-0.50	2.31
Banjarmasin	85.11	18.46	340.87	-0.26	1.72

Variables and Cities	Mean	Std. Dev	Variance	Skewness	Kurtosis
Manado	75.30	29.19	851.98	-0.03	1.35
Makassar	75.53	27.40	750.86	-0.08	1.31
CPI					
Medan	141.90	44.89	2,015.11	-0.18	1.75
Padang	148.95	49.67	2,467.35	-0.19	1.74
Palembang	138.72	42.00	1,764.42	-0.28	1.93
Bandar Lampung	152.32	50.65	2,565.24	-0.20	1.78
Jabodetabek-Banten	139.90	41.93	1,757.76	-0.18	1.73
Bandung	135.63	39.15	1,532.81	-0.15	1.82
Semarang	140.79	41.72	1,740.21	-0.23	1.79
Yogyakarta	138.29	41.70	1,739.16	-0.21	1.88
Surabaya	143.15	44.07	1,941.91	-0.12	1.76
Denpasar	141.91	41.63	1,732.76	-0.14	1.75
Pontianak	156.06	55.00	3,024.72	-0.13	1.62
Banjarmasin	145.08	48.57	2,359.36	-0.13	1.79
Manado	137.16	40.36	1,628.85	-0.22	1.75
Makassar	142.87	44.42	1,973.31	-0.11	1.76

Source: Author's data processing.

3.3. NARDL Estimation

Before estimating the NARDL model, stationarity tests were conducted to avoid spurious regression results. NARDL modelling allows variables to cointegrate at I(0) or I(1) but not at I(2). To assess stationarity, we employed the Augmented Dickey and Fuller (ADF) test (Dickey and Fuller 1979) and the Phillips and Perron (PP) test (Phillips and Perron, 1988). Both tests examine the null hypothesis of a unit root, indicating that the data are non-stationary. As shown in Table 3, the variables in all cities are not stationary at levels but become stationary after first differencing. This confirms that none of the variables is integrated at the second order, thus satisfying the requirements for NARDL estimation.

Table 3. Unit Root Identification

Cities	ADF		PP	
	REPI	CPI	REPI	CPI
Level				
Medan	-1.106	-2.035	-1.120	-1.007
Padang	-1.408	-1.718	-1.179	-0.786
Palembang	-0.644	-2.837	-1.695	-1.610
Bandar Lampung	-1.518	-1.431	-2.698	-0.663
Jabodetabek-Banten	-0.645	-1.520	-0.003	-0.771
Bandung	-0.261	-2.200	0.173	-1.661
Semarang	-1.603	-1.789	-1.141	-1.011
Yogyakarta	-2.890	-2.518	-2.518	-1.386

Cities	ADF		PP	
	REPI	CPI	REPI	CPI
Surabaya	-1.221	-1.540	-0.437	-0.658
Denpasar	-1.018	-1.191	-1.043	-0.781
Pontianak	-2.011	-0.393	-1.907	0.360
Banjarmasin	-2.511	-2.049	-1.239	-0.925
Manado	-0.545	-1.414	-0.122	-0.921
Makassar	-1.169	-1.824	0.076	-0.830
First Diff.				
Medan	-3.695**	-4.542***	-6.100***	-9.435***
Padang	-4.754***	-4.123***	-9.536***	-10.708***
Palembang	-2.681	-4.344***	-8.635***	-9.019***
Bandar Lampung	-5.641***	-5.507***	-10.742***	-8.857***
Jabodetabek-Banten	-3.712**	-4.772***	-6.279***	-8.739***
Bandung	-4.166***	-4.802***	-6.804***	-8.164***
Semarang	-4.170***	-4.724***	-5.402***	-8.998***
Yogyakarta	-3.978***	-4.246***	-6.230***	-7.990***
Surabaya	-2.893	-4.862***	-6.250***	-8.892***
Denpasar	-3.637**	-4.914***	-7.537***	-9.937***
Pontianak	3.514**	-4.836***	-7.120***	-10.394***
Banjarmasin	-4.857***	-4.657***	-8.917***	-10.651***
Manado	-2.760	-4.576***	-7.518***	-9.683***
Makassar	-2.234	-5.009***	-6.183***	-10.418***

Source: Author's data processing.
Note: *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.

Next, we employ the Brock-Dechert-Scheinkman (BDS) test to detect nonlinearity in the variables (Broock et al. 1996). This test is widely used to evaluate the null hypothesis of linear dependency or independent and identical distributions in time-series data. Table 4 presents the BDS test results using epsilon values from 2 to 6 and a standard deviation of 1. As reported in Table 4, the BDS statistics are significant at the 1% level for all cities. These results confirm the presence of nonlinear dynamics, thereby supporting the use of NARDL for our analysis.

Table 4. Nonlinearity Check

Variables and Cities	Dimension with 1 SD				
	2	3	4	5	6
REPI					
Medan	-4.42***	-6.39***	-5.75***	-8.13***	-10.86***
Padang	59.24***	78.37***	107.69***	155.31***	233.62***
Palembang	79.29***	105.28***	145.38***	210.85***	318.92***
Bandar Lampung	55.82***	72.16***	96.62***	135.58***	198.14***
Jabodetabek-Banten	88.84***	117.72***	162.04***	234.54***	354.15***

Variables and Cities	Dimension with 1 SD				
	2	3	4	5	6
Bandung	107.07***	143.94***	201.13***	295.40***	452.86***
Semarang	130.86***	178.31***	253.57***	379.61***	593.90***
Yogyakarta	21.53***	22.58***	23.92***	25.91***	28.65***
Surabaya	284.94***	375.63***	513.87***	737.33***	1,103.09***
Denpasar	129.94***	173.67***	241.26***	352.77***	538.44***
Pontianak	27.52***	33.01***	40.54***	51.68***	68.16***
Banjarmasin	72.07***	97.17***	136.47***	201.84***	312.11***
Manado	389.66***	516.26***	712.44***	1,031.57***	1,557.59***
Makassar	411.29***	546.03***	752.80***	1,090.67***	1,648.37***
CPI					
Medan	-0.47***	-1.02***	-0.09***	-0.83***	-1.82***
Padang	52.08***	67.35***	90.18***	126.36***	184.23***
Palembang	39.96***	50.02***	64.55***	8.07***	121.88***
Bandar Lampung	50.16***	63.76***	83.80***	115.17***	164.59***
Jabodetabek-Banten	62.05***	80.50***	108.19***	152.35***	223.42***
Bandung	53.44***	69.28***	93.09***	131.00***	191.96***
Semarang	53.02***	68.00***	90.28***	125.50***	181.42***
Yogyakarta	45.37***	57.60***	75.41***	103.23***	146.79***
Surabaya	63.66***	82.48***	110.58***	155.34***	227.19***
Denpasar	67.38***	87.23***	116.79***	163.87***	239.28***
Pontianak	73.00***	95.96***	130.60***	186.47***	277.29***
Banjarmasin	51.61***	66.27***	87.99***	122.31***	176.74***
Manado	56.45***	73.44***	98.89***	139.55***	205.08***
Makassar	60.33***	78.49***	105.71***	149.10***	218.84***

Source: Author's data processing.
Note: *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.

To examine the presence of a cointegration relationship, we conducted the F_{PSS} (Pesaran et al. 2001) and t_{BDM} (Banerjee et al. 1998) tests. Both tests assess the null hypothesis of no cointegration. Using additional STATA commands from Jordan & Philips (2018), we obtained the lower and upper-bound values for both tests. Long-term cointegration is supported when the derived *F* and *t* values exceed the I(1) critical value, whereas values below I(0) indicate no cointegration. The results that fall between the critical I(0) and I(1) values are deemed inconclusive. As shown in Table 5, the test reveals cointegration in Medan, Palembang, Bandar Lampung, Bandung, Semarang, Denpasar, and Makassar. However, the overall evidence is relatively weak, as the t-values fail to consistently confirm these relationships.

Table 5. Cointegration Check

Cities	t_{BDM}	F_{PSS}
Medan	-2.22	3.22*

Cities	t_{BDM}	F_{PSS}
Padang	-2.60	2.62
Palembang	-2.66	8.09***
Bandar Lampung	-2.95	3.13*
Jabodetabek-Banten	-1.77	1.42
Bandung	-2.94	3.06*
Semarang	-1.96	3.13*
Yogyakarta	-1.91	2.26
Surabaya	-0.87	1.17
Denpasar	-2.50	3.15*
Pontianak	-2.28	2.44
Banjarmasin	-1.45	2.19
Manado	-0.77	1.74
Makassar	-1.44	3.02*

Source: Author's data processing.
Note:

(1) *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.
(2) The lower and upper bounds of F_{PSS} critical values are 1.88 and 2.99, 2.14 and 3.30, and 2.65 and 3.97 for 10 %, 5 %, and 1 %, respectively.
(3) The lower and upper bounds of t_{BDM} test critical values are -2.57 and -4.56, -2.86 and -4.88, -3.42 and -5.40for 10 %, 5 %, and 1 %, respectively.

Finally, Table 6 presents the results of the robust NARDL estimation. Panel A shows the long-run parameters, and Panel B shows the short-run parameters. The model specification includes all the control variables, as shown in Equation (5). Interestingly, the estimation results suggest the presence of a long-run relationship in several cities, which is not entirely consistent with the cointegration check in Table 5. For example, although Palembang shows evidence of cointegration, the estimated long-run parameter is not statistically significant. There are two possible explanations for these inconsistent results. First, cointegration detection based primarily on the F statistic tends to be weak. Therefore, the estimated parameters will differ. Second, the parameters estimated in Table 6 used a robust command to address heteroskedasticity. This treatment further inflates the standard errors and causes the estimated parameters to be statistically insignificant. Consistent results across both approaches were observed only for Bandar Lampung, Bandung, and Denpasar, as shown in Tables 5 and 6. Due to these inconsistencies, we prefer the cointegration results reported in Table 6.

Table 6. Long and Short Run Estimation

	Medan	Padang	Palembang	Bandar Lampung	Jabodetabek -Banten
Long Run					
Ln CPI^{+}	-0.93	0.30***	-0.63	0.49***	0.16
Ln CPI^{-}	4.39	2.25	16.26	-3.09	-2.24

Short Run					
$\Delta\text{Ln CPI}_0^+$	0.23**	0.15	0.01	0.33***	-0.05
$\Delta\text{Ln CPI}_{t-1}^+$	0.23***	0.09	0.14**	-0.10	0.05
$\Delta\text{Ln CPI}_0^-$	0.01	-0.05	-0.96	0.04	-0.15
$\Delta\text{Ln CPI}_{t-1}^-$	0.16	0.48	-1.09	0.67	-0.74
ECT	-0.09**	-0.24**	-0.11***	-0.29***	-0.09*

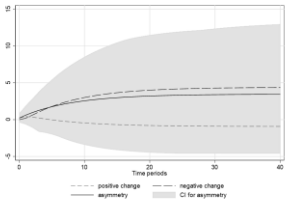
	Bandung	Semarang	Yogyakarta	Surabaya	Denpasar
Long Run					
Ln CPI^+	0.74***	-0.39	0.34***	-1.78	1.42**
Ln CPI^-	-9.51***	2.56	11.52*	-78.71	10.66
Short Run					
$\Delta\text{Ln CPI}_0^+$	0.46***	0.07	-0.10	0.34**	0.54***
$\Delta\text{Ln CPI}_{t-1}^+$	-0.06	0.12	-0.16	0.08	-0.14
$\Delta\text{Ln CPI}_0^-$	0.50	0.41	1.96	-2.32*	-1.86*
$\Delta\text{Ln CPI}_{t-1}^-$	-0.48	0.23	3.81**	-6.77**	1.13
ECT	-0.18***	-0.07*	-0.29*	-0.04	-0.10**

	Pontianak	Banjarmasin	Manado	Makassar
Long Run				
Ln CPI^+	0.29	-0.43	-2.84	-0.93
Ln CPI^-	5.46	13.48	29.53	61.29
Short Run				
$\Delta\text{Ln CPI}_0^+$	-0.11	-0.10	-0.20	-0.07
$\Delta\text{Ln CPI}_{t-1}^+$	-0.20	0.08	-0.20	0.03
$\Delta\text{Ln CPI}_0^-$	-0.46	-0.04	-0.33	0.50
$\Delta\text{Ln CPI}_{t-1}^-$	0.71	0.40	1.45**	0.04
ECT	-0.11**	-0.06	-0.03	-0.04

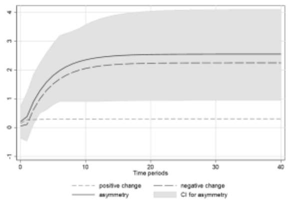
Source: Author's data processing.
Note : *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.

In general, these results provide four key insights. First, long-run hedging ability is observed in only a limited number of cities, including Padang, Bandar Lampung, Bandung, Yogyakarta, and Denpasar. Second, in the short run, the hedging ability is identified in six cities: Medan, Palembang, Bandar Lampung, Bandung, Surabaya, and Denpasar. Third, the presence of short-run hedging ability does not guarantee that this ability will exist in the long run. Similarly, the long-run hedging ability is not always supported by the existence of short-run hedging. Fourth, none of the cities shows perfect hedging ability for residential real estate. While some cities also show hedging ability, their ability to hedge against inflation remains imperfect, as indicated by the estimated coefficient being below one. The only exception is Denpasar, which stands out as the only city with consistent evidence of a long-run hedging ability.

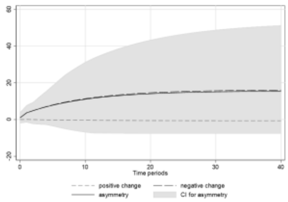
To further explore asymmetric responses, Figure 2 presents dynamic multiplier graphs illustrating how real estate prices respond differently during the inflation and deflation regimes. This graphical representation simplifies the quantification of the calculation results shown in Table 6. To determine whether the relationship was symmetric or asymmetric, we simply compared the patterns between the short and long dashes, which represent positive and negative changes in the CPI. When the pattern movement between these two lines is identical to the opposite line positions, the effect tends to be symmetric. Otherwise, it indicates asymmetric cumulative dynamic multipliers.



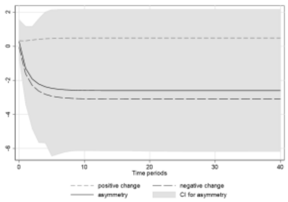
(a) Medan



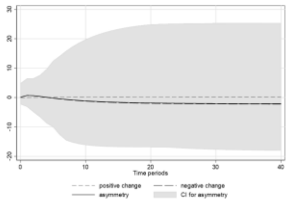
(b) Padang



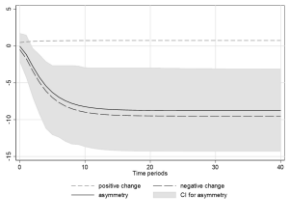
(c) Palembang



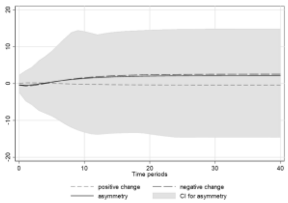
(d) Bandar Lampung



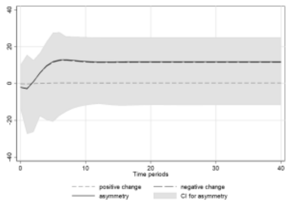
(e) Jabodetabek-Banten



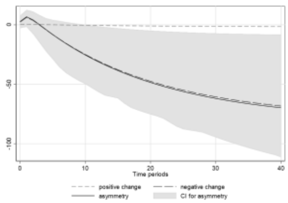
(f) Bandung



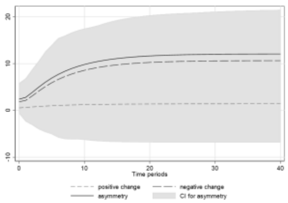
(g) Semarang



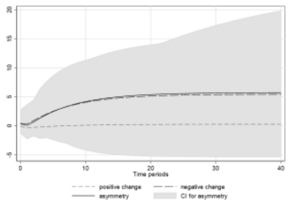
(h) Yogyakarta



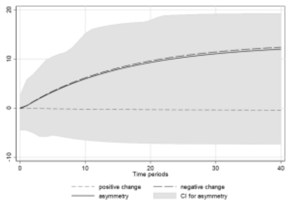
(i) Surabaya



(j) Denpasar



(k) Pontianak



(l) Banjarmasin

(m) Manado (n) Makassar

Figure 2. Cumulative Effect of CPI to RREPI

In general, we can see that in the short run, all cities clearly show an asymmetrical pattern. In the long run, asymmetry is observed in only four cities, including Surabaya, Banjarmasin, Manado, and Makassar. However, when we compare the quantitative evidence using the formal Wald test, none of the short- or long-run results is asymmetrical (the results are not reported in this paper). This occurs because the significant result is only partially observed—see the result in Table 6. A significant result in the asymmetry test will be obtained only when both positive and negative parameters are significant. Based on this, it suggests that while graphical evidence indicates asymmetry, quantitative results provide limited evidence.

These figures also provide insights into the speed of adjustment toward the long-run equilibrium. Excluding Surabaya, Banjarmasin, Manado, and Makassar, most cities exhibit convergence to the long-run equilibrium after 10–20 quarters, or equivalent to 2.5–5 years. With this speed, we can consider that residential real estate in Indonesia follows a moderate adjustment level.

Additionally, Table 7 presents the summary of the hedging performance across the cities based on the findings in Table 6. Once again, the table shows that in most cities, both the short-run and long-run coefficients lack statistical significance. This indicates that there is no substantial relationship between real estate prices and the CPI. Among the few cities with significant results, hedging is generally partial, meaning that price increases are insufficient to offset inflation effects.

Table 7. Hedging Ability Summary

Cities	Hedging ability	
	Long Run	Short Run
Medan	No hedge	Partial
Padang	Partial	No hedge
Palembang	No hedge	Partial
Bandar Lampung	Partial	Partial
Jabodetabek-Banten	No hedge	No hedge
Bandung	Partial	Partial
Semarang	No hedge	No hedge
Yogyakarta	Partial	No hedge
Surabaya	No hedge	Partial

Denpasar	Excessive	Partial
Pontianak	No hedge	No hedge
Banjarmasin	No hedge	No hedge
Manado	No hedge	No hedge
Makassar	No hedge	No hedge

Source: Author's own data.

After obtaining the parameters, we performed a diagnostic check on our estimated results using the following five indicators, including goodness-of-fit (R-squared), autocorrelation, heteroskedasticity, functional form misspecification, and residual normal distribution. Among the five indicators, only the heteroskedasticity test is not available here. We addressed this issue through robust estimation, which caused the standard error to be adjusted and the heteroskedasticity test to be irrelevant. The results presented in Table 8 indicate that most cities do not suffer from autocorrelation, except for Denpasar. However, functional form misspecification remains an issue in several cities; only four cities are free from this issue. Even after multiple adjustments were employed—by adding the lag and reducing the number of control variables—the misspecification test still showed a significant result. This limitation may reflect omitted control variables—other unknown controls—that are not captured in the model. Then, for the normality check, the error term from the modelling is not entirely normally distributed. However, because this study employs purely time series with relatively large sample sizes (91 observations for each city), the violation of normality will not cause any major problems. Overall, the model results are considered reliable for a subset of cities, while others should be interpreted with caution because of misspecification issues.

Table 8. Diagnostic Check

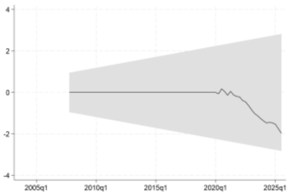
Cities	R^2	Port.	BP	RESET	JB
Medan	0.42	37.78	n.a.	1.75	24.85^{***}
Padang	0.44	46.58	n.a.	4.33^{***}	121.7^{***}
Palembang	0.47	38.35	n.a.	1.87	21.09^{***}
Bandar Lampung	0.37	30.96	n.a.	1.27	57.62^{***}
Jabodetabek-Banten	0.40	33.33	n.a.	1.52	88.61^{***}
Bandung	0.59	40.69	n.a.	6.07^{***}	118.2^{***}
Semarang	0.50	47.45	n.a.	3.47^{**}	172.8^{***}
Yogyakarta	0.45	26.5	n.a.	20.52^{***}	263.4^{***}
Surabaya	0.47	45.54	n.a.	3.59^{**}	82.84^{***}
Denpasar	0.36	54.64^{*}	n.a.	4.27^{***}	237.4^{***}
Pontianak	0.38	29.00	n.a.	12.16^{***}	110.7^{***}
Banjarmasin	0.28	36.96	n.a.	6.02^{***}	134.3^{***}
Manado	0.26	25.79	n.a.	5.36^{***}	41.90^{***}
Makassar	0.45	37.58	n.a.	3.79^{**}	4.98^{*}

Source: Author's data processing.

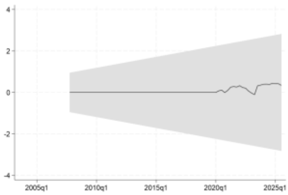
Note:

(1) *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.
(2) AR : Adjusted R square.
(3) Port. : testing the null hypothesis that there is no autocorrelation in the residuals up to lag 12.
(4) BP : testing the null hypothesis that the residuals are homoscedastic.
(5) RESET : testing the null hypothesis that the model is correctly specified.
(6) JB : testing the null hypothesis that the residuals are normally distributed.

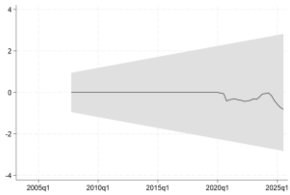
In the final stage, we evaluated the stability of these parameters. Although parameter stability checks are more commonly applied in linear modelling, it remains limited in the context of nonlinear modelling. Following Kirch & Kamgaing (2012) and Lee & Lee (2019), we employed the standard testing procedure using the cumulative sum (CUSUM) of recursive residuals. The results shown in Figure 3 are for all the cities studied. In general, the results indicate that most residential real estate parameters are stable over time. However, instability is observed in Yogyakarta and Banjarmasin toward the end of the sample period, as indicated by the deviation of the lines in 2024–2025.



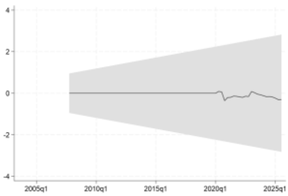
(a) Medan



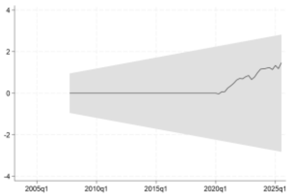
(b) Padang



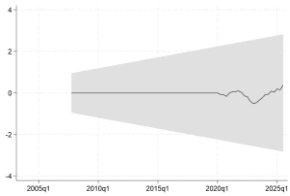
(c) Palembang



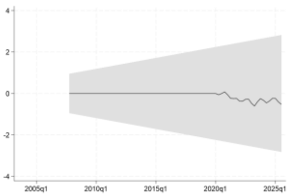
(d) Bandar Lampung



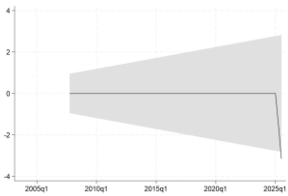
(e) Jabodetabek-Banten



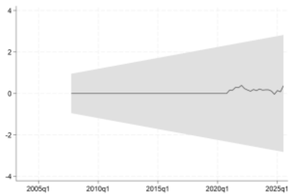
(f) Bandung



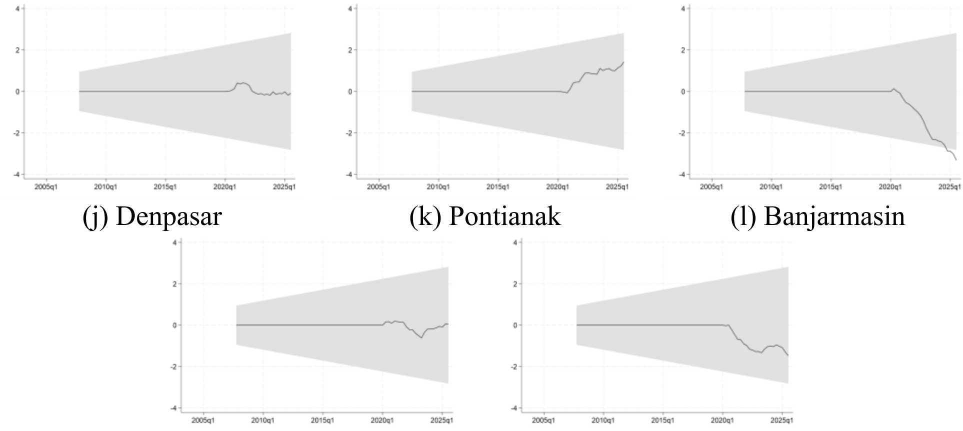
(g) Semarang



(h) Yogyakarta



(i) Surabaya



(j) Denpasar (k) Pontianak (l) Banjarmasin

(m) Manado (n) Makassar

Figure 3. CUSUM Plot

3.4. Heterogeneity Analysis

Our main result compares the inflation-hedging ability across cities using an aggregate residential real estate price index. However, we realized that different housing sizes represent distinct market segments. In urban areas, larger housing units are typically associated with upper-middle-class households. Conversely, smaller housing sizes represent a lower financial capacity for prospective homeowners. Therefore, we performed a heterogeneity analysis by categorizing residential real estate into three subgroups—small, medium, and large—and re-estimated the coefficients accordingly. Among the estimated coefficients, we are more interested in calculating the long-run parameters. This parameter is more meaningful because real estate is a long-term investment rather than a short-term decision.

Table 9 presents the heterogeneity analysis of the long-run RREPI parameters for the full sample. Overall, no general conclusions can be drawn from this analysis. However, in several cases—such as Padang, Bandar Lampung, Yogyakarta, and Denpasar—show that smaller residential sizes perform better in terms of hedging ability. This is indicated by higher estimated parameters compared to medium and large units. Medium-sized houses performed better only in Bandung. In most other cities, the parameter showed insignificant results, indicating that none of the residential size groups had hedging ability. While significant results are observed, they generally indicate partial hedging ability, with coefficients below one. Evidence of excessive ability was limited, appearing only in Bandung (medium size) and Denpasar (across all residential categories).

Table 9. Heterogeneity Estimation Result

Cities	Parameters	Small Sizes	Medium Sizes	Large Sizes
Medan	Ln CPI^{+}	-1.25^{**}	0.50	-1.70

	Ln CPI^{-}	-1.11	2.64	30.45
Padang	Ln CPI^{+}	0.65***	0.25	0.54***
	Ln CPI^{-}	1.99	3.67	0.91
Palembang	Ln CPI^{+}	-0.66	-0.65	-0.17
	Ln CPI^{-}	4.28	26.62	9.63
Bandar	Ln CPI^{+}	0.89**	0.44**	0.47***
Lampung	Ln CPI^{-}	-5.97	-0.51	-6.87*
Jabodetabek-	Ln CPI^{+}	0.26	-0.05	0.08
Banten	Ln CPI^{-}	-9.86	-0.19	2.93
Bandung	Ln CPI^{+}	0.34*	2.14***	0.70**
	Ln CPI^{-}	-6.76**	-17.74**	-10.57**
Semarang	Ln CPI^{+}	-0.54	-0.70	-0.22
	Ln CPI^{-}	-12.60	22.43	2.80
Yogyakarta	Ln CPI^{+}	0.58***	0.04	0.20
	Ln CPI^{-}	9.96	46.80*	-0.32
Surabaya	Ln CPI^{+}	-1.53	-1.12	-1.52
	Ln CPI^{-}	-64.01	-72.83	-18.64
Denpasar	Ln CPI^{+}	1.51**	1.05***	1.11*
	Ln CPI^{-}	13.17**	1.35	8.04
Pontianak	Ln CPI^{+}	0.26	0.65	0.03
	Ln CPI^{-}	7.75	10.82	-2.20
Banjarmasin	Ln CPI^{+}	0.05	0.53	-0.72
	Ln CPI^{-}	0.05	-0.43	37.80
Manado	Ln CPI^{+}	0.48	-10.55	0.40
	Ln CPI^{-}	10.92	11.52	16.14
Makassar	Ln CPI^{+}	-1.64	-0.22	0.30
	Ln CPI^{-}	77.32	52.21	30.58**

Source: Author's data processing.
Note: *, **, and *** represent significance levels of 10%, 5%, and 1%, respectively.

3.5. Implications and Additional Insights

Our study clearly shows that residential real estate in Indonesia does not provide effective protection against inflationary pressures. This result implies that residential properties should not be regarded as substitutes for financial instruments in preserving real wealth. Instead, housing should be viewed primarily as a consumption good and, in some cases, as an asset that generates income for its owner.

From a consumption perspective, individuals or households typically purchase housing properties mainly for living purposes and to improve their quality of life. As income increases, households may upgrade their dwellings or relocate to more desirable locations in response to changes in employment opportunities and living preferences. Therefore, residential property is not well-suited for speculative holdings based solely on inflation expectations.

From an investment standpoint, we recommend that individuals (or households) and investors adopt diversified portfolio strategies. Relying solely on residential property for inflation protection may expose investors to real wealth erosion, particularly during high-inflation periods. Combining property ownership with other alternative assets—such as gold, equities, bonds, and mutual funds—can help mitigate the risk and enhance long-term returns. As Torrente & Uberti (2025) suggest, maximum diversification strategies are highly competitive due to their lower risk exposure.

Nevertheless, owning residential real estate may still be beneficial, as long as it is aligned with residential and income-generating objectives rather than solely for hedging purposes. For instance, purchasing a new and larger dwelling in a better neighborhood can improve the overall quality of life. As Legros et al. (2025) found that living in better locations with access to better environments—such as private yards and wide sidewalks that will maintain social distancing—improves life satisfaction.

In the context of income-generating assets, residential property can serve as a source of income through rental activities. In the Indonesian context, common strategies include renting out boarding houses (*indekos*), homestays, and rentals for business purposes, such as film shoots, photo shoots, podcast recordings, catering, restaurants, cafes, laundry shops, clinics, salons, mini-stores, and private tutoring. Furthermore, splitting residential real estate for business purposes—or entirely, if an individual owns multiple properties in different locations—will compensate for wealth reduction and enhance overall financial resilience.

4. CONCLUDING REMARK

In terms of scope and data, we can confidently claim that our study differs significantly from previous research. Unlike mainstream studies that focus on developed countries, our study examines Indonesia as a representative emerging market and a developing country. In addition, instead of relying on real estate-infrastructure stock indices, we use residential real estate price indices from 13 cities and one metropolitan area, providing more direct evidence of physical property markets.

We acknowledge that the effectiveness of real estate as an inflation-hedging instrument remains debatable. Thus, our empirical study contributes to this discussion by providing current evidence. Using the NARDL framework, we conclude that residential real estate in Indonesia does not serve as an effective hedging instrument against inflation. In most cities, the ability to hedge—even partially—does not exist. In other cities, any short- or long-run hedging ability appears to be weak and often asymmetric. These findings suggest that residential real estate in Indonesia is better suited as a consumption good and, to some extent, an income-generating asset rather than a reliable store of real value.

We have three major suggestions for the future research agenda. Rather than merely addressing the limitations of our study, future researchers should explore the following areas. First, future studies should examine the relationship between transportation connectivity and residential property prices in non-urban areas. Although accessibility is widely recognized as a key determinant of housing value, its persistence and magnitude in the Indonesian context remain unexplored. Understanding whether such effects are temporary or long-lasting would benefit both investors and policymakers. For the government, this information would help adjust the real estate tax baselines. Second, we suggest that future research may further investigate the inflation-hedging potential of commercial real estate. In the first draft of our study, we examined the ability of commercial real estate to hedge against inflationary pressure. However, we excluded it from the final report due to limitations in model feasibility. Given that commercial properties are primarily used for business purposes, their investment characteristics may differ significantly from those of residential properties. Third, rather than focusing solely on the hedging ability of real estate, future studies may extend the analysis to portfolio optimization by exploring the optimal combination of real estate and other financial assets within a portfolio. Such an approach would provide valuable insights for investors seeking to maximize returns while minimizing inflation-related risks.

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Authors Contributions:
YH: Supervision. **MFM:** Conceptualization, Data curation, Formal analysis, Investigation, Validation, Methodology, Software, Visualization, Writing - original draft, Writing - review & editing.

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APPENDIX A.

Table A1. Previous Research Compilation

No.	Journal	Authors	Scopes	Period	Methods	Result
1.	Journal of Financial Economics	Fama & Schwert (1977)	USA	1963-1971	Regression	Housing is effective to hedge against inflation (expected and unexpected inflation).
2.	Real Estate Economics	Spellman (1981)	USA	1963-1978	Equation calculation	Housing asset is effective against inflation.
3.	Real Estate Economics	Hartzell et al. (1987)	-	1973-1983	Regression	Commercial real estate has the ability to hedge expected and unexpected inflation.
4.	The Journal of Real Estate Finance and Economics	Gyourko & Linneman (1988)	USA	1972-1986	Regression	Non-residential property returns are positively correlated with inflation.
5.	Journal of Real Estate Research	Rubens et al. (1989)	USA	1960-1986	Regression	The effectiveness of real estate (farmland, business, and residential) in hedging inflation is mostly indeterminate.
6.	The American Economic Review	Case & Shiller (1989)	USA (4 States)	1970-1986	Regression	Individual housing price changes are not predictable. Meanwhile, real interest rates do not appear to be incorporated into house prices.
7.	Real Estate Economics	Dokko et al. (1991)	USA (16 states)	1975-1984	Cross-section & time-series errors	Non-residential real estate may not outperform to the expected inflation.

No.	Journal	Authors	Scopes	Period	Methods	Result
					component model	
8.	The Journal of Real Estate Finance and Economics	Hoesli et al. (1997)	UK	1963-1993	Regression	The effectiveness of hedging unexpected inflation varies. For quarterly result, it may partially, while for real estate rental value, it appears not to be perfect.
9.	Journal of Real Estate Research	Bond & Seiler (1998)	USA	1969-1994	Added Variable Regression Methodology (AVRM)	Residential real estate effectively hedges against inflation, both on expected and unexpected inflation.
10.	Journal of Real Estate Research	Chatrath & Liang (1998)	USA	1972-1995	Regression and cointegration	There is no evidence that real estate can hedge inflation measures.
11.	Applied Economics	Onder (2000)	Turkey (Ankara)	1977-1996	Equation calculation	In a high-inflation environment, real estate investment does not hedge against inflation.
12.	Real Estate Economics	Anari & Kolari (2002)	USA	1968-2000	ARDL	House assets effectively hedge inflation in the long run.
13.	Journal of Real Estate Portfolio Management	Adrangi et al. (2004)	-	1972-1999	OLS	Real estate returns are negatively correlated with unexpected inflation.
14.	Journal of Real Estate Literature	Lee et al. (2011)	Malaysia, Philippines, and Taiwan	1981-2009	Dynamic OLS	Real estate stocks do not provide a hedge against inflation in the long term.

No.	Journal	Authors	Scopes	Period	Methods	Result
15.	The Journal of Real Estate Finance and Economics	Hardin et al. (2012)	USA	1980-2008	OLS	Hedging effects exist in real estate investments.
17.	Research in International Business and Finance	Taderera & Akinsomi (2020)	South Africa	1958-2016	VECM	Commercial real estate (retail and industrial property) is a pervasive hedge against inflation.
18.	Cogent Economics & Finance	Magweva & Sibanda (2020)	Brazil, China, India, and Indonesia	2009-2019	Panel ARDL	Stocks in infrastructure sector enable to hedge against inflation.
19.	International Real Estate Review	Lee (2021)	China, India, and Russia	2003-2019	ARDL	Residential properties provide a long-term hedge against inflation.
20.	Property Management	Ekemode (2021)	Nigeria (3 cities)	1999-2018	OLS	Real estate is effective for hedging inflation (actual, expected, and unexpected inflation).
21.	International Journal of Housing Markets and Analysis	Nguyen (2023)	Japan & USA	2001-2020	GARCH	Real estate is effective in hedging against inflation.
22.	Empirical Economics	Fehrle (2023)	Australia, Belgium, Canada, Denmark, Finland,	1870-2020	OLS, Pooled OLS, VECM	In the long run, housing hedges inflation perfectly in the post-war period.

No.	Journal	Authors	Scopes	Period	Methods	Result
			France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, UK, USA			
23.	International Journal of Housing Markets and Analysis	Zouari & Nasreddine (2023)	France (Paris)	1997-2017	AHC, correlation, regression	Physical residential real estate strongly hedges against unexpected inflation. Meanwhile, the listed real estate demonstrates no ability to counter inflation.
24.	Real Estate Management and Valuation	Wolski (2023b)	Poland	2009-2021	Cointegration analysis	Real estate has no ability to hedge against inflation.
25.	Journal of Risk and Financial Management	Nurdina et al. (2024)	Indonesia	2018-2023	Fama-French 5FF & 7FF model with OLS	Real estate stocks can hedge against inflation.
26.	Journal of Property Investment & Finance	Nasreddine & Zouari (2024)	France	2000-2023	Wavelet quantile correlation	Listed real estate exhibits compelling inflation hedging.

No.	Journal	Authors	Scopes	Period	Methods	Result
27.	Real Estate Management and Valuation	Dittmann (2024)	Poland	2006-2022	Regression	Only residential properties effectively hedge inflation.
28.	Real Estate Management and Valuation	Karp & Wolski (2025)	Poland (7 cities)	2007-2023	ECM	Real estate can serve as a hedge against value loss during periods of low inflation.
29.	The Journal of Real Estate Finance and Economics	Muckenhaupt et al. (2025)	UK, Japan, and Australia	1990-2023	Markov switching VECM	In the short term, listed real estate provides good protection against inflation (in a stable period) and becomes negative or zero during turbulence periods. In the long term, listed real estate is a good hedge against expected inflation.